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Climate change adaptation in water law: International, EU and Finnish perspectives

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Abstract

Climate change is expected to significantly alter hydrological regimes globally as well as locally. The impacts will encompass both long-term changes in hydrological trends and short-term extreme weather events. The need to anticipate and adapt to future changes will challenge legal rules and institutions, as these are bound to the past. This article analyses whether water law at international, EU and national (Finland) levels can deal with these hydrological changes. To this end, the analysis draws on a case study of the Finnish-Russian transboundary Vuoksi River. We discuss the main substantive and procedural challenges of water law and outline some necessary legal changes. Our analysis shows that while water law at these levels includes some legal mechanisms for managing varying hydrological circumstances, these will prove insufficient in the light of the scale of anticipated hydrological changes.

1 | INTRODUCTION

The 2015 Paris Agreement famously establishes a 1.5°C goal for climate change mitigation efforts. The mitigation target often overshadows the fact that the agreement also seeks to boost the capacity of societies across the globe to adapt to the adverse impacts of climate change.[1] Climate change adaptation squarely engages water law and governance: global and local hydrological cycles are undergoing rapid and fundamental changes due to the negative impacts of climate change.[2] The water-related impacts of climate change include increasingly severe droughts, floods and storms, as well as rising sea levels. The availability of, and demand for, water will be increasingly unpredictable. Climate change will also affect water quality through changes in precipitation patterns, seasonality and other processes. In short, climate change will bring about a wide range of water-related consequences that will disrupt societies.[3]

Water law plays a key role in climate change adaptation. It regulates the use of water resources as well as measures to protect against hydrological extremes (e.g., floods and droughts) and the preservation and management of water resources.[4] The relationship between climate change adaptation and water law has been discussed in legal research by, among other scholars, Keessen and van Rijswick (European water law), Craig (water law in the United States), Tarlock (international water law) and Verschuuren (basic elements of international and domestic water law).[5] Our review of the current water law literature reveals two gaps. First, existing literature often focuses only on one level (international, regional or national) of water law and thus

[1]Paris Agreement (adopted 12 December 2015, entered into force 4 November 2016) 55 ILM 740 art 2.

[2]UNESCO and UN-Water, 'United Nations World Water Development Report 2020: Water and Climate Change' (UNESCO 2020) 11–29.

[3]ibid.

[4]Regarding the scope of water law see, e.g., United Nations Convention on the Law of the Non-navigational Uses of International Watercourses (adopted 21 May 1997, entered into force 17 August 2014) 2999 UNTS 77 (UN Watercourses Convention) arts 1, 27–28.

[5]AM Keessen and HFMW van Rijswick, 'Adaptation to Climate Change in European Water Law and Policy' (2015) 8 Utrecht Law Review 38; RK Craig, 'Water Law and Climate Change in the United States: A Review of the Legal Scholarship' (2020) 7 WIREs Water e1423; AD Tarlock, 'International Water Law and Climate Disruption' in SC McCaffrey et al (eds), *Research Handbook on International Water Law* (Edward Elgar 2019) 186; J Verschuuren, 'Climate Change Adaptation and Water Law' in J Verschuuren (ed), *Research Handbook on Climate Change Adaptation Law* (Edward Elgar 2022) 234.

fails to consider the interlinkages between the levels. Second, the scholarship often discusses water security and hazards posed by climate change (especially floods and droughts). The implications for water use rights and authorisations of incremental hydrological changes, also a facet of climate change, are, however, often overlooked.

This article undertakes to address the two gaps in water law and climate adaptation scholarship identified above. Our argument is that, on many accounts, the current multi-level water law system is failing to keep pace with changing hydrological circumstances in its ambition to protect ecosystems and people from climate change. One explanation accounting for this situation is that the objectives, rules and institutions (e.g., permit regimes) of water law have been designed for stable hydrological conditions, that is, ones where future hydrological conditions can be predicted from past hydrological observations with relative certainty. A given river basin often has a limited level of resilience (i.e., capacity) to deal with fluctuations in water cycles. The assumption to date has been this variation will fall within a certain past hydrological range (e.g., maximum river flows doubling but not quadrupling).[6] However, with climate change, we are entering what Ruhl calls a 'no-analog' future, in which past hydrological observations are poor predictors of the future.[7]

As the hydrological conditions in which water law is designed and applied changes and contains high scientific uncertainty, the sector is faced with a monumental challenge to keep up with the pace and scale of change.[8] For example, in Finland, the water flow requirements in hydropower permits are usually set according to (past) annual hydrological cycles. One component of these cycles has been the occurrence of spring floods when ice melts on lakes and rivers.[9] However, with warming winters, permit conditions based on past cycles are increasingly proving too rigid, with options too limited to manage floods that differ from the predicted seasonal water flows and levels. This in turn decreases the ability of hydropower dams to mitigate increasing winter floods.[10] In sum, water law runs the risk of protecting the permanence of past legal decisions at the expense of effective climate change adaptation.[11]

One notable suggestion for improving the capacity of water laws to support climate change adaptation is to enshrine adaptive management as a key design principle of water law.[12] In a legal context, adaptive management seeks to improve the capacity of law to acknowledge and address the dynamic, complex and uncertain nature of social-ecological systems.[13] This approach involves an iterative decision-making framework that reviews prior management decisions, like water management permits, in instances where circumstances or legal requisites have changed or where decisions have been founded on outdated information.[14] What is more, adopting adaptive management in environmental legislation requires that the law itself must be able to change when necessary to accommodate changes in the socio-ecological context in which it operates.[15]

Building on the notion of adaptive management, the research question of this article is whether current water law at and between the international, EU and national levels (Finland) has the capacity to adapt to long-term incremental hydrological changes as well as to short-term exceptional circumstances such as floods and droughts. The particular focus is on changes in water quantity, but the article also touches upon questions of water quality, as the two are closely linked. We consider both the substantive and procedural provisions of existing water law. To provide adaptive capacity, legislation should be flexible enough substantively and include procedural mechanisms for amending both water laws and administrative decisions in response to hydrological changes.[16]

To concretise the challenges of water law and climate change adaptation on multiple levels of governance, we present a case study highlighting the legal regime of the Finnish-Russian transboundary Vuoksi River.[17] The case brings together questions of international, regional (European Union) and national (Finnish) water law and illustrates how law may both facilitate and impede adaptation to hydrological changes in a transboundary context. The case also provides an opportunity to combine legal findings with hydrological data and thus add a multidisciplinary dimension to the analysis. This multidisciplinary analysis holds particular interest here since the regulation of the

[6]Resilience is often defined as a characteristic of a system that can respond and has the capacity to adapt to changing circumstances without losing its core functions; see BH Walker et al, 'A Handful of Heuristics and Some Propositions for Understanding Resilience in Social-Ecological Systems' (2006) 11 Ecology & Society 13, 14; RK Craig, '"Stationarity Is Dead" – Long Live Transformation: Five Principles for Climate Change Adaptation Law' (2010) 34 Harvard Environmental Law Review 9, 22.

[7]JB Ruhl, 'Climate Change and the Endangered Species Act: Building Bridges to the No-Analog Future' (2009) 39 Environmental Law and Policy Annual Review 10,737.

[8]UNESCO and UN-Water (n 2) 16–18.

[9]E Hollo, *Vesioikeus* (Water Law) (Edita 2021) 347–364.

[10]N Veijalainen et al, 'National Scale Assessment of Climate Change Impacts on Flooding in Finland' (2010) 391 Journal of Hydrology 333, 339–343.

[11]O Green et al, 'Barriers and Bridges to the Integration of Social-Ecological Resilience and Law' (2015) 13 Frontiers in Ecology and the Environment 332, 333; B Cosens and L Gunderson, 'An Introduction to Practical Panarchy: Linking Law, Resilience and Adaptive Water Governance of Regional Scale Social-Ecological Systems' in B Cosens and L Gunderson (eds), *Practical Panarchy for Adaptive Water Governance: Linking Law to Social-Ecological Resilience* (Springer 2018) 1, 12.

[12]JB Ruhl, 'Climate Change Adaptation and the Structural Transformation of Environmental Law' (2010) 40 Environmental law 363; JB Ruhl, 'General Design Principles for Resilience and Adaptive Capacity in Legal Systems—With Applications to Climate Change Adaptation' (2011) North Carolina Law Review 1373; J McDonald, and MC Styles, 'Legal Strategies for Adaptive Management Under Climate Change' (2014) 26 Journal of Environmental Law 25, 26.

[13]A seminal work in the field is CS Holling, *Adaptive Environmental Assessment and Management* (Wiley 1978). The need for adaptive management policy and practices are recognised, for example, in CBD 'Conference of the Parties to the Convention on Biological Diversity Report of the Fifth Meeting' UN Doc UNEP/CBD/COP/5/23 (22 June 2000) 91–94, 104–108, 176–178.

[14]JB Ruhl, 'Regulation by Adaptive Management – Is It Possible?' (2005) 7 Minnesota Journal of Law, Science & Technology 21, 35–36; JB Ruhl, 'Taking Adaptive Management More Seriously: A Case Study of the Endangered Species Act' (2004) 52 Kansas Law Review 1249, 1252; CA Arnold and LH Gunderson, 'Adaptive Law and Resilience' (2013) 43 Environmental Law Reporter 10426; ST Puharinen, 'Free Rivers or Legal Certainty?: Review of Hydropower Permits Under EU Water Law' (2022) 31 European Energy and Environmental Law Review 54, 55.

[15]Ruhl 2010 (n 12); H Doremus, 'Adapting to Climate Change with Law that Bends without Breaking' (2010) 2 San Diego Journal of Climate and Energy Law 45, 59–63; Ruhl 2011 (n 12); J McDonald, 'The Role of Law in Adapting to Climate Change' (2011) 2 WIREs: Climate Change 283, 289–290.

[16]See United Nations Economic Commission for Europe (UNECE), 'Guidance on Water and Adaptation to Climate Change' (UNECE 2009) 40–42.

[17]Agreement between the Republic of Finland and the Union of Soviet Socialist Republics Concerning the Regulations Governing Lake Saimaa and the Vuoksi River (adopted 26 October 1989, entered into force 9 October 1991) 1663 UNTS 325 (the Vuoksi Discharge Rule).

Vuoksi River's flow adheres to historical hydrological conditions, despite the notable shifts in these conditions over time.[18]

Embarking on the analysis proper, Section 2 unpacks the hydrological impacts of various climate change scenarios and the challenges that they pose to the established rules, institutions and decisions underpinning current water legislation. Section 3 examines the case-study of Vuoksi, specifically the Finnish-Russian transboundary cooperation formalised in bilateral treaties and the difficulties the treaty system will face in keeping pace with incipient hydrological changes. This background provides the basis for Section 4, which analyses in more detail the multi-level legal instrumentation at play in the Vuoksi case. At the international level, we analyse the two global water conventions—the 1992 UNECE Water Convention[19] and the 1997 UN Watercourses Convention.[20] At the EU level, the focus is on the Water Framework Directive (WFD)[21] and the Floods Directive[22]—the Union's most important water law instruments for climate change adaptation. Finland then provides a national-level example, with the Vuoksi case aptly illustrating the capacity of water law to adapt to the changing needs of water-flow regulation, revision of water management and environmental permits, and flood protection. Section 5 takes the analysis a step further with a discussion of the main strengths and shortcomings of the current water law regimes. In Section 6, we conclude and put forward some guidelines for the future development of multi-level water law in the light of changing hydrological circumstances.

2 | HYDROLOGICAL CHANGES NECESSITATING ADAPTATION AND CHALLENGING WATER LAW

Water cycles and water availability are affected by temperature, precipitation and evaporation, all of which will change as the climate does.[23] While global mean precipitation and evaporation will increase with global warming, local and regional outcomes in precipitation will vary. In some areas, such as the dry mid-latitude regions, decreases in mean annual precipitation and runoff are expected, whereas the higher latitudes will see increases.[24] In areas with snow-dominated hydrology, an increase in air temperature is expected to cause shifts in seasonality and the timing of flow peaks from melting snow.[25]

Even more worrying is that for most regions of the world all emission scenarios predict that water cycle variability and extremes will increase faster than current average hydrological changes.[26] Heavy precipitation is projected to become more frequent in most parts of Europe.[27] The principal challenge southern Europe faces is a heightened risk of drought, while the primary concern in central Europe is predicted to be increased flooding.[28] Even within the same region, the challenges related to water cycle variability and extremes may differ considerably depending on the characteristics of individual watersheds and local vulnerability.[29] More specifically, in the case of watersheds, the changing climate is expected to impact the following: the seasonal timing of discharges (especially in areas with snow), the frequency of floods and low flows,[30] groundwater levels, heavy precipitation causing urban floods, nutrient effluent, and water temperature and quality.[31]

To date, changes in the water cycle attributable in part to human influences have been observed in global-scale changes in precipitation, intensification of heavy precipitation and the incidence of drought.[32] In the Nordic countries, the observed trends related to rising air temperatures include earlier spring floods and an increase in winter discharges.[33] Estimates of impacts on hydrology in Finland, including the Vuoksi river basin, show that climate change will have strong seasonal impacts but the results from different climate scenarios and hydrological models vary.[34] The average changes will be moderate increases in mean annual discharge of rivers (approximately 0–5% by 2040–2069). All scenarios predict an increase in winter discharge caused by warmer winters with more rainfall and snowmelt. Decreases in spring snowmelt discharge are projected for southern and central Finland.[35]

The seasonal rhythm of water levels in lakes will likely change considerably; indeed, this has been observed in recent years in central and southern Finland, which has seen mild and wet winters with little snow.[36] Finland has many regulated lakes, and many of the current

[18]See A Belinskij et al, 'Vuoksi Basin: Three-Stage Process of Coordinated Basin Development' in Promoting Development in Shared River Basins. Case Studies from International Experience (World Bank Group 2018), 101, 116.

[19]Convention on the Protection and Use of Transboundary Watercourses and International Lakes (signed 17 March 1992, entered into force 6 October 1996) 1936 UNTS 269 (UNECE Water Convention).

[20]UN Watercourses Convention (n 4).

[21]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 [2000] OJ L327/1 (WFD).

[22]Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks [2007] OJ L288/27 (Floods Directive).

[23]H Douville et al, 'Water Cycle Changes' in V Masson-Delmotte et al (eds), *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge University Press 2021) 1055.

[24]ibid Figure 8.14; and JY Lee et al, 'Future Global Climate: Scenario-based Projections and Near-term Information' in Masson-Delmotte et al (n 23) 553.

[25]ZW Kundzewicz et al, 'The Implications of Projected Climate Change for Freshwater Resources and Their Management' (2008) 53 Hydrological Sciences Journal 3, 5.

[26]Douville et al (n 23) 1058.

[27]European Environmental Agency (EEA), 'Climate Change, Impacts and Vulnerability in Europe 2016: An Indicator-based Report' (EEA 2017) 82.

[28]R Ranasinghe et al, 'Climate Change Information for Regional Impact and for Risk Assessment' in Masson-Delmotte et al (n 23) 1767, Figure 12.11.

[29]N Veijalainen, *Estimation of Climate Change Impacts on Hydrology and Floods in Finland* (PhD thesis, Aalto University 2012) 54–56.

[30]EEA (n 27) 29.

[31]I Huttunen et al, 'Effects of Climate Change and Agricultural Adaptation on Nutrient Loading from Finnish Catchments to the Baltic Sea' (2015) 529 Science of the Total Environment 168; H Tuomenvirta et al, 'Sää- ja ilmastoriskit Suomessa - Kansallinen arvio (Weather and Climate Risks in Finland - National Assessment)' (Publications of the Government's Analysis, Assessment and Research Activities 2018) 16–20.

[32]Douville et al (n 23) 1062–1063.

[33]J Korhonen, and E Kuusisto, 'Long Term Changes in the Discharge Regime in Finland' (2010) 41 Hydrology Research 253, 253; D Wilson et al, 'Has Streamflow Changed in the Nordic Countries? Recent Trends and Comparisons to Hydro-Logical Projections' (2010) 394 Journal of Hydrology 334, 334.

[34]Veijalainen (n 29).

[35]ibid.

[36]N Veijalainen et al, 'Climate Change Impacts on Water Resources and Lake Regulation in the Vuoksi Watershed in Finland' (2010) 24 Water Resources Management 3437, 3456.

regulation permits and practices were developed to decrease snow-melt floods in spring and summer.[37]

Nutrient leaching from agricultural areas and natural background leaching from Finland to the Baltic Sea catchment are projected to increase. Annual and winter runoff are expected to increase and the duration of the snow cover to decrease.[38] Agricultural adaptation is essential to mitigate the effects of climate change on nutrient loading.[39]

Although projections differ depending on the climate scenario chosen, it is beyond dispute that climate change will bring a heightened risk of floods in Finland. These will vary considerably depending on the location, size and characteristics of the catchment affected.[40] Warmer and wetter autumns and winters will increase floods during these seasons especially in large lakes and their outflow rivers. A decrease in spring flood discharges and flood hazards will be seen in central and southern Finland due to the anticipated decrease in snow accumulation.[41]

In Finland, studies have shown varying effects of climate change on the probability of drought.[42] Some suggest that in southern and central Finland, minimum discharges will decrease and the risk of summer droughts will increase. Changes in this risk depend on location, changes in precipitation and weather patterns. Projections vary between scenarios. Even though Finland has abundant water resources, some areas have been identified that will become vulnerable to droughts.[43]

All in all, climate change is skewing the range within which hydrological conditions vary, as well as producing unprecedented impacts on waters and their uses. Given that existing water laws and water use plans and permits are based on past monitoring data and geared towards preserving aquatic conditions within a certain, narrow range, they face mounting challenges.[44] As a solution, water laws regulating the planning and management of different water uses should adapt to changing circumstances rather than merely trying to mitigate the change.[45] In the following, we analyse whether the transboundary legal arrangements in the Vuoksi river basin (Section 3) and international, EU and Finnish water law (Section 4) are up to the task of managing the no-analogue future brought upon us by climate change.

3 | VUOKSI CASE STUDY

The Vuoksi River in South-East Finland is one of the rivers for which hydrological scenarios consistently show a particularly large increase in flood risk.[46] It is the principal outflow river of Lake Saimaa, Finland's largest lake, which flows into Russia and is regulated by dams in the Tainionkoski area in Southeast Finland. The river has a catchment area of 70,000 km^2. The Finnish-Russian cooperative arrangement in the area (cooperation is currently very limited due to Russia's invasion of Ukraine) covers four hydropower stations, two on each side of the border, as well as flood and drought management.[47] Climate change adaptation has been recognised as both a challenge and an opportunity in the countries' transboundary arrangement.[48]

The 1964 Finnish-Russian Transboundary Water Agreement[49] provides guidelines for cooperation between the two countries. As a substantive rule, the agreement requires that the States avoid causing damage or harm to each other.[50] Accordingly, a specific procedure must be followed in the case of measures that might alter watercourses or water flow or cause flooding or drought in the territory of the other state.[51] The 1989 Vuoksi Discharge Rule[52] agreed between the two countries sets out more detailed rules on the regulation of water flows from Lake Saimaa in Finland into the Vuoksi River.[53]

The Discharge Rule requires that the water level of Lake Saimaa and the flow into the Vuoksi River remain within 'normal' limits—defined as 50 cm above or below the median water level—which means a maximum flow of around 800 m^3 per second.[54] If there is an imminent risk of a flood and a need to prevent damage, the flow may be increased or decreased in accordance with a specific procedure.[55] The two countries must approve a water release programme every year, and Finland has an obligation to inform Russia of any changes in the normal water releases.[56] In sum, the Discharge Rule allows the two countries to adapt to hydrological circumstances by adjusting water flows, albeit to a limited extent.[57]

As things stand, the normal limits for Lake Saimaa and the flow into the Vuoksi River have made adaptation to hydrological fluctuations, amidst already occurring climate change, possible in Finnish-Russian cooperation. However, when hydrological circumstances continue to change in the future, the limits may prove inadequate, as the allowable range is based on the historical water levels of Lake Saimaa and the flow of the Vuoksi between 1847 and 1984.[58]

[37]ibid 3457.
[38]Huttunen et al (n 31) 168.
[39]ibid 180.
[40]Veijalainen et al (n 10) 347–348.
[41]ibid 348.
[42]G Forzieri et al, 'Ensemble Projections of Future Streamflow Droughts in Europe' (2014) 18 Hydrology and Earth System Sciences 85; P Roudier et al, 'Projections of Future Floods and Hydrological Droughts in Europe Under a +2°C Global Warming' (2016) 135 Climatic Change 341; N Veijalainen et al, 'Severe Drought in Finland: Modeling Effects on Water Resources and Assessing Climate Change Impacts' (2019) 11 Sustainability 2450.
[43]L Ahopelto et al, 'Can There be Water Scarcity with Abundance of Water? Analyzing Water Stress during a Severe Drought in Finland' (2019) 11 Sustainability 1548.
[44]Craig (n 6) 28–31.
[45]This is also a central viewpoint in adaptive water governance discussions; see B Cosens et al, 'Governing Complexity: Integrating Science, Governance, and Law to Manage Accelerating Change in the Globalized Commons' (2021) 118 Proceedings of the National Academy of Sciences 1; B Cosens et al, 'Designing Law to Enable Adaptive Governance of Modern Wicked Problems' (2020) 73 Vanderbilt Law Review 1687.
[46]Veijalainen et al (n 10) Figure 6.
[47]See UNECE (n 16) 93; Belinskij et al (n 18) 101.
[48]Belinskij et al (n 47) 106.
[49]Agreement between the Republic of Finland and the Union of Soviet Socialist Republics Concerning Frontier Watercourses (signed 24 April 1964, entered into force 6 May 1965) 537 UNTS 231.
[50]ibid arts 2–4.
[51]ibid art 2.
[52]Vuoksi Discharge Rule (n 17).
[53]Belinskij et al (n 18) 108–110.
[54]Vuoksi Discharge Rule (n 17) Appendix, art 2.4 and Annex I.
[55]ibid Appendix, arts 1–2.
[56]ibid Appendix, art 2.
[57]UNECE (n 16) 93; Belinskij et al (n 18) 116–118.
[58]Vuoksi Discharge Rule (n 17) Annex I.

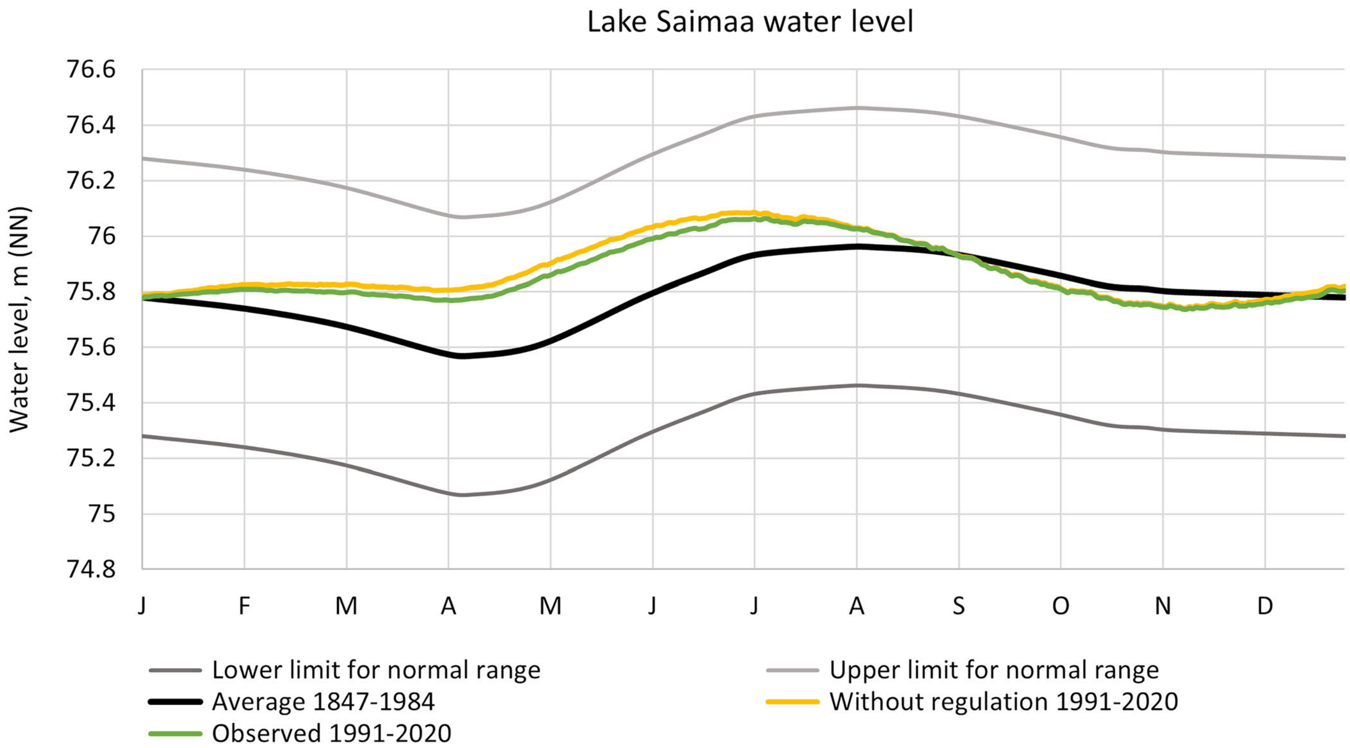

FIGURE 1 The water level at Lake Saimaa observed in the period of 1991–2020 and the limits of the normal range of water levels ±0.50 m from 1847 to 1984 (average). Figure by N Veijalainen [Color figure can be viewed at wileyonlinelibrary.com]

These 'normal' water levels and flows cannot be modified without amending the Discharge Rule.[59]

Climate change has already caused changes in the seasonal fluctuation of the water level of Lake Saimaa. With wetter winters and earlier spring snowmelt (Figure 1), the values seen in the current hydrological regime clash with the average water level in the regulation rule. Climate change will further increase winter floods and alter the timing of the largest discharges into the Vuoksi.[60] On the one hand, the increasing flood risk around Lake Saimaa can be alleviated by larger discharges into the Vuoksi, but on the other, this will increase the risk of floods on the Russian side of the border. An added concern here is that regulation of the lakes upstream of Lake Saimaa affects the water level of Lake Saimaa and those lakes as well will be impacted by climate change.

The normal water level and flow regulation limits have two consequences for climate change adaptation. First, Finland needs to consider and inform Russia of any changes in the normal water releases set down in the Vuoksi Discharge Rule. Second, changes in hydrological circumstances may affect the compensation to be paid between the two countries. According to the 1964 Finnish-Russian Transboundary Water Agreement, the contracting parties need to compensate one another for possible loss or damage caused to one party through a measure executed by the other.[61] The Vuoksi Discharge Rule requires that the parties monitor damages and benefits resulting from adjustments made to the normal flow and consider compensation for any damages.[62] To date, Finland has paid compensation to Russia if the water flows in the Vuoksi have exceeded the maximum level of 800 m^3 per second. In the future, such periodic flows might be sooner the norm than the exception.[63]

While the terms of cooperation are set out in the Finnish-Russian Transboundary Water Agreement, and in greater detail in the Vuoksi Discharge Rule, the arrangement does not operate in a legal vacuum. International, EU and national water law combine to provide the legal framework in which the cooperation functions in Finland. Next, we discuss how such a framework accommodates adaptation to climate change and plays out on the ground in the case of Vuoksi.

4 | CLIMATE CHANGE ADAPTATION IN INTERNATIONAL, EU AND NATIONAL WATER LAW

4.1 | International water law

International water law regulates the uses and protection of international surface water and groundwater resources that are situated in two or more States. International water treaties have two layers, one consisting of the global water conventions and the other of bilateral

[59]Belinskij et al (n 18) 120–121.
[60]Veijalainen et al (n 36) 3450.
[61]Finnish-Russian Transboundary Water Agreement (n 49) art 5.
[62]Vuoksi Discharge Rule (n 17) Appendix, art 2(2).
[63]Belinskij et al (n 18)121–124. See also UNECE (n 16) 93.

and multilateral transboundary water agreements.[64] The global water conventions are the 1997 UN Watercourses Convention and the 1992 UNECE Water Convention; States, for their part, have concluded numerous bilateral and multilateral transboundary water agreements, an example being the above-mentioned 1964 Finnish-Russian Agreement on the Utilization of Transboundary Watercourses.

Finland and Russia are both parties to the 1992 UNECE Water Convention, while only Finland is party to the 1997 UN Watercourses Convention. The UNECE guidance documents introduce some important elements of adaptive management discussed above. The key messages are that uncertainty can never excuse inaction; climate change adaptation needs to be flexible; legal barriers to adaptation must be removed; and transboundary cooperation is required if states are to adapt successfully.[65]

Neither the UNECE Water Convention nor the UN Watercourses Convention explicitly discusses climate change adaptation, which is understandable considering they were adopted in the 1990s. On the one hand, it has been claimed that international water law is not flexible enough to adapt to climate change.[66] On the other, the two conventions accommodate adaptive management in relation to existing water uses in a surprisingly comprehensive manner.

From a substantive perspective, the principle of equitable and reasonable utilisation is the essential underpinning of any decision on climate change adaptation in transboundary basins.[67] According to the UN Watercourses Convention, States must utilise international water resources in an equitable and reasonable manner with a view to attaining optimal and sustainable utilisation and benefits.[68] Existing water uses constitute only one of the factors relevant to this determination; hydrological and climatic factors also figure significantly in assessing what is equitable and reasonable.[69] Thus, the needs of climate change adaptation must be considered when deciding on the uses of international water resources. Ultimately, existing water uses are not strongly protected against revisions required by changing hydrological and climatic conditions.[70]

Significantly, the global water conventions contain provisions on adaptation to extreme hydrological conditions. The Watercourses Convention requires States to prevent or mitigate conditions such as floods and droughts that may be harmful to other states sharing a given watercourse,[71] while the UNECE Water Convention stipulates generally that any transboundary impact is to be prevented, controlled and reduced.[72] The former requirement forms an important bridge between international water law and climate change adaptation strategies.[73]

From a procedural perspective, the global water conventions highlight the need for cooperation between States that share international water resources. On the one hand, such cooperation includes long-term measures such as concluding bilateral and multilateral agreements and establishing joint water monitoring programmes and contingency plans. On the other hand, States need to hold consultations and inform each other about any critical or extreme short-term situations that may have transboundary impacts.[74] These procedural measures may be crucially important for States to enable climate change adaptation in transboundary basins.[75]

In general, the substantive provisions of the global water conventions are flexible, if ambiguous, in relation to climate change adaptation.[76] They provide a broad framework urging States to consider and react to hydrological and climatic factors and weather extremes in their transboundary cooperation. Procedurally, States need to cooperate to prevent and mitigate transboundary impacts, with these encompassing long- and short-term changes, short-term harmful conditions and emergencies related to climate change.[77]

Transboundary cooperation between neighbouring countries requires States to implement the principles set out in the provisions of the global water conventions. Considering that general international water law is adaptive in relation to existing water uses and hydrological and climatic factors, transboundary cooperation should also reflect this adaptivity and not be tied to historical hydrological data, as is the case with Vuoksi. However, changing transboundary water agreements between States may prove to be a challenging task.

In addition to the transboundary cooperation, climate change adaptation within the Vuoksi river basin in Finland is governed by both EU and national laws. The subsequent discussion delves into the adaptability of EU water law and the implementation of EU law requirements in the transboundary context of the Vuoksi river basin.

4.2 | EU water law

The most important, integrative piece of EU water legislation is the Water Framework Directive. Together with its related directives—the Groundwater Directive[78] and Environmental Quality Standards Directive[79]—the WFD provides a holistic framework for managing European waters and water uses and is thus a key EU legal instrument for climate change adaptation.

[64]See UNECE, 'Guide to Implementing the Water Convention' (UNECE 2013) 1.
[65]UNECE (n 16) 1–5. See also UNECE, 'Handbook on Water Allocation in a Transboundary Context' (UNECE 2021).
[66]See Tarlock (n 5) 189–204.
[67]UNECE (n 16) 19. On the equitable and reasonable utilization principle see, e.g., A Rieu-Clarke et al, 'UN Watercourses Convention User's Guide' (IHP-HELP Centre for Water Law, Policy and Science 2012) 100; UNECE (n 64) 22–25.
[68]UN Watercourses Convention (n 4) art 5.
[69]ibid art 6.
[70]See UNECE (n 64) 115–116. See also Verschuuren (n 5) 240–242.
[71]UN Watercourses Convention (n 4) arts 27–28.
[72]UNECE Water Convention (n 19) art 2(1).
[73]Rieu-Clarke et al (n 67) 201–202.
[74]ibid 210–212; UNECE Watercourses Convention (n 19) arts 9–14; UNECE (n 64) 63–89.
[75]See M Jafroudi, 'A Legal Obligation to Adapt Transboundary Water Agreements to Climate Change?' (2020) 22 Water Policy 717, 729.
[76]ibid.
[77]See A Tanzi and M Arcari, *The United Nations Convention on the Law of International Watercourses* (Kluwer Law International 2001) 222.
[78]Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration [2006] OJ L 372/19.
[79]Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council [2008] OJ L 348/84.

The WFD sets two core environmental objectives for member states: to (1) prevent the deterioration of water bodies and (2) achieve 'good water status'.[80] These 'no-deterioration' and 'good status' objectives form the main substantive obligations regarding water management in Member States and shape the implementation of national water policies. Water management measures in pursuit of the objectives are operationalised through river basin management plans (RBMPs).[81]

Another important EU legal instrument in relation to climate change adaptation is the Floods Directive. It regulates flood risk management and requires Member States to assess and map these risks as well as take measures to reduce them. Flood risk management is integrated in the WFD's RBMP system, and together, these instruments constitute the cadre for planning and implementing climate change adaptation measures in member states and in cooperation with non-Member States.

In the following sub-sections, we address (1) the environmental objectives outlined in the WFD, (2) adaptation measures in the WFD and the Floods Directive and (3) EU water law implementation in the Vuoksi River basin from the perspective of climate change adaptation. The first two sub-sections provide us an opportunity to assess the adaptive capacity of EU water law in general, whereas the last one includes a concrete implementation viewpoint within the Vuoksi case study context.

4.2.1 | Environmental objectives for water management

There are two main perspectives on the good status objective of the WFD that merit exploring in view of climate change adaptation. First, good status is tantamount to a well-functioning and resilient state of waters,[82] which means that reaching it would be important for climate adaptation in the climate-water nexus.[83] Second, climate change impacts risk imperilling achievement of good status within the timeframe set down in the Directive.[84] This being the case, it is crucial to assess whether the objective itself has sufficient adaptive capacity to remain relevant in the face of the projected hydrological changes.[85]

From both perspectives, the challenge is that the good status objective does not explicitly consider climate change impacts. As defined, good ecological status in the case of surface waters allows only minor deviations from historical, unimpacted ecological conditions;[86] this is an unrealistic goal for water policies in a changing climate.[87] By contrast, the quantitative status objective for groundwater envisages a sustainable balance of groundwater formation and abstraction that is defined in the course of water management. This allows for adaptation to climate impacts such as water scarcity, provided that demand is controlled to ensure a balance between water supply and demand.[88]

The WFD contains an exemption regime that allows for flexibility in the substantive aims of the Directive and thus affords opportunities to accommodate the changing climate. Article 4(6) allows a temporary exemption from the no-deterioration principle on the basis of circumstances of exceptional natural cause or *force majeure*, such as extreme floods or droughts. In cases where changing environmental conditions or increasing pressures make the primary objectives unattainable, Member States can either extend the deadlines for reaching good status or set less stringent environmental objectives, options provided for in Articles 4(4) and 4(5).

Yet the use of the WFD's exemptions poses potential problems as a source of adaptive capacity in EU water management. First, climate-induced changes in natural conditions are not limited to floods and droughts but may include gradually evolving and enduring long-term changes in the baseline conditions of water ecosystems across the EU.[89] This type of deterioration is not recognised in the text of the Directive. Second, adapting water management objectives by setting less stringent objectives in the case of individual water bodies does not match the scale of environmental impacts that climate change will cause; these will affect every water body in Europe. Furthermore, if used extensively, invoking less stringent environmental objectives may cause water management within the EU to become fragmented, undermining the Union's ambitions.[90] Rather than allowing the extensive use of exemptions, the legislation should embark on a coordinated effort to revise the definition of 'good status' and its reference points to the changing hydrological conditions.

4.2.2 | Adaptation measures

RBMPs operationalise adaptive management in 6-year cycles,[91] setting learning as the core of the management process.[92] This entails gathering knowledge on water bodies and their uses,[93] compiling programmes of measures,[94] constant monitoring,[95] updating assessments[96] and revising the environmental objectives, exemptions and

[80]WFD (n 21) art 4(1).

[81]ibid art 13.

[82]EEA, 'The European Environment: State and Outlook 2020. Knowledge for Transition to a Sustainable Europe' (EEA 2019) 98–109.

[83]Commission (EU) 'Commission staff working document accompanying the White paper - Adapting to climate change: towards a European framework for action Climate Change and Water, Coasts and Marine Issues' SEC(2009) 386, 1 April 2009.

[84]RL Wilby et al, 'Risks Posed by Climate Change to the Delivery of Water Framework Directive Objectives in the UK' (2006) 32 Environment International 1043; Commission (EU) 'The Common Implementation Strategy for the Water Framework Directive and Floods Directive (CIS), Guidance Document No 24: River Basin Management in a Changing Climate' (2009) 9; EEA (n 83) 98–109.

[85]ST Puharinen, 'Good Status in the Changing Climate? Climate Proofing Law on Water Management in the EU' (2021) 13 Sustainability 517.

[86]WFD (n 21) Annex V, sections 1.2 and 1.4.1.

[87]Doremus (n 15) 59–63; Ruhl 2010 (n 12) 391–395; McDonald (n 15) 289; Puharinen (n 85).

[88]Puharinen (n 85).

[89]ibid.

[90]ibid.

[91]WFD (n 21) arts 11(8) and 13(7).

[92]See, e.g., J Söderasp, *Law in Integrated and Adaptive Governance of Freshwaters: A Study of the Swedish Implementation of the EU Water Framework Directive* (PhD Thesis, Luleå University of Technology) 51–55; C Pahl-Wostl, 'Adaptive and Sustainable Water Management: From Improved Conceptual Foundations to Transformative Change' (2020) 36 International Journal of Water Resources Development 397, 403.

[93]WFD (n 21) art 5.

[94]ibid art 11.

[95]ibid art 9.

[96]ibid art 5(2).

overall policy as new knowledge is gained.[97] The RBMP process requires Member States to identify all pressures on water status and put together the most suitable management measures based on updated scientific information.[98] In 2009, the Commission adopted a guidance document establishing key principles for accommodating climate change impacts in RBMPs. The guidance encourages the Member States to take measures that are viable under changing climate conditions and to anticipate and mitigate climate impacts.[99]

Article 11(3) of the WFD lists basic water management measures that the Member States are to include in their water policies.[100] These measures include the periodical review and updating of water use permits to accord with the Directive's objectives.[101] In 2015, the European Court of Justice confirmed that the WFD's environmental objectives are binding in individual permitting situations[102]; however, the objectives' legal weight in reviewing existing permits and non-permitted water uses is still unclear.

The EU Floods Directive complements the WFD by establishing a process for management of flood risks within the administrative structures of the WFD. The Floods Directive requires Member States to establish appropriate objectives for flood risk management and the measures for achieving them with a focus on prevention, protection and preparedness.[103] The 6-year cyclic management process includes a preliminary flood risk assessment,[104] preparation of flood risk maps[105] and compilation of flood risk management plans (FRMPs) for potentially high-risk areas.[106] However, the Floods Directive does not set any harmonised substantive objectives and standards for flood protection, a shortcoming that has been criticised as undermining its ability to increase flood resilience.[107]

The Floods Directive makes direct reference to climate change by stipulating that the preliminary flood risk assessment should be based on both existing records and studies on long-term developments, in particular the impacts of climate change on the occurrence of floods.[108] The Directive also highlights that the likelihood of such impacts must be considered when reviewing and updating flood risk assessments and FRMPs.[109] The substantive objectives and measures of FRMPs can be adjusted when updating these plans based on climate-related changes in hydrological regimes in different areas.

While the EU has taken legislative measures to enhance flood risk management, the risk of drought has failed to attract comparable attention in EU law. The Commission has instructed Member States to use the methodology and RBMPs afforded by the WFD to identify and reduce the impacts of droughts. The Commission's rationale here seems to be that drought risk management is closely linked to the environmental objectives of and measures required by the WFD.[110]

4.2.3 | EU law implementation in the Vuoksi River Basin

The WFD and Floods Directive have an international water law dimension. Within a transboundary river basin district, the WFD requires coordination of the programmes of measures between the Member States and urges the coordination of administrative arrangements with non-Member States.[111] The Floods Directive, for its part, aims for coordinated flood risk management planning with the Member States and non-Member States alike.[112] Transboundary RBMPs provide an opportunity for implementing the EU law requirements in transboundary setting.[113] All in all, the WFD may contribute significantly to the functioning of transboundary water cooperation and to compliance with international water law.[114]

Finland has prepared an RBMP for the Vuoksi River Basin.[115] In addition to other particulars, the RBMP for the period 2022–2027 describes the impacts of climate change on water resources and water status. It anticipates that water runoff, water flows and seasonal water levels—including ground water levels—are expected to change, and the impacts will delay the achievement of the good water status objective in the Vuoksi basin.[116]

The RBMP includes a range of climate change adaptation measures such as the monitoring of water status, development of lake regulation, risk management in water services, water protection measures in peat production and better storm water management.[117] However, while the RBMP includes a climate impact assessment—according to which the climate impacts of water management measures will be mostly neutral—the impacts of the RBMP on climate change adaptation are not specifically assessed.[118]

The Vuoksi River is designated as a heavily modified water body due to the impacts of the hydropower production in the river, these including barriers to fish migration and short-term flow regulation.[119]

[97] ibid arts 4(4)–(7), 11(8).
[98] A Garmestani et al, 'Untapped Capacity for Resilience in Environmental Law' (2019) 116 Proceedings of the National Academy of Sciences 19899, 19900; Pahl-Wostl (n 92) 406–407; Puharinen (n 85).
[99] Commission (n 83).
[100] L Baaner, 'The Programme of Measures of the Water Framework Directive – More than just a Formal Compliance Tool' (2011) 8 Journal for European Environmental & Planning Law 82, 84.
[101] WFD (n 21) art 11(3)(e)-(i).
[102] Case C-461/13 *Bund für Umwelt und Naturschutz Deutschland*, ECLI:EU:C:2015:433.
[103] Floods Directive (n 22) art. 7.
[104] ibid, art 4–5.
[105] ibid art 6.
[106] ibid art 7.
[107] Keessen and van Rijswick (n 5) 49; S Goytia et al, 'Dealing with Change and Uncertainty Within the Regulatory Frameworks for Flood Defense Infrastructure in Selected European Countries' (2016) 21 Ecology & Society 23; PPJ Driessen et al, 'Governance Strategies for Improving Flood Resilience in the Face of Climate Change' (2018) 10 Water 1595, 9–10.
[108] Floods Directive (n 22) art 4(2).
[109] ibid art 14(4). See Goytia et al (n 107).
[110] Commission (n 84) 93–95.
[111] WFD (n 21) art 3(4–5).
[112] Floods Directive (n 22) art 8(2)–(4)
[113] G Reichert, 'Europe: International Water Law and the EU Water Framework Directive' in SC McCaffrey et al (eds), *Research Handbook on International Water Law*. (Edward Elgar 2019) 397, 399–400.
[114] ibid 411.
[115] J Kotanen et al (eds), *Raportteja 20/2022: Vuoksen vesienhoitoalueen vesienhoitosuunnitelma vuosille 2022–2027* (Etelä-Savon elinkeino-, liikenne- ja ympäristökeskus 2022) (Vuoksi RBMP 2022–2027).
[116] ibid 55–56, 144.
[117] ibid 73–116.
[118] ibid 144–145.
[119] ibid 53. On the heavily modified water bodies and their environmental objectives and classification see WFD (n 21) art 4(3), 4(1) and Annex V.

The ecological potential of the river is classified as good, but the RBMP seeks to improve the living conditions of migratory fish in the river. Moreover, the plan states that the harmful environmental impacts of the short-term flow regulation practices of the hydropower stations, especially during droughts, are to be mitigated in cooperation with Russia.[120] Discouragingly, however, the RBMP does not address the relationship between the improvement of the ecological state of the river and climate change adaptation measures such as the adjustment of flow regulation.

With regard to flood risk management, the Vuoksi water basin does not include any designated high-risk flood areas although some flood risks are recognised in the RBMP. No FRMPs have been prepared for the area. Where flood risk management measures are concerned, the RBMP mentions lake regulation, nutrient loading reduction in agriculture, nature-based hydraulic solutions, land-use planning solutions and water retention measures. It is anticipated that these measures will have only a light effect on flood and drought risk management.[121]

The Vuoksi RBMP recognises the transboundary cooperation between Finland and Russia but does not ascribe any additional value to their bilateral collaboration. Essentially, the RBMP does little more than describe the cooperative arrangements between the two countries, including the regulation of Lake Saimaa and the Vuoksi River water flow.[122] Thus, given the meagre input of the EU-law driven Vuoksi RBMP, the Finnish-Russian cooperation is governed only under the transboundary 1964 Water Agreement and the Vuoksi Discharge Rule. The RBMP does not clarify whether Finland has sought the coordination of the WFD related administrative arrangements with Russia in the Vuoksi basin as required in the Directive.

Ultimately, the climate change adaptation requirements stipulated by international and EU law are executed at the national level. In the following section, we thus analyse the adaptive capacity of Finnish water law.

4.3 | Finnish water law

Finnish water law is divided between two main branches of regulation: (1) the Water Act,[123] which regulates water uses, and (2) the Environmental Protection Act,[124] which regulates changes in water quality, that is emissions and pollution.[125] Typical projects under the Water Act include impoundment, hydropower generation and water abstraction,[126] whereas the Environmental Protection Act ordinarily governs discharge of wastewaters from industrial operations and wastewater treatment plants.[127]

The Water Act and the Environmental Protection Act establish water and environmental permit systems. As regards adapting existing water uses to climate change, the key legal question at the national level is whether and to what extent permits can be revised to accommodate hydrological changes and weather extremes. The specific provisions of Finnish water law related to water uses—and thus the implementation of international and EU water law—rely on these environmental and water permit systems. Their capacity to adapt to changing hydrological circumstances and weather extremes is discussed in the following sub-sections.

4.3.1 | Climate change adaptation in water permits

The permits for surface water impoundment and water abstraction are two types of water permits that may need to be revised to adapt to changes in the climate and in hydrological circumstances. Impoundment projects in Finland rely on dams and levees to regulate river flows for hydropower generation and flood protection. An impoundment permit typically requires the permit holder to maintain river flows and water levels at and below the dam within a range specified in the permit under any hydrological circumstances.[128] The challenge is that these ranges may be based on outdated data in the same way as in the Vuoksi Discharge Rule. In the case of abstraction permits, changed hydrological conditions alter the amount of surface water and groundwater available for sustainable abstraction and equitable sharing of water resources.[129]

As an overarching principle, the Water Act maintains that a permit cannot be revoked or extensively adjusted without the consent of the permit holder.[130] Permits granted for hydropower operations and water abstraction are seen as signifying private ownership of the water areas, which is protected by the right to property in the Constitution of Finland.[131] Notwithstanding, the Act establishes a number of exemptions from the doctrine where slowly evolving hydrological changes and weather extremes are concerned.[132]

In the case of slowly evolving hydrological changes, two main legal avenues allow for reviewing permit conditions. First, the issuing authority may revise permit conditions if the project has detrimental impacts that could not be foreseen when granting the original permit. However, when 10 years have elapsed following the completion of the project, these revisions are limited: they cannot significantly reduce the benefit gained from the project, and the permit holder must be compensated for other than minor losses of benefit.[133] Second, a permit authority may revise permit conditions if there are frequent floods or droughts in the area concerned.[134] In addition, some

[120] Vuoksi RBMP 2022–2027 (n 115) 63.
[121] ibid 102–143.
[122] ibid 27.
[123] Water Act 587/2011.
[124] Environmental Protection Act 527/2014.
[125] P Vihervuori, *Environmental Law in Finland* (Wolters Kluwer 2021) 356.
[126] ibid 1041.
[127] ibid 358.
[128] Hollo (n 9) 347–364.
[129] Veijalainen et al (n 42).
[130] Water Act (n 123) chap 19, s 4. See N Soininen et al, 'Bringing Back Ecological Flows: Migratory Fish, Hydropower and Legal Maladaptivity in the Governance of Finnish Rivers' (2018) 44 Water International 321.
[131] The Constitution of Finland 731/1999 s 15. See Soininen et al (n 130).
[132] M Hepola, *Oikeusvoimaopin transformaatio* (Transformation of the estoppel doctrine) (Edilex 2005) 446–448.
[133] Water Act (n 123) chap 3, s 21; chap 19, ss 5, 7.
[134] ibid chap 3, s 21; chap 18, ss 3a, 6.

water permits, such as water abstraction permits, are typically issued for a limited time period, providing latitude in managing hydrological uncertainties.[135]

In hydrological emergencies, a State authority can take control of an impoundment operation and derogate from permit conditions to mitigate floods and droughts upstream or downstream from the dam. This legal avenue can be used only in exceptional circumstances to avoid significant harm to public or private interests.[136] In recent years, State authorities have been forced to resort to such mitigation measures with increasing frequency, a trend that has sparked discussions about whether permit conditions for flow regulation should be modified to better take into account changed hydrological circumstances.[137] For example, in the Vuoksi basin, the conditions of Lake Pielinen's flow regulation permit were modified in 2021 to allow for better mitigation of the impacts of floods and droughts, making derogations unnecessary.[138]

Overall, the Water Act can sufficiently accommodate the impacts of climate change in controlling impoundment projects in hydrological emergencies. Changing permit conditions to provide for long-term hydrological circumstances, however, is somewhat restricted by the doctrine of permanence that applies to projects when 10 years have passed following their completion. The doctrine constrains the capacity of the Water Act to adapt the existing water permits to climate change. And even where the permit conditions can be changed, the process takes a long time: in the case of Lake Pielinen, while the investigation to determine the required permit condition changes started in 2013, the decision to revise the permit was not taken until 2021.[139]

4.3.2 | Climate change adaptation in environmental permits

The permit system of the Environmental Protection Act incorporates some flexibility allowing the review of permits to deal with long-term hydrological changes and emergencies, for example, where excessive rainfall obstructs regular water treatment processes. Where anticipated long-term hydrological changes make a review of permit conditions advisable, the Environmental Protection Act stipulates that conditions can be revised if the environmental impacts of the project deviate from those detailed in the original application.[140] However, the lack of monitoring data and the lack of automatic permit review pose challenges in this regard.[141] Indeed, the public authorities may lack resources to collect and provide monitoring data and to call for a permit review as needed.

As regards hydrological emergencies, the Environmental Protection Act requires that operators plan for exceptional circumstances and that the permits include conditions for them.[142] Even when the permit holder has taken all feasible precautions, it may deviate from permit conditions for a limited period if exceptional circumstances arise. However, the operator must submit a plan to a State authority describing how it will resume normal operations; the authority then decides how long the deviation will be allowed.[143]

5 | DISCUSSION

Research and the different climate scenarios discussed in Section 2 clearly show that long-term hydrological trends have changed. The variability of hydrological cycles and the frequency and seriousness of weather extremes have increased and will continue to do so. Water law plays a central role in facilitating the adaptation that will mitigate the impacts of incremental hydrological changes and weather extremes to ensure, for example, services such as flood control, hydropower and drinking water production and the maintenance of water quality.

Our analysis paints a picture of how climate change adaptation is accommodated inconsistently at the different levels of water law from substantive and procedural perspectives. Some elements of climate change adaptation (i.e., the possibility to consider scientific knowledge in reviewing water uses) are incorporated in the legal designs of the global water conventions, EU directives and national permit systems, but at each level, the instruments contain both substantive and procedural shortcomings. While law nowadays contains some elements to making it possible to react to hydrological extremes, concrete legal procedures to adapt existing water uses to changing hydrological circumstances are largely lacking.

The Vuoksi case study clearly illustrates the challenges of water law in climate change adaptation. To date, the Finnish-Russian cooperative arrangement has provided substantive and procedural possibilities to flexibly adjust flow regulation and accommodate exceptional circumstances within the historical hydrological limits; however, these limits are becoming outdated due to long-term hydrological changes and should be revised if the countries are to avoid the frequent use of exception mechanisms and monetary compensation. The historical range-of-flow regulations and objectives that seek to preserve existing water uses should be updated. In the Vuoksi regime, the anticipated changes in long-term hydrological circumstances will not affect the legal regulation of existing water uses, which also makes it difficult to adapt these uses to shorter-term hydrological extremes. This lack of flexibility in the face of the projected hydrological changes may

[135] See, e.g., Finnish Supreme Administrative Court 13 April 2017 case 1711 (KHO 13.4.2017 t. 1711) concerning a water abstraction permit.
[136] Water Act (n 123) chap 18, s 4.
[137] Finnish Government Bill 87/2013 on the revision of the Water Act (Hallituksen esitys HE 87/2013 eduskunnalle laiksi vesilain muuttamisesta) 8.
[138] Eastern Finland Regional State Administrative Agency Decision No 34/2021 on 16 April 2021.
[139] ibid.
[140] Environmental Protection Act (n 124) s 89.
[141] A Belinskij and N Soininen, 'KHO:n Finnpulp-päätös (KHO 2019:166) ohjaa sopeutuvampaan lupien muuttamiseen ja yhteisvaikutusten hallintaan' (Case analysis of the Supreme Administrative Court Finnpulp decision KHO 2019:166: towards more adaptive permit changes and the management of cumulative impacts) Edilex 2020. <https://www.edilex.fi/artikkelit/20434>
[142] Environmental Protection Act (n 124) ss 15, 52.
[143] ibid s 123.

compromise the stability and effectiveness of the entire transboundary agreement regime between the two countries.[144]

The Finnish-Russian agreement regime has been highlighted by the Strategic Foresight Group as the prime example of well-functioning transboundary water cooperation.[145] However, as it stands, it does not reflect the flexible legal framework of the global water conventions, which enables States to review the uses of international water resources in step with changing hydrological circumstances and to react to weather extremes. In the global water conventions, the main substantive principle of equitable and reasonable utilisation requires States to balance the existing water uses with current and anticipated hydrological and climatic circumstances. Then again, the conventions cited do not include any specific procedural provisions on feedback loops to adapt water management and uses in the light of evolving knowledge. Such adaptations should be negotiated bilaterally or multilaterally between countries sharing international water resources.

The Vuoksi cooperation arrangement does not reflect the requirements of EU water law either. As noted, the Vuoksi RBMP does not provide much guidance on how the requirements of EU law should be implemented in transboundary water management. What is more, EU water law is substantively inconsistent in its own response to climate change. Although attaining the WFD's water quality targets is crucial for climate change adaptation if we are to avoid the loss of a host of the ecosystem services currently provided (e.g., good-quality water for drinking water abstraction), the environmental objectives of the Directive do not centre on adaptation per se. The key substantive challenge here is to reach what is a historically good ecological status of waters under changing hydrological circumstances.

The WFD system needs more flexibility if the environmental objectives for water management are to remain relevant in a changing environment. Currently, what substantive flexibility the Directive has is largely derived from the exemptions it allows, a mechanism that risks creating an excessively fragmented response within the EU. While the Floods Directive, for its part, requires the planning of flood risk management, it lacks substantive objectives and standards to buttress the process. On balance, EU water law does not provide much guidance to the Member States as to the specific measures needed to adapt to long-term hydrological changes or short-term weather extremes.

Procedurally, EU water law strongly supports adaptive water management through the 6-year planning cycles and monitoring requirements of the WFD and Floods Directive. As part of this framework, the WFD requires the member states to review water permits periodically—and as needed—to reach the relevant environmental objectives. Water management planning and permit reviews furnish EU law with a feedback mechanism to adapt water uses based on scientific knowledge.

In Finland, the legal challenge substantively is that existing water permits cannot be easily adapted to long-term hydrological changes due to the doctrine, described above, that upholds the permanence of water permits. The Water Act provides an unreasonably strong protection of property rights by demanding that the review of permit conditions cannot significantly reduce the benefit of the project to the permit holder and that the permit holder must be compensated for other than minor losses. The permanence of environmental permits is not as strongly protected. It should be noted, however, that the above-mentioned doctrine notwithstanding, Finnish water law allows flexible responses to exceptional circumstances, such as floods and droughts.

Procedurally, Finnish law does not provide any system to periodically review water and environmental permits. The competent authority needs to initiate a permit review and, in the general case, needs to compensate the permit holder for other than minor losses even if the review is required for climate change adaptation. In short, Finnish water law concentrates more on permitting single projects than on river basin-wide adaptive management.

All in all, one of the key problems is that water law and authorisations for different water uses are based on historical hydrological circumstances and geared towards protecting existing water uses and circumstances (e.g., a certain amount of water abstraction or particular river flows).

What water law should do is substantively allow—indeed require—changes to water uses based on the latest hydrological knowledge and provide procedures that support climate change adaptation (e.g., agreement and permit reviews). Climate change adaptation underscores the need to allow for flexibility in water law. Law needs to encourage the interaction of law and science by requiring that the monitoring and modelling data compiled on hydrological impacts be translated into revised plans and permits. The law itself must be able to change its standards and rules when they prove to be out of touch with the current climatic and hydrological realities.

Finally, pressures affecting water quality, such as land-based nutrient loading from agriculture, may intensify when hydrological conditions change. This contingency requires an array of norms and subsidies that are not traditional solutions to be found in water law; the scope of water law should be revised, especially at the national level, to encompass the management of cumulative impacts in addition to traditionally permitted activities.

6 | CONCLUSION AND A VIEW FORWARD

Water law is one of the key sectors of law that needs to create a strong legal basis for adaptation to climate change and the consequent changes to the hydrological cycle. Substantive and procedural flexibility are both important in water law if society is to adapt to long-term hydrological change, water cycle variability and weather extremes.

Our analysis shows that the different levels of water law include elements that facilitate adaptation of existing water uses. On the one hand, some of these elements will likely be insufficiently flexible as the hydrological impacts of climate change continue to intensify. On

[144]See Jafroudi (n 75) 718.

[145]See Strategic Foresight Group, 'Water Cooperation Quotient 2017' (Strategic Foresight Group 2017) 68.

the other hand, EU water law, for example, might even entail too much flexibility in that it fails to pursue a uniform approach to climate change adaptation in its implementation.

While water law today enables legal responses to the exceptional circumstances of floods and drought, adapting existing uses to long-term incremental hydrological changes is a major challenge in the light of the Vuoksi case and Finnish examples. The problem is both substantive and procedural in nature. In concrete terms, on the one hand, water law still widely highlights legal certainty and the permanence of existing uses as substantive principles; on the other hand, it lacks the necessary procedural feedback loops that would provide possibilities for changing existing water uses. Our analysis shows that legal mechanisms geared to exceptional circumstances are not functional if legal exemptions are needed on a regular basis.

The laws should be reinterpreted and redesigned with climate change in mind. The first step would be to prepare for a 'no-analoge' future, as suggested by Ruhl, one which requires modelling long-term change and constant monitoring of hydrological change in the short term. These data should feed into a legal process of water planning and management that does not seek to protect a certain historical hydrological equilibrium but rather allows adaptation to new circumstances. Water use permits and rights should be revised whenever hydrological circumstances have significantly changed or are about to change in the relevant timescale.

Interpreting and redesigning water law with climate change adaptation in mind requires changes at all levels. While global water conventions provide a flexible legal framework for cooperation between States, bilateral and multilateral water agreements should be reviewed with due consideration to changing hydrological circumstances. In EU water law, the historical water status against which the environmental objectives are measured should be reconsidered in the light of changing hydrological circumstances. In our national-level example, Finnish water legislation requires changes if it is to accommodate the anticipated changes in hydrological circumstances; what is needed are provisions that would facilitate a periodical review of impoundment, abstraction and pollution permits.

The Vuoksi case study illustrates that water law needs to approach climate change adaptation at the river basin scale and from an interdisciplinary perspective. Future water law should provide a well-functioning science-law nexus where water management is based on the evolving hydrological understanding of the impacts of climate change. Moreover, transdisciplinary research is needed in which insights by water managers and stakeholders are considered in developing climate change adaptation measures at the river basin level.

All in all, water law needs to have the substantive and procedural flexibility to facilitate adaptation to new hydrological circumstances rather than rigid provisions protecting the historical uses of waters from all change. Hydrological changes are upon us whether we like it or not. The present article has put forward a broad analysis of climate change adaptation in water law on multiple levels. Follow-up research is needed to determine what legal and legislative changes would afford the flexibility needed to successfully address the impending hydrological changes. Particularly salient would be a series of case studies in different river basin settings: investigating varying hydrological conditions could illustrate how water law may adapt to climate change and bring discussion of the challenges forward.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article, as no new data were created or analysed in this study.

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