EU4Environment in Eastern Partner Countries:
Water Resources and Environmental Data (ENI/2021/425-550)

PROPOSAL OF A NATIONAL METHODOLOGY FOR THE ASSESSMENT OF THE HYDROMORPHOLOGICAL STATUS OF THE BLACK SEA COASTAL AND TRANSITIONAL WATER BODIES IN GEORGIA

Contract-No: 20940-Cl/GE-MG-2023/1-A1

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ABOUT THIS REPORT

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ABOUT EU4ENVIRONMENT – WATER RESOURCES AND ENVIRONMENTAL DATA

This Programme aims at improving people's wellbeing in EU's Eastern Partner Countries and enabling their green transformation in line with the European Green Deal and the Sustainable Development Goals (SDGs). The programme's activities are clustered around two specific objectives: 1) support a more sustainable use of water resources and 2) improve the use of sound environmental data and their availability for policy-makers and citizens. It ensures continuity of the Shared Environmental Information System Phase II and the EU Water Initiative Plus for Eastern Partnership programmes.

The Programme is implemented by five Partner organisations: Environment Agency Austria (UBA), Austrian Development Agency (ADA), International Office for Water (OiEau) (France), Organisation for Economic Co-operation and Development (OECD), United Nations Economic Commission for Europe (UNECE). The action is co-funded by the European Union, the Austrian Development Cooperation and the French Artois-Picardie Water Agency based on a budget of EUR 12,75 million (EUR 12 million EU contribution). The implementation period is 2021-2024.

https://eu4waterdata.eu

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List of abbreviations

ADA .... Austrian Development Agency
ArcSWAT .... ArcGIS Extension of the Soil and Water Assessment Tool (SWAT) hydrological model
AWB .... Artificial Water Body
BQE .... Biological Quality Elements
CEN .... European Committee for Standardization
CTW .... Coastal and Transitional Waters
CW .... Coastal Waters
DSAS .... Digital Shoreline Analysis System
EIA......................... Environmental Impact Assessment
ESA........................ European Space Agency
EU .... European Union
EU4EnvWD............ EU4Environment in Eastern Partner Countries: Water Resources and Environmental Data
EUWI+ .... European Union Water Initiative Plus
GCS .... Good Chemical Status
GE .... Country Code for Georgia
GEP .... Good Ecological Potential
GES........................ Good ecological Status
GIS......................... Geographic Information System
HAI .... Hydromorphological Alteration Index
HMWB .... Heavily Modified Water Body
HQI .... Hydromorphological Quality Index
HYMO .... HydroMorphological
ISO .... International Organization for Standardization
LTAA...................... Long Term Average Flow
MEP .... Maximum Ecological Potential
MEPA .... Ministry of Environmental Protection and Agriculture of Georgia
MImAS .... Morphological Impact Assessment System tool
NASA .... National Aeronautics and Space Administration
NEA .... National Environment Agency
NGOs..................... Non-Governmental Organisations
PONTOS .... Copernicus assisted environmental monitoring across the Black Sea Basin project
PSA........................ Particle Size Analysis

RBMP .... River Basin Management Plan
ToR........................ Terms of References
TSM....................... Total Suspended Matter
TW .... Transitional Waters
QEs........................ Quality Elements
ROV....................... Remotely Operated underwater Vehicle
UBA....................... Umweltbundesamt GmbH, Environment Agency Austria
UNCLOS................ The 1982 United Nations Convention on the Law of the Sea
UNDP .... United Nations Development Programme
UNECE.................. United Nations Economic Commission for Europe
UNEP/GRID .... UN Environment's The Global Resource Information Database
USGS .... United States Geological Survey
WFD .... Water Framework Directive

Executive Summary

The proposed National Methodology of Georgia for the Assessment of the Hydromorphological Status of the Black Sea Coastal and Transitional Water Bodies provides comprehensive guidance and data requirements for assessing the hydromorphological status of Coastal and Transitional Waters (CTW) along the Black Sea coast of Georgia, based on the requirements of the Law of Georgia on Water Resources Management, as well as the requirements of the Water Framework Directive, related guidance documents, and respective European standards for the monitoring of CTW bodies.

After an introductory first chapter; in the second chapter this document briefly discusses the methods for identifying and designating Heavily Modified and Artificial Water Bodies; the third chapter contains basic typologies, reference conditions and classification systems; the fourth deals with hydromorphological monitoring of CTW bodies; the fifth and sixth chapters present general and specific considerations for monitoring the hydromorphological quality elements of CTW bodies; and the final, seventh section defines tools and routines for the hydromorphological classification of Georgian Black Sea CTWs, based on European best practices and taking into account Georgian specificities, as well as the format and availability of the relevant data and reference literature. The eighth chapter provides key conclusions, while the last nineth chapter in two annexes specifies further hydromorphological data requirements for assessing CTWs status and, importantly, provides current delineation of Georgian Black Sea CTWs subject to future adjustments as more data, information, knowledge and experience is accumulated.

Key considerations of this document include:

1. Data Acquisition: Emphasis on obtaining data on coastal dynamics, shoreline alterations, sediment dynamics, hydrological parameters, and anthropogenic activities.
2. Methodologies and Tools: Adoption of the latest European best practices, particularly the Hydromorphological Quality Index (HQI) based on the CTW Morphological Impact Assessment System (MImAS) tool, for classification and assessment.
3. Metrics and Assessments: Detailed metrics for assessing shoreline alteration, presence of barriers, bed disturbance, habitat change, tidal regime, wave regime, river flow, residence time, sediment characteristics, turbidity, stratification, and salinity changes.
4. Classification and Reporting: Aggregation of metric scores to determine Total Deviation and Hydromorphological Alteration Index (HAI), ultimately leading to the HQI classification (High, Good, Moderate, Poor, Bad) aligning with the Water Framework Directive (WFD).

This document provides a framework for assessing the hydromorphological quality of Georgia's Black Sea Coastal and Transitional Waters, potentially playing a crucial role in facilitating evidence-based decision-making and promoting sustainable management practices along Georgia's Black Sea coast. Aligned with the requirements of the Water Framework Directive, it can ensure the seamless integration of hydromorphological assessment results with the biological and physico-chemical status of Georgia's Black Sea CTWs, thereby contributing to the development of River Basin Management Plans (RBMP) for rivers discharging into the Black Sea along Georgia's coast.

1. Introduction

Georgia has adopted the Law of Georgia on Water Resources Management,[1] undertaking the provisions of the Association Agreement of 2014 between the European Union and Georgia[2] to gradually approximate its legislation to EU legislation, in particular the Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive, WFD),[3] and specifically meeting the commitment of the adoption of national legislation and designation of competent authority/ies.

In addition to lakes and rivers and their basins, Coastal and Transitional Water (CTW) bodies are the basic monitoring units under the EU Water Framework Directive (WFD), which have also been transposed into national legislation with the Law of Georgia on Water Resources Management.

The Coastal and Transitional Waters of Georgia are to be delineated into water types and water bodies according to the WFD System B (system with mandatory and optional delineation factors), as set out in Annex 2 of this document, which is to be subjected to adjustments on a periodic basis as all identified Coastal and Transitional Water bodies has to continuously undergo a verification process based on most recent monitoring data, substrate composition, surface salinity distribution in specific water bodies, etc.

The ecological status of the monitored water bodies needs to be assessed on the basis of the status of the physico-chemical and biological quality elements, the status of the river basin-specific pollutants (which are still being determined in Georgia), as well as the status of the **hydromorphological** quality elements in order to complete assessment of the ecological status.

The Law of Georgia on Water Resources Management contains several references to the **hydromorphological** status and monitoring of Coastal and Transitional Waters:

- The law defines Heavily Modified Water Body as a surface water body that has significantly changed its biological, **hydromorphological** and physico-chemical characteristics as a result of human activity.
- The law also defines Ecological Status as an expression of the quality of the structure and functioning of water ecosystems related to surface waters, which is determined on the basis of biological, **hydromorphological** and physico-chemical quality elements.
- The Ministry of Environmental Protection and Agriculture of Georgia is specified as the competent government authority responsible for organising the qualitative, quantitative and **hydromorphological** monitoring of water resources.
- When classifying surface water bodies, quantitative, biological, **hydromorphological** and physico-chemical indicators should be taken into account. On this basis, water bodies are categorised as having ecological status a) high; b) good; c) moderate (average); d) poor; or e) bad.
- For all types of surface water bodies, typical **hydromorphological**, physico-chemical and biological background/baseline conditions are determined that correspond to the respective indicators of water bodies of the same type as having high ecological potential, as heavily modified water bodies

[1] https://matsne.gov.ge/ka/document/view/5846594?publication=0

[2] https://eur-lex.europa.eu/legal-content/en/TXT/PDF/?uri=CELEX:22014A0830%2802%29

[3] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02000L0060-20141120

and/or as artificial water bodies. The status of the indicators for surface waters are to be reviewed every 6 years.

- The State Monitoring System for Water Resources per legislation is a regular observation and data analysis within the framework of the unified national monitoring network, through which hydrological, hydrochemical, hydrobiological, **hydromorphological** and hydrogeological monitoring programmes are carried out.
- State monitoring of water is carried out by a legal entity under public law, which is part of the Ministry's system - the National Environment Agency. The monitoring plan is drawn up annually by the National Environment Agency and approved by the Minister. The guiding rules for the planning and implementation of monitoring has to be laid down by a Resolution of the Government of Georgia.

This document deals specifically with the development of a national methodology for the assessment of the hydromorphological status of Coastal and Transitional Water bodies, based on the requirements of the Water Framework Directive and related guidance documents,[4, 5, 6] the provisions of the respective European Standard for the monitoring of CTW bodies[7] and, last but not least, the respective requirements of the Law of Georgia on Water Resources Management.

Based on these European directive guidances and standards and the requirements of national legislation, the first introductory chapter in the second chapter this document briefly discusses the methods for identifying and designating Heavily Modified and Artificial Water Bodies; the third chapter contains basic typologies, reference conditions and classification systems; the fourth deals with hydromorphological monitoring of CTW bodies; the fifth and sixth chapters present general and specific considerations for monitoring the hydromorphological quality elements of CTW bodies; and the final, seventh section defines tools and routines for the hydromorphological classification of Georgian Black Sea CTWs, based on European best practices and taking into account Georgian specificities, as well as the format and availability of the relevant data and reference literature. The eighth chapter provides key conclusions, while the last nineth chapter in two annexes specifies further hydromorphological data requirements for assessing CTWs status and, importantly, provides current delineation of Georgian Black Sea CTWs subject to future adjustments as more data, information, knowledge and experience is accumulated.[8]

[4] https://circabc.europa.eu/sd/a/f9b057f4-4a91-46a3-b69a-e23b4cada8ef/Guidance No 4 - heavily modified water bodies - HMWB (WG 2.2).pdf

[5] https://circabc.europa.eu/sd/a/85912f96-4dca-432e-84d6-a4dded785da5/Guidance No 5 - 0characterisation of coastal waters - COAST (WG 2.4).pdf

[6] https://circabc.europa.eu/sd/a/63f7715f-0f45-4955-b7cb-58ca305e42a8/Guidance No 7 - Monitoring (WG 2.7).pdf

[7] https://www.en-standard.eu/csn-en-17123-water-quality-guidance-on-determining-the-degree-of-modification-of-the-hydromorphological-features-of-transitional-and-coastal-waters

[8] This delineation was initially produced in 2020 with the support of the EUWI+ project. As a result of 2 surveys from Kobuleti to Anaklia in 2022 and 2023, this delineation proposal was slightly improved for the area from Sarpi to Anaklia. The EU4Env Water and Data GE Delineation proposal will be presented in the document: “An improved delineation proposal of Georgia’s Coastal and Transitional Waters, reference conditions and assessment of the ecological status of water bodies in the pilot area from Kobuleti to Anaklia”. This report will be prepared in March 2024.

2. Identification & Designation of Heavily Modified & Artificial Water Bodies

Definitions of Coastal HMWB and AWB

Heavily Modified Water Body (HMWB) means "a body of surface water which as a result of physical alterations by human activity is substantially changed in character".

The following types of activities are likely to result in a water body being designated as a HMWB:

- shipping, including port facilities, or recreation;
- drinking water supply, power generation or irrigation
- water regulation, flood protection, land drainage;
- other important sustainable human development activities.

HMWBs should be

- physically altered by human activity;
- substantially changed in character.

Artificial Water Body (AWB) "means a body of surface water created by human activity".

Environmental objectives of HMWB or AWB are "good ecological potential" (GEP) and "good chemical status" (GCS) but not "good ecological status" (GES). For HMWB and AWB the reference condition is the "maximum ecological potential" (MEP).

Ecological impacts resulting from physical alterations are allowed for HMWB or AWB as far as (i) their existence are necessary to support a specified use or (ii) must be maintained to avoid adverse effects on the wider environment.

The designation of HMWB and AWB, the definition of the MEP, the identification of GEP as well as the programme of measures to achieve the relevant environmental objectives have to be part of the River Basin Management Plans (to be revised every six years).

Designation of Coastal HMWB and AWB

Figure 1 illustrates the overall stepwise approach to the identification and designation of HMWB and AWB. These steps are explained briefly below:

Step 1: The water body identification is iterative and adaptive process (up to step 6 and beyond) that has to be done for all surface waters (natural, heavily modified and artificial waters), defining the units for which status is being assessed, objectives established and achievement of objectives checked.

Step 2: AWB in this second step identifies whether the water body concerned has been "created by human activity". Option is to identify and designate it as AWB (ignoring test step 7 and going to step 8), or in some cases, identify it as a natural water body.

Step 3: A screening process serves to reduce efforts needed for HMWB designation tests, avoiding those water bodies that likely may fail to achieve GES, but which show no hydromorphological changes.

Step 4: is concerned with water bodies which have not been "screened out" in step 3, having significant changes in hydromorphology, which should be described, as well as resulting pressures and impacts should be assessed.

Step 5: Within this step it has to be assessed whether the reasons for failing the GES are hydromorphological changes and not other pressures such as toxic substances or other quality problems.

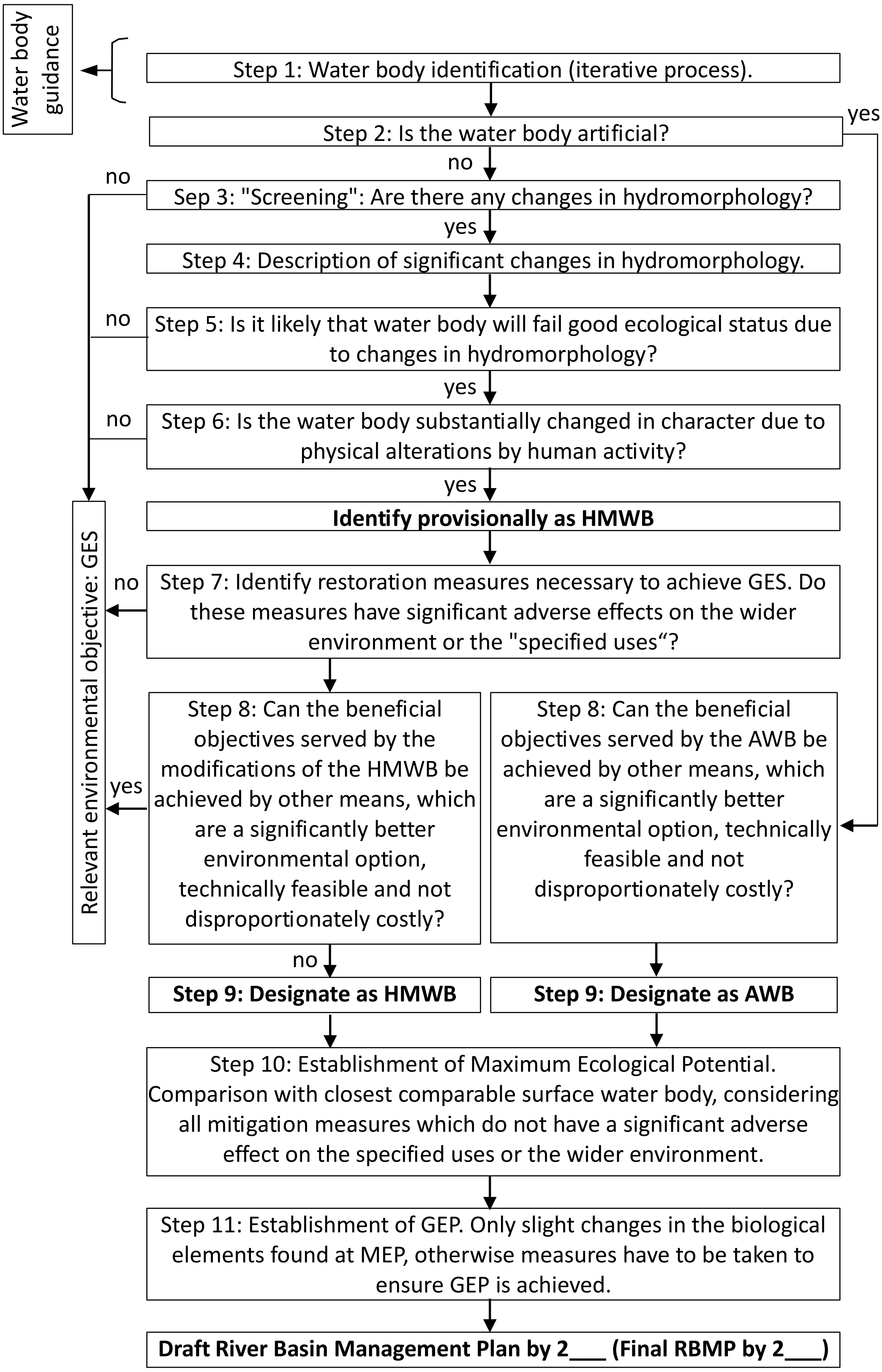

Figure 1. Steps of the HMWB & AWB identification & designation process

Step 6: The purpose of this step is to select those water bodies where the changes in hydromorphology result in the water body being substantially changed in character. Such water bodies can be provisionally identified as HMWB. The remaining water bodies likely to fail GES, which are not substantially changed in character, will be identified as natural water bodies setting GES or less stringent environmental objectives.

Step 7: Provisionally identified HMWBs must undergo “designation tests”. The first test under step 7 identifies and considers necessary hydromorphological changes ("restoration measures") to achieve "good ecological status" (GES). In case "restoration measures" have significant adverse effects on either the "specified uses" or the "wider environment", then second test (step 8) has to be carried out.

Step 8. The second designation test first identifies "other means" (alternatives) to achieve the beneficial objective and then assesses whether the "other means" are a) technically feasible, b) a better environmental option and c) not disproportionately costly. If any of the sub-tests a), b) or c) are negative, the water bodies may be designated as heavily modified (step 9). If either the mitigation measures have no significant adverse effects (step 7) or if "other means" can be found that fulfil the criteria a), b) or c) (step 8), the water body must not be designated as heavily modified and the relevant environmental objective would be GES or a less stringent objective.

Step 10: Reference condition for HMWB and AWB, the Maximum Ecological Potential (MEP), is defined.

Step 11: Based on the MEP, Good Ecological Potential (GEP) environmental quality objective is defined.

The steps 1-11 have to contribute to the RBMP and its Programmes of Measures required to ensure the achievement of the environmental objectives for natural, heavily modified and artificial water bodies.

3. Typology, Reference Conditions and Classification Systems

Common understanding of the terms related to CTW

WFD Definitions for CTW categories:

'Transitional waters' are bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to Coastal Waters but which are substantially influenced by freshwater flows.

'Coastal water' means surface water on the landward side of a line, every point of which is at a distance of one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured, extending where appropriate up to the outer limit of Transitional Waters. 'Coastal waters' shall be identified and assigned to the nearest or most appropriate river basin district or districts.

'Body of surface water' means a discrete and significant element of surface water such as a lake, a reservoir, a stream, river or canal, part of a stream, river or canal, a Transitional Water or a stretch of Coastal Water. The water body is the management unit of the WFD.

'Natural water bodies', 'heavily modified water bodies' and 'artificial water bodies' may be identified for all surface waters.

Characterisation of water bodies, including the type-specific reference conditions, so as to reflect greater understanding and knowledge of the systems and natural variability including climate change, must be reviewed by the state every six years.

Wetland creation and enhancement can provide sustainable, cost-effective and socially acceptable mechanisms to achieve environmental objectives for CTWs. In particular, wetlands can help reduce the impacts of pollution, mitigate the effects of flooding, achieve sustainable coastal management and promote groundwater recharge.

Typology of CTW

The purpose of typology is to enable type specific reference conditions to be established which then become the anchor for classification systems. Typology has consequences for operational aspects of the implementation including monitoring, assessment and reporting.

Surface water bodies shall be assigned to one of the following categories: rivers, lakes, transitional, coastal, artificial or heavily modified surface water bodies. These categories must then be further divided into types.

Under WFD System B for characterisation of Transitional Waters (TW) and Coastal Waters (CW) the same Obligatory and following Optional factors are used (defined in further tables):

Obligatory: latitude, longitude, tidal range, salinity.

Optional: depth (TW only), current velocity, wave exposure, residence time, mean water temperature, mixing characteristics, turbidity, retention time of enclosed bays (CW only), mean substratum composition, shape, water temperature range.

Salinity		**Mean Spring Tidal Range**	
Freshwater	< 0.5 (‰)	Micro tidal	< 1 m
Oligohaline	0.5 to 5 - 6 (‰)	Meso tidal	1 m to 5 m
Mesohaline	5 - 6 to 18 - 20 (‰)	Macro tidal	> 5 m
Polyhaline	18 – 20 to 30 (‰)		
Euhaline	> higher than 30 (‰)		

Exposure (wave)

Extremely exposed	Open coastlines which face into prevailing wind and receive oceanic swell without any offshore breaks (such as islands or shallows) for more than 1000 km and where deep water is close to the shore (50 m depth contour within about 300 m).
Very exposed	Open coasts which face into prevailing winds and receive oceanic swell without any offshore breaks such as islands, or shallows for at least several hundred kilometres. Shallow water less than 50 m is not within about 300 m of the shore. In some areas exposed sites may also be found along open coasts facing away from prevailing winds but where strong winds with a long fetch are frequent.
Exposed	The prevailing wind is onshore although there is a degree of shelter because of extensive shallow areas offshore, offshore obstructions, or a restricted (<90°) window to open water. These stretches of coast are not generally exposed to strong or regular swell. Coasts may also face away from prevailing winds if strong winds with a long fetch are frequent.
Moderately exposed	These sites generally include open coasts facing away from prevailing winds and without a long fetch but where strong winds can be frequent.
Sheltered	At these sites there is a restricted fetch and/or open water window. Coasts can face prevailing winds but with a short fetch e.g. 20 km or extensive shallow areas offshore or may face away from the prevailing winds.
Very sheltered	These sites are unlikely to have a fetch greater than 20 km (the exception being through a narrow channel) and may face away from prevailing winds or have obstructions such as reefs offshore or be fully enclosed.

Depth		**Mixing**	**Substratum**
Shallow	< 30 m	Permanently fully	Hard (rock, boulders, cobble)
Intermediate	30 m to 50 m	Mixed partially	Sand-gravel
Deep	> 50 m	Stratified permanently	Mud
		Stratified	Mixed sediments

Proportion of Intertidal Area

Small	< 50%
Large	> 50%

Residence Time

Short	Days
Moderate	Weeks
Long	Months to years

Current Velocity

Weak	<1 knot
Moderate	1 knot to 3 knots
Strong	>3 knots

Duration of Ice Coverage

Irregular	
Short	< 90 days
Medium	90 to 150 days
Long	> 150 days

Reference conditions for CTW

The *reference condition* is a description of the *biological* quality elements only. *High ecological status* incorporates the *biological, physico-chemical* and *hydromorphological* elements.

Qualitative and quantitative aspects of reference conditions should be published as part of the River Basin Management Plan and be available to the public.

Classification of ecological status within CTW

The classification of ecological status is based upon the status of the biological, hydromorphological and physico-chemical quality elements (see Figure 2 and Figure 3).

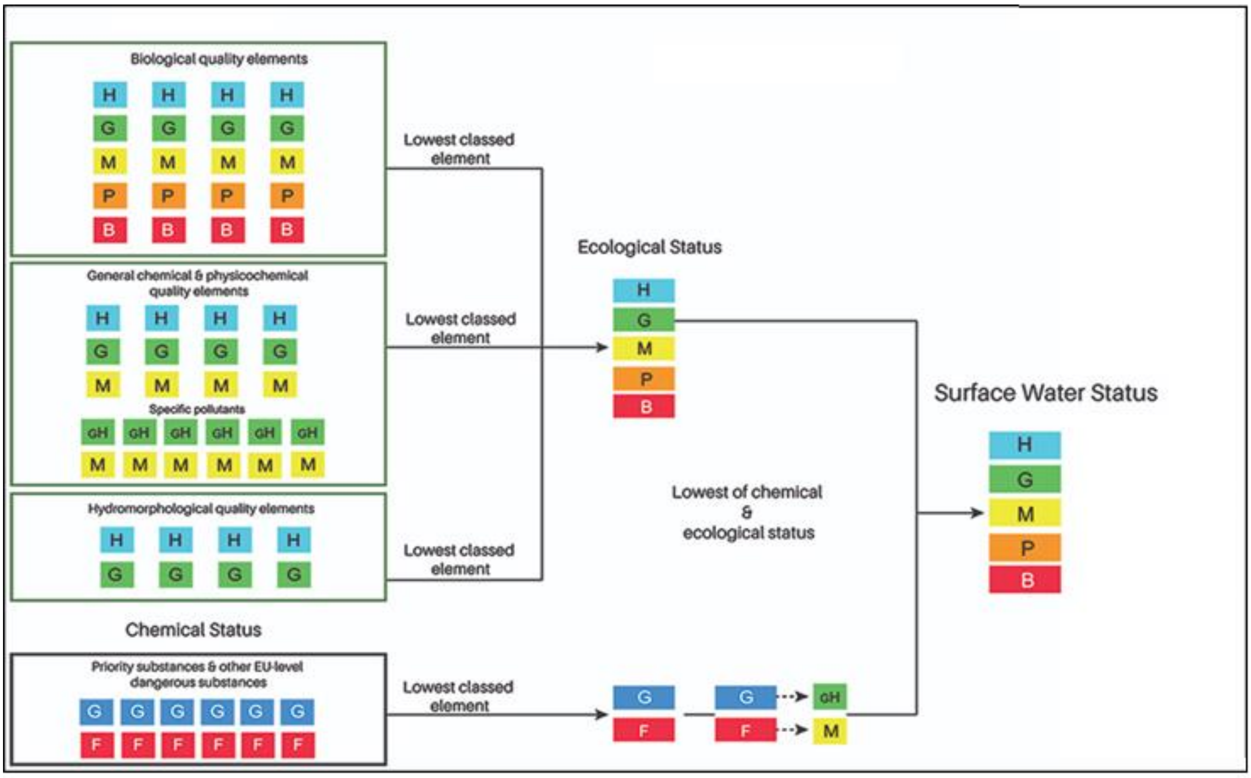

Figure 2. Schematic classification of the surface water status und the Water Framework Directive.

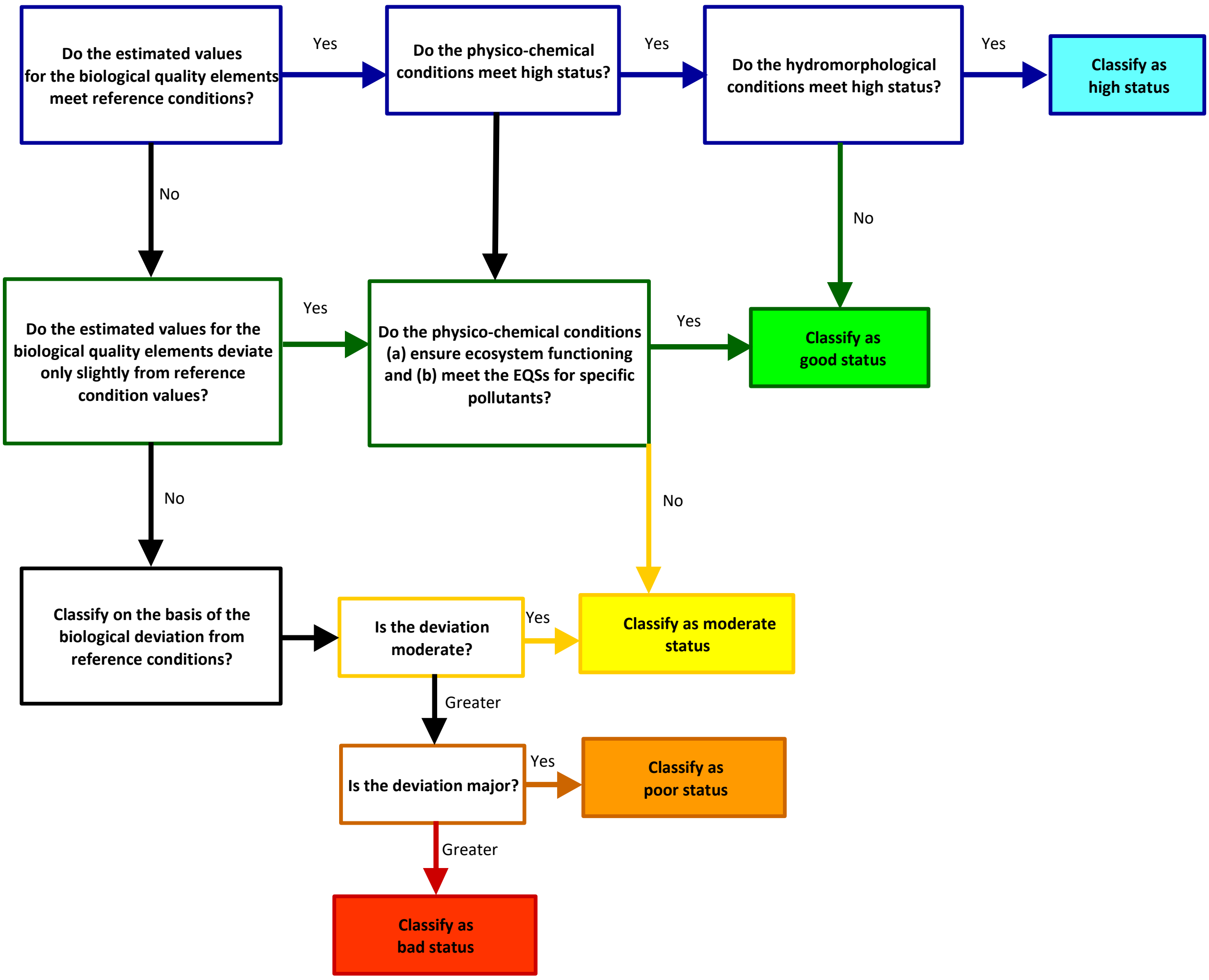

Figure 3. Classification based on biological, hydromorphological, physico-chemical quality elements

In case of hydromorphological assessment as high or good, the overall status of a surface water body is described by its ecological and chemical status (see Figure 2 and Figure 3), while in case of moderate, poor or bad hydromorphological assessment, the overall status is described by the ecological potential and chemical status of a water body. Those water bodies that do not achieve at least good hydromorphological status are declared as heavily modified water bodies (HMWBs).

In addition to HMWBs, the WFD also recognises artificial water bodies (AWBs), which are surface water bodies created by human activities. The status of artificial water bodies is also assessed based on their ecological potential and chemical status.

The classification of hydromorphological quality elements in CTWs must be based upon:

- Morphological conditions: depth variation quantity, structure and substrate of the bed structure of the inter-tidal zone (both for TW and CW); and
- Tidal regime: wave exposure, freshwater flow (only TW), direction of dominant currents (only CW).

Definitions of Hydromorphological quality elements at high, good and moderate status are defined in the following manner for:

TRANSITIONAL WATERS

High status	Good status	Moderate status
Morphological conditions:		
Depth variations, substrate conditions, and both the structure and condition of the inter-tidal zones correspond totally or nearly totally to undisturbed conditions.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Tidal regime:		
The freshwater flow regime corresponds totally or nearly totally to undisturbed conditions.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.

COASTAL WATERS

High status	Good status	Moderate status
Morphological conditions:		
The depth variation, structure and substrate of the coastal bed, and both the structure and condition of the inter-tidal zones correspond totally or nearly totally to the undisturbed conditions.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Tidal regime:		
The freshwater flow regime and the direction and speed of dominant currents correspond totally or nearly totally to undisturbed conditions.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.

4. Monitoring hydromorphology in CTW

The monitoring covers Transitional[9] and Coastal[10] Waters up to one sea mile from the territorial waters UNCLOS baseline of Georgia.

"Water bodies" are the monitoring units used for reporting and assessing their status on compliance with the environmental objectives set.

There are three types of monitoring: surveillance, operational and investigative.

The objectives of **surveillance** monitoring are:

- Efficient and effective design of monitoring programmes
- Assessment of long-term changes in natural conditions; and
- Assessment of long-term changes resulting from widespread anthropogenic activity.

Investigative monitoring may also be required in specified cases, e.g. where the reason for exceedance of environmental objectives is unknown, or to ascertain magnitude and impacts of accidental pollution.

The objectives of **operational** monitoring are to:

- Establish the status of those bodies at risk of failing to meet their environmental objectives; and
- Assess any changes in the status of such bodies resulting from the programmes of measures.

The most important quality elements (QEs) for determining hydromorphological status in CTW bodies are tidal regime and morphological conditions. The conditions of these QEs are based on the degree of change in natural conditions (generally as a result of physical alteration by human activities) in freshwater flow, direction of prevailing currents, depth variation, substrate structure, etc., in specific water bodies (Figure 4 and Figure 5).

Based on hydromorphological monitoring results, the hydromorphological status of water bodies is classified as high, good, moderate, poor, or bad.

This chapter provides guidance on the selection of quality elements and parameters for Transitional Waters and Coastal Waters, summarised in Figure 4 and Figure 5 and key features of each hydromorphological quality element for Transitional Waters and Coastal Waters summarised in Table 2 and Table 3, respectively. Some typical activities that have negative impacts on hydromorphology and aquatic ecology are listed in Table 4, while in compliance with the provisions of the WFD Clause 1.3.4. frequency of monitoring for CTW quality elements is defined in the **Error! Reference source not found.**.

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[9] Definition of Transitional Waters: 'Transitional Waters' are bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to Coastal Waters but which are substantially influenced by freshwater flows.

[10] Definition of Coastal Waters: 'Coastal water' means surface water on the landward side of a line, every point of which is at a distance of one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured, extending where appropriate up to the outer limit of Transitional Waters.

Table 1. Frequency of monitoring

Quality element	Transitional	Coastal
Biological		
Phytoplankton	6 months	6 months
Other aquatic flora	3 years	3 years
Macro invertebrates	3 years	3 years
Fish	3 years	3 years
Hydromorphological		
Morphology	6 years	6 years
Physico-chemical		
Thermal conditions	3 months	3 months
Oxygenation	3 months	3 months
Salinity	3 months	
Nutrient status	3 months	3 months
Acidification status		
Other pollutants	3 months	3 months
Priority substances	1 month	1 month

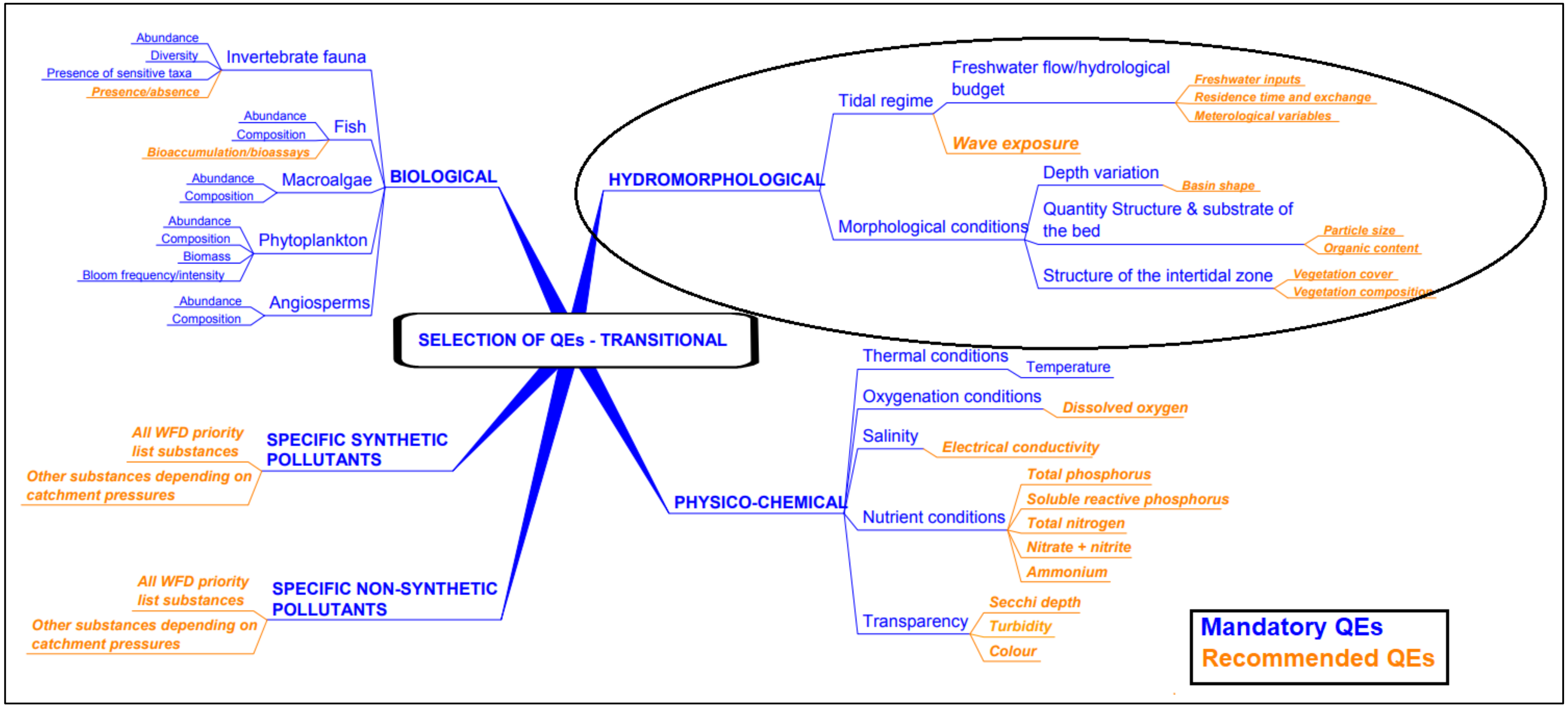

Figure 4. Mandatory and recommended quality elements for Transitional Waters.

Table 2. Key features of each Hydromorphological quality element for Transitional Waters

Aspect/feature	Morphological conditions			Tidal regime Hydrological budget
	Depth variation	**Quantity, structure and substrate of the bed**	**Structure of the transitional zone**	
Measured parameters indicative of QE	Shape of the basin	Grain size Organic content	Vegetation cover Vegetation type	Freshwater inputs Exchange with the ocean Water residence time Meteorological variables
Pressures to which QE responds	Hydrological modification Suspended solids Dredging	Mechanical and organic pollution Hydrological modification Suspended solids. Dredging	Land use and modification of hydrology	Modifications of land use Modifications of marine sandy coasts Outlet modification
Level and sources of variability of QE	Slow changes due to impaired decomposition Solid transport through the ecotone from the terrestrial environment, freshwater transport High variability for some typology due to sand transport and accumulation.	Low natural variability Moderate variability due to human impact	Low natural variability Moderate variability due to human impact	High temporal variability due to hydrological and meteo-conditions Low temporal variability due to groundwater uses and land use

Aspect/feature	**Morphological conditions**			**Tidal regime** **Hydrological budget**
	Depth variation	**Quantity, structure and substrate of the bed**	**Structure of the transitional zone**	
Sampling methodology	Echo soundings Remote sensing	Corers	Remote sensing images and field surveys	In situ measurements of water flows
Typical sampling frequency	Once every 5 years	Once every 3 years	Once every 3 years	A complete annual cycle with quarterly samplings, every 3 years
Time of year of sampling	Indifferent	Indifferent	Spring-summer	Seasonal
Typical "sample" size or survey area	Grid from 1 X 1 m up to 10 m X 10 m	Undisturbed bottom sample from 10 cm X 10 cm up to 200 cm X 200 cm	Entire ecotone	All water inputs and outputs
Ease of sampling / measurements	Rapid electronic measurements	Rapid sampling, time consuming laboratory analysis	Easy Rapid using remote sensing technology, if possible.	Easy and rapid sampling when supported by expensive field equipment
Basis of any comparison of results / quality / stations e.g. reference conditions / best quality	Maps of the National Hydrographical services	No	Corine habitat maps	No

Aspect/feature	Morphological conditions			Tidal regime Hydrological budget
	Depth variation	Quantity, structure and substrate of the bed	Structure of the transitional zone	
Methodology consistent across EU?	No	Folk method (Sediment triangle and hierarchy classification method)	No	No
Current use in monitoring programmes or for classification in EU	No	No	No	No
Existing monitoring systems meet requirements of WFD?	No	No	No	No
Existing classification systems meet requirements of WFD?	No	No	No	No
ISO/CEN standards	Yes	Yes	Yes	Yes
Applicability to Transitional waters	Yes	Yes	Yes	Yes
Main Advantages	Rapidity of sampling and map making	Rapid sampling	Rapid sampling and map making	Rapid sampling and map making
Main disadvantages	None	Time consuming laboratory analysis		Expensive instrumentation

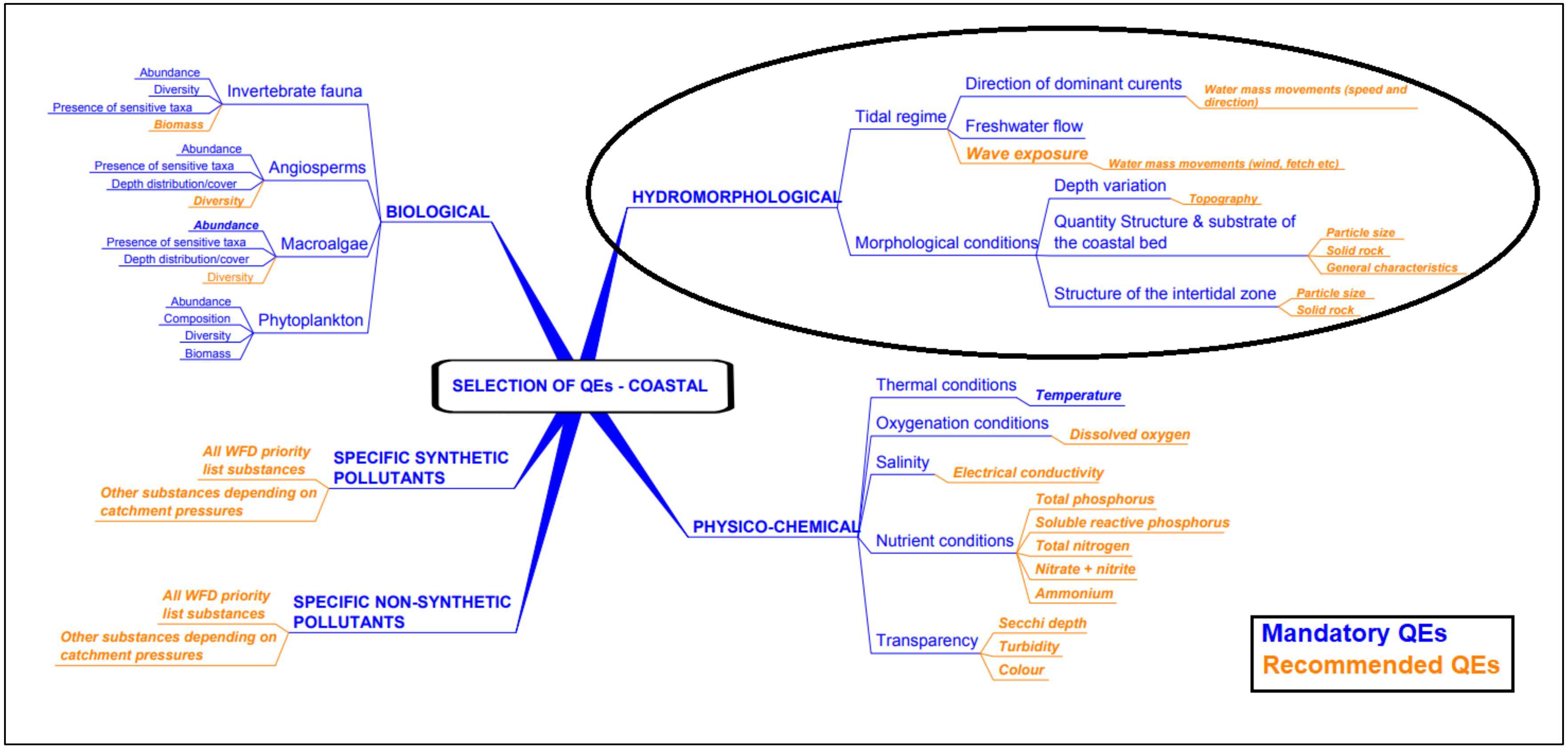

Figure 5. Mandatory and recommended quality elements for Coastal Waters.

Table 3. Key features of each Hydromorphological quality element in Coastal Waters

Aspect/feature	Morphological conditions			Tidal regime	
	Depth variation	**Structure and substrate of the coastal bed**	**Structure of the intertidal zone**	**Direction of dominant currents**	**Wave exposure**
Measured parameters indicative of QE	Topography of the type of water body	- Grain size - Solid rock - Other general characteristics: coarse description (mud, sand, gravel, hard soils or rocks sedimentological structures (ripples, sand reefs, under water dunes etc.) - bioturbation, lamination in sediment cover, oxygenation conditions in sediments	- Rock type, form and exposure to waves, - Grain size - Distribution of biological communities - H/L tide levels - erosion/deposition	Water mass movements (speed and direction)	Water mass movements (wave, wind, Fetch-index) frequency of storms directions H/L tide/surge levels
Pressures to which QE responds	Landfill, dredging, dumping, and natural large scale bottom dynamics	Mechanical disturbance and variation in structure and substrate composition due to anthropogenic input	- Mechanical disturbance and variation in structure and substrate composition due to anthropogenic input - Change in macroalgal composition due to chemical inputs - Diking - Beach nourishment	Natural modification (mechanical and climatic) of coastline Anthropogenic modifications (constructions)	Natural modification (mechanical) of coastline climate Constructions

Aspect/feature	Morphological conditions			Tidal regime	
	Depth variation	**Structure and substrate of the coastal bed**	**Structure of the intertidal zone**	**Direction of dominant currents**	**Wave exposure**
Level and sources of variability of QE	Very low variability due to natural erosion and sedimentation. Moderate variability due to human impact Seasonal variations are important in nearshore areas	Low natural variability Moderate variability due to human impact Seasonal variations are important in nearshore areas	High natural variability (regularly: tidal flooding and drought periods. irregularly: storms, etc.). High variability due to human impact	High natural variability depending on winds, tides and climatic changes Low frequency climatic changes (oscillations)	Seasonal variability Low frequency climatic changes (oscillations)
Sampling methodology	Echo soundings ROV	Corers Scanning acoustic techniques Diving Video	- Skindiving, photo, corer (intertidal soft bottom) - Remote imaging (satellite airborne systems); - Viewpoint photography; - In-situ measurements along transects	Drifters In situ measurements Autographic instruments Doppler Historical flows data Modelled flows (mainly large scale)	In situ measurements Autographic instruments Fetch calculations Calculations (mainly large scale) from maps and meteorological data modelling gauging
Typical sampling frequency	Once every 5/6 years Before and after significant pressure applied	Once every 5-6 years Sampling "ad hoc" for specific reasons (i.e. construction, benthic studies support)	Once / twice every 5-6 years Sampling for specific reasons (i.e. construction, mapping)	Annual cycle	Annual cycle

Aspect/feature	Morphological conditions			Tidal regime	
	Depth variation	**Structure and substrate of the coastal bed**	**Structure of the intertidal zone**	**Direction of dominant currents**	**Wave exposure**
Time of year of sampling	Indifferent Important if seasonal variations in nearshore areas	Indifferent	Summer (to avoid winter with possible ice cover) and if using biological communities	Annual cycle	Annual cycle
Typical "sample" size or survey area	Hydromorphological grids vary according to desired scales. Suggestion: Grid from 100 m X 100 m up to 500 m X 500 m	Undisturbed bottom sample from 10 cm X 10 cm up to 200 cm X 200 cm box grab samples (50 cm x 50 cm, where appropriate) Larger areas covered by ROV/divers Side Scan Sonar	Whole intertidal zone using imaging techniques Sediment samples collected by a 5 cm diameter corer, 15 cm depth Undisturbed bottom sample from 10 cm X 10 cm up to 200 cm X 500 cm (Norway)	Instruments integrate information from large spatial and temporal areas Importance of instrument's location Operational modelling	Instruments integrates information from large spatial and temporal areas Importance of instrument's location
Ease of sampling / measurements	Rapid electronic measurements	Rapid sampling, time consuming laboratory analysis	Rapid sampling, time consuming laboratory analysis depending on substrate type or sampling technique	Rapid sampling and map making with autographic instruments	Rapid sampling and map making with autographic instruments

Aspect/feature	**Morphological conditions**			**Tidal regime**	
	Depth variation	**Structure and substrate of the coastal bed**	**Structure of the intertidal zone**	**Direction of dominant currents**	**Wave exposure**
Basis of any comparison of results / quality / stations e.g. reference conditions / best quality	Maps of National Hydrographical /Geological services	Seabed sediment maps from National Geological Surveys	Biological maps should use a standard classification such as EUNIS Maps from National Geological Surveys	No	No
Methodology consistent **across EU?**	No	No	No	No	No
Current use in monitoring programmes or for classification in EU	Used in operational monitoring, but not continuously in most of the countries	Italy Sweden (in connection with benthic studies)	UK – SAC monitoring programme		
Existing monitoring systems meet requirements of WFD?			Partially for UK		
Existing classification systems meet requirements of WFD?					
ISO/CEN standards	Yes	Yes	Yes	Yes	Yes
Applicability to Transitional waters	Yes	Yes	Yes	Yes	Yes

Aspect/feature	Morphological conditions			Tidal regime	
	Depth variation	**Structure and substrate of the coastal bed**	**Structure of the intertidal zone**	**Direction of dominant currents**	**Wave exposure**
Main Advantages	Rapidity of sampling and map making	Rapid sampling Provides information about hydrodynamism and different community distribution	Rapidity of sampling and map making Provides an overview of a whole system to identify extent of localised effects Provides link with biological QE	Continuous measurement, ease of mapping Information on dispersion of pollution (i.e. oil spill) and loads dilution	Continuous measurement, ease of mapping Information on dispersion of pollution (i.e. oil spill) and loads dilution
Main disadvantages	None	Time consuming laboratory analysis	Time consuming laboratory analysis for sediment characterisation Mapping can be expensive	Expensive instrumentation	Expensive instrumentation
Recommendation / Conclusion	Depth variations could be important elements to be monitored in areas where disturbances are expected: anthropogenic changes will have relevance for the status classification of the water body.	Indicator of hydrodynamism and supporting element for community distribution; Changes in morphological conditions and/or nature of the substratum may exert severe detrimental effects on benthic organisms.	Not relevant for the Mediterranean, Black Sea and the Baltic ecoregions, given their low tidal range. Thus, it is suggested to use the “intertidal/ mediolittoral” term for meaningful ecological relevance.	Direction and intensity (speed) of dominant currents are important parameters, especially in ecoregions or part of ecoregions with low tidal range (Black Sea, Baltic, Mediterranean) where tidal currents play a very minor role, if any. Can be particularly relevant in areas where anthropogenic disturbances occur. It can be necessary to take into account short term effects.	To be monitored in areas submitted to anthropogenic disturbances. Suggested parameters are frequencies of storm, direction, high/low tide surge levels.

Table 4. Effects on hydromorphology and ecological impacts due to typical human activities in Transitional and Coastal Waters

Use/activity	Nature of physical modification	Effect on hydromorphology	Ecological impacts
Flood risk management	Hard engineering protection e.g. concrete revetment, concrete and/or stone sea walls	Morphology: - intertidal zone and bed structure - bathymetry change	Changes to / loss of intertidal habitat (benthic communities: macroalgae, invertebrates, angiosperms)
Coastal defence / erosion control	- Concrete sea walls, - groins, - sediment filling (artificial beach construction)	Morphology: - depth variation (i.e. loss of natural gradient) - loss of existing natural sediment - intertidal zone structure - sediment input and distribution Hydrology: - obstructed freshwater inflow and distribution - formation of stagnant water bodies (e.g. trapped near groins)	Changes to / loss of intertidal and shallow inshore habitat (benthic communities: macroalgae, invertebrates, angiosperms)

Use/activity	Nature of physical modification	Effect on hydromorphology	Ecological impacts
Barrier, barrage, impounding structure	Sluice for water level management, channel constructions	Hydrology: - freshwater inflow, - salinization - sediment flow Morphology: - changes of natural sediment accumulation and erosion patterns - bed structure and substrate changes - bathymetry changes (e.g. shallowing)	Loss of continuity for fish passage
Navigation dredging	Dredging for navigational safety	Morphology: - bed structure (e.g. bathymetry changes) - bed substrate Hydrology: - water quality (e.g. turbidity)	Changes to seabed or intertidal habitat (benthic communities (invertebrates, angiosperms)

Use/activity	Nature of physical modification	Effect on hydromorphology	Ecological impacts
Land claim, reclamation, realignment	Embankment, concrete revetment, channels	Morphology: - depth variation (i.e. loss of natural gradient) - intertidal zone structure - bed structure - bed substrate Hydrology: - freshwater inflow and distribution - current velocities	Changes to / loss of intertidal habitat (benthic communities: macroalgae, invertebrates, angiosperms)
Port and harbour infrastructure	Non- or semi permeable protection structures (concrete, stone or synthetic)	Morphology: - depth variation (i.e. loss of natural gradient) - intertidal zone structure - bed structure (e.g. bathymetry changes) - bed substrate Hydrology: -variation of currents and waves - water quality (e.g. turbidity)	Changes to / loss of intertidal habitat (benthic communities: macroalgae, invertebrates, angiosperms)

Use/activity	Nature of physical modification	Effect on hydromorphology	Ecological impacts
Aquaculture	Anchored cages or floating structures (fish and shell fish farms)	Morphology: - bed substrate Hydrology: -organic enrichment - water turbidity	Changes to / loss of intertidal habitat (benthic communities: invertebrates, macroalgae, angiosperms)
Seabed infrastructure (pipelines, cables, etc.)	Laid and fixed pipes	Morphology: -bed structure and substrate (minor influence) Hydrology: -temporary water turbidity - water quality in case of disasters	Changes to / loss of intertidal habitat (benthic communities: invertebrates, angiosperms)
Infrastructure supporting recreational use	Delimitation net, embankment (gravel, sand), aqua park structures, artificial beaches, beach replenishment	Morphology: -from minor influence (net) to changes of intertidal zone structure and bed structure -bed substrate Hydrology: - water quality - water turbidity	Changes to / loss of intertidal habitat (benthic communities: macroalgae, invertebrates, angiosperms)

5. Generic considerations for monitoring hydromorphology quality elements

Aspects and features of the different hydromorphology quality elements to be monitored for Transitional Waters are summarised in the Table 2 above, while key considerations are provided in section 4.1 below.

Similarly, aspects and features of the different hydromorphology quality elements to be monitored for Coastal Waters are summarised in the Table 3 above, while key considerations are provided in 4.2 below.

4.1 Transitional Waters

It is suggested to consider the hydrological budget a quality element more general than the freshwater flow, which is actually a component of the hydrological budget. Hydrological budget responds to variation of the freshwater flow but also to variation in the sand accumulation vs. sand erosion processes.

Morphological conditions

Refer to same paragraph of Section 4.2 (Coastal waters).

Depth variations

Refer to same paragraph of Section 4.2 (Coastal Waters).

Structure and substrate of the Transitional Water bed

Refer to same paragraph of Section 4.2 (Coastal Waters).

Structure of the transitional zone

The structure of the transitional zone can be monitored in terms of structure of the vegetation occurring at the land-water interfaces, as affected by features of the substrate (mud, sand, rock, etc.), of the climatic and hydrologic regimes and of the anthropogenic pressures.

Vegetation coverage, vegetation type and floristic composition are the parameters that can be monitored.

A major problem is that the structure of vegetation is only an indirect indicator of the activity of the transitional zone as a buffering zone for the pressures of the anthropogenic activities in the watershed.

The structure of vegetation can be monitored every three years.

Hydrological budget

The hydrological budget characterizes the different transitional waters, i.e. estuaries, deltas, lagoons, coastal lakes, ports or gulfs, determines the sediment distribution and affects the sensitivity and resilience of transitional water ecosystems. Consequently, the hydrological budget has a major influence on all the quality elements in transitional waters.

Hydrological relevant parameters for an estuary are the volumes entering the estuary during high and low tide (tidal volume). The waterflow (volume and velocity) varies very locally. Subsequently erosion and sedimentation processes are sensitive to anthropogenic measures (LT-process) and extreme events like storm (ST-process). Special attention has to be given to the fish breeding areas between 0 to 5 m water depth and currents below 0.5 m. Monitoring these areas should be included in the program.

Changes in the components of the hydrological budget, due to human activities, are expected to be relatively slow. Therefore, monitoring is recommended every three years. Monitoring should be performed with data collection on all the freshwater inputs and outputs arranged on a seasonal scale.

4.2 Coastal Waters

Morphological conditions

The morphological characteristics of coastal areas are generally subjected to low variability due to natural large-scale bottom dynamics processes or changes in tidal regime and weather patterns.

Relevant for ecological status is the time scale of the changes resulting from human impact in the past. A time scale of 10 to 25 years means that relevant changes in hydromorphological conditions have an impact on ecology. In addition, sea level rise makes it necessary to adapt the monitoring frequency and spatial scale to analyse the processes and to find the sand budgets in coastal zone, sheltered seas and estuaries.

Monitoring the trends in depth gradients has to take into account water management measures like dredging and dumping activities and naturally induced variability, under particular weather conditions such as storm events and ice winters/ice coverage, as well as natural coastal erosion and elevation of the land.

Depth variations

The topography of the area (shape, bathymetry, slope) influences the biological communities living in it. Depth variations could be important elements to be monitored in areas where disturbances are expected, anthropogenic changes will have relevance for the status classification of the water body.

Structure and substrate of the coastal bed

Changes in morphological conditions and/or nature of the substratum may exert severe detrimental effects on benthic organisms. Differences between communities in coastal zones and estuaries are linked to a coastal typology:

Possible causes of anthropogenic alterations in structure, substrate and shape of the coastal bed are:

- ➢ coastal constructions (dredging, dumping, dams, artificial reefs, etc.); and
- ➢ variations in riverine sediment inputs (solid transport regime) due to human impact.

For depth variation and structure and substrate of the coastal bed it may be sufficient to collect the required information once (e.g. a map of the coastal bed) and to record:

- ➢ at each sampling carried out after first thorough survey: typical parameters (e.g. nature of substratum) and obvious changes (e.g. visible changes after big storm events); and
- ➢ changes due to anthropogenic impact (e.g. dam construction).

A thorough survey should be repeated in regular, but longer intervals (e.g. once per management period or longer, depending on parameter).

Structure of the intertidal zone

As for the structure of the intertidal zone, it cannot be used as a quality element in the Mediterranean and the Baltic and Black Sea ecoregions, given the low amplitude of tides in the Mediterranean basin and in the Baltic and Black Seas.

Thus, it has been proposed to introduce the intertidal/mediolittoral term as its ecological relevance is due to the fact that it comprises living assemblages that require or tolerate immersion but cannot survive permanent or semi-permanent immersion (same definition for the intertidal). Thus, mediolittoral zone supports diverse and very productive assemblages of algae and invertebrates that can be considered analogues to those of intertidal habitats.

Possible causes of anthropogenic alterations in structure, substrate and shape of the intertidal are:

- coastal constructions (dredging, dumping, dams, artificial reefs, etc.);
- chemical inputs (nutrients) leading to a change in the composition of macroalgal communities; and
- variations in coastal or riverine sediment movements (sediment transport regime) due to human impact.

It is suggested to focus particular attention on the structure and condition of the mediolittoral and upper infralittoral zones in tideless seas, since several species and communities thriving in this area are very good biological indicators, as exposed to a wide range of anthropogenic impact due to their critical position at the interface between the sea and the land.

Tidal regime

Tidal regime in terms of direction of dominant currents and level of wave exposure can be seasonally predictable and are available from most of the National Hydrographic Services. Deviations from the natural pattern in tidal regime derive from direct anthropogenic intervention on the profile of the coastline and may have severe bearings on the stability of the biological assemblages, thus they need to be taken into consideration. Asymmetry in the tidal waves results in positive or negative yearly budgets of sediments.

Due to the low tidal range in the Mediterranean, Baltic and Black Seas, tidal currents play a very minor role, if any.

Direction of dominant currents

The direction and intensity (speed) of currents represent the main hydromorphological quality elements influencing the biological elements. They could be important elements to be monitored in areas where anthropogenic disturbance could be relevant for the status classification of the water body.

These parameters assume quite a relevant importance in those ecoregions and specific areas where the tidal range being very low poorly influences the coastal processes.

Mainly changes in hydrodynamics induced by morphological changes will result in relevant ecological effects. Temporal changes (storms, anthropogenic activities) could be balanced in the time scale of 5-6 years. On local scales this could not be the case. Monitoring should take into account these short term-effects.

Wave exposure

Wave exposure (wave height, wind, Fetch-index) varies considerably according to coastal typology (from highly exposed to very sheltered) and meteorological conditions, in the different ecoregions. Parameters to be monitored in case of anthropogenic disturbances are e.g. frequencies of storms, directions, high/low tide surge levels.

6. Specific considerations for monitoring hydromorphology quality elements

National resources

The data needed for the assessment of the hydromorphological status of Coastal and Transitional Water bodies has to be requested from competent governmental authorities and non-governmental and private organisations. Data for the area concerned has to be requested from competent institutions covering last 10 years, as well as earlier periods in appropriate cases (e.g. for shoreline dynamics), indicated with relevant maps and datasets. Data request has to refer to results of the regular monitoring carried out in the sea, along the coast and in river estuaries concerning the physico-chemical, biological and hydromorphological parameters, indicated in Annex 1.[11]

The availability of historical data on the Georgian coast (maps, shapefiles), sea level and subsidence, morphological conditions, freshwater flow, direction of prevailing currents, depth variations, substrate structure, etc., as well as the institutional location of these data should be carefully documented.

The most appropriate hydromorphological quality elements for Coastal and Transitional Waters in Georgia should be assessed on the basis of the data obtained and expert judgement according to the national hydromorphological assessment system with the threshold values for high, good, moderate, poor, and bad status proposed in this guideline.

Relevant office and field equipment needed for hydromorphological monitoring and protocols for monitoring Coastal and Transitional Waters should be secured and mobilised for field work and desk analysis, including the availability of hardware and software needed for such analysis.

Regional/international data and resources

Data and information provided by Georgian authorities and non-statutory sources can and should be supplemented by various scientific references and reports as well as regional/global data; non-exhaustive sources are briefly described below.

An excellent up-to-date overview of coastal dynamics along the Black Sea coastline of Georgia can be found in Megvinetukhutsesi, N. et. al, Report on Dynamics of Coastal Line Changes, PONTOS-GE, GA, Tbilisi, 2022.[12]

It is proposed that the same tools used in this source are applied to characterise coastal dynamic processes for the purposes of hydromorphological assessments in Georgia. The USGS Digital Shoreline Analysis System (DSAS) [13] is indeed useful when applied to the whole of Georgia, including the Apkhazeti Autonomous Republic (Zone 1), as well as the Samegrelo-Zemo Svaneti region, the Guria region and the Achara Autonomous Republic (Zone 2), as in the report cited above.

The DSAS tool can be used to analyse coastline changes with different types of Earth Observation instruments, such as long-term data with lower repetition and lower resolution (>40 years, bimonthly,

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[11] Data has to be requested in electronic and where appropriate and available, in geospatial formats.

[12] https://pontos-eu.aua.am/pontos-assessments

https://pontos-eu.aua.am/wp-content/uploads/2023/03/GRAL_Report-on-dynamics-of-coasltine-change_Eng.pdf

[13] https://www.usgs.gov/centers/whcmsc/science/digital-shoreline-analysis-system-dsas

approx. 15 m accuracy, USGS Landsat satellite 30 m pixel), medium-term data with medium repetition and medium resolution (>10 years, weekly, approx. 5 m accuracy, ESA Sentinel-2 satellite 10 m pixel) and short-term data with high repetition and high resolution (>5 years, daily, approx. 2 m accuracy, Planet's 8-band SuperDove 4 m pixel). These data sources are either free and open to use (USGS and ESA) or can be made freely available for research and educational purposes (Planet Labs). Satellite images with very high resolution (in the sub-metre range), as well as drones can also be used if sufficient financial and technical resources are available.

Another tool that can be applied using the same satellite Earth Observation data sources (Landsat, Sentinel-2, SuperDove) is the Georgian Data Cube pilot, first developed by UNEP/GRID-Geneva (http://geodatacube.unepgrid.ch) and then extended and operationalised by the same PONTOS platform Data Cube. Its Coastal Change as well as Water Quality TSM (Total Suspended Matter) tools can be used to visualise and collect data products for coastal dynamics and marine TSM at different temporal and spatial scales, including through the acquisition/ingestion of higher resolution imagery.

There are other global, European and regional datasets that can also characterise other water quality parameters, such as chlorophyll-a. The results for the whole of Georgia and for Zone 2 using the two tools DSAS and Data Cube are shown in Figure 6.

Changes to the coastline can be the result of anthropogenic (man-made) changes, but also natural influences. Only anthropogenic changes should be considered in the assessment of hydromorphological status. Therefore, the above tools should be used in combination with other data and information to distinguish between anthropogenic and natural causes of HYMO changes.

Data and information contributing to and used in the assessment of hydromorphological quality elements should be thoroughly documented, citing the necessary references and sources for both the literature and data sets used.

As regards tools for the assessment of hydromorphological quality elements, the latest, most reliable and easy-to-use European best practice tools should be applied, taking care that the tools are available and properly maintained in the long term due to the long-term nature of hydromorphological processes.

Such assessment tools, adopted and adapted for Georgian conditions, are proposed in the next final section of this guideline.

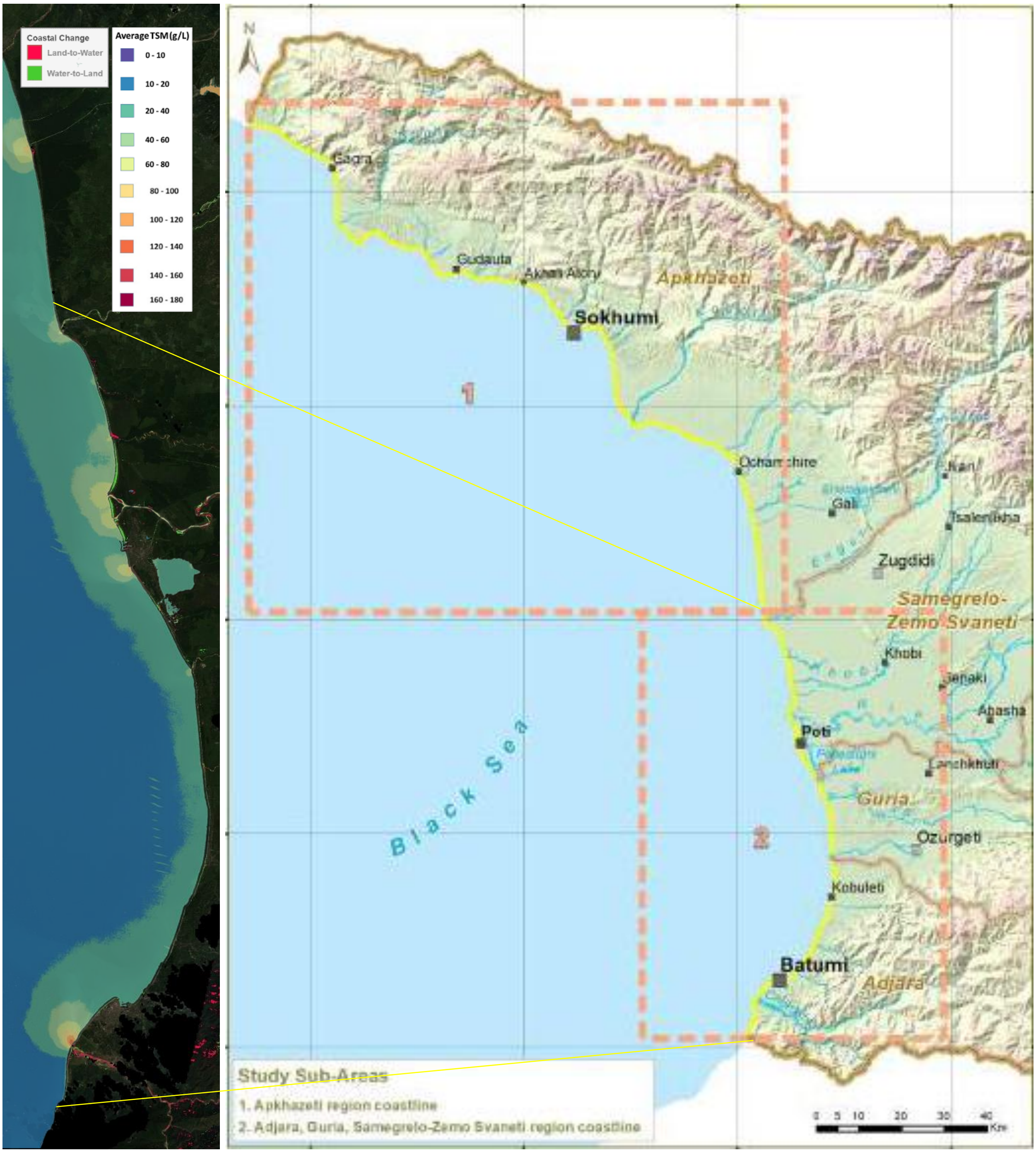


Figure 6. Zones 1 & 2 of Georgia for coastline change analysis with the DSAS tool (right) and visualisation of coastal change (Landsat-7, 1999-2016) and TSM (Landsat-5, 1984-2011) with the Data Cube tool, Zone 2 (left).

7. Methodologies and tools to classify hydromorphology quality elements

Classification methodology has to be approved by MEPA (*re:* Law of Georgia on Water Resources Management, Article 26. Clause 8).

It is proposed that the hydromorphological classification of the CTW bodies of the Black Sea in Georgia will be carried out by the National Environment Agency of MEPA directly or by outsourcing to qualified consultants using the latest European best practice[14] Hydromorphological Quality Index (HQI)[15] based on the CTW Morphological Impact Assessment System (MImAS) tool.

This chapter closely follows and prescribes this methodology and tool for the Black Sea coast of Georgia.

The HQI was developed as a WFD tool covering all 9 generic feature categories (see below) listed in the European guidance on characterisation of hydromorphology in CTW, following CEN 2014[16] & CEN 2017.[17]

The approach is based on an assessment of 13 metrics, culminating in a final classification derived from the cumulative score. The index categorizes a water body into 5 distinct classes. Semi-qualitative and quantitative criteria are employed to allocate a morphological classification that aligns directly with that of the WFD, encompassing designations of *high*, *good*, *moderate*, *poor*, and *bad* status.

The correlation between the 13 metrics employed in the calculation of HQI and the standard features outlined in Table 1 of the Guidance document (CEN, 2014) is delineated in Table 5 below.

Table 5. Standards correspondence matrix

Categories	No.	Generic features	Metric
Morphology	1.	Physiography/ Depth/Elevation	Metric 1a. Shoreline alteration
	2.	Connectivity	Metric 2a. Presence or absence of barriers within and between water bodies
	3.	Geology	Metric 3a. Bed disturbance Metric 3b. Change in habitat
	4.	Biogenic structures	Metric 4a. Change in the spatial extent of Marshes and/or Seagrass beds

[14] Phelan, N., Rumley, J. and Salas Herrero, M.F., Hydromorphological assessment and monitoring methodologies in Coastal and Transitional Waters, EUR 30891 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-43480-1, https://dx.doi.org/10.2760/735195.

[15] Keogh, J. Wilkes, R., O'Boyle, S., 2020. A new index for the assessment of hydromorphology in Transitional and Coastal Waters around Ireland. Mar. Pollut. Bull. 151, 110802, https://doi.org/10.1016/j.marpolbul.2019.110802.

[16] CEN, 2014. Water quality – Guidance standard on assessing the hydromorphological features of Transitional and Coastal Waters. EN 16503. European Committee for Standardisation, Brussels.

[17] CEN 2017. Water quality – Guidance on determining the degree of modification of the hydromorphological features of Transitional and Coastal Waters. EN 17123

Hydrology	5.	Tidal regime, water level and current	Metric 5a. Change in tidal regime, floods & sea level
	6.	Wave regime	Metric 6a. Changes in wave regime
	7.	Freshwater inputs and runoff	Metric 7a. Change in river flow Metric 7b. Change in residence time
	8.	Sediment dynamics	Metric 8a. Change in dominant fraction particle size Metric 8b. Change in turbidity
	9.	Stratification or degree of mixing	Metric 9a. Change to stratification Metric 9b. Change in salinity

The HQI utilizes a combination of field-based data (derived from WFD monitoring) and GIS observations (pertaining to morphological alteration/activity data) to populate the metrics essential for quantifying the generic features delineated in the CEN Guidance. The 13 metrics are detailed below.

In instances where there is a lack of data or insufficient data to compute the baseline and/or ascertain deviations from the baseline condition metric, data collection measures should be incorporated into the Programme of Measures.

Metric 1a. Shoreline alteration

Supporting a diversity of marine life and habitats, alterations to the shoreline profoundly affect CTW ecology. Lengths of hard engineering reinforcement, soft engineering reinforcement, and flood defence embankments are mapped for this metric.

Metric 1a: Shoreline alteration	Score
Shoreline in natural condition. <5% of shoreline altered.	+2
Slight alterations on the shoreline. 5-15% of the shoreline altered.	+1
Moderate shoreline alteration. 15-35% altered	0
Major shoreline alteration. 35-75% altered.	-1
Severe alteration of the seashore. >75% altered.	-2

Digital Shoreline Analysis System (DSAS)[18] and Data Cube is to be used to map coastal dynamics with low (Landsat) medium (Sentinel-2), high (SuperDove) and very higher resolution multispectral imagery.

[18] https://www.usgs.gov/centers/whcmsc/science/digital-shoreline-analysis-system-dsas

Metric 2a. Presence or absence of barriers within and between water bodies

Barriers change current patterns, tidal regime, sedimentation rates and disrupt migration and recruitment. A data layer of impoundments, bridges and piers allowed the percentage width of a barrier across a water body to be determined.

Metric 2a. Presence or absence of barriers within and between water bodies	Score
No barriers to impede water movement. <5% of water body width blocked.	+2
Presence of minor artificial structures such as groynes, bridges and jetties. 5-15% of water body width locked.	+1
Water movements impeded by features extending across the entire water body but water can pass through, e.g. bridge.15-35% of water body width.	0
Water movement impeded to a major extent. 35-75% of WB width blocked.	-1
Water movement severely impeded. >75% of water body width blocked.	-2

Metric 3a. Bed disturbance

Activities such as fishing and dredging can modify bed substrate and disturb benthic communities. Turbidity from dredging or dumping effect light regimes, a potentially limiting factor for phytoplankton production in estuarine ecosystems. Loss of sediment can affect the food and space resource. Licensed data determined area affected by dredging, aquaculture, fishing activity and pipelines, expressed as a percentage of total water body area.

Metric 3a. Bed disturbance Relative bed disturbance based on pressures and activities. (% of area affected)	Score
Little or no bed disturbance. <5% bed disturbance.	+2
Slight bed disturbance. 5% to 15% disturbance.	+1
Moderate bed disturbance. 15% to 35% disturbance.	0
Major bed disturbance. 35% to 75% disturbance.	-1
Severe bed disturbance. >75% bed disturbance.	-2

Metric 3b. Change in habitat

Loss of habitat (through land claim and building infrastructure) changes the shape, hydrography and sediment patterns of an estuary as well as removing feeding (e.g. mudflats) and refuges (e.g. saltmarsh). In adjacent areas, the effects can range from shifts in the aquatic plant composition to alterations in the benthic communities. A GIS land claim layer can be used to determine water body habitat lost to anthropogenic activity. The area is expressed as a % of the total water body area.

Metric 3b: Change in habitat	Score
Little or no habitat loss. <5%	+2
Slight habitat loss. 5 to 15%	+1
Moderate habitat loss. 15 to 35%	0
Major habitat loss. 35 to 75%	-1
Severe habitat alterations. >75%	-2

Metric 4a. Change in the spatial extent of Marshes and Seagrass Beds

Marshes and seagrass effect wave attenuation and shoreline stabilisation and are recognized as being important in sequestering carbon while providing rare and unique habitats supporting biota. As two of the biological quality elements, their biological status assesses against area change. Spatial extents are to be assessed and compared to a baseline. Where both elements occur in the same water body, the highest score is assigned. With seagrass distribution restricted around the Georgian coast and relative abundance of marshes in some parts, only this subset of water bodies is assessed.

Metric 4a: Change in the spatial extent of Marshes and Seagrass beds	Score
Little or no habitat loss. <5%	+2
Slight habitat loss. 5 to 15%	+1
Moderate habitat loss. 15 to 35%	0
Major habitat loss. 35 to 75%	-1
Severe habitat alterations. >75%	-2

Metric 5a. Change in tidal regime, coastal flood recurrence and/or sea level rise rates

Tidal regime influences water movements (current velocity), residence time and the degree of mixing between freshwater and seawater effecting tidal bed stress, erosion and deposition patterns and hence the composition of the substratum. Tidal regimes are classified according to three categories, microtidal (< 2m), mesotidal (2 to 4 m) and macrotidal (> 4 m). Nautical chats and other (e.g. global) data are to be used to determine if there is a change in the tidal regime. In addition, sea level rise combined with land subsidence, both superimposed on tidal regime change can have devastating long-term effect on coastal zone inhabitants and habitats, including coastal flood recurrence rates.

Metric 5a: Change in tidal regime, coastal flood recurrence and/or sea level rise rates	Score
No change. / No sea level change	+2
Slight change. <50% within a tidal category / sea level change rate <2 mm/y	+1
Moderate Change. >50% within a tidal category / sea level change rate <3 mm/y	0
Major change. Tidal regime altered by one category / accelerated sea level change rate <4 mm/y	-1
Severe change. Tidal regime changed by two categories/accelerated sea level change rate >4 mm/y	-2

Metric 6a. Change in wave regime

Changes to wave regime influences exposure, altering the composition and biomass of marine communities. Wave action increases physical damage to biota compounded by additional stressors usually present. Using a CTW MImAS assessment method, piled structures are to be assessed as a proxy for change. Area of piled structure are to be determined from a piled structures GIS data layer and multiplied by 10 to determine the area influenced by piled structures (Environment Agency, 2005).

Metric 6a: Change in wave regime Area influenced by structures/area of water body	Score
Minor change. <5% of the water body area influenced by structures	+2
Slight change. 5-15% of the water body area influenced by structures	+1
Moderate change. 15-35% water body area influenced by structures.	0
Major change. 35-75% water body area influenced by structures.	-1
Severe change. >75% of the water body area influenced by structures.	-2

Metric 7a. Change in river flow

Change in freshwater input (e.g. through abstraction) influences supply (loading) and concentrations of nutrients, the freshwater-seawater interface (changing phytoplankton community structure), the residence time (impacting nutrient supply) and mixing of the estuary (affecting phytoplankton growth). Long Term Average Flow (LTAA) determines changes (increases and decreases) into CTW body freshwater input. Data is to be obtained from the MEPA, NEA, other national agencies and from international sources. Daily time series data and ArcSWAT model is to be used to model catchment hydrology in terms of water quantity and quality.

Metric 7a: Change in river flow	Score
Minor change in freshwater input. (<5% change in LTAA)	+2
Slight change in freshwater input. (5 to 15% change in LTAA)	+1
Moderate change in freshwater input. (15% to 35% change in LTAA)	0
Major change in freshwater input. (35 to 75% change in LTAA)	-1
Severe change in freshwater input. (>75 change in LTAA)	-2

Metric 7b. Change in residence time

Residence time influences phytoplankton biomass in estuaries, particularly if residence times increase. Short residence times in nutrient-enriched estuaries may favour bottom-growing macroalgal blooms. In estuaries with longer residence times, phytoplankton growth in the water column can attenuate light reaching the bottom restricting the growth of macroalgae. This metric looks at changes in the residence time in a water body over time. Three residence time categories are used: days, weeks and months.

7b. Change in Residence Time	Score
No change to residence time	+2
Slight change to residence time. <50% within a residence time category	+1
Moderate change to residence time. >50% within a residence time category	0
Major change to residence time (days to weeks, weeks to months etc.)	-1
Severe change to residence time (days to months, months to yeas)	-2

Metric 8a. Change in dominant fraction particle size (sediment characteristics)

Substratum features are the result of hydro-geomorphological processes including the hydrological influences on the underlying geology. Any activity on the seabed can have an adverse effect on macrobenthic community. This metric looks at the dominant sediment fraction of samples. Particle Size Analysis (PSA) data from benthic water body surveys is to be combined. The mean percentage of each sediment fraction is calculated and the dominant fraction determined. This metric assesses the change in the dominant fraction mode.

Metric 8a: Change in dominant fraction particle size	Score
Little or no change in sediment composition (<5%)	+2
Slight change in the dominant sediment fraction composition (5-15%)	+1
Moderate change in dominant sediment fraction composition (15-35%)	0
Major change in dominant sediment fraction composition (35-75%)	-1
Severe change in dominant sediment fraction composition (>75%)	-2

Metric 8b. Change in turbidity

For aquatic plants, the sub-surface light climate has a major influence on growth particularly in inshore and nearshore environments where a high level of suspended particulate material may severely restrict the availability of light. The amount of photosynthetically active radiation in natural waters is of critical importance in determining the growth of aquatic plants. Turbidity is routinely measured in the WFD monitoring programme using a Secchi disk. The summer median Secchi depth is to be used to determine the turbidity of a water body.

Metric 8b: Change in Turbidity	Score
No change to turbidity	+2
Slight change to turbidity. Change of 1 class	+1
Moderate change to turbidity (change of 2 class)	0
Major change (change in 3 classes)	-1
Severe change in turbidity (change in >3 classes)	-2

Metric 9a. Change to stratification

The vertical mixing state (stratified or otherwise) of receiving waterbodies and the residence/flushing time of freshwater and its nutrients determine the system sensitivity to eutrophication. Stratification being critical in the distribution and fate of organic matter in an estuary. Data from WFD monitoring are to be used to determine change to stratification in a water body.

Metric 9a: Change to stratification	Score
No change to stratification	+2
Slight change in stratification. >50% change within stratification category.	+1
Moderate change in stratification. (Stratified to partially stratified. Partially stratified to mixed. Mixed to partially stratified. Partially stratified to mixed.)	0
Major change in stratification. Changes from mixed to stratified and vice versa.	-1
Severe change in stratification.	-2

Metric 9b. Change in salinity

Salinity is one of the main factors controlling the distribution and composition of estuarine communities. Data from WFD monitoring is to be used to determine changes in water body salinity. Median summer salinity across the water column is to be used to determine the salinity band category of a water body. Transitional & Coastal Water bodies are to be classified in the following salinity bands: freshwater, < 0.5; oligohaline, 0.5 to < 5.0; mesohaline, 5.0 to < 18; polyhaline, 18 to < 30; euhaline, >30.

Metric 9b: Change in salinity	Score
No change in salinity	+2
Slight change in salinity. 1 salinity band change (e.g. freshwater to oligohaline, polyhaline to euhaline, etc.)	+1
Moderate change in salinity. 2 salinity band change (e.g. freshwater to mesohaline)	0
Major change in salinity. 3 salinity band change (e.g. freshwater to polyhaline)	-1
Severe change in salinity. 4 salinity band change (e.g. freshwater to euhaline)	-2

Collation into a classification

Each metric undergoes assessment by calculating the deviation from the baseline condition. For each water body, the score (deviation) from all the metrics is aggregated. The total sum of all the recorded deviations yields the Total Deviation (S_{total}). The maximum potential deviation for each water body provides the Maximum Deviation (S_{max}).

A Hydromorphological Alteration Index (HAI) is calculated by:

HAI = S_{total}/S_{max}

The HQI is calculated by

HQI = 1-HAI

The HQI class boundaries and corresponding WFD Quality Class are: High (>0.95), Good (>0.85-0.95), Moderate (>0.65-0.85), Poor (>0.25-0.65), Bad (<0.25).

8. Conclusions

The following are the key conclusions that can summarise the document in the numbered bullet points:

1. Methodology: The document outlines a comprehensive methodology for assessing the hydromorphological status of Georgia's Black Sea Coastal and Transitional Water bodies, aligning with European standards and newly enacted national water legislation.

2. Data Requirements: Extensive data requirements are specified for assessing various aspects including coastal dynamics, shoreline alterations, sediment dynamics, hydrological parameters, and anthropogenic activities.

3. European Best Practices: The methodology adopts the latest European best practices, particularly the Hydromorphological Quality Index (HQI) based on the CTW Morphological Impact Assessment System (MImAS) tool, for classification and assessment.

4. Metrics and Assessments: Detailed metrics are provided for assessing shoreline alteration, presence of barriers, bed disturbance, habitat change, tidal and wave regimes, river flow, sediment characteristics, turbidity, stratification, and salinity changes.

5. Classification and Reporting: Metric scores are aggregated to determine total figures for HQI classification scores of High, Good, Moderate, Poor, Bad in alignment with the Water Framework Directive.

6. Data Acquisition Methods: The document emphasizes the importance of obtaining field-based data (from WFD monitoring) and GIS observations to populate metrics essential for quantifying hydromorphological features.

7. Integration: The methodology ensures seamless integration of hydromorphological assessment results with biological and physico-chemical status, feeding into respective River Basin Management Plans (RBMP) for sustainable management practices.

8. Decision Support: By providing a structured framework for assessing hydromorphological quality, the document facilitates informed decision-making and supports sustainable management practices along Georgia's Black Sea coast.

9. Compliance and Adaptation: The methodology ensures compliance with the Water Framework Directive while allowing for adaptation to Georgian-specific conditions and future adjustments based on evolving data and knowledge.

10. Annexes: Two annexes first specify extensive data requirements to successfully complete HYMO assessments and second provides for the successfully current delineation of Georgian Black Sea CTWs, subject to future adjustments based on accumulating data and knowledge in mowing forward towards the sustainable management of Georgia’s coastal zone.

9. Annexes

Annex 1: Data Requirements for Georgian Black Sea Coastal and Transitional Waters and References

Hydromorphological status

- Coastal protection and flood risk management with hydrotechnical hard structures (such as concrete revetments, concrete and/or stone sea walls, groins, embankments, barriers, barrages, impounding structures, sluices, channels, etc.), as well as with soft structure (sediment filling, artificial beaches, beach replenishment, etc.).
- Non- or semi-permeable protection structures (concrete, stone or synthetic) for port and harbour infrastructure.
- Dredging works in the sea, along coast and in rivers (navigation dredging, extraction of construction/inert material).
- Water regulation and distribution facilities altering hydrological regime of the rivers and operational parameters of these infrastructure.
- River and sea embankments and dikes.
- Terrestrial/land reclamation areas.
- Stagnant water areas (e.g. trapped near groins, other hydrotechnical facilities).
- Bathymetric data, depth variation, shallowing.
- Intertidal zone and bed structure (type and composition).
- Submarine slope and beach profiles and their changes/dynamics.
- Discharge/influx of beach-forming material (average, daily) and its distribution.
- Cross shore transport and distribution of beach-forming sediments/materials.
- Offshore losses of beach-forming sediments/material.
- Erosion processes and dynamics of shoreline change.
- Intertidal zone structure.
- Freshwater discharges (daily, average).
- Salinization and its dynamics.
- Fish migration and barriers (obstructed freshwater inflow), fish passes.
- Water quality (temperature regimes, turbidity, nutrient enrichment areas).
- Sea circulation, marine and river currents and their velocities.
- River flow/discharge rates (daily and average).
- Wave climate (average and daily).
- Winds (average and daily).
- Precipitation rates (average and daily)
- Coastal sediment balance regimes (input, transport, erosion, losses).
- Fixed and/or mobile aquaculture structures & their anchoring placement/plans (fish & shell fish farms).
- Seabed infrastructure: pipelines, cables, etc. (laid or anchored).
- River and seashore water intake and water discharge sites: treatment facilities, including infrastructure with variable temperature regimes (laid or anchored);

- Recreational infrastructure: delimitation nets, soil erosion or alteration (sand, gravel), water amusement park facilities and structures, other beach infrastructure, beach reclamation areas.
- Sand-gravel mining, bed filling, infrastructure development in Transitional and Coastal Waters, which lead to disruption of the hydrological regime and bottom/bed morphology.
- Spatial data on coastal dynamics and coastline types.
- Changes/loss of intertidal habitats (benthic communities, macroalgae, invertebrates, angiosperms).
- High-resolution aerial and satellite images of the pilot area, Lidar images, all other types of geospatial data at the disposal of the Georgian authorities, both recent and of historical periods.

Ecological status

- Temperature, salinity, oxygen concentration, transparency, nutrients (nitrate, nitrite, ammonia, total nitrogen, orthophosphate, total phosphorus, etc.)
- Phytoplankton, macroalgae, angiosperms, benthic invertebrates and fish (in transitional waters).

Chemical status

- Concentrations of priority substances and dangerous chemical components defined by the legislation of Georgia and environmental regulations as well as provided by the Water Framework Directive.

Pressure-impact sources

- Data on sources of anthropogenic pressure-impact (point and diffuse sources).
- Geolocations of sewerage and other pollutant discharge sources and load/discharge parameters (official sources and also existing ones that are not officially registered).
- Data related to global changes such as invasive species, climate change, sea level rise, coastal land subsidence, coastal flood recurrence periods/rates/frequencies, etc.
- Self-monitoring data (flow water volume and chemical composition) of runoff from landfills in the area during the last 5-10 years. Also, if available, technical and design documentation and reports of the planed landfills (including feasibility and engineering design studies, EIAs, etc.).
- Bathing water monitoring data on indicators of bacteriological as well as biological pollution of sea water in the pilot area for last 5-10 years. Also, data on sewage discharges, including through channels that discharge into the sea along the coast, indicating geolocations of discharge points, discharge rates and other relevant data.
- For last 5-10 years' data including geo-locations on illegal discharges in the urban drainage networks and canals in Poti and the entire pilot area, as well as the discharge endpoints into the sea. Please also provide feasibility/design studies and EIAs documentation related to the appropriate wastewater treatment projects executed and/or planned in the pilot area.
- For last 5-10 years, data of the water-using facilities in the Poti pilot area, according to the database of the annual reporting of water use, as well as the agreed limits of polluting substances for the facilities subjected to EIA environmental decisions, including discharge geolocations.
- Self-monitoring data of discharge of wastewater into the sea from Poti and other wastewater treatment plants, including daily discharge of wastewater (m3/day), indicating respective physical, biological and chemical parameters of discharges.

- The distribution of population connected to water supply and discharge networks in the Poti pilot area with maximum spatial detail, including geospatial data on physical and legal entities connected to the network.
- GIS data on water /wastewater networks in the pilot coast area. Implementation plans and documentation for the potential expansion of water/wastewater network.
- In the Poti pilot area and for last 5-10 years' data on cases of illegal water discharges, discharge of polluted water, violations of environmental norms, violations of established water discharge norms (pollution limits and technical regulations/ regalement's) and fines charged, provided in the form of geospatial data.
- In the Poti pilot area and for last 5-10 years', the licenses issued for the extraction of inert/aggregate materials and minerals, indicating the performance parameters of the facilities and other relevant related data, in the form of a geospatial database.

Various studies in the field of waste management and pollution of water bodies. Unauthorised waste dump sites inventory data and relevant maps.

Annex 2: Delineation of Georgian Black Sea Coastal and Transitional Waters

https://drive.google.com/file/d/1pv70CWiGVXlFPKBUHh7qtVpV_70CRrLE/preview

Annex 2 is attached as a separate document.

Action funded by the EUROPEAN UNION

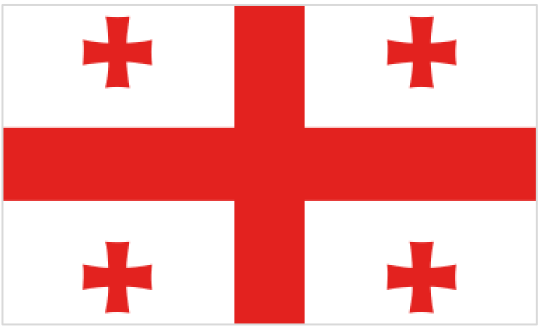
EUWI+ EU WATER INITIATIVE FOR EASTERN PARTNERSHIP

European Union Water Initiative Plus for the Eastern Partnership Countries (EUWI+): Results 2 & 3

DELINEATION OF GEORGIAN TRANSITIONAL AND COASTAL WATERS IN THE EUWI+ PILOT AREA FROM SARPI (BORDER WITH TURKEY) TO KOBULETI AND DELINEATION PROPOSAL FOR THE COASTAL AREA FROM KOBULETI TO PSOU (BORDER WITH RUSSIA)

INCLUDING

PROPOSED SURVEILLANCE MONITORING STATIONS FOR THE ASSESSMENT OF WFD SUPPORTING PHYSICO-CHEMICAL AND BIOLOGICAL QUALITY ELEMENTS IN THE EUWI+ PILOT AREA”



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December, 2020

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Abbreviations

EMBLAS .... Environmental Monitoring in the Black Sea
EPIRB .... Environmental Protection of International River Basins
EUWI+ .... European Union Water Initiative Plus
IOWater/OIEau .... International Office for Water, France
MSFD.................... Marine Strategy Framework Directive
UBA .... Umweltbundesamt GmbH, Environment Agency Austria
UNDP.................... United Nations Development Programme
WFD...................... Water Framework Directive

Country Specific Abbreviations

NEA .... National Environmental Agency

1 EXECUTIVE SUMMARY

The WFD requires surface waters within a River Basin District to be split into water bodies which represent the classification and management units of the Directive.

Based on the analysis of former two delineation proposals for the Georgian coastal zone, the outcomes of EUWI+ delineation workshops and trainings, as well as the results of three coastal surveys, the improved delineation of transitional and coastal water types and bodies in the EUWI+ Pilot area, from Sarpi (border with Turkey) to Kobuleti, is presented. For the remaining part of the Georgian coastal zone, from Kobuleti to Psou (border with Russia), a draft delineation proposal is introduced. The latter has to be confirmed by field measurements in particular water bodies.

System B has been applied for the delineation. Beyond the required obligatory delineation factors, one optional factor has been used for transitional waters (origin of transitional waters), whereas two optional factors (depth and substratum size) have been applied for coastal waters.

According to these delineation factors, one transitional and five coastal water types have been identified in the EUWI+ Pilot area. According to the applied typology, one transitional and five coastal water bodies are present in this area. One of the coastal water bodies, Batumi harbour, is proposed as a candidate for acquiring the status of a heavily modified water body.

In the coastal area from Kobuleti to Psou (border with Russia), two transitional and five coastal water types have been outlined. Five transitional and ten coastal water bodies are present in this area. One of the identified coastal water bodies, Poti harbour, is proposed as a candidate for acquiring the status of a heavily modified water body.

In the entire Georgian coastal area, from Sarpi (border with Turkey) to Psou (border with Russia), two transitional and five coastal water types, as well as six transitional and seventeen coastal water bodies have been identified.

The transitional and coastal water types are identified as units for the development of national type specific reference conditions, while the water bodies are suggested as basic units for WFD harmonised monitoring, assessment and reporting.

2 INTRODUCTION

The coastline of Georgia, from Sarpi (border with Turkey) in the south to the Psou river (border with Russia) in the north, is 315 km long. To date, a single draft proposal for the delineation of all transitional and coastal waters in this area (EMBLAS/UNDP, 2017), and two draft delineation proposals for a smaller (pilot) area, from Sarpi to Kobuleti (EPIRB/MENR, 2016; EUWI+, 2018), have been presented.

A critical analysis of all three draft proposals has been performed during EUWI+ Workshops held in Batumi (2017; 2019), and during training sessions held at the Department of Fisheries, Aquaculture and Water Biodiversity in Batumi (2019).

The outcomes of the EUWI+ workshops and training sessions on the delineation are as follows:

- The EPIRB/MENR draft proposal is not in line with the WFD delineation guidelines (WFD Common Implementation Strategy, No5.),
- The other two draft proposals (EMBLAS/UNDP, 2017 and EUWI+, 2018) are formally in accordance with the WFD, however, they also reveal some weaknesses related to the delineation factors (Table 1).

Considering the strengths and weaknesses of both draft proposals, identified during workshops and trainings, as well as the results of three coastal surveys performed in the pilot area during 2019 and 2020, this final proposal defines delineation factors and coastal and transitional water types, as well as water bodies present in the entire Georgian coastal zone. Water bodies, identified in the EUWI+ Pilot area, can be considered as confirmed, while the water bodies in the remaining coastal area from Kobuleti to Psou river still have a draft status, i.e. there is a need for further evaluation based on future surveys of substrate composition and salinity distribution.

Table 1: Strengths and weaknesses of former CTW delineation proposals for Georgia

STRENGHTS	DRAFT DELINEATION PROPOSALS	COMMENTS
Typology for coastal and transitional waters in accordance with the WFD	EMBLAS/UNDP, 2017 & EUWI+, 2018	
Transitional and coastal water types logically divided into particular water bodies	EMBLAS/UNDP, 2017 & EUWI+, 2018	
Batumi harbour recognised as a candidate for coastal HMWB	EUWI+, 2018	Batumi harbour is a typical heavily modified coastal water body
WEAKNESSES	DRAFT DELINEATION PROPOSALS	COMMENTS
One mesohaline type ($5 < S < 18$) defines all coastal water bodies	EMBLAS/UNDP, 2017 & EUWI+, 2018	During EUWI+ coastal surveys (2019-20), a coastal stretch near the Chorokhi estuary with **significant lower** surface salinity, in relation to other coastal areas, has been identified
CW delineation factor “Wave exposure” not correctly applied	EMBLAS/UNDP, 2017	The coastal water stretches defined as **sheltered** are not really sheltered
CW delineation factor “Depth” indicates three coastal water types (shallow, intermediate and deep)	EMBLAS/UNDP, 2017	There is **no biological relevance** for a differentiation in three depth zones
Substrate type in particular coastal water bodies, according to this delineation factor, not correctly identified	EMBLAS/UNDP, 2017 & EUWI+, 2018	Sediment samples taken during the EUWI+ coastal surveys (2019-20) indicate **different substrate composition** in particular coastal water bodies
The used designation for coastal water bodies (water body code) precludes future changes of the water bodies (splitting, adding etc.).	EMBLAS/UNDP, 2017	The coastal water bodies have been designated as CW1, CW2, CW3… CW13, **precluding future changes** of coastal water bodies.
The identified transitional waters in the Chorokhi and Rioni estuary border directly on Marine waters	EMBLAS/UNDP, 2017	According to the horizontal salinity gradient, waters **between transitional waters and marine wate**rs should be described as coastal waters

3 EUWI+ DELINEATION PROPOSAL FOR GEORGIAN TRANSITIONAL AND COASTAL WATERS

3.1 Definition of transitional and coastal waters

According to the definition of "Transitional and Coastal waters" under the WFD (Common Implementation Strategy for the Water Framework Directive, Guidance document no. 5, 2003):

- Transitional waters are bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to coastal waters but which are substantially influenced by freshwater flows;
- Coastal water means surface water on the landward side of a line, every point of which is at a distance of one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured, extending where appropriate up to the outer limit of transitional waters.

3.2 Appearance of transitional and coastal waters in Georgia

As the WFD gives no indication of the minimum size of transitional waters to be identified as separate water bodies, transitional waters in Georgia can appear in all river mouths of the Black Sea region, if they can be characterized as a discrete and significant element of surface waters. To date, this characterisation has been performed in the EUWI+ Pilot area from Sarpi to Kobuleti with one transitional water body identified in the Chorokhi estuary (Figure 1).

In the remaining part of the Georgian coastal zone from Kobuleti to Psou, five potential candidates for transitional water bodies have been drafted in this proposal. Four of the candidates for transitional waters are located in the estuaries of the Supsa, Rioni, Enguri and Bzipi rivers, while one occupies the area of the Paliastomi Lake (Figure 1). The occurrence and shape of these potential transitional waters have yet to be verified by hydrographic measurements.

The area of Georgia's coastal waters, based on the WFD definition, is shown in figure 1.

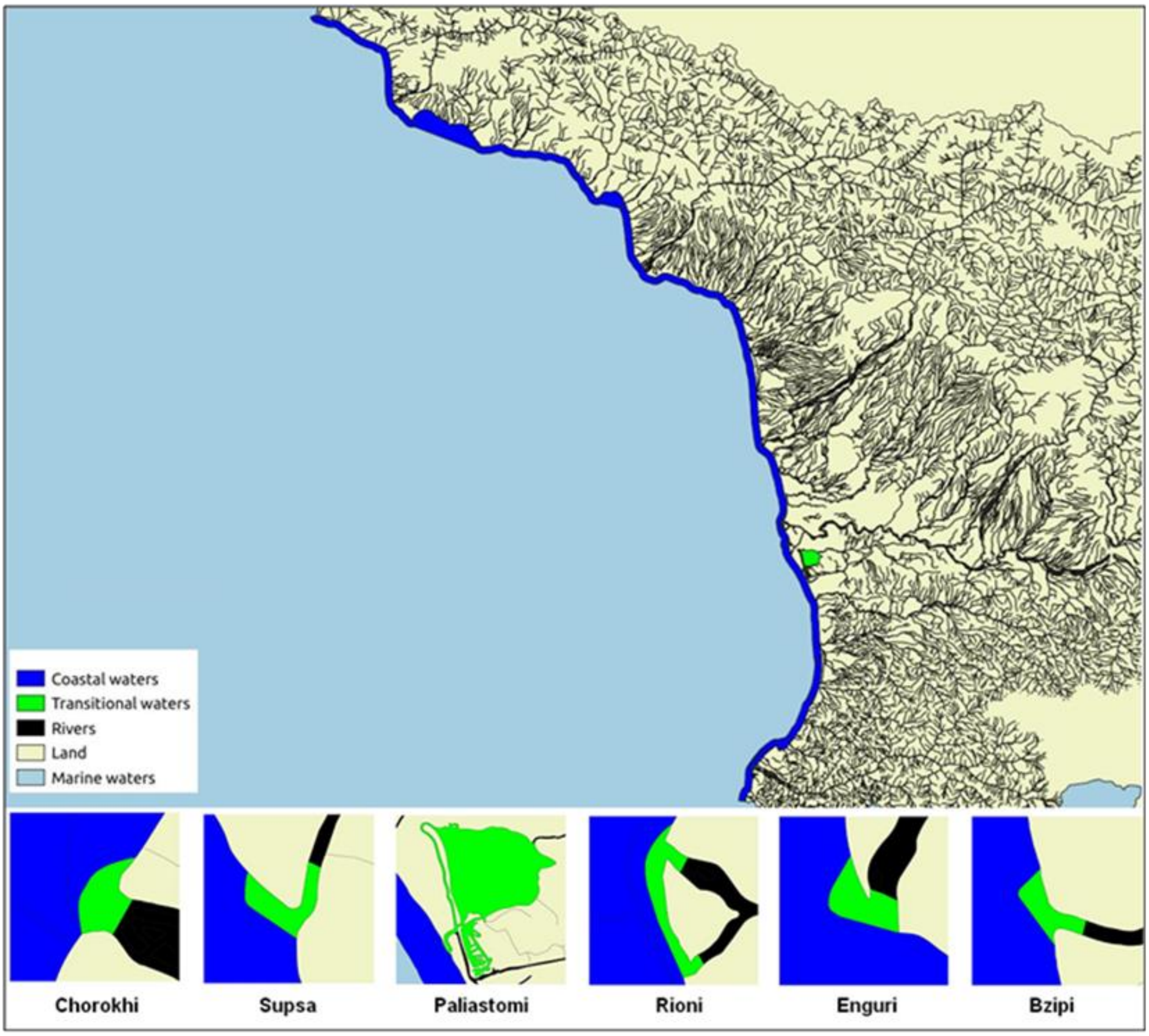

Figure 1: Transitional and coastal waters in Georgia

3.3 Typology system of transitional and coastal waters in Georgia

One of the first stages in the implementation of the WFD in the River Basin district is the characterisation of all naturally occurring water bodies. This process can be referred to as typology. According to the provisions of the WFD, the characterisation of water bodies within each surface water category can be undertaken according to two typology systems: System A (fixed system with obligatory delineation factors) or System B (system with obligatory and optional delineation factors).

SYSTEM B has been applied for the delineation of transitional and coastal waters present in Georgia.

3.4 Water types in transitional and coastal waters of Georgia

3.4.1 Transitional waters

Obligatory and optional factors for transitional waters appearing in Georgia are given in table 2.

Table 2: Obligatory and proposed optional typology factors for transitional waters in Georgia

TYPOLOGY FACTORS FOR GEORGIAN TRANSITIONAL WATERS		
Transitional waters	**Obligatory**	Latitude, Longitude
		Tidal range
		Average annual salinity range
	Optional	Origin of transitional waters

According to the obligatory factors, all Georgian transitional waters are:

- located in the Ecoregion “Black Sea”;
- exposed to a microtidal range (< 1m);
- characterised with fluctuating salinities in the range of 0,5 – 10 (oligo-mesohaline).

In addition to the obligatory factors, the selected optional factor differentiates the transitional waters, originating from marine waters or lakes and limans.

Taking these delineation factors into account, theoretically, 2 transitional water types can be defined in Georgia (Table 3).

Table 3: Possible transitional water types appearing in Georgia

Transitional water type		Ecoregion	Tidal Range	Salinity Range (PSU)	Origin
Description	**Code**				
Oligo-mesohaline transitional water type with estuary origin	GE_TW11	Black Sea	Microtidal	0,5 < s < 10	Marine
Oligo-mesohaline transitional water type with lake/liman origin	GE_TW12				Lake/Liman

3.4.2 Coastal waters

Obligatory and optional factors for coastal waters appearing in Georgia are given in table 4.

Table 4: Obligatory and proposed optional typology factors for coastal waters in Georgia

TYPOLOGY FACTORS FOR GEORGIAN COASTAL WATERS		
Coastal waters	**Obligatory**	Latitude, Longitude
		Tidal range
		Average annual salinity range
	Optional	Mean depth
		Mean substratum size

According to the obligatory factors, all Georgian coastal waters are:

- located in the Ecoregion “Black Sea”;
- exposed to a microtidal range (< 1m);
- characterized by a narrow average annual salinity range (15 < S < 18), except for areas in the vicinity of rivers with significant freshwater discharge, where the annual salinity fluctuations are more strongly expressed (10 < S < 18).

In addition to the obligatory factors, the selected optional factors are:

- depth, which differentiates shallow (< 30m) from deep (> 30m) coastal areas;
- substratum size, which differentiates fine grained substrate (< 45 µm; clay and mud) from coarse grained substrate (> 45 µm; sand – pebble),

Taking these delineation factors into account, theoretically, 8 coastal water types can be defined in Georgia (Table 5).

Table 5: Possible coastal water types appearing in Georgia

Coastal water type		Ecoregion	Tidal Range	Salinity range (PSU)	Mean depth (m)	Mean substratum size (µm)
Description	**Code**					
Mesohaline, shallow coastal water type with fine grained substrate	GE_CW111	Black Sea	Microtidal	10-18	Shallow (< 30m)	Fine grained (< 0,45 µm)
Mesohaline, shallow coastal water type with coarse grained substrate	GE_CW112			10-18	Shallow (< 30m)	Coarse grained (> 0,45 µm)
Mesohaline, deep coastal water type with fine grained substrate	GE_CW121			10-18	Deep (> 30m)	Fine grained (< 0,45 µm)
Mesohaline, deep coastal water type with coarse grained substrate	GE_CW122			10-18	Deep (>30 m)	Coarse grained (> 0,45 µm)
Narrow mesohaline, shallow coastal water type with fine grained substrate	GE_CW211			15-18	Shallow (< 30m)	Fine grained (< 0,45 µm)
Narrow mesohaline, shallow coastal water type with coarse grained substrate	GE_CW212			15-18	Shallow (< 30m)	Coarse grained (> 0,45 µm)
Narrow mesohaline, deep coastal water type with fine grained substrate	GE_CW221			15-18	Deep (> 30m)	Fine grained (< 0,45 µm)
Narrow mesohaline, deep coastal water type with coarse grained substrate	GE_CW222			15-18	Deep (>30 m)	Coarse grained (> 0,45 µm)

The principle of the applied type coding of transitional and coastal water types is shown in table 6.

Table 6: Principle of transitional and coastal type coding

<table>
<tr><th rowspan="2">Country</th><th rowspan="2">Surface water category</th><th colspan="4">Typology factor</th><th rowspan="2">Type code</th></tr>
<tr><th>Salinity</th><th>Origin</th><th>Depth</th><th>Substrate size</th></tr>
<tr><td rowspan="9">Georgia (GE)</td><td rowspan="3">Transitional waters (TW)</td><td>Oligo-meso-haline</td><td>-</td><td colspan="2" rowspan="3">-</td><td>GE_TW1 _</td></tr>
<tr><td>-</td><td>Marine</td><td>GE_TW_ 1</td></tr>
<tr><td>-</td><td>Lake/Liman</td><td>GE_TW_ 2</td></tr>
<tr><td rowspan="6">Coastal waters (CW)</td><td>Mesohaline</td><td rowspan="2">-</td><td>-</td><td>-</td><td>GE_CW1 _ _</td></tr>
<tr><td>Narrow mesohaline</td><td>-</td><td>-</td><td>GE_CW2 _ _</td></tr>
<tr><td>-</td><td rowspan="2">-</td><td>Shallow</td><td>-</td><td>GE_CW_ 1 _</td></tr>
<tr><td>-</td><td>Deep</td><td>-</td><td>GE_CW_ 2 _</td></tr>
<tr><td>-</td><td rowspan="2">-</td><td>-</td><td>Fine grained</td><td>GE_CW_ _ 1-</td></tr>
<tr><td>-</td><td>-</td><td>Coarse grained</td><td>GE_CW_ _ 2</td></tr>
</table>

3.5 Additional delineation criteria

Besides the basic, significant natural physical features, additional delineation criteria have to be considered as well.

Protected areas: Annex IV of the WFD states that the register of protected areas shall include the following types of protected areas:

- areas designated for the abstraction of water intended for human consumption;
- areas designated for the protection of economically significant aquatic species;
- bodies of water designated as recreational waters, including areas designated as bathing waters;
- nutrient-sensitive areas, including areas designated as vulnerable zones and areas designated as sensitive areas;
- areas designated for the protection of habitats or species where the maintenance or improvement of the status of water is an important factor in their protection, including relevant Natura 2000 sites.

In regard to the EUWI+ Pilot area (Sarpi to Kobuleti) and the remaining Georgian coastal area from Kobuleti to the Psou river, drinking water protected areas, economically significant aquatic species (freshwater fish and shellfish) protected areas and nutrient-sensitive areas have not been identified, or are yet to be designated.

In Georgia, recreational and bathing waters have been identified as protected areas, but the delineation of associated water bodies is not necessary, and no spatial data reporting is required (Clarification note, 2016). Therefore, water bodies listed in tables 7, 8 and 9 have not been further subdivided according to these criteria.

As Georgia has one National Park (Kolkheti National Park), which partially covers the marine and coastal area of the Black Sea (Figure 2), the designation of the coastal part of the National Park as a WFD protected area, in relation to the *protection of habitats or species where the maintenance or improvement of the status of water is an important factor in their protection,* should be adopted at the national level.

Figure 2: Black Sea part of thr Kolkheti National Park

Status criteria: According to the CIS Guidance document No.2 (2003), a discrete element of surface water (i.e. water body) should not contain significant elements of different status. As the status of a water body is mainly affected by pressures, the pressure – impact analysis and the risk assessment, performed in the Chorokhi-Ajaristskali River Basin Management Plan (EPIRB/MENR, 2016), as well as the EUWI+ survey results, indicate that no further subdivision of proposed water bodies in the EUWI+ Pilot area (Table 7) is required with respect to this delineation criteria. For the remaining part of the Georgian coastal area, from Kobuleti to the Psou river, further subdivision of water bodies has to be considered once survey results are obtained and pressure-impact analysis has been performed.

Artificial and heavily modified water bodies: The designation of AWB and HMWB is the last step in the delineation process. According to the available data artificial water bodies:

- in the EUWI+ Pilot area are not present; however, Batumi harbour can be considered as a candidate for a heavily modified water body (Table 7, figure 4);
- in the remaining Georgian coastal area from Kobuleti to the Psou river, are not present, but the area of Poti harbour can also be considered as a candidate for a heavily modified water body (Tables 8 and 9, figure 6).

The designation of both harbours as HMWB's should be undertaken according to the procedure described in the WFD CIS Guidance document No4 (Identification and Designation of Heavily Modified and Artificial Water Bodies).

4 IDENTIFIED TRANSITIONAL AND COASTAL WATER TYPES AND BODIES IN THE COASTAL ZONE OF GEORGIA

4.1 Transitional and coastal water types and bodies in the EUWI+ Pilot area from Sarpi to Kobuleti

In the EUWI+ Pilot area (Sarpi to Kobuleti), one transitional and five coastal water types have been identified (Table 7, figure 3). According to the applied typology, one transitional and five coastal water bodies are present in this area (Table 7, figure 4). One of the coastal water bodies (Batumi harbour) is proposed as a candidate for acquiring the status of a heavily modified water body (CW211_BaHa).

Table 7: Transitional and coastal water types and bodies in the EUWI+ Pilot area

Surface water category	Water type	Water body		Geographic position (min, max)** (WGS84)	
		Site	Name	Latitude	Longitude
Transitional waters	GE_TW11	Chorokhi estuary	TW11_Ch*	41,598801 N 41,60808 N	41,573412 E 41,582099 E
Coastal waters	GE_CW111	From Chorokhi estuary to Batumi cape - near coast	CW111_ChBaC	41,5988 N 41,649227 N	41,571387 E 41,627758 E
	GE_CW211	Batumi harbor	CW211_BaHa	41,646346 N 41,655154 N	41,647855 E 41,660823 E
		From Korolistskali river to Tsikhidziri cape	CW211_KoTs	41,667299 N 41,779636 N	41,673601 E 41,759632 E
	GE_CW212	From Chorokhi estuary to Batumi cape	CW212_ChBa	41,597429 N 41,673666 N	41,554294 E 41,647106 E
	GE_CW221	From Batumi cape to Korolistskali river	CW221_BaKo	41,649063 N 41,679554 N	41,645445 E 41,688704 E
		From Tsikhidziri cape to Kobuleti	CW221_TsKb	41,773139 N 41,869945 N	41,739112 E 41,782162 E
	GE_CW222	From Sarpi to Chorokhi estuary	CW222_SaCh	41,51876 N 41,606517 N	41,528452 E 41,572925 E

Xx Abbreviations of particular site names. Geographic positions** are extracted from shape files*

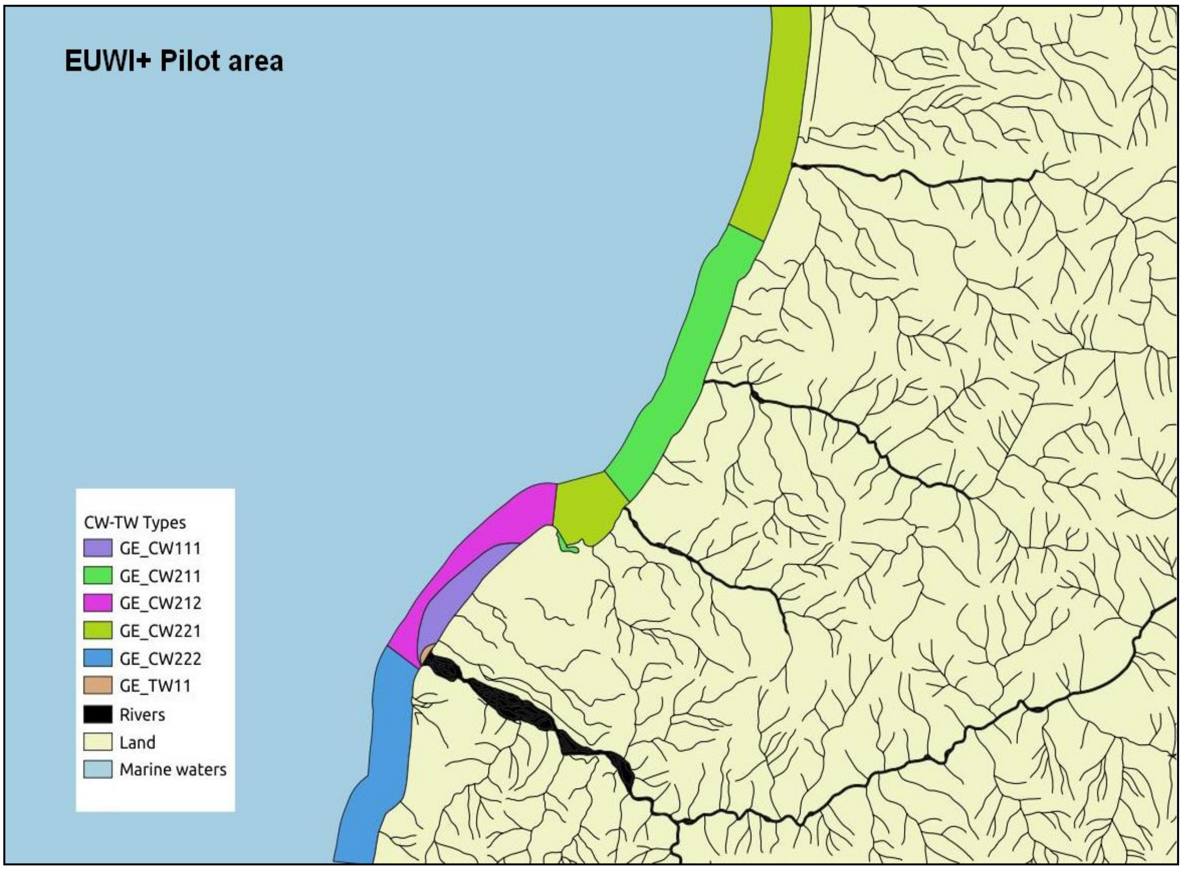

Figure 3. Positions and shapes of appearing transitional and coastal water types in the EUWI+ Pilot area from Sarpi to Kobuleti

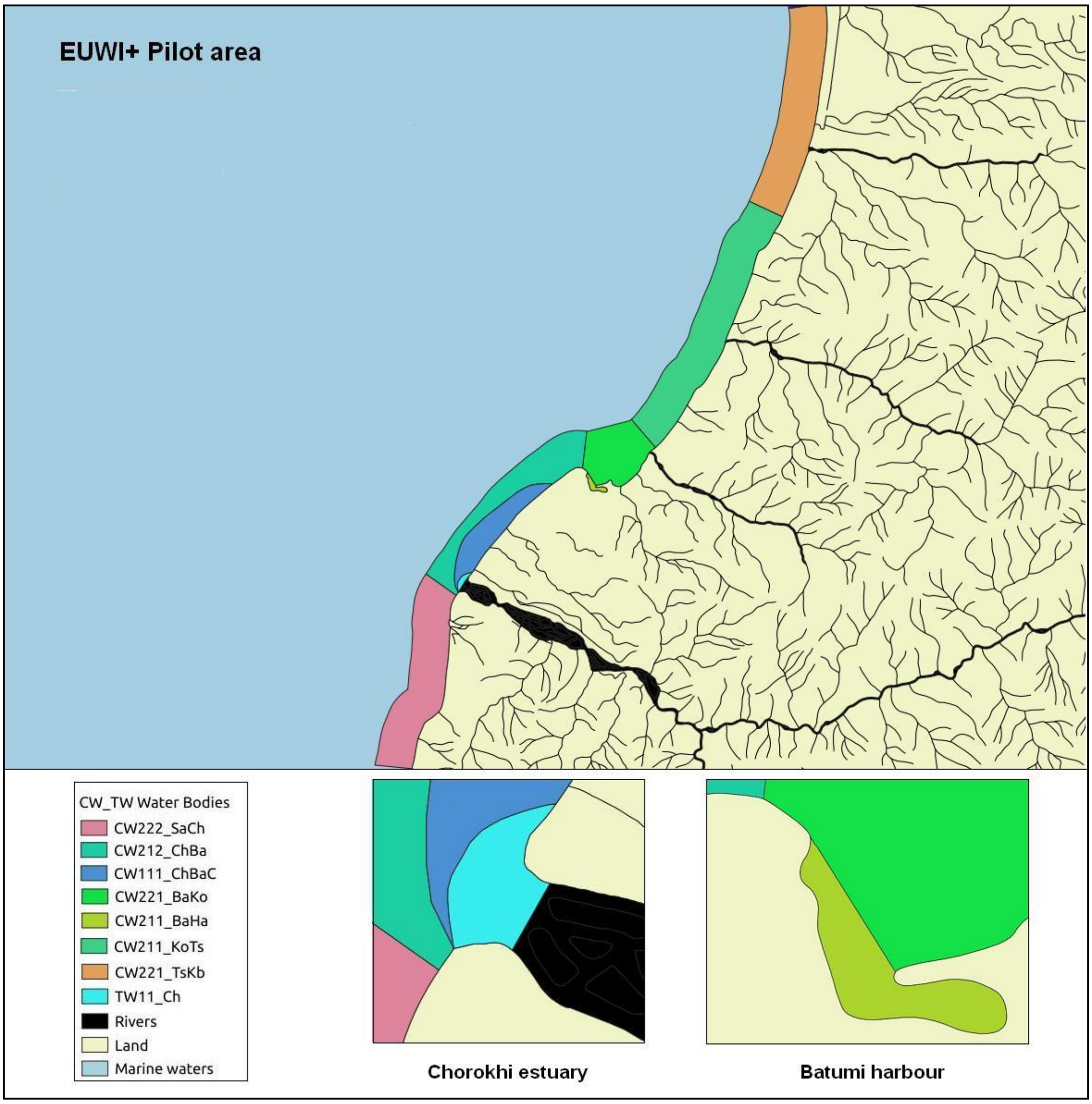

Figure 4: Positions and shapes of transitional and coastal water bodies appearing in the EUWI+ Pilot area from Sarpi to Kobuleti

4.2 Transitional and coastal water types and bodies in the coastal area from Kobuleti to Psou

In the coastal area from Kobuleti to Psou (border with Russia) two draft transitional and five coastal water types have been identified (Table 8, figure 5). According to the applied typology for transitional and coastal waters, five transitional water bodies and ten coastal water bodies are present in this area (Table 7, figure 6). One of the identified coastal water bodies (Poti harbour) is proposed as a candidate for acquiring the status of a heavily modified water body.

Table 8: Transitional and coastal water types and bodie in the coastal area from Kobuleti to Psou

Surface water category	Water type	Water body		Geographic position (min, max)* (WGS84)	
		Site	Name	Latitude	Longitude
Transitional waters	GE_TW11	Supsa estuary	TW11_Su*	42,015827 N 42,023345 N	41,749861 E 41,759571 E
		Rioni estuary	TW11_Ri*	42,184838 N 42,21268 N	41,633891 E 41,649081 E
		Enguri estuary	TW11_En*	42,386483 N 42,394854 N	41,55435 E 41,565067 E
		Bzipi estuary	TW11_Bz	43,189095 N 43,19292 N	40,281025 E 40,285766 E
	GE_TW12	Paliastomi lake	TW12_Pl	42,072157 N 42,141249 N	41,687826 E 41,770515 E
Coastal waters	GE_CW111	Rioni- near coast	CW111_RiC*	42,182006 N 42,238425 N	41,629565 E 41,648108 E
	GE_CW211	Poti harbour	CW211_PoHa	42,148257 N 42,160383 N	41,649354 E 41,668343 E
	GE_CW212	From Kobuleti to Rioni estuary	CW212_KbRi	41,866955 N 42,195513 N	41,617369 E 41,780554 E
		From Rioni estuary to Kodori cape	CW212_RiKo	42,19486 N 42,802293 N	41,185311 E 41,6478 E
		From Dzista estuary to Gudauta	CW212_DzGu	43,029771 N 43,09911 N	40,563613 E 40,90805 E
	GE_CW221	From Kodori cape to Kelasuri	CW221_KoKe	42,773852 N 42,971396 N	41,053383 E 41,191709 E
		From Kelasuri to Sukhumi cape	CW221_KeSu	42,956008 N 42,997384 N	40,978455 E 41,067795 E
		From Sukhumi cape to Dzista estuary	CW221_SuDz	42,961828 N 43,038719 N	40,88858 E 40,991622 E
		From Pitsunda to Psou	CW221_Pips	43,128305 N 43,389087 N	39,991278 E 40,358023 E
	GE_CW222	From Gudauta to Pitsunda	CW222_GuPi	43,080318 N 43,173225 N	40,351449 E 40,579888 E

Xx	Abbreviations of particular site names. Geographic positions** are extracted from shape files*

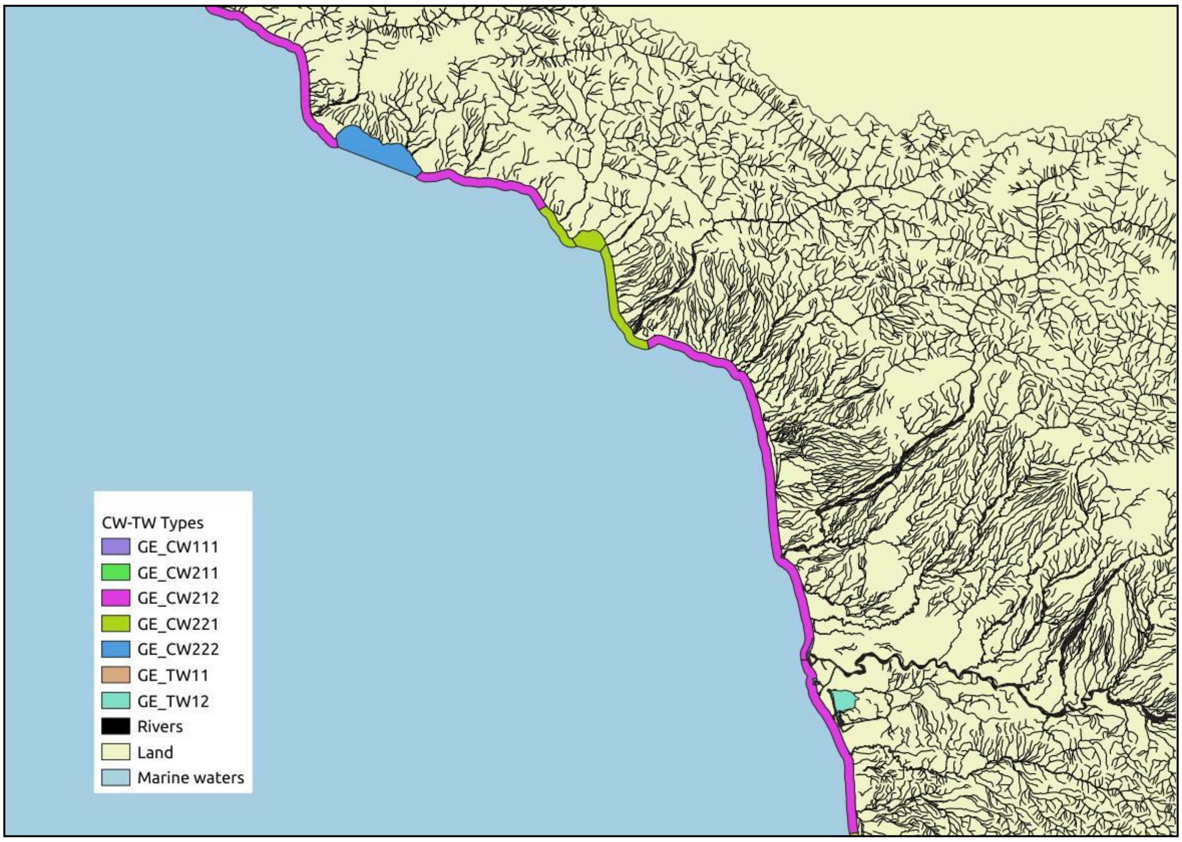

Figure 5: Positions and shapes of transitional and coastal water types appearing in the coastal area from Kobuleti to Psou (border with Russia)

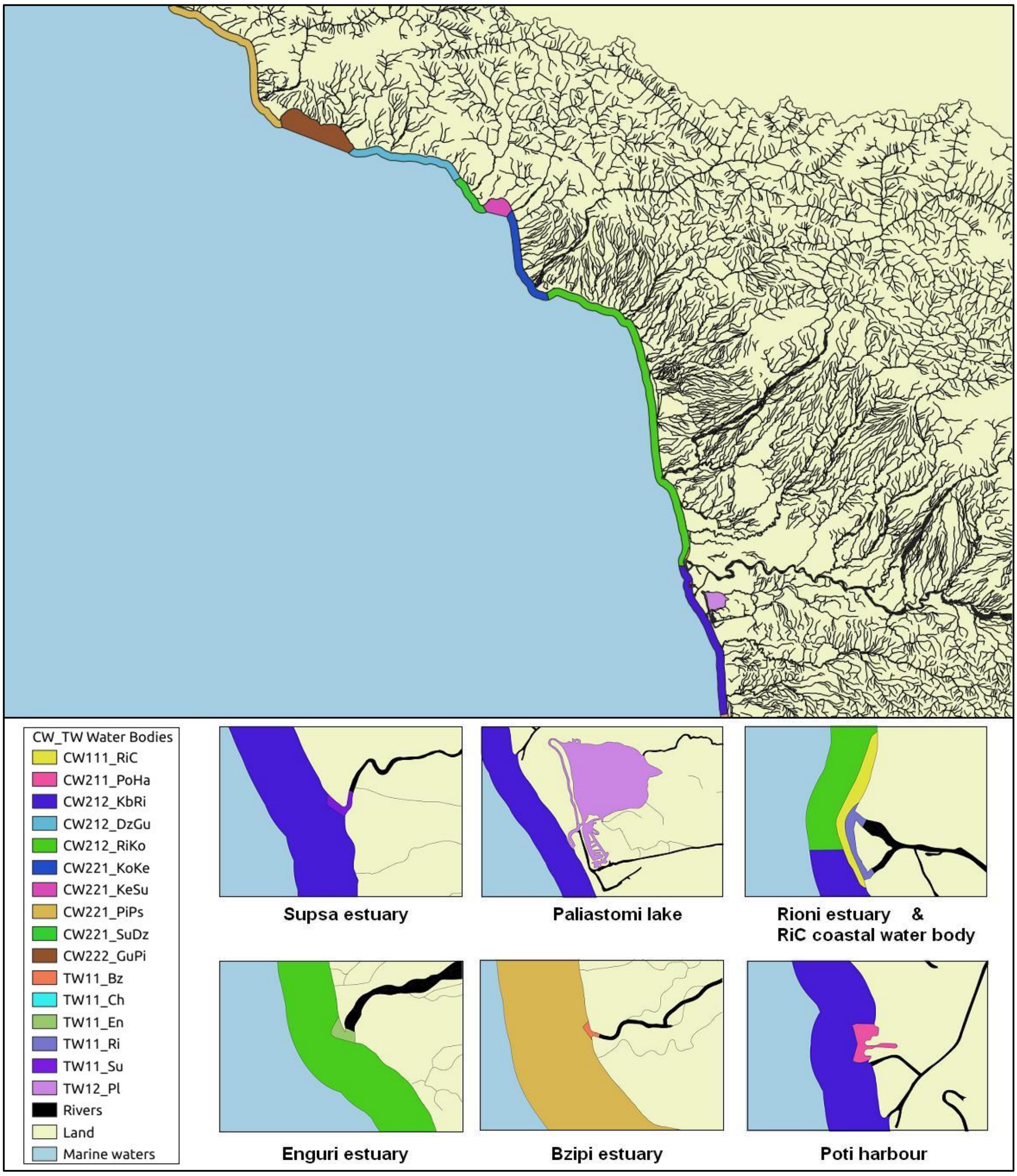

Figure 6: Positions and shapes of transitional and coastal water bodies appearing in the coastal area from Kobuleti to Psou (border with Russia)

4.3 Transitional and coastal water types and bodies in the whole Georgian coastal area from Sarpi (border with Turkey) to Psou (border with Russia)

In the whole Georgian coastal area, from Sarpi (border with Turkey) to Psou (border with Russia), two transitional and five coastal water types have been identified (Table 9, figure 7). According to the applied typology for transitional and coastal waters, six transitional and seventeen coastal water bodies appear in this area (Table 9., figure 8). Two of the identified coastal water bodies (Batumi harbour and Poti harbour) are proposed as candidates for acquiring the status of heavily modified water bodies.

Table 9: Transitional and coastal water types and bodies in the Georgian coastal area from Sarpi to Psou

Surface water category	Water type	Water body		Geographic position (min, max)* (WGS84)	
		Site	Name	Latitude	Longitude
Transitional waters	GE_TW11	Chorokhi estuary	TW11_Ch*	41,598801 N 41,60808 N	41,573412 E 41,582099 E
		Supsa estuary	TW11_Su	42,015827 N 42,023345 N	41,749861 E 41,759571 E
		Rioni estuary	TW11_Ri	42,184838 N 42,21268 N	41,633891 E 41,649081 E
		Enguri estuary	TW11_En	42,386483 N 42,394854 N	41,55435 E 41,565067 E
		Bzipi estuary	TW11_Bz	43,189095 N 43,19292 N	40,281025 E 40,285766 E
	GE_TW12	Paliastomi lake	TW12_Pl	42,072157 N 42,141249 N	41,687826 E 41,770515 E
Coastal waters	GE_CW111	From Chorokhi estuary to Batumi cape - near coast	CW111_ChBaC*	41,5988 N 41,649227 N	41,571387 E 41,627758 E
		Rioni- near coast	CW111_RiC	42,182006 N 42,238425 N	41,629565 E 41,648108 E
	GE_CW211	Batumi harbor	CW211_BaHa	41,646346 N 41,655154 N	41,647855 E 41,660823 E
		From Korolistskali river to Tsikhidziri cape	CW211_KoTs	41,667299 N 41,779636 N	41,673601 E 41,759632 E
		Poti harbour	CW211_PoHa	42,148257 N 42,160383 N	41,649354 E 41,668343 E
	GE_CW212	From Chorokhi estuary to Batumi cape	CW212_ChBa	41,597429 N 41,673666 N	41,554294 E 41,647106 E
		From Kobuleti to Rioni estuary	CW212_KbRi	41,866955 N 42,195513 N	41,617369 E 41,780554 E
		From Rioni estuary to Kodori cape	CW212_RiKo	42,19486 N 42,802293 N	41,185311 E 41,6478 E
		From Dzista estuary to Gudauta	CW212_DzGu	43,029771 N 43,09911 N	40,563613 E 40,90805 E
	GE_CW221	From Batumi cape to Korolistskali river	CW221_BaKo	41,649063 N 41,679554 N	41,645445 E 41,688704 E
		From Tsikhidziri cape to Kobuleti	CW221_TsKb	41,773139 N 41,869945 N	41,739112 E 41,782162 E
		From Kodori cape to Kelasuri	CW221_KoKe	42,773852 N 42,971396 N	41,053383 E 41,191709 E
		From Kelasuri to Sukhumi cape	CW221_KeSu	42,956008 N 42,997384 N	40,978455 E 41,067795 E
		From Sukhumi cape to Dzista estuary	CW221_SuDz	42,961828 N 43,038719 N	40,88858 E 40,991622 E
		From Pitsunda to Psou	CW221_PiPs	43,128305 N 43,389087 N	39,991278 E 40,358023 E
	GE_CW222	From Sarpi to Chorokhi estuary	CW222_SaCh	41,51876 N 41,606517 N	41,528452 E 41,572925 E
		From Gudauta to Pitsunda	CW222_GuPi	43,080318 N 43,173225 N	40,351449 E 40,579888 E

*Xx** Abbreviations of particular site names. Geographic positions** are extracted from shape files*

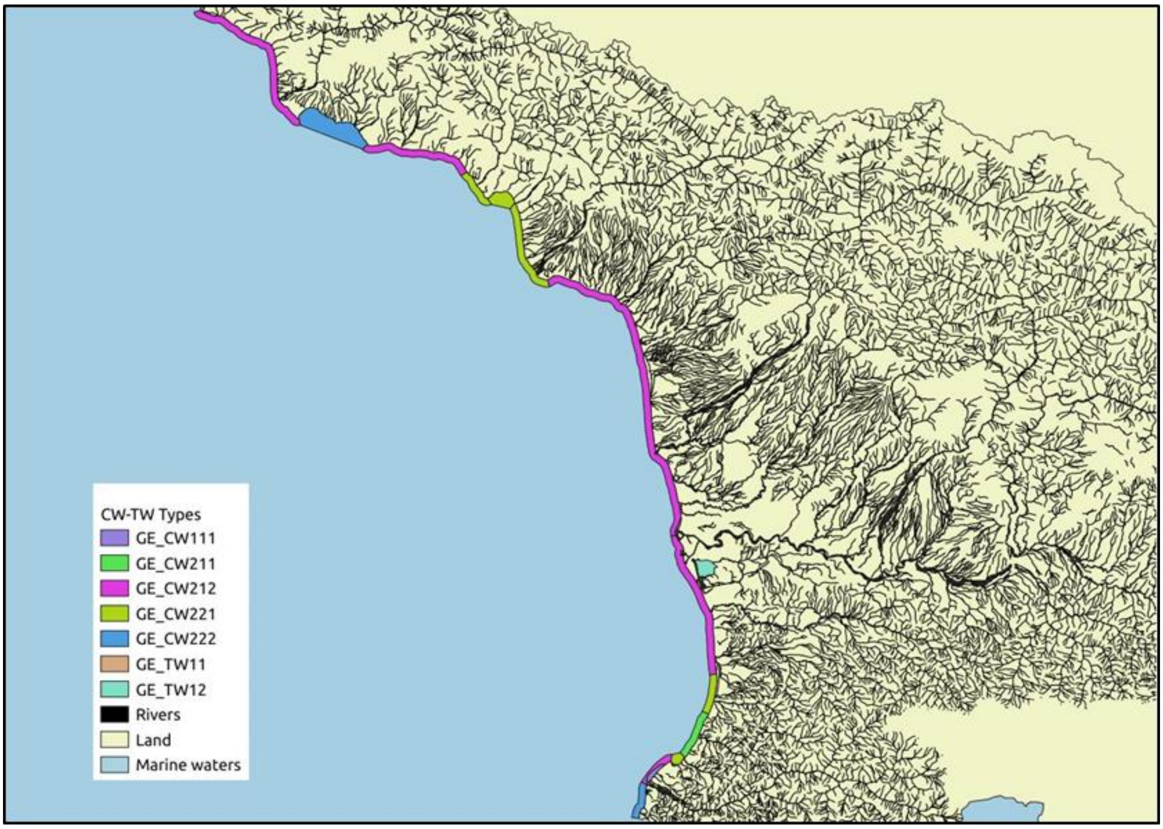

Figure 7: Positions and shapes of transitional and coastal water types appearing in the coastal area from Sarpi (borrder with Turkey) to Psou (border with Russia)

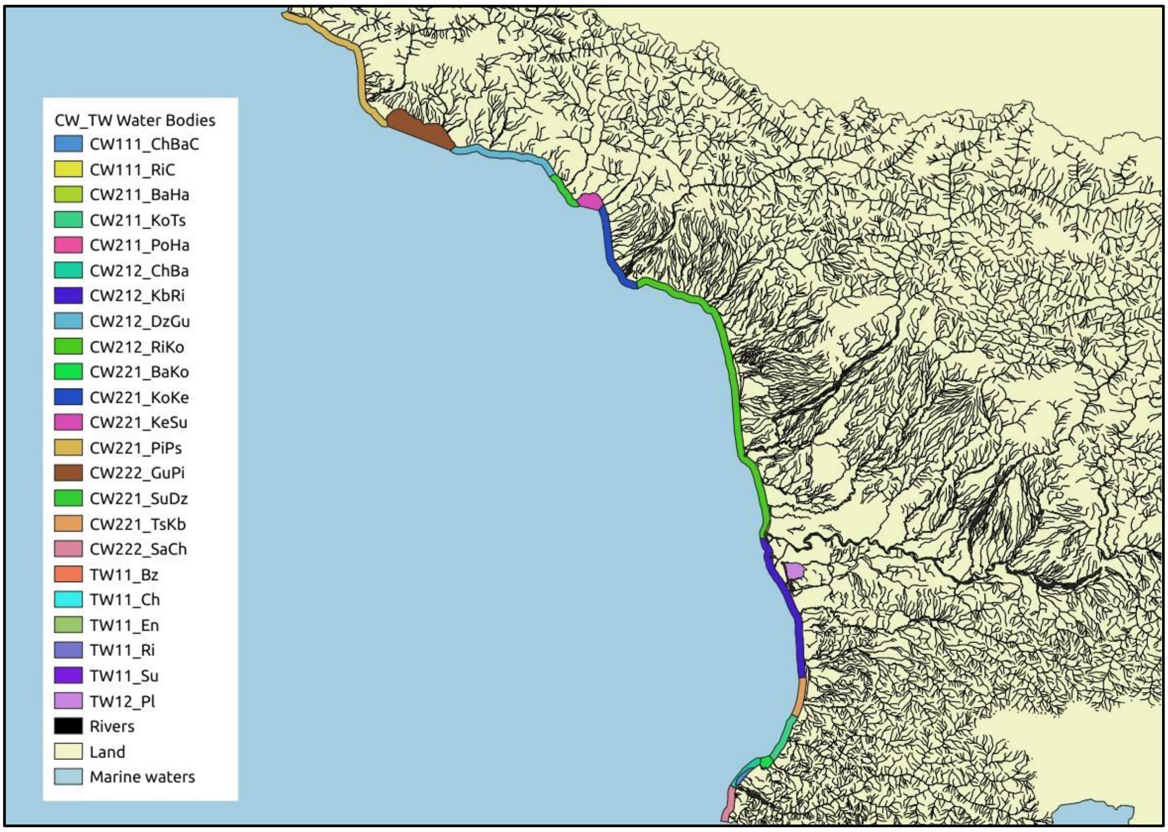

Figure 8: Positions and shapes of transitional and coastal water bodies appearing in the coastal area from Sarpi (border with Turkey) to Psou (border with Russia)

5 PROPOSED SURVEILLANCE MONITORING STATIONS IN THE EUWI+ PILOT AREA FROM SARPI TO KOBULETI

Surveillance monitoring stations in the EUWI+ Pilot area are proposed for each of the identified water bodies. The quality elements, selected for surveillance monitoring and determination of the ecological status, and their monitoring frequencies are presented in table 10.

Table 10: Obligatory quality elements included in the surveillance monitoring and minimum monitoring frequency requirements

Quality elements		Monitoring frequency in transitional waters	Monitoring frequency in coastal waters
Physico-chemical	Thermal conditions	4x in 1 Year	4x in 1 Year
	Salinity	4x in 1 Year	4x in 1 Year
	Oxygenation	4x in 1 Year	4x in 1 Year
	Nutrients (N, P, Si)	4x in 1 Year	4x in 1 Year
Biological	Phytoplankton	2x in 1 Year	2x in 1 Year
	Other aquatic flora	1x in 3 Years	1x in 3 Years
	Macro invertebrates	1x in 3 Years	1x in 3 Years
	Fish	1x in 3 Years	Monitoring not required
Hydromorphological		1x in 6 Years	1x in 6 Years
River basin specific pollutants		4x in 1 Year	4x in 1 Year

On the list of obligatory quality elements to be monitored during surveillance monitoring, the hydromorphological parameters, which are used for the determination of the hydromorphological status in Georgian coastal and transitional waters, still have not been defined. Same is true for the River basin specific pollutants.

Monitoring station positions in particular water bodies in the EUWI+ Pilot area are shown in figures 9 and 10 referring to the transitional water body TW11_Ch and the coastal water bodies, respectively. The geographic positions of the stations are presented in tables 11 and 12.

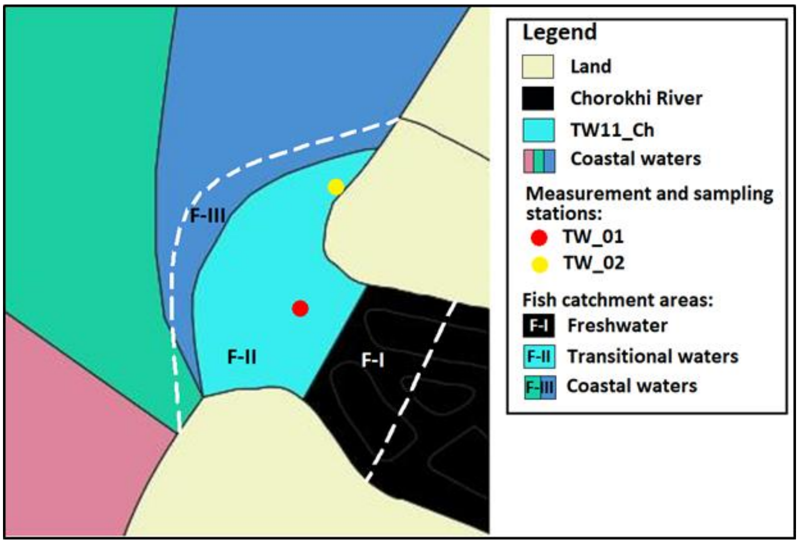

Figure 9: The transitional water body TW11_Ch with indicated monitoring stations for WFD quality elements, additional eutrophication indicators, and the catchment areas for biological quality element Fish

Table 11: Geographic positions of sampling stations in the transitional water body TW11_Ch

Transitional water body	WFD quality elements	Additional eutrophication indicators	Station		
			Code	Latitude	Longitude
TW11_CH	Phy-chem, Phyto	Zoo, HB	TW_01	41.605107° N	41.574285° E
	Phy-chem, Phyto	Zoo, HB	TW_02	41.606794° N	41.575293° E
	Fish	-	Catchment area: F-II (obligatory)		
			Catchment area: F-I (optional)		
			Catchment area: F-III (optional)		

Phy-chem - Physico-chemical parameters, Phyto – Phytoplankton, Fish – Ichthyofauna, Zoo – Zooplankton, HB – Heterotrophic bacteria

In this water body (TW11_Ch), only three obligatory quality elements can be monitored (physico-chemical, phytoplankton and fish). Due to the very coarse substrate (pebble and stone) sediment sampling for the determination of benthic invertebrates is unfeasible, while suitable angiosperms have not been detected for status determination in Georgian transitional waters.

In addition to the obligatory parameters, sampling of additional eutrophication parameters should also be considered.

Two sampling stations are proposed for physico-chemical parameters, phytoplankton and additional eutrophication parameters:

- Station TW_01, located in the centre of the water body, where sampling may only be carried out from a small boat;
- Station TW_02, located at the shore, where sampling can be carried out by hand, in the surface layer.

Fish sampling should be performed in the TW catchment area F-II, but during the first years of monitoring we also suggest fish sampling in the freshwater (F-I) and coastal water part (F-III) of the estuary. This type of extended monitoring should enable the identification of estuarine resistant fish species. Regarding the required monitoring frequency of once every three years (Table 11), according to our recommendation, monitoring should be carried out twice in one year of the first six-year monitoring cycle.

Three obligatory WFD quality elements (physico-chemical, phytoplankton and benthic invertebrates) should be measured in all coastal water bodies from Sarpi to Kobuleti. The status of Macrophytes should be investigated at the identified habitat sites. In addition to the obligatory quality elements, we also suggest measurements of eutrophication indicators. Generally, the number of sampling stations is one per water body, with the exception of the water bodies CW211_KoTs and CW221_TsKb, for which 3 and 2 sampling stations are proposed, respectively. Sampling and measurement frequencies should be in accordance with the WFD minimum monitoring frequencies given in table 11.

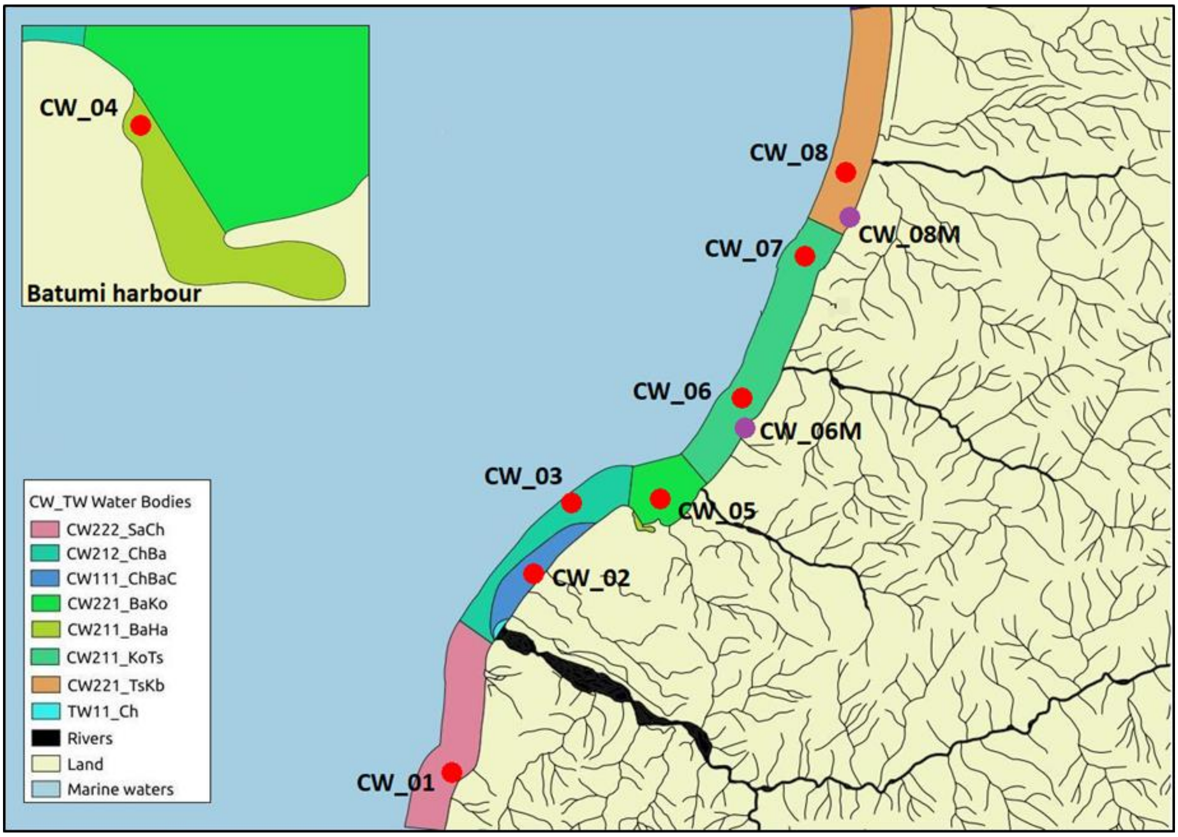

Figure 10: The coastal water bodies in the EUWI+ Pilot area with indicated monitoring stations for WFD quality elements and additional eutrophication indicators

Table 12: Geographic positions of sampling stations in the coastal water bodies from Sarpi to Kobuleti

Coastal water body	WFD quality elements	Additional eutrophication indicators	Station		
			Code	Latitude	Longitude
CW222_SaCh	Phy-chem, Phyto, BI	Zoo, HB	CW_01	41.538133° N	41.547700° E
CW212_ChBa	Phy-chem, Phyto, BI	Zoo, HB	CW_02	41.623750° N	41.586100° E
CW111_ChBaC	Phy-chem, Phyto, BI	Zoo, HB	CW_03	41.655217° N	41.602767° E
CW211_BaHa	Phy-chem, Phyto, BI	Zoo, HB	CW_04	41.653717° N	41.644900° E
CW221_BaKo	Phy-chem, Phyto, BI	Zoo, HB	CW_05	41.658833° N	41.654133° E
CW211_KoTs	Phy-chem, Phyto, BI	Zoo, HB	CW_06	41.708617° N	41.699650° E
	Phy-chem, Phyto, BI	Zoo, HB	CW_07	41.769267° N	41.736717° E
	Macrophytes	-	CW_06M	41.693867° N	41.705800° E
CW221_TsKb	Phy-chem, Phyto, BI	Zoo, HB	CW_08	41.800083° N	41.753750° E
	Macrophytes	-	CW_08M	41.779417° N	41.754600° E

Phy-chem - Physico-chemical parameters, Phyto – Phytoplankton, BI – Benthic invertebrates, Zoo – Zooplankton, HB – Heterotrophic bacteria

6 CONCLUSIONS

The entire Georgian coastal zone, from the border with Turkey to the border with Russia, has been delineated in relation to appearing transitional and coastal waters. The system B was applied for the delineation. In addition to mandatory delineation factors, the origin of transitional waters along with the depth and substrate size ranges for coastal waters have been applied as optional factors.

In total, two types of transitional waters and six transitional water bodies have been identified, as well as five types of coastal waters and seventeen coastal water bodies.

Artificial water bodies have not been identified, but two heavily modified water bodies, located in the harbours of Batumi and Poti, have been nominated as candidates for HMWBs.

GIS shape files indicating the shapes and positions of particular water bodies have been produced.

Twelve surveillance monitoring stations for the EUWI+ Pilot area are proposed.

7 REFERENCES

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Clarification note in relation to the reporting of spatial data for Water Framework Directive (WFD) protected areas, in the context of the March 2016 reporting of the second River Basin Management Plans (RBMPs) - cdr.eionet.europa.eu/help/WFD/WFD_521_2016/GISGuidance

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Common Implementation Strategy for the Water Framework Directive (2000/60/EC), 2003. Guidance document no. 3. Analysis of Pressures and Impacts. 148 p.

Common Implementation Strategy for the Water Framework Directive (2000/60/EC), 2003. Guidance document no. 4. Identification and Designation of Heavily Modified and Artificial Water Bodies. 108 p.

Common Implementation Strategy for the Water Framework Directive (2000/60/EC), 2003. Guidance document no. 5 Transitional and Coastal Waters. Typology, Reference Conditions and Classification Systems. 107 p.

8 ANNEXES

The delineation shape files for transitional and coastal waters are attached to this document.

Acknowledgements

The author would like to express his gratitude to:

- Alexei Iarochevitch from BlueRivers, Ukraine for providing the GIS shape files of the EMBLAS/UNDP delineation proposal;
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