HYDROECOLOGICAL CONNECTIVITY AS A NORMATIVE FRAMEWORK FOR AQUATIC ECOSYSTEM REGULATION: LESSONS FROM THE USA

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DECLARATION

I, William Russell Harding, hereby declare that the work on which this thesis is based is my original work (except where data processing assistance, under my guidance and direction was sought, detailed in my Methodology and Acknowledged) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university. I authorise the University to reproduce for research either the whole or any portion of the contents in any manner whatsoever.

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ABSTRACT

Very little has been achieved during the first five decades of development and application of what is now known as environmental law, in terms of slowing the global rate of biodiversity loss and ecosystem degradation. A major factor in this lack of effectiveness has been, perhaps, too narrow a focus on individual elements that exist within ecosystems, rather than on the health of the ecosystems themselves. Additionally, very little attention has been paid to maintenance of the integrity of the many types of connections that exist between the different components of ecosystems, notably aquatic ecosystems. These components are connected not only by water, but also by a variety of ecological connections and pathways — here termed 'hydroecological connectivity' (HEC). These connections are not only important in terms of providing abiotic and biota corridors between components, but they also act as conduits which can translocate pollutants from one location, over vast distances, throughout a fluvial ecosystem, consequently impacting virtually all areas of human life and nature.

This thesis outlines the science underpinning the first connectivity-based water law regulation, the American Clean Water Rule (CWR) and analyzes a set of legal challenges to this Rule. Barring one instance, no substantive merit was found for any of the disputed claims. Furthermore, this thesis identifies the transferability of the Rule to South Africa. It was possible to empirically substantiate the merit of the single instance that lacked appropriate qualification in the CWR.

The importance of HEC is elucidated in this work using the example of headwater streams which, in aggregate, comprise 79 per cent of the aggregate length of the mapped rivers in South Africa. Also provisionally evaluated is a brightline distance, lateral to fluvial watercourses, within which water resource components that are likely to be connected to the mainstem will be found. This provides a guideline for HEC-directed administrative decision making.

A connectivity-based approach to water resource governance will require limitations on some land uses on portions of land that is likely to be perceived as terrestrial but which, in fact, forms part of an aquatic ecosystem. This requirement raises obvious implications for property ownership and expropriation. Here the principles of the public trust, already legislatively expressed in South African water law, provide an institutional legal framework that renders 'public' any lands which form part and parcel of the integrity an aquatic ecosystem.

The public trust doctrine anchored the reform of the post-apartheid water law of South Africa. It was introduced in a transformative and emancipatory approach to the democratisation of the nation's water resources and the restoration of water equity. This work provides the first historico-legal and comprehensive perspective of the genealogy and intentions for, the public trust in South Africa, and distils out the principles which the trust embodies. An example protocol is developed which shows how the trust principles underpin the formulation of guidance for determinations of beneficial water uses.

Recommendations are made regarding the operationalization of the currently moribund South African public trust in water and highlights the role of the public trust as an effective and reformatory tool of water law.

In summary this work is a translational and transdisciplinary example of aquatic science into environmental law. The complex and challenging concept of HEC is communicated in plain language and then its perceived weak point — the need to isolate areas of land which form part of the aquatic resource and incorporate these within the trust *res* — is construed using the principles of the public trust doctrine. Simultaneously the potential of the public trust to offset obstacles to environmental protection, such as the need for reformed guidance for administrative decision making, has been highlighted. On this model the public trust enfolds an ecosystem-directed HEC approach into a transformative and normative governance package which is integrative, adaptive, multi-disciplinary and proactive.

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'Since it came to Earth, the water has been cycling through air, rocks, animals and plants. Each molecule has been on an incredible journey. When you feel alone, try to remember that at some point the water inside you would have been inside dinosaurs, or the ocean, or a polar ice-cap, or maybe a storm cloud over a faraway sea at a time when the sea was still nameless. Water crosses millennia and boundaries and borders.

Remember, we all have something in common, and that is the water that runs through us'.

Christy Lefteri, *Songbirds*
Penguin Random House 2021

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ATL	Atmospheric Trust Litigation
CBD	Convention on Biodiversity
CFR	Code of Federal Regulations
CSIR	Council for Scientific and Industrial Research
CWA	Clean Water Act
CWR	Clean Water Rule (2015)
DWAF	Department of Water Affairs and Forestry (now DWS)
DWS	Department of Water and Sanitation
EF	Environmental Flows
EFR	Environmental Flow Requirements
EU	European Union
FWPCA	USA Federal Water Pollution Control Act
GBO	Global Biodiversity Outlook
GHG	Greenhouse gas
HEC	Hydroecological connectivity
IFR	Instream Flow Requirements
IHI	Index of Habitat Integrity
IRES	Intermittent rivers and ephemeral streams
NEMA	South African National Environmental Management Act
NWA	South African National Water Act
NWPR	Navigable Waters Protection Act
NWPWP	South African National White Paper on Water Policy
NWRS	South African National Water Resource Strategy
PTD	Public Trust Doctrine
RCO	Res omnium communes
ROWSA	Rowing Organisation of South Africa
SA	South Africa
SANBI	South African National Biodiversity Institute
UCT	University of Cape Town
USA	United States of America
USACE	United States Army Corps of Engineers
WOTUS	Waters of the United States
WSA	South African Water Services Act
WUL	Water Use Licence
WWF	World Wildlife Fund

CHAPTER 1: INTRODUCTION

'Man lives from nature, ie nature is his body and he must maintain a continuing dialogue with it if he is not to die'[1].

I. Everything is connected to everything else

Akin to the capillaries, veins and arteries that comprise an integral, inter-connected flowpath for carrying vital, life-supporting blood through the tissues of the human body, so too do springs, streams, rivers, wetlands and groundwaters exhibit a fundamental, integrated 'water-mediated connectivity', conveying this essential element through terrestrial environments, from source to sea, and back via the hydrologic cycle (See Figure 1.1). Aquatic ecosystems, while essentially linear, also incorporate the lateral — between the channel and the adjacent terrestrial environments — and the vertical, downwards to the groundwater.[2] Layered across this inter-connected whole are a myriad of abiotic and biotic processes and interactions, which may or may not be water-mediated,[3] but which together comprise a functional aquatic ecosystem.[4] Ecologically-sustainable governance of aquatic ecosystems should, therefore, have express regard for this multi-dimensional natural reticulation system.[5]

The future of humankind depends on the intrinsic connections between human health, animal health and the functional integrity of the environment,[6] but also — often detrimentally — on the exploitation of its resources.[7] From an ecological perspective, a major failing of the prevailing economic mindset is that land is regarded as being merely a freely-exploitable factor

[1] Marx K (1844) 'Economic and Philosophic Manuscripts'. Downloaded on 30 May 2022 from https://www.marxists.org/archive/marx/works/1844/epm/index.htm.
[2] Seliger C & B Zeiringer (2018) River Connectivity, Habitat Fragmentation And Related Restoration Measures. Chapter 9 in *Riverine Ecosystem Management: Science for Governing Towards a Sustainable Future* (Schmutz S & J Sendzimir eds) Springer Aquatic Ecology Series.
[3] Many aquatic organisms disperse or migrate between habitats overland or by aerial routes.
[4] Craig S, Olden JD and AH Arthington et al (2017) 'Meeting the challenge of interacting threats in freshwater ecosystems: A call to scientists and managers'. *5 Elem Sci Anth*. Article 72. https://doi.org/10.1525/elementa.256
[5] Higgisson W, Higgisson B & M Powell et al (2019). 'Impacts of water resource development on hydrological connectivity of different floodplain habitats in a highly variable system'. *River Res. Applic.* 1-11; Reid MA, Delong MD & MC Thoms (2012) 'The influence of hydrological connectivity on food web structure in floodplain lakes'. *28 River Res. Applic.* 827-844; Steinfeld CMM & RT Kingsford (2013) 'Disconnecting the floodplain: Earthworks and their ecological effect on a dryland floodplain in the Murray-Darling Basin, Australia'. *29 River Res. Applic*. 206-218.
[6] Leopold A (1933) The conservation ethic. In: *The River of Mother Of God And Other Essays* (Flader and Callicott eds) 181-192.
[7] European Commission (2022) Proposal For A Regulation On Nature Restoration. COM(2022) 304 Final. Brussels 22 June 2022.

of production. More cynically, contemporary economic teachings regard land as 'all natural resources,' having 'no production cost, existing 'as a 'free gift' of nature'.[8] That this modality of thinking still pervades economic determinations is paradoxical when juxtaposed with environmental sociology and ecologically-sustainable development — despite it having been linked to ecological overshoot and consequently degraded ecosystems.[9] The social aspect of environmental problems cannot be ignored, and the need for ecological sidewalls to restrain inappropriate economic production is increasingly being advocated.[10] Recognition of the importance of ecosystems is increasingly being viewed as essential for overcoming many present-day ecological challenges.[11] An ecosystem approach requires that the operative focus be shifted from the object of regulation, for example a fish stock, to each individual component — and the temporal and cross-scale ecosystem processes — that underpin the very existence of the regulated object.[12] Another example here would be the general ineffectiveness of the technological objectives of 'pollution control', as opposed to objectives derived from criteria underpinning 'ecological conservation'. The latter is an example of what is termed 'translational ecology'[13] (= translational environmental science) — a concept which relies on scientists substantially augmenting how they communicate their science to other audiences. This thesis is an example of such an attempt to communicate the need for a new policy-relevant approach to water resource governance. In plain terms, if scientists wish science to lead the law, it is imperative that they communicate the value and 'implications and application[14]' of science, that is of relevance to actionable regulatory decisions, in plain language. This skillset is not only of relevance in communications between scientists and lawmakers, but particularly with administrative decision makers tasked with interpreting broadly expressed statutes and regulations.

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[8] McConnell C (1987) *Economics*. McGraw-Hill New York, at 672.
[9] Blignaut J and J Aronson (2020) 'Developing a restoration narrative: A pathway towards system-wide healing and a restorative culture'. 168 *Ecological Economics* at 3. Blignaut maintains that this strong anthropocentric economic view underpins neo-classical economic thinking in South Africa (email dd 30 May 2020, copy on file with author). South African contemporary economics teaching regards land (as 'natural resources') merely as one of four factors of production (eg Van den Bogaerde (1981) *Elements of Macro Economics*. Van Schaik Ltd. Pretoria. at 262.
[10] Costanza R et al (2015) Ecological economics and sustainable development: building a sustainable and desirable economy-in-nature. Chapter 18 in *Routledge International Handbook of Sustainable Development* (Redclift and Springett eds). At 284 et seq.
[11] eg De Lucia V (2017) 'Beyond anthropocentrism and ecocentrism: a biopolitical reading of environmental law'. 8 *Journal of Human Rights and the Environment* 181-202.
[12] De Lucia (Ibid).
[13] eg Adler RW (2020) 'Translational ecology and environmental law.' 50 *Envtl. L*. 703. See also Jasanoff S (1997) *Science at the Bar: Science and Technology in the USA*. Harvard University Press.
[14] Schlesinger WH (2010) 'Translational ecology' 329 *Science* 609.

Accumulation of wealth should, therefore, not be at the expense of harm to the systems that support renewable resources.[15] Ecologically-sustainable development depends, morally and ethically, on the preservation of natural capital within a socio-ecological context. The example utilised here is that of aquatic ecosystems, given the life-supporting role of water for all forms of life. The welfare of any or all water-dependent organisms is contingent on the effectiveness of an ecosystem-directed management approach.

Figure 1.1: The structure of the Dragon Blood tree (*Dracaena cinnabari*) provides an excellent visual analogy of a river catchment. Rain falls on the catchment (the leaves) and then collects in, and flows through a myriad of small to large streams (the branches), these confluencing into large rivers and ultimately the river mainstem (the trunk). (Image Credit: Shutterstock.)

Despite claims to the contrary,[16] this socio-ecological awareness is not new. In the mid-19th century Karl Marx recognized the complexity of humankind's interactions with nature in

[15] Foster JB (1992) 'The absolute general law of environmental degradation under capitalism'. 3 *Capitalism, Nature, Socialism* 77-81. Foster argues quite correctly that consumption cannot deplete those elements of nature necessary for the survival of the planet.
[16] De Wet C & ON Odume (2019) 'Developing a systemic-relational approach to environmental ethics in water resource management'. 93 *Environmental Science and Policy* 139-145. These authors maintain that there is a

his theory of metabolic rift. Furthermore, he was clearly attuned to the fact that if development was to be sustainable, it had in fact to be 'ecologically'-sustainable.[17] This thesis holds that if human health and survival is a function of the integrity of ecosystems, then 'sustainable development' as a term of phrase makes no sense absent ecological context. On this argument, users of land should only use it in an ecologically-responsible fashion.

Following the environmental devastation brought about by WWII, the notion of land as a 'community' — as opposed to a 'commodity' — of soil, water, plants, non-human animals and man led to the concept of a 'land ethic'[18] that limits land use[19] activities that are detrimental thereto.[20] A land ethic approach is deontological, ie it underpins a positive, moral and duty-based approach. It is a fundamental assumption of ecology that humans are morally accountable for damage caused to the environment.[21] Aldo Leopold's view was that a land ethic was 'a mode of guidance for meeting ecological situations so new or intricate, or involving such deferred reactions, the path of social expediency is not discernible to the average individual.'[22] As with Joseph Sax,[23] Leopold presciently foresaw the need for an ecology-based appreciation of land uses. The world now, eighty years later, faces burgeoning existential threats from these unattended challenges and will require a fresh look at what sustainability is all about. The public trust, land ethics and indeed other trust paradigms are regarded as overlapping and mutually-reinforcing in having a fundamental regard for intergenerational equity. A land ethic approach to environmental law can break down the barriers of 'anthropogenic single-mindedness' but it will take time to do so.[24]

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contemporary growing recognition of the role played by humans in socio-ecological systems, without acknowledging the existence of this awareness in the socio-political and economic realms for more than 150 years (eg Marx n1).

[17] Foster JB (1999) 'Marx's theory of metabolic rift: Classical foundations for environmental sociology'. 105 *AJS* 366-405. While South Africa has not qualified its legal definitions in this manner, others have, for example the 1991 New South Wales Protection of the Environment Act 60, Section 6.2.

[18] In ecological terms an ethic may be regarded as a limitation on freedom of action, essentially a mode of moral guidance. Leopold's use of the term 'land' encompassed the whole of a watershed, water and land, together with all things living in it. See Cooke et al (2021) 'Stewardship and management of freshwater ecosystems: From Leopold's land ethic to a freshwater ethic'. *Aquatic Conserv: Mar Freshw Ecosyst* 1-13 at 2.

[19] 'Land use' is taken here to mean 'human use of land'.

[20] Leopold A (1949) *A Sand County Almanac*. Library of America. In this book Leopold refers to 'wild and accelerating wastage' in South Africa, presumably referring to inappropriate land use practices.

[21] Glacken (1967) Cited in Keller DR (2019) *Ecology and Justice — Citizenship in Biotic Communities*. Springer Publishing.

[22] Leopold (1949) ibid. See also: Leopold AC (2004) Living with the land ethic. *54 Bioscience* 149.

[23] Progenitor of the environmental law era public trust. See Chapter 4.

[24] eg Karf JP (1989) Also 'Leopold's land ethic: Is an ecological conscience evolving in land development law'. 19 *Envtl. L* 737.

Within this ethical view resides the biopolitical role of water, an inorganic medium, a 'non-substitutable flow resource [that is] essential for life and ecological health, of deep spiritual and aesthetic significance, highly sensitive to pollution and a necessary input for industry, urbanisation and agriculture.'[25]

Although connectivity science started to gain traction in the 1990s, warnings were sounded much earlier, in fact contemporaneously with the advent of modern environmental law, that 'legislation which ignores the biospheric perspective or the complexity of the *landscape mosaic* is ultimately naive' (own emphasis).[26] This statement underscores the fundamental tenet of ecology that 'everything is connected to everything else', and further that the sustainable functioning of ecosystems is dependent on the integrity of this web of connections.[27] The corollary here is that an impact in, or on, one or more components will probably be translocated to others. It is, accordingly, heartening that connectivity-based thinking is increasingly being embedded in policy and planning initiatives. For example, these currently form the basis of the International Union for the Conservation of Nature's (IUCN) recent integrated planning objectives[28] and a key facet of ecological corridor restoration efforts for the Danube River.[29] The United States of America's Clean Water Rule (CWR)[30], provided the global-first example of a water resource regulation based solely on providing a sustainable assurance of HEC.

Hydrologic connectivity, defined as the water mediated transfer of matter, energy or organisms between components of a hydrosystem, is an 'ecological property'.[31] Emphasis must be placed on the fact that connectivity is more than that simply made possible by the presence or movement of water. Connectivity between water resource components is also mediated by, for example, organisms (insects, fish, amphibia, birds) moving overland using their own locomotion. The action of wind (aeolian transport) also facilitates the exchange of materials

[25] Bakker K (2012) 'Water: Political, biopolitical, material.' 42 *Social Studies of Science* 616-623.
[26] Likens GE & FH Bormann (1974) 'Linkages between terrestrial and aquatic ecosystems'. *24 BioScience* 447-456.
[27] Commoner B (1971) *The Closing Circle: Nature, Man and Technology*. AA Knopf, New York.
[28] Lausche B (2019). Integrated Planning. Policy And Law Tools For Biodiversity Conservation And Climate Change. Gland, Switzerland.
[29] *http://www.interreg-danube.eu/approved-projects/measures*
[30] The Clean Water Rule: Definition of "Waters of the United States" Final Rule. USACE 33 CFR Part 328; USEPA 40 CFR Parts 110, 112, 116, 117, 122, 230, 232, 300, 302 and 401.
[31] Pringle CM (2001) 'Hydrologic connectivity and the management of biological reserves: A global perspective'. 11 *Ecological Applications* 981-998. See also Pringle CM (2003) 'What is hydrologic connectivity and why it is ecologically important?' 17 *Hydrological Processes* 2685-2689.

between the landscape and bodies of water. It is, accordingly, proposed that HEC is a more appropriate and all-encompassing term of use.

(a) Ecological sustainability

'Ecological sustainability'[32] is substantively underpinned by ecosystem integrity, ie the maze of connections, links and processes that support ecosystem redundancy. Many species simply survive more easily within a connected network of ecosystems. In the context of water resource management, contemporary approaches typically strive to mimic equivalence of flows and timing determined as necessary to achieve a particular class of ecosystem health — wherein 'ecosystem health' denotes a combination of ecological integrity and societal values.[33] By contrast, the contemporary focus is often more about the instrumental value of the water, rather than on the ecosystem it comes from.[34] This disparity between instrumental and systemic appreciations of aquatic ecosystems is addressed hereunder.

What is extremely important for an ecological approach to environmental protection is that the moral commitment to protect should be motivated by the systemic worth, as opposed to instrumental value, of the system under consideration. This relates primarily to the condition of these adjacent areas and how that condition impacts on the adjacent river or stream. As will resonate throughout this thesis, the condition and integrity of a watercourse is a function of the condition and integrity of its catchment. Of course, for systemic worth to become a criterion or metric for aquatic ecosystem appreciation, there needs to be an established underpinning for a systemic-relational approach. Such an approach is deemed to be currently lacking in South African water resource governance.[35] This creates something of a mismatch between providing water for human needs and the economy, at the expense of water resources which are set in a particular class or category that is informed by economically-beneficial and instrumental mindsets.

[32] Ecological sustainability is the long-term viability of well-being of an ecological system, inclusive of human communities. eg Bosselmann K, cited in Collins L (2021) *The Ecological Constitution: Reframing Environmental Law*. Routledge New York. at 7 and n1.
[33] Meyer JL (1997) 'Stream health: incorporating the human dimension to advance stream ecology'.16 *J.N. Am. Benthol. Soc*.439-447.
[34] See Chapter 2.
[35] See de Wet and Odume (2019) n12. They describe a systemic-relational approach places primary emphasis on the value of socio-ecological systems and not on individual components. On this model each component has intrinsic value as supportive of other components and the value of the whole.

(b) Practical limits to an ecological approach

The effectiveness of an ecological approach in South Africa is deemed here to be limited by various factors, inter alia: First, ecology is not a 'taught science' at any level and no chartered association of professional, accredited ecologists exists. Environmental assessments are typified by various natural sciences acting separately (eg botany, limnology, soil morphology etc) — and their findings are generally evaluated separately. This silo approach conflicts with the principles of ecology and indeed with the land ethic 'community' vision. Ecology provides the 'connective linkages' between the various natural science disciplines. Very seldom are the findings considered and aggregated by an experienced ecologist, or indeed the assessment process facilitated by an ecologist. Second, the economic inequities that characterise the global south in general and South Africa in particular, place great pressure on development agencies to perhaps favour economic development over the needs of sustaining the environment.[36] There is, however, a nuance of imbalance here in that many developments, two of which will be highlighted infra, favour development that will only benefit the rich, rather than alleviate suffering of the poor. Third, the extent of infrastructure collapse, including in the water and wastewater fields, has reached pre-disaster proportions, aggravated by sustained drought in some areas and floods in others. Less than half of the 995 wastewater treatments are able to cope even marginally with their treatment challenges, with a lack in scientific and engineering skillset, together with financial resources, at the heart of the problem.[37]In short, South Africa is hampered by a lack of necessary skills, capital infrastructure and financial resources — especially in the rural areas. Fourth, there is a growing lack of trust in science, fuelled in no mean part by the 'fake news' assaults on climate change science and vaccines. Fifth, general levels of trust in government and inter-personal trust generally in South Africa are amongst the lowest in the world.[38] This, combined with poverty and corruption, pandemics and political instability results in new initiatives being treated with suspicion and cynicism — hampering efforts to entrain social cooperation in order to alleviate environmental justice imbalances.

[36] South Africa has suffered a decade of institutionalised corruption which has all but destroyed essential infrastructure and services (eg. electricity provision, water and wastewater treatment, railways, hospitals, education, security). *Judicial Commission Of Enquiry* ('Zondo Commission) into State Capture. Parts 1-IV (2021-2022).

[37] Green Drop National Report 2022. Department of Water and Sanitation.

[38] eg Inglehart R (1999) Trust, well-being and democracy. Chapter 4 in *Democracy And Trust* (Warren ME ed) Cambridge University Press. Moosa M and J Hofmeyr (2021) 'South Africans' trust in institutions and representatives reaches new low'. *Afrobarometer* Dispatch 474.

These limitations render a connectivity and trust principled regulatory approach all the more important.

II. Background to the problem

This thesis departs from the view that environmental law has not and is not achieving its envisaged goals. In this regard it supports the Oslo Manifesto for Ecological Law and Governance which states, *inter alia*, that:

> '[t]o overcome the flaws of environmental law, mere reform is not enough. *We do not need more laws, but different laws from which no area of the legal system is exempted*. The ecological approach to law is based on ecocentrism, holism and intergenerational and interspecies justice. From this perspective... the law will favour ecological interdependencies and and no longer favour humans over nature and individual rights over collective responsibilities (own emphasis).'[39]

Furthermore, that environmental law faces two simultaneous problems:

> First, '*reforming the tools at hand, to make them stronger and more sufficient*' and secondly, '*…building structures, institutions and rules sufficient for the transformative demands of [specific] problems*' (own emphasis).[40]

Drawing from the phrases in the quotations above, this thesis does not propose creating new or additional laws. Rather it is about the appropriate, practical and pragmatic re-rendering of existing laws and regulations that are better suited to the challenges at hand. In essence it is about '[reformulating] a scheme of property law that pays more attention to those parts of nature that are ultimately owned by the people collectively.'[41]

By the 1970s, ie just ahead of the emergence of what may be regarded as 'modern' environmental law and the 'sustainable development' discourse,[42] it was clear that, in an environmental context, a multitude of connections and processes characterise all ecosystems — moreover that these connections are not simple linear linkages, but encompass a complex and intricate fabric that supports functional redundancy.[43] Most importantly, this inter-

[39] Olso Manifesto for Ecological Law and Governance (2016) Oslo 21 June 2016.
[40] Perceival et al (2018*) Environmental Regulation: Law Science and Policy* (Eighth Edition) Wolters Kluwer (New York). at 2.
[41] Freyfogle ET (2011) Taking Property Seriously. Chapter 3 in *Property Rights and Sustainability* (Grinlinton and Taylor eds) Martinus Nijhoff Publishers, Leiden. at 57.
[42] ie following the 1972 UN Conference on the Human Environment.
[43] Commoner B (1971) n27.

connected fabric of resilience can act as both a shock-absorber or amplifier of impact.[44] A connectivity-based approach provides an effective counter to linear thinking which all too often regards singular events as entirely separate and deriving from a single cause.

This analysis employs the demonstrative example of enabling an assurance of the connectivity of aquatic systems — however the same broad context discussed here is adaptable to other ecosystem types.

Statistics on the ecological condition of natural freshwater resources paint a globally-dismal picture, compounded by a lack of relevant data which may reveal that the situation is considerably worse than is currently perceived.[45] Several leading legal scholars consider environmental law to have failed in its duty to halt and reverse the degradation of natural resource assets.[46] In South Africa, data compiled for the second National Water Resource Strategy (NWRS)[47] revealed 60 per cent of river ecosystems as being 'threatened', and with 25 per cent thereof being critically endangered, and with only fifteen per cent of these ecosystems located in protected areas. Furthermore, 65 per cent of wetlands are reported to be threatened, with 48 per cent critically endangered. As a single example, in the twenty years post-1997, fourteen per cent of the wetlands within the massive uMfolozi floodplain were converted to agricultural use, a change in land use which should no longer be happening in light of the contemporary understanding of wetland worth.[48] With respect to man-made lakes (reservoirs), as much as 76 per cent of raw potable storage is problematically enriched with nutrients, mostly derived from wastewater effluents.[49] With respect to estuaries, 39 per cent are critically

[44] This means, for example, that a relatively small impact at one location may have a substantially-greater impact somewhere else in the connected system.
[45] Towards a Worldwide Assessment of Freshwater Quality: A UN Water Analytical Brief (2016) UN Water. Downloaded from UN website, *www.unwater.org* on 27 March 2019.
[46] Wood MC (2009) 'Advancing the sovereign trust of government to safeguard the environment for present and future generations (Part 1): Ecological realism and the need for a paradigm shift'. 39 *Envtl. L* at 44.
[47] National Water Resource Strategy (NWRS, Edition 2*)* (2013) Department of Water Affairs, South Africa. at 9.
[48] Dlamini M et al (2021) 'A remote sensing-based approach to investigate changes in land use and land cover in the lower uMfolozi floodplain system, South Africa'. 76 *Transactions of the Royal Society of South Africa* 13-25.
[49] Harding WR (2015) 'Living with eutrophication in South Africa: a review of realities and challenges'. *Transactions of the Royal Society of South Africa. http://dx.doi.org/10.1080/0035919X.2015.1014878*.

endangered.[50] Singly or in aggregate, these data provide a grim audit of aquatic assets within an arid country whose climate will be severely altered by global warming.[51]

By comparison, the USA's 2017 National Water Quality Inventory Report[52] for the period 2004 - 2009 provides a similar picture: Forty-six per cent of rivers and streams were in a poor biological condition; 26 per cent of lakes, ponds and reservoirs were significantly nutrient enriched (hypereutrophic), and 32 per cent of wetlands were deemed to also be in poor biological condition. While the indicators used are not directly comparable with the South African data (separate data for the arid American west would be insightful here), the general levels and trends of aquatic resource impairment are clear. With respect to wetlands, it is significant to note that the USA's wetland 'no net loss' policy, irrespective of some in-built accounting flaws, reduced wetland loss from 290 000 acres per year in the 1980s, to almost zero by 2009.[53] No comparative wetland loss/gain data are available for South Africa.

The summaries of conditions in South Africa and the United States are by no means isolated examples. Human pressures are forecast to dominate pressure on aquatic ecosystems for the foreseeable future.[54] In the European Union (EU), by 2015 only 41 per cent of waters reflected 'good' or 'high' ecological status.[55] Aquatic ecosystem degradation portends globally the warning to humanity, first issued in 1992, that 'a great change in [mankind's] stewardship of the Earth and the life on it is required if vast human misery is to be avoided.' This warning has not been heeded. A re-evaluation of the 1992 warning 25 years later has revealed that 'humanity has failed to make significant progress... in solving foreseen environmental problems... and... most of them are getting far worse '.[56] The Living Planet Index (LPI) for the freshwater realm fell by 83 per cent between 1970 and 2014, four-times greater than the

[50] South Africa's Fifth National Report to the Convention on Biodiversity. March 2014. Downloaded from *www.cbd.int* on 27 March 2019.
[51] Scholes B, Scholes M & M Lucas (2015) *Climate Change: Briefings from South Africa*. Wits University Press, Johannesburg.
[52] National Water Quality Inventory: Report to Congress. USEPA August 2017.
[53] Dahl TE (2011) Status and Trends of Wetlands in the Conterminous United States 2004-2009. United States Fish and Wildlife Service. Report to Congress; Gardner RC, Zedler J and A Redmond et al (2009) 'Compensating for wetland losses under the Clean Water Act (Redux): Evaluating the Federal Compensatory Mitigation Regulation'. *38 Stetson L. Rev*. 213. Here it should be noted that loss of natural wetlands can be offset by artificial systems, ie the latter unlikely to be ecologically comparable with what they replaced.
[54] Bunn SE (2016) 'Grand challenge for the future of freshwater ecosystems'. 4 *Front. Environ. Sci*. at 1.
[55] Similar scales of aquatic ecosystem degradation have been reported for Central and Eastern Europe eg Filipe AF, Feio MJ and A Garcia-Raventós et al (2018) 'The European Water Framework Directive facing current challenges: Recommendations for a more efficient biological assessment of inland surface waters'. 9 *Inland Waters* 95-103.
[56] Ripple WJ, Wolf C and TM Newsome (2017) 'World scientists' warning to humanity: A second notice'. *67 BioScience* 1026-1028.

comparable index for terrestrial populations.[57] Australia and South Africa are often compared due to both being southern hemisphere arid climes. Australia's State of the Environment reporting for the period 2016-2021 reveals a massive scale of environmental degradation as a result of climate change, habitat loss, invasive species, pollution and resource extraction — with 'competition for land resources' a key exacerbating factor.[58]

The sheer number of environmental laws, norms and standards notwithstanding, freshwater ecosystems are, in a global context, in a dire and worsening state. Aquatic issues cannot be seen in isolation from the converging crises of climate change, biodiversity loss and/or pressures to offset economic inequality by condoning environmentally damaging development. This fact strongly suggests that those tasked with the governance of these assets are not yet awake to the sustained issuance of warnings and alerts about aquatic ecosystem degradation.[59]

(a) Connectivity as a fundamental maxim of aquatic ecosystem governance

The integrity of an aquatic ecosystem, or any ecosystem for that matter, cannot be maintained if sustained and damaging abuse occurs to one or more of the components that comprise its physical, chemical or biological functionality. Importantly, such impacts in aquatic ecosystems do not occur in spatial isolation — their inherent connectivity results in the real risk of impacts being translocated from where they occur to their upstream, lateral and/or downstream environments. International assessments have stressed the need for 'increased protection and connectivity of freshwater ecosystems' as a means to offset anthropogenic fragmentation of linear lotic environments.[60] A failure to account for the interconnected nature of 'stream networks' has been identified as being problematic in the EU[61] and, as stressed by Tarlock *infra*, a quarter of a century ago, is a primary factor in the failure of freshwater ecosystem protections. All of these admonitions simply call attention to why connectivity is important.

[57] Reid AJ, Carlson AK & IF Creed et al (2019) 'Emerging threats and persistent conservation challenges for freshwater biodiversity'. *94 Biol. Rev*. 849-873.
[58] 2021 (Australian) State of the Environment Report. Downloaded from soe.dcceew.gov.au on 19 July 2022.
[59] The recent statements by the Stockholm+50 movement attest to this concern eg Spinosa MF (2022) 'Can Multilateralism Rise to the Moment for Stockholm+50'. https://www.pathway2022declaration.org/article/can-multilateralism-rise-to-the-moment-for-stockholm-50. Downloaded on 7 February 2022.
[60] IPBES. 2019. Global Assessment Report On Biodiversity And Ecosystem Services Of The Intergovernmental Science- Policy Platform On Biodiversity And Ecosystem Services. Brondizio ES, Settele J, Díaz S, and HT Ngo (eds). IPBES Secretariat, Bonn, Germany. Table SPM-1 and s39.
[61] Felipe et al (2018) 'The European Water Framework Directive facing current challenges: Recommendations for a more efficient biological assessment of inland surface waters'. *9 Inland Waters* 95-103. at 99.

What is lacking are efforts to provide substantive guidance on how to provide an assurance of connectivity.

Diligent governance of aquatic ecosystems should consider their integrally connected nature, as opposed to any reliance on a discrete spatial focus. Critically, it is human activities that reduce and/or degrade lateral connectivity.[62] There is no escaping the fact that environmental alteration, land fragmentation and land use changes are the primary causes of biodiversity loss and ecosystem degradation. While the organic or biospheric relationships between terrestrial and aquatic environments have long been apparent to landscape ecologists, this understanding has been less apparent within other disciplines, particularly the importance of lateral connectivity of fluvial hydrosystems[63] to their adjacent terrestrial realm. Additionally, this awareness is assumed to be generally lacking amongst non-expert administrative decision makers adjudicating water use proposals. Moreover, lateral considerations frequently do not extend beyond the alluvial floodplain, potentially excluding isolated aquatic environments as discussed in Chapter 2.

(b) The Clean Water Rule: A brief introduction

The United States Clean Water Act[64] (CWA) provides the foundation for federal water resource protection in the United States of America (USA). International water law, and the water laws of many countries, are acknowledged as being grounded in the United States experience.[65] A similar foundational reliance on the European Union's Water Framework Directive also can be discerned.[66] The objective of the CWA is to 'restore[67] and maintain the chemical, physical and biological integrity of the nation's waters'. This description equates with the central goal of sustaining 'ecosystem condition'[68], viz the 'physical, chemical and biological condition or quality of an aquatic ecosystem at a particular point in time,' and aligns with the

[62] Besacier-Monbertrand A-L, Paillex A & E Castella (2012) 'Short-term impacts of lateral hydrological connectivity restoration on aquatic macroinvertebrates'. *30 River Res. Applic*. 557-570.
[63] Streams and rivers.
[64] Federal Water Pollution Control Act 33 U.S.C. (1972).
[65] Tarlock AD (1996) 'International water law and the protection of river system ecosystem integrity'. 10 *Brigham Young University Journal of Public Law* at 186. Tarlock discusses at length the US experience with accommodating 'multiple use' approaches to water resources and how this understanding has expanded globally.
[66] Directive 2000/60/EC of the European Parliament and of the Council. 23 October 2000. See Giakoumis T & N Vouvoulis (2018) 'The transition of EU Water Policy towards the Water Framework Directive's Integrated River Basin Management Paradigm'. 62 *Environmental Management* 819-831.
[67] Restoration of not only linkages but also the connected sub-ecosystems themselves is vitally important.
[68] Maes et al (2018) Mapping and Assessment of Ecosystems and their Services: An Analytical Framework for Ecosystem Condition. Publications Office of the European Union. Luxembourg.

'ecosystem approach' principles of the Convention on Biological Diversity (CBD)[69] — the 'interpretation and application of the ecosystems approach... now incorporated into all CBD programmes...'.[70] The ecosystem approach is also a foundational aspect of the Convention on International Watercourses.[71]

The CWA is overtly 'ecosystem orientated'. The first, defining, sentence of the Act speaks to ensuring the *'chemical, physical and biological integrity*' of the Nation's waters. A detailed analysis of the Congressional record and intent[72] reveals that the original intention was indeed ecosystem-orientated. One of seven goals listed in the Act lists '...an interim goal of water quality which provides for the protection and propagation of fish, shellfish and wildlife...'. This goal is rendered an operative provision by s303(c) of the Act. Furthermore, the Act speaks to the prevention of 'pollution' — defined as the 'man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of the water' — language which clearly speaks to more than mere pollutants and aligns with the aforementioned goal. Moreover, examination of the genealogy of the Act, again via the records of the House of Representatives and/or the Senate, reveals that the legislators intended the Act to apply to aquatic ecosystems. This turns on how they viewed the concept of biological integrity:

> 'Maintenance of such integrity requires that any changes in the environment resulting in a physical, chemical or biological change in a pristine water body be of a temporary nature, such that by natural processes, within a few hours, days or weeks, the aquatic ecosystem will return to a state functionally identical to the original.'

&

> furthermore, '... that it should be national policy to take those steps... *which will maintain a healthy environment and provide for a stable biosphere essential to the well-being of human society*' (own emphasis). [73]

The legislators' clear intentions and prescient awareness of anthropogenic damage to the environment, for an ecosystem approach for the CWA is finally confirmed by:

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[69] Grizzetti B, Liquete C & A Pistocchi et al (2019) 'Relationship between ecological condition and ecosystem services in European rivers, lakes and coastal waters'. *671 Science of the Total Environmen*t 452-465.
[70] Brels S, Coates D & F Loures (2008). Transboundary Water Resources Management: The Role Of International Watercourse Agreements In *Implementation Of The CBD*. CBD Technical Series no. 40, at 22.
[71] Convention on the Law of the Non-navigational Uses of International Watercourses (1997). Articles 20 and 22 recognise the ecosystem nature of watercourses.
[72] Adler RW (2009) 'Freshwater: Sustaining use by protecting ecosystems.' 33 *Envtl. L.* 29-77.
[73] S Rep No 92-414 (1972) at 76 (sourced from 1972 U.S.C.C.A.N. 3678-79).

> *'The word "integrity" as used is intended to convey a concept that refers to a condition in which the natural structure and function of ecosystems is maintained'. 'This definition is in no way intended to exclude man...[but] man has exceeded nature's homeostatic ability to respond to change*' (own emphasis).[74]

The CWR was added to the lexicon of the CWA in June 2015. This definitional regulation,[75] was formulated in direct response to thirty years of case law disputes, a lack of clarity in various guidelines and calls from the courts and the regulated community for clarity as to which 'Waters of the United States' (WOTUS) were federally regulated.[76] The outcomes of a trilogy of cases, seminally the now notorious *Rapanos v US*,[77] engendered much controversy by expanding and then substantially narrowing the notion of connectivity.[78] This contestation occurred despite the legislative history of the CWA showing a clear intention for all waters of the USA to be federally regulated.[79] It also occurred despite clear indication that all components of aquatic ecosystems are integrally connected and not only via visible, unbroken surface water. On a positive note, a dissenting opinion in *Rapanos* introduced the concept of 'a significant ecological/hydrological nexus between waters', a concept that spawned the connectivity-based foundation for the CWR.[80]

Given that river systems may be regarded as globally generic insofar as their fundamental governance needs are concerned, the scientific underpinnings and procedural rigour that characterised the formulation of the CWR provided much-needed guidance which, being solely definitional could, *mutatis mutandis*, be integrated transnationally into any set of water resource regulations. South African water law, currently lacking any comparable detail or connectivity underpinning would, in all probability, be substantially augmented by incorporating a CWR-type approach. Furthermore, the NWA uniquely provides a public trust underpinning which, as will be demonstrated, holistically enfolds all the components of aquatic ecosystem, terrestrial and aquatic, into a single integrated and accommodating regulatory mechanism.

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[74] H.R. REP No 92-911 at 76-77 (1972).
[75] The regulation does not establish any regulatory requirements.
[76] See Chapter 3.
[77] *US v Riverside Bayview Homes Inc*. 474 U.S. 121 (1985); *Solid Waste Agency of Northern Cook County* 531 U.S. 159 (2001); *Rapanos v US* 126 S. Ct 415 (2006).
[78] See Chapter 3.
[79] S. Conf. Rep. 92-1236 at 144, cited in Sapp, WW, Starr TL and MA Burdette (2006) 'From the fields of Runnymede to the Waters of the United States: A historical review of the Clean Water Act and the term "Navigable Waters" '. *36 Environmental Law Reporter* 10190.
[80] See Chapter 3.

Given the foregoing it would be reasonable to assume that the advent of the CWR would have been a welcome addition to the CWA. This was, however, far removed from the reality as promulgation of the rule met with numerous legal challenges from, *inter alia*, states, industry foundations, housing developments, and agriculture and mining lobbies. The rule was subsequently stayed by Executive Order of the Trump Administration in 2017, and has become the focus of a live controversy, comprising ongoing legal challenges.[81] Proposed revisions to the rule that are predicted to continue until at least November 2023 or beyond.[82] The reasons behind why this resistance has been so epidemic provides a unique and seminal opportunity to understand just how various sectors of the regulated community have construed the scope and intentions of the CWR, insofar as these pertain to the science-informed connectivity-basis for ensuring the physical, chemical and biological integrity of the resource. The focus here, however, is on the CWR as originally formulated, as a seminal example of a regulation founded on HEC.

The CWR provides an, as-yet, unparalleled example of definitional clarity intended to protect aquatic ecosystems based on sustaining their inherent connectivity. It is trite that for environmental law to be effective, it must keep pace with contemporary scientific understanding. Nowhere has this been more evident in recent years than in the arena of climate change where, despite clear, scientifically underpinned warnings anchored in empirical observations — and latterly by visual proof from heatwaves, fires and floods — binding international agreements remain elusive. As does climate change science, the CWR employed evidence-based science to provide clarity in the regulation of the ecological infrastructure — streams, rivers and wetlands — that store and/or convey an essential, irreplaceable natural asset, water. Furthermore, a connectivity focus speaks to the ecological corridor role provided by river networks[83] — expressed here as 'rivers being wider than they seem.' However, it is probable that the CWR regulation would be inimical to, for example, the US oil and gas industry — currently engaged in disputes over linear pipeline projects that propose to ferry toxic fossil fuel derivatives across many hundreds of streams, rivers and wetlands, over

[81] For example: *Washington Cattlemen's Association v USEPA et al*. 2:19-cv-00569. Filed 16 April 2019. Discussed in Chapter 3.
[82] Porter JR (2022) 'EPA follows the first rule of holes in its eighth attempt to determine the reach of the Clean Water Act'. National Law Review 22 June 2022. Downloaded 3 July 2022. https://bit.ly/3yDc7JV
[83] Rinaldo A, Gatto M & Rodriquez-Iturbe (2018) 'River networks as ecological corridors: A coherent ecohydrological perspective'. *112 Advances in Water Resources* 27-58.

thousands of kilometers.[84] The advent of the CWR, had it become a legal reality, meant that every intersection of the pipeline with an aquatic habitat would have required evaluation.

It may be assumed that the nature of the resistance to the CWR is likely to be as generic as are rivers and streams. Accordingly, similar tensions and challenges could arise, *mutatis mutandis*, in any country where a similar regulation might be proposed, not least in South Africa. The challenges to the CWR were broadly three-fold: (a) procedural/jurisdictional disputes; (b) contention with apparently incontrovertible science; or (c) issues pertaining to the regulation of aquatic ecosystems on private lands. The latter two aspects are relevant to this analysis of the role that a connectivity-based regulation could play in South Africa.

Related to the issue of providing an assurance of ecosystem integrity and functioning founded on connectivity and, given that attempts to regulate this met significant opposition, the burning question arises whether an existing legal doctrine can provide an institutional framework for oversight and protection. In this regard this analysis, while drawing lessons from the CWR, adds the potential of the Public Trust Doctrine (PTD)[85]. The principles of the PTD are considered here as being the enfolding of an ecosystem approach into water resource governance. Further will be argued that, while the NWA centrally embodied the PTD as the backbone of South African water law, water resource protection tools overtly anchored in trust principles have yet to emerge, rendering the expression of the trust moribund. To demonstrate the potential of the PTD in this regard, the intentions behind placing the trust into the NWA are explored, the underpinning principles are elucidated and then applied to an example of protecting the integrity of headwater streams.

(c) Protecting aquatic resources using the Public Trust Doctrine

(i) Necessary background concepts

Before proceeding to a brief overview of the role that the public trust can play to protect water resources, it is necessary to introduce to concepts that have spatial implications for how aquatic resources should be comprehended.

[84] Bruderly LM & GE Steinbauer. Water law update: Recent developments expected to affect the natural gas industry. PIOGA Press (November 2018). Downloaded from *www.babstcalland.com* on 27 June 2019.
[85] This was not an option for the federal CWR as the PTD only exists in State-level law and constitutions in the USA. Of course it would devolve to the prerogative of state legislatures to utilise their version of the PTD had the CWR not been remanded.

A concept of water resource 'domains'

Water resources occur within spatially-variable 'domains' which may include elements of surface water (streams, rivers, wetlands, lakes), groundwater (seeps, hyporheos) *and include* areas of land adjacent thereto, eg riparia. The outer boundary of a water resource domain may not be as visually simple as a riverbank, but rather may be quite nebulous in terms of being able to delineate where the aquatic ecosystem ends and terrestrial land begins. This is a limiting aspect in terms of being able to discern the true extent of resource flows — highlighting the paramount need for regard for connectivity between all parts of the domain.[86] Accordingly, having regard for water resources as domains highlights the need to consider land beyond an obvious wet/dry edge.

The nature and role of 'ecotones'

The aforementioned 'nebulous' fringes around or adjacent to watercourses are termed 'ecotones'. It is within these zones that the transition from aquatic to terrestrial occurs, either vertically, laterally or a combination thereof. From the definition[87] it will be immediately apparent that delineation of ecotones will be extremely difficult, if not practically or pragmatically impossible. This entrains the need for an empirically defined zone within which such transitional connections are likely to occur.[88] Water resource components and their ecotones are located within the boundaries of a particular water resource domain.

Movement or migration pathways across ecotones fall into five categories, as listed below, moving between:

1. Surface waters of the channel and the floodplain;
2. The channel and contiguous aquifers;
3. The channel and the riparian zones;
4. The floodplain surface and the vegetation canopy;
5. The floodplain surface and the uplands.[89]

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[86] See Chapter 2.
[87] Verry S et al (2004) 'Riparian ecotone: A functional definition and delineation for resource assessment'. 4 *Water, Air and Soil Pollution: Focus* 67-94. Riparian ecotones are a three-dimensional space of interaction that include terrestrial and aquatic ecosystems that extend down into the groundwater, up above the canopy, outward across the floodplain, up the near-slopes that drain to the water, laterally into the terrestrial ecosystem, and along the watercourse, at a variable width.
[88] See Chapter 3.
[89] Ward JV et al (1998) 'The boundaries of river systems: the metazoan perspective'. 40 *Freshwater Biology* 531-569.

Any or all of these routes needs to be considered if, for example, vegetation removal is planned which might impact on a life-cycle stage under pt 4 above.

(ii) The need to protect water resource domains

A significant proportion of the damage to aquatic ecosystems may arguably be likely to occur on land which is privately owned and/or divorced from general public scrutiny (see Figures 1.2 & 1.3).

Figure 1.2 Example of a private landowner allowing waste to be dumped into a valley near Durban. (Image Credit: The Bateleurs)

Fulfilling the goal of protecting aquatic resources frequently entails declaring corridor areas or creating ecological buffers alongside streams or around wetlands, or between wetlands and a river or stream. Such actions may be perceived to impose, from a land use perspective, a virtual sterilisation of such portions of adjacent or intervening land, which may not be overtly or visually perceived as 'aquatic', yet are absolutely essential to ensuring the integrity of the aquatic ecosystem.[90] As such, while the land itself is not severed from private ownership, the nature of the use thereof should be subject to regulatory measures

[90] See Chapter 4.

necessary to ensure ecosystem integrity. A common example of this is the restriction of development within lands subject to flooding.

A brief snapshot of the role of the public trust doctrine

The PTD, firmly ensconced in post-apartheid South African water law[91] and anchored in Section 25 of the Constitution[92] is not encumbered by issues of compensation. Significantly, this legislatively expressed doctrine, wherever it is deployed, is founded in the common law and with the state as trustee, appears to stand immune to being trumped by statutory law. In one view it is seen as '... sacrosanct, holding a power beyond modification or revocation by legislative action'.[93] As such the PTD foreshadows an extremely powerful and principled bulwark against harms to aquatic ecosystems.[94]

[91] Section 3 of the National Water Act (Act 36 of 1998) reads as follows:

3. Public trusteeship of nation's water resources.

(1) As the public trustee of the nation's water resources the National Government, acting through the Minister, must ensure that water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner, for the benefit of all persons and in accordance with its constitutional mandate.

(2) Without limiting subsection (1), the Minister is ultimately responsible to ensure that water is allocated equitably and used beneficially in the public interest, while promoting environmental values.

(3) The National Government, acting through the Minister, has the power to regulate the use, flow and control of all water in the Republic.

[92] Constitution of the Republic of South Africa 1996. Section 25(2) provides for the expropriation of property in the public interest, bolstered by 25(8) which empowers the state to take such measures as deemed necessary to 'achieve land, water and related reform'... to 'redress the results of past racial discrimination', ie the primary aim of the inclusion of the PTD as a foundation for the reform of South African water law.

[93] Takacs, D (2008) 'The Public Trust Doctrine, environmental rights and the future of private property'. *16 N.Y.U Envtl. L.J.* At 715.

[94] See Chapter 4.

Figure 1.3: Previously natural stream which has been completely overtaken by an informal settlement, the polluted runoff and litter from which are accumulating in the watercourse. (Image Credit: The Bateleurs)

Joseph Sax, the progenitor of the modern public trust doctrine and who contributed directly to the inclusion of the trust covenant in the NWA, crafted three conceptual principles as the underpinnings of the PTD in the United States of America and, indeed, wherever it may be deployed in law or regulation:[95]

1. 'certain interests are so intrinsically important to every citizen that their free availability tends to mark the society as one of citizens rather than of serfs';
2. 'certain interests are so particularly the gifts of nature's bounty that they ought to be reserved for the whole of the populace';
3. 'certain uses have a peculiarly public nature that makes their application to private use inappropriate'.

In this context 'certain interests' refers to the sustainable protection of renewable natural resource 'commons' such as water, the atmosphere and soil. Sax was principally concerned with private landowners despoiling ecological resources which should be protected by custodial

[95] Sax J (1970) 'The Public Trust Doctrine in natural resource law: Effective judicial intervention'. *68 Mich. L . Rev* at 484.

public ownership. Here Sax found the PTD to provide a procedural right to challenge the actions of state agencies that violate their duty to protect such resources.[96] These interpretations are particularly relevant given that the USA application of the PTD and its judicial interpretation in cases such as *National Audubon*[97] served as role model for its integration into the extant policy and water law of South Africa.[98]

Importantly, water resource custodial issues are cross-cutting at state level, not limited to one department. In this context the PTD elevates the protection of natural assets such as water to government level, *rendering all state departments and actors as trustees*, not just the department whose brief is that of water resource management (own emphasis).

Perhaps the best summary of the intended dual role of the public trust inclusion in the NWA has been that by David Takacs — who refers to the 'disinterment' of the trust and its dual application, first as an emancipatory tool of democracy to make water available to all citizens, as well as to provide for ecosystem health.[99] Takacs casts the former in terms of equity and the latter in those of ecology. Hitherto, attempts at in-depth interrogation of what the PTD does or could mean for the development of environmental law in general, and water law in particular, in South Africa has been brief and speculative (see Chapter 5). The potential of the PTD to anchor liability for the 'legacy' damage to the environment arising from acidic mine (effluent) drainage (AMD) has been questioned.[100] US case law provides a clear answer to this issue:

> ′[t]rustees have an affirmative duty to recoup monetary damages against third parties that destroy trust assets' and to 'the sovereign must pursue damages in order to make the public — the beneficiaries — whole again and to restore the asset for future generations'.[101]

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[96] Sax J (1970) ibid at 498.
[97] *National Audubon Society v Superior Court of Alpine County* 658 P.2d 709 (Cal). See Chapter 4.
[98] Stein R (2005) 'Water law in a democratic South Africa: A country case study examining the introduction of a public rights system'. *83 Texas Law Review* 2167. Stein cites a dictum from *Audubon* where the court held that '[an] integrated system of preserving the continuing sovereign power of the state to protect public trust uses, a power which precludes anyone from acquiring a vested right to harm the public trust, and imposes a continuing duty on the state to take such uses into account in allocating water resources' which provided an underpinning for the South African regulatory framework necessary to give effect to constitutional obligations. at 2173/4. See Chapter 5.
[99] Takacs D (2016) 'South Africa and the human right to water: Equity, ecology and the public trust doctrine.'34 *Berkeley J. Int'l L.* 55. The role of the public trust in the NWA is analysed in Chapter 4.
[100] Feris L (2012) 'The public trust doctrine and liability for historic water pollution in South Africa'. *LEAD* 8/1.
[101] Wood MC (2009) op cit n39 at 97. Here Wood cites inter alia *City of Bowling Green* 313 N.E. 2d at 411 but notes that there may be tension between statutory and common law on this issue.

A recent body of scholarship has been developed which examines the role that the PTD could play in the protection of South African biodiversity.[102]

> 'The [PTD] has been explicitly included in South Africa's Constitution and environmental legislation. Despite its existence there for over 20 years, it has enjoyed little prominence in academic discourses and judgments taken by the judiciary. The rapid loss of biodiversity at a species and habitat level, highlights *the need to rediscover the doctrine as a means of enabling both the government and the public to bring added protection to the country's natural heritage*' (own emphasis).[103]

This view is equally relevant for water resources by the simple replacement of 'loss of biodiversity at a species and habitat level' with 'degradation of water resources'.

These statements questioned the readiness of the PTD to be deployed into the arena of South African environmental law. With respect to the central issue of private property, it has been noted that the implications of the doctrine for the South African property regime remain to be determined.[104] What is lacking is any policy framework intended to guide the application and operationalisation of the PTD in South African environmental law in general and in water law and for aquatic ecosystem protection in particular. Moreover, there has been a complete absence of any attempt to discern the intentions for the doctrine that was in the minds of the drafters of South Africa's new water law.

Against this context, it is postulated that the PTD can provide an embracing legal framework for protecting both aquatic ecosystems in a holistic sense, ie enfolding both the aquatic component and that adjacent land necessary for sustaining aquatic ecosystem ecological integrity and functioning. Also acknowledged, at the outset, is that mobilising the PTD to any vestige of its proven or deemed potential will not be easy. It will require the efforts of a range of stakeholders, including legislators, scholars, legal practitioners, departmental officials and the judiciary.

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[102] Blackmore AC (2018) *The Rediscovery of the Trusteeship Doctrine in South African Environmental Law and its Significance in Conserving Biodiversity in South Africa*. (unpublished PhD Thesis, University of Tilburg, Netherlands).
[103] Blackmore AC (2018) op cit Chapter 9 at 283.
[104] Viljoen G (2017) 'South Africa's water crisis: The idea of property as both a cause and a solution'. *21 Law Democracy & Development* at 179.

III. The problem addressed by this research

(a) Rationale for connectivity-based, rule-guided administrative decision making

A failure to adequately consider aquatic ecosystems as a complex of functionally-connected components may be environmentally harmful in the extreme. Seemingly benign impacts may, singly or cumulatively, result in consequences which disrupt the integrity of the whole. A common example of an introduced 'disconnect' is that of an alien species, such as a fish or plant which then disrupts the natural fauna in any or all connected components to which it may be able to gain access (see Figure 1.4). More predictable impacts result from the large-scale development of major rivers, either by impoundment or abstraction.[105] The focus here is on impacts arising from land uses on the land adjacent to watercourses — and how a combination of an HEC approach, enfolded within the public trust, has the potential to substantially prevent, attenuate or mitigate harms to aquatic ecosystems.

Figure 1.4 Infestation of alien water hyacinth covering the water surface of Roodeplaat Dam, Gauteng South Africa. (Image Credit: ROWSA)

Environmental law competes in a race against time, in addition to multiple constraints superimposed by, *inter alia*, a lack of political will, public support, resources, knowledge and capacity, as well as institutional barriers and conflicts of interest. Aquatic resources are being increasingly degraded and, as illustrated above, environmental law is deemed to have been largely ineffective in slowing the rate thereof. To be relevant, environmental law must, therefore, keep pace with contemporary science and understanding.

So, if it is accepted that providing an assurance of regard for HEC is of vital importance to an ecosystem approach to water governance, then what is required is an enabling legal and

[105] Tarlock AD (1996) 'International water law and the protection of river system ecosystem integrity.' *10 Brigham Young University Journal of Public Law* at 182/3. Tarlock maintains that '[environmental] law... facilitates the destruction of the ecological integrity' of river systems, and that this results from attempts to balance development against ecosystem protection, ie development at the expense of nature. This position is echoed by Bosselmann K (2010) 'Losing the forest for the trees: environmental reductionism in the law'. *2 Sustainability* 2424-2448.

institutional framework that provides for legitimate restrictions of land use on private property. Argued here is that the PTD provides an ideal, principled approach for placing legitimate limitations on land use to protect and sustain the public trust in water. While the PTD is centrally embedded as the backbone of the NWA, its *modus operandi* has not yet been developed through policy or regulation.

South Africa currently lacks a connectivity-based approach to water resource management. In fact it was only during 2021 — as this research drew to a close — that a national wetland working group identified the need to extend audits of terrestrial condition to 'other realms' such as 'rivers, wetlands and estuaries...', or that 'considerations of wetlands should be extended to include rivers and streams'.[106] The South African ecosystem classification strategy does not mention the broad range of ecotonal continua that exist at the aquatic: terrestrial interface.[107]

(b) Problem statement

With the foregoing in mind, assessing the potential of an HEC-based regulatory approach arises from the following observations:

i. the ecological state of global freshwater resources is in a rapid and dangerous state of decline. South African water resources fall within this paradigm;
ii. environmental laws and regulations governing water resource management need to keep pace with the relevant science, in this specific instance the emerging science of hydroecological connectivity;
iii. appropriate governance of freshwater resources is not fully predicated on an '*ecosystem approach*'[108] that ensures ecologically and/or hydrologically relevant connections between waters. Moreover, regulatory guidance, such as that provided by the example

[106] For example see *Accounts for Protected Areas*, 1900-2020. Statistics South Africa 2021. Section 6(2): 'Directions for Future Work: Expand the accounts to include all realms'.
[107] South African National Ecosystem Classification System Handbook. Dayaram A et al (2021) South African National Biodiversity Institute (SANBI) Pretoria. at 11.
[108] Stacey (2016) 'The environmental emergency and the legality of discretion in environmental law' *52 Osgoode Hall L.J.* at 992) describes ecosystems as follows: 'Ecosystems are comprised of myriad intricate and indeterminate relationships between humans, plants, animals and the abiotic components of the environment, such as climate. These relationships are themselves adaptive, or changing over time, which makes predicting the impacts of our actions on the environment extremely difficult'. 'Complex adaptive systems are characterised by two phenomena: The first is indeterminacy or the fact that ecosystems are comprised of non-linear dynamics... the second is the relatively high chance of an extreme event, or *tipping point*, that dramatically and unexpectedly changes the dynamics of the system. (emphasis added).

of the CWR, needs to guide and facilitate fair and reasonable HEC-aligned administrative decision making;[109]

iv. freshwater ecosystem problems and challenges are, in the main, of a globally generic nature — such that tools and guidance developed in foreign jurisdictions, such as the CWR are, *mutatis mutandis*, likely to be locally relevant;[110]

v. as protection of water resources may impose a limitation on private land use(s), the PTD is the appropriate proactive[111] overarching institutional governance framework within which an HEC regulatory framework may be situated.

(c) Hypothesis

The underlying hypothesis comprises the following:

- Sustaining HEC is of paramount importance to the integrity and functioning of aquatic ecosystems wherever they occur;
- The CWR reflects the status of contemporary scientific understanding of HEC;
- Analysis of the challenges to the science underpinning the CWR will identify any aspects requiring of further general consideration or adaptation for local conditions;
- Challenges to a connectivity-based regulatory approach are likely to stem from perceptions of legislative over-reach into the realm of private property ownership and land use;
- The public trust doctrine can serve to accommodate the protection of aquatic resources wherever they occur;
- The current expression of the PTD in the NWA is weak and vague. Elucidation of the principles of the public trust will define their scope of potential application;

[109] There is strong scientific support for the conclusion that ephemeral, intermittent and perennial streams are physically, chemically and biologically connected to downstream waters. Furthermore that this connectivity occurs on a gradient that is a function of frequency, duration, magnitude, predictability and consequences of physical, chemical and biological connections. Connectivity exists in four dimensions (longitudinal, vertical, lateral and temporal). USEPA Science Advisory Board - Review of the Draft EPA Report Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence. EPA-SAB-15-001 (17 October 2014). Copy on file with author.

[110] The common assaults on water resources are: habitat modification, water withdrawals and flow modifications, impoundments, pollution (in the main from urban wastewaters and industrial discharges), drainage and infilling and infestation by alien plants and animals.

[111] Ballentine AS (2016) 'How the Public Trust Doctrine's fiduciary duty requirement requires states' proactive response to promote offshore power generation'. *6 Seattle Journal of Environmental Law* at 99. "... the management of public resources... should require, at a minimum that the States manage proactively rather than merely reactively".

- Compliance with the principles of the public trust can form the basis of a test for determining whether a water use is reasonably beneficial and in the long-term public interest.

(d) Research question

To what extent can the approach to hydroecological connectivity, as contained in the CWR, when combined with the Public Trust Doctrine, provide a model for water resource regulation in South Africa?

Sub-questions:

1. What is the relevance of HEC for water resource management?
2. What were the science-based challenges to the CWR?
3. What utility does the CWR offer for South African water resource protection legislation, especially with regard to land use on private property?
4. What is the history of the PTD in South African water law, and what were the intentions underpinning its overt inclusion in the NWA?
5. To what extent does the PTD accommodate perceived loss of private land use?
6. To what extent would the PTD principles serve to delineate the bounds of connectivity-directed discretion afforded to administrative decision makers?

(e) Rationale

There is little time to waste on planning what should be done to attenuate environmental degradation in general, or that occurring in the freshwater realm in particular. An appropriate focus should rather be on what can be done, *right here and now*, using existing instruments of proven worth and/or applicability. The CWR provides a unique opportunity to comprehensively assess the formulation of a locally-relevant water law regulation, the subject of which — a connectivity-based assurance of ecosystem protection of aquatic environments — is absent in South African water law. The lessons-learnt from a globally generic CWR, should be of immediate and substantive value to the evolution of an equivalent South African water resource regulation. Not only will such a narrative regulatory approach provide clear, ecosystem-aligned, legal sidewalls for administrative decision making, it will also define the discretional leeway available to agency decision makers. Furthermore, push-back to this approach will be proactively fettered by the obligations and fiduciary duties imposed by the

PTD. Additionally, the interpretive clarity provided by a narrative regulation such as the CWR, enfolded within the PTD, will offset judicial deference to a departmental decision and, in cases where there is a lack of clarity, enable the courts to refer the regulation(s) back to the legislature for consideration and review.

IV. Objective of this thesis

The objective here is to demonstrate that both the content of the CWR and the challenges thereto are of significant relevance to the formulation of a similar regulatory instrument for South Africa. Water law in South Africa, with respect to ecosystem connectivity, lacks equivalent narrative detail and remains open to wide interpretation, resulting in vastly-different approvals for developments affecting water resources — for example the (legally justifiable) requirement to (i) remove fill illegally placed in a wetland,[112] confusingly juxtaposed with the (ii) approval of a Water Use Licence to allow the infilling of an instream wetland for the purpose of a potentially-hazardous activity, viz. constructing a fuel filling station,[113] or (iii) extending to an arbitrary and capricious requirement to licence a shallow furrow in a suburban garden as a 'watercourse'.[114]

The disciplines of science and environmental law have a fundamental dependency on definitions. Whilst appreciating the limits of definitional clarity, it can be argued that a connectivity-based, ecosystem-directed definitional regulation, such as the CWR, should play an obvious and pivotal role in augmenting regulatory clarity, as well as delineating clear legal sidewalls to environmental approval decision-making. These should guide the process towards, ultimately, a decision that is aligned with connectivity and ecosystem-integrity, one requiring of a focus on the connected ecosystem, rather than just that portion proximate to where the activity is proposed to occur. Lastly, the clear and narrative quality of such an instrument should proactively provide both the regulator and the regulated community with a clear prior understanding of exactly what does/does not fall within the regulatory ambit.

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[112] *Minister of Water and Sanitation and Another vs Really Useful Investments and Another* (436/2015) [2016] ZASCA 156 (3 October 2016). In this case the respondent had illegally infilled a wetland wherein it believed it possessed development rights. Their application for compensation for loss of development opportunities was denied on appeal to the SCA and on further subsequent appeal to the Constitutional Court.

[113] Libradene Wetland (Boksburg South Africa) Department of Water and Sanitation Water Use Licence No: 08/C22B/1C/6654 dd 16/02/2018. Obtained by Public Access to Information Request February 2018.

[114] DH Environmental Consulting, Somerset West, South Africa. Consultancy report. Nature of a furrow occurring on erf 204, Cape Town. June 2017. Copy on file with author.

In this vein, it is proposed that an approach which provides detailed, narrative and transparent epistemic regulatory guidance, underpinned by contemporary science, and enfolded within and enabled by the PTD will, in considerable measure, encapsulate discretionary decision-making within a normative framework that provides optimal protection to aquatic ecosystems. It is acknowledged that eliminating discretion from the administrative decision-making process is not possible but that it can be constructively and scientifically fettered. Within an epistemic and science-directed framework, it will thus be possible to craft regulations in mandatory language that provides clear legal sidewalls to the decision-making process.

V. Methodology

This research examines the CWR as a 'lessons learnt' case study analysis in order to distil the aspects necessary to inform the drafting of an HEC instrument for South African water law. The research is accordingly of transdisciplinary intent. The methodology for this research comprises a combination of desktop analysis and semi-structured interviews, conducted by email and/or via recordable internet video conferencing. The desktop analyses will utilise Congressional/Parliamentary records (legislative history), legislation, policy documents, case law and various texts dealing with water law in both South Africa and the USA. Legislative history is herein considered as a singularly important interpretive tool in order to construe the intended purpose and meaning of particular statutory phrases — especially insofar as the Clean Water Act is concerned.[115] Additionally, there exists a rich trove of United States case law — particularly from the more arid western states having climates akin to those in South Africa[116] — and where the PTD has been mobilised at state level for the protection of natural resources.[117] Operationalisation of the public trust in many US western states has been

[115] Gluck RA & LS Bressman (2013) 'Statutory interpretation from the inside—an empirical study of congressional drafting, delegation and the canons'. Part 1. *65 Stan. L. Rev*. 901, 965.
[116] Craig RK (2010) 'A comparative guide to the western states' public trust doctrines: Public values, private rights and the evolution towards an ecological public trust.' 37 *Ecology Law Quarterly* 54. See also comparative analysis of the USA Eastern States, Craig RK (2007) A comparative guide to the Eastern Public Trust Doctrine: Classifications of states, property rights and state summaries. *16 Penn State Environmental Law Review* 1-113.
[117] eg *Just v Marinette County* (1972) - wetlands; *State Water Res. Control B. Cases* (2006) - balancing of public trust with public uses; *State of California v Superior Court* (1981) - non-tidal waters; *Robinson v Ariyoshi* (1982) - groundwater; *National Audubon* (1983) - non-navigable tributaries; *Baxley v State* (Alaska) (1998) - wildlife; *Envtl. Prot. Info. Ctr. v California Dep't Forestry and Fire Prot*. (2008) permits for logging; *Crt. for Biological Diversity, Inc. v FPL Grp., Inc* - (2008) windfarms and harm to wildlife; *People v Davis* (2016) - theft of water; *People v. Rinehart* (2016) - dredging. Lazarus (2016) lists approximately 100 cases relating to the PTD. See Annexure 1 for foundational case citations.

described by Craig as reflecting 'conscious struggles' over a scarce resource, or where 'water- and environment-based tourism' are of significant economic importance.[118]

The history leading to the need for and creation of a new law is important as it is '[impossible to] develop an identity, a consciousness, an understanding or a philosophy without an historical awareness or background knowledge of the events and the people who contributed to a particular development'.[119] Additionally, it is argued here that the fact that the public trust principles have yet to be elucidated and called on in South African case law speaks volumes to their opaque nature. With this in mind, this historico-legal research placed a core focus on (a) establishing in-person the intentions of the progenitors of the public trust in the NWA in the context of the circumstances prevailing at the time of the law reform process; (b) what their future intentions for the public trust were and (c) how the contemporary demands on the NWA can be accommodated

The interview process was conducted using approved questionnaires, responded to either in writing or transcribed from verbal interviews. Each of the NWA interviewees was requested to first indicate their willingness to participate by means of a consent form. The initial round of interviews generated some follow-up queries which, in turn, revealed other potential sources which expanded the pool of information sources. The focus of the questionnaires was, in addition to confirming the affiliation and role of the persons being interviewed, intended to determine when and how the PTD was identified and by who, what it was intended to achieve in the NWA, its relationship to s24 of the Constitution; whether there was an awareness of any prior existence of a trust doctrine in South Africa and which foreign legal regimes had contributed to the review?

Cohort of South African interviewees

The Water Law Review process ('the review') consisted of various groupings comprising a Policy and Strategy Team, a Drafting Team, as well as administration and co-opted technical and departmental staffers. Table 1.1 lists the names of those interviewed — or, in the case of those since deceased, had their role and input identified via those who worked with them, alternatively via curated documents and records. In the summary that follows

[118] Craig RK (2010) op cit at 58.
[119] Sperotto F (2015) 26 *South African Journal of Industrial Engineering* 1-9.

individual respondents are identified by their surnames and first name where necessary). Only one respondent chose to remain anonymous.

Table 1.1 List of persons interviewed (unless otherwise indicated)

Name & initial*	Affiliation	NWA Role
Asmal, K	DWAF	Minister: Water Affairs and Forestry (deceased 2011)
Abrams, L	DWAF	(Did not respond)
Anonymous	DWAF	DWAF Strategic planning
Audie, C	DWAF	Deputy DG (not interviewed) (deceased 2020)
Babbitt, B	USA Government (Dept of the Interior)	Inter-governmental support
(Conley, A)	DWAF	DWAF Strategic planning
(Du Bois, F)	University of Cape Town	NEMA advisor
Garlipp, L	DWAF	Legal services (did not respond)
Gildenhuys, A	Judge (Land Claims Court)	Chairperson of Drafting team
(Glazewski, J)	University of Cape Town	NEMA advisor
(Kavin, H)	DWAF (legal services)	Special advisor
Klug, H	Wisconsin Uni Law School	Special advisor
(Leshy, J)	US Gov (Interior)	Inter-governmental support
(Love, J)	ANC MP	Special advisor
(MacKay, H)	DWAF	Special advisor
Muller, M	DWAF	Director General
(Palmer, C)	Rhodes University	Technical support (environment)
Roberts, R	Consultant	Special advisor
(Roberts, P)	DWAF	DWAF Strategic planning
(Rowlston, WS)	DWAF	DWAF Strategic planning
Sax, J	USA Academic (Boalt Law)	Co-opted specialist advisor (deceased 2014)
(Schreiner, B)	DWAF	Special advisor
Stein, R	Attorney in private practice	Special advisor
* Names in bold text indicate team members directly involved with the public trust considerations. Names in parentheses ( ) were not directly involved with the trust but were able to provide contemporary context.		

A second questionnaire was presented to a small set of USEPA and associated officials who contributed to the formulation of the CWR. These individuals are treated as anonymous sources per their own request.[120]

[120] This decision was taken given reluctance of in-service government staffers to provide their opinions.

Data processing

During the analysis of the CWR an unexpected need arose to validate a lateral distance for its relevance in determining the adjacency of wetlands to water courses. A protracted process of trying to locate the CWR source for this was unsuccessful and it was eventually discovered that no actual empirical source existed. Given the indicated importance of this component of the CWR, a decision was taken to test the validity of the distance rule using South African river and wetland data. This required the co-opting of a Geographical Information System (GIS) specialist, possessing of the required computational ability, as well as access to the relevant datasets, to undertake a comparative analysis of South African data under the direction of this author.[121] The specialist was provided with the parameters within which to run the data analysis, and the required deliverables. The specialist did not contribute towards the interpretation of the outputs or the conclusions arising therefrom.

VI. Thesis structure

This chapter has set out the basis of the research proposal, viz an evaluation of the role that a PTD-enfolded HEC approach could play as a template for a South African HEC regulatory approach. Chapter 2 sets out the nature of HEC and its potential role for the governance of South African water resources. Chapter 3 analyses the challenges to the CWR and identifies and further develops a critical aspect which was a primary cause of resistance to the new regulation. Chapter 4 examines the role of the public trust as providing of an appropriate institutional framework for HEC-based regulation. The particular focus of this chapter is an elucidation of the trust principles and how they may be used to guide decision making. Chapter 5 details the history of and intentions for the public trust in South African water law, this being the first occasion when the drafters of the statute were used to understand the context and intentions behind Section 3 of the NWA. Finally, Chapter 6 translates the trust principles into a format for test of what constitutes a reasonable beneficial use in water.

Annexure 1 contains 60 citations, spanning the period 1774 — 2019, these being case law examples which are here regarded as being the foundational steps in the dynamic evolution of the public trust in the United States of America.

[121] See Chapter 3.

Annexure 2 contains the text of the promulgated version of the CWR (CWR, 2015), annotated to show the text that appeared in the 1986 guidelines, as well as the text that remained included in the subsequent NWPR (2020).

CHAPTER 2: THEORETICAL FRAMEWORK: HYDROECOLOGICAL CONNECTIVITY AS A REGULATORY NORM

'A thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise.' [122]

I. Introduction

This thesis proposes that ensuring watershed-level, 'source to sea' HEC underpins a fundamentally normative framework within which the sustainable regulation of watercourses may be optimally achieved. On this view, the integrity of a matrix of water resource components, aquatic and terrestrial, is assured. The theoretical framework of this analysis maintains that any or all decision-making, which must consider potentially harmful impacts on water resources, must have regard for the intrinsic values embodied in providing an assurance of HEC. Linked hereto is that an HEC-based regulatory-approach will probably invoke the need to limit certain use(s) of land located adjacent to water resources, in instances where such use(s) may pose a risk of avoidable harm. Here the public trust is viewed as a self-executing body of principles which provides an established institutional framework enabling limitations on land use, absent any need for land expropriation.[123] As explained in Chapter 1, as with the merits of HEC-directed water resource governance, the utility of the public trust principles has yet to be elucidated in South African water law.

This chapter provides the science-based underpinnings of HEC. Chapter 3 then employs this understanding to analyse and critique the challenges that were made to the CWR, as well as further developing a critical aspect thereof.

In this chapter, after noting that HEC is a factor prone to being overlooked in administrative decisions, Section II examines the key aspects of established science underpinning of the role and importance of HEC in water resource governance. It also sets out how ecosystem fragmentation can impair vital aquatic ecosystem services through disruption of connectivity-supported ecosystem integrity. For this purpose, the specific example of

[122] Leopold A n20.
[123] See Chapter 4.

critically important headwater streams, which comprise the major portion by aggregate length of river systems, is employed.

HEC and administrative decision making

'Freshwater ecosystems and their associated biota are among the most endangered in [a] world...'[124] '..which is facing a confluence of unprecedented crises.'[125] As the Problem Statement set out,[126] there is a growing body of informed opinion that points to failings in administrative decision making which are compounding, rather than attenuating, the globally prevalent rate of environmental degradation, biodiversity loss and declining human well-being.[127] While the rate of biodiversity loss in aquatic ecosystems exceeds that of any other ecosystem-type, very little consideration has been afforded to protecting both the land and waters *which together constitute* an aquatic ecosystem (own emphasis).[128] The prevailing water law enigma is that although modern environmental law arose from problems of water pollution, 'laws worldwide continue to allow the ongoing drying and contamination of rivers, streams, aquifers and estuaries.'[129] This [arises from] 'treatment of the environment as property and not as partner.'[130]

The normative and sustainable protection of freshwater aquatic ecosystems, at a watershed level, requires that all the components thereof, viz groundwater, springs, streams, river and wetland domains and the atmosphere, at all times be viewed to the greatest extent possible as being part of a HEC-interconnected whole. Often overlooked is that the aquatic environment is intrinsically and inherently connected to its adjacent terrestrial lands such that, 'all land that is part of a watershed... is shaped by the water that flows over and through it... meadows, forests, marshes and backwaters of floodplains [are] part of rivers and rivers part of

[124] Nel JL, Roux DJ and R Abell et al (2009) 'Progress and challenges in freshwater conservation planning'. 19 *Aquatic Conserv: Mar. Freshw. Ecosyst*. 474-485.
[125] Global Land Outlook (Second Edition) (2022) Land Restoration for Recovery and Resilience. United Nations Convention to Combat Desertification. Key Messages.
[126] Chapter 1, sII.
[127] The WWF 2020 Living Planet Report declares that "[h]umanity's destruction of the nature is having catastrophic impacts not only on wildlife populations but also on human health and all aspects of our lives". Living Planet Report 2020 - Bending the curve of biodiversity loss. WWF, Switzerland; The GBO5 report reveals that while biodiversity is declining at an unprecedented rate, none of the 2020 Aichi targets were achieved (Global Biodiversity Outlook 5 www.cbd.int/GBO5). In 2012, 13% (633 000) of all deaths in the EU were attributable to environmental causes (Healthy Environment, Healthy Lives: How The Environment Influences Health And Well-Being In Europe. European Environment Agency http://europa.eu).
[128] Sinnadurai P, Jones TH and Ormerod SJ (2016) 'Squeezed out: the consequences of riparian zone modification for specialist invertebrates'. *25 Biodiversity and Conservation* 3075-3092.
[129] Sheehan L (2013) Realizing nature's rule of law through rights of waterways. Chapter 13 in *Rules of Law for Nature: New Dimensions and Ideas in Environmental Law*. Voight C (ed). Cambridge University Press. at 222.
[130] Sheehan L (2013) Ibid.

them'.[131] At an overarching scale, 'ecological connectivity is the unimpeded movement of species and the flow of natural processes that sustain life on earth'.[132] It is this aspect, of having regard for the ecosystem pathways facilitated by connectivity, that is proposed as a normative basis for scientifically-informed and guided administrative decision making that seeks to ensure aquatic ecosystem integrity. Recent advisory science encapsulated in the form of the CWR, has highlighted the central role of HEC for the functional integrity of aquatic ecosystems.[133]

As mooted in Chapter 1, there is a view that socio-ecological considerations are not serving as effective constraints on development, in particular that there is inadequate attention to a future view of how present day uses may limit essential, non-renewable resources such as water. This inattention perpetuates what have been termed 'green crimes'[134] and draws into focus the role that a 'hard-look' interrogation of administrative decisions, in terms of public trust protections for water resources, can provide. In this regard a combination of HEC and the public trust principles together provide the necessary basis for appropriate administrative rigour.

II. Aquatic-aquatic and aquatic-terrestrial HEC

The application of ecosystem science to environmental management is not 'rocket science' — it is significantly and profoundly more difficult. It is not necessary to set out the basis for HEC as this was, as detailed in Chapter 1, comprehensively undertaken for the CWR — and begs no further qualification.[135]

The CWR speaks directly to the nature and importance of HEC, both linear and lateral. The development of the rule was singularly comprehensive, encompassing: (i) a scientific assessment and review of the hydrological and ecological inter-connectivity of water resources (the 'Connectivity Report'[136]); (ii) the preparation of a Technical Support Document to serve as

[131] McCully P (1996) *Silenced Rivers: The Ecology and Politics of Large Dams*. Zed Books (London).
[132] Global Land Outlook (2022) (n125) ibid at 34.
[133] Jasanoff S (1990) The Fifth Branch: Science Advisors as Policymakers. Harvard University Press. Chapter 7.
[134] Lynch MJ et al (2021) Green Criminology. Chapter 17 in *Handbook of Environmental Sociology* (Schaefer et al, Eds). Springer Publishing.
[135] Chapter 1 Section II(b).
[136] Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence. US Environmental Protection Agency EPA/600/R-14/475F. USEPA Office of Research and Development, Washington. 7 Chapters plus appendices. Copy on file with author.

an aide memoire to the review study (the 'Technical Support Document'[137]); (iii) review of the Connectivity Report by the White House Scientific Advisory Board (the 'SAB Review'[138]); (iv) an assessment of the social justice implications of the new Rule (the 'Social Justice Report'[139]) and (v) circulation of the proposed Rule for public comment. More than one million comments were assessed, responded to and documented in 17 compendia.[140] The rulemaking records comprised 20 400 documents and in excess of 350 000 pages. The process included 400 stakeholder meetings. As such the CWR constitutes a prime example of translational ecology. The outcome was consolidated into a suite of definitions comprising just 2708 words.[141] The definitive conclusions were, *inter alia*, that:[142]

- '[t]he scientific literature unequivocally demonstrates that streams, individually or cumulatively, exert a strong influence on the integrity of downstream waters. All tributary streams, including perennial, intermittent and ephemeral streams, are physically, chemically and biologically connected to downstream waters via channels and associated alluvial deposits where water and other materials are concentrated, mixed and transported';
- '[t]he literature clearly shows that wetlands and open waters in riparian areas and floodplains are chemically, physically and biologically integrated with rivers...';
- '[w]etlands and open waters in non-floodplain landscape settings... provide numerous functions that benefit downstream water integrity';
- '[w]atersheds are integrated at multiple spatial and temporal scales by flows of surface and ground water';
- '[a]ll parts of the watershed are connected... by the hydrologic cycle or the dispersal of organisms';

[137] Technical Support Document for the Clean Water Rule: Definition of Waters of the United States. US Environmental Protection Agency and Department of the Army. 27 May 2015. 423 pp. Copy on file with author.
[138] SAB Review of the Draft EPA Report Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence. EPA-SAB-15-001. Office of the Administration Science Advisory Board. Washington D.C. 93 pp plus appendices. Copy on file with author.
[139] Environmental Justice Report for the Clean Water Rule: Definition of "Waters of the United States Under the Clean Water Act; Final Rule. US Environmental Protection Agency & Department of the Army. May 2015. 27 pp.
[140] Response to comments for the Clean Water Rule: Definition of "Waters of the United States". 17 Compendiums. *https://www.epa.gov/cwa-404/response-comments-clean-water-rule-definition-waters-united-states.*
[141] The definitions are encapsulated within a detailed narrative preamble that provides the links to the connectivity science.
[142] Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence. Op cit.

- '[t]he incremental effects of individual streams and wetlands are cumulative across entire watersheds and therefore must be evaluated in context with other streams and wetlands'.

In point of fact, the Connectivity Report, with its supporting annexures, constitutes the most up to date 'textbook' on the subject of HEC available in the world today.

All types of ecosystems (for example grasslands, forests, savannahs, rivers and wetlands, estuaries), on which humans depend for a variety of directly- and indirectly obtained ecosystem services, are comprised of a myriad of interconnected components. These connections comprise both intra- and inter-ecosystem linkages which are, at best, only comprehended at a rather coarse level. Abiotic and biota-mediated connections are enabled, to varying degrees, by a multitude of transport and exchange mechanisms which vary in time and space on a continuous basis. Functional connectivity is a key factor in the maintenance of species richness,[143]with connectivity disruptions limiting species dispersal in communities dependent on same.[144] Should any of these connections become impaired, the functionality of the whole may become negatively constrained. The cumulative loss of redundant connections may accumulate to exceed the resilience of the system to recover, resulting in a loss of functionality and a reduction in the quality and/or quantum of ecosystem integration and services.[145] The consequences are reflected in the dismaying results reported, *inter alia*, in the 2020 WWF and GBO5 reports cited above.

Chapter 1 set out the concept of the ecosystem approach, ie the management and protection of ecosystems that devolves from considering the whole system to the maximum extent possible, rather than individual parts or sections thereof.[146] Centrally-highlighted was the need for a watershed-level appreciation of connectivity, especially valid for fluvial hydrosystems which, typically, flow from their origins in mountain streams, over long distances and through a variety of landscapes, lakes and estuaries to the ocean.[147]

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[143] Parra G et al (2021) *'The future of temporary wetlands in drylands under global change'*. 11 *Inland Waters* 445-456.
[144] Heino J (2013) 'The importance of metacommunity ecology for environmental research within the freshwater realm'. 88 *Biological Reviews* 166-178.
[145] Grizetti B et al (2019) 'Relationship between ecological condition and ecosystem services in European rivers, lakes and coastal waters'. 671 *Science of the Total Environment* 452-465.
[146] Chapter I(a).
[147] Although outside of the scope of this thesis, but not to be lost from consideration, is that the outflow from rivers to the ocean forms a fundamental component of the ecosystems that form in response thereto. The increasing quantity demands on river flows - and hence discharge to the ocean, as well as quality impacts from

In this context, having regard for a watershed approach is important as this 'define[s] the [catchment] boundaries and sub-boundaries and the flow[s] across each with some reasonable degree of precision'.[148] Important here is that streams and rivers, especially those located at the upper reaches of catchments, act as collectors for essential allochotonous[149] contributions of energy and materials. A significant portion of what ends up in waterways has originated in, or passed through, ecosystems which may not, at least to a lay perception, be viewed as connected to each other. Of relevance here is that the outcome of such transfers may be either beneficial, harmful or a mixture thereof, eg catchment-generated pollutants may reach waterways together with essential minerals. The condition of the watercourses may thus be regarded as a reflection of the condition of the catchment through which they flow.

Ecological sustainability is substantively underpinned by ecosystem integrity, ie the maze of connections, links and processes that support ecosystem redundancy. In the modern world, water resource management approaches mainly strive to mimic an equivalence of flows and timing determined as necessary to achieve a particular class of ecosystem health — 'health' and 'integrity' denoting quite different aspects, yet which are often conflated as being synonymous. What these fail to focus on is what has been described as 'maintaining enough of the historically particular components', also termed 'continuities of form'[150] here regarded as those areas situated adjacent to or otherwise ecologically associated with, for example, rivers or streams. In simple terms this may described as 'let Nature be Nature'.

As explained in Chapter 1, instrumental value tends to predominate in the lower reaches of catchments, or where towns have been built in the highlands around, for example, mining complexes such as Johannesburg. In general terms, however, there is a reasonable expectation that the higher lying, low order stream areas tend to be less impacted. However, for systemic worth to become a criterion or metric for aquatic ecosystem appreciation, there needs to be an

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pollution, have induced significant alterations in coastal ecosystems. eg Auricht et al (2018) 'Have droughts and increased water extraction from the Murray River (Australia) reduced coastal ocean productivity?' 69 *Marine and Freshwater Research* 343-356; Scharler UM and MJ Ayers (2019) 'Stoichiometric multitrophic networks reveal significance of land-sea interaction to ecosystem function in a subtropical, nutrient-poor bight, South Africa'. 14 *PLos ONE*:e0210295.

[148] Ruhl JB (1998) 'The (political) science of watershed management in the ecosystem age'. 35 *J. Am. Water Res. Ass'n* 519.

[149] Originating in a place other than in the receiving water body (cf autochotonous).

[150] Holland A (1994) Natural Capital. In*: Philosophy and the Natural Environment* (Attfield & Belsey eds) Cambridge University Press. at 178. These are intact parts of a system of connected whole that can serve to buffer loss of function in altered portions.

established underpinning for a systemic-relational approach. Such an approach is deemed to be lacking in South African water resource governance.[151]

(a) The dimensions of HEC

Aquatic ecosystems exhibit six-dimensional connectivity (longitudinally, up- and downstream, laterally to the floodplain, vertically to the hyporheos[152] or groundwater or the atmosphere, as well as temporal variability) (See Figure 2.1).

These connections encompass not only the aquatic environment, but also often spatially extensive adjacent terrestrial areas such as riparia, floodplains, or ecological-corridors linking isolated wetlands or areas of importance during the non-aquatic lifecycle stages of various organisms, to the fluvial hydrosystem (see Figure 2.2)[153].

[151] See de Wet and Odume (2019). They describe a systemic-relational approach places primary emphasis on the value of socio-ecological systems and not on individual components. On this model each component has intrinsic value as supportive of other components and the value of the whole.
[152] The hyporheos is the zone immediately below and adjacent to a watercourse. It may extend as much as 2 km laterally or to a depth of 10 m. eg Boulton AJ et al (2010) 'Ecology and management of the hyporheic zone: stream-groundwater interactions of running waters and their floodplains'. 29 *J. N. Am. Benthol. Soc* 26-40.
[153] Lane CR, Leibowitz SG & B Autrey et al (2018) 'Hydrological, physical, and chemical functions and connectivity of non-floodplain wetlands to downstream waters: A review.' 54 *Journal of the American Water Resources Association* 346.

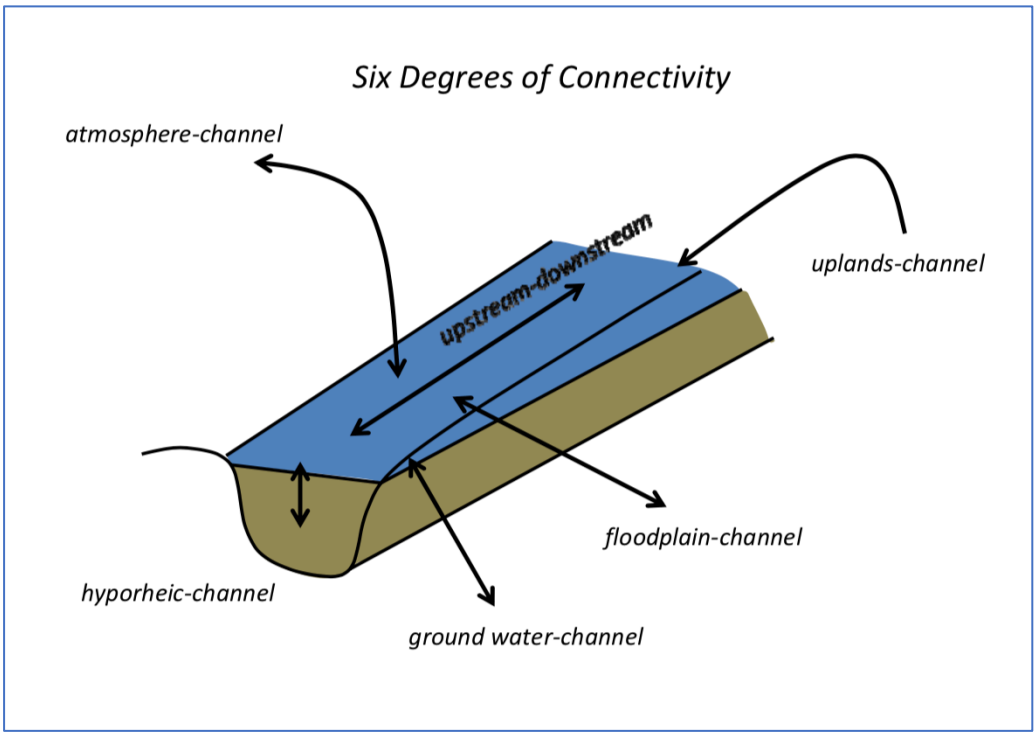

Figure 2.1: Schematic illustration of the dimensions of hydrological connectivity. All of the indicated dimensions are bi-directional except for flows off uplands to the channel. Source: Wohl 2013.[154]

These adjacent zones form a complex, widely variable and often discontinuous matrix enfolding important nodes of biodiversity supported by a network of connecting linkages and complementary habitats, spanning riparia and floodplains. As such, streams and rivers are, from an ecological perspective, much more than just the area between their banks. Furthermore, maintaining the integrity of the connected whole is fundamental to the ecological sustainability thereof, given that the very viability of many organisms (eg invertebrates, amphibians, birds or fish) is dependent on their being able to move unhindered from one aquatic environment to another, or to an area of semi-aquatic or terrestrial habitat necessary to sustain a particular life cycle stage.[155] Examples of habitat-connections range from an organism having a terrestrial life-cycle stage in the riparian zone, to organisms inhabiting flood plain soils or riparian vegetation during the wet season. If these connections are broken then populations of

[154] Wohl E (2013) *Rivers in the Landscape*. Wiley-Blackwell Publishers. Figure S1.3. Reproduced with permission.

[155] Bunn SE and AH Arthington (2002) 'Basic principles and ecological consequences of altered flow regimes for aquatic biodiversity'. 30 *Environmental Management* 492-507. These authors stipulate the maintenance of aquatic ecosystem connnections as one of four fundamental principles underpinning the importance of flow regimes and biodiversity. See also Thorp et al (2006) 'The riverine ecosystem synthesis: Biocomplexity in river networks across space and time'. 22 *River Res. Applic.* 123-147, describing fluvial hydrosystems as connected and variable 'arrays of hydrogeomorphic patches'.

organisms may become fragmented, or even isolated into sinks from which they cannot escape, with the risk of extinction.

Using the blood-vessel analogy presented at the outset of Chapter 1, stream and river networks flow through the ecological matrix that is the watershed, enfolding a countless array of integrated abiotic and biotic hydrological dynamics which, ultimately, sustain the ecological functionality and the ecosystem health or condition of the whole.[156]

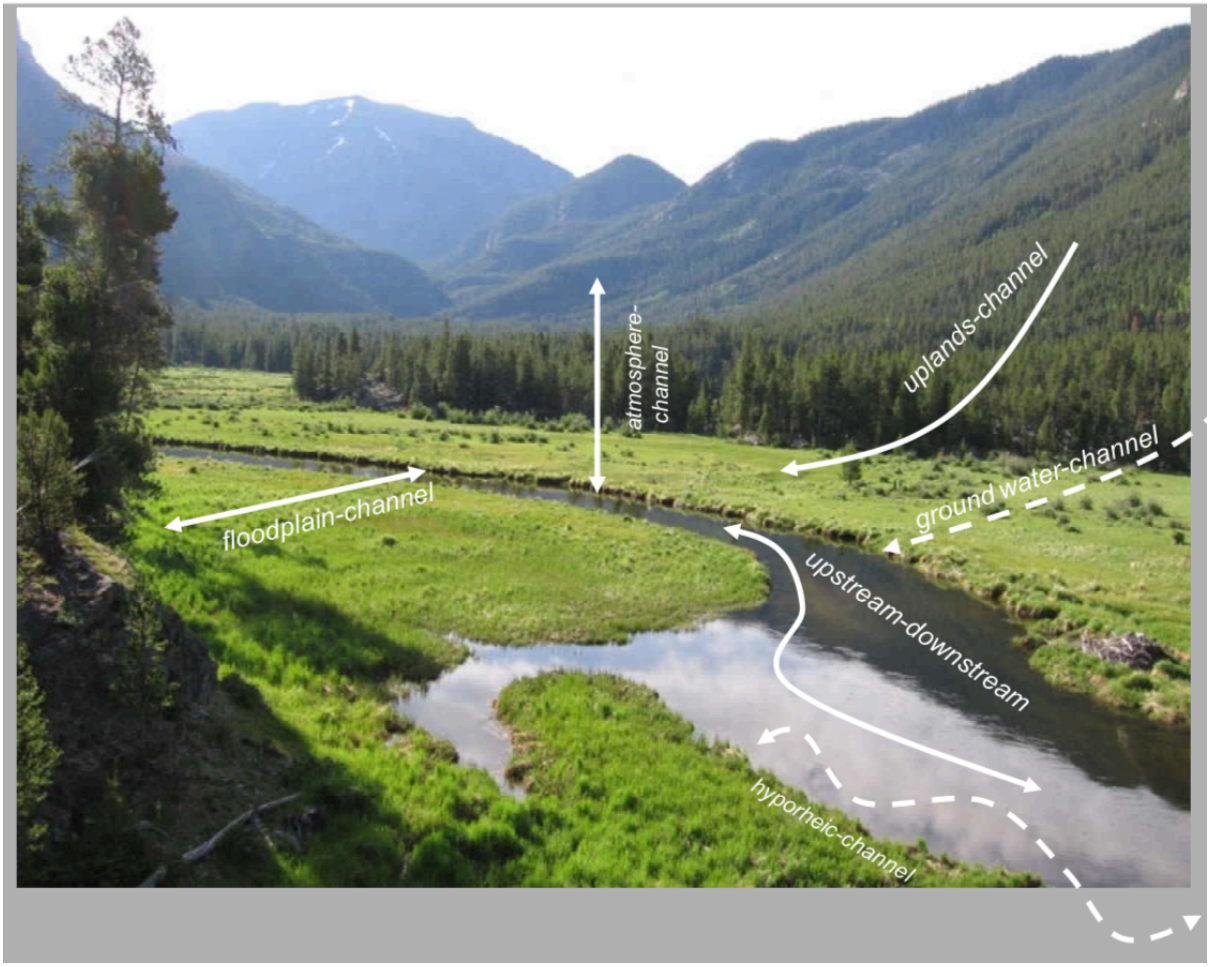

Figure 2.2: Illustrative view of the six connectivity dimensions in Figure 2.1 superimposed on a watercourse image (Source: Wohl 2015).[157] All of the areas linked to the channel form integral parts of the watercourse ecosystem and must form part of the assessment of any activity that may impact upon it.

Within the dual context of a watershed-level/aquatic ecosystem-focus, conservation initiatives may be positively augmented because 'the closer the connection to water, the greater

[156] Rinaldo A et al (2018). n83.
[157] Wohl E (2013) Ibid. Figure S1.8. Reproduced with permission.

the possible limitations *to reattach land rights* to the broader landscape',[158] ie a reduction of options for offsetting or reversing fragmentation (own emphasis). Such consideration, of itself, limits the expectations of landowners in terms of their not being able to develop land/water connections that are important in the public interest but triggering property ownership conflicts. As such, a watershed-level approach is herein regarded as fundamental to connectivity-informed decision-making, given that the whole of the aquatic ecosystem comprises a multitude of variously interconnected components spread throughout it.

(b) HEC as a regulatory construct

'Connectivity is a cornerstone' to sustaining freshwater ecosystem functionality.[159] Hydrologic connectivity has been defined as an ecohydrological construct[160] embracing 'the water-mediated transfer of matter, energy and/or organisms within or between elements of the hydrologic cycle'.[161] 'Water-mediated' is, however, not the best term to use as it can suggest that connections only exist when water is present. HEC is regarded here as encompassing both active and passive exchange and/or dispersal mechanisms such as, for example, migratory waterfowl moving between a river and an isolated wetland or oxbow lake; or amphibians migrating overland between their terrestrial habitat and seasonal breeding ponds, or leaf-fall contributing organic detritus into streams (see Figure 2.3). In this regard the term encompasses the transfer of matter, energy or organisms, which have a functional association with an aquatic ecosystem, by any natural, non-anthropogenic means.

Rivers are generally regarded as integrators of the physical, chemical and biotic processes occurring within the environment through which they flow.[162] As recognised in *US v Rapanos*, 'nesting, spawning, rearing and resting sites for aquatic or land species... provide values [that] are hardly independent ecological considerations... instead they are integral to the

[158] Tarlock AD (2000) 'Reconnecting property rights to watersheds'. 25 *Wm. & Mary Envtl. L. & Pol'y Rev*. 69. On this argument, portions of land which form part of the aquatic ecosystem cannot be 'detached' from their specific landscape role to allow uses which may be detrimental to the water resource.
[159] Sullivan MSP, Rains MC & Rodewald AD et al (2020) 'Distorting science, putting water at risk'. 369 *Insights* 766-768.
[160] Hydroecology is a relatively new emerging paradigm in the biological sciences. See Hannah et al (2004) 'Ecohydrology and hydroecology: A 'new paradigm' ' 18 *Hydrol. Process* 3439-3445. It is supported by recent trends wherein ecology presents as an integrative agent for the separation of natural science disciplines that occurred in the biological sciences circa 1960-1980 — and, inevitably, led to a fragmented process of assessment. See Barrett GW (2001) 'Closing the ecological cycle: the emergence of integrative science'. 7 *Ecosystem Health* 79-84.
[161] Pringle C (2003) op cit n31.
[162] Wohl (2013) (n154) at 6.

chemical, physical and biological integrity of the Nation's waters,' setting a clear awareness of the role played by HEC.[163]

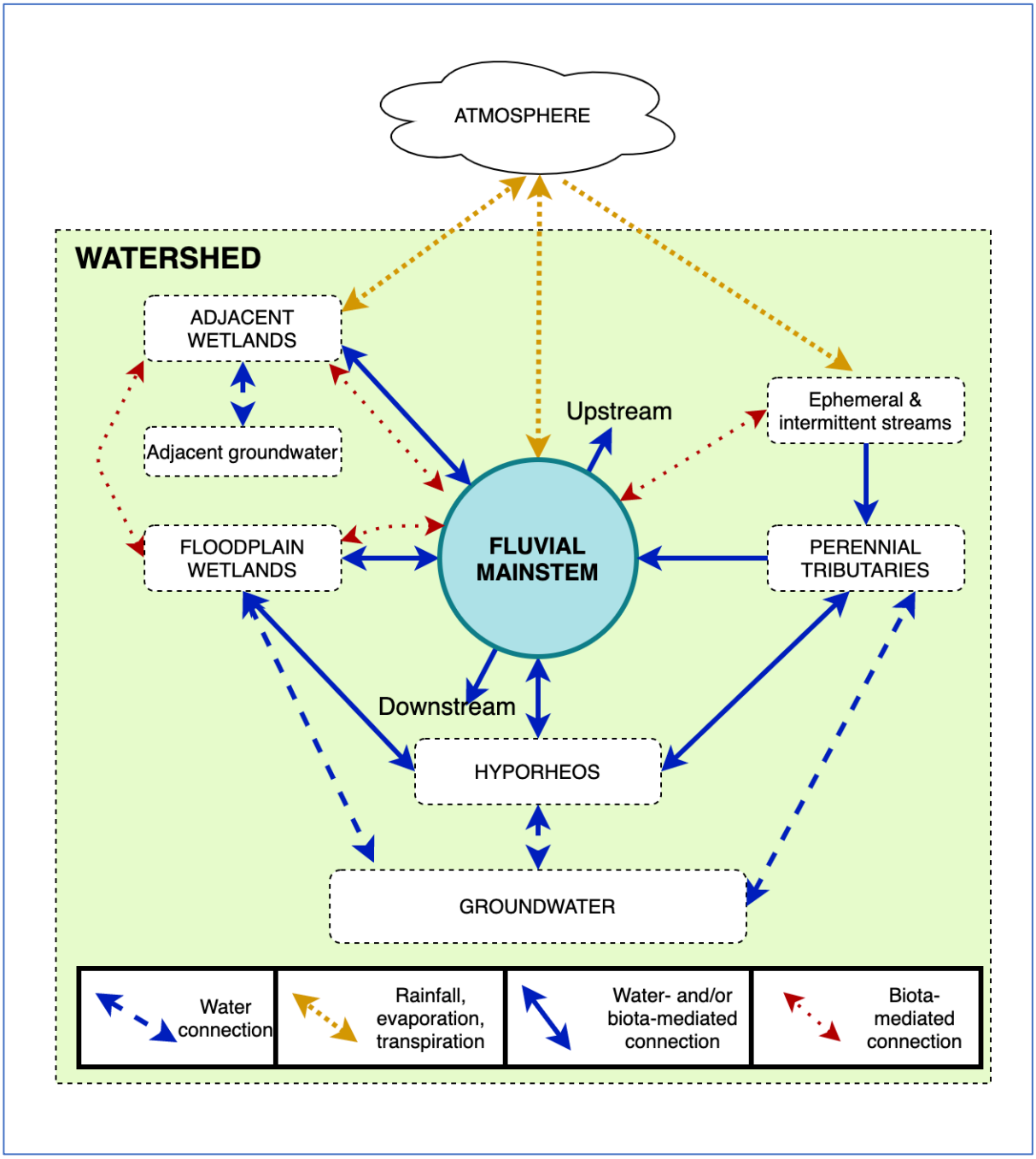

Figure 2.3: Diagrammatic representation of the types of connections, between a stream or river (fluvial mainstem) and aquatic environments, including land, directly connected or adjacent thereto.

From an ecological perspective, connectivity may be described as the 'degree to which a landscape facilitates or impedes the movement of organisms between their desired resource

[163] *Rapanos v United States*; 33. U.S.C. §1251(a). See Chapter 4.

patches'.[164] The ability of a species to persist in a landscape is a function of the size and degree of connectedness of the patches it must inhabit in order to survive.[165] As a patch becomes fragmented and the inter-patch links are broken, so species resilience declines. The concept of 'landscape connectivity' thus refers to the interaction between the attributes of species and the landscape structure within which they occur, and how these factors determine the movement of biota amongst habitat patches.[166] Sustaining this connectivity is 'fundamental to ensuring species persistence, ecosystem integrity and human well-being'.[167]

From the foregoing, HEC (or its equivalent expression, 'ecohydrological' connectivity) is here defined as the degree to which the components of an aquatic landscape are joined by and interact through various transport mechanisms, including but not limited to the movement or presence of water, that function across multiple spatial and temporal scales, and which are determined by the characteristics of both the physical landscape and its biota. Alternatively defined, HEC is the movement of material, energy and biota through and between fluvial hydrosystems and their adjacent, integrated aquatic, semi-aquatic and/or terrestrial environments, via a variety of transfer mechanisms.

(c) The disruption of HEC

It has been apparent for many decades that water resources, globally, continue to suffer as unwilling receivers of anthropogenic pollution and other abuses. Limnologists are aware that 'nowhere is the biodiversity crisis more acute than in freshwater ecosystems'.[168] Hydroecological 'alterations', permitted under the title of 'water uses', even with the best of intentions, can result in very negative outcomes that contribute to an insidious progression of 'collateral squander' and progressive ecosystem decay.[169] Widespread neglect of the environment in general, coupled with narrow prioritisation of ecosystem services, have resulted in the accelerated decline in ecosystem condition and hence reductions in the provision of

[164] Pringle C (2003) Op cit at 2686.
[165] Rivers-Moore N, Mantel S & P Ramulifo et al (2016) 'A disconnectivity index for improving choices in managing protected areas for rivers'. 26 *Aquatic Conserv: Mar. Freshw. Ecosyst* 29-38.
[166] Merriam G (1984) cited in Pringle (2003) at 2686. See also Hermoso V, Linke S & J Prenda et al (2011) 'Addressing longitudinal connectivity in the systematic conservation of fresh waters'. 56 *Freshwater Biology* 57-70.
[167] Jaeger KL et al (2014) Climate change poised to threaten hydrologic connectivity and endemic fishes in dryland streams. 111 *PNAS* 13894-13899. Also: Schofield KA, Alexander LC & CE Ridley et al (2018) 'Biota connect aquatic habitats throughout freshwater ecosystem mosaics'. 54 *J. Am. Water Resour. Assoc*. 372-399.
[168] eg Tickner D et al (2020) 'Bending the curve of global freshwater biodiversity loss: An emergency recovery plan'. *BioScience* https://doi.org/10.1093/biosci/biaa002. 1-13.
[169] eg Naiman RJ & D Dudgeon (2011) 'Global alteration of freshwaters: influences on human and environmental well-being'. 26 *Ecological Research* 865-873.

essential services therefrom. The 'de-coupling' of connection-dependent foodwebs leads to the formation of 'ghost species', akin to 'dead species walking' - organisms which will be unable to survive because the connections to resources essential for their survival have been lost.[170]

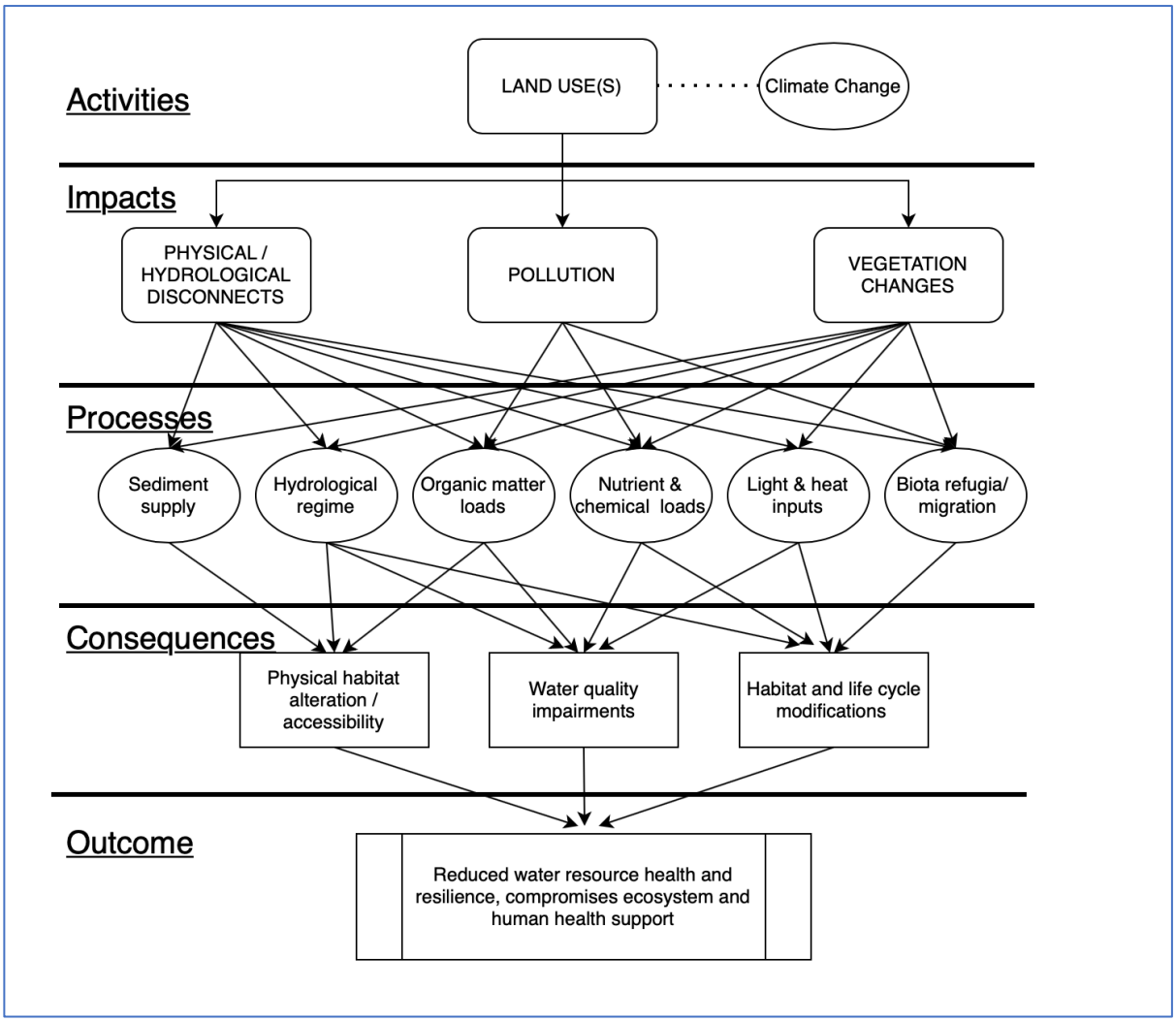

Figure 2.4: Flowchart of the causes and consequences of land use activities on aquatic ecosystems (modified from Beechie *et al* (2003).

The principal threats to aquatic ecosystems are habitat loss and degradation, invasive species, pollution, over-exploitation and climate change (see Figure 2.4). Connectivity disruptions, a form of ecosystem fragmentation, exacerbate all of these threats and, for protection measures to be effective, consideration needs to be taken of the upstream drainage network, the surrounding land, the riparian and floodplain zones and the downstream reaches.[171] Furthermore, climate change — via the intimate links between atmosphere and

[170] Heleno RH, Ripple WJ and A Traveset (2020) 'Scientists' warning on endangered foodwebs'. 20 *Web Ecol* 1-10.
[171] Arthington AH et al (2016) 'Fish conservation in freshwater and marine realms: status, threats and management'. 26 *Aquatic Conservation: Marine and Freshwater Ecosystems* 838-857.

hydrosphere — is having, and will continue to wreak devastating global pandemic-scale impacts that will, *inter alia*, cause distributional shifts and further delink aquatic environments, especially wetlands, from their watersheds. The predictions are that South Africa will experience extreme and adverse climate change effects.[172] These impacts emphasize the need for urgency in considerations of preserving connectivity functions.[173] Seen from a global perspective, the need to 'safeguard and restore freshwater ecosystem connectivity' is one of six targets recently embedded in a Convention on Biodiversity-aligned 'Emergency Recovery Plan' aimed at stemming the tide of freshwater biodiversity loss.[174] This awareness is, however, perhaps already too late to attenuate much of the already extant fragmentation.

Both the CWA and the NWA have a distinct core focus on pollution control. Pollution also creates disconnections, for example the flow of unwanted materials and pollutants, originating from discrete or diffuse land use activities, at one area of the catchment, into and through the downstream aquatic environment. In one example, extremely high levels of herbicides and fungicides were detected in an impoundment fed by three rivers in the Gauteng Province of South Africa, creating a one-hundred fold increase in cancer risk over baseline levels in the raw potable water and biota in the reservoir.[175] In other instances elevated pollutant loads downstream of the discharges from wastewater treatment facilities can create a chemical barrier to organisms wishing to move up- or downstream, as well as altering habitat.

The environmental paradox

The need for a wider civil society awareness of ecosystem de-coupling has potentially been retarded by arguments which suggest that human well-being continues to increase despite worsening environmental conditions, the so-called 'environmentalists' paradox'. [176] Although beyond the scope to address this aspect in any detail here, such conclusions have clearly been made largely at a 'global scale' and fail to adequately consider economic strata and conditions at local or sub-local levels. The importance of a relevant scale is vital to this type of analysis.

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[172] eg Gumbo AD et al. (2022) 'A systematic study site selection protocol to determine environmental flows in the headwater catchments of the Vhembe Biosphere Reserve'. 19 *Int. J. Environ. Res. Public Health* at 2.
[173] Seavy NE et al (2009) 'Why climate change makes riparian restoration more important than ever: Recommendations for practice and research'. 27 *Ecological Restoration* 330-338.
[174] Tickner (2020) n168 op cit at 7
[175] Barnhoorn I and C van Dyk (2020) 'The first report of selected herbicides and fungicides in water and fish from a highly-utilised and polluted freshwater urban environment'. *27 Environmental Science and Pollution Research* 33393-33398.
[176] eg Raudsepp-Hearne et al (2010) 'Untangling the environmentalists' paradox: Why is human well-being increasing as ecosystem services degrade?' 60 *Bioscience* 576-589.

Furthermore, such findings are perhaps willfully ignorant of the socio-economic hardships and declining well-being in countries such as South Africa, as well as of the differences inherent in weak- vs strong-sustainability. Additionally, such arguments tend to ignore the idea that the temporal drawdown of ecosystem service-providing resources embodies a certain level of resilience redundancy which does not support a linear relationship between apparent well-being and resource condition.[177] What this means is that there is often a sustained lag between a new land use and evidence of negative impacts. The unfortunate consequence of these claims is that, rather than foster a need for increased environmental protections, an impression may be created that supports a 'business as usual' development approach — which may influence the perceptions held by administrative decision makers. Arising from this brief discussion of this paradox is that water resource governance founded on providing an assurance of connectivity should go some way towards providing additional in-built safeguards aligned with the need for an ecosystem-wide perspective.

(d) The need to include consideration of lateral zones

Chapter 1 introduced the concepts of water resource domains, lateral zones adjacent to watercourses and ecotones. Water resource domains comprise not only the visually evident watercourse within its banks, but also riparian lands adjacent thereto.

River and stream riparia are defined as 'the stream [corridor] between the high and low water marks and that portion of the terrestrial landscape from the high water mark towards the uplands, where vegetation may be influenced by elevated water tables or flooding, and/or by the ability of the soils to retain water'.[178] As will be evident from the foregoing consideration of connectivity, these lateral zones are essential for a plethora of biophysical and chemical exchanges and interactions between the aquatic and terrestrial environments (see Figure 2.3).[179] Also apparent is that these areas may be both spatially extensive and difficult to delineate.

[177] eg Nelson GC (2011) 'Untangling the environmentalists' paradox: Better data, better accounting and better technology will help'. 61 *Bioscience* 9-10.
[178] Naiman RJ and H Decamps (1997) 'The ecology of interfaces: riparian zones'. 28 *Annual Review Ecology and Systematics* 621-658.
[179] Sheldon F et al (2010) 'Ecological roles and threats to aquatic refugia in arid landscapes: dryland river waterholes'. 61 *Marine and Freshwater Research* 885-895. See also Boulton et al (2010) 'Ecology and management of the hyporheic zone: stream-groundwater interactions of running waters and their floodplains'. 29 *J. N. Am. Benthol. Soc*. 26-40 — highlighting the need to not lose sight of the vertical dimension of surface-groundwater linkages.

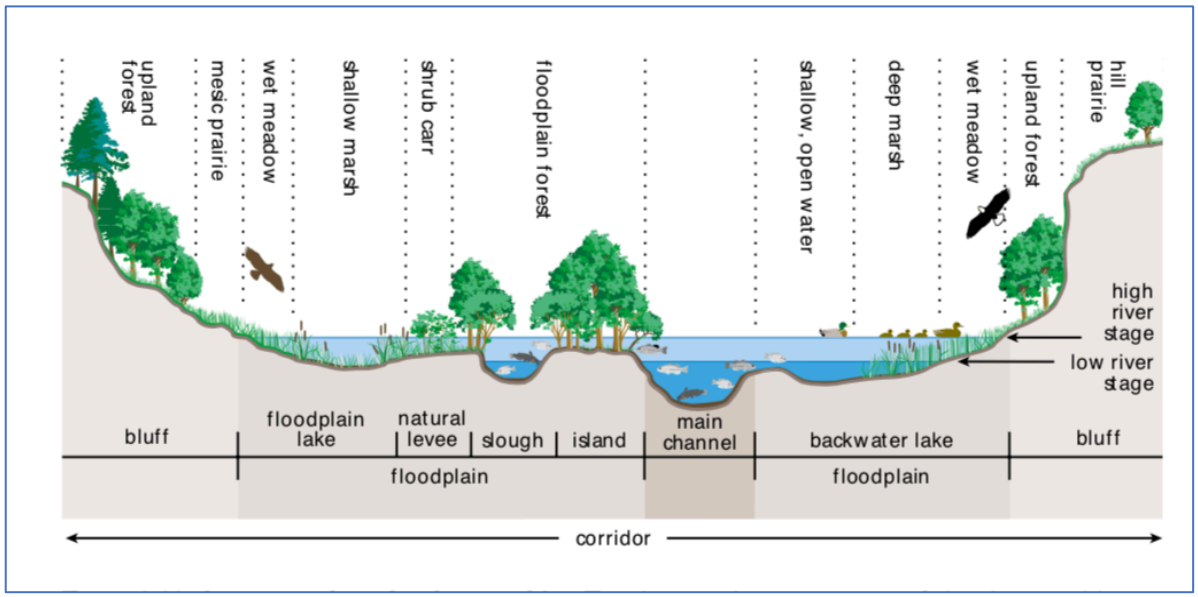

Figure 2.5: Typical lateral elements of a watercourse corridor, showing how these are connected or separated by the water level (river stage). Source: USDA[180]

There is a global tendency to inadequately cater for the protection of these important lateral and fringing environments,[181] resulting perhaps from ignorance of the fact that the condition of the entire catchment influences downstream river condition and biodiversity and that impact-related decision making must be from a pan-catchment perspective.[182] Habitats (= ecosystems) which may appear insular are often 'reticulately connected'.[183] Some boundaries may simply be almost impossible to discern with the naked eye. Crucial to this understanding is that the lateral zones encompass areas which must remain connected, actively or passively, above or below ground, or both, to the mainstem, especially in seasonal to ephemeral systems.[184] The CWR provides a specific example of agency recognition of the need to expressly protect the connectivity of waterscapes and thus mitigate the risk of exclusion of connected environments.[185]

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[180] United States Department of Agriculture (USDA) (1998, 2001 Revision) Stream Corridor Restoration: Principles, Processes and Practices. Part 53 of the National Engineering Handbook. USDA Natural Resources Conservation Center. Figure 1.11.

[181] eg LeRoy Poff N et al (1997) 'The natural flow regime'. 47 *BioScience* 769-784.

[182] Hermoso V, Kennard ML and S Linke (2012) 'Integrating multidirectional connectivity requirements in systematic conservation planning for freshwater systems'. 18 *Diversity and Distributions* 448-458. See also Johnson LB & GE Host (2010) 'Recent developments in landscape approaches for the study of aquatic ecosystems'. 29 *J. N. Am. Benthol. Soc*. 41-66.

[183] Talley DM, Huxel GR & M Holoak (2010) Connectivity At The land—Water Interface. Chapter 5 in Connectivity Conservation. Cambridge University Press.

[184] Hermoso V, Ward DP & MJ Kennard (2013) 'Prioritizing refugia for freshwater biodiversity conservation in highly seasonal ecosystems'. 19 *Diversity and Distributions* 1031-1042; Amoros C & G Bornette (2002) 'Connectivity and biocomplexity in waterbodies of riverine floodplains.' 47 *Freshwater Biology* 761-776.

[185] Creed IF, Lane CR and JN Serran et al (2017) 'Enhancing protection for vulnerable waters'. 10 *Nature Geoscience* 809-815.

It is therefore clear that rivers and their riparian zones must remain HEC-connected in order to sustain their functional integrity. The corollary arising from this is that land uses in the riparian zone must have regard for these linkages. For example, determinations of ecological flow requirements (instream flows) must routinely consider the role that flow dynamics play in structuring riparian vegetation.[186] In a development-related context, the placement of, for example, buildings or sportsfields needs to be informed by the need to retain all or portions of the floodplain unaltered and in hydrological contact with an adjacent river, stream or wetland. Clearing of riverbanks or adjacent lands must therefore have regard for what these areas may provide, may have provided or prevented from reaching the river — for example attenuation of flood flows or the sequestration of pollutants. In an agricultural setting there is a need to consider water quality and manage the quality of runoff accordingly.[187] Research has shown that restoration of degraded riparian zones not only reduces pollution but can also augment stream complexity.[188]

(e) Out of sight, out of mind: The overwhelming importance of small, headwater streams

On a global scale, small waterbodies are the most numerous aquatic environments — and they are also the least-well understood.[189] The uppermost reaches of river networks, the headwaters or 'source' waters, are largely comprised of small ephemeral, seasonal or perennial streams, denoted as being First or Second Order (see Figures 2.4 & 2.5). [190] They are the most abundant in both number and distance of travel of any stream order and, as a consequence, are in contact with a very high proportion of catchment area — and hence are potentially exposed to the potential impact of a plethora of land use impacts. At the same time, their aggregate length interfaces with large areas of upland terrestrial habitats.[191] Without largely intact headwater catchments the ecological integrity of downstream river networks are threatened.[192]

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[186] James CS et al (2016) 'Does stream flow structure woody riparian vegetation in sub-tropical catchments? ' *Ecology and Evolution* (John Wiley and Sons Ltd) 1-14.
[187] eg Hunter H et al (2006) 'Managing riparian lands to improve water quality: optimising nitrate removal via denitrification'. Cooperative Research Centre for Coastal Zone, Estuary and Waterway Management. Technical Report 57. Coastal CRC, Indooroopilly, Qld. Australia.
[188] Laceby JP et al (2017) 'The effect of riparian restoration on channel complexity and soil nutrients'. 68 *Marine and Freshwater Research* 2041-2051.
[189] Biggs J, von Funetti S & M Kelly-Quinn (2017) 'The importance of small waterbodies for biodiversity and ecosystem services: implications for policy makers'. 793 *Hydrobiologia* 3-39.
[190] Streams between a source, eg a spring, and the first connecting stream of the same order, are First Order, and downstream of the confluence of two First Order streams a Second Order stream is formed.
[191] See text associated with n189 infra.
[192] Meyer JL et al (2007) 'The contribution of headwater streams to biodiversity in river networks'. 43 *Journal of the American Water Resources Association* at 97.

These two orders of streams generally comprise between seventy and eighty per cent of the total channel length of river networks.[193] In the USA, headwaters reported to comprise 53% of total river length (2.9 million kilometers) and 59% of the total length, are made up of intermittent or temporary waters (3.2 million kilometers).[194] In South Africa, having just 164 000 km of rivers, a very significant 79 per cent of total river length is comprised of First and Second Order headwaters and small tributaries.[195] Given the dire condition of the mainstem and lowland rivers generally (see Chapter 1), the importance of maintaining healthy upstream tributaries is catapulted into prominence, otherwise conservation targets will simply not be attainable.[196]

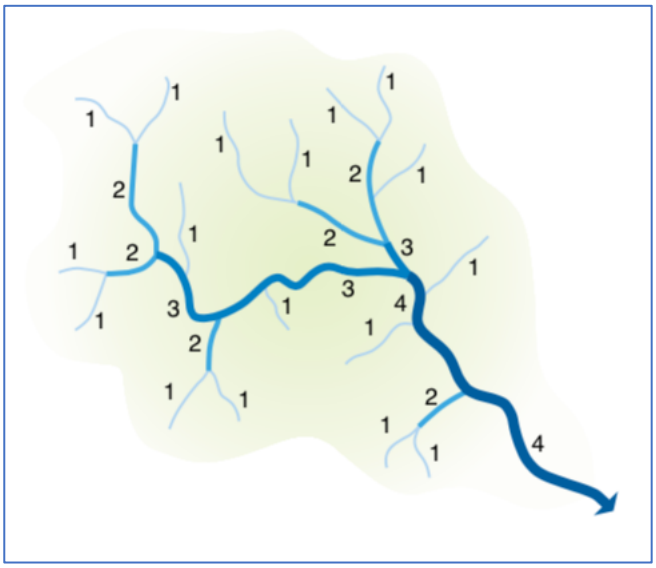

Figure 2.6: Diagram showing ordering of streams (Source: USDA[197]).

Headwater streams provide a suite of ecosystem services that percolate throughout the whole of the downstream riverine network eg retaining or transmitting sediment, providing habitat and refugia for a diverse array of both aquatic and riparian organisms, providing migration corridors between the uplands and the downstream and 'governing connectivity at a watershed-scale'.[198] This stream type is very closely coupled to the landscape sources of

[193] Wohl E (2017) 'The significance of small streams'. 11 *Front. Earth Sci*. 447-456.
[194] Nadeau T & MC Rains (2007) 'Hydrological connectivity between headwater streams and downstream waters: How science can inform policy'. 43 *Journal of the American Water Resources Association* 118-133. These data are from the National Hydrography Dataset in which stream order is not used as a metric.
[195] Harding WR and H van Deventer (in preparation) 'An analysis of lateral (riparian) aquatic ecosystem brightline distances for South African rivers: A hydroecological connectivity-based perspective'. See Chapter 3.
[196] Nel JL, Roux DJ & G Maree et al (2007) 'Rivers in peril inside and outside protected areas: a systematic approach to conservation assessment of river ecosystems'. 13 *Diversity and Distributions* 341-352.
[197] USDA (1998) (ibid, Figure 1.30).
[198] Wohl (2017) ibid.

materials and biota important to the whole of a river ecosystem, sources described as 'subsidizing' downstream river communities.[199] Furthermore, as set out above, they may provide unique habitat not present anywhere else in the stream network.[200] The bulk of the water volume and nutrient supply delivered from the headwaters to higher order streams, augmented with the physical and biochemical processes occurring in the headwaters, positively influence the water quality downstream.[201]If it is assumed that upstream environments, or those located in protected areas such as national parks, are less impacted than lowland rivers in developed areas, then the value of the transfers of materials from the intact biocomplexities upstream to downstream become evident.

Figure 2.7 provides a clear example of the relationship between small streams and a watershed in both intra- and inter-annual contexts. In the comparison of two annual hydrocycles, it was apparent that that fluvial connections throughout the watershed only occurred in July 2012, whereas for the other five months represented, the watershed was largely disconnected from the fluvial mainstem. These variations in water flow notwithstanding, a governance policy founded on a connectivity-based regulatory approach should ensure that the importance of, and need to protect, these headwaters is equivalent, whether wet or dry.

Despite their unique and significant importance to the health of the connected river system, headwaters are, generally, not adequately recognised as essential water resource components other than by aquatic ecologists.[202] Consequently, abuse to these waters runs the risk of eluding regulatory protections, resulting in their 'aggressive alteration'.[203] Alternatively, the owners of lands through which these waters flow, generally farmers, modify their lands for example by creating dams for irrigation or re-directing streams into ditches absent any consideration of the resultant fragmentation of the stream network or, through the creation of fields, contribute to the loss of riparian and connected upland habitat. While such abuse may be willfully inflicted, it is also likely to arise as a consequence of simple ignorance.[204]

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[199] Wipfli MS, Richardson JS and RJ Naiman (2007) 'Ecological linkages between headwaters and downstream ecosystems: Transport of organic matter, invertebrates, and wood down headwater channels'. 43 *Journal of the American Water Resources Association* 72-85.
[200] Richardson JS (2019) 'Biological diversity in headwater streams'. 11 *Water* 366.
[201] Alexander RB, Boyer EW, Smith RA, Schwarz G & RB Moore (2007) 'The role of headwater streams in downstream water quality.' 43 *Journal of the American Water Resources Association* 41-59.
[202] Wohl (2017) ibid.
[203] Wohl (2017) ibid. See also Wohl (2006) 'Human impacts to mountain streams' 79 *Geomorphology* 217-248.
[204] Wohl E (2006) 'Human impacts to mountain streams'. 79 *Geomorphology* 217-248. Table 1 lists the types of land use activities having a direct or indirect impact on lower order streams.

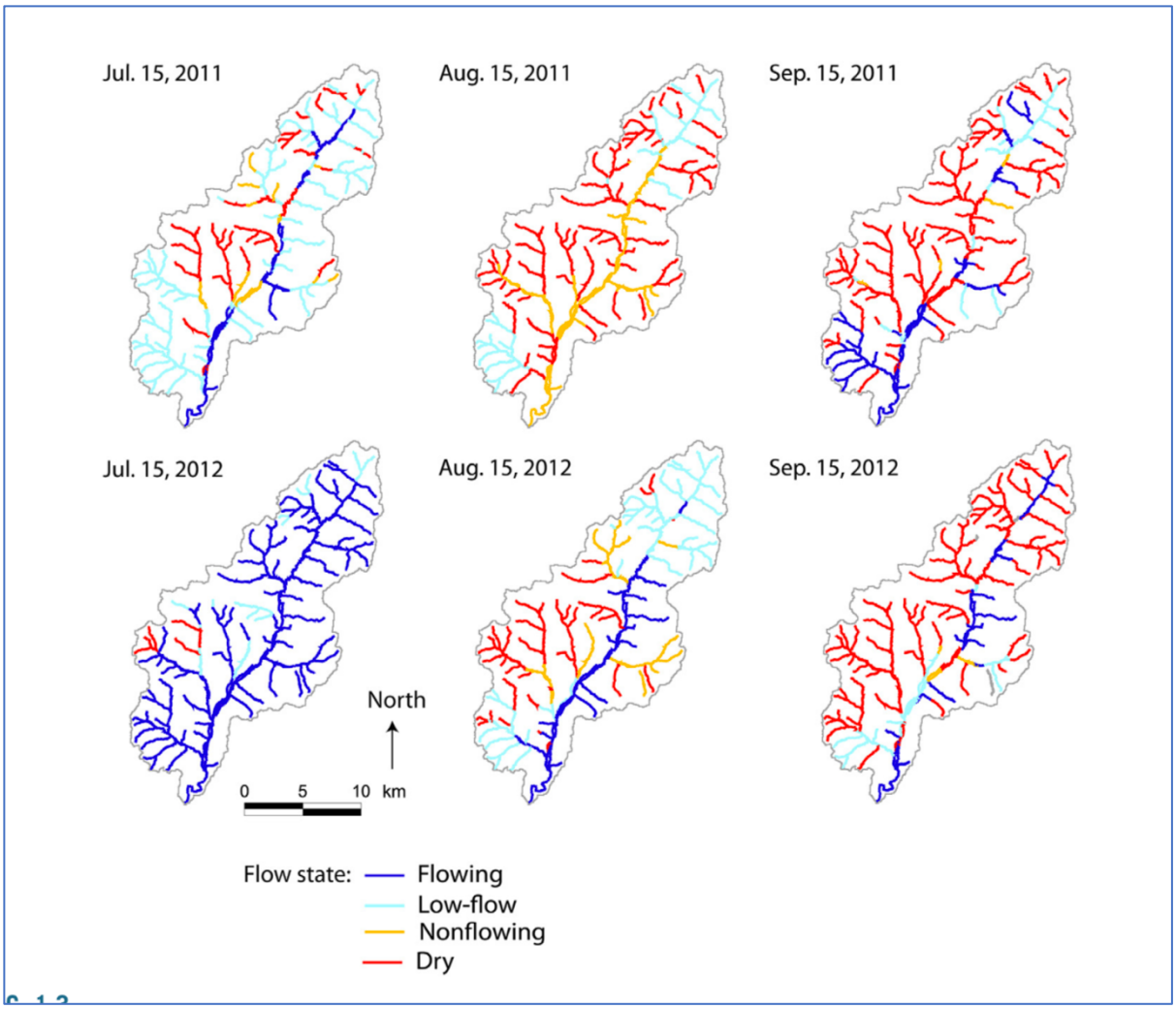

Figure 2.7: Example showing inter- and intra-annual variability in streamflow in a single watershed. Note the extremes of flow patterns between August 2011 (top, middle - mostly all stream orders dry) vs July 2012 (bottom left, almost all flowing) (Source: Datry et al (2017).[205]

(f) Intermittent river and ephemeral stream considerations

Intermittent rivers and ephemeral streams ('IRES') are numerous in certain landscapes, especially in dryland and arid environments such as occur over much of South Africa, the American southwest, Spain, Italy and elsewhere. Even without anthropogenic interference, this class of waters has its own suite of connectivity challenges which are naturally part and parcel of the delicate arid ecosystem types they form. Their ecology is considerably less understood when compared to that of perennial waters — invoking a greater need for caution in the absence of type-specific information.[206] Cessation or reduction in flows produce longitudinal

[205] Datry T, Bonada N & AJ Boulton (2017) (General Introduction) *Intermittent Rivers and Ephemeral Streams*. Academic Press. Figure 1.3.
[206] Mazor RD et al (2014) 'Integrating intermittent streams into watershed assessments: applicability of an index of biotic integrity'. 33 *Freshwater Science* 459-474.

disconnects that prevent the passage of biota or the transfer of materials; the stream banks can become hydrologically isolated as the stream dries up; or the surface to hyporheic zone connections are interrupted. The formation of these 'patchy, non-linear discontinua' underpin the functionality and biological worth of IRES, with intermittently-connected waters increasing the complexity of their associated habitats.[207] Rare and novel species commonly occur in such naturally-stressed ecosystems.

As the progenitor of climate change, human agencies indirectly create negative ecological consequences in addition to direct, watershed level impacts. Climate change will have disproportionately large impacts on small streams, headwaters and temporary/intermittent aquatic environments. Climate change may increase disconnects in IRES as a result of an increase in extreme droughts which will transform intermittently connected waters into 'ecological [death] traps' which will lead to species eradication.[208] Given the extent to which climate change has progressed and will progress before interventions might slow the process, many more disconnects will unavoidably occur. Accordingly, avoiding disconnections caused by direct anthropogenic actions becomes even more critical for future view water resource governance.

All too often IRES, in particular, and headwater streams in general, are not recognized by officials or the lay public[209] as being essential components of fluvial hydrosystems, yet they provide generally the same hydroecological functions as larger perennial waters, in addition to their being connected — by virtue of their aggregate length — to most of the catchment in which they occur.[210] When dry, these channels are often prone to being regarded as mere 'ditches', with no biological or biodiversity value whereas, in truth, flows occurring via these

[207] Boulton AJ et al (2017) 'Hydrological connectivity in intermittent rivers and ephemeral streams'. Chapter 2.3 in *Intermittent Rivers and Ephemeral Streams*. Elsevier Inc.
[208] Van der Vorste R, Obedzinski M & S Pierce et al (2020) 'Refuges and ecological traps: Extreme drought threatens persistence of an endangered fish in intermittent streams'. *Global Change Biology* DOI:10.1111/gcb.15116. On this model intermittent and tolerable disconnects will become permanent, with many species unable to survive.
[209] Here this thesis regards laypersons as largely inclusive of administrative decision makers.
[210] IRES waters 'provide landscape hydrologic connections; stream energy dissipation during high-water flows to reduce erosion and improve water quality; surface and subsurface water storage and exchange; ground-water recharge and discharge; sediment transport, storage, and deposition to aid in floodplain maintenance and development; nutrient storage and cycling; wildlife habitat and migration corridors; support for vegetation communities to help stabilize stream banks and provide wildlife services; and water supply and water-quality filtering. They provide a wide array of ecological functions including forage, cover, nesting, and movement corridors for wildlife. Because of the relatively higher moisture content in arid and semi-arid region streams, vegetation and wildlife abundance and diversity in and near them is proportionally higher than in the surrounding uplands'. Levick LR et al (2008) 'The Ecological and Hydrological Significance of Ephemeral and Intermittent Streams in the Arid and Semi-arid American Southwest'. USEPA EPA/600/R-08/134. 166pp.

very connections can produce dramatic and rapid triggering of physico-chemical and biotic responses, in most cases involving organisms which have specifically evolved to respond to such brief moments of water availability where life and reproduction become possible. Headwater streams are highly dependent on allochotonous[211] inputs of materials with their disconnection from the lateral environments cutting off this vital source of energy, nutrients and organic materials and, most importantly, the transfer thereof to downstream environments.[212] In many cases these systems provide vital habitat for rare and endangered species. In the same vein, there exist major natural science knowledge gaps regarding the biota, ecology and functioning of IRES, an aspect which invokes the need for caution in decisions that may impact on such environments — ie adopting a precautionary approach. Consequentially this type of hydrosystem has been especially prone to human activities such as, *inter alia*, ploughing, stripping of vegetation cover along the banks, conversion to field drains or ditches carrying irrigation runoff or interruption by multiple small dams and weirs.

South Africa's Grootrivier agricultural area is a case in point: During the 1980s government-funded water schemes were fully subscribed. In order to augment water supplies, farmers in the Grootrivier area in the southern Western Cape were encouraged to build as many small dams as they could on the small streams and gulleys on their farms, simply by pushing up small sand walls across the drainage lines. This watercourse fragmentation practice flourished, so much so that the main channel of the Grootrivier disappeared and the irrigation return-flow water collected in the small dams increased in salinity, creating severe water quality problems. The prolific presence of small dams on farm streams, especially in headwater areas, is a very common practice throughout South Africa.[213]

III. The value of an HEC-approach for water law and policy

The legal systems of the USA and South Africa have both implicitly adopted an ecosystem approach to environmental management.[214] In South Africa the right to an environment not harmful to health is constitutionally guaranteed as a fundamental, self-executing justiciable right.[215] Clear recognition of the role played by HEC was recently incorporated into US federal

[211] Inputs originating external to the aquatic environment.
[212] Richardson JS (2019) op cit.
[213] Anonymous (formerly Department of Water Affairs Planning Department) Interview submission per email dd 3 December 2020. Copy on file with author. Casual examination of GoogleEarth satellite imagery attests to this fact.
[214] See Chapter 1.
[215] South African Constitution (1996) s24.

law as the Clean Water Rule.[216] In South Africa, while a need for connectivity as a policy guideline for water resource protection has been identified, the concept has not hitherto been proposed or considered to be a normatively-cohesive foundation. Its absence from, for example, the delineation of national parks has been found wanting.[217] Any mention of consideration of connectivity is generally absent from water resource management strategy plans,[218]despite scientific recognition of the importance of lateral environments as important sources of allochotonous materials essential for aquatic environments.[219]

Analyses of water resource conservation challenges in South Africa has similarly identified the need to have regard not only for a particular water resource component, but also for 'the surrounding land and [connected] network of [other waterbodies]'.[220] Despite this scientifically-substantiated recognition, an explicit connectivity-directed approach for water resources remains lacking, including within environmental flow methodologies associated with Ecological Reserve determinations.[221] Accordingly, adjacent waters having a significant hydroecological nexus with the fluvial mainstem may be overlooked.

Highlighted at the outset of this chapter was the potential for risk of harm to, or loss of, aquatic ecosystem integrity arising from regulatory failings, in this specific context a failure to consider the connectivity linkages between water resource components. At a global level, the 'regulatory' fragmentation of ecosystems, particularly aquatic, occasioned by spatial regulatory myopia[222] or physical or other disruptions (eg dams, water diversions) to any of the aforementioned dimensions of connectivity, continues to be decried and considered by many legal scholars to be a pervasive problem.[223] In the USA, for example, 98 per cent of the nation's streams have been interrupted by physical barriers and only 12 per cent of its wetlands are

[216] The Clean Water Rule arose directly from jurisdictional uncertainty after a trilogy of cases which ended in the US Supreme Court — but with the need for the maintenance of connections apparent well before the final decision. See, for example, Kerns J (2006) 'A nexus runs through it: Wetlands, hydrological connections, and federal jurisdiction in the post-*SWANCC* world'. 36 *ELR* 10222.
[217] Reis V et al (2017) 'A global assessment of inland wetland conservation status'. 67 *BioScience* 523-533.
[218] eg Mukheibir P (2009) 'Water resources management strategies for adaptation to climate-induced impacts in South Africa'. 22 *Water Resour Manage* 1259-1276.
[219] eg Richoux et al (2015) Connectivity Through Allochotony: Reciprocal Links Between Adjacent Aquatic And Terrestrial Ecosystems In South Africa'. Water Research Commission Report 2186/1/15.
[220] Nel et al (2009) 'Progress and challenges in freshwater conservation planning'. 19 *Aquatic Conserv: Mar. Freshw. Ecosyst*. 474-485.
[221] Prof A Arthington, pers. comm by email dd 2 August 2021). Copy on file with author.
[222] This term refers in this thesis to the deplorable practice of environmental impacts only being assessed within a very narrow spatial context, or a failure to consider the quantum of cumulative impacts on the same ecosystem (=cumulative harms).
[223] eg Craig RK (2008) 'Climate change, regulatory fragmentation and water triage'. 79 *University of Colorado Law Review* 825-927.

located in protected areas.[224] In South Africa there remains only a single major river that has not yet been impounded.[225]

At a human level, the 2020 corona virus disease (COVID) pandemic has also refocused attention on earlier scientific predictions that anthropogenic interference with, and fragmentation of, ecological processes in general could augment an increased incidence of novel zoonotic infectious diseases.[226] This warning should, indirectly, heighten the need for urgent action to protect the functional integrity of the remaining aquatic and associated ecosystems, especially those in headwater areas and the remnant healthy fragments in the developed lowlands. The recent OneHealth framework expands previous initiatives such as EcoHealth[227] to the 'inextricable connection of humans, pets, livestock and wildlife, with their social and ecological environments'.[228]

A significant and negative over-arching impact on hydrologic connectivity, especially for ephemeral or intermittent waters sometimes referred to as dryland systems — is that posed by climate change.[229] This will bring about devastating consequences for many aquatic ecosystems and, consequently, impair the linked dependencies of human health and well-being.[230]

Also not to be lost from consideration is the potentially-negative outcome of induced connections created by increased rainfall patterns, or by inter-basin transfer schemes whereby water is transferred from one catchment to another via pipelines and canal systems — in the process providing an unnatural connection whereby organisms endemic to one system can pass into and disrupt the ecology of another.[231] These lie, however, within a category of 'gross

[224] Reis V et al (2017) *Op cit* at 527.
[225] Doring River, Western Province.
[226] eg McMichael AJ (2001) 'Human culture, ecological change and infectious disease: Are we experiencing history's fourth great transition?' 7 *Ecosystem Health* 107-115. See also: Kawabata Z (2011) 'Environmental change, pathogens, and human linkages. Part 1: ecological case studies'. 26 *Ecological Research* 863-864.
[227] Lebel, J. (2003). *Health: An ecosystem approach.* International Development Research Centre Canada. Available from https://bit.ly/34fYoO1.
[228] Chapter 1, Section 1. See also Mackenzie JS and M Jeggo (2019) 'The One Health Approach — Why is it so important'. 4 *Trop. Med. Infect. Dis.* 88. The One Health goal is the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment. See also Keune H, Unnikrishnan P, Morand S & SR Rüegg (2022) 'One Health and Biodiversity.' Chapter 4 in *Transforming Biodiversity and Governance* (Visseren-Hamakers IJ & MTJ Kok eds) Cambridge University Press.
[229] Jaeger KL et al (2014). n167.
[230] Naiman RJ and D Dudgeon (2011) n169.
[231] eg Shelton JM et al (2017) 'Population crash in Lesotho's endemic Maloti minnow *Pseudobarbus quathlambae* following invasion by translocated smallmouth yellowfish *Labeobarbus aeneus*.' 27 *Aquatic. Conserv: Mar. Freshw. Ecosyst.* 65-77. In this instance, a connection between two dams in the Lesotho

alterations', whereas this analysis is mainly concerned with individually and relatively small, yet cumulatively significant, land use harms which progressively weaken the integrity of an ecosystem.

From a regulatory perspective, the sheer complexity of ecosystem connectivity presents significant challenges for administrative governance. With respect to HEC, it would be administratively futile to attempt to delineate the fine-scale minutiae of connectivity. Alternatively expressed, the architecture of HEC is exceedingly complex — ie that 'avoiding connectivity disruptions, to the greatest extent possible' should be the underlying precautionary mantra, as restoration prospects are likely to be limited in the extreme.[232] This makes it preferable to adopt a distance-based approach which will sweep in all likely-to-be connected components at the outset.[233]

Furthermore, as will be addressed in this and subsequent chapters, a large percentage of the upper reaches of streams, rivers and wetlands occur on privately-owned land, for example farmland, and are often hidden from public awareness or scrutiny. Agricultural practices can result, *inter alia*, in a reduction of refugia and habitat. Such areas, which might harbour vital habitat or materials, may be impacted by, *inter alia*, insecticides, grazing, habitat destruction (ploughing, burning) and/or soil erosion.

Connectivity considerations extant in South African water law

This section sets out the extent to which South African water law and policy may be perceived to incorporate HEC nuances. In South Africa, while all types of watercourses are regulated, the integrality of their connected components, while perhaps implied, is not a foundational premise on which their regulation is currently based. Furthermore, components such as wetlands and groundwater are only tangentially regulated and often from quite discrete spatial perspectives. On the grounds of having regard for rivers as ecological integrators, a regulatory water resource governance approach requires that all HEC-connected components be drawn into the same regulatory framework. Moreover, such an approach goes far beyond the ecological imperatives of managing an ecosystem an integrally-connected whole — it also provides a framework on which all permitted water uses in a particular watershed can be practically and pragmatically

Highlands Water Scheme, which delivers water to the industrial heartland of South Africa, allowed one species to almost completely eradicate Lesotho's only endemic fish species.

[232] Fuller IC and RG Death (2017) 'The science of connected ecosystems: What is the role of catchment-scale connectivity for healthy river ecology?' 29 *Land Degrad Dev*. 1413-1426.

[233] Developed further in Chapter 3.

concomitantly reviewed.[234] The goals and objectives of the NWA are to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in a suitable and equitable manner so as to, *inter alia*, meet basic human needs... and to 'protect aquatic and associated ecosystems and their biological diversity'.[235] Giving effect to these goals and objectives is a trusteeship obligation to be executed in the public interest, ie it is a fiduciary obligation.[236] The obligation is anchored in and mandated by the Constitution via Sections 24,[237] 25[238] and 27.[239]

In the aforementioned constitutional clauses can be discerned the essence of the public trust obligations. Section 24(b) provides for a future-view ecosystem approach to the environment (within which aquatic ecosystems constitute a primary component); Section 25 allows for expropriation of land — which, in the context of the dual title of land ownership facilitated by the PTD principles, which is assumed would encompass restrictions on land use

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[234] See Chapter 6. The underlying rationale here is that all instances of a licenced use on a fluvial hydrosystem should be evaluated together and not on a piecemeal basis which could fail to appropriately consider impacts translocated from one use to another, or from non-licenced land use impacts.

[235] Act 36 of 1998, s2 & s3.

[236] Ibid s3(1 & 2).

[237] Constitution of the Republic of SA (Act 108 of 1996)
Section 24. Environment
Everyone has the right
a. to an environment that harmful to their health or well-being; and
b. to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that
i. prevent pollution and ecological degradation;
ii. promote conservation; and
iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

[238] Section 25. Property
1...
2. Property may be expropriated only in terms of law of general application
a. for a public purpose or in the public interest; and
b. ...
4. For the purposes of this section
a. the public interest includes the nation's commitment to land reform, and to reforms to bring about equitable access to all South Africa's natural resources; and
b. ...
8. No provision of this section may impede the state from taking legislative and other measures to achieve land, water and related reform, in order to redress the results of past racial discrimination... .

[239] Section 27. Health care, food, water and social security
1. Everyone has the right to have access to
a. ...
b. sufficient food and water; and
c. ...
2. The state must take reasonable legislative and other measures, within its available resources, to achieve the progressive realisation of each of these rights.
3. ... .

that would impact negatively on the aquatic environment. Section 25 is nuanced, in the wording of sub-section 8, to have a distinct focus on righting the wrongs of apartheid, in specific re-allocation of water resources to all citizens. It is assumed here, however, that 'to achieve land, water and related reform' implies a future view of an ecosystem approach to the ecological sustainability of water resources. With respect to the right to water in Section 27, it is further assumed that the operationalisation of the public trust would constitute a fundamental part of 'reasonable legislative and other measures' necessary to sustainably realise a right to water.

The NWA makes no explicit mention of connectivity in a fluvial-, hydroecological- or watershed-based context. However, Principle 5 of the National Water Policy White Paper (NWPWP) refers to the 'necessity to recognise the unity of the water cycle and the interdependence of its elements...' [from a] 'catchment' perspective.[240] Similarly, nowhere do the NWA regulations address the need to provide an assurance of aquatic ecosystem connectivity. The National Water Resource Strategy (NWRS2), the policy instrument underpinning the implementation of the NWA, is required to, *inter alia*, 'promote the management of catchments in a holistic and integrated manner'[241]— ie empowering the Minister to craft any measures necessary to give effect to this duty. The section of the NWRS dealing with the protection and restoration of ecological infrastructure contains two connectivity-orientated principles: Principle 4, which deals with the conditions for water use authorisation, stipulates that the 'quality of all aspects of the resource [including]... the integrity of riparian and instream habitats and aquatic organisms... will be considered to ensure that water resources are protected'.[242] Here the use of the words 'integrity' and 'riparian' are presumed to enfold an implicit need for consideration of connectivity, but there is no explicit guidance. Furthermore, there is no policy or guidance that frames the role and values of HEC.

Equally, based on maintaining ecosystem integrity, Principle 6, entitled Integrated Protection of Aquatic Ecosystems, requires that aquatic ecosystems 'are to be managed in an integrated way'.[243]

[240] *White Paper on a National Water Policy for South Africa* (1997).
[241] NWA Section 6(1)(l).
[242] NWRS2 (2013) Principle 4, at 43.
[243] NWRS2 (2013) Principle 5, at 43.

Both of these principles are retained in the eight principles contained in the pending third revision of the NWRS (NWRS3).[244] In addition, in the NWRS3, the section addressing regulation in the water and sanitation sector highlights the threat of hydraulic fracturing to the 'interconnectivity and interdependence' of groundwater and surface water resources.[245] As such it may be assumed that the strategic policy contains a tacit requirement for ensuring the connectivity of a fluvial hydrosystem on its passage through a watershed from source to sea. However, any overt requirement to have regard for connectivity considerations, as for example provided by the CWR, is lacking. An explicit requirement for connectivity considerations is fundamentally essential, especially for the purposes of a focus on ensuring the maintenance of biotic linkages (see Figure 2.8).

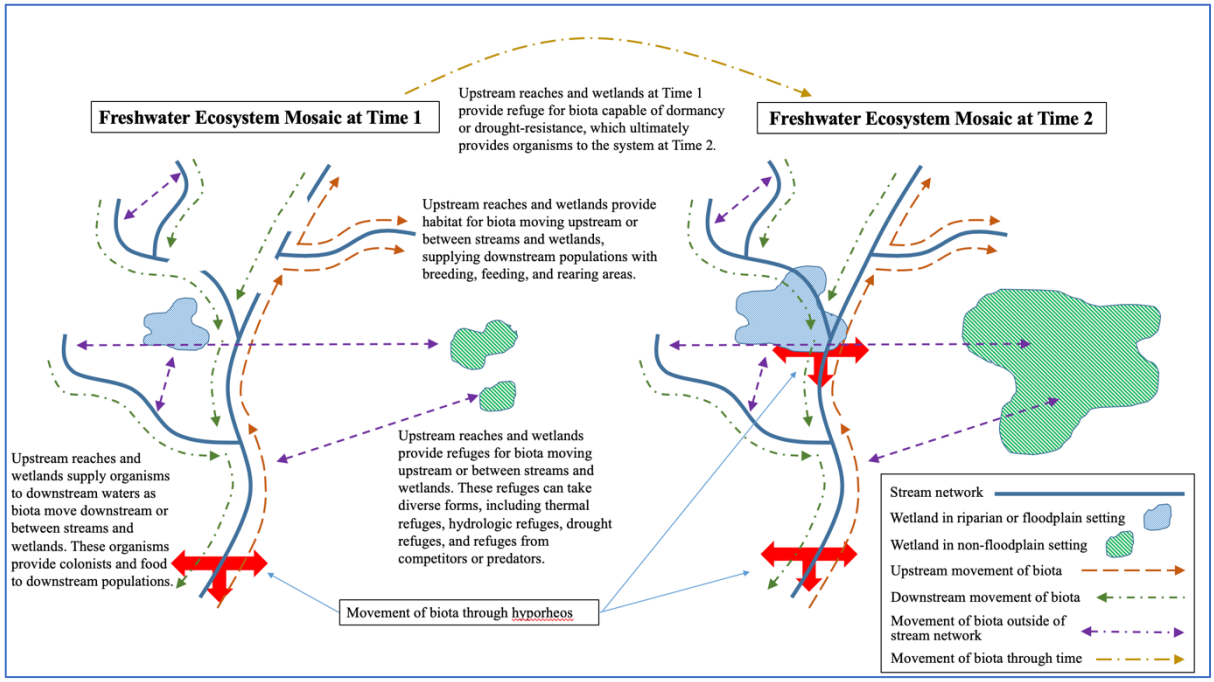

Figure 2.8: Diagrammatic representation of the various pathways by which biotic connectivity occurs in upstream reaches of fluvial hydrosystems. The diagram shows two phases of a hydrological cycle, dry on the left and wet on the right - reflected in the latter by the expanded area of the wetland nodes. Upstream movements are shown on the right of the mainstem, downstream on the left. Biota movement through the hyporheos (red bold arrows) will variously occur throughout the hydrosystem and is notionally shown here at just three locations. Modified from Schofield at al. (2018)[246] with permission.

[244] NWRS3 (Draft, Version 2.4) April 2020, page 130. Copy on file with author. The two additional principles deal with aspects of sanitation policy.
[245] NWRS3 (ibid) at page 90. Issues pertaining to the regulation of hydraulic fracturing emerged as a national concern post-NWRS2 eg Feris L and WR Harding (2020) The Disposal of Water from Hydraulic Fracturing: A South African Perspective. Chapter 17 in *Regulating Water Security in Unconventional Oil and Gas, Water Security in a New World*. Buono RM et al (eds). Springer International Publishing AG.
[246] Schofield KA et al (2018). n167.

Chapter 3 of the NWA requires that 'all or part of every *significant* water resource' (own emphasis) must be afforded a classification and 'resource quality objectives' which may relate to, *inter alia*, flow, pollution, aquatic biota, riparian habitat and/or land-based activities which might affect the quantity and/or quality of the water resource.[247] The Reserve, which provides the ecological foundation for water resource protection, describes the quantity and quality (and presumably seasonal timing) of water required 'to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource'. Water resources are defined as a watercourse, surface water, estuary or aquifer, with watercourses encompassing rivers, springs, wetlands, natural channels and lakes or dams.[248] Furthermore, 'resource quality' refers to the quality of *'all aspects of a water resource* including', *inter alia*, 'the character and condition of the... riparian habitat' (emphasis added).

The definition of riparian habitat, in turn, provides a clear indication of the extent of the riparian that must be considered, namely that which is routinely or regularly flooded so as to be characterised by the presence of 'alluvial soils' and at a frequency that results in the presence of 'vegetation that is distinct from that of adjacent land areas' — ie 'alluvial' vegetation.[249] As such, while actual distances are not prescribed in the Act, the definitional information makes it clear that a hydraulically-defined extent of floodplain comprises an integral part of a watercourse. Section 144 of the NWA contains a provision that all townships must be located above the 1:100 year flood line — this being the one per cent recurrence interval flood. Thus, while there is a distinction towards prioritising strategically-important water resources, there is also a clear indication that areas lateral to a watercourse are of fundamental importance to the ecological condition and functioning thereof, as well as to flood risks to human life and property. Accordingly, the scientific tools and norms used to determine the class of water resource should reveal how aspects of HEC should be assessed.

In the absence of lateral 'brightline' distances being specified in the Act, some resort has been made to subordinate legislation in the form of regulations. Herein the regulated area of a watercourse, excluding wetlands, is defined as the greater of the outer edge of the 1:100

[247] The qualification of a water resource as being 'significant' is here deemed to be problematic and exclusive of a host of waters, for example waters which are not part of the strategic water sources of the country.
[248] As the term 'dam' refers to the physical barrier constructed to impound a river, in the context of watercourses this is taken to mean the reservoir created upstream of a dam.
[249] Mucina L and MC Rutherford (eds) (2006) *The vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. SANBI, Pretoria.

year flood line or, alternatively, the delineated riparian habitat.[250] For wetlands and pans this area extends for consideration to 500 meters outside of the delineated edge thereof.[251] As such this regulation, which is specific to two of eleven water uses requiring permitting, sets an over-arching brightline distance applicable to desktop assessments and which can then be confirmed by an on-site delineation.[252] Reliance on flood lines may, however, be considerably less valuable than on empirically-determined distances adjacent to streams and rivers within which wetlands are most likely to occur.[253]

There is also an absence of guidelines that inform how the vertical and lateral extent to which groundwater, occurring either in the hyporheos[254] or deeper layers, is to be considered — although the aforementioned NWRS3 expresses regard for the impacts of hydraulic fracturing, which suggests a widening awareness of the connected sub-surface extent of subterranean waters. There has also been a recent and pleasing introduction of hydropedology guidance,[255] which will provide information on the extent of and linkages to the hyporeheic zone, as an adjunct to water resource investigations.[256]

IV. Property and land use considerations

This thesis examines how an HEC-based regulatory approach might affect private landownership and how trust-principled 'private ownership within a public trust framework enables long-term ecological protection'.[257] Concerns surrounding perceptions of the primacy

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[250] This thesis shows that HEC-connections may occur well beyond the 1:100 year delineator and that a lateral 'bright line' jurisdictional rule is a more reliable indicator. See Chapter 3.
[251] GN509 (2016) GG40229 (27/7/2016) Definitions: "regulated area of a watercourse" (a)-(c). Regulations applicable to protection of water resources from mining activities specify the 1:50 year flood line or a 100 m lateral distance, whichever is the greatest. GN704 (1999) Government Gazette 20119 (4 June 1999) s4(b) and 10(b).
[252] Applies to Section 21(c) and (i) uses.
[253] Reliance on flood line delineations is prone to data accuracy, land-use changes in the catchment, climate cycles and statistical interpretation. Moreover they are most often not temporally current or even available at all. By contrast a reliance on, for example, river and wetland mapping provides an empirically-accurate alternative. See Chapter 5 regarding an empirical determination of South African wetland proximity to watercourses.
[254] The hyporheos refers to the ecotonal zone occuring between surface and groundwater inside of river sediments. This zone is extremely important for river function, but is more often than not overlooked. Hyporheic zones may extend widely lateral of and below the surface expression of a stream or river. The zone is populated with organisms which form part of the pool of riverine biodiversity. eg Marmonier et al (2012) 'The role of organisms in hyporheic processes: gaps in current knowledge, need for future research and applications'. 48 *Ann. Limnol. - Int. J. Lim*. 253-266.
[255] Hydropedological surveys characterise dominant surface and sub-surface flowpaths of water through the landscape to wetlands, streams or groundwater.
[256] Department of Water and Sanitation (2021) Guideline for Hydropedological Assessments and Minimum Requirements. Van Tol JJ, Bouwer D and PAL Le Roux.
[257] Wood MC (2014) *Nature's Trust: Environmental Law for a New Ecological Age*. Cambridge University Press. at 309.

of land ownership, in specific riparian water rights, were a central reason that the NWA expressly included the norm of the public trust.[258] The effective operationalisation of the public trust will provide an instrument which can counter or ameliorate challenges to perceptions of ownership rights to water — as well as, most importantly, establishing the basis for an ecological public trust.[259]

Streams, rivers and wetlands exist along a variable continuum of public-private property, for example from public (eg nature reserve/mountain areas), through private (eg farmland) and back to public again (eg urban). In a document prepared for the South African water law reform, the late Advocate Francois Junod, when discussing the ownership of water allocations, observed that '[t]he characteristics of a river can continually change from public to private, making proper management impossible'.[260] From such an opinion arises the question 'does a legal paradigm exist which does render possible the protection of such waters by accommodating them within the scope of private property?' Here the principles of the public trust stand foremost in this regard, in that the doctrinal protection afforded to essential natural resources, such as water resources, does not amount to a depravation of land, ie no expropriation of land to the State occurs.[261] Portions of land may thus be 'severed' from use, but not requiring of severance from ownership. In this context the PTD may be regarded not as a binary but as a continuum existing between poles of anthropo- vs eco-centric.[262]

As analogised by the blood vessel example, the condition and health of a fluvial hydrosystem is proportional to the condition and health of the catchment through which it flows. The achievement of effective stream protection presupposes the inevitably of some constraint of the adjacent land use choices. Examples could be the need to establish riparian buffer zones, limiting how close to a stream a field may be ploughed, or where aquaculture may be conducted or animal wastes may be discharged, or a stream dammed to create a livestock watering point — all impacts directly in or on the land-water ecotone (see Figures 2.9 & 2.10) and is likely to result in push-back from some landowners.

[258] See Chapter 4.
[259] See Chapter 4.
[260] Junod HF (1995) 'Ownership and Allocation of Water'. Section vi/Anomalies in the Water Law. A Compendium of the South African Water Law Review Post-1994. Water Research Commission Report No 2250/1/18. Appendix: Legal Aspects of Water Law, Document 27.
[261] See Chapters 4 & 5.
[262] This notion is developed further in Chapter 4.

As elucidated above, the PTD impresses private ownership rights with a dual character, such that natural resources are distinctly separate and protected from alteration other than within the limits of reasonable beneficial use. Moreover, this dual nature forfends claims of financial compensation should a private use be declared unlawful and/or require restoration of the affected environment. The PTD 'does not seek to impose an environmental or commons utopia'. It does not seek to 'bar development or privatization', rather it foreshadows a 'viable legal theory'[263] buffer to excessive development or privatisation that would harm the environment.[264] Equally, environmental proponents of the doctrine need to understand this accommodation function that is rendered in the public interest.

Figure 2.9: Headwater stream abuse in the very arid Sandveld on the South African west coast. The landowner has ploughed through what remains of a stream, from side to side, to seed grasses, watered by the hyporheos, to provide sheep and goat fodder during the dry season (Image Credit: WR Harding).

[263] Cohen BS (1970) 'The constitution, the public trust doctrine and the environment'. *Utah L. Rev*. 388.
[264] Thompson BH (2006) 'The public trust doctrine: A conservative reconstruction and defense'. 15 *Southeastern Envtl.L.J.* 47.

Figure 2.10: In many instances agricultural development has completed transformed the riparian areas adjacent to rivers. At top left the riparian zone has been reduced to a narrow steep fringe on each bank; at top and bottom right any notion of riparian width has been almost obliterated; at bottom left a braided river and its tributaries has all but completely disappeared into intensive field lots and thereafter into wheat fields ploughed almost into the watercourse. Image credit: WR Harding.

The logical conclusion to draw from the science is that it is of paramount importance to sustain the connectivity of aquatic ecosystems. Equally, that the corollary thereto would be to assume that there would be wide societal support for connectivity-ensuring water resource regulations. As the resistance to the CWR has shown,[265] however, nothing could be further from reality.[266] The CWR was a long-needed regulation that was a logical outcome of many years of administrative dispute and caselaw. Yet, a tsunami of sustained 'Lockeian'[267] resistance emerged rapidly from both the USA private sector (mining, industry, housing developers and farmers), as well as from some state and public entities, presumably under the influence of private lobby interests — exactly the type of resistance facing the effective implementation of environmental law in general as alluded to earlier. These challenges continue, despite the Rule

[265] See Chapter 3.
[266] See Chapter 3.
[267] John Locke was a liberalist philosopher with the view that property rights subordinated the environment.

having been repealed, presumably through fears that a change in government could see the reinstatement of the Rule once again.[268] The value of the analysis of these challenges, as set out in the following chapter, will provide guidance for a similar approach in South Africa.

V. Conclusions

There exists a voluminous body of scientific evidence that positions HEC as an essential underpinning to an assurance of the integrity and functioning of aquatic ecosystems. Just as keeping all the veins and arteries in the human body connected and healthy, so too the importance of ensuring HEC in aquatic ecosystems should be self-evident. Moreover, as is the health of the body tissues through which blood vessels flow vital to the condition of the body, so too the body of terrestrial lands adjacent to streams and rivers are of vital importance to the health and condition of the fluvial hydrosystem that passes through it.

While HEC may be tacitly embedded in policy and specific regulations, it does not yet exist in South African water law as an overt and fundamental guiding norm for water resource protection. As such, a high degree of reliance has had to be placed on individual assessors being aware of the need to evaluate connectivity-associated impacts at the widest practical, ideally watershed-level, spatial scale. In the absence of connectivity-based guidelines and regulations, however, a spatially-relevant assessment of HEC remains something of a lottery, dependent on the experience of the specialist(s) providing the information necessary for administrative consideration and decision making — and the decision maker being alert to the role of HEC. A corollary is that, if there is no regulatory requirement to do so, it would be quite easy to deliberately exclude connectivity-based considerations, eg should there be an intention to deceive the decision-maker. As proposed in Chapter 1, the provision of a definitional, connectivity-directed regulation, akin to the CWR,[269] would serve to focus assessment attention at an appropriate, watershed level spatial scale.

Chosen as a subset are the aquatic systems that occur in the upper reaches of watersheds, these being headwater and low stream order waters and their associated wetlands. These typically occur in areas that are hidden from regular scrutiny, for example on farms. These upper reaches generate the bulk of the allochotonously-derived material, energy and

[268] The CWR was revoked by Executive Order of the Trump administration and replaced with the Navigable Waters Protection Rule. The latter was determined to provide insufficient protection for water resources and was remanded and vacated in 2021 (*Pasqua Yaqui Tribe v USEPA*, CV-20-00266-TUC) District Court of Arizona). Following this decision the regulatory agencies reverted to the pre-2015 *Rapanos* guidance.
[269] The Clean Water Rule is analysed in Chapter 3.

biotic building blocks for supply to downstream environments. In many instances, particularly on farms and housing developments, streams and wetlands are redirected, impounded, drained, ploughed over or polluted, with the consequences of such abuse (loss of biodiversity, ecosystem disconnection and transfer of pollutants) impacting negatively on the downstream environment. Other consequences also occur in the upstream areas, for example flooding and/or water-logging of lands that were previously drained by headwater streams. The extent to which such small streams dominate the greatest linear percentage of fluvial aquatic ecosystems in South Africa is detailed in the annexure to Chapter 3.

Because HEC may impose limitations on land use, an appropriate institutional framework which accommodates this is required. The principles of the public trust, embodied in the NWA, provide exactly what is required. This aspect is developed further in Chapters 4-6.

In summary, the connectivity dimension encapsulated within a proposed conceptual framework may be set out as follows:

- A high level of assurance of HEC is fundamentally vital for water resource protection and governance;
- HEC may be variously and negatively impacted by land uses, not least in headwater stream catchments;
- Much of the anthropogenic impact on river systems exists in the higher order streams, heightening the importance of sustaining the integrity of the upper catchment low order streams;
- Offsetting connectivity disruptions will require a legal framework that enables legitimate limitations of land use activities which may harm the water resource, either directly (eg pollution, impoundment), or indirectly, the latter via alteration of lands adjacent to streams and rivers which contribute to the health and condition thereof;
- HEC should be regarded as a general objective of environmental policy;
- The USA's Clean Water Rule provides a seminal example of a regulatory approach that is based on ensuring HEC;
- The principles of the public trust serve to accommodate and balance the protection of water resources within a land use context;

- The institutional legal framework that is the public trust, already exists in South African water law, but principled policy guidance for its utilisation has yet to be developed.[270]

[270] Section 21 of the NWA addresses eleven types of water uses which require licencing. None of these, read with the rest of the Act, speak to a requirement for an assurance of ecosystem connectivity. Arguably s21(i), 'altering the... characteristics of a watercourse' tangentially relates to the maintenance of HEC — but it does not invoke a direct obligation to consider connectivity. It must be borne in mind that the NWA is a framework statute and requires that specific issues be developed by policy and regulation.

CHAPTER 3: THE SCIENTIFIC VALIDITY OF THE CLEAN WATER RULE

'We cannot expect to preserve the remaining qualities of our water resources without providing appropriate protection for the entire resource.'[271]

I. Introduction

A governance framework which provides an assurance of the HEC-connectivity[272] of a hydrosystem[273] underpins a normative approach to water resource regulation.[274] The CWR, as promulgated in 2015,[275] is here proposed as a sound and scientifically-validated format from which a version thereof might be adapted for application in South Africa.[276] The CWR[277], the first connectivity-based regulatory approach promulgated anywhere in the world, provided a novel and much needed reform for water resource governance based on maintaining functional HEC. This analysis assesses the challenges made to the science underpinning the CWR as a means to identify where it might require further specific substantiation for use in South Africa.

The CWR was a definitional regulation forming part of the USA's CWA. As such the CWR did not impose any new environmental standards — it merely set out to define the extent of federally regulated waters based on their connectivity and/or adjacency to one another.[278] Furthermore, waterbodies separated by, for example, constructed levees, ie adjacent to each other but not connected by a direct surface water connection, may have various other forms of HEC providing vital functional ecosystem linkages between the two. Lastly, that a connectivity-based approach would ensure that ephemeral and intermittent streams be drawn

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[271] Senator Howard Baker (1977) 123 Congressional Record 26718. Cited in Alexander LC (2015) 'Science at the boundaries: scientific support for the Clean Water CWR'. 34 *Freshwater Science* 1588-1594.
[272] See Chapter 2.
[273] A hydrosystem is here taken to mean a complex of water resource components (eg springs, streams, rivers, wetlands, lakes and groundwater) occurring within a defined geographical space — typically at a catchment or watershed spatial scale.
[274] Chapter 2.
[275] 80 FR 37054.
[276] EO 13778 (28 February 2017). One of the first actions of the Biden Administration, EO 13990 (20 January 2021) ordered, inter alia, that EO 13778 be reviewed, signaling the possibility for a revised CWR to appear in the years to come.
[277] The CWR was replaced by the Navigable Waters Protection Rule (NWPR) 82 Fed. Reg 12497 (28 February 2017). This rule was subsequently held to be arbitrary and capricious, in fact as being in direct conflict with the findings of the agencies own experts, indeed found to pose a threat of serious environmental harm. The NWPR was remanded and vacated on 30 August 2012 (*Pasqua Yaqui Tribe v USEPA*, 4:20-cv-00266-RM), whereafter the agencies reinstated the pre-CWR (2015) regulatory regime and guidance.
[278] A major difference between US and South African water law is that the latter regulates all types of water resources — whereas in the US pre-CWR the CWA only covered a relatively minor subset of the total. The CWR specifically defined which waters should be regarded as part of the regulated whole.

into federal jurisdiction. As will become apparent hereunder, the function of the CWR was intended to render HEC, previously implicit in the CWA, as an explicit underpinning of the regulatory framework. As explained in Chapter 2, providing an assurance of functional HEC between the components of a watershed is of vital importance to ensuring appropriate ecosystem-directed management of water resources.

The CWA and NWA are here both deemed to be weakened by a lack of explicit emphasis on the need to ensure inter- and intra-ecosystem HEC. In the case of the CWA, the statute is hampered by the binary distinction between WOTUS, which are federally regulated under the CWA, and other waters which may be regulated to varying degrees by the individual states or local government entities. Centrally, while the mainstem of a river may be WOTUS-regulated, its tributaries are often not. This binary approach signals an obvious tension arising from different — and perhaps inconsistent — regulatory schemes for different, yet fundamentally connected, parts of the same whole. A further and significant complicating factor is that groundwater is not regulated under the CWA.

The NWA regulates all forms of water resources. However, components such as wetlands and groundwater are separately, indirectly or tangentially regulated, and reservoirs/impoundments not at all. The underlying theme here is that a HEC approach will ensure optimally integrated water resource governance. Therefore it will simply be impossible to consider one component or feature of a water resource absent consideration of any or all connections to other components.

In essence the WOTUS 'regulatory binary' created separately regulated categories of public and private waters — with public waters deemed to be providing public beneficial uses.[279] The concept of 'public use', vis a vis the health of an aquatic ecosystem extends, by virtue of connectivity, to how water resources are governed on private land. This separation becomes most apparent, in the USA, at the junction between primary waters (rivers and large streams, which are generally WOTUS) and tributaries, intermittent and ephemeral waters (IRES[280]) and wetlands, which are typically non-WOTUS State waters. As such there is no regulatory assurance of connectivity between upstream waters and downstream WOTUS. In

[279] *Lamprey et al v Metcalf et al* 52 Minn. 181 (1893) at 181(4) '[t]he division of waters in navigable and nonnavigable is merely a method of dividing them into public and private... . So long as they are capable of being put to any beneficial public use, they are public waters.' This distinction, seen in the contemporary context of the public interest being served by integrally-intact hydrosystems, is no longer valid (see Chapter 3).
[280] Intermittent rivers and ephemeral streams (see Chapter 2).

South Africa, while all waters are public waters under the NWA, a large percentage thereof occur on privately-owned land.[281] However, as is set out in Chapter 4, the extent to which any waters can provide beneficial use values to the public, make them public waters, this arising from the central tenet of the overarching applicability of the PTD to water resources.

The regulatory disconnect between different categories of waters, which the CWR sought to resolve, is problematic in that it produces, for example, a situation wherein the discharge of pollution into a WOTUS would require a permit under the CWA, but no such permit would be required to discharge into an upstream, non-WOTUS tributary. Consequently, if the tributaries that flow into a WOTUS are not subject to equivalent protection, the protection of the physical, chemical and biological integrity of any inter-connected waterbody is rendered simply and fundamentally very difficult, if not impossible, to achieve.

A recent US case provides a clear example of where the lack of a regulatory connectivity basis for water resource regulation fails to provide HEC-level protection.[282] A fuel tanker operator was found guilty of dumping 3 000 US gallons of diesel fuel into a stormwater drain. The fuel had then flowed some distance via the stormwater system and some small streams, into a WOTUS. The operator pled guilty to a federal offence and was sanctioned with incarceration and a fine. However, the verdict was successfully appealed on the grounds that, despite there being a clear hydrological connection between the various waters through which the fuel flowed, no evidence had been led to prove that the discharge impacted on a WOTUS, ie on a CWA-regulated watercourse.[283] Few would believe that the fuel would not have had a devastating effect on the ecology of any or all of the waters through which it flowed to the WOTUS, yet in the absence of federal protection there was no recourse available.[284]

Comparatively, while the South African NWA regulates all waters of South Africa, as set out in Chapter 2, there is no overt requirement other than perhaps implied for any administrative consideration of connectivity, either hydrological or ecological, in order to ensure ecosystem integrity.[285] Reliance on ensuring HEC cannot be implied or even tacit, it

[281] See Chapter 3.
[282] *United States v Coleman* 2020 WL 7244923 (*Coleman*).
[283] Prior to the CWR, a direct surface connection between an adjacent waterbody and a WOTUS was required for a harm incurred in the adjacent waterbody; alternatively proof that harm to the chemical, physical or biological integrity of a WOTUS was the outcome of a pollution event.
[284] This somewhat bizarre anomaly could arguably be regulated under local or state water law. However, it makes infinitely more sense to have a single regulatory framework for all connected waters.
[285] A guiding principle of the NWA is to protect water resources which are defined as watercourses, surface waters, estuaries or aquifers (as distinct from groundwater). Aquifers are defined as a geological formation

must be overtly expressed[286] — otherwise the very real possibility of individual components of watersheds being evaluated on a discrete and disconnected basis presents itself.[287] A connectivity-based normative framework will provide dispositive guidance underpinning administrative decisions involving water resources.

This chapter proceeds as follows: Section II briefly sets out the background of the CWA and the Congressional intentions behind it, particularly its spatial scope; Section III examines the genealogy behind the CWR and incorporates comments and opinion gleaned through interviews with people who were associated with its drafting. This approach is taken on the grounds that both the prevailing circumstances initiating a particular regulatory approach, as well as the intentions and aspirations of the drafters thereof, sheds important contextual light on the final legal instrument[288]; Section IV examines and analyses the challenges made to the science behind the CWR; while Section V verifies the validity of a distance-based regulation proposed but not validated by the CWR.

II. The Clean Water Act (CWA)

The CWA, formerly the Federal Water Pollution Control Act (FWPCA, 1948)[289] was completely re-written in 1972 — largely in response to warnings about worsening environmental pollution in the USA.[290] Within the PTD context of this work, the FWPCA amendments occurred concomitant with the development of the Saxian PTD (circa 1965-1979) and, coincidentally, with the appearance of public trust language in early South African strategic water policy.[291] The CWA demonstrated a keen awareness of the need for an ecosystem approach underpinning environmental management. The CWA was established with the goal to 'restore and maintain the chemical, physical and biological integrity of the Nation's waters' ie a program that is by definition orientated towards an ecosystem approach of

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which has structures or textures that hold water or permit appreciable water movement through them. Watercourses are defined as:

(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and
(d) any collection of water which the Minister may declare to be a watercourse.

[286] A similar argument for the public trust was advanced in Chapter 3.
[287] As highlighted in Chapters 3 and 7, the fundamental need to consider hydrosystems as the aggregate of all connected parts is not yet a foundational attribute of water resource governance in South Africa.
[288] This same approach is followed in Chapter 4 regarding the South African public trust origins.
[289] Federal Water Pollution Control Act, 33 U.S.C. §§ 1251–1387 (2006).
[290] White House Report: *Restoring the Quality of Our Environment*. Report of the Environmental Pollution Panel, Presidents Science Advisory Committee. November 1965. Downloaded from www.hathawaytrust.org.
[291] See Chapter 4.

water resource governance. Moreover, the CWA requires that pollution[292] be controlled at source, clearly suggesting that the CWA scope encompasses all waters — and not just those components that were 'navigable in fact'. It would be illogical to regard the source of any pollution as being the point at which pollutant-bearing non-WOTUS water enters a WOTUS. The CWA is jointly administered by the USEPA and the US Army Corps of Engineers (USACE) (the Agencies).

The architect of the CWA, Senator Edmund Muskie, proclaimed in strong terms that:

> 'these [goals of the CWA statute] are not merely the pious declarations that Congress so often makes in passing laws; on the contrary, *this is literally a life or death proposition for the Nation'* (own emphasis).[293]

Over the intervening years since promulgation, two aspects have particularly characterised the interpretation of the CWA: First, a need for clarity regarding which of the 'Nation's waters' are regulated by this federal statute and, secondly, whether the Act enfolds aquatic ecosystems such as wetlands occurring adjacent to, but absent a direct water connection with, a WOTUS.

(a) The intentions behind the jurisdictional reach of the Clean Water Act

Much of the controversy regarding the spatial scope of the CWA is because the Act broadly and ambiguously defines 'navigable waters' as 'waters of the United States, including the territorial seas'.[294] The underpinning imperative to be able to control pollution at source notwithstanding narrow interpretations equating WOTUS as waters that are only truly navigable for the purposes of commerce,[295] would limit the scope of the Act to less than two percent of the nation's waters. This has long been construed as a legal fiction.[296] While the

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[292] 33 U.S.C. s1251(a). The CWA defines pollutants as: dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water.

[293] 118 Cong. Rec 33,693 (4 October 1972)

[294] 33 U.S.C. s1442(7)

[295] The jurisdictional scope of the CWA is enabled by the US Commerce Clause, US Constitution Article 1, Section 8, Clause 3), which provides the US Congress with the power ' *to regulate Commerce with foreign nations, and among the several States and with the Indian Tribes*'. This debate goes back to the very earliest days of the country, at which time there was considerable conflict between federal functions and state rights. The states agreed that the federal government could regulate interstate commerce and because the waterways were a vital part of this commerce, the interstate commerce clause of the Constitution was used to regulate water pollution which was seen as impeding such commerce. However, it is reasonable to assume that states would be required to draft laws that did not conflict with the federal mandate.

[296] Sapp et al. n71. See also Kelso H (1941) 'Navigable Waters" as a legal fiction'. 17 *Journal of Land & Public Utility Economics* 394-405 & *U.S. v Appalachian Power* US 311 377 (1940) which construes navigable in fact

general tendency evidenced from case law has shown courts to adopt a wider interpretation some, and centrally the protracted *Rapanos v US* matter,[297] reverted to a narrow reading and set the stage for the eventual formulation of the CWR (these cases are discussed hereunder).

The CWA emerged from an amalgamation of Bills formulated by both the US House[298] and the Senate[299]. The joint statement of the Conference Committee read (emphasis added):

> *'The conferees fully intend that the term "navigable waters" be given the broadest possible constitutional interpretation* unencumbered by agency determinations which have been made or may be made for administrative purposes.' (own emphasis).[300]

The foregoing statement provided clear evidence that the legislative intention was for the jurisdictional scope of the CWA to encompass both navigable and non-navigable waters.[301] Confirmation of this intent was indeed provided at the time by Representative Dingell who declared that '[*t]hus, this new definition clearly encompasses all water bodies, including main streams and their tributaries*...'.(own emphasis).[302] Despite these apparently clear intentions, the push-back against expanding federal regulation of US waters persisted and persists to this day.

(b) Lighthouse rulings defining the jurisdictional reach of the CWA

Despite the apparent clarity of its underpinning intentions, the jurisdictional scope of the CWA has continued to be questioned, coupled with attempts to roll back the legislation to the pre-1972 era.[303] Three cases, spanning a protracted period between 1985 and 2006, were to underpin the move by the USEPA to develop the CWR as a basis for regulating hydrosystems with consideration of and regard for the connectedness of their components.

The first of these cases was *US v Riverside Bayview Homes Inc* (*Riverside Bayview*)[304] which considered a proposed development requiring the infilling of wetlands adjacent to a navigable-in-fact waterway, but which were separated therefrom by a berm. The Supreme

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waters to be a legal fiction. It is an artefact of American history that 'has long outlived its usefulness' Adler RW (2009) n72.

[297] 126 S. Ct 415 (2006).

[298] H.R. 11896, 92nd Cong. s502(8) (1971).

[299] S.2770, , 92nd Cong, (1971).

[300] S. Conf. Rep. 92-1236 at 144, cited in Sapp et al (2006).

[301] Sapp et al (2006) at 23.

[302] 118 Cong. Rec. 33756-57 (4 October 1972) cited in Sapp et al (2006) at 25.

[303] Sapp et al (2006) *inter alia* at 33.

[304] *US v Riverside Bayview Homes Inc* 474 U.S. 121 (1985).

Court concluded that the term 'waters of the United States' encompassed *'all wetlands adjacent to other bodies of water over which* [the USACE] *has jurisdiction'* (own emphasis). This was a positive start in a process to enfold wetlands into the framework of streams and rivers, a process which culminated in the short-lived appearance of the CWR forty years later. The problem, however, lay in the interpretation of 'adjacent'. Had a term such as HEC been used, a very different outcome would probably have ensued.

Riverside Bayview was followed sixteen years later by *Solid Waste Agency of Northern Cook County* (*SWANCC*).[305] In this matter the USACE held that a series of ponds in a disused quarry fell within their jurisdiction in terms of their Migratory Bird Rule[306] ie that the affected waters constituted an essential stepping-stone in the life cycle of migratory birds moving between patches of aquatic habitat — which, in the context of the CWR would have constituted a clear form of HEC. The rule relied on in SWANCC drew waters 'which are or could be used as habitat by birds protected by the Migratory Bird Treaty,' or by other migratory birds crossing state lines, into the then-applicable definition of WOTUS. Aquatic birds requiring patches of water along a migratory route is unmistakeably an attribute of HEC, irrespective of the distance between a patch and a regulated waterbody.

The US Supreme Court, however, declined to accept this argument and, in a divided 5- 4 decision, ruled against the Corps, in effect striking down the protection offered by the Migratory Bird Rule, but without approaching the question of jurisdiction over isolated wetlands.[307] In so doing, millions of acres of wetlands were removed from federal protection. *SWANCC* thus became the trigger case for intensified attention to the needs of protecting adjacent wetlands.

In *Riverside Bayview* the Supreme Court recognised the connectedness of adjacent waters, whereas in *SWANCC*, the same court declined to validate the relationship between isolated bodies of water which provide essential 'connected' habitat, albeit not 'water mediated' for particular faunal species. A narrow focus that equates aquatic ecosystem connectivity as

[305] 531 U.S. 159 (2001).
[306] 40 C.F.R. 328 et seq.
[307] The ruling in SWANCC was arguably incorrect as the ponds in question provided actual habitat for the migratory bird species (the sole attested basis for jurisdiction was the use of the ponds by migratory birds. Furthermore, no evidence was led to show what other waters in the vicinity would have provided redundancy of habitat for the bird species in question — ie a demonstration of inter-waters connectivity. If this had been demonstrated the loss of the wetlands would have conflicted with the interests of state commerce. See also Government at 131 ('the CWR avoids the deficiency in SWANCC by requiring a significant nexus...'.

solely water mediated, and even more narrowly as only 'surface' water mediated, disregards the wide range of abiotic and biotic mechanisms by which hydroecological connections occur, including that of brief hydraulic connections arising during floods.[308] The term HEC, as opposed to just 'connectivity', is employed here in order to preclude focusing on surface water connections alone.

The third case in this trilogy began in 1989 and continued over a period of twenty years.[309] It amounted to little more than the actions of an unscrupulous developer who, despite having been warned of the existence of wetlands on three of his properties, and after a wetland specialist confirmed this, proceeded nonetheless to fill them in.[310]

In *Rapanos*, the legal question was whether the infilled wetlands were 'adjacent' to a regulated (WOTUS) water as defined by the CWA[311]. Two contrasting views were voiced in amicus opinions and which serve to emphasise how disparate the opposing views were. A pro-connectivity opinion held that the failure to regulate such isolated wetlands could and would impact negatively on other waters within the same watershed — and that a 'source to sea' jurisdictional approach was appropriate. [312] The opposing opinion adopted the view that the law was attempting to regulate water '*...to envelop any molecule of water that might one day reach a river*' (own emphasis). [313] The latter view failed to acknowledge that the issue to hand was about regulatory assurance of connectivity between parts of a hydrosystem, and not simply the flow of water between them — in point of fact to have regard for the unitary character of the hydrocycle. However, any semblance of HEC was not centrally argued, making way for a ruling that had regard only for a water-mediated surface connection.

In *Rapanos*, which to all intents and purposes was a clear-cut infringement of US federal law arising from the illegal infilling of wetlands, the case resulted in an infamous 4-1-

[308] See Chapter 2.
[309] 126 S. Ct 415 (2006). The *Rapanos* Supreme Court case combined two USEPA/USACE challenges to wetland infilling (all in the State of Michigan), three by John Rapanos et al and one by June Carabell et al.
[310] This case closely parallels the South African *Really Useful* matter - see Chapters 1 & 5.
[311] The nearest 'navigable waters' were between 11 and 20 miles away, but connected to the sites by drains and ditches as is typical of many urban wetlands whose original connections have been captured into stormwater and road drainage systems.
[312] Cheasapeake Bay Foundation brief as amici curiae supporting respondents in *Rapanos v United States* 376 F.3d 629 (6th Circuit 2004).
[313] Washington Legal Foundation brief as amici curiae supporting petitioners in *Rapanos v United States* 376 F.3d 629 (6th Circuit 2004).

4 decision of the Supreme Court.[314] Four judges voted to affirm the lower court decision that the wetlands were 'connected waters', but five (4+1 dissenting) voted to return the matter to the lower courts.

The plurality opinion declared that, for waters to be jurisdictionally WOTUS, they had to possess a continuous surface connection to a traditional WOTUS. While concurring with this opinion, Justice Kennedy wrote a separate opinion which allowed for adjacent waters to be WOTUS if they possessed a 'significant nexus' to jurisdictionally-covered waterbody.[315] The concept of a 'significant nexus' encompassed any relationship between the adjacent water and a WOTUS such that changes to the condition of the adjacent water would 'significantly affect the chemical, physical and biological integrity of the [federally] covered water'.[316]

In retrospect, the finding in *Coleman*[317] closely reflects the *Rapanos* outcome, ie that a harm to a watercourse does not necessarily incur liability unless there is proven harm to a connected WOTUS.

By the time the *Rapanos* matter was being heard, other courts notably various USA Circuit Courts of Appeal, had already delivered clear rulings linking harms in wetlands as being translocatable to distant WOTUS. Two of these progressive rulings highlighted the problem surrounding the use of the term 'adjacent to,' instead of the vastly more descriptive terms 'connected to'.

The first example, *US v Earth Sciences* (*Earth Sciences*), involved a discharge of cyanide-containing leachate into a stream which then discharged into a reservoir that provided water for recreation and irrigation.[318] The court rejected a claim that the stream was not a

[314] Five separate opinions were delivered: one plurality opinion, two concurring opinions and two dissenting opinions. No single opinion underpinned a majority of the Court. Four justices considered that the USEPA/USACE interpretation of WOTUS was reasonable. The outcome was that the controlling legal principles was derived from the principles espoused by five or more judges, resulting in the narrow plurality decision and the Kennedy significant nexus test, either of which held to be definitive in a jurisdictional determination of WOTUS.
[315] A significant nexus indicates the existence of a fundamental aspect of connectivity between two water resource components, the loss of which would lead to functional impairment of one or both components, as well as to any other connected entities.
[316] A significant nexus indicates the existence of a fundamental aspect of connectivity between two water resource components, the loss of which would lead to functional impairment of one or both components, as well as to any other connected entities.
[317] See *Coleman*.
[318] *US v Earth Sciences Inc*. 599 F.2d 368 (1979).

WOTUS on the grounds that, even though its contribution to interstate commerce might be small, it was nonetheless connected to a WOTUS and, as such, covered by the Act.[319]

In the second matter, *US v Gerke Excavating Inc* (*Gerke*), a construction company infilled a small area of wetland which was drained by a ditch that ran into a non-navigable creek, thence into a non-navigable river and finally into a WOTUS, ie the WOTUS was thrice removed from the wetland.[320] The court first dealt with the issue of adjacency, clearly showing that while the wetland was not physically adjacent to the WOTUS, it was indeed connected thereto. Secondly, the court held that the ditch clearly performed the same function as a stream, and that the regulations did not distinguish between a stream and its man-made counterpart.[321] Third, while the wetland in question was small, the court expressed regard for the fact that it formed part of a class of wetlands which, in aggregate,[322] contributed water to the downstream river and hence to the functional value of the river. In terms of the Commerce Clause 'Congress *must be able to regulate the entire class* if the class affects commerce'(own emphasis).[323] Lastly, the court found that nothing in the US Constitution forbade the CWA from regulating any wetlands connected to WOTUS 'whether the wetlands are 100 miles from the waterway or 6 feet... the wetlands are WOTUS'.[324]

Other cases further reinforced these opinions, confirming that 'small tributaries were without question within the scope of the CWA.[325]In *US v TGR Corp*, a matter involving the discharge of hazardous asbestos-containing slurry which, as in Coleman, *ended* up in a WOTUS. The court declared that the CWA was 'unconstitutionally vague' as to what constituted a WOTUS and that 'specific definition' was needed to clarify terms that could be misconstrued. Further was held that 'Congress should amend the definition of WOTUS to include tributaries... .'[326]Similarly, in *Re Vico Construction Corporation* a claim that discharge

[319] Ibid at 375. This decision conflicts, however, with the cynically dismissive view of the SCA (7th Circuit) in *Orchard Hill v USACE* in which the possible loss of 2.7 per cent of the wetlands in the watershed was deemed to be 'trivial' (1:15-cv-06344).
[320] *US v Gerke Excavating Inc*. 412 F.3d 804 (2005).
[321] Ibid at 805.
[322] The finding that the wetland merited consideration based on it forming part of a matrix of similar wetlands is an important conclusion from a hydroecological perspective. Wetland matrices exhibit a redundancy of ecosystem services which is nature's way of compensating for not all wetlands being contemporaneously in the same condition.
[323] Ibid at 806.
[324] Ibid at 807.
[325] *Quivira Mining Company & Homestake Mining Company v USEPA* 765 F.2d 126 at 12.
[326] *US v TGR Corp* 171 F.3d 762 (1999). See also Harens S (1999) 'United States v TGR Corporation: Clean Water Confusion. 4 *Great Plains Nat. Resources J*. 104'.

of pollutants into a stormwater drain did not constitute discharge to a regulated water was denied.[327] Two decades earlier, cases dealing with tidal waters (WOTUS) and non-tidal waters (non-WOTUS) had comparatively found that 'the public's right in non-tidal waters' was equal to that in tidal waters.[328]

These cases reveal that by the time of the *Rapanos* decision, there already existed an ample body of evidence in the USA that clearly established a progressive understanding of the role of connectivity between waters, and how this rendered all the connected parts as WOTUS. Furthermore, it addressed the issue that a requirement for connectedness was not predicated on spatial adjacency or proximity. In light of this wider judicial understanding, the contrary plurality decision in *Rapanos* was arguably irrational, resulting in later environmentally dismissive findings such as *Coleman*.

It is of some significance to note that after *Rapanos*, Congressional attempts were initiated to clarify the jurisdictional scope of WOTUS by means of the proposed Clean Water Restoration Bill.[329] This Bill, raised in 2010, and which unequivocally set out the intentions of Congress to regulate all waters of the United States, failed to be ratified. Of course, the US Congress can, at any time, decide to amend the CWA to include all waters of the US as WOTUS and heed the original congressional intentions — however, this is regarded here as a most unlikely political outcome. It would also be arguably considered unconstitutional as the federal reach is not unreserved within the individual states — however a stipulation in the CWA to the effect that state laws be equivalent or stricter than the federal expression would, all else being equal, ensure regulation of waters to the same standard.

In summary, the plurality decision in *Rapanos* confined federally protected WOTUS to 'relatively permanent, standing and continuous[ly] flowing bodies of water that are... geographic features such as streams, rivers and lakes... and not those [which are] intermittent or ephemeral' (see explanatory demonstrative example Figures 3.1 & 3.2). With respect to adjacent wetlands, only those with a 'continuous surface connection' would be deemed to be

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[327] *USEPA v Vico Construction Corporation & Amelia Venture Properties LLC.* CWA-03-2001-0021.
[328] eg *Lyon* 29 Cal. 3d at 230
[329] S. 787, 11th Congress, 2nd Session. Report 111-361 to amend the Federal Water Pollution Control Act to clarify the jurisdiction of the United States over waters of the United States. The Bill set out to (1) *'reaffirm the original intent of Congress...*' (2) *'to clearly define the waters of the United States...*' and (25)(A) *'In general —the term waters of the United States means all waters subject to the ebb and flow of the tide, the territorial seas, and all interstate and intrastate waters, including lakes, rivers, streams (including intermittent streams) mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes and natural ponds, all tributaries of any of the above waters, and all impoundments of the foregoing*'.

WOTUS.[330] Chapter 2 highlighted how many waters, fluvial or wetland, were summarily excised from federal jurisdiction by this finding.

In effect, the findings of the *Rapanos* (2006) plurality curtailed all the juridical progress made over the preceding twenty-five years between *Earth Sciences* (1979) and *Gerke Excavating* (2005).[331] The only saving grace emerging from the *Rapanos* matter was contained in the concurring opinion which, additionally, proposed a science-informed test for all waters not clearly defined as being federally jurisdictional. This analysis became known as the 'significant nexus' test, in other words the outcome of a case-by-case assessment of the existence of hydroecological interdependency between two or more waters.[332] The test reflects the finding from *Riverside Bayview* twenty years previously, where it was held that adjacent waters may together function as 'integral parts of the aquatic environment.' Of course, the prosecutorial procedural failure to apply the 'significant nexus' test in *Coleman* allowed an evidently egregious environmental harm to be set aside. This would have been obviated had there been regard for all components of a hydrosystem as parts of the same whole.

[330] The plurality did concede that if a pollutant 'naturally washes downstream', it probably violates the Act - although this finding did not emerge in *US v Coleman*.
[331] See n317 & 319, respectively.
[332] The Kennedy significant nexus analysis was subsequently held to be the controlling precedent for 'interpreting fractured [WOTUS] decisions.' eg *Pasqua Yaqui Tribe v USEPA*, 4:20-cv-00266-RM at 3.

Figure 3.1: Per the *Rapanos* plurality decision, all of the waters visible in this image (river, instream wetlands, adjacent wetlands, lagoon and near coastal zone would be hydrologically connected. (Image Credit: WR Harding)

Figure 3.2: Less likely to be seen as a WOTUS would be this ephemeral watercourse in an arid zone. Within hours of water appearing after rains, this area will be teeming with an array of life-forms adapted to short periods of water availability, many of which may be unique to this environment. (Source: WR Harding)

III. The road to the Clean Water Rule[333]

This section highlights the principal building blocks of the CWR. The regulatory definition of WOTUS that emerged subsequent to *Riverside Bayview* was, in effect, entirely encapsulated into the CWR.[334] The post-*Riverside Bayview* guidance was again amended after *SWANNC* and again with major changes, as the so-called '*Rapanos* Guidance,' in 2007. These efforts to inform the regulated community remained tortuous and confusing, and the agencies were regularly requested to provide clarity, with similar demands from various courts. In sum the impetus for creation of the CWR was thus established.

The CWR emerged at a time when water pollution concerns amongst the citizens of the USA were at an all-time high.[335] This was also coincident with the fact that the period between 1970 and 2016 had seen a frightening 84 per cent global decline in monitored populations of freshwater organisms.[336] More recently, hydro-morphological stresses have emerged as a principal threat to the health and status of river systems.[337] Finally, there was clearly a need to render connectivity as an explicit attribute of integrated aquatic ecosystems.

(a) CWR Origins - the 'Rapanos Guidance'

The Agencies published the so-called '*Rapanos* Guidance' in June 2007.[338] This differed from the 1986/1988 guidance, which followed the positive outcome in *Riverside Bayview*, in the following respects:

- The inclusion of tributaries *was narrowed* to non-navigable tributaries of traditional navigable waters that are relatively permanent, and where the tributaries typically flow year-round or have continuous flow for at least three months;
- Wetlands *were limited* to those that directly 'abut' such tributaries;
- Inclusion of the significant nexus test for: (i) non-permanent non-navigable tributaries; (ii) wetlands 'adjacent to' non-permanent, non-navigable tributaries; (iii) wetlands adjacent to but not directly abutting a relatively-permanent non-navigable tributary.

[333] The full text of the final CWR runs to 2060 words excluding the heading. A copy of the 2015 version is annexed to this chapter for ease of perusal. The 2015 CWR was never adjudged in a court; it was made subject to an injunction and then stayed by Executive Order on 28 February 2017. It was subsequently been replaced by the Navigable Waters Protection CWR which has since been remanded.
[334] 40 CFR 230.3(s) 1986/1988 Regulatory Definition of 'Waters of the United States'. See Annexure 2.
[335] https://news.gallup.com/poll/207536/water-pollution-worries-highest-2001.aspx
[336] WWF (2020) *Living Planet Report 2020 -Bending the curve of biodiversity loss*.
[337] Lemm et al (2021) 'Multiple stressors determine river ecological status at the European scale'. https://onlinelibrary.wiley.com/doi/epdf/10.1111/gcb.15504.
[338] Clean Water Act Jurisdiction following US Supreme Court's Decision in *Rapanos v US* and *Carabell v US*.

- A requirement that the significant nexus test should consider hydrologic and ecologic factors such as the transfer of pollutants and/or flood waters to traditional navigable waters, provision of aquatic habitat that supports a traditional water, role of wetlands in flood and sediment attenuation and the maintenance of water quality in traditional navigable waters.[339]

This guidance is fraught with avoidable descriptive complexities and definitional confusion: As observed in *Earth Sciences*,[340] waters that were previously described as traditional/navigable were long since re-defined as WOTUS, rendering the continued use of the confusing, esoteric terms 'traditional' and 'navigable' obsolete. The *Rapanos* guidance uses both the terms 'abut' and 'adjacent', whereas the Code of Federal Regulations defines 'adjacent' wetlands as, *inter alia,* 'abutting' or 'touching a WOTUS at (at least) one point (ie a wetland that abuts is adjacent);[341] and, finally, despite the requirement for 'ecologic' considerations, there is no mention of connectivity — this was to emerge a decade later but was clearly already evident by 2005 from *Gerke Excavating* — although the elements of the nexus test point to ensuring connectivity.

The *Rapanos* guidance arguably did little to provide real clarity as to which waters were regulated under federal law and which were not. This resulted in increased resort to the significant nexus test to clarify connectivity within a watershed, with the unavoidable outcomes of a greater administrative load, and increased time and financial costs to both the regulated community and government. As such, the need for a clear set of regulatory definitions was born, to which staffers of the agencies carefully applied their minds over the next seven years, with their efforts culminating in the CWR.

(b) Agency response to the need for interpretive clarity

This research posed questions to current and former US agency staffers, as well as to practitioners involved with applying the guidance directives. The intended numerical scope of the interviews was substantially constrained to just ten respondents, including senior authors of the science components. Most of those approached declined to participate, even

[339] This requirement is distinctly orientated towards HEC, drawing in not only linear flow of pollutants to downstream waters (eg the *Coleman* matter) but also adjacent environments (aquatic habitat) forming part of an inter-connected hydrosystem.
[340] See n317.
[341] 40 C.F.R. § 120.2

anonymously, and other scientists who had contributed to the formulation of the CWR had resigned their agency positions.[342]

The interview process, however, provided sufficient information to establish the following consensus regarding the origins of, and the intentions for, the CWR:[343]

- The driving impetus for the CWR originated amongst wetland scientists and ecologists at the USEPA and the US Fish and Wildlife Service (FWS);
- The formulation of the CWR arose in direct response to the confusion and jurisdictional crisis occasioned by conflicting and regressive court decisions, notably *Rapanos*;
- The decision to formulate the CWR arose at the highest levels of the Executive Branch of government;
- The CWR was fundamentally ecosystem-directed, supported by the ecosystem provisions of the CWA, and that an ecosystem approach was necessary in applying the significant-nexus test;
- An awareness of the need to apply the CWA along the lines of ensuring connectivity, inclusive of groundwater, had existed in the USEPA for a long time prior to the advent of the CWR;
- The CWR aligned entirely and holistically with the congressional intentions for the CWA. Herein was implicit that it was entirely the prerogative of the agencies to 'take action' to interpret the scope of the meaning of 'navigable waters';
- The material covered by the Connectivity and allied reports[344] speaks directly to underpinning the application of the significant nexus test;
- The CWR was necessary to provide informed and scientifically-based clarity to the regulated community, a need identified, *inter alia,* by the courts;
- The CWR reflected approximately four decades of developing watercourse and wetland science in the USA.[345]

[342] https://www.ecowatch.com/federal-agencies-scientists-2650218864.html?rebelltitem=3#rebelltitem3. It is of significance to note that the research for this work was performed during the Trump Administration.
[343] Anonymous Respondents A-J.
[344] See Chapters 2 & 3.
[345] Trump Administration USEPA staffers claimed that the CWR had, in fact, *'placed too much emphasis on science'* (own emphasis). See https://www.sciencemag.org/news/2018/07/obama-s-wetlands-protection-rule-put-too-much-emphasis-science-trump-officials-argue?utm_campaign=news_weekly_2018-07-06&et_rid=307814892&et_cid=2167359

In summary these responses speak to an identified need for all connected parts of a hydrosystem to fall within the same jurisdictional and regulatory frame. Furthermore, that the connectivity-based approach of the CWR was arrived at in direct response to a sustained period of regulatory confusion. Of importance was that a connectivity approach was not a new concept, rather that it had always been implicit — ie all that the CWR did was to provide overt and express clarification of what was already scientifically recognised as a fundamentally important characteristic of hydrosystems. This illustrates a central problem with an assumption that something that is only implicitly implied will receive overt due consideration.

(c) The CWR versus prior rules and guidance, and subsequent CWR changes

The text of the CWR, annotated to show the inclusion of text from the 1986 rule, and that subsequently removed by the Navigable Waters Protection Rule (NWPR),[346] is provided as Annexure 2.

Of significance are the differences between the text of the proposed CWR[347] and that which appeared in the final 2015 version. These differences triggered the core challenges to the science behind the CWR.

The draft CWR contained just 1001 words of definitional text. This version established the connectivity underpinning by simply including all tributaries to WOTUS as being part of the connected whole, ie in alignment with the science as described in Chapter 2. However, the final version contained an additional 1062 words which were not previously submitted for public comment, and which established brightline categories based on distances from watercourses or for particular types of regionally characteristic waters, as well as the elements necessary for the significant nexus analysis.[348] The intentions for and consequences of these late inclusions are discussed hereunder.

IV. Challenges to the connectivity-science underpinning the CWR

The Clean Water CWR encompassed the following basic goals:[349]

[346] 85 FR 22250 (2020)
[347] 79 FR 22188 (2014)
[348] Parenteau P (2016) 'A bright line mistake: How EPA bungled the Clean Water Rule'. 46 *Environmental Law* 379-993.
[349] What the Clean Water Rule Does. USEPA https://www.epa.gov/cleanwaterCWR/what-the-clean-water-rule-does. Downloaded 01/03/2017.

- Clearly define and protect tributaries that impact the health of downstream waters;
- Provide certainty in how far safeguards extend to nearby waters;
- Protect the nation's regional water treasures (those regionally-specific water resource types as listed in the CWR;
- Focus on streams, not ditches other than those constructed in streams and which function as streams;
- Reduce the need for (time consuming and costly) case-specific analyses of waters.

Importantly, the above advisory also set out what the CWR was not intended to do, or not capable of doing, *inter alia*:[350]

- Protect any types of waters not historically covered by the CWA;
- Interfere with or change private property rights;[351]
- Regulate ditches other than those providing stream function;
- Address land use;
- Regulate erosional features;
- Include groundwater.[352]

The inability to regulate the use of land adjacent to water courses is a significant limitation which this thesis specifically addresses.

The CWR was enjoined,[353] shortly after promulgation, by a federal court on 25 August 2015.[354] The Court held that the CWR was inconsistent with the *Rapanos* opinion in that it (i) asserted jurisdiction over 'vast numbers of waters' that were unlikely to have a significant nexus to navigable waters; (ii) that it was equally unlikely that remote and intermittent waters could impart an effect on navigable waters and (iii) that a 4 000 US foot (4 000') brightline limit was arbitrary and not a 'logical outgrowth' arising from the proposed CWR.[355] However, the court

[350] What the Clean Water Rule Does Not Do. USEPA https://www.epa.gov/cleanwaterrule/what-the-clean-water-rule-does-not-do. Downloaded 01/03/2017.
[351] As set out in Chapter 2, given the need for a watercourse and its adjacent land to be protected, adhering hereto would be fraught with complications.
[352] While the exclusion of groundwater from a connectivity-directed initiative is counter-intuitive, the reason for this is that the jurisdiction of the CWA does not extend to include groundwater. Groundwater in the USA is primarily regulated at state level.
[353] The term 'enjoin' in US law is equivalent to an injunction in South Africa.
[354] *North Dakota v USEPA* 3:15-cv-59.
[355] The '4 000 foot rule' is discussed in detail later in this chapter.

did not approach the merits of the underpinning science and the CWR was enjoined pending decision on which US courts could hear the challenges.

The procedural challenges, travelled all the way to the Supreme Court,[356] where it was decided that the appropriate forum was the federal district courts — thereby triggering the likelihood of a multitude of challenges and appeals across the nation — but which was shuttered by Executive Order of the Trump administration terminating the rules further use.[357] As such, the critical determination of its efficacy as a science-underpinned definition of WOTUS remains completely untested by a court of law.

For the purposes of this analysis, the principal challenges to the CWR, and the responses by the Obama administration thereto, provide a means to identify the issues and concerns raised regarding the underpinning science. At this juncture it is pertinent to first summarise the five main conclusions of the Connectivity Report:[358]

a. Perennial, intermittent and ephemeral streams are physically, chemically and biologically connected to downstream waters and individually or cumulatively exert a strong influence on the integrity of these downstream waters;
b. Wetlands and open waters in riparian areas of floodplains are physically, chemically and biologically integrated with rivers and the integrity of downstream waters;
c. Wetlands and open waters in non-floodplain landscapes provide numerous ecosystem functions to downstream waters and occur on gradients of connectivity;
d. Connectivity of streams and wetlands to downstream waters occurs along a continuum described in terms of the frequency, duration, magnitude, timing and rate of exchange of water, material and biotic fluxes to downstream waters;
e. The incremental effects of individual streams and wetlands are cumulative across entire watersheds and must therefore be evaluated in combination with other similar waters.

As set out in Chapter 1, the CWR was presented to the regulated community on a very solid, peer-reviewed foundation of hydroecological science, with the goal of protecting the majority of America's water resources. At no point were any red flags raised regarding the science, other than recommendations made in the SAB report to improve textual clarity.

[356] *National Association of Manufacturers v Department of Defense* et al. 16-299 (22 January 2018).
[357] EO 13378 (28 February 2017).
[358] Chapter 2 provides the scientific background derived from this report.

In sum, the Connectivity Report constituted the equivalent of a limnological textbook describing the importance of HEC for aquatic ecosystems — this characteristic rendering it, *mutatis mutandis*, applicable in any country, not just the USA. What was different, however, was that the final CWR included a suite of distance-based and watercourse-type brightline CWRs which the reports did not address, nor had the new materials been subjected to prior public or expert scrutiny.

On the same day that the CWR became law, a coal-mining corporation, Murray Energy,[359] filed a civil action in a West Virginia district court.[360] This action argued, *inter alia*, that the CWR expanded the reach of the regulatory agencies 'beyond the bounds... supported by science'. Consequentially, *Murray* maintained that its five West Virginia mines would have to 'expend resources to comply with the CWR and will suffer economic loss'. Furthermore, that the non-WOTUS waters into which these mines discharged wastes were 'non-jurisdictional and... did not have the federal legal obligations of those requirements [imposed by the CWR]'. So, in effect this was tantamount to a large-scale version of the *Coleman* case, ie noxious materials discharged into non-WOTUS waters.

The single science-related issue directly raised by *Murray* was that the SAB Review (see Chapter1) had allegedly regarded the connectivity approach adopted in the Connectivity Report as flawed. What the SAB Report had, in fact, maintained was that any notion of connectivity existing as a binary (connected, not-connected) should be dispelled by describing all connectivity relationships as existing along a continuum.[361] In so doing the SAB Review had, in fact, substantially bolstered the importance of a connectivity underpinning for water resource governance. As such, the *Murray* challenge appeared to be grounded in pecuniary self-interest and profit-taking, at the expense of the existential threat to the environment posed by the practice of coal mining. Its civil action was tantamount to gaining an early 'foot in the door' to the process of judicial review.

What *Murray* saw as the principal threat to its 'business as usual' practices was that the CWR extended government jurisdictional reach to non-WOTUS waters — which, of course,

[359] The complaint held that Murray Energy is the largest privately-owned coal company in the USA — without qualifying how this fact related to obligations to protect water resources. Murray was a major donor to the Trump election campaign. https://thehill.com/policy/energy-environment/329587-energy-companies-donate-millions-to-trumps-inauguration, and to the Republican Party https://www.weirtondailytimes.com/news/local-news/2019/11/murray-a-major-donor-to-gop/
[360] *Murray Energy Corporation v USEPA & USACE* 1:15-cv-110.
[361] See bullet (d), above.

the CWR expressly and unavoidably did as this was its specific aim in the furtherance of ensuring connectivity.[362]

Other challenges for or against the CWR were lodged on the same or subsequent days. These were combined, together with a very detailed Government response,[363] into the selection drawn for this analysis, as listed below:

(a) Challenges to the CWR

1. *Waterkeeper Alliance Inc et al v USEPA and USACE.* Complaint for declaratory and injunctive relief ('*Waterkeeper'*); [364]
2. *Murray Energy Corp v USEPA*, Amicus brief by the Association of California Water Agencies et al. ('*ACWA*'); [365]
3. *Murray Energy Corp v USEPA et al*. Brief of members of Congress in support of State and Business and Municipal Petitioners (*'State & Business Petitioners'*);[366]
4. *North Dakota et al v USEPA et al*. Brief of amicus curiae National Rural Water Association supporting State petitioners ('*NRWA*');[367]
5. *Murray Energy Corporation v USEPA et al* Amicus Brief of Washington Legal Foundation urging that the CWR be vacated (*'Washington Legal'*);[368]
6. *National Association of Manufacturers v Dept of Defense at al*. Respondents brief on behalf of petitioner Agrowstar LLC et al. ('*Agrowstar*');[369]
7. *Washington Cattlemens Association v USEPA and USACE* ('*Cattlemens*');[370]

[362] 1:15CV110 Memorandum opinion and order dismissing without prejudice plaintiffs complaint for lack of jurisdiction (26 August 2015).
[363] The responding Government argument provides a detailed, 546 page summary of the scientific underpinnings used in the CWR.
[364] 3:15-cv-03927 (US District Court, Northern District of California. (Filed 27 August 2015)
[365] 15-3751 (US 6th Circuit Court of Appeals) (Filed 4 November 2016).
[366] 15-3751 (US 6th Circuit Court of Appeals) (Filed 8 November 2016).
[367] 15-3831 (US 6th Circuit Court of Appeals) (Filed 8 November 2016).
[368] 15-3751 et al (US 6th Circuit Court of Appeals) (Filed 8 November 2016).
[369] 16-299 (US Supreme Court) (Filed 26 April 2017).
[370] 2:19-cv-00569 (US District Court Washington at Seattle) (Filed 16/04/2019). This challenge, as were others, filed after the CWR had already been enjoined. This illustrates the controversial nature of the CWR and the apprehension on the part of business interests that it may be resurrected under the Biden administration. The reason may be that the CWR was never enjoined in any court in Washington State. The USEPA announced on 9 June 2021 that they intended to revise the definition of 'waters of the United States'. Federal Register 86 41911 (4 August 2021).

(b) Defending/supportive motions

8. *Murray Energy Corp v USEPA et al.* Brief for Respondents ('*Government Respondent*').[371]
9. *Murray Energy Corporation v USEPA et al*. Amicus brief by scientists in support of upholding the CWR ('*Scientists*');[372]

In summary, the science-directed challenges claimed as follows[373] — in each case further interpretation of each aspect is provided in Section IV(c) *et seq*.

- The CWA is only about water quality, and not also ecosystem health and integrity;[374]
- The CWR unreasonably expands the spatial scope of the CWA;[375]
- The significant nexus standard constitutes a faulty legal premise;[376]
- Tributaries and adjacent waters are not jurisdictional as WOTUS;[377]
- Ephemeral and intermittent streams are neither tributaries nor WOTUS;[378]
- The use of physical indicators to define streams is an invalid metric;[379]
- The use of brightline distance-based CWRs[380] for determining adjacency is invalid;[381]
- Tributaries cannot have man-made sections, ie. that tributaries which include man-made sections are no longer tributaries;[382]
- Ditches do not provide the same function as tributaries;[383]
- Delineative use of the 1:100-year floodplain is not supported by the science;[384]

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[371] Brief for Respondents: 15-3751 and consolidated cases. (US 6th Circuit Court of Appeals) (Filed 13 January 2017). 546 pages.
[372] 15-3751 et al (US 6th Circuit Court of Appeals) (Filed 20 January 2017).
[373] The set of challenges analysed here was determined from the response arguments contained in the US governments response brief (see Note 100).
[374] The stated purpose response of the CWA is to 'restore the physical, chemical and biological integrity of waters of the United States'.
[375] If water resources are to regulated based on their inherent connectivity, then the spatial scope of the CWA must spatially widen to include all connected components of a hydrosystem.
[376] The significant nexus approach fundamentally provides a science-underpinned basis for determining the existence of hydroecological linkages between components of a hydrosystem.
[377] This statement merely perpetuates outdated thinking which harks back to the strict application of only navigable-in-fact waters being regulated.
[378] As established in Chapters 2 & 3, this is patently incorrect.
[379] This statement refers to the ability to discern the bed, banks and ordinary high water mark of watercourses in arid environments. Any inability to do so does not render these waters non-jurisdictional.
[380] See n417 for definition of brightlines.
[381] In this particular instance the challenge is correct on the grounds that no scientific validation was provided for the 4 000 Foot CWR. This aspect is addressed in some detail in this chapter.
[382] This is both an inaccurate assumption and ignores US case law findings to the contrary.
[383] Ditches provide both continuity of connection in streams and rivers, as well as proxy ecosystem services.
[384] While not ideal for ecological assessments, the 1:100 delineator provides an excellent indicator of floodplain extent.

- The CWR cannot apply to non-wetland adjacent waters such as oxbows;[385]
- Groundwater remains excluded from the CWA.[386]

Before proceeding to consider each individual claim, some general comments follow: While the (final) CWR itself is a mere 2060 words, it is embedded in ~82 000 words of detailed narrative explanation. Few, if any, regulations anywhere are accompanied by so much clarifying detail. Admittedly, reading and digesting all of this would be a daunting task for anyone not familiar with the field of aquatic sciences, yet the language in these documents has been carefully tempered so that it clearly articulates the meaning to a layperson's understanding. This notwithstanding, none of the challenging submissions mentioned or acknowledged the fundamental purpose, viz the connectivity underpinning of the CWR — which contained a wealth of examples to illustrate each and every point made.[387] Accordingly, all of the challenges, barring those for the 4 000' rule and for groundwater, are here deemed to lack merit.[388]

Centrally absent from the listed suite of complaints is any evidence of an awareness or acknowledgment that the hydrological cycle is indivisible amongst the individual conduits[389] that convey water from where it falls on land as precipitation, to where it re-enters the atmosphere (transpiration/evaporation), or infiltrates to groundwater, or discharges into the sea. Also absent is any mention of the role of faunally-mediated connectivity of waterbodies — where animals provide the connecting vectors, or perhaps of energy and material transfer such as is mediated by leaf-fall from tree canopies over stream courses. The Technical Support Document refers to the former as, for example, 'hitch-hiking' on migratory animals.[390] So, migratory birds, for example could, as they move from waterbody to waterbody, 'piggy-back' essential inocula of floral and/or faunal propagules from one body of water to another.

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[385] Cut-off sections of channel, such as oxbows, retain aerial, overland and hyporheic connections to the fluvial mainstem.
[386] This is correct as the CWA has never regulated groundwater. However, the exclusion of groundwater from a regulatory approach based on HEC cannot be other than flawed.
[387] The principal reason behind the assaults on the CWR are likely to be property-ownership based. The *Cattlemen's* amicus brief states that '[p]laintiffs members are injured because they hold beneficial interests in property that will be subject to increased federal regulatory authority...' (at 13) — evidencing a desire to the unfettered use of their land and, in particular, any non-WOTUS waters they may be harming.
[388] For any or all challenges to have merit they should show that the CWR is arbitrary, capricious, an abuse of discretion or otherwise not in accordance with law. 5 U.S.C. § 706(2)(A).
[389] streams — (including ephemeral and intermittent), rivers, wetlands, non-wetland waterbodies and groundwater.
[390] Technical Support Document at pages 254, 334, 363, 366 and 373.

Additionally, there was no acknowledgment of the inter-connected ecosystem nature of watershed components comprised of non-WOTUS. Lastly, an awareness of the fundamental necessity to ensure healthy functional aquatic ecosystems in order to sustain human health and well-being, as well as economic development, is almost entirely absent — and replaced by a mantra that suggests that water resource protection is anathema to the economy. An awareness of the continuing impacts of anthropogenic inattention to protecting the aquatic environment is singularly lacking.[391]

(c) Claim: The Clean Water Act is only about water quality

Perhaps the most startling finding of this analysis was that there appears to be a lack of awareness of what the CWA is intended to achieve, or to the role of the CWR in achieving the statutory goal. The *State & Business Petitioners* amicus brief was signed by no less than eighty-eight lawmakers, viz. Senators (21) and Members of Congress (67). The stated intention of their brief was to 'provide our insight regarding congressional intent and legislative history'. To all intents and purposes, such an approach would ordinarily have immense value but, in this case, the signatories make three claims, all of which are incorrect: First, that the intentions of the CWA were to regulate only 'navigable in fact' waters; second, the *SWANCC* ruling excluded all isolated waters from federal jurisdiction and thirdly, that all that the CWA regulates is water quality, and that the regulation of water resources in terms of 'quantity' and/or 'habitat' amounts to a 'contrived theory'.[392]

The absence of an understanding of the role of water quality as a single metric in ecosystem-directed water resource management is inherent in not asking the question 'what role does water quality play in the furtherance of the CWA?' The fact is that, as set out above, the readily-accessible Congressional record, legislative history and published CWA guidance, all clearly invalidate the *State & Business Petitioners'* argument.[393] Furthermore, the Clean

[391] Bradshaw CJA, Ehrlich PR and A Beattie et al (2021) 'Underestimating the Challenges of Avoiding a Ghastly Future'. *Front. Conserv. Sci.* 1:615419. doi: 10.3389/fcosc.2020.615419.
[392] *State Petitioners* Brief at page 22. 'The Agencies' new theory assumes that all bodies of water have "aquatic life" as the "designated use" ', which is not true (at 24).
[393] Case law that predates *Rapanos* makes quite clear that the CWA applies to '...virtually all bodies of water' *International Paper Co. v Ouellette 479 U.S. 481*, citing the Congressional Record wherein was stated that 'it [the Act] means "all the waters of the United States" in a geographical sense' (1 Legislative History of Water Pollution Control Act Amendments of 1972 (Committee Print compiled for the Senate Committee on Public Works by the Library of Congress), Ser. No. 93–1, p. 250 (1973). The Clean Water Act Jurisdictional Handbook (2nd edition, 2012) underscores that the word 'integrity' included in the CWA objective refers to "a condition in which the *natural structure and function of ecosystems is maintained*" (emphasis added).

Water Act Restoration Bill was intended to discard 'navigable' in favour of WOTUS.[394] The *State & Business Petitioners* also appear to not have comprehended the basis of the significant nexus test — which the available published guidance clarified for them.[395] With respect to the *SWANCC* decision, this is yet another example — as explained earlier, of a misreading in that the findings did not engage with jurisdiction over isolated waters.[396] Arguably, even it had, this would not have precluded the agencies from crafting a more appropriate definition.

The *State & Business Petitioners* do not appear to have appreciated that water quality is only one factor necessary to ensure healthy aquatic ecosystems and hence the ecosystem services that underpin human health, well-being and economic prosperity. In truth, their argument suggests that they perhaps regard watercourses as little more than the reticulation system necessary to convey water — rather than as living ecosystems, parts of which also convey water. Their apparent reluctance to further the efforts of their erstwhile Senate and Congressional peers, some five decades previously,[397] should be of profound concern to the American public given the existential threats to watercourses and wetlands. At the very least, if a lack of informed awareness is indeed prevalent, this indicates the need for a comprehensive program to inform the American public from the top down as to why a regulation such as the CWR is so very necessary.

In a conflicting and contrary claim, the very same petitioners opined that for a significant nexus determination to be valid, all three forms of integrity — chemical, physical and biological — must apply concurrently.[398] If this were indeed true, where a water was affected only by pollution, it would not be jurisdictional under the CWA. [399] This was clearly not the intentions of the drafters of the CWA.

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[394] S.912 Clean Water Authority Restoration Act of 2005.
[395] The CWA Handbook suggests asking 'whether a given wetland or stream, either alone or as part of a category of similar features, is important to the health of downstream waters. Here it should be patently evident that 'health' refers to more than just water quality. Sapp et al (2006) provide a detailed history of the intentions underpinning the CWA and that "[w]e cannot expect to preserve the remaining qualities of our water resources *without providing appropriate protection for the entire resource*" (emphasis added). Citing Senator Baker, 4 August 1977). See also Kearns J (2006) A nexus runs through it: Wetlands, hydrological connections and federal jurisdiction in the post-SWANNC world. *36 ELR 10222*.
[396] See *Cattlemen's* amicus brief at page 5 (another instance of a misreading of the SWANNC decision).
[397] For example see Sapp et al (n394).
[398] *State Petitioners* at 31-33.
[399] *Government* at 129.

(d) Claim: The Clean Water Rule unreasonably expands spatial jurisdiction over water resources

A common thread throughout the challenges is that the CWR unreasonably expanded the spatial jurisdictional scope of the CWA, through employing science-informed connectivity between water resource components as the operative underpinning.[400] By including, for example, tributaries as WOTUS — overtly the intent of the CWR — and the fundamental reasoning for this, viz that pollution entering a tributary may make its way into a primary water, the outcome must necessarily require expanding the spatial reach.

This particular aspect is arguably a weak point in the CWR and entrains three of the issues listed above which the CWR was precluded from addressing, viz:

- Interfere with or change private property rights;[401]
- Address land use;
- Include groundwater.[402]

The expansion of water resource regulation to include all types of water resources unavoidably steps into the issue of how this will relate to the occurrence of such waters on private property, ie the first two bullet points listed above. As has been set out in Chapters 1 & 2, and developed further in Chapter 4, a connectivity-based approach to water resource protection will, in the main, unavoidably intrude on private land use. This is accommodated by combining hydroecological considerations for water resource regulation in South Africa within the enfolding principles of the public trust. On this view, all three of the above 'constraints' are accommodated by the custodial protections afforded by the trust. As the public trust is not a federal doctrine in the USA it could not be called on to provide support for the CWR.

[400] The *Cattlemen's* brief admits that the CWA 'provides no intelligible principle for determining which upstream, non-navigable waters are [WOTUS]', astoundingly missing the fact that the purpose of the CWR was to introduce connectivity as this very principle.
[401] As set out in Chapter 2, given the need for a watercourse and its adjacent land to be protected, adhering hereto would be fraught with complications.
[402] While the exclusion of groundwater from a connectivity-directed initiative is counter-intuitive, the reason for this is that the jurisdiction of the CWA does not extend to include groundwater. Groundwater in the USA is primarily regulated at state level.

(e) Claim: The 'significant nexus' constitutes a faulty legal premise

As set out above, the concept of a significant hydrological nexus[403] emerged first from *SWANNC* and was subsequently concretised into a hydroecological context in *Rapanos* (the concurring, science-based opinion of Justice Kennedy J).[404] Within the six years following *Rapanos*, the nexus decision therefrom was referred to in more than ninety cases from 35 US states.[405] The application of the test is also set out in detail in the CWA Handbook. Its proposal by the Supreme Court heralded an astute appreciation of the need to assess the connectivity of hydrosystem components at a deeper level than might otherwise be apparent solely from surface water connections.

Despite the rulings culminating in *Rapanos,* the jurisdictional scope of the CWA remained problematically ambiguous — triggering the need to formulate a regulation having the significant (connectivity) nexus as its fundamental 'backbone'.[406] The CWR justifiably incorporated the significant nexus outcome of a Supreme Court decision, as subsequently upheld by the majority of states, into the CWR.[407]

Arguably, very few reasonable ecologists would attempt to gainsay the significant nexus approach. In essence, this type of approach has, for many years, provided an implicit unwritten norm in Environmental Impact Assessments (EIAs) as an objective requirement for identifying biotic and abiotic linkages across a landscape.[408] The CWR provided substantial further clarity to the application by listing nine scientific factors to be assessed in or to guide a significant nexus determination to underpin sound administrative governance.[409] However, the application of the significant nexus test has been in effect, and upheld by many courts, over a sustained period, as outlined earlier in this chapter, and centrally embedded in the so-called *Rapanos* guidance. [410]

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[403] The significant nexus test determines whether two or more components of a water resource are connected in such a manner that if the connection is broken or disrupted, this will impair the physical, chemical or biological integrity of the aquatic ecosystem.
[404] *Rapanos* 547 U.S at 767 'Absent a significant nexus, jurisdiction under the Act is lacking'.
[405] *CWA Jurisdictional Handbook* (Second Edition, May 2012). Case Appendix at 46. Environmental Law Institute, Washington DC.
[406] *Government* at pages 43 & 51 — referring to the significant nexus as the backbone of a response to restore governance of waters following the fractured *Rapanos* decision.
[407] *Government* at page 49.
[408] Having regard for an implicit norm is dependent on the experientially-informed skill of the specialist(s) tasked with assessing a particular water resource.
[409] CWR 5(1-ix), see Annexure 2.
[410] Of note is that the significant nexus analysis, despite its Supreme Court origin in *SWANCC*, does not appear in the NWPR.

(f) Claim: Tributaries and adjacent waters are not jurisdictional as WOTUS

The need to render all tributaries jurisdictional has long been the intention of, or implicit in, the CWA.[411] Including tributaries, intermittent and ephemeral streams and wetlands as WOTUS was a specific goal of the CWR, as explained in the narrative support thereto, as well as in the Connectivity Report. While such waters may be dry for sustained periods, they are catapulted into importance for the brief periods they contain water. The Connectivity Report went to considerable length to set out why smaller headwater and IRES streams were crucial to the integrity of the whole of a hydrosystem. The clear and evident intentions of the CWR were established on the basis of ensuring HEC between the various aquatic components of a watershed (and hence activities in the watershed which might impair such functionality), to expand the defined jurisdictional reach of the CWA.[412] Coupled hereto is that the original intentions of the CWA, as set out above, were for it to cover most, if not all, of the water resources in the USA — and that this was in fact enforced by a variety of court decisions. Accordingly connected waters would first need to be rendered jurisdictional for the CWR to have succeeded.[413]

(g) Claim: Ephemeral and intermittent streams are neither tributaries nor WOTUS

Approximately half of the aggregate length of streams in the USA are comprised of ephemeral waters.[414] From the background provided in Chapter 2, the importance of headwaters and IRES to stream and river networks, is without question. Rather than these temporary and often ecologically delicate environments being ineligible as jurisdictional waters, their very characteristics amplify their importance and grounds for absolute inclusion. The SAB review confirmed the 'strong influence' that such waters exert on the downstream environment.[415] These are the waters which, singly or in aggregate, provide inocula of materials and biota (the latter often rare species) — which occur nowhere else in the watershed — which are essential to the integrated and balanced functioning of downstream waters. As was evident from

[411] See detailed historical analysis of these intentions in Sapp et al (2006).
[412] In *US v Ashland Oil* 504 F.2d 1317 (1974) the court declared that 'the analysis of the Act set forth [above] amply demonstrates that Congress was concerned with pollution of the tributaries of navigable streams as well as with the pollution of the navigable streams. We also believe that it is incontestable that substantial pollution of one not only may but very probably will affect the other'.
[413] The *Government* response declares the significant nexus between tributaries, adjacent waters and primary waters as 'unassailable' (*Government* at page 70).
[414] Fesenmyer KA et al (2021) 'Large portion of USA streams lose protection with new interpretation of Clean Water Act'. Pre-print copy on file with author.
[415] SAB Report at 3.

Figure 3.2 above, IRES environments may certainly be difficult to discern to the untrained eye — which is exactly why the CWR sought to provide definitional guidance.

Some of the challenges were made on the argument that many streams and rivers in the arid west of the USA only flow for relatively short intervals,[416] ignoring the fact that such pulses of flow, and their associated resuscitation of species specially adapted to respond thereto, underpins the biodiversity and ecological value of intermittent and ephemeral waters. An agency analysis of the effect of the rule that replaced the CWR found that it excluded virtually all assessed streams, ie waters that would have been regulated under the CWR or the pre-CWR regulatory process.[417]

(h) Claim: Misplaced reliance on physical indicators and bright-line distance-rules for determining adjacency

As introduced above, the final version of the CWR incorporated various approaches to be used to determine adjacency of one waterbody to another. These introduced various parameters or metrics which generated a large proportion of the challenges to the CWR — centered on two aspects — the use of physical indicators to determine the edge of a watercourse and/or the use of distance-based brightline rules[418] to determine jurisdiction of an adjacent water.[419] Both approaches are not without their limitations, but both have merits that significantly outweigh any perceived constraints. Additionally, various specific categories of regional waterbody types were added.

Three issues related to qualification of adjacency arose from the challenges to the CWR. These (i-iii) are set out hereunder:

(i) Claim: The use of physical indicators to define streams is an invalid metric

This challenge refers to a requirement for the presence of physical indicators, such as *inter alia* a visible ordinary high water mark (OHWM), scour lines or debris to discern the outer edge of the reach of floodwaters or floods of a particular magnitude. These indicators, while commonly

[416] *State Petitioners* at page 62.
[417] *Pasqua Yaqui Tribe v USEPA*, 4:20-cv-00266-RM at 9.
[418] A brightline rule or test provides a clear, simple and objective standard which can be applied to a jurisdictional determination. It provides a judicial rule that precludes interpretive ambiguity through setting a standard in order to arrive at clear, simple and consistent responses to a particular situation. In environmental regulations, the use of physical distances between, for example, types of waterbodies or of the proximity of waters to potentially-harmful activities, in order to inform appropriate governance responses, is common.
[419] The CWR also incorporated brightline categories of waters endemic to various regions of the USA.

used by hydrobiologists when they need to delineate a flood plain edge, are not always present as clear visual indicators. As such the challenges maintain, correctly, that such indicators are not always present or are difficult to discern, especially in arid environments. This does not, however, render them invalid as aids to watercourse delineation, their absence merely indicates that resort must be had to other tools such as photographs, anecdotal records, waterlines on trees and walls, anecdotal experience and other signs pertinent to the specific case in question. The ecosystem value of such waters is not diminished by the fact that they may not leave readily observable physical evidence of their bank-full width. Other methods, if needed, are available for this purpose.

(ii) Claim: Brightline distance-based rules for determining adjacency are not scientifically supported

Brightline distance-based rules are of enormous value for the screening of activities or issues that may or may not be subject to a regulatory requirement, such as the need to undertake a permitting process or trigger a more detailed assessment protocol. They are commonly employed in many aspects of environmental law as a first-level screening test to determine the need for further investigation.[420] The use of brightlines provides an empirically determined lateral distance which is likely to sweep the majority of a certain type of feature into consideration for assessment. The CWR, responsive to multiple requests for specific limits to be set,[421] provided brightlines but underpinned their usage by including the fallbacks of the significant nexus test and consideration of similarly situated waters, ie if a wetland fell within the brightline distance, it would automatically need to be subjected to a significant nexus analysis. This approach is invariably not inclusive, ie there may be water resources beyond the specified distance but, in the main, the majority of likely-to-be connected features should fall within the set lateral distance.

The CWR incorporated two sets of categorical, distance-based, brightline rules, these being: first, for defining a 'neighbouring' water[422] and, secondly, distances that could trigger the need for a significant nexus determination[423]. As stated above, these were not specified in the draft CWR, although the latter made numerous references to distance-based proximity of primary to other waters. For a brightline delineator to have jurisdictional value it should arise

[420] 'Brightline tests are a fact of regulatory life' *Macon County* 7 F.3d (1993) at 768.
[421] CWR Response to Comments Volume 3 (on file with author).
[422] CWR Section c(2)(i-iii).
[423] CWR Section a(8).

as the product of reasoned empirical determination. While the final version of the CWR specified distances, no supporting methodology regarding how they were determined was provided.[424] It appears that by 2015, in the waning months of the Obama Administration, pressure to promulgate the CWR led to a hasty decision to include the brightlines absent further public engagement.[425] In such an unsubstantiated format it would be difficult to ground a requirement for detailed assessment of any waters falling within its ambit.

Challenges to the distances were based on three issues: First, that they had been included without warning in the final version of the CWR.[426] Secondly, that the distances employed were not based on science or, at least, that the CWR had not provided the scientific underpinning. Third, that the application of the CWR would remove from protection any waters occurring beyond the maximum (outermost) set distance of 4 000 US feet' (4 000').[427]

On the available evidence the distance-based claims have some merit. A possible exception would be the 1:100 year flood return period — which is commonly used throughout the world as a guideline distance for restricting floodplain development (see hereunder), as well as in the natural sciences.[428] In their support for rules based on distance, the *Scientists* brief only cited papers which, at best, implied the importance of distance without quantifying same.[429] However, while not perhaps empirically determined, deference to the vast experience of the USEPA should have provided grounds for specific distance-based CWRs, as long as these simply initiated a requirement to look more closely and perhaps trigger a significant nexus determination.[430]

Distance cannot be the sole indicator to determine categorical jurisdiction. It can merely provide a guideline as acknowledged by the SAB Report.[431] The Government's response to this

[424] Protracted enquiries revealed that while no empirical spatial analysis had been undertaken, a set of 200 wetlands was assessed and their distance from the nearest WOTUS approximated. This process revealed that 198 of the wetlands were situated within 4000 US feet of a WOTUS.
[425] Respondents C & F.
[426] *Washington Legal* amicus brief at page 4. The draft CWR had, however, intimated that such distance-based tests could be included ('... the agencies also propose, where supported by scientific literature and consistent with the law, brightline categories of waters that are and are not jurisdictional') Proposed CWR at page 22198.
[427] In point of fact the proposed CWR would have encompassed all waters under the significant nexus test. In an assessment of 199 jurisdictional determinations the USEPA found that only 4 thereof lay beyond 4000 feet from a jurisdictional water. Government at 123.
[428] Connectivity Report at 2-5.
[429] *Scientists* amicus brief at pages 29 & 38.
[430] In *National Mining Association v USACE* (1998) the court held that 'a reasoned attempt to draw such a [distance-based] line would merit considerable deference'. 145 F.3d 1399.
[431] SAB Proposed CWR Review at 3. See also Government at page 98.

challenge merely stated that the agencies use of the various distances was 'reasonable' which, as per the preceding paragraph, it may well be.[432] Scientists involved with the CWR drafting were not informed that the brightline rules were to be included.[433] As such, the manner in which the lines were deployed was both clumsy and reasonably questionable, especially where such use categorically excludes waters beyond a particular distance from another water. Against this must be argued that the CWR clearly states that it is not based solely on science and that 'agency discretion' supports the delineation of the bounds of jurisdiction and — as the Supreme Court acknowledged in *Rapanos* — this discretionary ability recognises that science must be policy relevant. An instrument such as the CWR requires an adaptable and flexible relationship with emerging science.[434]

That wetlands, globally, require especial protection, irrespective of their proximity to other watercourses, has over many years become axiomatic. This notwithstanding, development pressures exerted to transform wetlands into developable land persist.[435] The use of brightlines as categorical determinants of inclusion or exclusion is fraught with problems — in the main that it underpins a dangerously-simplistic binary and, with respect to wetlands, can discard huge swathes of wetlands that are connected to others but, by virtue of 'being on the other side of the line' become excluded from protection.[436] This is a risk associated with exclusive reliance on flood lines (see hereunder). However, distance-based rules do have a positive role to play in the form of 'trigger-lines' or thresholds which invoke progressively higher tiers of analytical consideration under certain circumstances. Such usage requires a commensurate degree of scientific explanation and regional interpretation, ie a particular distance applicable in one region may be of considerably more or less value in another.[437]

Given the potential value of the brightline distances included in the CWR, the relevance of the 4 000' rule was empirically verified against the proximity of wetlands to rivers in South

[432] The CWR maintained that 'the vast majority of waters where a significant nexus [exists]... are located within the 4000 foot boundary' (80 Fed. Reg at 37090) — yet no supporting evidence was provided. Empirical evidence was, however, available that revealed that the 4000' distance was substantiated. See EPA-HQ-OW-2011-0880-20882.pdf & Jurisdictional Determinations_Redacted.pdf 695 pages. Copies on file with author.
[433] Respondents A & D.
[434] The CWR text confirms this at 37081.
[435] Four such examples are described in Chapters 6 & 7.
[436] Calhoun AJK, Mushet DM and LC Alexander et al (2017) 'The significant surface-water connectivity of "geographically isolated wetlands" ' 37 *Wetlands* 801-806.
[437] Ibid.

Africa. The latter analysis found that the 4 000' distance was inclusive of almost all wetland types likely to have connections to another waterbody.[438]

(iii) Claim: Delineative reliance on the 1:100-year floodplain is not supported by the science

Use of the 1:100 hydraulic return period as a delineator of the extent of a floodplain is a global commonality, not least in the United States. As indicated above, its primary practical intention is to delineate the area associated with a fluvial hydrosystem within which development may be at the risk of flood damage (risk to life and/or property). From a scientific perspective, the 1:100-year extent will encompass the extent of land adjacent to a fluvial watercourse that will be inundated, or HEC-connected, at this flood interval.[439] As such, this physical indicator is commonly relied on in desktop assessments. However, the 1:100 line by no means implies that no potentially connected waters or components of water course lie beyond it — in fact many do, not least due to the fact that the extent of floods varies over time. As catchments develop, so floodlines may increase, conversely if dams are built or there is large-scale abstraction, they may recede — leaving behind components which remain connected via, for example, the hyporheos. Both extremes are variously dependent on the effects of climate change.

What was perhaps evident from the challenges is that what is meant by a 1:100-year flood event appears to have been widely misunderstood — viz that it is a flood that only occurs once in 100 years, whereas more correctly it represents a one per cent chance of an hydraulic event of this magnitude occurring in a given year. 1:100-year floods can occur more than once in a century or even more than once a year — and with climate change probably will in some parts of the world. Arguments were also presented that perhaps the limits of smaller flood events, eg 1:20 year (with a 20 per cent chance of occurring and which occur several times per year) were suggested. This would counter-productive, however, as decades of experience by risk analysts has shown the 1:100 to be definitive for protection of both life and property.[440]

(i) Claim: Tributaries cannot have constructed sections, or ditches may not be tributaries

This claim combines two related challenges.

The claimants alleged that an engineered section, for example a concrete culvert installed beneath a road to allow the passage of a stream, would render the whole stream non-jurisdictional, as the OHWM indicator would be disrupted.[441] For a long time it has been common, especially in urban and peri-urban environments, and along roads and railways, that a canal, culvert or similar engineered device has been included to assure the hydraulic integrity of the surrounding built environment. While such interruptions do indeed limit the nature of

[438] See infra.
[439] The spatial scale of flood events must '[cover] all available habitats' SAB Science Review at 41.
[440] US National Flood Insurance Program sets the base flood (minimum for flood protection) condition as the 1:100 year event — but includes the 1:500 year flood as the maximum. Appendix E, NFIP Regulations (44 CFR Parts 49, 50, 65 & 70).
[441] *State Petitioners* at page 63.

the aquatic ecosystem, they do not necessarily preclude the passage of materials and biota or isolate the upstream environment.[442] Furthermore, many options exist to ameliorate the impacts such as shallow weirs to create pools, or fish ladders to facilitate the upstream movement of fish. The interruption is, however, not of such a nature that they disqualify the whole of the stream from being a functional watercourse.[443]

The second challenge on this topic addresses unlined ditches — which are very common on agricultural land to route streams and drainage waters around fields or on, for example, mine precincts. While in many cases these may have no relation to an original natural stream course, they still provide a fluvial connection between a headwater and a downstream environment — for example where a stream is led around or through ploughed fields. In many instances ditches become progressively 'naturalised' over time, to the extent that they regain compensatory, often substantially so, ecosystem service attributes — a form of 'produced environment'[444] arising in response to anthropogenic transformation. As with the need for constructed culverts, the incorporation of ditches into drainage lines is an inevitable fact of life that does not necessarily transform the whole.[445]

As with the issue of tributaries not being WOTUS, earlier case law provided clear guidance on the intermingling of ditches with natural tributaries. In *US v Deaton*,[446] cited in *Treacy v Newdunn*, it was held that 'the [USACE] definition of 'tributary' included the 'entire tributary system including roadside ditches'.[447]

(j) Claim: The CWR cannot apply to non-wetland adjacent waters such as oxbows[448]

The presumption drawn from this claim is that there exists a perception that as a river naturally changes its course (meanders) over time, so the space it previously occupied — or any feature left behind — is no longer part of the water resource. Watercourses meander naturally — this

[442] Such breaks in connectivity arise from culverts having, for example, vertical steps that prevent biota from moving upstream.
[443] This was recognized by the court in *Gerke* (see text associated with n319).
[444] A produced environment is where a constructed feature, such as a stormwater treatment wetland, provides aquatic ecosystem services, for example waterfowl habitat in an area otherwise devoid of ponds and pools.
[445] In *US v Moses* (2009) the US 9th Circuit Court held that 'a mere man-made diversion... does not render a river... something else and eliminate it from national concern'.
[446] *United States v Deaton,* 332 F.3d 698 (4th Cir. 2003).
[447] *Treacy v Newdunn Associates, LLP* 344 F.3d 407 (2003). Here was cited the USACE guidance that '[t]he discharge of a pollutant into a waterway generally has the same effect downstream whether the waterway is natural or manmade.'
[448] Oxbows very often become isolated wetlands connected to the meandered main channel via the hyporheos as well as by flood inundation and/or faunal migration.

can be problematical in instances where a river course forms the boundary between two properties. From an ecological perspective, however, the process may leave behind isolated, yet adjacent channels (paleochannels, anabranches) or cut-off sections of the river (oxbow-shaped depressions, or pools). In the majority of cases, as will be apparent from Chapter 2, these fragments are invariably likely to remain connected to the main channel through the hyporheos, as well as by virtue of overbank flooding. Alternatively, they may remain independently functional as isolated pools. They may, for example, sustain populations of biota, and/or function as breeding and spawning ponds or refugia — and in some cases they have been described by scientists as 'hotspots of ecological function and processes'.[449] Isolated wetlands and fragments originally part and parcel of the natural dynamics of river channels, continue to provide essential landscape functionality, ecosystem services and refugia and, in most cases, fall within the connected floodplain associated with the primary watercourse.[450]

(k) Claim: Groundwater remains excluded from the CWA

A critique in quasi-favour of the CWR was based on the argument that it did not extend far enough and, in particular, continued to exclude groundwater.[451] Of all the challenges this one has the greatest merit, as any attempt to regulate water resources based on connectivity cannot but have regard for sub-surface connections. In fact, in its review of the CWR, the SAB stressed that *there is no scientific basis for the groundwater exclusion* (own emphasis).[452] As would be expected, none of the opposing challenges mentioned the omission of groundwater — as to have done so could have condoned expanding the spatial reach of the CWR to all waters of the United States — which most of the challenges clearly sought wholeheartedly to avoid. However, in so doing, the CWR — while indirectly acknowledging the importance of shallow groundwater and hyporheic flows on several occasions — continued the practice of ignoring the indivisibility of the hydrological cycle, declaring this to simply be a 'long-established' interpretation of the CWA.[453] Perpetuation of this view places groundwater resources at great

[449] *Scientists* amicus brief at 29.
[450] Cohen MJ, Creed IF & L Alexander (2016) 'Do geographically isolated wetlands influence landscape functions?' 113 *PNAS* 1978-1986.
[451] The CWA only regulates discharges to groundwater that has a direct hydrological connection to surface waters. Under US law groundwater governance is provided by the Safe Drinking Water Act (SDWA 1974).
[452] *Waterkeeper* amicus brief at 27.
[453] *Government* at 38 & 143 - which maintains that it was not the intention of Congress to include groundwater which, if true, strongly suggests a misunderstanding of the hydrological cycle that prevailed for a while during the 1970s.

risk of over-exploitation and, in particular, the disconnection of vital, ecosystem sustaining links with surface waters.[454]

While excluding groundwater, the CWR nonetheless makes numerous references to where groundwater provides intra- and inter-system connections — actually accentuating its importance as part of the hydrological cycle.[455] Groundwater is as much a 'water resource' as are wetlands, streams and rivers. With respect to so-called 'isolated wetlands', described more correctly as 'upland-embedded wetlands',[456] groundwater exchanges can provide the dominant hydrological connection between systems — for example seepage flows into a nested endorheic[457] wetland. The CWR provides no guidance as to how it would address the inevitable intersection with groundwater flows in jurisdictional determinations of hydrological connectivity. By contrast, recent case law has clearly started to recognize the connectivity function of groundwater (see *Maui*, below).

Groundwater was acknowledged, by the interviewed scientists contributing to the CWR, as undoubtedly fundamental to providing or sustaining hydroecological connections between various aquatic landscape elements. Furthermore, that the temporary storage of groundwater sustains baseflows, or that shallow sub-surface and groundwater flows connect rare and special aquatic environments to downstream waters.[458] The assumption must be made that, while there may have been a desire from the agency scientists to include groundwater, the historic inertia tied to its sustained statutory exclusion from the CWA was simply too great to overcome. This notwithstanding, the inability to be able to draw on groundwater to define the extent of water resource domains, so as to dictate protection of water resources on private land, is likely to be an insurmountable future constraint and potentially a fatal flaw in the CWA.

Whatever the future of the CWR or a related regulatory approach may hold, the continued exclusion of groundwater as a WOTUS is likely to sustain an irresolvable tension between the CWA and whichever other regulatory instruments address the protection and use of groundwater. In a world where demands for and threats to groundwater and/or the integrity

[454] In *Silver et al v Pueblo del Sol Water Company* the court noted that the stance in Arizona that surface water is hydrologically separate from groundwater was a 'legal fiction' (at 61); that Arizona utilised more groundwater 'than nature could replenish' (at 64), and that groundwater abstraction in the catchment of the San Pedro River had reached a stage where it 'will imperil the riparian ecosystem...' (at 64) (*CV-16-0294-PR*, August 2018).
[455] There are 14 such references made to underground tributaries connecting surface elements of a watercourse, eg at 37078.
[456] Ibid
[457] A waterbody into which water flows without any outflow occurring (cf exorheic).
[458] Alexander LC (2015) See n271.

of aquifer systems[459] abound, it is imperative that this component of water resources not be governed separate from the rest of the hydrological cycle.

Post CWR recognition of groundwater connectivity

Subsequent to the CWR, the findings of and guidance following the *County of Maui v Hawai'i Wildlife Fund*[460] ('*Maui*') case have both advanced and retarded progress towards rightful inclusion of groundwater as the fundamental connectivity underpinning for surface water resources. In *Maui* the legal question surrounded whether a pollutant discharged into, and travelling via, groundwater to a WOTUS constituted a point-source discharge to the latter ie requiring CWA permitting. The Supreme Court upheld this link[461] but, in the process, crafted a seven-step test to be used to determine whether a groundwater-conveyed discharge is 'functionally-equivalent' to a direct point source discharge into the federal waterbody.[462] Included in this problematical analysis are direct impacts on the groundwater itself (accumulation of pollution), connections between the affected aquifer and non-WOTUS waters, or indeed on water being extracted as, *inter alia*, raw potable water.

V. How relevant is the 4 000' rule?

If HEC is to provide a normative framework for water resource governance, then what are the spatial implications of a regulation set to this purpose? Alternatively stated, within what spatial adjacency to watercourses is HEC likely to be relevant? In simple terms, what is the distance either side of a watercourse within which HEC, especially that encompasses aquatic-terrestrial gradients or 'ecotones',[463] should be evaluated and possibly regulated? A corollary arising herefrom will be, how much land adjacent to watercourses will need to fall within the regulatory prisms so as to protect the resource? Evaluating the 4 000' rule provides a place to start seeking answers to these questions.

This chapter has provided an analysis of the challenges to the CWR that were justifiably directed against the science. With two exceptions, the scientific underpinnings were found to

[459] For example hydraulic fracturing.
[460] *County of Maui v. Hawaii Wildlife Fund* 140 S. Ct 1462 (2020)
[461] This decision begs the question how the Hawai'i Supreme Court would have judged the *Coleman* matter.
[462] Guidance Memorandum: Applying the *Maui* decision in the Clean Water Act Section 402 NPDES. 14 January 2021. USEPA Office of Water.
[463] Riparian ecotones are defined as a 'three-dimensional space of interaction that include terrestrial and aquatic ecosystems that extend down into the groundwater. up above the canopy, outward across the floodplain. up the near-slopes that drain to the water, laterally into the terrestrial ecosystem, and along the watercourse at a variable width. Verry ES et al (2004) n79.

be without question. The exceptions were the exclusion of groundwater[464] and the failure to provide an empirical substantiation for the 4 000' rule. The primary intention of the 4 000' rule was to render all, or a large proportion of, wetlands occurring within this delineator as being potentially-jurisdictional under the CWA.[465] As such, the science-based regulatory validity of this distance was correctly called into question as, absent such substantiation, it cannot provide guidance regarding which waters adjacent to watercourses are likely to be HEC-connected. Of course nothing prevented the Agencies from reliance on their manifest experience and declaring a particular distance to be the guideline they will work to. Reliance on a proven distance, however, would be the more effective approach.

If substantive empirical reliance can be obtained from a fixed linear distance, then this would constitute a preferred regulatory approach. Such a line can either be employed as a jurisdictional fact (eg '...all wetlands within this distance are automatically regulated...') or as a guideline (eg '...all wetlands within the indicated distance must be further evaluated for their HEC relationship(s) to the fluvial watercourse...') — or as a combination thereof with all wetlands closer to the watercourse being automatically regulated and those further away possibly subject to further assessment.

Accordingly, this chapter analyses, using South African river and wetland GIS data, the potential value of the 4 000' (= 1 220 m)distance as a means of pre-identifying wetlands or other HEC-aquatic ecosystem elements within a defined distance from the watercourse. South African water policy provides no guidance or recommendations as to what constitutes an appropriate distance within which to consider the proximity of wetlands to watercourses. As such evaluating the 4 000' rule provides a starting point for analysing the proximity of South African wetlands and adjacent fluvial hydrosystems.

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[464] Groundwater was not considered in the CWR as groundwater is not regulated under the CWA. Groundwater is a regulated component of water resources in South African law and as such exists as a key component of HEC assessments. This aspect was discussed in detail in Chapter 4.

[465] The CWR set the brightline distances as follows: (8) All waters located within the 100-year floodplain of a water identified in paragraphs (a)(1) through (3) of this section and all waters located within 4 000 feet of the high tide line or ordinary high water mark of a water identified in paragraphs (a)(1) through (5) of this section where they are determined on a case-specific basis to have a significant nexus to a water identified in paragraphs (a)(1) through (3) of this section. For waters determined to have a significant nexus, the entire water is a water of the United States if a portion is located within the 100-year floodplain of a water identified in paragraphs (a)(1) through (3) of this section or within 4 000 feet of the high tide line or ordinary high water mark. Waters identified in this paragraph shall not be combined with waters identified in paragraph (a)(6) of this section when performing a significant nexus analysis. If waters identified in this paragraph are also an adjacent water under paragraph (a)(6), they are an adjacent water and no case-specific significant nexus analysis is required.

This chapter provides the results of a provisional empirical analysis specifically undertaken, in response to the findings in Chapter 3, to evaluate the relevance of this distance, using the most recent datasets for South African rivers and wetlands.[466]

(a) Methodology

River length as a function of stream order: Using the National Biodiversity Assessment rivers dataset (NBA, 2018),[467] and after removing all components that extended beyond (outside of) South Africa's borders, the aggregate length of each stream order (1-9) was summed and tabulated.

Wetland area as a function of distance from streams and rivers: Each stream or river was buffered at distances of 32, 50, 100, 500 and 1220 meters either side and cross-tabulated with the National Wetlands Map (Version 5).[468] The aggregate area of wetlands occurring within each buffer (0-32, 33-50, 51-100, 101-500, 501-1220 and > 1220 m) was then summed and tabulated.

Headwater stream length (Orders 1 & 2) as a function of land use: Four categories of land use (list) were compiled from the National Land Cover (NLC)[469] dataset and cross-tabulated with the river dataset used above. The aggregate length of stream orders 1 & 2 transecting each of the four categories was then determined and expressed as a percentage of the total length per land use category.

(b) Results

(i) Rivers

South Africa has 164 000 km of (mapped) rivers and streams, of which 98 000 km and 31 650 km are, respectively, first and second order streams, ie comprising 79 per cent of the aggregate length of all rivers in the country (see Table 3.1).[470] A total of 47 per cent of the river extent was comprised of mainstems, with 53 per cent formed by tributaries. Of the combined total of

[466] Harding and Van Deventer (in preparation, see n195).
[467] Rivers dataset. Council for Scientific and Industrial Research. 2018 South African Inventory of Inland Aquatic Ecosystems (File Geodatabase) [Vector] 2018. Available from the Biodiversity GIS website, downloaded on 30 November 2021.
[468] Wetland dataset Council for Scientific and Industrial Research. 2018 National Wetland Map 5 and Confidence Map [Vector] 2018. Available from the Biodiversity GIS website, downloaded on 30 November 2021.
[469] https://bit.ly/3OAH3Rw
[470] All data pertaining to rivers and wetlands were sourced from the National Biodiversity Assessment & National Wetlands Map V5.0 (2018).

129 950 km of first and second order watercourses, 44 370 km (34 per cent) are mainstems and 85 600 km (66 per cent) are tributaries.[471] Both metrics illustrate the dominance of South African hydrosystems by headwater streams.

[471] Distances rounded up to nearest whole number.

Table 3.1: Total length of South African rivers, per mainstem, tributary and river order.

River order	Extent of mainstem (km)	Extent of tributaries (km)	Total extent (km)	Percentage of total mainstem river length (%)	Percentage of total tributary river length (%)	Percentage of total river length (%)
1	22018	76283	98301	28.7	87.4	59.9
2	22346	9302	31649	29.1	10.7	19.3
3	15469	1102	16571	20.1	1.3	10.1
4	8874	367	9241	11.6	0.4	5.6
5	6762	181	6943	8.8	0.2	4.2
6	704	10	715	0.9	0.0	0.4
7	674	0	674	0.9	-	0
Total	76848	87249	164097	46.8	53.8	100

Of the combined length of first and second order watercourses, 89 per cent transected natural or undeveloped lands (including forestry), while a further ten per cent thereof, or 12 062 km, were located on land defined by the NLC as developed agricultural, ie farmlands.

(ii) Wetlands

South Africa has 26 400 km^2 of (mapped) wetlands — of which almost half (44 per cent) were found to lie within 1 220 m of a watercourse (see Table 3.2). By comparison, only fifteen per cent of South Africa's wetlands lie within 100 m of the nearest watercourse, and 32 per cent within 500 m. Additionally, as the majority of wetland typologies that would be expected to be geographically-isolated (eg endorheic[472] depressions) all lay beyond 1 220 m. Accordingly the 1 220 m brightline appears, on its face, to be a highly-significant delineator of the separation between putative HEC and non-HEC waters.

Table 3.2: Wetland area by distance from a watercourse

Distance to watercourse (m)	Wetland area (km^2)	Cumulative percentage
<= 32	1546	6
33-50	729	9
51-100	1517	15
101-500	4525	32
501-1220	3244	44

A breakdown of wetland areas by wetland category is provided in Table 3.3. It will be noted from the data that large extents of channelled valley bottom (CVB), un-channelled valley bottom (UVB) and floodplain (FP) wetland types, 2 906, 865 and 1 290 km^2, respectively, were analysed as being located further than 1220 m from a fluvial watercourse. This is outwardly

[472] Waterbody that has no outflow.

irregular as these specific types are typically located immediately adjacent to, or astride, a fluvial watercourse. This outcome is attributed to a map-scale dependent anomaly that has resulted in the association between these wetlands and adjacent streams or rivers not being apparent.[473] Therefore, following a future increase in representation of watercourses and wetlands at a larger scale, an accompanying increase in the accuracy of geographic distribution of floodplain and valley-bottom wetlands to watercourses can be expected and the anomaly will disappear. An anticipated outcome of this will be that the percentage of wetlands within 1220 m will increase substantially.

Table 3.3: Areal extent of wetlands (km^2) within distances from river lines

Wetland category	0-32 m	33-50 m	51-100 m	101-500 m	501-1220 m	> 1220 m	Total
CVB	742	321	594	1337	1337	**2906**	6714
Depressions	34	18	49	317	317	6728	7647
Floodplain	513	259	582	1843	1843	**1290**	5442
Seep	139	71	155	561	561	2923	4538
UVB	117	59	135	449	449	**865**	1881
Flats	1	1	2	19	19	100	153
CVB = channelled valley bottom wetland; UVB = un-channelled valley bottom wetland. Bold text in the > 1220 m column represents areas that will change significantly once the mapping of all South African rivers is completed.							

Therefore, at such time as the stream and river mapping is revised at the appropriate scale, it is anticipated that the bulk of these three wetland types will be categorised as located less than 1 220 m from a watercourse — and that the total areas for each type will increase. If it is assumed that only a small percentage of each type will remain beyond the 1 220 m delineator, for example in instances of very broad lowland floodplains, the aggregate percentage of all wetland types located less than 1 220 m from a fluvial hydrosystem is expected to increase by 8 500 km^2, ie from 11 560 km2 (=44 per cent of all wetland types, Table 5.2) to 20 000 km^2, approximately 80 per cent of aggregate wetland area. As such, the overwhelming majority of South African wetlands are shown to lie within a lateral distance equivalent to the CWR's 4 000' rule.

Moreover, 88 per cent of the area of depressional wetland types, ie a type that is highly likely to be geographically isolated, were found to be located beyond the 1 220 m delineator. Additionally, 64 per cent of area of seepage wetlands were similarly situated. Accordingly this

[473] What this means is that many smaller rivers and streams are not yet mapped.

delineator has undoubted potential as a brightline rule that enfolds the bulk of South African wetlands that are likely to be connected to other watercourse components.

(iii) Wetland adjacency to headwater streams

With respect to the association of wetlands with headwater streams, the analysis revealed that 34 per cent (8 960 km^2) of the aggregate area (26 400 km^2) of all South African wetland types are located within 1 220 m of first and second order streams. Accordingly, of the 44 per cent of all wetlands that lie within 1 220 m of a mapped watercourse (Table 3.1), a substantial 77 per cent thereof are associated with headwater streams. This finding further exemplifies the importance of the headwater stream and wetland HEC to the overall watershed landscape.

(iv) Analysis of selected quaternary catchments

To complete this limited exploratory analysis of distance-based stream:wetland associations in South Africa, a set of ten quaternary[474] catchments, ranging in type from extreme arid to extreme wet and inclusive of inland and coastal locations, were randomly selected and screened in the same manner as set out above. This sample set reflects, respectively, 0.4 per cent and 1.9 per cent of the total number of inland and coastal quaternary catchments. The results are set out in Tables 3.4 and 3.5.

The number of stream orders present in each case ranged from four to seven across the ten case study catchments (Table 3.5). The percentage of first and second order streams, as a function of total stream length, ranged from 79 to 92 per cent. In three catchments the area of wetlands ranged from 19 to 51 per cent, and from one to seven per cent in the remaining seven. Of these wetlands, those associated with first and second order streams, and located within 1 220 m thereof, varied between 25 and 100 per cent, with six catchments between 97 and 100 per cent. While the national-level data revealed that approximately 34 per cent of all wetlands are associated with headwater streams, the ten case studies reported on here revealed a much higher level of association, irrespective of catchment location or type. This has obvious implications for considerations of the importance of HEC on an individual catchment basis, ie

[474] Quaternary level catchments are 4th Order catchments which provide the basic unit for water resource management in South Africa.

that the demographics of wetland:stream associations need to be assessed, at least at quaternary scale, prior to any determinations of the impacts that might arise from envisaged water uses.

However, as is apparent from Table 3.5, higher levels (greater than 50 per cent of wetlands per quaternary) of wetland proximity to headwater streams may occur at significantly lesser distances (50-100 m) than 1220 m. Table 1 shows that only six and nine per cent, respectively, of all wetlands occur within 32 or 50 meters, ie relatively close, to a watercourse. However, the limited sample size notwithstanding, these provisional results reveal a generally closer proximity of wetlands to headwater streams.[475] In three quaternaries 49-72 per cent of wetlands were within 32 m, and a further three between 49-52 per cent. In six instances between 62 and 98 per cent of wetlands occurred within 100 m of a watercourse.

Table 3.4: Cumulative percentage of wetlands by quaternary catchment and distance from headwater streams.

Quaternary	<= 32 m	33-50 m	51-100 m	101-500 m	501-1220 m
STL[1]	2	3	6	21	35
MLD[4]	9	13	22	50	73
KOS[1]	2	3	5	24	18
SER[5]	56	68	83	100	100
UKB[6]	49	63	82	99	99
HAK[2]	4	5	10	27	38
KR1[7]	41	57	84	100	100
TSI[1]	38	49	62	90	100
KRU[3]	38	52	71	90	92
KR2[7]	72	90	98	100	100
Key to quaternary types: 1 = coastal; 2 = arid; 3 = semi-arid; 4 = inland wet; 5 = Mediterranean (dry); 6 = Mediterranean wet; 7 = bimodal. Shaded cells indicate percentages ~>50					

[475] The relatively close proximity of wetlands with headwater streams is an expected and logical outcome of the generally-steep gradients and narrow valleys that typify the upper reaches of most catchments.

Table 3.5: Summarised case study quaternary catchment wetland and headwater data

(Ranked by percentage of quaternary catchment occupied by wetlands)									
Quat	Rivers			Wetlands					
	Number of Stream Orders Present	1 & 2 orders, km	% 1 & 2 vs total Km	Total wetland area, km^2	%catchment = wetlands	Wetlands <1220 m km^2	% wetlands <1220m	1 & 2 order stream wetland <1220m km^2	% total wetlands
STL[1,5]	7	335	90	709	51	286	40	244	34
MLD[4]	4	210	79	171	25	135	79	125	73
KOS[1]	4	269	90	500	19	123	25	90	73
SER[6]	6	348	88	12	7	12	100	12	100
UKB[7]	6	693	88	20	5	20	100	20	100
HAK[2]	7	1634	92	840	4	349	42	323	38
KR1[8]	6	428	91	7	3	7	100	7	100
TSI[1]	5	351	90	8	3	8	100	8	100
KRU[3]	6	780	84	9	1	9	97	8	95
KR2[8]	4	240	84	1	1	1	100	1	100
Key to Quaternaries: As for Table 2.									

(c) Summary

This provisional empirical analysis of the application of the 4 000' rule to South African river and wetland data indicates that it effectively separates wetlands that are ordinarily expected to occur relatively close and connected to rivers and streams, from wetland types which are, *sensu strictu*, geographically-isolated — for example endorheic depressional systems and hillslope seepages. This is not to say that this should be applied as the definitive distance for use in this country, but there is a clear indication of a high degree of relevance of this distance to the spatial association of rivers and wetlands in South Africa.

This analysis, combined with that for the two-hundred jurisdictional wetland determinations screened for the CWR, validates the relevance of 1 220 m as enfolding of the proximity of the majority of the types of wetlands likely to occur adjacent to watercourses.[476] As such this analysis, *mutatis mutandis*, provides substantiation for this particular distance rule, as proposed in the CWR, for use in South Africa.

VI. Conclusions

Chronologically coincident with the 1970s global advent of modern environmental law in general, and the CWA in particular, was the realisation that land use activities occurring in the

[476] See Chapter 4.

headwater stream areas of a catchment may significantly affect the connected, up- and downstream, longitudinal and lateral water resource environments.[477] Moreover, that intermittent and/or ephemeral streams, especially in arid regions such as the US southwest, were extremely prone to disruptive and fragmentary modification by land use practices. More recently, a body of science emerged and evolved which illustrated the importance of connectivity as a basis for ensuring the ecological functionality and ecosystem-supported biodiversity of aquatic systems.[478] This understanding highlighted the fact that activities undertaken in any of the connected components of a watercourse can result in knock-on negative impacts to the aquatic ecosystem condition, including over great distances from the point of impact. Consequently, the importance of attention to spatial connectivity, as well as having regard for a 'source-to-sea' approach in regulating the integrated and connected nature of river systems, became increasingly and centrally evident to law makers and those tasked with the stewardship of essential natural resources.

In parallel with the developing science, courts and regulators in the USA were grappling with questions regarding whether federal statutory protections extended to components of a river system that did not meet the definition of what constituted a 'water of the United States' (WOTUS). A logical solution to protecting water resources was to base the regulatory approach on providing an assurance of HEC throughout a watershed — moreover irrespective of on whose land the water resource occurs. The CWR was a world-first in defining regulated waters on the basis of their HEC at a watershed level.

The lack of substance in the challenges against the CWR, as assessed in this chapter, serve to confirm its scientifically underpinned validity. The CWR embodied a clear, ecosystem-based, approach to water resource regulation, dovetailing with the documented intentions of the legislature that wrote the CWA. To all intents and purposes the CWR was accordingly scientifically accurate and lawful and circumscribed by the boundaries of the statute.

The CWR could have been stronger. A singularly important omission was that groundwater was not drawn into the connectivity-based regulatory process, a valid failing put

[477] Hyne's paradigm states that the 'valley CWRs the stream' and that upstream and downstream areas must be concomitantly considered. Hynes HBN (1975) 'The stream and its valley'. 19 *Verh. Internat. Verein. Limnol* 1-15.
[478] eg Fausch et al (2002) 'Landscapes to riverscapes: bridging the gap between research and conservation of stream fishes'. 52 *BioScience* 483-498 at 485.

forward only by those in favour of a more comprehensive regulation. The exclusion of groundwater is here regarded as a CWA legacy problem which was beyond the scope of the CWR to accommodate.

The principal substantive challenge to the science behind the CWR focused on the brightline rules inserted between the draft and final versions, insertions which were admittedly not subjected to the public scrutiny and comment process. They appear to have been inserted at the eleventh hour, ostensibly to bolster the need to ensure that wetlands adjacent to water courses were swept into the regulatory space. Arguably, these insertions might have fared better had they not been intended as WOTUS-jurisdictional, as opposed to simply providing trigger lines for a significant nexus determination — but nonetheless they were likely to draw criticism. Further review was clearly called for, alternatively, the offending portions could have been vacated pending review, while allowing the remainder of the CWR to remain in effect.[479] To do so, however, would have removed a primary purpose of the CWR, viz. the inclusion of adjacent wetlands within the regulatory framework. As noted above, the term 'adjacent' is problematical, and that it should have been replaced by 'hydroecologically-connected.'

Testing the 4 000'/1 220 m rule on South African river and wetland data revealed it to be highly relevant as a guideline distance. This suggests that a similar analysis attached to a future revision of the CWR may reveal equivalent utility.

Regrettably the scientific foundations of the CWR and their alignment with congressional intentions, regulatory guidance and case law were never ventilated in court. However, as the Biden administration has ordered review of the CWR, the connectivity basis for the CWR may in future again be called upon to provide strategic protection to all waters of the United States. Troubling here is that the US Supreme Court has not shown any signs of being in favour of extending the reach of the CWA to its intended boundaries.

While the science underpinning the CWR was not faulted, it was centrally apparent that long-standing concerns about federal overreach onto private land use fuelled most of the resistance to the new regulation.[480] The ambit of the CWR expressly excluded private land

[479] This assuming that the CWR included a separability clause, otherwise the whole would have to be vacated (JA Thornton, pers. comm. by email. copy on file with author).
[480] Bakst et al (2017) '[the] WOTUS rule makes it exceedingly difficult for landowners to use their own property.' 'Restoring meaningful limits to "Waters of the United States'. https://regproject.org/paper/restoring-meaningful-limits-waters-united-states/

issues from consideration. It is undeniable that perceptions of property ownership 'rights' will always be a bone of contention, in the absence of informed reasonableness concerning what landowners may or may not do with their property. These collisions between land use and water resource protection must be resolved head-on which is what a connectivity-based approach strives to achieve. It will only succeed, however, if everyone (regulators and the regulated community) is on the same page in terms of the undeniable importance of governing water resources on the basis of their inherent connectivity. In truth, landowners are extremely limited regarding what land uses they may exercise, absent a permit, without triggering a police-power intervention.[481] The *Rapanos*, *Gerke Excavating* and *Earth Sciences* cases provided examples of such limitations associated with watercourses.

Employment of a normative connectivity basis for water resource regulation in South Africa would arguably trigger similar property ownership concerns — albeit substantially limited in favour of the environment by the public trust provisions. As set out in Chapters 2 & 4, and from the case law examples provided in this Chapter, the protection of watercourses that arise on or flow through private property may require that areas of land lateral to the watercourse form part of the regulated environment, effectively placing them in a servitude.

The impact of excluding connectivity considerations from the CWA regulatory regime became apparent when, for the year June 2020 to April 2021, 76 per cent of 40 211 aquatic resource determinations, which would under the CWR or prior regulations have been jurisdictional, were rendered non-jurisdictional.[482]

[481] Freyfogle E (2006) 'Goodbye to the public-private divide'. 36 *Environmental Law* 7. The use of private property is only legitimate to the extent that it fosters a shared, common or collective good.
[482] *Pasqua Yaqui Tribe v USEPA*, 4:20-cv-00266-RM at 9.

CHAPTER 4: THE PUBLIC TRUST AS APPROPRIATE INSTITUTIONAL FRAMEWORK FOR HEC REGULATION

'[Humankind's] ability to alter the environment often far outstrips [an] ability to foresee with any degree of certainty what untoward effects these changes may bring'.[483] *'An owner of land has no absolute and unlimited right to change the essential natural character of his land...to use it for a purpose which injures the rights of others'.*[484]

I. Introduction

Of relevance to an assurance of HEC is that the public trust renders all parts of the water resource 'domain'[485] as 'public', irrespective of whether they may transect 'private' property.[486] This connotation of the public trust has been variously expressed as a 'servitude'[487] or 'covenant'[488] that envelopes the trust resource and all associated ecosystems which contribute to the ecological integrity thereof. Additionally, that it promotes the furtherance of public welfare far above that possible simply via the police power.

Although many may consider the overt expression of the public trust in the NWA as somewhat novel, it will be shown that trust language and awareness substantially pre-dated the revision of South African water law. This analysis, while providing essential background as to the evolution of the public trust, focusses less on its historical application and rather on its contemporary 'environmental law era' potential, as well as for having regard for the trust as a democratizing underpinning of water rights. This goal is achieved by close examination of the trust principles.

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[483] *Lead Industries Association v USEPA* 647 F.2d 1130 (1980)
[484] *Just v Marinette County* 201 N.W. 2d 761 (1972).
[485] See Chapter 1.
[486] eg Van der Schyff (2011) Chapter 14 in *Property Rights and Sustainability* (Grinlinton and Taylor eds) Martinus Nijhoff Publishers, Leiden. Vd Schyff confirms that 'property clothed [by the PTD] has been converted from private to public...'. At 339.
[487] Blumm MC and MC Wood (2021) *The Public Trust Doctrine in Environmental and Natural Resources Law*. 3rd Edition. Carolina Academic Press. In this casebook the authors cite numerous examples which place the public trust firmly within the realm of property law at 86.
[488] Reed SW (1986) 'The public trust doctrine: Is it amphibious?' 1 *J. Envtl. L. & Litig*. At 118. Phrase cited with approval in *Orion Corp v State*, 109 Wash.2d 621 (1987)

(a) Roots, evolution and contemporary role of the PTD

The legal instrumentality[489] of the PTD for the protection of renewable natural resources is arguably immense, yet largely unproven.[490] The doctrine powerfully invokes a fiduciary, non-discretionary obligation on the state to act in the best interests of essential natural assets, not simply to set targets and goals. Within this anti-monopoly role lies the perceived strength of the PTD for surmounting obstacles to environmental protection. Much has been written, debated and speculated about the potential of the doctrine, not only in countries where its emergence has been recent,[491] but also in the USA where the doctrine is founded on case law and constitutional history extending back to 1774,[492] and the earliest codification thereof a century earlier in 1641.[493] This review does not delve further into detail into the history of the PTD as recent publications have provided composite summaries and case law analyses.[494]

A detailed analysis of the common law roots of the American doctrine describes three phases of doctrinal evolution[495]: (i) traditional or historical; (ii) Saxian (after Joseph Sax, the progenitor of the modern environmental doctrine in 1970[496]), and (iii) the most recent inculcation, the Atmospheric Trust Litigation (ATL) version, which is currently the focus of multiple litigation actions in the United States and elsewhere, within which public trust obligations towards the condition of the atmosphere are argued. The ATL may be considered as an amalgam of the traditional doctrine — with its arguably dubious reliance on the term 'air' in its Roman law root — and the Saxian model, where the value of the trust relies on the wealth of American public trust decisions protecting natural resources over and above those arising from the traditional format.

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[489] In this context, legal instrumentality is taken to mean a regulation, by means or agency of which a particular objective is accomplished (Black's Law Dictionary 10th Edition, 2014).
[490] For example, despite the hype that surrounded the Mono Lake (*Nat'l Audubon*, see Table 1) case in California in 1983, the PTD has only been successfully used in litigation in a single case in the intervening period to 2012. It has had more of an impact in the realm of administrative law. See Owen, note 227.
[491] eg India. Goswami P (2016) 'Public trust doctrine: Implications for democratisation of water governance'. 9 *NUJS. L. Rev* 67.
[492] *Harrison v Sterett,* 4 Harris and McHenry 540 (Provincial Court, Proprietary Province of Maryland 1774). However, *Arnold v Mundy*, 6 N.J.L. 1 (1821) is generally regarded as the first case in which an American court established the link to Roman law.
[493] Massachusetts Ordinance of 1641, cited in *Storer v Freeman 6 Mass. 435* (1810).
[494] eg Blumm MC and M Wood (2021).
[495] Ruhl JB & TAJ McGinn (2020) 'The Roman public trust doctrine: what was it and does it support an atmospheric trust? 47 *Ecology Law Quarterly* 117-178.
[496] Sax J (1970) n95.

The doctrine, in its traditional and Saxian formats, is a fundamental instrument of property law.[497] It is of especial use for the regulation of resources that are not capable of private ownership. Prior to the California *National Audubon*[498] case it was applied only to tidelands and shorelands, navigation, commerce and fishing.[499] This changed markedly when *National Audubon* added ecological concerns, describing the affected Mono Lake as being an 'ecological treasure of national significance'.[500] In the USA, historically, the doctrine proved instrumental in resolving land disputes as America expanded westwards through a variety of legal systems (English, French and Spanish). Molly Selvin describes the doctrine in that period as 'an effective and multifaceted tool which the state and federal courts and state legislatures repeatedly invoked... ..to promote and direct economic growth'.[501] The PTD ultimately became vested in the American Commerce Clause,[502] insofar as the need to maintain highways, waterways and inter-state waters as corridors of commerce is concerned, ie a decidedly anthropogenic 'access for commerce' focus.

(i) A brief comment on the PTD in atmospheric trust litigation

There are strong indications that the concept of a unitary hydrocycle — entwining water on Earth to the atmosphere, may be the keystone for evolution of public trust principles in ATL and for the public trust to be viewed as a tool of international environmental law. By virtue of the connection between the atmosphere and water on Earth, it is arguable that dimunition of the atmosphere amounts to a dimunition of the public trust for water and interdependent resources.[503] Many of the USA State-level ATL challenges have invoked PTD and sought the formulation of Climate Recovery Plans from their government trustees.[504] One of these cases (*'Foster II'*), lodged in Washington, a State that has one of the most farsighted ecological agencies in the USA, met with surprising State recalcitrance — and was countered in turn by a bold judge who, scathing in her condemnation of agency time-wasting, not only

[497] Blumm MC and MC Wood (2021).
[498] See n97.
[499] Littleworth AL (1988) 'The public trust vs. the public interest'. 19 *Pacific Law Journal* 1201-1223.
[500] *National Audubon*.
[501] Selvin M (1980) 'The public trust doctrine in American law and economic policy' 1789-1920. *Wisconsin Law Review* 1403.
[502] US Constitution Article 1, Section 8, Clause 3 — enabling the US Congress to regulate commerce with foreign Nations and among the States and Indian Tribes. Given the historical importance of rivers as commerce routes (highways) they fall within the ambit of the Commerce Clause.
[503] Sagarin RD & M Turnipseed (2012) 'The public trust doctrine: Where ecology meets natural resources management.' 37 *Annu. Rev. Resour.* 473-96.
[504] Wood and Woodward (2016) 'Advancing the sovereign trust of government to safeguard the environment for present and future generations (Part II): Instilling a fiduciary obligation in governance', at 97. *39 Envtl. L.* 92-118. at 643.

set timelines for agency response but found that the PTD was present in the State Constitution and left no doubt as to the role it played in the case at hand:

> '[T]he State has a constitutional obligation to protect the public's interest in natural resources held in trust for the common benefit of the people... If ever there was a time to recognize through action this right to preservation of a healthy and pleasant atmosphere, the time is now.'[505]

Countering the challenge that the atmosphere did not fall within the scope of the doctrine, the court found that, as the atmosphere and water resources were inextricably linked, and as water resources already fell within the doctrinal reach, that the atmosphere was similarly protected:

> 'The navigable waters and the atmosphere are intertwined and to argue that a separation of the two, or to argue that GHG emissions do not affect navigable waters, is nonsensical'.[506]

This ruling was of considerable import, given that in earlier cases in state courts it was held 'without deciding' that the atmosphere was part of the PTD.[507] *Foster II* thus provided precedent across all US states.

In the widely publicised *Juliana* matter, which relies on both the PTD and on federal constitutional protections of due process and equal protection, and despite an attempt by the State to foreclose use of the Trust Doctrine, the court allowed both the constitutional and trust claims to go forward. Importantly, while the PTD is commonly regarded as a State-held doctrine, the *Juliana* case located the PTD in the wording of the US Constitution's Fourteenth Amendment:

> 'The doctrine is deeply rooted in our Nation's history and indeed predates it'.[508]

The globally pandemic threats associated with climate change bring into sharp focus the risks associated with the exceedance of ecosystem 'tipping points' — alterations to ecosystem dynamics beyond which inbuilt resilience is incapable of supporting a recovery to the former

[505] *Foster II* No 14-2-25295-1 SEA at 8-9 (Washington Superior Court, November 19, 2015.
[506] *Foster II* Ibid at 8. This case revealed that the PTD is enshrined in the 17th Amendment to the Washington State Constitution.
[507] For example *Butler v Arizona*, Arizona Court of Appeals, 1 CA-CV 12-0347.
[508] *Juliana v* USA 6.15-cv-01517-TC at 20, the court citing *Shively v Bowlby* 152 U.S. 1 (1894).

condition. Increasing temperatures in aquatic environments, both marine and freshwater, are already evidencing worrying perturbations.[509]

(b) Summary of Roman law origins of the public trust

Many scholarly articles describing the doctrine or characteristics of its application, anchor their arguments solely on the 21-word *res communes omnium* ('RCO') phrase attributed to Emperor Justinian's compilation of the Roman law Institutes in the sixth century AD viz:

> 'these things are common to all of mankind. The air, running water, the sea and consequently the shores of the sea'.[510]

These analyses appear to implicitly accept that the RCO is sufficient to ground the PTD in Roman law and hence in the common law of any legal regime arising from or incorporating Roman law roots. However, as explained by Roman law scholars,[511]if contemporary reliance is placed on the roots, a much deeper, contextually-interpretive, analysis is needed, in particular to derive an understanding of what the express intentions for the doctrine in Roman law were, and how it was intended to be applied: for example did it ever have an environmental nuance or did 'air' imply the atmosphere, or perhaps only smoke pollution? More importantly, these authors maintain that the Roman origins, while being entirely factual, are nowadays of minimal importance as compared with how the doctrine has been developed and expanded, under either its common law use and juridical interpretation, or by its codification within a particular legal regime. Importantly, as will be explained hereunder, regulated water resources are *res publicae*, not RCO.

With respect to the term 'public,' Roman law clearly shows that this referred to 'common use by all', not 'ownership'.[512] There exists a clear contemporary perspective that there is no clear distinction between public and private property, rather that these concepts are best understood on a continuum which is defined by the degree of regulatory control, or police-power, that applies.[513] Property rights are a tool for fostering well-being on a collective basis, and these rights only have meaning when landowners have reasonable stability in their ownership. However, most importantly from a social and environmental justice perspective,

[509] Wood and Woodward (2016) at 640.
[510] The Institutes of Justinian 2.1.1 (cited in Ruhl and McGinn 2019, at 6).
[511] Frier B (2019) 'The Roman origins of the Public Trust Doctrine'. *Journal of Roman Archaeology*. 641.
[512] see Frier (2019).
[513] Freyfogle ET (2006) (n480).

the public has a legitimate interest in how all land is used, and that no land use can take place in isolation, irrespective of ownership.[514] In this regard it has been emphasized that property rights cannot be defined without, for example, taking nature into account,the hydroecological needs of a stream passing through private land. These cannot be any different to the needs of the same stream on public lands — protection of the integrity of the water resource being the paramount obligation.[515] Appropriately coordinated use of lands is the subject of land use planning law. Private ownership of property does not bear any rights which render it immune from state control. However, certain libertarian views tend to regard the PTD as an absolutist constraint to private rights,[516] whereas according to Sax 'the scope of private rights in water has always been sharply limited'.[517] The latter view is particularly determining in the context of water resources.

While Justinian is commonly associated with the PTD in Roman law, a brief yet deeper examination of the roots of the doctrine reveals that, for the sake of historical correctness, the RCO passage is, in fact, an amalgam of passages created three centuries earlier, by the Roman jurists Gaius (160 AD) and Marcian (~ 220 AD), with significant influence from Ulpian, a contemporary of Marcian and who is regarded as the progenitor of the PTD.[518]

(c) Early US caselaw interpretations

The traditional format of the PTD in America is solidly vested in a wealth of case law, policy and the constitutions and/or laws of forty-five of the fifty States.[519] The development of the Saxian version, as an instrument of environmental protection, has now seen five decades of evolution since 1970. Most recently the doctrine has been integrated into a multitude of cases directed at climate change controls and carbon dioxide emissions.[520] The latter rely on the word 'air' in the RCO to equate with atmosphere but it is improbable that this is what Roman legislators intended.[521] In fact, under Roman law, the term 'air' was most commonly associated

[514] See *Munn v Illinois* 94 U.S. 113
[515] See reference to Adv Francois Junod's concern in text associated with n260.
[516] Blumm MC (2016) 'Two wrongs? Correcting Professor Lazarus's misunderstanding of the public trust doctrine'. 46 *Environmental Law* 481-489. See also Lazarus RJ (1986) Changing conceptions of property and sovereignty in natural resources: Questioning the Public Trust Doctrine. *71 Iowa L. Rev*. 631.
[517] Sax JL (1990) 'The constitution, property rights and the future of water law'. 61 *U. Colo. Law Review* 257.
[518] Ruhl and McGinn (2019) at 50-52.
[519] Blumm MC (ed) (2014) *The Public Trust Doctrine in 45 States*. http://ssrn.com/abstract=2235329.
[520] Three examples of high profile cases that integrate public trust considerations within an atmosphere:hydrosphere context are *Juliana v United States* (2015) 6:15-cv-01517; *Held v Montana* CDV-2020-307 (Mont. Dist. Ct.) & *La Rose vs Her Majesty The Queen* T-1750-19.
[521] Ruhl & McGinn (2019).

with smoke pollution and there is no evidence that Roman law ever incorporated or indeed even considered the need for environmental protections. Thus, the role of the PTD in ATL, and in South African water law for that matter, remains to be developed *stare decisis* and/or with the involvement of the executive in developing related policy and regulations. The ATL inculcation of the PTD may, however, well prove to be the strongest lever yet available to centrally position the doctrine in contemporary international environmental law.

The analysis here, viz consideration of the active role of public trust principles in water resource management at a landscape scale, bears historical contemporaneity with key events in the maturation of environmental law. Two hundred years ago the duality of *jus privatum* vs *jus publicum*, the core of the public trust's background property principles, was set down in the USA case of *Arnold v Mundy*:[522]

> 'Common property includes the air, running water, the sea, fish and wild beasts. [These are things] in which a sort of transient usufructuary possession only can be had... [which] the wisdom of the law has placed in the hands of the sovereign power... to be held, protected and regulated for the common use and benefit... of all the people'.

Thirty years after *Arnold v Mundy*, another court in *Commonwealth v Alger* (*Alger*) held that any use of private property is held under the *'implied liability that such use 'shall not be injurious to the equal enjoyment of others*', nor... *'to the rights of the community'* — the latter phrase alluding to the wider public interest and perhaps also to intergenerational obligations — as the judgment highlights the trust obligations foreclosing the alienation, transfer, limitation or restrainment of the *jus publicum.*[523]

The findings of *Arnold v Mundy* and *Alger* are but two early examples from a rich two-hundred-year history of public trust litigation in the USA — a trove of jurisprudence expressed largely with respect to the traditional doctrine but, in the last half-century, illustrating the evolution of the doctrine, beyond the close confines of its presumed Roman roots, to include wildlife, wetlands, heritage, public parks and, most recently, the live discourse surrounding its role in atmospheric trust litigation. This evolutionary character of the public trust is particularly relevant with respect to water. Water constitutes a finite resource balanced between an increasing global population and pollution levels and, consequentially, an increasingly-

[522] 6 *N.J.L.* 1 (1821)
[523] 61 *Mass*. 53 (1851)

degraded resource base. The ravages of climate change and the likely profound impacts thereof on aquatic ecosystems, especially in arid regions such as southern Africa and the western USA, continue unabated.[524]. In the same vein, as highlighted in this chapter, increasing land use pressures will require the public trust to enable encroachment onto terrestrial lands hitherto believed inviolate to the reach of the state.[525]

(d) The environmental law era

The advent of modern environmental law is very recent event on the timeline of law in general. Almost concomitantly with the appearance of environmental law, Joseph Sax published his seminal article on the role of the public trust,[526] echoed just two years later in the trust-embodying principles of the Stockholm declaration, *inter alia* that:

> 'Man... bears a solemn responsibility to protect and improve the environment for present and future generations'.[527] and that
>
> 'The natural resources of the earth... must be safeguarded for the benefit of present and future generations'.[528]

These pertinent admonitions reflect age-old jurisprudence that 'no possessor of property has an absolute title to it', but rather that the owner of property is bound into a trust relationship 'for the benefit of mankind'.[529] Contemporary applications show the trust principles increasingly regarded either as part of natural law and/or constitutionally embodied in several countries (South Africa, India, Pakistan, Uganda, Kenya, Bangladesh & Indonesia)[530].

In 1998 South African lawmakers deliberately enfolded the public trust into the principles that underpinned the democratic transformation of the nation's water law, and further operationalised these intentions in Section 3 of the NWA.[531] This legislative expression of the trust dissolved any perceptions of ownership rights in water but, as set out in this analysis, the

[524] Climate Change 2021: The Physical Science Basis. IPCC August 2021.
[525] eg *Paepcke v Public Bldg. Comm.* 46 Ill.2d. 330 (1970).
[526] Sax J (1970) Ibid.
[527] Stockholm Declaration (Principle 1).
[528] Ibid (Principle 2).
[529] Behring Fur Seals Arbitration, Paris (1892)
[530] See discussion infra.
[531] Water Law Principles: Discussion Document. Department of Water Affairs and Forestry, April 1996, read with the National White Paper on Water Policy (NWPWP, 1997). National Water Act 36 of 1998. Klug (pers comm) email dd 15/03/2021, copy on file with author.

trust may be called on yet again to limit the use of lands adjacent to watercourses which are integrally connected parts of an aquatic ecosystem.

During the past quarter-century there has also been a progressive trend towards reliance on securing water rights by means of moral and ethical guiding paradigms which dovetail with the imperatives defined by the public trust.[532] This progression, in effect embracing water within a interlinked and pluralistic ethical framework, suggests not only a growing awareness of the ecological intimacy between water and the catchment though which it flows, but also of the custodial role of each and every person on earth in respect of water resource protection. This understanding also reflects the jurisprudential need to 'strengthen the capacity of judges, lawyers and all persons' who have a role to play in water resource protection — ie that everyone has a role to play in securing the objectives of public trusts.[533] It appears that the recently proposed amendment to the Rome Statute, adding the international crime of 'ecocide', embodies a public trust foundation.[534] In sum, these progressions position the public trust towards the right of the anthropocentric:ecocentric continuum described earlier. In South Africa there has been a recent example of public trust-aligned language defining 'sustainable use — this term arguably equivalent to 'beneficial use' — being integrated into wildlife environmental law absent specific mention of the public trust — but which establishes sustainable, ecosystem-level protections of a resource in the public interest. This suggests a

[532] The Cochabamba Declaration (2000) declared water as, inter alia, belonging to the earth, sacred to life, a fundamental human right and a public trust to be guarded by all levels of government. The principles of the Brasilia Declaration of Judges on Water Justice (2018), founded on an ecosystem-based platform, holds that governments must have regard for stewardship of water as a public interest good (Principle 1); that this duty binds all people (Principle 2); that headwater catchments and streams play a pivotal role in the ecological and hydrological functioning of water resources (Principle 3); that judges need to be aware of the 'essential and inseparable connection that water has with the environment and land uses' — and that cases should be adjudicated accordingly (Principle 9); and that in all cases of uncertainty the principle of *in dubio pro aqua* should prevail (Principle 6). Less than a year after the Judges Declaration the Supreme Court of Pakistan invoked *in dubio pro natura*, considering this to be a leading precedent for South Asia, as well as in a global context.

[533] Brasilia Declaration of Judges on Water Justice (2018) Resolution III.

[534] The proposed amendment refers to, inter alia, that 'parts and systems of the environment... the global commons, cannot be said to belong to any nation(s) not to any generation(s) of human beings'; further that 'significant and durable harms to the environment pose a direct threat to current and future human populations' and deprivations of ecosystem services can threaten the wellbeing and survival of [susceptible] populations. (Preamble). Article 8(1 & 2). Independent Expert Panel for the Legal Definition of Ecocide (June 2021). Downloaded from https://bit.ly/3On2G7d. See also Gray MA (1996) The international crime of ecocide 26 *Cal Western Int Law J* 215, placing ecocide firmly within an environmental public trust framework.

wider organic awareness and realisation of the value of operative application of public trust principles, albeit arrived at absent any deliberate infusion thereof.[535]

For water resource protection to be effective, it must be directed towards ensuring the physical, chemical and biological integrity thereof at a landscape-based and ecosystem-directed level.[536] To illustrate this, the merits of a water resource management approach which is founded on providing an assurance of HEC is set out infra. This approach respects the principle of a unitary hydrological cycle and requires that any or all decision making considers the translocation of impacts either in-stream or transversely between the water course and its riparian and/or upland ecotonal zones. As mentioned, the implementation of a hydroecological approach may lead to perceptions of expropriation — a notion which must fail in the face of long-established public trust principles.

Furthermore, this echoes the globally widespread concerns that environmental law, during the five decades of its existence, has not come close to meeting with expectations. By contrast, the world has experienced a rapid and burgeoning loss of ecosystem services and biodiversity. Placing too great a reliance on the statutory police-power has failed to ensure compliance with well-intentioned regulatory instruments. By contrast, public trust principles inhere deeper than the police-powers of land use regulation can reach. As noted, what is needed is not more environmental laws, but better laws that have practical utility for resource protection and which provide legal indications of their effectivity.

In South Africa, as this chapter will highlight by means of case study examples, administrative decisions underpinning licences for water uses fail to heed the basic elements of a principled application of the public trust — creating a situation whereby 'some receive

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[535] The 2021 Draft Policy for the Conservation and Ecologically Sustainable Use of Elephant, Lion, Leopard and Rhinoceros GG45160 GN870 dd 14 September 2021) defines 'sustainable use' as follows (this authors emphasis):

> (3) Sustainable use: in relation to the use of a biological resource means responsible use that...
> (a) *does not contribute to the long-term decline of the resource in nature*;
> (b) does not lead to the loss of biodiversity of the ecosystem of which it is a component;
> (c) *does not compromise ecological integrity or ecological resilience*...;
> (d) ...
> (e) serves in, or is not detrimental to, the public interest;
> (f) ...
> (g) *ensures benefits... which meet the needs and aspirations of present and future generations*...

[536] Water Law Principles 1996 (Principle A.1), NWPWP (1997) (Principle 5), recognising the *'unity of the water cycle and the interdependence of its elements*' (own emphasis). Per Ryan (2021) (see text accompanying n578) 'the ecosystem should be protected not just for the services they provide us, but as the necessary sustaining conditions for all living things within it'.

disproportionate benefits and others disproportionate losses'.[537] This is deemed here to stem simply from a general lack of understanding as to the nature of what a public trust determination should entail, ie there is no protocol that guides such decisions on a principled public trust platform. Deliberate and purposeful integration of the public trust principles — into any or all regulatory considerations pertaining to water resource management — will underpin socially beneficial outcomes rendered in the public interest.

II. PTD Principles

The PTD is based on adaptable and equitable common law principles, governed by the same rules applicable to trusts in general.[538] The core principles are that: (a) the people (beneficiaries) have a paramount interest in how the resource is managed for both present and future generations;[539] (b) the state, as public steward[540] of the resource, will determine how the resource is managed in the public interest and (c) all of the resource is the property of the people. In this regard, the trustee (the state) may not (i) convey public resources exclusively to a private entity; (ii) issue a legislative grant (eg by licence or permit) the sole purpose of which is to benefit a private interest[541] — where such a permit may result in avoidable harm to the resource (Duty of Precaution); or (iii) (by its actions or deeds) attempt to relinquish its power over a public resource.

Accordingly, the state is burdened with an affirmative duty to consider the trust principles when allocating water resources or water uses and must continually exercise a duty of care and of protection by supervising the permitted use. This fiduciary duty is, in fact, a promissory pledge made by the state to its peoples. Most importantly landowners, through whose property a watercourse may flow, 'have their [title] impressed with a dominant estate in

[537] Epstein RA (1987) 'The public trust doctrine'. 7 *Cato J*. 411, 422-428. Du Bois (1994) (n755 at 83) observed that 'administratively directed water allocation easily falls prey to manipulation by the most influential sectors of society' and that it is for this very reason that state control over water resources is precisely to 'curb local decision-making powers'.
[538] *Idaho Forest v Hayden Lake* 733 P.2d 733 (1987). However, while there may be similarities, the specific nature of the public trust has no equivalence in private or public law and analogising the two should be avoided. eg Sand PH (2014) 'The rise of public trusteeship in international environmental law'. 44 *Environmental Policy and Law* at 211. See also Sand PH (2004) Sovereignty bounded: Public trusteeship for common pool resources. 4 *Global Environmental Politics* 47.
[539] *Robinson* 658 P.2d (2013) at 310.
[540] Although not clearly stated, the aspect of co-trusteeship between the state and the public, whereby the public have 'correlative duties or responsibilities to their fellow beneficiaries' is encouraged. See *US v 1.5 Acres of Land* (Annexure 1).
[541] *Robinson* ibid at 312.

favour of the public,'[542] ie that the PTD provides a governmental defence against claims of expropriation.[543] As USA case law has shown, no compensation is due if a deemed use was not part of the land title to begin with.[544] Lastly, the conveyance of a trust by permit or licence is revocable should new knowledge or circumstances indicate a usage that has become inconsistent with contemporary needs.[545] It follows, therefore, that the PTD encompasses protected uses[546] of certain essential natural resources (sustainability), and ensures the availability of the resources to the public (present and inter-generational equity).

Flowing from the foregoing is the need to express the PTD principles as obligations to protect water resources.[547] Six fiduciary duties that usefully and clearly frame the extent of the state's responsibility to protect the public trust in water have been proposed:[548] (1) a duty of security of waters, water supplies and infrastructure; (2) a duty (both by the state and by the public) to *conserve* water resources consistent with trust purposes; (3) *control* and *manage* water for long-term *sustainability*, for human and biological life generally, watersheds and hydrologic processes, local communities and society in general (with a presumption in favour of public use);[549] (4) a duty of equity in terms of social justice; (5) a duty to invest resources in the resource; and (6) a duty to engage with long-term sustainability planning at a watershed scale.[550] These criteria thus provide the basis for a juridical test that evaluates how the principles of the doctrine have been considered, in the public interest.

(a) Applicability of public trust principles for water resource governance

As set out in Chapter 1, the public trust provides a globally relevant, dynamically malleable and principled foundation for the protection of essential natural resources for the benefit of present and future citizens. The public trust[551] operates as a limitation on the discretion of administrative agencies and provides the basis for a 'hard look' doctrine for reviewing decisions

[542] *Galt v State Department of Fish, Wildlife and Parks* 731 P.2d 912 (Mont. 1987).
[543] This attribute of the public trust rendered it extremely attractive for inclusion in the revised South African Water Act of 1998, ie to provide a bulwark against demands for compensation arising from the removal of riparian water rights.
[544] *Lucas v South Carolina* 505 U.S. 1003 (1992).
[545] This implies that a permit may not permit alteration of the resource such that, should the permit be revoked, it would not be possible to restore the pre-permit condition. This also speaks to the issue of a reversionary role for the PTD in instances where historical alterations may be easy to restore.
[546] Ecological, recreational and similar values for renewable natural resources.
[547] This aspect is addressed in Chapter 5 of this thesis.
[548] Arnold CA (2009) 'Water privatisation trends in the United States: Human rights, national security and public stewardship'. 33 *Wm. & Mary Envtl. L. & Pol'y Rev*. 785.
[549] Emphasis denotes exact or equivalent terminology used in Section 3 of the NWA (see n80).
[550] This duty speaks directly to the maintenance of HEC as set out in Section 1 of this chapter.
[551] A trust for the benefit of the public. A Dictionary of Law (10 ed.).

related to trust resources.[552] The trust can evolve in parallel with ever-changing societal needs and concerns — in tandem with the constant necessity of reviewing human relationships with natural resources. As such the trust may be regarded as a fundamental underpinning of democracy.[553] The trust imposes a mandatory duty and obligation on the sovereign nation to ensure that specific natural resources are maintained such that their condition supports, and continues to support, the welfare and survival of the public. The public trust thus serves as a limitation on natural resource use.[554] Importantly, the public trust should be viewed as a 'background principle' of property law, 'rendering public' those resources present on private land which form part of a public natural resource, such as a watercourse.[555] As such, the protection of water resources on private land does not constitute a constraint of ownership, as rights to the public resource were never part of the bundle of property ownership rights to begin with. As described earlier, the trust operates to accommodate any duality of private vs environmental rights which might exist on private property,[556] effectively placing the trust resource within a (public) servitude.[557]

The central principle that the traditional public trust requires that protected resources not be conveyed into private ownership is not absolute. Partial or unavoidable conveyances which do not result in permanent impairment of the resource are permitted. However, the trust democratises water resource governance by precluding the state from acting in a *dominus fluminus* capacity, by obliging it to instead act as a trustee on behalf of its citizens.

(b) Traditional principles

The most quoted historical public trust case is that of (1892) *Illinois Central*.

This case examined the legality of municipal permission for the construction of a railroad along the edge of Lake Michigan — conflicting with state title to the affected submerged lands. Suffice is to quote two excerpts which speak directly to the sovereign

[552] Wilkinson CF (1980) 'The public trust doctrine in public land law'. 14 *U.C. Davis L. Rev*. 269. See also: Wilkinson CF (1989) The headwaters of the public trust: Some thoughts on the source and scope of the traditional doctrine. 19 *Envtl. L.J.*
[553] Blumm and Wood (2021) at 77. Blumm MC (2003) 'Public property and the democratisation of western water law: A modern view of the public trust doctrine'. 3 *Issues in Legal Scholarship* See also Goswami P (2016) n458.
[554] Ibid at 79. Goswami (2016) '... the PTD curtails the state's unfettered control over natural resources and does not allow unlimited rights' (at 69).
[555] Ibid at 84.
[556] Blumm (2011).
[557] Blumm and Wood (2021) at 86.

obligation of respect for the trust and that a state may not divest itself of its trust obligation through a transfer of property to a private interest:

> 'The trust devolving upon the State for the public . . . cannot be relinquished by a transfer of the property. The control of the State for the purposes of the trust can never be lost, except as to such parcels as are used in promoting the interests of the public therein, or can be disposed of without any substantial impairment of the public interest in the lands and waters remaining'.
>
> 'The state can no more abdicate its trust over property in which the whole people are interested, like navigable waters and soils under them, so as to leave them entirely under the use and control of private parties . . . than it can abdicate its police powers in the administration of government and the preservation of the peace.'[558]

What is not immediately clear from the Illinois Central ruling is whether it is simply persuasive — or whether it invokes a deeper mandatory implication. If the former then there is ample leeway for states to tailor their interpretations to the possible disfavour of the environment.

(c) Saxian principles

This work focusses on the legal instrumentality of the Saxian (modern) PTD for the protection of renewable natural resources, in particular freshwater resources. Sax regarded water with special reverence, variously referring to it as a 'public commons', 'common capital', a 'community's capital stock' and a 'heritage resource'.[559] Pivotally, Sax realised in the 1960s — concomitant with the onset of modern environmentalism — that changing societal demands were re-moulding perceptions of how water resources (and other natural resources) should be governed to ensure the sustainability of society.[560] Sax, circa 2010, expressed the potential of the public trust for protecting water resources on private land as 'the next big development' for property law.[561] To protect the environment he foresaw that governments needed *'empowerment against the importuning of private stakeholders' at the expense of society* (emphasis added).[562] Herein he perceived a move from a 'transformative economy' to one based

[558] *Illinois Central 146 U.S.* at 453. See Annexure 1 for a list of the foundational PTD cases which pre-date the advent of environmental law.
[559] Thompson BH (1998) 'Water law as a pragmatic exercise: Professor Joseph Sax's water scholarship'. 25 *Ecology Law Quarterly* 363-383.
[560] Sax JL (1989) 'The limits of private rights in public waters'. 19 *Environmental Law* 472-483.
[561] This was conveyed in a discussion between Sax and Mary Wood (email communication from Mary Wood to this author, dd 19 June 2020, copy on file with author).
[562] Rose CM (1989) 'Joseph Sax and the idea of the public trust'. 25 *Ecol. L. Q*. 351.

on a science- and knowledge-founded 'economy of nature' — derived from three emerging demands on water policy: (i) increased demand for conservation and recycling; (ii) reallocation of existing supplies to meet new demands for water; and (iii) the maintenance and augmentation of instream flows.[563] All three of these factors, and especially the second, underpinned the needs to be accommodated in South Africa's water law revision undertaken in the mid-1990s.

In his seminal paper introducing his thoughts on the PTD, Joseph Sax established its core principles, which have since become engrained in public trust consciousness, as follows:[564]

- '... certain interests are so intrinsically important to every citizen that their free availability tends to mark the society as one of citizens rather than of serfs';
- '... [these interests] are so particularly important that they ought to be reserved for the whole of the populace' ('... one does not own a property right in water... only a usufruct — an interest that incorporates the needs of others'); and
- '... certain uses have a particularly public nature that makes their adaptation to private use inappropriate.'

The phrasing used by Sax highlights the fact that the public trust protections enshrined in these principles are fundamentally applicable to renewable natural resources that are essential for life support. Sax declared water to be the 'best known example' of such a resource. In subsequent work he extended the 'traditional' trust obligations in water to include usufructuary rights in soil and air[565], a progression which, had he still been alive today, Sax would surely have regarded as being pertinent to climate change and atmospheric pollution protections.

The trust extends to encompass water resources arising on, or passing through, privately-owned land, 'impressing' such resources with 'a dominant estate in favour of the public',[566] the interests of the public being considered paramount. *Just v Marinette County*[567]

[563] Thompson BH (1998) ibid at 373.
[564] Sax (1970).
[565] Sax JL (1990) 'The search for environmental rights'. 6 *Journal of Land Use and Environmental Law* 93-105. As early as 1912 the South African Soil Conservation Act expressed the need for soil conservation using trust terminology (see Chapter 4).
[566] *Galt v State Department of Fish, Wildlife & Parks* 731 P.2d. 912 (Mont 1987).
[567] *Just v Marinette County* 56 Wis. 2d 7 (1972).

provided one of the first Saxian-era cases addressing wetland protection for the overall purpose of ensuring integrated ecosystem health.' Herein it was held that 'wetlands [are] a necessary part of ecological creation' and accordingly, 'an owner of land may not... use it for a purpose for which it was unsuited in its natural state'... and in so doing '[injure] the rights of others'.

(d) Edith Brown Weiss principles

Weiss has long been a proponent of a 'planetary trust' as a tool of general application for ensuring environmental stability,[568] located within a framework of intra- vs intergenerational considerations and accommodations, ie reliance on a moral obligation to respect the dual duty owed to each of the present- and future-generations to preserve the corpus of the trust.[569] The objective of the planetary trust view is to sustain the welfare of future generations, but with full recognition and allowance for the fact that there must be an accommodation with the needs of the present occupants of the planet. This invokes the fundamental challenge to sustainability, viz that the present population should at all times endeavour to live within its means so as not to limit the potential of the global ecosystem to support life on earth. In terms of water resources this devolves quite simply to 'don't pollute the aquatic environment'.

Weiss was clearly keenly attuned to this conundrum in articulating the trust principles as a triad of sustainability-oriented conservation goals — in order to bequeath a planet in 'no worse condition' than it was received. Given the environmental decay of the past fifty years, and that Weiss identified these needs almost forty ago, this has been an arguably futile objective. In the absence of a deepening level of compassion for others, such as is evidenced in simple example by the wilful resistance to vaccinations or wearing face masks during the COVID-19 pandemic, achieving public trust goals may be exceedingly difficult, if not impossible.

Weiss framed her goals around three ecocentric trust criteria: (i) sustaining the life-support systems of the planet; (ii) sustaining the ecological and environmental conditions that underpin the survival of the human species and (iii) sustaining a healthy and decent environment.

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[568] Weiss EB (1984) 'The planetary trust: Conservation and intergenerational equity'. 11 *Ecology Law Quarterly* 495-581.
[569] Weiss EB (1992) 'In fairness to future generations and a sustainable planet'. 8 *American University International Law Review* 19-26.

Weiss' option-directed trust principles are underpinned by *the need to conserve*[570] (emphasis added):

- the diversity of the natural resource base so as not to limit the usufructuary-use *options available in the future*;
- the *quality of the planet* so that it is bequeathed in a condition no worse than it was received by the present incumbents;
- *equitable rights of access* to the legacy of past generations and of *conservation of this access for future generations*.[571]

Weiss' rendition of the trust principles are thus overtly orientated towards a 'conservation now' focus that underpins security in the future. This view is of paramount importance as there is an overarching and overlooked need to *'build generational wealth in the environment*' (own emphasis). Furthermore, the Weiss interpretation is overtly of an international law flavour, as is evidenced by her reference to the 'quality of the planet'. Essential finite, non-substitutable resources, such as water and the atmosphere, lack distinct national boundaries, placing them firmly within a planetary natural resources trust framework.

Significantly, the Weiss principles dovetail intimately with those echoed by the Stockholm, Brasilia Judges and the Cochabamba declarations discussed *supra*.[572]

(e) The 'Olson principles'

Professor James Olson has a long history as a public trust law practitioner and has defined the core principles in terms of the 'modern' reach of the trust:[573]

Basic principles:

i. Non-alienation of resources and conveyance thereof only for a beneficial public purpose;
ii. No interference with, or impairment of, the trust *corpus* (capital);

[570] Weiss' focus here is on the maintenance and/or betterment of the trust corpus, i.e. that there should be no net loss of extant environmental quality.
[571] Weiss EB (1984)
[572] See n531.
[573] Derived from Olson J (2014) 'All aboard: Navigating the course for universal adoption of the public trust doctrine'. 15 *Vermont Journal of Environmental Law* 136.

iii. Government's duty to account for the protection of public trust waters and uses - such that a proposed use will not be in violation of (i) or (ii).

Corollary principles:

i. The burden of proof that a water use will not alienate or impair a water resource lies with the person proposing same (ie presumption of innocence lies with the resource);
ii. The use must not incur any cumulative effects. If this cannot be demonstrably shown to be the case then a finding that the use will not impair the resource cannot be the outcome;
iii. There is an affirmative duty to protect flows, water levels, water quality and ecosystem integrity *including ecosystems connected to the public trust resource* (emphasis added);[574]
iv. Uses may be balanced or accommodated as long as they does not alienate or impair the resource;

Olson maintains that the trust principles render the PTD flexible and that they dynamically evolve in concert with the changing needs of society and pressures on the environment.

[574] Here Olson places the trust firmly in the context not only of instream flows and quality but also HEC, viz. that the trust has been 'extended to all parts of the inextricably connected ecosystem that is part of or essential to the common body of water and the people's use of the resource'. Olson (2014) at 174.

(f) The Accommodation Principle

Public trust academic Michael Blumm proposed his 'principle of accommodation' as a counter to any notion that there is a lineal division between public and private land rights.[575] This dovetails with the 'PTD as a continuum' approach. Blumm's interpretation clearly speaks to an 'amphibious' public trust where 'the frontiers of the public trust... *lie in upland resources with great public value*' (own emphasis). Here Blumm was not referring to the lateral hydroecological view held in this analysis — rather to that of recreational access. However, the need for the trust to span the wetland to upland ecotone renders his 'frontier' statement equally valid in an HEC-context. The public trust, in effect, is not anti-private property, rather it exerts a democratic transformation — in effect protecting water resources thereon which were never 'free to use' within the context of private ownership. While the use of a portion of the property may be limited by trust interests, such rights are but 'one stick in the property bundle'.[576] Blumm further describes this as a mutual 'co-existence of public and private uses'. The underpinning for an accommodation view arose from *Illinois Central*'s holding that [land uses] could only be approved in cases where there was 'no substantial impairment of the public interest in the lands and waters remaining'.[577]

This nuance of accommodation is somewhat different from the other principles set out in this section in that it floats over, and applies to, all of them. In effect 'accommodation', as opposed to 'balancing' is a most appropriate nuance for the manner in which the public trust concept should be applied in order to optimally assess a beneficial water use.

Recognition of the dual title character of the PTD is not recent — having first emerged in American caselaw in *Arnold v Mundy* (1821)[578] and, more recently in the Saxian PTD era, in *Marks v Whitney* (1971)[579] where private property was found to be 'burdened' by public rights such that 'two distinct estates are created'. Subsequent to *Arnold v Mundy* the PTD has been extended to, *inter alia*, waters suitable for recreation, including parklands, access for hunting

[575] Blumm MC (2010) 'The public trust doctrine and private property: The accommodation principle'. 27 *Pace Environmental Law Review* 649. Blumm places *Arnold v Mundy* as the case initiating a lineal view.
[576] Blumm (2010) at 651.
[577] 146 U.S. 387 at 453.
[578] *Arnold v Mundy* 6 *N.J.L.* 1; 1821 Lexis 2. This decision set out a lineal division between public and private rights.
[579] *Marks v Whitney* 6 Cal.3d 251, 491 (1971).

rights on lakes and wetlands, man-made canals, groundwater and indeed even to land flooded by the construction of a dam.[580]

Duality of land title, however, cannot pose an absolute bar to the privatization of trust assets. Limited privatization is possible when the action (i) furthers public purposes (ie is a use overwhelmingly consistent with the public interest, such as the construction of a dam for public water supply) and (ii) does not impart any substantial impact on the remaining trust resource.[581] Importantly, however, privatization for a beneficial use does not remove any of the obligations imposed by the public trust, ie that continuous supervision of the use of the asset remains paramount. As such, granting permission for limited beneficial use creates a co-trustee type of arrangement between the state and the user.

(g) Examples of principles derived from caselaw in the environmental law era

(i) Arizona Central v Hassell[582]

- The state must administer its interest in lands that are subject to the public trust consistent with trust purposes.

(ii) National Audubon Society (Mono Lake) v Superior Court

A century after *Illinois Central*, the court in the protracted *Mono Lake*[583] matter formulated a corollary set of principles which serve to distil out the trust responsibilities:

- Water resource management agencies have an affirmative duty to take the public trust into account in the planning and allocation of water resources, and to reconsider allocations that no longer serve trust purposes in the public interest;
- The trust imposes on the state a continuing duty of supervision (monitoring), inter alia supporting revocation of a permit which may be found to be inconsistent with contemporary knowledge or current needs;
- The issuance of permits pertains only to usufructuary and beneficial water uses which do not pose any threat of irreversible harm to the resource;

[580] *Marks v Whitney* ibid.
[581] In this specific regard the need to consider cumulative impacts of multiple activities of the same type is important. Assessing impacts on aquatic systems from a connectivity perspective draws in the need to examine the up- and downstream environments in order to quantitatively include cumulative impacts.
[582] 172 *Ariz. 356* (1991)
[583] n97.

- In some cases the exigencies of practical necessity may dictate the issuance of a water use permit that may result in foreseeable and/or unavoidable harm to public trust uses. In such instances the uses protected by the trust should be as far as is possible, in the public interest[584].
- There is an ongoing duty to monitor the outcome of an approved water use.

(iii) Re Water Use Permit Applications (Supreme Court of Hawai'i)[585]

Just two decades after *Mono Lake*, the Hawai'ian Supreme Court set out what they considered to be the fundamental principles of a 'water resources trust':

- The state has the authority and duty to preserve the rights of present and future generations in the waters of the state;[586]
- The continuing *authority* of the state over its water resources precludes any grant or assertion of vested rights to use water to the detriment of the public trust (original emphasis);[587]
- The state is empowered to revisit prior diversions and allocations, even those made with due consideration of their effect on the public trust;[588]
- The state bears an affirmative *duty* to take the public trust into account in the planning and allocation of water resources, and to protect public trust uses wherever feasible (original emphasis).[589]

An Hawai'ian Commission on Water Resources provided a succinct, concise and globally relevant summary of the constitutional scope of the public trust as follows:

> 'The duty to protect public water resources is a categorical imperative and the precondition to all subsequent considerations, for without such underlying protection the natural environment could, at some point, be irrevocably harmed and the ‘‘duty to maintain the purity and flow of our waters for future generations and to assure that the waters of our land are put to reasonable and beneficial uses’’ could be endangered. However, the duty to protect does not

[584] *National Audubon* n97. The court referred specifically to the avoidance of harm to 'source streams'. In *State v Public Service Com'n* (275 *Wis*. 112 (1957) it was held that unless the impairment of the trust resource is substantial, it will not amount to a violation of the trust.
[585] 94 *Haw*. 97 (Haw.2000).
[586] *In Re Water Use Permit Applications* 9 P.3d 409 (Hawai'i 2000), citing *Robinson v Ariyoshi 658 P.2d.* at 674; also *State v Central Vt. Ry*. 153 Vt. 337 at 571 '[t]he state's power to supervise trust property in perpetuity is coupled with the ineluctable duty to exercise this power'.
[587] Ibid citing *Robinson* at 658; *National Audubon* at 727 and *Kootenai* 671 P.2d at 1094 ('the public trust takes precedent over vested water rights')
[588] Ibid, citing *National Audubon* at 728.
[589] Ibid.

> necessarily or in every case mean that all off-stream uses must cease, that no new off-stream uses may be made, or that all waters must be returned to a state of nature ... . The particular level of protection may vary with circumstances and from time to time; but the primary duty itself remains'.[590]

The Hawaii'i principles align with a proposed 'reconceptualisation of water', considered in the context of water privatisation. This identifies three core principles of water stewardship, these being: [591]

- water should be under public ownership and control, but allowing of private usufructuary uses that are in the public interest;
- private property interests in water are defined by the 'unique characteristics' of water[592] and [water uses] should be view as part of an 'interconnected webs of interests';[593] and
- the government bears fiduciary stewardship responsibilities[594] for the governance of water at watershed level.

(iv) Loyola[595]

While US case law is abundantly populated with interpretations of the public trust, one in particular stands out insofar as setting out the principles of the public trust in a practical 'everyday administrative decision' context. While the 1892 *Illinois Central[596]* case is widely regarded as the 'lodestar' for the public trust, this matter, *Lake Michigan Federation vs USACE,* from the same state, was heard in the modern era of environmental law. It serves to bring into

[590] Water Resources Commission Report (1995), cited in *In Re Water Use Permit Applications* 9 P.3d at 425.
[591] Arnold CA (2009) n547.
[592] Arnold (Ibid) describes water as 'an element of nature with physical, chemical, biological and ecological characteristics'. Arnold importantly expanded the government obligation by including a co-trustee obligation, ie. that each public beneficiary bears a 'correlative duty' to other members of the public. In the view of this analysis, this horizontal obligation is essential to the fulfilment of a public trust in water resources. As mooted above, placing reliance on the state to monitor the entirety of an interlinked web of water resources is an arguably unreasonable assumption. By contrast, broad-based citizen involvement would substantially facilitate geospatial oversight of adherence to trust principles. Recent case law in *Gillen v City of Neenah* 580 N.W. 2d 628 (Wis 1998) held that the PTD allows a citizen to sue a private party if the State fails to act in futherance of the trust obligations.
[593] This is a useful analogy wherein many different persons, entities and/or communities may have interconnected interests associated with property. The landowner bears a duty of care to others who have this shared interest.
[594] The fiduciary responsibility, according to Arnold, is burdened with six duties: (1) an assurance of water security; (2) conservation of water resources; (3) sustainability; (4) equity in accordance with the principles of social justice; (5) investment — in all aspects of water resource and water supply governance; and (6) future long-range planning for the security, sustainability and conservation of water supplies and watersheds.
[595] *Lake Michigan Federation vs USACE* 742 F.Supp. 441 (1990).
[596] See Chapter 1 and Annexure 1.

clear focus what the scope and objectives of the trust represent — in particular the risk of loss of all or part of a water resource for exclusive private benefit.

The case involved a challenge by an environmental organization to a USEPA approval of an application to infill a section of shoreline on Lake Michigan. The purpose of the application was for constructing sportsfields at Loyola University.

The court, citing a third Illinois matter, found that approval of the application had 'violated the public trust doctrine', in particular that '..any attempted ceding of a portion [of the lake] in favour of a private interest has to withstand a most critical examination'.[597] Furthermore that in order for the obligations set by the PTD to be met, that (emphasis added):

- the primary purpose of the conveyance of land *must be to benefit the public*;
- the *benefit to the public must be direct* and that claims of public interest based on job creation and economic development were 'too indirect, intangible and elusive to satisfy the requirement of a public purpose'.[598]

In its analysis, the *Loyola* court held that the 'very purpose of the trust doctrine is to police the legislature's disposition of public lands.' Furthermore that purported public interest benefits claimed under the application were merely 'incidental to the primary, private goal'. This is an important conclusion, given that many applications are 'promoted' on the purported merits of job creation and economic development — which is a spurious argument in that, if it constituted valid reasoning, it would render the intentions of environmental law entirely toothless. The court was critical of such attempts, declaring them to be 'cosmetic' and simply an attempt to make the application more 'palatable'. This argument highlights the public trust role of attaching weight to the environmental aspects of a development application. The court held that:

- Courts should be critical of attempts by the state to surrender valuable public resources to a private entity;
- The public trust is violated when any primary purpose of a legislative grant is to benefit a private interest;

[597] Citing *People ex rel. Scott v. Chicago Park District* 360 N.E.2d.
[598] *People ex rel,* Ibid.

- The public trust invalidates any attempt by the state, or any co-trustee thereof, from relinquishing its power over a public resource.[599]

In this context the trust embargoes any conveyance of public property to solely satisfy a private interest 'however laudable such interest might be'.[600]

(h) Principles contained in policy

Wisconsin's public trust doctrine

The Wisconsin public trust in water is the oldest and most developed of all state-level public trusts in any state of the USA. The state PTD is underpinned by the following principles:[601]

1. The public trust in water involves identifiable trustees, beneficiaries and trust property;
2. There is a legal duty to protect public rights in water;
3. Trustees must maintain a supervisory duty based on a policy of adaptive management;
4. The public trust is a 'fluid doctrine' that expands as needed to protect the water commons and public rights;
5. Legislative grants of public trust resources may only be made under specific conditions;
6. Private riparian rights must not encroach on public rights;
7. A healthy public trust requires active enforcement by both the trustees and beneficiaries.

The PTD and related ethics — the public trust as one of three interlocking ethics

Alluded to earlier was a moral and ethical underpinning for the public trust. For the trust to function effectively as a property-moderating covenant it must promote an ecosystem-orientated vision for the common good. This section speaks briefly to a proposed intertwined role of public trust ethics, common heritage imperatives for ecological integrity and the moral obligations and reasoning of natural law. It is in the harnessing of this intersection of doctrinal approaches that 'accommodation' comes to the fore.

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[599] *Illinois Central* 146 U.S. '[t]he state can no more abdicate its trust over property in which the whole people are interested, like navigable waters and soils under them so as to leave them under the control of private properties...'. See also *Obrecht v National Gypsum* 361 Mich. 399 (1960).
[600] Blumm and Wood (2021) at 191.
[601] Scanlan MK (2012) 'Implementing the public trust doctrine: A lakeside view into the trustee's world'. 39 *Ecology Law Quarterly* at 129.

III. The relevance of a public trust 'ethos'

A possible means of ameliorating resistance to land use aspects of environmental law might lie in the development of a progressive inculcation of ethics as an agent for change — the ethical obligations of the public trust being one example. This might be founded in the expression of ecosystem services as nature's contributions to people (NCP) — wherein benefits from nature, eg water purification, need to be seen in the light of the harms that a polluted, degraded or disconnected nature can also convey to people, eg disease transmission.[602] A criticism that has been raised against the operative potential of the public trust has targeted it's perceived 'anthropocentric orientation', viz historically that the trust has provided a 'balancing mechanism' between water resource protection and water resource use by people. Centrally, public trust determinations are made in the public interest, the latter being a societal construct that can vary over time and/or be politically manipulated to the advantage of a particular use or minority economic benefit[603] at the expense of the physical, chemical and biological integrity of the water resource. However, the real shortcoming of the public trust lies in it being dependent on the willingness of the State and its appointed trustees[604] to fulfil the aims and intentions thereof.[605] It lacks a collective public dimension. The fact that 23 years have passed since the NWA was promulgated and that the responsible department (the 'trustee') has yet to actively operationalise the trust,[606] does not bode well for it being the 'beating heart' of the statute.[607] The value and nature of the public trust will only become fully apparent through an understanding of the underpinning principles. Importantly, the value of the trust lies in it being

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[602] eg Ellis EC, Pascual U & O Mertz (2019) 'Ecosystem services and nature's contribution to people: negotiating diverse values and trade-offs in land systems'. 38 *Current Opinion in Environmental Sustainability* 86-94. A core focus of NCP is that of social interactions with land management.

[603] The promotion of hydraulic fracturing ('fracking') provides one example of how an environmentally-hazardous activity can be promoted as being 'economically-beneficial'. If such reasoning holds water then it should be apparent that any natural resources, and the ecosystems which sustain them, can simply be sacrificed for economic benefit, completely abrogating the intentions of environmental law.

[604] State bureaucrats are not conventional 'trustees' and, currently, are not specifically empowered to act as trustees of the public interest. They need to be equipped in order to effectively apply the trust principles in their day-to-day decisions.

[605] See concerns expressed in Chapter 1 eg by Mary Wood and others ('environmental law has failed us...'). This thesis maintains that for the public trust in water to be effective, state trustees/officials must possess of a deep moral and ethical belief in the trust principles. However, they may have no knowledge of what these principles are and how they should be operationalised — at least not until policy, underpinned by jurisprudence, has anchored their validity. See also Cooke et al (2021).

[606] Although the public trust is relied on in both policy (the National White Paper) and legislatively expressed in the Water Act, this insertion was and has remained absent of any distillation of the trust principles and how they should be applied. As such the role of the trust is merely implicit. This thesis maintains that this is inadequate and rather holds that the trust principles should be overtly and explicitly defined. For a legal instrument such as the public trust to have demonstrative value, it should be applied via a clear process of determination based on the underlying principles.

[607] This was the wish of the late Minister Kader Asmal who oversaw the drafting of the NWA (see Chapter 5).

regarded as a partnership between humans and what Leopold termed their 'biotic' community of land.

The need for a public trust ethos embedded in environmental water law is aptly contained in the following statement:

> 'A legal system that fails to prevent people from destroying the functioning of ecosystems that provide the water that it requires also fails to create the conditions necessary for social harmony, enhanced well-being and human rights.'[608]

(a) Some thoughts on the public trust as a continuum

The perceived 'lack of ethos'-based challenges to the value of the public trust arose in 1991[609] and again, thirty years later, in 2021[610]. They are underpinned by the view that Sax ignored — or even displaced — other, potentially more effective approaches, such as considerations of the thinking of Aldo Leopold — enunciating the values for a 'rights of nature'-orientated ethos.[611] These challenges, however, ignore the fact that the adaptable scope of the public trust may be and has been augmented by the infusion of rights of nature nuances into the trust framework through policy or legislative expression. Here a different view is taken, namely that the principles of the public trust should work in concert with those of rights of nature, human rights, the common heritage of mankind and others. The nature of this mix of principles positions, by virtue of law and/or policy, the role of the public trust on a continuum that ranges from anthropocentric at one extreme, and rights of nature ('RoN' = ecocentric) for all of nature at the other (see Figure 4.1). As such, while the anthropocentric character of the public trust may be acknowledged, especially viewed in the context of the definition of the environment as contained in the (South African) National Environmental Management Act (NEMA),[612] this is

[608] Cullinan C (2013) The Rule of Nature's Law. Chapter 5 in *Rules of Law for Nature: New Dimensions and Ideas in Environmental Law*. Voight C (ed). Cambridge University Press. at 100. Cullinan expresses a need to 'align legal systems with Earth's laws.' at 108.
[609] Delgado R (1991) 'Our better natures: A revisionist view of Joseph Sax's public trust theory of environmental protection, and some dark thoughts on the possibility of law reform'. 44 *Vanderbilt Law Review* 1209.
[610] Ryan E et al (2021) 'Environmental rights for the 21st Century: A comprehensive analysis of the public trust doctrine and rights of nature movement.' 42 *Cardozo L. Rev.* 2447.
[611] There is no evidence that alternatives to the public trust such as earth rights, ecofeminism, indigenous law or Rights of Nature approaches were poised to gain traction in parallel with the development of modern environmental law post-1970. By contrast this analysis regards the PT as the framework on which such approaches could be posited.
[612] Act 107 of 1998. NEMA anthropogenically defines the environment as the 'surroundings within which humans exist...'.

not the end of the story, as the manner in which the public trust principles are legislatively expressed imbues them with nuances of RoN values and ethos.

Both Delgado (1991) and Ryan (2021) fail to acknowledge the symbiosis between the trust and an RoN approach. Ryan sets out three RoN categories that variously protect: (i) all of nature; (ii) specific natural features of ecosystems;[613] or (iii) specific species. Also, Ryan further notes that the greatest degree of conformity between public trust and RoN thinking is with regard to water. Arguably an 'all out', 'all of nature focus' would constitute a bridge too far in terms of attaining effective resource protection,[614] whereas the other two categories are already common features of statutory protection, located somewhere between the extremes of the proposed public trust continuum. As already set out, water resource protection in South Africa is ecosystem-directed and, as water is an essential life-supporting resource underpinning all life on earth, a water resources public trust would likely be located substantially towards the RoN extreme of the continuum. Secondly, protections closely akin to RoN rights commonly exist for specific areas and species and are provided for in specific statutes which include the principle of public trust protection.[615] On this model it is deemed best to start with a 'basic' public trust notion and then infuse specific conditions underpinning ecosystem or habitat or species protection, which alternatively augment the trust scope with aspects of indigenous and/or cultural law.

The take-home value drawn from the above is that the public trust is an adaptable and malleable construct which conforms to changing societal needs without compromising the integrity of the resource on which these needs rely. Moreover, it embodies a futurity-orientated perspective. Its optimal value lies, however, as part of a team of paradigms which together should foster ethical, balanced and reasonable to solutions for socio-economic-political challenges

[613] In specific instances such as for the Whanganui watershed in New Zealand, legal personhood has been afforded to the water resource. This falls within the second category described by Ryan (n609).
[614] Akin to the push-back against the proposals made by Stone (1972) 'Should Trees Have Standing'. 45 *Cal. L. Rev.* 455.
[615] For example in the National Environmental Management: Protected Areas Act (NEMPAA), Act 57 0f 2003, Chapter 1(3) or the National Environmental Management: Biodiversity Act (NEMBA), Act of 2004, Chapter 1(3).

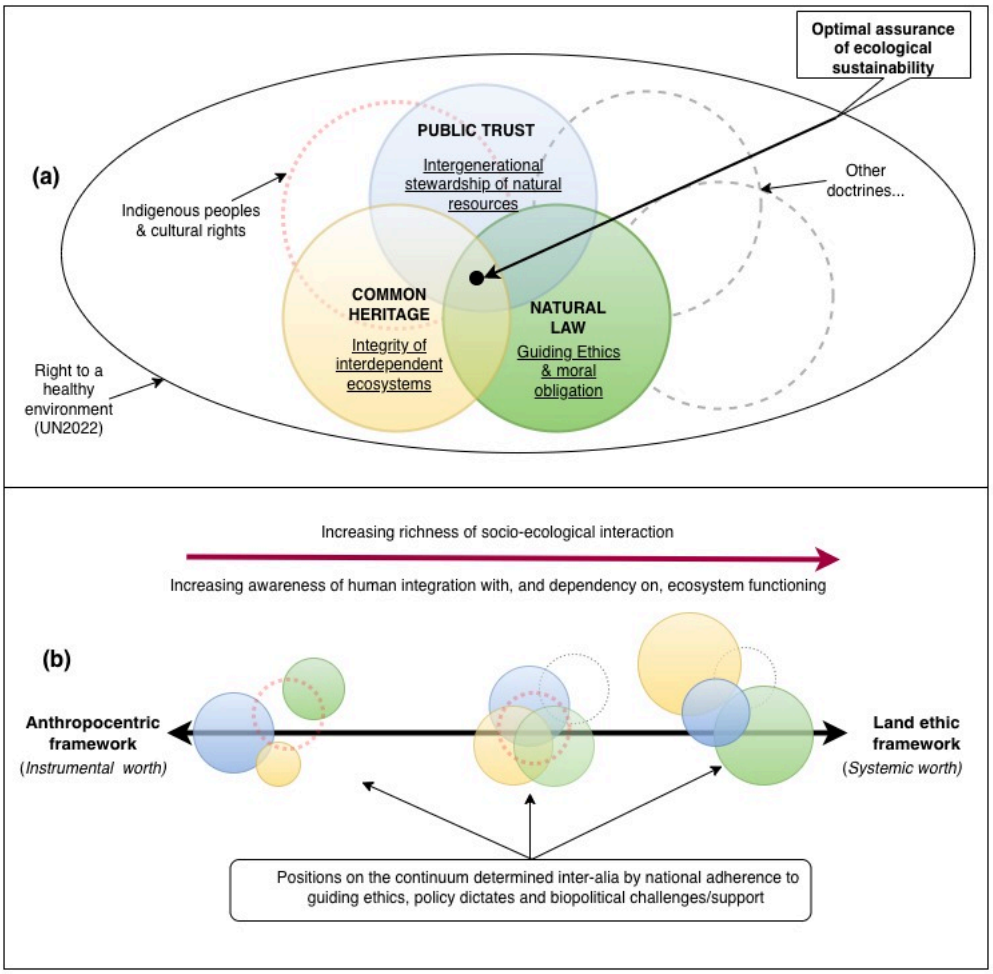

Figure 4.1: Concept diagram illustrating a pluralistic interaction of the principles of the public trust, common heritage of mankind and natural law. Empty circles represent other paradigms which may be invoked. In this example the property amending nature of the public trust underpins its likely dominance at the anthropogenic pole of the continuum (solid line), whereas at the ecocentric pole the principles of natural law and rights of nature will predominate — but will still rely on the property accommodating nature of the public trust. In-between these poles will lie various positions dictated by prevailing characteristics of governmentality and ecopolitics. At any one such location the manner in which policy and guidance adheres to any or all of the trust paradigms will determine their intersection with the continuum and maximisation of a provision of ecological sustainability. The size of a paradigm circle reflects its relative weight for a particular instance. Over the whole floats provision for indigenous and cultural rights of first peoples. All of the paradigms are here deemed to reside within the context of the 2022 United Nations declaration of a human right to environmental health (see n806).

What is clear, however, is that the PTD is not immutable.[616] While some environmentalists may view it as a panacea for rectifying environmental ills,[617] its application must operate within legal limitations, juridical reservations, political interference and lax administrative decision making that should operate within an established and tested operationalising framework. While the indicia from two centuries of American application reveal the doctrine to be extremely adaptable to a wide range of natural resource protections (see Annexure 2), its scope is not decreed by legislation, but by rulings and dicta. The public trust is generally regarded in America as a doctrine that is developed by the judiciary.[618] It is a fundamental legal instrument that protects public resources and public welfare,[619], and provides a means to refine and augment existing rules and regulations, policy and to support the custodial role that is environmental administrative decision making. The doctrine provides clear, actionable principles of sovereign fiduciary responsibility, working in tandem with the police-power of the public interest, the latter providing a metric against which compliance with the PTD can be adjudged. However, the PTD remains prone to the influences of political forces and judicial deference.[620] It will be especially vulnerable where it has not been developed by policy, regulation or juridical interpretation — as is the present case in South African water law. Moreover, empirical analyses of the successes of the doctrine are virtually non-existent, meriting careful evaluation of its actual utility in contemporary environmental law regimes which are largely statute-controlled.[621] Simply put, unless the utility of the public trust is explicitly elucidated, it will remain a moribund entity, at best an aspirational principle.

Despite likely interpretive weaknesses, the doctrine clearly embodies enormous potential and scope. Public trust scholars Torres and Bellinger have expansively considered the doctrine to be the 'law's DNA', indeed they express it as 'the slate on which the US Constitution was written', a 'foundation for standards of government conduct', principles which exist in law without having to be 'written down' and a legal tool with which the public, as trust beneficiaries,

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[616] Scanlan MK (2000) 'The evolution of the public trust doctine and the degradation of trust resources: Courts, trustees and political power in Wisconsin'. 27 *Ecological Law Quarterly* 135.
[617] Scott GR (1998) 'The expanding public trust doctrine: A warning to environmentalists and policy makers'. 10 *Fordham Environmental Law Journal* 1-70.
[618] Owen D (2012) The *Mono Lake Case*, the public trust doctrine and the administrative state. 45 *U. Cal. Davis L.R.* 1099.
[619] The US Supreme Court has held that 'the concept of the public welfare is broad and inclusive. The values its represents are spiritual as well as physical, esthetic as well as monetary'. *Berman v Parker* 348 U.S. 26, 33 (1954).
[620] Scott GR (1998) ibid. Three cases that conflict with the proper implementation of the PTD are *Lucas* (see Blumm MC 2016 & *Tulare Lake* and *Casitas* (see also Scott, I, Takacs D & R Bratspies (2019) 'Environmental Law. Disrupted'. 49 *Envtl. L. Rep. News and Analysis* 10038.
[621] Owen D (2013) ibid.

can compel compliance.[622] A former US Secretary for the Interior regarded the doctrine as being '[broad] and of enormous power' for reasserting divested rights in water in the public interest.[623] Mary Wood has doubled down on the opinion of Torres and Bellinger, considering the PTD to be 'the slate on which *all* constitutions are written'.[624] David Takacs, with reference to property issues, considers the PTD to be 'sacrosanct, holding a power beyond modification or revocation by legislative action'.[625] Goswami has expressed the PTD as the *'sine qua non'* of water resource democratisation — ie the observance of a fiduciary legal responsibility which Boudreau, in his analysis of the Law of Nations, regarded as the *'sine qua non* of a state's legitimacy and authority'.[626] These views might arguably be construed to suggest that the PTD is capable of more than it actually is. On the other hand, perhaps the PTD constitutes a preemptory norm. It is, however, clearly and widely regarded as a moral and ethical covenant, written or unwritten, existing between the sovereign state and civil society. Consequentially, the management of essential natural resources such as water, soil and air cannot be free of the principles and protective envelope provided by the PTD.

The importance of the PTD, and its potential for re-framing environmental decision making, lies not in endless recitations of its history, but rather in determining its contemporary applicability and utility, informed by societal needs and demands. This potential is underpinned by the expression of the doctrinal principles. As will become apparent hereunder, the utility of the public trust lies centrally in its ability to render 'public' those areas of private land that occur adjacent to water resources, such lands forming part of the functionally-and ecologically-integrated whole of the water resource.

All of the characteristics and attributes of the public trust set out in the preceding four paragraphs are as applicable to the future of the trust in South Africa as they were for the

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[622] Torres G and N Bellinger (2014) 'The Public Trust: The law's DNA'. *4 Wake Forest J.L & Pol'y* 281.
[623] Babbitt B (1993) 'The public interest in Western Water'. *23 Envtl. L.* 933. Mr Babbitt contemporaneously played a role in facilitating the input of Professor Sax towards the inclusion of the public trust in the South African Water Act.
[624] Wood MC (2014) Nature's Trust. It is not clear whether Wood is referring to the constitutions of the individual US states or to national constitutions everywhere - but the inference drawn that it is to the latter. The Supreme Court of the Phillipines considered the PTD to 'predate all governments and constitutions' *Oposa v Factoran* 223 S.C.R.A. 792 (Phil. S. Ct 1993). In *Robinson Township* (see Table 1) the court regarded the Pennsylvania Constitution as preserving of pre-existing rights to natural resources.
[625] Takacs D (2008) 'The Public Trust Doctrine, environmental human rights, and the future of private property'. *16 N.Y.U. Envtl. L.J.* 711.
[626] Boudreau TE (2012) The modern law of nations: Jus gentium and the role of Roman jurisprudence in shaping the post-World War II international legal order. 20 *DIG.:National Italian American Bar Association Law Journal* at 33.

development of the trust in the USA. The concept of HEC provides just one area of application against which the value of the trust principles may be measured.

The PTD, therefore, imparts a 'transformative effect' over private property rights — an evolutionary characteristic of the doctrine. As will become apparent in Chapter 5, this is exactly what the intentions were behind the inclusion of the trust in the National Water Act — albeit in a different context aimed at removing riparian water rights provided by the erstwhile statute. The doctrine ostensibly offers the same 'protection' to aquatic resources as they transect private property, as they enjoy on public lands and, as centrally maintained herein, provides a means to restrict land use(s) where these may impact negatively on the physical, chemical and/or biological integrity of a water resource.

IV. Summary

The various formats of public trust principles, as outlined above, speak directly to the HEC-identified need to protect all parts of water resource domains which contribute to the functional integrity thereof. The principles may be condensed into a single set, as follows:

a. the nation's people (the trust beneficiaries) have a paramount interest in how the nation's water resources are managed for both their present and future generations (the born and unborn) [access to water now coupled with sustainability and inter-generational equity];
b. the state, as public steward of the resource, shall determine how the resource is managed in the public interest [as *inter alia* set down by the Water Act in respect of basic human needs, pollution control and the assurance of the Ecological Reserve];
c. all of the resource is the property of the nation's people. In this regard the trustee (the state or its provincial or local authority co-trustees) may not:
    i. convey public resources to a private entity;
    ii. issue a legislative grant (eg a licence or permit) the purpose of which is to benefit a private interest — other than
    iii. where limited usufructuary beneficial use or accommodation may be permissible, such licences or permits may not result in avoidable or irreparable

harm to the resource, alternatively in instances where the conveyance is overwhelmingly shown to be in the public interest;[627]

iv. attempt to relinquish its power over a public resource;

v. neglect to supervise, monitor or review any approved use.

Application of these principles should have regard for the conservation and sustainability-orientated principles proposed by Edith Weiss *supra*.

The following fiduciary obligations attach to the public trust principles in that the State bears a duty to:

1. ensure security of water resources, water supplies and infrastructure;
2. conserve and protect water resources consistent with trust purposes;
3. control and manage water for long-term sustainability, for human and biological life generally, watersheds and hydrologic processes, local communities and society in general (with a presumption in favour of public use);
4. give effect to equity in terms of social justice;
5. invest resources in the resource;
6. engage with long-term sustainability planning at a watershed scale.

(a) Tests and checklists

The above listed principles and obligations provide the basis of a public trust 'test' or determination deployed to evaluate an instance where a proposed development or land use has the potential to infringe on a water resource. Other examples of similarly intended tests are available, with two such examples of 'universally-relevant' public trust tests provided hereunder:

(i) Supreme Court of Hawai'i

In *Kauai Springs,*[628] a checklist of principles was formulated with the express purpose of guiding public trust determinations. This set of requirements encapsulates all of the principles set out above:

[627] For example the construction of a dam to provide water for human needs or the construction of flood control works to protect life and property.
[628] 133 *Hawai'i* 141 (2014)

a. The trustee's duty and authority are to (i) maintain the purity and flow of our waters for future generations and (ii) ensure that waters are put to reasonable and beneficial use;
b. A proposed use must be consistent with trust purposes [which are the]:
    i. maintenance of waters in their natural state;
    ii. protection of domestic water use;
    iii. protection of water in accordance with indigenous, traditional and customary rights;
    iv. ...

c. The trustee must apply a presumption in favour of public use, access, enjoyment and resource protection;

d. Proposals should be evaluated on a case-by-case basis and there can be no vested rights in the use of public water;

e. A high level of scrutiny should be applied to any private or commercial applications;

f. Applications should be evaluated under a 'reasonable and beneficial use' standard which examines the application in relation to other public and private uses;

g. Applicants bear the burden of justifying a proposed use, *inter alia* through a demonstration of:

    i. actual needs and the propriety of taking water from a public trust resource;
    ii. the absence of a practicable alternative;
    iii. the absence of harm and that the use is indeed reasonable and beneficial.

(ii) Adaptation of a public trust test for parklands

The example of a test outlined below has been adapted here — from parklands — for use with water resources. This was derived from a substantive test proposed for courts to apply when determining whether a diversion or alienation of a public trust resource, in this instance parklands, violates the trust principles:[629] According to this test, a diversion or alienation would be permissible when:

[629] Williams SM (2002) 'Sustaining urban green spaces: Can public parks be protected under the Public Trust Doctrine'. 10 *S.C. Envtl. L. J.* at 42. The criteria proposed here were adapted from two water resource cases.

1. The water resource is a declared public trust entity;[630]
2. The resource use would be devoted to public use and access, ie beneficial in the public interest;
3. The harm (diminution) should be small ie a usufructuary use which does not impair the resource capital;
4. No other public uses of the resource would be destroyed or impaired;[631]
5. The proposed use is overwhelmingly beneficial to the public interest, ie does not favour a minority interest.

(iii) Modified Cominiti Test

In this matter the court crafted a two-step test for determining whether an alienation of a trust resource has occurred and, if so, what is the extent of the alienation in terms of impact on the trust *res*.[632] This has been modified here as follows to provide what in essence is a structured assessment of regard for the trust principles:

Has an alienation of a trust resource occurred, or is likely to occur? If yes then:

(a) Is the land in question burdened by public trust duties and obligations? If yes then

(b) Does the proposed activity convey all or part of the trust resource [irrevocably] into private ownership? (ie that the conveyance is tantamount to the state relinquishing its trusteeship role over the affected resource). If yes then

b(i) Does the conveyance promote the future interests of the public in the trust resource? and/or

b(ii) Does the conveyance substantially impair the future interests of the public in the trust resource? and/or

b(iii) Does any positive benefit outweigh the negative impact?

Q2: If 1(a) = no then b(i-iii) may still apply in certain non-alienation instances.

[630] All water resources in South Africa reside within the public trust framework.
[631] This requirement is aligned with the proposed framework, ie which considers if an impact at one location in a connected system will impinge negatively on any others.
[632] *Caminiti v Boyle* 107 Wash.2d / 732 P.2d

These examples of tests shepherd the decision maker through a sequence of questions that check for adherence to specific trust principles.

An illustrative example: Protea Village

Mentioned in Chapters 1, 3 & 5 was the *Really Useful* case wherein the infilling of a wetland for the purposes of housing development was robustly opposed by the local authority.[633] This second example provides a juxtaposed example where a state, provincial and local authorities condoned the development of a headwater stream and wetland node purely for private benefit.

This matter is taken from a review appeal against an Environmental Authorisation, and presents an example of where both the public trust principles and HEC ought to have been considered.[634] The matter involves a land restitution claim wherein a community displaced by the apartheid government during the 1960s sought restitution and had their land restored to them. However, to be able to finance their return to the land and its development into housing, the community requested additional land on which they could develop properties for sale or lease and in this fashion generate an income stream. As such the additional land was to be sacrificed to their business model.

The local authority in this instance, the City of Cape Town, acceded to this request by including an adjacent portion of land with the restitution. This particular portion of land, however, was an historical public open space, long developed as an arboretum and on which headwater streams, exiting the world-famous Kirstenbosch Botanical Gardens, confluence. In addition to this confluence node, the property contains two springs and several adjacent wetlands, ie the property exhibits headwaters character in its own right.

As was set out in Chapter 2, headwater streams and their confluence nodes comprise an extremely important component of watersheds. The Protea Village development will permanently transform this property, with a strong likelihood of a significant and negative impact on the downstream river network, almost all of which is already within urban development. As such, any residual ecosystem service subsidies contributed from the confluence node into the downstream environment would either be lost, or at the very least, severely impaired.

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[633] See Chapter 4.
[634] *Friends of the Liesbeek v Minister of Local Government* et al (2022), High Court of South Africa (WC) 4889/22.

By including this particular portion of trust *res* into the land restitution claim, the local authority co-trustee, assisted by the departments condoning the development and issuing the Water Use Licence (state trustees), has abrogated all of the guiding principles of the public trust, *viz* by not considering that the entire resource is the property of the nation's people. In this regard the trustee (the state or its provincial or local authority co-trustees) may not:

i. convey public resources to a private entity;
ii. issue a legislative grant (eg a licence or permit) the purpose of which is to benefit a private interest — other than
iii. where limited usufructuary beneficial use may be permissible, such licences or permits may not result in avoidable or irreparable harm to the resource; or
iv. attempt to relinquish its power over a public resource.

However, in fact, this property has (i) been approved for a private use that is tantamount the property being permanently conveyed to a private interest and (ii) afforded a permit[635] for a water use that is by no means usufructuary and will (iii) permanently and irrevocably alter the site, with (iv) the trusteeship role of the state being relinquished in exchange for the commodification, for private pecuniary gain, of a potentially and hydroecologically-significant water resource node. In short, the trustee appears to have abdicated all its sovereign duty to protect the water resources trust and, by implication, any related duty to trust responsibilities invoked through other legislation.[636]

This particular matter is arguably strongly nuanced by social justice interests. However, it is counter-argued here that social justice restitution should not trump the public trust in water resources — if it does then this sets a very dangerous precedent indeed — somewhat akin to the fallacy that the loss of essential natural resources can be argued away on the basis of economics and job creation. In this instance, by condoning the water resource loss, an historical social injustice has been 'rectified' by allowing what may in the future come to be regarded as an irrevocable environmental injustice. Obvious alternatives were available, for example municipal land elsewhere in the city could have been offered for the income-generating component.

[635] Authorisation 22144074 dd 24 October 2019. Despite the wealth of aquatic ecosystem components present on this site, it was only assessed at General Authorisation and not Water Use Licence level.
[636] For example as may pertain to the protection and conservation of biodiversity.

Both this example and that of *Really Useful* occurred within the same local authority jurisdictional area, but were treated quite differently: In *Really Useful* the authorities acted immediately and vigorously to offset further environmental damage to a wetland and rehabilitate the impact that had taken place. By contrast, in *Protea Village*, the loss of an entire headwater resource node (springs, streams and wetlands) was seemingly of minor consequence to the same local authority. This lack of conformity is problematical from the perspective of establishing a negative precedent.

It is important to consider that this apparent lack of reliance on the public trust was likely to be the outcome of unwitting ignorance. There is no guidance yet available in South Africa that sets out the public trust principles and how they should be used. Insofar as can be determined, this is the first instance wherein the principles have been elucidated. It was apparent in the Protea Village matter, however, from responses prepared by the applicant's environmental law practitioners, that the public trust interests were regarded as being of no consequence.[637] The outcome had the potential to be quite different had there been a requirement to rely on the intentions and principles of the public trust in arriving at the decision to allow the property to be built over.

[637] Response by applicants attorneys to public trust based appeal. Copy on file with author.

CHAPTER 5: THE PTD IN SOUTH AFRICAN WATER LAW

'It is therefore significant that the Government should have come to the conclusion that, as trustee for future generations, it bears the responsibility to ensure, as is the case for water, that the soil is so utilised by the present owners as to be preserved intact for the future'.[638]

This section comprises two parts: Section I reviews the existence of public trust principles in South Africa prior to the promulgation of the NWA. Section II sets out the findings emanating from interviews with members of the water law review strategy team, insofar as their express intentions related to the role of the doctrine were concerned. Additional context is provided from career officials at the state department for water. Prior hereto, first-hand detail of the actual hopes and aspirations for the doctrine have remained elusive and, at best, speculative. A small number of South African scholars have attempted to characterise the trust by simply equating it with the principles embodied in the NWA itself (eg sustainability, precaution).[639] Others have compared it to its German equivalent in order to provide an identity, absent considering its possible prior South African roots.[640] These approaches, while valid, do not present the rich legacy of the public trust, extending over many decades of application, or its transition into a mature format that is aligned with the challenges of contemporary environmental law. The research reported on here searched for the actual intentions of the inclusion of the trust as an element of South Africa's water law reform; evidence of trust language and principles in prior South African water law and policy; as well as elucidating the principles of the trust as determined from the application of the public trust in the USA and elsewhere. As such, while the South African format of the public trust doctrine will assume its own unique character, it has much to gain from consideration of its proven application.

I. The South African public trust pre-1998

As set out in Chapter 4, the historical origins of a doctrine are of minimal import once its application has been established through case law and precedent, or via statutory or

[638] Commission of Enquiry into Water Matters, s5 at 156.
[639] Young CL (2014) Public Trustreeship and Water Management: Developing the South African Concept of Public Trusteeship to Improve Management of Water Resources in the Context of South African Water law. Unpublished PhD thesis, University of Cape Town. See also VD Schyff E (2013) Stewardship doctrines of public trust: Has the eagle of public trust landed on South African soil? 130 *SA Law Journal* 369-389.
[640] Viljoen G (2016) Water as Public Property: A Parallel Evaluation of South African and German Law. Unpublished LLD thesis, North West University. See also: Njotini M (2017) Examining the 'objects of property rights' — lessons from the Roman, Germanic and Dutch legal history. *De Jure* 136-155.

constitutional underpinnings. In South Africa the public trust is now an explicit, legislatively expressed and indeed emancipatory foundation of the NWA — but has yet, despite these strong credentials, to receive any measure of juridicial interpretation and development. In light of this, interpretive guidance on the characteristics of the contemporary doctrinal application may be sought from the jurisprudence of the USA.[641] Additionally, this research analyses the history of the principles of the doctrine associated with the Water Act of 1956,[642] the predecessor to the NWA, as well as with other pre-democratic South African statutes.[643] This history thus complements the geneaological analysis of the origins of the doctrine in South African water law, particularly as it appeared contemporaneously with the development of the modern doctrine by Joseph Sax.

There are several instances that historically situate the doctrine, or a semblance thereof, in South African environmental law. These are not discussed in chronological order.

(a) Policy

The first of these is that the White Paper that preceded the 1998 Act acknowledged the *prior existence* of the PTD in South African water law but only in generalised terms of the Roman law roots generalisation — stating (own emphasis):

> '[t]he idea of the public trust *is not a new one to South African law*. It is based in Roman law from which South African property law descends, where it was generally used to determine rights in rivers, the sea and the seashore.'[644]

(b) Case law

Secondly, there is a single case from the colonial period that declares the seashore to be the responsibility of the state in the national interest — 'No doubt the Government are, in one sense, the custodians of the seashore, but they are such only on behalf of the public'.[645]

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[641] Section 39(1) of the Constitution allows for a court to consider foreign law when interpreting the Bill of Rights. This provision is especially relevant to the PTD given its relative global absence of use outside of the USA.
[642] Act 54 of 1956.
[643] eg Soil Conservation Act 45 of 1946. The Act speaks variously to obligations to conserve soil, water ('stream, river, water course and water course lands') and vegetation ('veld').
[644] NWPWP (1997) Section 5.1.2. Judge Antonie Gildenhuys does not agree with this interpretation in that he maintains that trusteeship — a private law concept — did not form part of Roman or early Roman Dutch law.
[645] *Anderson & Murison v The Colonial Government* (1890-1891) 8 SC 293. This ruling aligns with the traditional interpretation of the PTD.

This aligns generally with the traditional interpretation of the trust responsibilities underpinned by Roman law.[646]

(c) 1970 Commission into Water Matters (1970 Enquiry)

Thirdly, the most overt recognition of a trust obligation, couched in clear public trust language, is tucked away deep in the report of a strategic analysis of water and water use in South Africa. This commission was convened in the mid-1960s, culminating in a report published in 1970. The Terms of Reference for the 1970 Enquiry could, for all intents and purposes, have provided the foundation of South Africa's first national water resource strategy.[647] While it echoed the irrigation-bias of the 1956 Water Act, it also contained an awareness of social inequalities and future needs, and set these out in language that is both comparable with the present Constitution and with the principles of the Saxian trust doctrine. Coincidentally, the enquiry took place in temporally serendipitous parallel with Joseph Sax's formulation of the modern trust doctrine.

Chapter 27 of the 1970 Enquiry, entitled "The Administration of Water Affairs" commences with:

> '[w]ater has certain peculiar characteristics which lend an *overriding national interest to its development and utilisation'*. Because of these characteristics, *private rights to the use of water* can only be recognised to the extent that they are not in conflict with *the overall national interest... ..its interest extends to every aspect of its development, conservation and utilisation'* (emphasis added).[648]

This view, which closely parallels the wording of s3(1) of the NWA, was rendered at a time when South African water law afforded riparian water rights to private landowners. The report further noted that the 1956 Act afforded the State:

> '...the power to intervene at any time and, as the representative of the people, to exercise control over public water' — ie asserting its *dominus fluminus* role. Furthermore, that the 'State has become *legally and morally*

[646] The RCO phrase (see Chapter 4).
[647] *Presidential Commission of Enquiry into South African Water Matters* (1970). Copy on file with author. The purpose of the enquiry was to 'report upon and to submit recommendations on all aspects of water provision and utilisation within the Republic... with special reference to [inter alia]... available and potential water supplies and their systematic development... the future water requirements of the whole country in order to ensure balanced development and growth of the national economy...' and the 'compilation of a broad, long-term national master plan for the coordinated development and conservation of and control over water resources... .'
[648] Commission of Enquiry into Water Matters, s5, at 155. This language is consistent with the 'no substantial impairment' finding in *Illinois Central*.

> *compelled* to plan the development of this national asset with great care and to *distribute water efficiently among all users*' (emphasis added).[649]

The apartheid-dominated circumstances of the period during which the 1970 Enquiry was undertaken render definition of the intended demographic extent of 'all users' debatable but, as suggested by what followed (see below), there was a clear awareness within the state water department — and indeed at government level — of regard for the grossly disparate nature of access to water resources.

The 1970 Enquiry went further to develop the theme of stewardship by drawing in the nuance of 'well-being' alongside the principle of inter-generational equity, as well as an awareness of environmental concerns through observing the need for recreational opportunities:

> 'As the guardian of the *people's health and recreational facilities*, [the State] is interested in the *intangible benefits that accrue from the promotion of water resources*. Finally, as the *custodian of the country's water resources*, it is interested in its conservation and its *unimpaired transmission to future generations* (emphasis added).'[650]

This language, employing the term 'custodian' together with intergenerational equity connotations, speaks equivalently to trust-nuanced principles, as well as to the sovereign obligations of the doctrine.

The 1970 Enquiry then went a profound step further and, in referring to soil conservation,[651] used the term 'trustee for future generations' in relation to inter-generational responsibility, placing it centrally within the realm of the PTD and the environmental right as enshrined in Section 24 of the Constitution.

> '[i]t is therefore significant that the Government should have come to the conclusion that, *as trustee for future generations*, it bears the responsibility to ensure, as is the case for water, that the soil is *so utilised by the present owners as to be preserved intact for the future*' (emphasis added).[652]

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[649] Ibid. s5, at 156. Note that water regulation in the Cape Colony and subsequently in the Free State and Transvaal Republics was *dominus fluminus* between 1661 and 1813, and again from 1956 until 1998 (see Conley 1993 n664).
[650] Ibid. s5, at 155.
[651] Together with water, the Enquiry focussed on the need to conserve and protect South Africa's soil resources.
[652] Commission of Enquiry into Water Matters, s5, at 156. At the time there was a clear overlap between soil conservation concerns and matters pertaining to water. Air, water and soil are generally considered as the natural resource foundations essential for sustaining life.

The language of the 1970 Enquiry is thus semantically public trust doctrinal, *sensu strictu*.[653] It reflects intentions that combined the issue of human welfare (well-being) with parity of access to essential resources (inter-generational equity, water) and, of itself, the statements are probably one of the earliest expressions of these terms rendered at the outset of the modern environmental law era. What is unclear is what is being referred to by the phrase 'that the Government should have come to the conclusion' — this suggests a much wider awareness arising outside of the Enquiry.

The 1970 Enquiry provides no hint as to where this awareness originated from, and none of the authors are still alive. It is, however, deemed likely, that the political pressures arising in South Africa post-1960, for example the Sharpville Massacre[654] and the economic sanctions that followed, and/or the devastating 1966 drought[655] had brought the government to the realisation that socio-economic and redistributive justice changes were necessary[656]. Moreover, if the economy was to grow and offset external sanctions, then redistribution and/or reallocation of water to a greater proportion of the population was essential. However, at the time, the political sway of the Conservative Party, particular in the agricultural domain, was allegedly such that the 1970 Enquiry report was regarded as a 'political hot potato'[657] and was rendered to Cinderella status, hidden but not forgotten, and only receiving of its due acknowledgement and existence value twenty-eight years later (discussed hereunder).

In summary, the findings of the 1970 Enquiry appear to confirm that public trust principles and awareness were already entrenched amongst South African strategic water policy experts, more than three decades prior to it being overtly stated in contemporary legislation — a fact that, as will be shown below, did not go unacknowledged in the formulation of the NWA.[658] Furthermore, the 1970 Enquiry's recommendations on nature conservation and

[653] See Chapter 2.
[654] Opinion (anonymous respondent)
[655] Opinion of Conley (see Table 1.1).
[656] Anonymous respondent
[657] Anonymous (ibid).
[658] Various examinations of the origin of the Public Trust Doctrine in South African water law allocate its genesis to the period during which the extant Water Act was being planned and drafted (e.g. Van der Schyff 2010; Stein R (2004) n90. Mention of the doctrine in a document that originated in 1966 (the Commission of Enquiry into Water Matters) suggests a much older awareness contemporary with the work of Joseph Sax that led to his 1970 publication. See also: Stein R (2000) South Africa's new democratic water legislation: National government's role as public trustee in dam building and management activities. *18 J. Energy and Nat. Resources L.* 284.

recreation indicated both an ecological awareness and a marked swing towards an awareness of the environmental and social concerns that pervaded the 1970s.[659]

In addition to the above there were two other instances of a prior awareness regarding the inappropriateness of riparian rights to water.

(d) The 1898 Hall Report[660]

In 1898 the Cape Government commissioned the services of the reknowned American hydraulic engineer, William Hammond (Ham) Hall. Hall was an expert on water resource regulations in arid climates, notably western Europe and the western United States. Hall did not mince words in stating that water was an 'essential element of life', to be used in the 'public interest' and for the common good of all.[661] Hall was also critical of attempts to regulate the water needs of an arid country with laws developed in countries where water was plentiful — and that rights to water should be determined by 'the necessity of the many, even though opposed by the desires of the few.'[662] Hall advocated strongly against any form of riparianism in a country where irrigation was the dominant need,[663] and was in favour of central control underpinned by custodial obligations. Hall regarded water resources as 'indivisible' and the 'property of everyone in common' — ie suggestive of advocation of a government trusteeship obligation. There appears to have been an intention for Hall's views to be incorporated into the first Cape Water Act — but this was not to be and the British-influenced riparian regulatory approach remained entrenched.[664]

Interestingly, Hall opined that the water law of a country such as Italy would have been infinitely better suited to South African conditions — noting that Italy had by 1865 declared water resources to be the 'property of the Government as [representing] the people of the nation'.[665]

Hall's reference to Italy is of particular significance in that the changing face of water law in 'the home of Roman law' caught the attention of the Director of the [South African]

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[659] Enquiry into Water Matters, Recommendations 6(iv & v) at 17.
[660] Hall WH (1898) Report On Irrigation Legislation and Enterprise as Applicable to the Cape Colony. [G.45-'98]. 69 pp.
[661] Hall WH (1898) Ibid at 1.
[662] Ibid at 2.
[663] Citing *Stowell v Johnston* 7 Utah 215, 26 P. 290 (1891) that the 'appropriation of water.. for irrigation.. is entirely and unavoidably in conflict with the common law doctrine of riparian ownership.'
[664] Cape Water Act 40 of 1899
[665] Hall WH (1898) at 48.

Irrigation Department,[666] Dr AD Lewis, in the mid-1920s. [667] So much so that Lewis first learnt Italian and then visited Italy to make an in-depth study of their approaches to water regulation[668]. He discovered that the common law rights to water no longer existed, long since replaced by 'a foundation of public interest and the general welfare of the community.' Water use rights were, by the time of his visit in 1927, allocated by permit solely determined according to practical and impartial considerations of time and necessity, with oversight from a Water Tribunal. Here was evidence of a custodial, nation-directed approach to regulation that pre-dated the 1970 Commission into Water Matters by half a century. By 1995 Italian water law was positioned on a nexus of safeguarding future generations by ensuring an intact environmental heritage in which all waters are regarded as public with the state as custodian.[669]

In summary, an awareness of the need for custodial and fiduciary responsibility for South African water resources has clearly been present for a very long time, yet did not manifest into law. Moreover, as revealed by the 1970 Enquiry, the trusteeship protection of water resources was contemporaneously defined and juxtaposed with the principles of inter-generational equity, recreational needs, sustainable use and the nuance of human well-being — as it was subsequently expressed in the NWA.

Apart from the 1970 Enquiry, other earlier statutes also refer to a custodial responsibility for essential resources. Reference is made to the 'custodianship' of soil in South Africa in the 1946 Soil Conservation Act.[670] The importance of soil conservation in relation to water was also included in the 'trustee for future generations' statement in the 1970 Enquiry (above). The Sea-shore Act (21 of 1935) declared the Governor-General to be the 'owner of the sea-shore' (being at the time the area between the low and high water marks) and that the sea-shore was 'not capable of being alienated'[671] other than for the purposes of scheduled permitted uses and subject to regulations (Section 10). These reflect a trusteeship-awareness extending much wider than just within the department responsible for the nation's water resources. What is significant is that this advanced thinking did not translate via the Hall

[666] Predecessor to the Department of Water Affairs.
[667] Lewis AD (1928) cited in Conley AH (1993) 'South Africa's water management: burning questions and key trends'. 13 *Water Sewage and Effluent*. at 42.
[668] Report of the Director of Irrigation for the Period April 1927 to March 1928. Union of South Africa [U.G. 8-'29]. Preliminary Report on Irrigation in Italy. Appendix A. Section 11: Water Law.
[669] Boscolo E (2021) Water Resources Management in Italy: Institutions, Laws and Approaches. Chapter 5 in *Water Law, Policy and Economics in Italy*. Springer.
[670] Act 45 of 1946. Sections 26 & 27 speak to the conservation of soil in the national interest.
[671] Act 21 of 1935. Section 2(1&2).

Commission[672] into the 1956 Water Act, a statute which entrenched preferential riparian rights within a re-introduced yet apartheid-skewed *dominus fluminus* regime. Similarly, none of the custodial thinking found its way into what may be described as the second version of a water resource strategy for South Africa.[673]

II. Genealogy of the public trust in the South African water law review process

Between 1994 and 1996, the years which encompassed the bulk of law reform thinking, attention and effort was initially focused on the drafting of the South African Constitution. Once that process was complete, the need to review the inadequacies of the 1956 Water Act, coupled with the need to align the water law with the Bill of Rights, commenced in earnest. The 1998 NWA overtly mentions the public trust in its Chapter 1 (Fundamental Principles) and also immediately following the purpose of the Act.[674] There is, however, no definition of the term and no guidance was provided, or has since emerged, to direct its substantive or procedural application as envisaged by the drafters. This thesis endeavours to alleviate this obscurity.

(a) The water law review process

The review commenced in earnest in 1996 following publication of the Constitution. In June of the same year, team members[675] Gildenhuys,[676] (Ronald) Roberts and Garlipp went on a fact-finding visit to the USA. During this visit Roberts identified the PTD as being of potential value, a view that was not shared by his travel companions or later by Muller (see hereunder).[677] In September 1996 Klug, a Wisconsin University constitutional law scholar who was familiar with the work of Sax and the PTD, prepared a position paper[678] which, *inter alia*, comprehensively outlined the role the doctrine could play and discounted the fears surrounding expropriation and compensation. Just three weeks later, Asmal used this material to expound on the constitutional imperatives underpinning the need for a public trust approach in the new

[672] Report of the Commission of Enquiry Concerning the Water Laws of the Union (1959) (Hall CG et al., Commissioners) Government Printer, Pretoria. 128 pp.
[673] Management of the Water Resources of the Republic of South Africa (1986) Department of Water Affairs. Pretoria.
[674] NWA Section 2.
[675] See Table 1 in Chapter 1.
[676] Chairperson of the drafting team (see Table 1.1)
[677] Gildenhuys.
[678] Klug H (1996) 'Water Law and the Constitution'. Unpublished paper dd 23 September 1996 (15 pages).

water law.[679] It is unclear whether Asmal was aware of the public trust prior to his appointment as Minister but his constitutional law background suggests that he might well have been.[680]

(b) The role of Joseph Sax

At a consultative workshop in June 1997 Asmal introduced Sax as a 'very special guest... a leader in the field of natural resources and water law'.[681] Asmal referred to 'issues which are innovative in the South African context, such as the role of government as custodian of the nation's water resources, ... in the public interest... and to protect as a public trust'.[682]

Sax made two visits to South Africa (see Figure 5.1), the first to the aforementioned workshop, and the second to address an International Bar Association symposium on energy and natural resources law in Cape Town during March 1998.[683] His 1997 visit included two

[679] In his address to the Consultative Conference on the SA Water Law Review (17/18 October 1996), Asmal drew specific attention to the fact that s24 of the Bill of Rights "imposes on government, in effect, a constitutional obligation to act as a trustee, in the public interest, of water resources".
[680] MacKay opines that what Asmal required was the technical background and language necessary to apply the trust to water allocation and water resource management.
[681] n634 ibid at 1.
[682] n634 ibid at 4. These statements by Asmal reflect the content of Principle 13 of the National Water Policy White paper. This principle also bundles together custodianship, public interest and the public trust, rendering custodianship and the public trust essentially synonomous.
[683] The 1998 IBA meeting included a special session entitled "The New South African Water Law and its International Context" - at which papers were delivered by Asmal, Stein, Roberts R and Sax.

days in Cape Town during which he met with UCT academics Jan Glazewski and Francois du Bois (see Figure 5.1)[684] who, at the time, were involved with providing input to the National Environmental Management Act (NEMA)[685] and also to coastal management legislation.[686] Sax continued engaging with the review strategy team until at least March of 1998,[687] just a few months ahead of the NWA being assented to on 20 August 1998.[688]

Figure 5.1: Professors Joseph Sax (c), Francois du Bois (l) and Jan Glazewski (r) at Cape Point, South Africa, June 1997 (Source: Sax papers).

Although various records located in Sax's papers[689] indicated the scope of his discussions with the review team, regrettably the texts of both his 1997 and 1998 speeches could not be located. It has, therefore, not been possible to ascertain how Sax regarded the operationalisation of the public trust in relation to the specific South African law review needs. What is clear is that his first visit to South Africa in 1997 resulted in significant impetus for the trust to be incorporated into the NWA.[690] His notes also reflected that the application of the trust in South Africa would need to be quite different to that practiced in the USA.

(c) The intentions for the inclusion of the trust doctrine in the NWA

Two clear opinions are evident from the interview responses conducted during this research programme. First, that the public trust, as a constitutional doctrine, gave the Government complete allocative control of water resources.[691] The trust further provided an ideal instrument whereby the reformed water law would provide legislation enabling of key constitutional and policy objectives for the progressive realisation of the Bill of Rights.[692] Secondly, the public trust is a legal concept, encompassing stewardship, legal accountability and intergenerational equity, which dovetails closely with the constitutional imperatives in the Bill of Rights (rights to dignity, life, environment, property and socio-economic needs).[693] For this to have maximal effect and clarity of meaning, the doctrine needed to be explicitly framed as it was in Section

[684] Glazewski and du Bois were introduced to Sax by Asmal (Glazewski interview).
[685] Act 107 of 1998.
[686] Sax Papers, Bentley Reference Library, University of Michigan.
[687] Fax request (31 March 1998) from Stein to Sax requesting a copy of the (Sax) paper 'The elements of private rights in public water'. Source: Bentley Reference Library, Michigan, USA.
[688] Sax papers (ibid).
[689] Bentley Library, University of Michigan.
[690] Glazewski interview.
[691] Kavin interview.
[692] Klug, Roberts R & Stein interviews.
[693] Roberts R, Stein & Klug interviews.

3 of the NWA.[694] This was not a simple transplant of the American trust doctrine — it was made in a statutory context which, at a base level, would preclude any ruling in favour of private rights to water.[695] The South African application was intended to be transformative of the erstwhile law in order to dispel any notions of private ownership.[696] Centrally, it was to enable the emancipatory, non-compensable re-allocation of water to those previously denied this basic right while, at the same time, making possible the provision of water for *in extremis* basic human needs, as well as for environmental protection by means of the Reserve.[697] Importantly, the right to water as property was not adjudicated to any significant extent under the previous 1956 Act, hence rendering any perceived rights as 'assumed' and therefore capable of reallocation.[698]

It was apparent that the doctrinal principles as outlined earlier are implicitly enshrined in certain of the water law principles — but that no objective process of including them in the Act's wording was undertaken (see Table 5.2).[699] Generally, most of the respondents understood that the intentions were, in addition to the rather obvious issue of riparian ownership of water rights, to underpin an ecologically-based, aquatic ecosystems-directed approach based on the interconnected nature of the water cycle, ie to offset obstacles to the environmental protection of water resources.[700] Table 5.1 provides a side-by-side comparison of those principles contained in the NWA with the equivalent public trust principle.

The interviews revealed a minority contrasting view: Here the express inclusion of the public trust in the NWA was considered to have no substantive relevance, value or purpose in the NWA[701] and was, in fact, regarded as already provided for by the constitutional environmental rights clause.[702] Moreover, there was a belief that inclusion of the trust doctrine would trigger the need for the state to pay compensation, and that it emanated from a legal regime of no relevance to or with legal foundation in South Africa.[703] Furthermore, that the doctrine was never intended to have a specific impact, rather that it was a generic way of

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[694] Ibid.
[695] Klug interview.
[696] Roberts R interviews.
[697] Many years earlier Sax had foreseen new emerging demands that would require changes in water policy. See Chapter 2 s2.3.2.
[698] Klug interview.
[699] Klug, Stein, MacKay, Palmer, Roberts R interviews.
[700] Roberts R, Stein, Kavin, Palmer, Rowlston and Schreiner interviews.
[701] Gildenhuys interview.
[702] Muller interview.
[703] Muller & Gildenhuys interviews. This view appears to be have been anchored in ignorance of the trust principles which, by the time and as set out infra, clearly evoked the contrary.

addressing the public interest in the environmental domain.[704] The public interest and public trust principles may be closely construed — which is indeed true — but only so if the public interest is considered through a future view lens of ecological sustainability. The arguably correct equivalence of the public interest and the public trust was put forward as providing of a constitutional justification for the public interest acting in place of a separate expression of the public trust.[705] An opinion was expressed that the public trust was 'an unnecessary and unwelcome implant of a hitherto unknown doctrine' — a view that contrasts with the earlier awareness outlined above.[706] These views have merit as the basis for an investigative discourse around the conflation of public interest and public trust principles. This analysis believes that it would be a mistake to place too much reliance on the public interest and that the specific principles of the public trust need to be drawn into clear focus.

Grounds for these opinions rest partly and not unreasonably on the fact that the public trust was not defined in the NWA and that it has not been mentioned anywhere, then or since, outside of the Act's brief Section 3.[707] Furthermore, the inclusion of the trust obligation was certainly not based on a prior objective analysis of trust principles.[708] It was alleged that the inclusion of the trust was solely due to the 'political grandstanding' whims of Minister Asmal, ie that the PTD was included simply because Asmal wanted it so.[709] Despite the holding that 'many' of the drafting team held this view, based upon the responses received, and following subsequent specific enquiry, it was clear that this was unlikely to have been the case.[710]

[704] Muller interview.
[705] Love interview. Chapter 6 addresses why sole reliance on the public interest, which is contingent on the public interest as expressed at a particular point in time, fails to address futurity issues which are provided for the public trust.
[706] Gildenhuys interview.
[707] A conclusion drawn here is that the public trust entered the law reform process late in the day and there was no opportunity to expand on its utility in any forum. Equally, the fact that the law reform team disbanded after the Acts' promulgation and Minister Asmal was appointed as Minister of Education precluded opportunities to further develop the public trust intentions post-1998 (Stein).
[708] Roberts R interview.
[709] Gildenhuys interview. This view, ie that Asmal possessed the agency to override the committee, could not be substantiated from followup enquiries to other team members.
[710] Gildenhuys interview.

Table 5.1: Comparative alignment of NWA and PTD principles

NWA Principle	Enfolding Public Trust Principle
Principle 1: The water law shall be consistent with the Constitution in all matters including the determination of the public interest. Principle 9: ... so that human use of water does not compromise the long-term sustainability of aquatic and associated ecosystems.	People have paramount interest in how water is managed for present and future generations.
Principle 2: All water, wherever it occurs in the water cycle, is a resource common to all. Principle 12: The national government is the custodian of the Nation's water resources. Principle 13: As custodian of the Nation's water resources, the National Government shall... using the criteria of public interest...[reflecting its public trust obligations]...	State will manage the resource in the public interest.
Principle 2: All water, wherever it occurs in the water cycle, is a resource common to all. Principle 3: There shall be no ownership of water, only an authorisation for use. Principle 4: The location of the water resource in relation to land shall not in itself confer preferential rights to usage.	All of the resource is the property of the people.

The question as to whether or not the environmental rights section of the Constitution rendered s3 of the NWA redundant has some validity — not least because it begs the question as to the reasons for its overt expression in the water statute. Glazewski opines that while s24 of the Constitution reflects an implicit Roman Law notion of *res publicae*, it does not imply inclusion of the public trust per se.[711] The interviews further revealed an opinion, also with some justification, that s3 of the NWA would have had the same meaning had the words 'public

[711] Glazewski makes the point that the public trust may have been incorrectly compared with the doctrine of *res publicae*, as opposed to *res omnium communes*. He further maintains that the public trust clause in the NWA should have been drafted in *res publicae* terms.

trustee' in s3(1) been omitted.[712] However, as pointed out by Klug, there was a need for the water law to heed s25(8) of the Constitution.[713] Accordingly the team had considered it vitally important to create a constitutionally-underpinned and statutory mandate for the regulation of water.[714]

Moreover, a contrary view was expressed that, for the public trust to be effective, it was better that it be expressed explicitly, ie not to have to rely on s24 for interpretive protection.[715] Accordingly, something being merely implicitly enshrined in the Constitution was not specific enough for Asmal and his desire for the role of the trust doctrine to be clear and unambiguous in the statute.[716] Furthermore, Asmal was made aware by the technical advisors that water 'came packaged in ecosystems' and that the success or failure of water resource governance — and all the socio-economic reliance thereon — in South Africa was dependent on how well these ecosystems were managed.[717] Asmal maintained that the doctrine 'must become a governing idea in all of our thinking about the new regulatory regime — to be 'woven' throughout the NWA[718] and that '[i]t's logic must all pervading'.[719] This language suggests that it is unlikely that implicit reliance on s24 of the Constitution would have met with Asmal's aspirations.[720] Lastly, that he was unlikely to have been reliant on leaving the interpretation of the public trust intentions simply to chance.[721] Given all of the above, it is thus very surprising that development of the trust principles did not receive any further attention after 1998.

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[712] Muller interview.
[713] Section 25(8) reads: 'No provision of this section may impede the state from taking legislative or other measures to achieve land, water and related reform, in order to redress the results of past racial discrimination...'.
[714] Roberts R interview.
[715] Roberts R interview.
[716] Stein, Rowlston interviews.
[717] MacKay interview.
[718] MacKay interview.
[719] Memorandum from Asmal to Muller 9 October 1996. At page 10. This was in response to a memo dd 29 September 1996 from Muller in which he appears to have informed Asmal that he, Gildenhuys and Garlipp were not in favour of the PTD being included and that it would attract compensation obligations (see memo from Roberts R to Heard, dd 11 October 1996 in which Roberts sets out that the doctrine 'as relevant to South Africa, is essentially a constitutional one' and that '[the doctrine], [*m]ore than any other available legal concept... [suggests] that the government has wide scope to reshape water rights <u>without</u> payment of compensation'* (Memo pts 2 & 3) (own emphasis). The Roberts' memo further states the opinion that Gildenhuys had 'adopted an uncritical and expansive pro-property position, with which our American hosts differed... and has interpreted the doctrine in a way that would impose compensation obligations...' (memo pt 5). Asmal's response to Muller on 9 October appeared to terminate any further opposition to the inclusion of the doctrine.
[720] Stein, Roberts R interviews.
[721] MacKay interview.

Delivering the distinguished Abel Wolman Lecture in Washington DC in May 1998, Asmal provided clear insight as to what his aspirations for the NWA were, as well as that he had by this stage become aware of a prior trust awareness in his department:

> '[I]t is South Africa's intention to *revive* the lost role of government as *public trustee* of South Africa's water resources... a concept that acknowledges that water is an inherently public resource and it acknowledges the needs of the environment; [r]evival of the public trust is linked to the more general constitutional goals of water law reform... *water law reform is an integral part of vindicating our Constitution*; The Bill of Rights confers the right to a healthy environment for the benefit of present and future generations. *This is the context within which we have embarked on water law reform*; The inclusion of the trust doctrine... is a modest kind of legal renewal, *a rebirth and expansion of longstanding principles that were ignored in the previous political system,* to the detriment of people and the environment alike.'[722] (own emphasis).

(d) 'Prince Asmal and Cinderella's glass slipper'

There is strong semantic alignment between the public trust language used in the 1970 Enquiry, and the intended instrumentality of the trust doctrine as embedded in the 1998 NWA. Additionally, recommendations for and awareness of central custodial regulation of water resources were documented from as early as 1898. Arguably, had the political environment of the 1970s been conducive, the advent of a revised 1956 Water Act, inclusive of the sentiments expressed in the Enquiry's Chapter 27, might have emerged many years earlier. However, while this awareness was clearly present by 1970, it was ostensibly unacceptable to a political regime that was yet to admit to the iniquities and inequities of the prevailing apartheid era land and water legislation.[723] As such the public trust Cinderella was relegated to languish in the basement and perhaps be discovered another day.

While the report of 1970 Enquiry is listed in an incomplete compendium of the water law review documents,[724] none of its content appears to have been identified during the law reform process — in fact Roberts R, the deemed co-progenitor, along with Asmal and Klug, of the PTD in the NWA, observed that 'he wished the team had unearthed this very pertinent information at the time'. However, as he also correctly noted, both the aspirations of the

[722] Asmal K (1988) 'Water, Life and Justice: A Late 20th Century Reflection From the South'. Presented to the National Academy of Sciences, Washington DC. 21 May 1998.
[723] Anonymous respondent.
[724] From the interview process it became apparent that several key documents were not included in the WRC Compendium. Additionally, key speeches such as those made by Sax in 1997 and 1998 were not captured.

Enquiry and that of the NWA remain absent of judicial interpretation, returning to the point that the history of the doctrine is insignificant when measured against its proven application and judicial development.[725]

At the final step in the law reform process, Minister Asmal, when announcing the completion of the review to the National Assembly[726] and the National Council of Provinces[727] in June and July of 1998, respectively, allowed the public trust Cinderella to finally emerge. In his speeches he graciously acknowledged that '*all of the proposals'* included in the new law *'were first made as long ago as 1970*, by a government-appointed commission of its best and brightest water managers... a chink of light on a dark landscape' (own emphasis). He alluded to the recommendations arising from the 1970 Enquiry that were put to the then-Minister of Water Affairs and Forestry as early as 1986 — but which were rejected out of apparent fear for the political consequences.[728] He pointed out that the public trust *protects both people and the environment*, and that the *withdrawal of a water allocation under the new law was not tantamount to an expropriation* (own emphasis). Furthermore, that sections 25(2) and (3) of the Constitution (the property clause which balances the public interest and those who might suffer a depravation of water use) did not apply, ie that a limitation on a water use made in the public interest was not an expropriative action. Throughout the whole review process this is the clearest enunciation of the intentions behind a public trust in water.

It is not clear when Minister Asmal became aware of the 1970 Enquiry and the content of its Chapter 27. In his earlier speeches he only made reference to the public trust as 'running throughout the entire body of legislation'.[729] It thus appears that Asmal may have become aware of its existence somewhere between February and June 1998. Its' prior existence was not, however, apparent to the review team — as admitted to by Roberts. It was, however, known to the department strategic planners of the time who, insofar as can be determined, were not consulted on matters pertaining to the review.[730]

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[725] See Chapter 4.
[726] Speech to the National Assembly by Prof Kader Asmal (second reading of the National Water Bill) 9 June 1998.
[727] Speech by the Minister of Water Affairs and Forestry to the National Council of Provinces. 23 July 1998.
[728] This was at a time when the Planning Services Directorate of the DWAF was already wholeheartedly embracing the need for environmental considerations in their engineering projects. eg Roberts CPR (1984) 'Engineering and the Environment: Conflict or Co-operations' Presentation to the South African Institute of Civil Engineers, Pietermaritzburg, 31 August 1984.
[729] Opening remarks by Prof Kader Asmal at the presentation of the National Water Bill to the Portfolio Committee for Agriculture, Water Affairs and Forestry (9 February 1998).
[730] Rowlston interview.

(e) Why was the doctrine not developed post-1998?

The role of the South African Department of Water and Sanitation is clearly enunciated in two concise paragraphs on their website, the first of which is relevant to this analysis:[731]

> 'The Department of Water and Sanitation is the *custodian* of South Africa's water resources. It is *primarily responsible for the formulation and implementation of policy governing this sector.* It also has an overriding responsibility for water services provided by local government.' (own emphasis).

Development of the utility and operationalisation of the public trust has not yet been undertaken by those tasked with developing the scope of South African water law post-1998. A WWF/CSIR review compiled just five years after the Act's promulgation stressed that the full value of the innovations inbuilt to the NWA were, from the outset, *reliant on the development and implementation of good governance systems to capacitate the use of the tools* provided in the policy and statute (own emphasis). Furthermore, that holding the trustee, the South African government, to its trust obligations was *'the responsibility of society... acting in a watchdog role'* (own emphasis).[732] Moreover, the review contrastingly sounded a warning that South African civil society was ill-equipped to surveil matters pertaining to water, and that this placed it at the risk of its interests in water being harmed by other sectors such as industry or agriculture. So, just as the trustee should develop the public trust tool, so too should it inform civil society as to the scope and role of, and intentions for, the public trust. This enabling of the public to act in a co-trustee role has yet to happen but is centrally important.

Minister Asmal had the following to say about the challenges he regarded as facing the operationalisation of the public trust (own emphasis):

> '.. *developing the government's role* as public trustee of water is not an overnight achievement, nor can it ever be said... to be a finished accomplishment. Rather, *government must wake every day determined to ensure that the public trust is maintained*; ... the trust is the legal concept through which a system of water law *commits itself to evolve with changes in the water economy and the evolving needs of society*'.[733]

[731] https://bit.ly/3PuwsYu. Accessed on 16 July 2022.
[732] *Towards a Just South Africa: The Political Economy of Natural Resource Wealth* (2003) (Reed D and M de Wit, Eds). WWF Macroeconomics Program Office (Washington), CSIR-Environmentek (Pretoria).
[733] Wolman Lecture 1998 (n719).

To all intents and purposes Asmal's important public trust legacy has received short shrift — not only with respect to the NWA, but in relation to other subordinate environmental statutes into which the same doctrine was subsequently inserted.[734] None of the latter have the trust as a legislatively expressed empowering provision, merely as a guiding principle — although, as observed by the Supreme Court in the *Harmony* matter[735], '[these principles] are of considerable importance to the protection and management of the environment', ie that express regard should be afforded to them. A significant question remaining is why was the concept of a water resources trust not further developed through guidance and regulations, ie via the mandate to progressively develop the trust water law, which could have provided the trust with a definition, a set of principles and an outline of its intended scope? Very few opinions on this aspect were expressed in the interview responses. Those proffered indicated the exigencies of more pressing political challenges that pertained post-1998. While the bogeyman of challenges to water rights expropriations never emerged in opposition to the dissolution of riparian water rights after 1998, present-day threats and obstacles to environmental protection remain at the forefront of water resource challenges. The land use impact of fragmented HEC is but one of these. Pollution, for example, remains a paramount disconnective force, with wastewater treatment works in a critically dire state.[736]

The interviews referred to the public trust as becoming the 'beating heart'[737] of the NWA — yet no efforts were made to heed Minister Asmal's wishes and 'restore and unambiguously recognize' its values. The reasonable expectation would be that once the NWA had been promulgated, successive Minister(s) would then proceed to initiate and progressively craft the policy and regulations necessary to give public trust-based effect to the measures and provisions embodied in the statute. Minister Asmal spent only one five-year term of office as Minister of Water Affairs, before being moved to the Department of Education. The interviews revealed that had he stayed in the water department, he would likely have insisted on the further development of the public trust.[738] An opinion was proffered that the shift towards a cost-recovery water management perspective which occurred soon after 1998 — allied to the

[734] This thesis maintains that the inclusion of the PTD in the NEMA and various SEMAs was a simple cloning absent any detailed examination of the role that the PTD could play.
[735] See text associated with n752.
[736] Green Drop National Report 2022. Department of Water and Sanitation.
[737] Stein interview.
[738] Stein interview.

adoption of the GEAR policy[739] — diluted the scope for attention to the public trust. Further was observed that the overriding legal interests (at the time of promulgation) were towards issues of compensation and were 'dismissive of science-related involvement'.[740]

From the interview process arose the observation that the public trust is an untested doctrine in South African law and remains to be developed through caselaw and/or administrative application.[741]

IV. The public trust in South African case law

There are four examples where the protective mantle of the public trust has been raised as a bulwark against the exploitation of South African natural resources. While they each had the potential to anchor the role of the public trust in local environmental law, none did. A fourth example illustrates a missed opportunity whereby HEC and the public trust could have been conjoined.

(a) Can water be stolen? Mostert v The State[742]

A little-known case had the potential to distinguish between RCO and *res publicae* and also anchor the role of the public trust in South Africa. The matter involved, *inter alia*, a charge of theft of water by means of falsifying abstraction records. Despite the State having argued that the NWA had demonstrably altered the nature of water rights, the Supreme Court expressed the view that as water was RCO it could not be stolen. This was patently incorrect but remains as *obiter dictum* which could have persuasive force in the lower courts. As this chapter has explained, *res omnium communes* refers to natural resources available in such prolific quantity that regulation is not required. Demands on finite water resource have, however, rendered such a view obsolete. The contemporary PTD, as installed in the NWA, positions water resources as a regulated 'common pool resource'[743] with the State as custodian, ie expressing water

[739] Growth, Employment and Redistribution Policy. A five-year investment-dependent macroeconomic policy which, for a variety of homegrown and international fiscal constraints, has largely failed to deliver its promised outcomes.
[740] Klug, Palmer. This attitude is a classic failing of the interface between law and science eg Jasanoff S, (1990). *The Fifth Branch: Science Advisors as Policymakers*. Harvard University Press, Cambridge.
[741] Gildenhuys interview.
[742] *Mostert v The State* (338/2009) [2009] ZASCA 171 (1 December 2009)
[743] Common pool resources are those from which it is difficult to exclude users while, at the same time, especially prone to pollution. Sagarin RD & M Turnipseed (2012) n502.

resources as *res publicae*.[744] Seen in this context, theft of water from a public trust, ie from the nation, is indeed possible.[745]

It is evident from the Heads of Argument[746] in this matter that the prosecutor attempted to convince the court that the RCO view no longer applied under the NWA and that water had been placed in a trust to strictly steward, authorise and police its use, ie the State's role as sole allocative authority.[747] Had this view prevailed it might have significantly cemented the role of the PTD in South African water law by dispelling any notions of ownership, other than that of the state trustee acting in a custodial role for the benefit of present and future citizens.[748]

Examination of the historical evolution of the principles underpinning South African water law reveals that State control (*dominus fluminus*) both ante- and post-dated the period of riparian rights under British colonial rule (1813-1956).[749] While the notion of *res publicae* was clearly recognised as a custodial duty under both modalities, it was corrupted in favour of the white minority through its étatisation — such that the true *res publicae* trusteeship role of the State was progressively obscured in favour of State 'owned' property.[750] Section 3 of the NWA revoked this apartheid era injustice. As such the decision in *Mostert* was incorrect and a setback for the operationalisation of the public trust in water that has yet to be rectified.

(b) Can marine resources be stolen in territorial waters? USA v Bengis

The second case involved the illegal poaching and sale of rock lobster from South African territorial waters[751]. An expert opinion drafted by South African environmental law academic Jan Glazewski maintained that South Africa was the custodian of the nation's fish resources in

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[744] Two distinct versions of *res publicae* exist: Property owned by the state and the second owned by society at large, for societal benefit and independent of any government interests. Public property in a non-technical sense (eg government buildings) is not synonomous with res publicae where the latter means property of the people of the State. See *Vd Walt v Rex* 1938 GWLD 52.
[745] See concurring opinion of Van der Schyff E and T vd Walt (2012) 'Is water flowing in a public river of stream 'a thing capable of being stolen?' 2 *SACJ* at 302.
[746] Saak tussen *Mostert en Die Staat*. Respondent se Betoogshoode TPA A774/07 at 21 (copy on file with author).
[747] The prosecutor subsequently confirmed that this was indeed his intention. Email from Advocate L Kok dd 7 March 2022, copy on file with author.
[748] Glazewski has opined that Section 3 of the NWA could have been better expressed in a *res publicae* context. Email dd 15 November 2021, copy on file with author.
[749] eg Forster SF et al (1990) Proposal for the Revision of South African Water Law. Department of Water Affairs: Strategic Planning.
[750] Van Der Vyver JD (1989) The Étatisation of Public Property. In: *Essays on the History of Law* (Visser DB ed.) Juta, Cape Town. At 261, 286 & 299. The author refers to the South African 'disfiguration of the common-law notion of *res publicae'.* At 275.
[751] *United States v Bengis* (2013)

terms of the 'public trust doctrine'.[752] While this is an undoubtedly correct opinion, it curiously relied on the Water Services Act (WSA),[753] which is silent on the public trust, rather than on the Water Act in which the public trust is legislatively expressed. Quite apart from extending the PTD in freshwater to the marine environment, it is unclear why the WSA was relied on as this Act does not mention the public trust other than via the NWPWP. This notwithstanding, the opinion was accepted by the US court. The ruling also suggested that the public trust was knocking on the door of international environmental law.

(c) Is a limitation on development expropriative and compensable? Really Useful

In a third case, a developer who infilled a wetland in order to build houses sought compensation for what the developer determined to be lost opportunity costs for the units they were no longer able to bring to market. A High Court opinion acknowledged the NEMA public trust principle but still awarded compensation.[754] On review by the Supreme Court, absent any reliance on the public trust, it was held that the grounds relied on for the compensation were incorrectly interpreted and the claim was denied.[755] This case, akin to the subject matter of *Rapanos*, was a missed opportunity for the state defendants to argue the public trust as grounds for water resource protection —as the developer never had a right to build in a wetland in the first place — ie that a claim for loss of deemed 'developable value' has no merit — as the owner suffered no loss of the land, rather that a protective limitation for the wetland portion was applicable.

In hindsight, all three of these cases tentatively reveal the presence of the public trust in South African freshwater and marine resources, yet none of them has been subsequently used to further expand the operationalisation of the trust. This has been a missed opportunity.

(d) Can induced underground connections threaten water resources?

In the so-called '*Harmony*'[756] case, the pollution of surface waters occurred as a result of uncontrolled and acidic groundwater flows accumulating in disused gold mine voids. A long history of mining in the local area had led to the workings becoming interconnected. The matter revolved around the liability of the former mine owners to continue dewatering after the mines

[752] Glazewski J (undated). *Case S1 03 CR.308 (LAK)*. See also *US v Bengis* (2013). Also: Glazewski J (2016) Transboundary International Fisheries Crime and Restitution for South Africa: The Case of *US v Bengis* (2013). Chapter in Environmental Crime in Transnational Context. Routledge.
[753] Act 108 of 1997.
[754] *Really Useful 1nvestments No 219 (Pty) Ltd v City of Cape Town and others* [2015] JOL 33067 (WCC).
[755] *Minister of Water and Sanitation and another v Really Useful Investments 219 (Pty) Ltd. SCA 436/2015.*
[756] *Harmony Gold Mining Co Ltd v Regional Director: Free State, Department of Water Affairs and Forestry*. ZASCA 206.

were closed. While not argued on either public trust or HEC grounds the court finding, in effect, indirectly interpreted connectivity between ground and surface waters as falling within the ambit of the NWA. Irrespective of the fact that the mines in question were long disused, a failure to implement continuous dewatering after mine closure resulted in the connected voids filling up and eventually spilling out at the surface as acidic mine drainage (AMD). As such, these man-made underground connections created an induced and harmful form of HEC, the outcome of which was the pollution of groundwater and surface waters. These connections were recognized by the court as a 'labyrinth of interconnecting tunnels... [creating] a pathway through which.. water [flowed] from aquifers into the mines.'[757] This case forewarns of the risks of induced subterranean HEC that may arise from the process of hydraulic fracturing.

V. Conclusions

The inclusion of the public trust in the NWA transformed South African water law, first, by rendering the people of South Africa as the beneficiaries of the regulation of water resources by the State. In this context rights to 'use' water are predicated on a constantly evolving social contextualisation that strives to best serve the public interest in the resource. Secondly, the intentions of the public trust in the NWA demonstrate clear and evident regard for the need to maintain the health of the resource from which a water use is derived — recognising the fundamental integration of ecosystem processes, water quality and human values. On this view, the public trust negatively limits the use of private property by positively qualifying the rights of the public to access the unadulterated resource, by ensuring that any water use does not impact on the ecosystem's health. This accords broadly with the 'accommodation principle' interpretation of the public trust as set out by Blumm, and with the original views of Sax on the limitations of rights to water resources.[758] It further aligns with the maxim that '[a] man's right in his property is not absolute... that rights are relative and there must be an accommodation when they meet... [t]he necessity for such curtailments is greater in a modern industrialised and urbanised society than it was fifty, 100 or 200 years ago'.[759]

Two juxtaposed opinions on the need for the public trust have been distilled out here: First, that a reliance on the public trust, as the central thread woven through the NWA, was deemed eminently suited to the democratic and transformative role that the trust could provide

[757] *Harmony* Ibid at 2.
[758] See Chapter 2.
[759] *State v Shack* 58 N.J 297 (1971).

for reallocating water resources in accordance with the slogan that accompanied the law reform viz. 'some [water] for all, forever,' as well as protect to the ecosystems in which water resources are 'packaged'. Secondly, the contrary view held that explicit inclusion of the trust in the NWA was unnecessary — seen in light of the constitutional environmental right and that this was a transplant of a foreign doctrine that would struggle to find application in South Africa and might lead to expropriation claims. Both arguments have merit, the former more so than the latter. The pro-trust view was undoubtedly in lockstep with the progressive thinking of the time, having regard for the need to address social justice inequities, as well aligned with the global groundswell of scientific opinion underpinning of ecosystem-directed water resource management. The opposing view relied solely on sustainability in the public interest as the maxim for water resource protection. Of course, what has occurred has been the NWA operating in the absence of any deliberate invocation of public trust principles.

While the original anticipation of a property-based challenge to the trust doctrine, viz. the need to dispense with 'riparian ownership' of water, has long evaporated, the impacts of private land use remain a clear and present obstacle to water resource protection. As has been highlighted, some land use practices on land that is integrally part of an aquatic ecosystem may be detrimental to the latter, requiring that such use be limited. This is likely to be perceived as regulatory over-reach into the realm of private property. The apparent meekness with which the NWA's abolition of riparianism was accepted is unlikely to repeat itself in this instance. Into this challenge steps the public trust, by virtue of its inclusion of the entirety of a water resource (aquatic and terrestrial elements) within the protection of the public trust. The inalienability of the public trust is considered here to be similar to the role that police powers can play for the protection of water resources. The fact that the NWA includes both, however, places a moral and ethical futurity nuance on the police powers.

Despite the best intentions of the South African law reform, the detailed guidance for the public trust remains lacking. The responsible state department has not, in the words of Asmal, 'woken every day to maintain the public trust' — although a weak and unlikely counter argument may be the presumption that the trust principles are so well inbuilt that they operate autonomously. The conclusion to be drawn is that the NWA's trust doctrine is hiding in plain sight and still remains to be operationalised. This is still to be achieved through policy-based elucidation and interpretation of its role and its embodiment into, for example, the HEC-directed regulations herein. Equally, it is apparent that there is an overt policy approach to

ensuring watercourse connectivity has an important function to fulfil. This process will not be without its challenges, not least from the regulated community — as Minister Asmal clearly foresaw. However, well-established hooks exist on which to hang a connectivity-based approach to water resource governance, underpinned by best available contemporary science are provided by a public trust that clearly impresses land ownership with environmental protection. Importantly, though, the development of public trust understanding extends much wider than the single example of HEC. Efforts to develop and promote an awareness of the trusts role in water law will be of general benefit to a wide range of environmental legislation in other disciplines.

There are thus two options for the future of public trust in South African water law — simply leave it as it is and assume that it operates as a background principle across the operative provisions of the Act, or, alternatively, to expose its potential to become a proactive instrument to guide administrative decision making. Given the sheer scale of threats to South African water resources, the second alternative is the only viable choice.

The reform of the South African water law prominently installed a powerful and effective instrument, the public trust. However, the subsequent lack of development and operationalisation of the potential of the trust has led to the instrumental value thereof remaining moribund. An ability to be able to address anticipated land use challenges to the implementation of HEC, as a strategic regulatory framework for water resource governance, is herein deemed to provide one example of substantiation for the need to overtly develop a supportive public trust determination approach. As will be presented in Chapter 6, the ability of the public trust principles to underscore whether a water use is 'beneficial in the public interest' constitutes the core value of a public trust approach.

The origins of the contemporary format of the public trust in South African water law clearly lie in the United States, with the progenitor of the modern public trust, Professor Joseph Sax, having played an advisory role in the process. Together with Minister Asmal, water law reform team members Robyn Stein, Ronald Roberts and Heinz Klug parented the inclusion of Section 3 of the NWA. The role of the trust was for it to transform and democratise the law in the best interests of all of the citizens of South Africa, and that the needs and futures of diffuse minorities be thoroughly represented.[760]

[760] Sax J (1970).

The current expression of the public trust in the NWA is considered to be both weak and vague. As highlighted the development and strengthening of the public trust to render it both understandable and useable, remains the central challenge. An understanding of the role of the public trust has been demonstrated *in legio* case law examples from the United States and elsewhere, examples which are referred to in many countries seeking to employ public trust principles.[761] While these do indeed emanate from different national legal regimes, a high proportion of environmental threats to water resources, the resolution of which could be augmented by a public trust approach, are *mutatis mutandis* largely generic, irrespective of where they arise. As a single example, wastewater pollution of a lake entrains largely the same cause and effect pathway sequences, and the same categories of threats to human health and well-being, irrespective of where in the world it occurs. Accordingly, read with the provision in Section 39(1)(c) of the Constitution, viz. 'When interpreting the Bill of Rights a court.. may consider foreign law', the vast repository of foreign public trust case law available to be considered to aid the interpretation of the Bill of Rights and associated legislation.

[761] eg Chile,where environmental reform needs are top of the reform agenda, is currently preparing to include the public trust in the amendment of its Constitution. Protección de la naturaleza y una nueva Constitución para Chile: Lecciones de la doctrina del Public Trust. Bauer et al (2021) Chile California Conservation Exchange (CCCX). Copy on file with author. See also: Blumm MC & M Hebert (2022) 'Constitutionalising the public trust doctrine in Chile'. 52 *Environmental Law* 1-31.

CHAPTER 6: LOCATING THE PUBLIC TRUST PRINCIPLES IN DETERMINATIONS OF BENEFICIAL WATER USE: A PROPOSED WAY FORWARD

'The challenge for water law is... to mediate the interaction between a changing social landscape and an elastic resource by coming to terms with seemingly intractable demands'.[762]

I. Introduction

The intention of this work is to embed a scientific norm, HEC, within a legal framework, the public trust: First, it argues that a watershed-level governance approach to water resources is ideally located with a framework which ensures HEC of the hydrographic unit, that is to say, one that strives to maintain all abiotic and biotic linkages in a river system, from source to sea. While the importance of HEC has been known to limnological science for a long time, it was for the first time included in a regulatory instrument, the CWR, in 2015.[763] The CWR was intended as a definitional regulation appurtenant to the CWA.

The CWR was evaluated by examining the legal challenges levelled at the scientific underpinnings thereof — with two exceptions all of which were found to lack merit or substance.[764] Further substantiation was provided by the testing of a provisional guideline for the distance lateral to river systems, within which hydroecologically-connected, adjacent water resource components are most likely to be found.[765] This distance has relevance to the second goal, being that it serves to delineate areas of land on which certain land use activities might be harmful to the adjacent water resource(s). Finally the principles of the public trust will serve to underpin an accommodation between land use and resource protection.

This chapter sets out a proposed approach which provides a checklist template for ensuring that administrative decisions, wherein the state must have regard for its affirmative duty to protect, use, develop, conserve, manage and control water resources in a sustainable and equitable manner.[766] Such reasonable uses should be accommodating of the need to regulate land uses which may impair water resource health and condition and, *inter alia*, impair

[762] Du Bois F (1994) 'Water rights and the limits of environmental law'. 6 *Journal of Environmental Law* 73-84. Issues pertaining to water are typically, inherently and simultaneously demanding of ecological, political and social considerations.
[763] Federal Register 80 (124) June 29, 2015 / Rules. 37054
[764] Chapter 3. Exceptions were the CWA exclusion of groundwater and the 4000' Rule (the latter was substantiated as part of this thesis).
[765] Chapter 3.
[766] Act 36 of 1998, Section 3(b).

HEC. Essentially, any or all conditions pertinent to the determination of a water use should be subjected to a 'hard look' having regard for the public trust principles.

The final step in this analysis is to illustrate the extent to which the identified trust principles are currently embodied in the NWA and how the Act could be strengthened in order to ensure HEC. Chapter 4 of the NWA addresses water use and provides for eleven water uses that require an authorisation.[767] Additionally, the NWA provides a list of conditions which must be considered in the evaluation of water use authorisations.[768] It is within the latter section that the trust principles are likely to be found. However, because the NWA requires water uses to be 'beneficial' in the public interest, the scope and nuances of these terms must first be clearly established, as they are herein regarded as being pivotally integrated with both public trust and public interest considerations.

II. What is a reasonable, beneficial, use

As presented,[769] the public trust principles enfold an affirmative, *parens patriae* fiduciary obligation on the state to protect and preserve the nation's water resources.[770] This duty is dynamic and responsive to evolving circumstances. It further requires that effective monitoring and supervision be maintained over said resources so that a permit can be revised or revoked if found to be no longer beneficial. Accordingly, this custodial duty should provide the citizenry with the comfort of an assurance that the integrity of the resource will not be harmed while, simultaneously, allowing a licenced user(s) to reap their permitted benefits arising from a commonly-held resource. Seen thus, the public trust principles should provide a framework within which it is possible to qualify what constitutes a reasonable and acceptable benefit to the water resources trust.

The NWA includes several substantive mentions of the term 'beneficial use', [771] absent any definition of its intended meaning, ie it appears to have been included as a legal term of art

[767] NWA Section 21 (a-k). The wording of the Act is such the listing is presumed here to be non-exclusive.
[768] NWA Section 27(1)(a-k). As with Section 21 the list is not limited to the considerations listed, ie that *all relevant factors must be taken into account* (emphasis added).
[769] Chapters 2—6.
[770] eg Chapters 3 & 6.
[771] The preamble establishes that the government must ensure 'equitable allocation of water for beneficial use' (see also the preambles to Chapter 4 —Water Use and Chapter 5 — Financial Provisions); Section 2 includes the promotion of the 'efficient, sustainable and beneficial use in the public interest'; In Section 3, which details the public trust obligations, 'water must be allocated equitably and used beneficially in the public interest'; Section 27(c) require that when considering a licence application, regard must be had for the efficient and beneficial use of water in the public interest (see also Section 43(b) which deals with compulsory licence

requiring of progressive elucidation as to its intended scope.[772] However, absent appropriate definition or case law interpretation, the term is arguably of minimal or hortatory value — at it remains prone to administrative discretion.[773] In many instances statutes and regulations specify that a beneficial use must be 'in the public interest' — the latter term also absent an appropriate definition — while others have clearly established a primary public interest foundation.[774] In an arid, water-scarce, climate change threatened and economically-inequitable country such as South Africa, what construes a beneficial water use demands accurate definition. The alternative is that a principled procedure — herein proposed as a 'public trust determination' — may be employed to define the boundaries of what qualifies as an acceptable and reasonable beneficial use. Moreover, the public trust principles are accommodating of the fact that what may have been reasonable at one point in time may no longer be the case at another.[775] As set out in Chapter 4, the public trust is eminently suited to such constantly changing dynamics of ecological structure in response to societal needs and demands.

As pointed out in Chapter 4, interpretation of which values are engaged by the public interest at a particular point in time may not necessarily be aligned with the long-term sustainable development needs of a water resource. In a majority of cases, short term economic persuasions are very likely to hold sway over precaution regarding possible future risks to environmental and public health.[776] Hence something more is required to delineate the outer limits of an acceptable beneficial use, especially uses which may fragment HEC and translocate impacts throughout the wider aquatic ecosystem. Such an analysis must be alert to the risks associated with what may be 'large benefits to the individual but [with] undesirable detriment to society as a whole'.[777] Herein also lies a clear danger in construing the extent of a loss to

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applications in water stressed areas); and Section 56(5)(b)(i) which provides for incentives/disincentives for promoting efficient and beneficial water use.

[772]This generality of use, which assumes a well-known meaning, is common in many water legislations, with notable exceptions where what amounts to a beneficial use has been specifically defined (e.g. California, Hawai'i, Florida and Alaska). The Alaskan Code defines a beneficial use as being 'a use of water for the benefit of the [user], other persons or the public, that is reasonable and consistent with the public interest, including... domestic, agricultural, irrigation, industrial, manufacturing, mining, power, public, sanitary, fish and wildlife, and recreational uses' (at 23).

[773] Other terms commonly used in the context of beneficial use and also absent any definition are 'reasonable(ness) and appropriate(ness).

[774]eg the California Constitution Article 10 §2 states that the conservation of water resources 'is to be exercised with a view to the reasonable and beneficial use thereof in the interest of the people and for the public welfare'.

[775] See Chapter 5.

[776] While a particular project may at face value appear to be of economic benefit, in a beneficial use and public trust analysis it must also prove to be economically necessary.

[777] Alaskan Constitution (1956) Articles VIII §1&2.

society at too narrow a demographic spatial scale as harms, even when widely spread amongst a large population, may nonetheless be inequitable and thus amount to real harms. Furthermore, any proposed use must not be evaluated only at a discrete temporal scale, but rather be thoroughly considered in terms of future loss of benefits at a watershed level. Here HEC provides the literal map to guide decision making.

A beneficial use must be interpreted much wider than what may be merely beneficial to the licenced user — but, in many instances, this latter narrow view may be the dominant perspective in a water use application (the 'balancing equation' of jobs and economics vs the environment). More correctly, however, viewed within a public trust framework, *a water use must be beneficial to all beneficiaries*, viz to the licenced beneficiary, *as well as to all other beneficiaries of the trust, and to the water resource itself*, ie water uses must be seen through a wide-angle lens of ecological and social benefit (own emphasis). In this regard, the trust is viewed here in the context of a perpetual charitable trust, ie an inter-generational (sustainability) arrangement supporting of a vast number of beneficiaries (the nation's citizens). As such, a 'beneficial use' must, ultimately, be beneficial to society as a whole in terms of being able to build generational wealth.

To ensure that uses which might be harmful to the trust capital are avoided, it is proposed that the legal sidewalls to a reasonable beneficial use must be clear and evident and, ideally, circumscribed by the public trust principles.[778] This will require that private initiatives are exercised with due regard for the wider public interest. Such an approach should arguably also serve to counter problems of legal indeterminacy arising in instances of seemingly irreducible scientific uncertainty which is a common characteristic associated with interpretations of complex, non-linearly responsive ecosystems such as rivers and wetlands. Lastly, any or all considerations of water uses should be made in accordance with a protocol, such as the CWR, which provides an assurance of the integrity of HEC.

The trust principles as set out in Chapter 4 make clear that, for a use to not be harmful to the resource, it should be at most usufructuary in nature and at least entirely revocable. The term 'usufruct' derives from the latin *usus* (use), meaning to use or enjoy a thing, and *fructus* (fruit) which represents a right to enjoy a profit or benefit — but conditional on the capital not being materially altered. A useful analogy here is that of a fruit tree: A user or users may be

[778] See Chapter 5.

awarded a right to pick fruit from the tree, but they may not do anything that will harm the tree (the capital) and, by so doing, decrease its potential to continue to produce fruit (sustainability). Other new/potential users may subsequently be deemed to have an equitable right to some of the fruit and this may limit the quantum of prior allocations. Removing branches (~ HEC disconnects) or cutting down the tree for any purpose that is not in the greater public interest would be forbidden. If the tree becomes unhealthy and can no longer sustain the use(s), then the permissions may be amended or revoked to allow the resource to recover. Thus is illustrated the foundational principles of a public trust approach, ie that the beneficiaries are assured of a sustainable beneficial use that will not harm or diminish the capital and, where the latter may occur, that the use may be revoked in favour of resource protection. Furthermore that the flow of water, energy and materials through the tree from roots to leaves is unimpaired (see Figure 1.1). For a use to be truly and reasonably beneficial, it cannot favour the licenced user at the expense of the resource itself and the aggregate of born and unborn beneficiaries. While this analogy was respected in *Really Useful*, the tree was cut down in *Protea Village,* highlighting the need for a standardized procedure for administrative decisions associated with public trust water resources. An example of this is set out hereunder.

It is clear that the concept of beneficial use has transformed over time from an almost exclusive property-linked user right[779] — albeit always limited by the common law doctrines of harm or nuisance — into a format which is alert to sustaining increasing demands on a finite essential natural resource such as water. Whilst, historically, much depended on the opinion of a judge to determine 'reasonableness',[780] contemporary approaches must be sensitive to the need to adopt a societally inclusive future view from the outset of a use application. The protection, management and conservation of essential water resources must be predicated on an outcome which ensures benefits to society over and above the cost thereto. This awareness is reflected in, for example, the NWA requirement for uses that may be potentially detrimental to the resource to be subject to a process of approval and licensing.

Of course, the determination of reasonableness in administrative decision making will be prone to the same human failings that permeate all decision making. It cannot simply be

[779] Bell NH (1965) 'Beneficial use of water'. 3 *Willamette L.J.* 382. Bell points out that beneficial use lacks a precise definition and, as a common law entity, requires elucidation through case law interpretation. In an extreme example, *Lakeshore Duck Club* 166 Pac 309 (1917), the court assigned 'complete dominion and control' to a water use appropriation.
[780] Bell (1965) Ibid.

expected that every humanly-fallible official tasked with evaluating a submission for a beneficial use has the best interests of water resources and the community to heart. Moreover, administrative decisions may be compromised by the pervasive economic and infrastructure collapse, now increasingly common across many South African municipalities[781] — and where pressure to alleviate economic or service delivery stress, absent due regard for the environment, may arise out of sheer desperation. Last, but by no means least, there is the underlying threat of politics and/or corruption inveigling the decision making process.[782] Consequently there needs to be a guiding policy and protocol which ensures that all relevant issues are considered and respected in the decision making process. The principles of the public trust define the limits of the decision-making process in favour of the sustainable health and condition of the water resource, and the public interest. In so doing the public interest sets limits for private benefit.

The concept of beneficial use, then termed 'valuable use', first appeared in 1859.[783] The water use permit system, based on beneficial use, which originated in the US state of Wyoming in 1890, became regarded as the *sine qua non* for [the then] 'modern' water law of the period.[784] In 1892, in the widely-regarded seminal public trust case, *Illinois Central*, water use was declared to be conditional on the absence of impairment of the public interest therein.[785] In 1905 Oklahoma law expanded the definition of beneficial use for water appropriations as 'the basis, the measure and the limit of the right to use water'.[786] Much later, the Saxian-era public trust-developing *National Audubon* case of 1983 cited a case 130 years earlier which declared the right of property in water to be usufructuary.[787] During the 1950s, at the time the first seeds of present-day environmental law were being sown, there arose a growing demand for recreation and conservation to be considered as part of the suite of beneficial uses.[788]

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[781] For example, the 'Out of Order' assessment. https://outoforder.news24.com accessed on 18 October 2021.
[782] Professor Tracy Field has observed that 'there is an increasingly trenchant critique that sustainable development has been captured by a neoliberal agenda that sidelines ecological integrity *and* social justice...' Humby T (2016) 'The right to development-in-environment and its ecological and development thresholds'. 32 *SA Journal on Human Rights* 219-247.
[783] Couch DA and CL Klaver (2012) 'Beneficial use in Oklahoma Water Law: Opportunity for better management or more mischief?' 64 *Oklahoma Law Review* 615. Citing *McDonald v Bear River* where the concept of beneficial use [in 1886 Wyoming law] was deemed to have its roots in Mormon irrigation practices in Utah.
[784] Trelease FJ (1967) 'Alaska's new Water Use Act'. 11 *Land and Water Law Review* 1.
[785] 146 U.S. 387 (1892) at 435.
[786] Couch and Klaver (Ibid) at 616.
[787] *Eddy v Simpson* (1853) 3 Cal. 249, 252.
[788] Trelease FJ (ibid) The Alaskan Water Act was one of the earliest progenitors of a movement to recognize a unitary hydrological cycle and place all types of water into a single class (at 15). See also Trelease FJ (1957) 'The concept of reasonable beneficial use in the law of surface streams'. 12 *Wyo. L. J.* 1

The need for the most recent revision of South African water law arose out of a quasi-emergency situation that was urgently needed to redress decades of inequity, and socially undesirable practices related to the provision of water to the majority of the nation's citizens. The NWA enabled the potential for economic prosperity and water resource protection at a socially appropriate scale. Much earlier examples of very similar statutory amendments, arising absent an emergency context, emanated from Alaska, California and Florida.[789]

Considerations of what amounts to a beneficial use, within a public trust-principled governance framework, dovetails with the concept of environmental law operating flexibly and adaptively in response to a rapidly changing and complex array of anthropogenic pressures. This need for rapid adaptability is necessary in order to provide sufficient support for burgeoning human needs, arrayed against a finite and degrading base of water resources, smoothing a path towards a balanced appraisal of societal wishes, desired ecosystem functions and the needs of the water user. Just as the public trust enshrines an adaptable approach to water resource governance, so does reasonably beneficial use provide a flexible and adaptable concept — as such ideally suited to an adapting South African environmental law landscape which continues to transition from primarily irrigation-based uses to ecosystem health, recreation and other instream uses. Within this present-day context, considerations of beneficial use are strongly nuanced by the need for efficiency of use and resource protection. In short, the public interest considerations necessary to support a beneficial use determination arise from the public trust principles.

Overall, two aspects emerge from this analysis of beneficial use: (i) the scale or nature of the use, insofar as impact thereof on the parent water resource is concerned, and (ii) whether the manner of use is socially acceptable. From the perspective of the public trust, these align with the principles of usufructuary and ecologically sustainable use.

The custodial role of the public trust in South African water law is that of a co-trustee caretaker role placed on the holder of a water use, whereby the water use is regarded here as being rendered from constitutional property. As such the use is much more than simply an authorisation for the use, rather it imposes a significant limitation and strict duty on the user to ensure that it is indeed usufructuary — and may not be 'exercised in a manner which is harmful'

[789] Trelease (Ibid) As an example, the Alaskan Constitution of 1956 stated that '[a]ll surface and subsurface waters reserved to the people for common use... shall be limited to stated purposes and subject to preferences among beneficial uses... and to the general reservation of fish and wildlife'.

to any or all beneficiaries of the public trust.[790] As early as 1885 South African courts declared that [landowners] did not possess 'exclusive dominion over their waters' and that all licences were 'revocable at pleasure'.[791] It is thus evident that, while 'water use' is an old common law concept, the circumstances within which a use must be considered have changed dramatically.

A key conclusion drawn from this consideration of the doctrine of beneficial use is that it resides completely nested within the principled sidewalls of the public trust (see Figure 6.1) — ie that a use that does not have regard for the trust principles cannot be regarded as beneficial. [792] Adding an HEC layer, any use which irrevocably fragments or impairs HEC are unlikely to be beneficial. Thus, there is a need to measure a proposed beneficial use against the trust principles. The notion of beneficial use exists within a constantly evolving framework that is bounded by the practical exigencies of contemporary societal existence. Paramount in this context is the need to ensure that water uses do not impair the water resources which are essential for human life and health.

[790] Van der Walt M and G Pienaar (2012) 'The concept beneficial use as a limitation of the right to use water'. *J. S. Afr. L* 418 at 431 & 419.
[791] *Commissioners of French Hoek v Hugo* 1885 PC 90 at headnote and 107.
[792] This aspect is addressed hereunder.

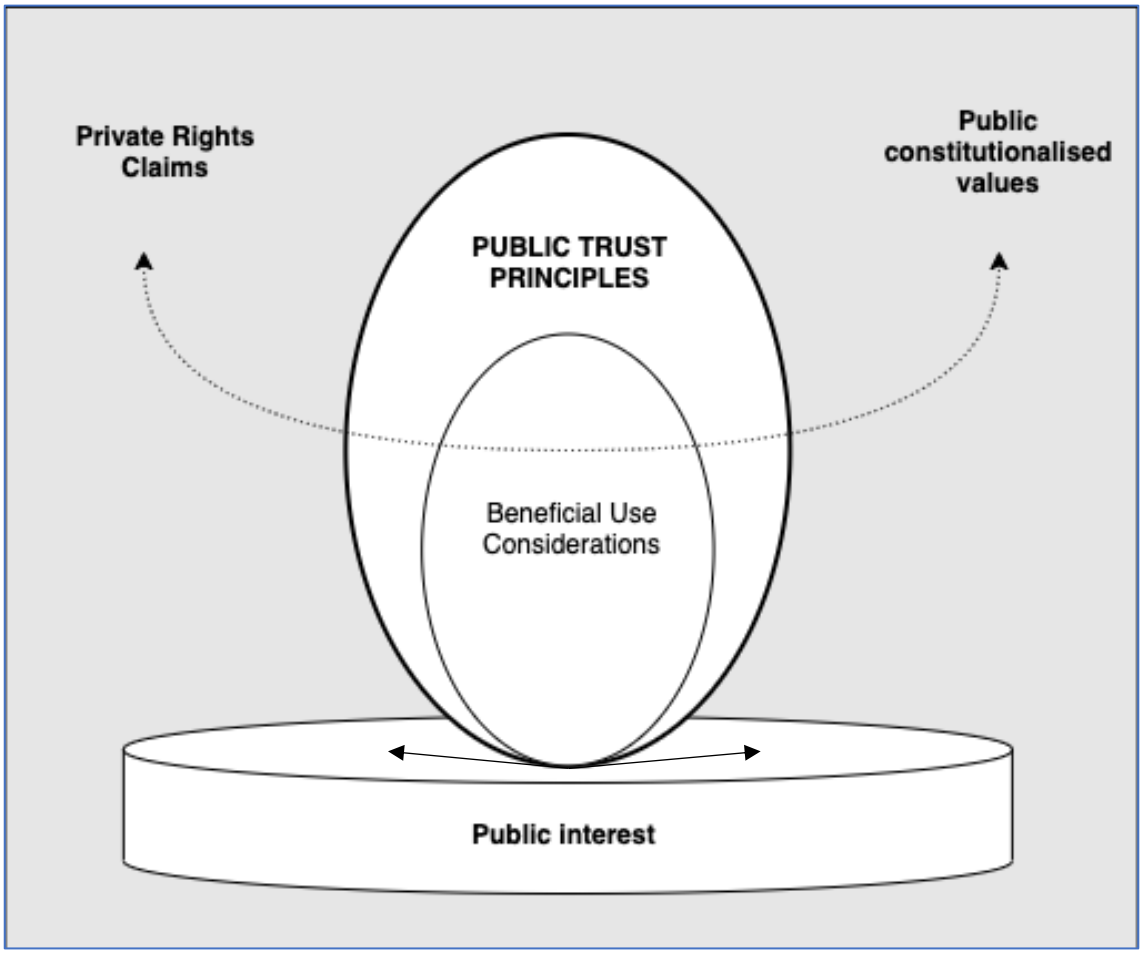

Figure 6.1: Schematic representation of the placement of the public trust principles in relation to the determination of a beneficial water use in accordance with the public interest. Herein a water use is deemed beneficial if it conforms to the trust principles. The nested public trust/ beneficial use determination is depicted as floating on a public interest platform with which it intersects and dialogues and positions itself at the point most appropriate to societal choices. The shaded surrounding box represents the catchment management space and, arrowed, the spectrum of tensions that arise between private property and public constitutionalised limitations thereon — these issues enfold all three elements of beneficial use, public trust and the public interest. Compliance with the public trust principles should serve to balance the contest between these two dimensions in favour of water resources through the futurity requirement of the public trust.

III. Water uses as expressed in Section 21 of the NWA

Section 21[793] of the NWA divides eleven listed uses into six categories, as follows: (i) taking or abstraction of water [a & j]; (ii) alteration of flow patterns [b, c & d]; (iii) pollution [f, g &

[793] Section 21 includes the following water uses:
(a) taking water from a water resource;
(b) storing water;

h]; (iv) physical alteration of the characteristics of a water resource [i]; (v) controlled activities (eg strategic needs such as irrigation, power generation, aquifer recharge) [e]; and (vi) recreation. HEC considerations are thus implicitly cross-cutting across all of these. Given the ecosystem-favouring bias of the NWA, the assumption made here is that any or all of these uses must conform to a usufructuary and reasonable beneficial use. With respect to the *res publicae* resource capital, it is further assumed that any or part of a resource may not be conveyed into private ownership, or that a use may not be solely for private economic benefit at the expense of the resource or of the public trust beneficiaries. While there may be exceptions to these limits, they would arise in extreme circumstances where the benefit to the public at large would override the harm to the resource.

Although not dealt with in any detail here, there are many examples of quite extensive volumes and regions of occurrence of water resources having been condoned for exclusive private benefit by means of a Water Use Licence.[794] This is regarded here as being tantamount to conveying part of the trust resource into private ownership — breaking the first principle of the trust. It is not readily apparent whether such instances are the result of a failure of the public trust protections, arbitrary or capricious decisions, or flagrant and simply incorrect interpretations of the protections enshrined in the law. Per the public trust principles (Chapter 5) and the analysis hereunder, such instances may well be foreclosed when subjected to a public trust determination.

(c) impeding or diverting the flow of water in a watercourse;
(d) engaging in a streamflow reduction activity;
(e) engaging in a controlled activity;
(f) discharging waste or water containing waste via a conduit or outfall;
(g) disposing of waste in a manner which may detrimentally impact on a water resource;
(h) disposing of water [emanating from] an industrial or power generation process.
(i) altering the bed, banks, course or characteristics of a watercourse;
(j) removing, discharging or disposing of water found underground...
(k) using water for recreational purposes.

[794] Examples of where a Water Use Licence or a General Authorisation has allowed the irrevocable loss of a component of a wetland water resource are: Libradene Wetland (Boksburg) [Licence Number 08/C22B/1C/6654] where a filling station was built in an instream-wetland node (see Barlow N (2021) Fueling Environmental Corruption...; permission to build over a headwater stream, spring and wetland node at Bishops Court (Cape Town) [General Authorisation Number 22144074] in order to provide funds for a land restitution claim; permission to infill by several meters and build over a wide area of culturally-significant riparian floodplain on the lower Liesbeek River (Cape Town) for the purposes of a business park [Licence Number 01/G22C/CGI/10589].

IV. Section 27[795] of the NWA and the public trust principles

(a) The trust principles

As derived in Chapter 5, the core trust principles are summarised as follows:

1. the nation's people (the trust beneficiaries) have a paramount interest in how the nation's water resources are managed for both their present and future generations (the born and unborn) [access to water now coupled with sustainability and inter-generational equity];
2. the state, as public steward of the resource, will determine how the resource is managed in the public interest [as, *inter alia*, set down by the Water Act in respect of basic human needs, pollution control and the assurance of the Ecological Reserve];
3. all of the resource is the property of the nation's people. In this regard the trustee (the state or its provincial or local authority co-trustees) *may not*:
    - convey public resources exclusively to a private entity;
    - issue a legislative grant (eg a licence or permit) the purpose of which is to solely benefit a private interest — other than where limited usufructuary beneficial use or accommodation may be permissible;
    - issue licences or permits which may result in avoidable or irreparable harm to the resource;
    - attempt to relinquish its power over a public resource;
    - neglect to supervise, monitor or review any approved use.

[795] Section 27 of the NWA lists eleven considerations for a Water Use Licence application:
(a) existing lawful water uses;
(b) the need to redress the results of past racial and gender discrimination;
(c) efficient and beneficial use of water in the public interest;
(d)the socioeconomic impact — (i) of the water use if authorised; or (ii) the failure to authorise the water use or uses;
(e)any catchment management strategy applicable to the relevant water resouce;
(f)the likely effect of the water use... on the water resource and on other water users;
(g)the class and resource quality objectives of the water resource;
(h)investments already made and to be made by the water user in respect of the resource in question;
(i)the strategic importance of the water use to be authorised;
(j)the quality of water in the water resource which may be required to meet the Reserve/international obligations;
(k)the probable duration of any undertaking for which a water use is to be authorised.

Application of these principles should have close regard for the conservation and sustainability-orientated principles proposed by Edith Weiss,[796] ie preserving of opportunities to exercise options with respect to water uses, either now or in the future.

Furthermore, the following fiduciary obligations attach to, and must be read together with, the public trust principles, such that the State bears a duty to:

- ensure security of water resources, water supplies and infrastructure;
- conserve and protect water resources consistent with trust purposes;
- control and manage water for long-term sustainability, for human and biological life, watersheds and hydrologic processes, local communities and society in general (with a presumption in favour of public use);
- give effect to equity in terms of social justice;
- invest resources in the resource; and
- engage with long-term sustainability planning at a watershed scale.

Nowhere in the NWA or associated policy has a *modus operandii* for using the public trust been explicated. As such application of the trust resides in uncharted legal waters. To assess the extent to which public trust principles may be encapsulated in considerations for water use approvals, it is necessary to interrogate Sections 27(a-k) and 29(a & b)[797] of the NWA. For this purpose, the application of the above core trust principles has been formatted into a flow chart/checklist (see Figure 6.2). The purpose of this proposed tool is that the beneficial use is evaluated from the perspective of the public trust principles. The six proposed question stages (1-6) therein are identified below in parentheses:

The chart is entered at the top (Water Use Licence Application) and commences with (1) a determination of whether giving effect to the use is tantamount to the resource be

[796] See Chapter 4.
[797] Section 29. Conditions for issue of general authorisations and licences. (1) A responsible authority *may attach* (emphasis added) conditions...
(a) relating to the protection of-
(i) the water resource in question;
(ii) the stream flow regime; and
(iii) other existing and potential water users;
(b) relating to water management by-
(i) specifying management practices and general requirements for any water use, including water conservation measures;
(ii) requiring the monitoring and analysis of and reporting on every water use...
(iii) ...

conveyed into private ownership[798] and, if so, (1b) whether there is an overriding public interest consideration in the loss of all or a significant portion of the affected water resource, ie to respond to the question of whether the desired use necessarily and permissibly injurious to the relevant water resource. This stage of the process is similar to the Stage 1 query process in the *Cominiti* Test.[799]

The process then determines (2) whether the use is of a usufructuary nature and, if not, is the benefit to the public welfare an overriding factor (1b). An example of such a necessarily injurious use exception might be the need to discharge urban wastewater from a treatment works that is unable to meet its effluent requirements and which may be condoned for a specific period of time to allow for technical or technological upgrades. However, if the intended use bears the risk of irrevocable harm (3) to the water resource into which the waste is discharged — the 'receiving water' — then the application for a licence must, in all likelihood fail.[800]

Should the desired use, of itself, present an acceptable level of risk to the receiving water, then it remains to be considered (4) in a cumulative context of other pre-existing uses — these being either prior water use allocations and/or local land use activities already impacting on the condition of the water resource. An example here might be the loss of a functional riparian zone or wetland connection corridor to in-place agricultural practices, the amelioration of which (4a) might serve to render the desired use permissible.

The need to exercise an abundance of precaution resides in a thorough examination of any or all unknown factors (5) which might eventuate over time. This stage of the process is susceptible to the vagaries that arise from legal indeterminacy — especially where differing specialist opinions arise and distinguishing a beneficial use is prone to an imprecisely apparent question of degree. However, within the girdle of the public trust any hesitation should ideally invoke the doctrine of *in dubio pro aqua,* ie a precautionary decision in favour the desired assurance of HEC.

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[798] This thesis details three examples of where a water use has been authorised whereby all or part of the resource has been permanently and irrevocably altered, absent any perceivable, over-riding, benefit to the public interest (see Chapter 6).

[799] See text associated with n631.

[800] Failing wastewater treatment capacity in South Africa has resulted in many treatment works becoming unable to meet their licence requirements (eg Harding 2015, n43). This situation is exacerbated by the fact that in most, if not all instances, there is no alternative but to continue discharging non-compliant loads of waste into rivers and/or the coastal zone.

Lastly, but by no means least, is the need to determine whether the impact of the use can indeed be effectively monitored (6). In all too many instances imposed monitoring requirements are of a relatively-coarse nature and avoid expensive, but ultimately very necessary, diagnostic techniques and procedures. Inadequate and ineffective monitoring poses the risk of a significant harm only becoming apparent long after it was caused and beyond the point where remediation might be practically possible. Again, if there is any room for doubt that the effects of an intended use can be effectively monitored, the application should fail.

Insofar as providing an assurance of HEC is concerned, all six query stages are proposed, per the shaded area in Figure 6.2, as residing within a 'connected waters protocol' that, as did the CWR, defines the nature of connections to be protected and the methodology for determining where such connected components may be found. As such, each of the query stages should be informed, *inter alia*, by the types of connections as depicted in Figure 2.3 and the impact links set out in Figure 2.4.

The review component of the licence cycle is especially important, for at least two reasons: First it allows for the proposed public trust-based determination to be applied to an existing licence, so ensuring that the original determination may be trust-aligned. Secondly, and while it does not yet do so, the review step should be undertaken such that all licenced uses in the same watershed should be reviewed together — the review period of 5 years is short enough to bring all reviews into chronological equivalence and review all together. Insofar as HEC is concerned, this would provide for the concomitant consideration, over the same time frame, of any or all impacts potentially translocated to other locations in the watershed. An alternative consideration is that the benefits of an ecosystem approach for a particular hydrosystem will be maximised if all uses and activities are contemporarily evaluated — this quite apart from minimising the associated administrative burden.

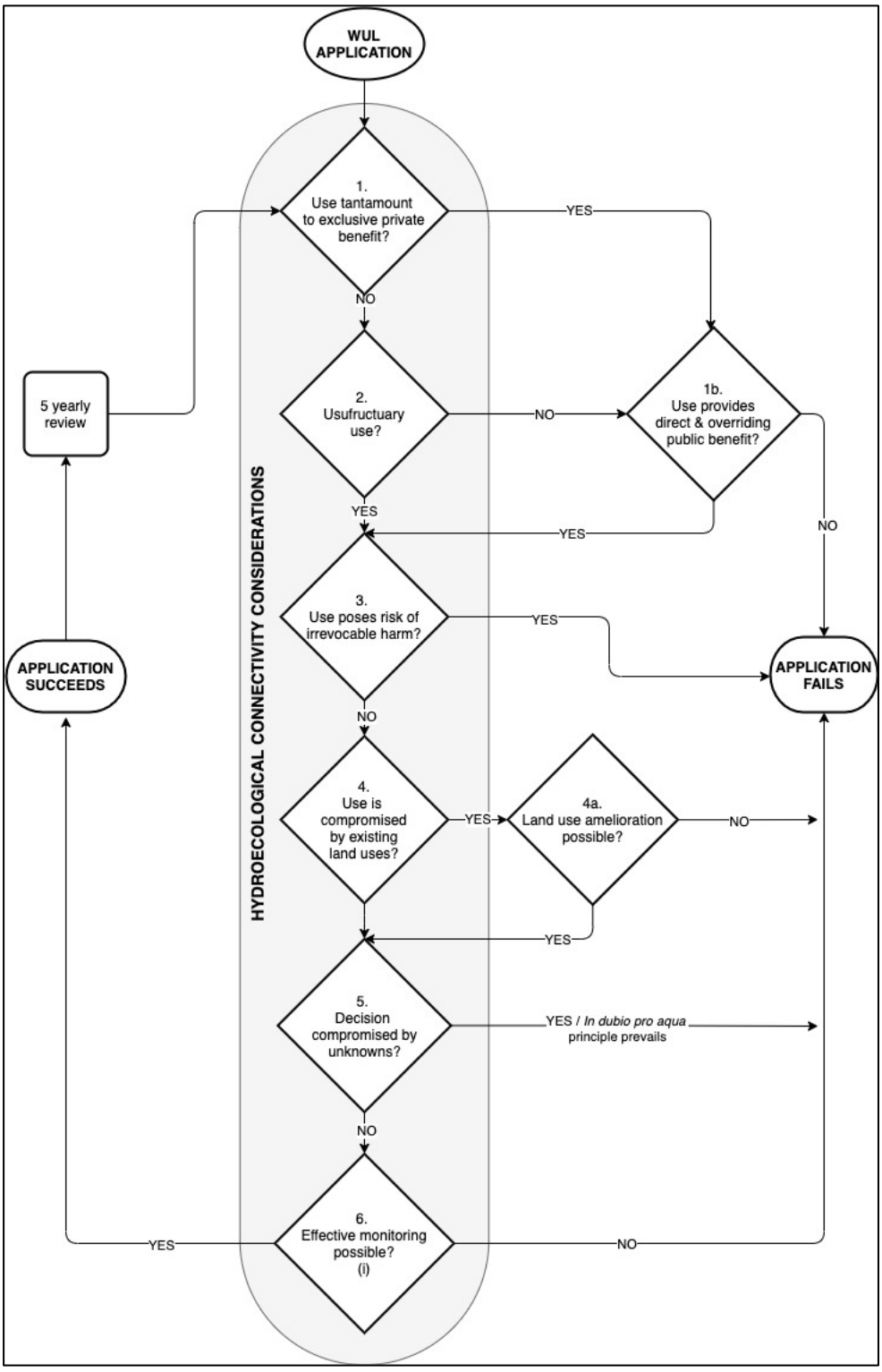

Figure 6.2: Schematic flowchart for a proposed 6-step beneficial water use determination, constructed using the public trust principles as outlined above and in Chapter 6. The query process rests on a platform (surrounding shaded area) of HEC considerations — *requiring that each query stage have regard for any or all aspects of connectivity that serve to sustain the physical, chemical and biological integrity of the water resource*.

(b) Do Sections 27 & 29 contain the trust principles?

Chapter 4 of the NWA, which addresses water uses, does not mention the public trust, in fact the trust is not mentioned anywhere in the Act other than in Section 3. Sections 27 & 29 of Chapter 4 set out, respectively, the considerations for the issue of a licence and the essential requirements thereof, While the NWA does not provide for privatisation of trust assets, nowhere is conveyance for a permanent and exclusive use, at the expenses of the public interest, forbidden. Additionally, neither in Section 27, nor anywhere in the NWA, is mention made of the fundamental water resources trust principle requiring that the use be usufructuary and/or non-harmful to the water resource upon which the use is to be imposed. However, Section 27 does list at (c) that consideration must be had for 'efficient and beneficial use of water in the public interest'. From the beneficial use analysis above, this single requirement for consideration is here considered to entrain the public trust principles as the foundation for a beneficial use determination. The latter thus provides the hook that links the public trust principles into a beneficial use determination. Such a determination is assisted by the trust-principles flowchart type of approach proposed in Figure 6.2.

The other considerations listed in Sections 27 & 29 conform loosely to the trust principles but are arguably ineffective to a public trust determination unless the trust relevance of each is deliberately explicated. They are, however, very similar to public interest criteria used in other legislations.[801] The individual considerations are aligned with the trust principles as contained in Figure 6.2.

From Table 6.1 it is apparent that certain trust principles are embodied in the various considerations listed in Section 27, but that these are neither clearly nor explicitly set out to function in a deliberatively public trust context. Significantly they are present only intrinsically and not as the result of a process of formulating conditions based on an objective analysis of trust principles. They remain at best implied and arguably 'implied' is not enough for the public trust values to be fully ventilated, rather than an explicit analysis that weighs the conditions against the trust principles is overtly relevant to a public trust approach to water resource governance.

[801] Alaskan State Code §46.15.080 provides a very similar list of considerations comparable with those contained in Section 27 of the NWA.

Table 6.1: Relevance of Section 27 & 29 considerations to the public trust principles

Query Stage (per Fig 2)	Query	Relevant Section Considerations
1	Does the use benefit a private interest?	**
1a	Will the use be tantamount to privatisation of the resource?	-
1b	Does the private use provide an overriding public benefit?	27 b,d,e,h & i
2	Is the use usufructuary and/or non-harmful to the resource?	27 c,f
3	Does the use pose a risk of irrevocable harm?	27 g,j
4	Is the use compromised by existing uses/land uses?	27 a, f & g; *29(a)(iii)
4a	Can existing use impacts be ameliorated?	**
5	Is the desired use compromised by unknown factors?	**
6	Is effective monitoring possible?	** *29(b)(i&ii)

* These are optional conditions which 'may be attached'..., ie. there is no specific question that leads the decision maker to undertake an audit of all existing land uses or licences extant in the affected watershed.
** While these questions undoubtedly form part of the due diligence/risk analysis process that accompanies a permit application, they do not arise from a public trust requirement. For their true value to be exercised they should arise from a need to comply with the relevant public trust principle, ie. which provides the greater public good context as to why the question is being asked at all.

Of greatest potential significance here is the absence of any consideration of the use being tantamount to privatisation of the resource or commodification solely for private benefit — seen against ensuring the physical, chemical and biological hydroecological integrity of the water resource hydrographic unit.[802] This aspect — the first query in the proposed assessment flowchart shown in Figure 6.2 — is regarded here as being absolutely fundamental to meeting the requirements of the public trust. If this is not heeded then, as per the examples discussed *supra*, bits and pieces of a perpetual trust resource can simply be handed out for private benefit, the ultimate costs of which will be borne, in time, by the trust beneficiaries. To allow same abrogates the intentions of the public trust, viz to remove obstacles to water resource protection by ensuring the maximal integrity of these complex interconnected land/water ecoscapes.

[802] For example an entry-level query would be 'will the proposed use convert water resources to another land use type?' ie a use that would destroy the supporting resource, alternatively substantially impair its ecosystem health and resilience.

V. Summary, recommendations and conclusions

(a) Summary

This thesis has presented how a transdisciplinary and scientifically relevant approach to water resource governance may be based on an assurance of HEC. As such it is translational of science into law. Furthermore, it has elucidated how the principles underpinning a water resources public trust can structure reasonable beneficial water use determinations in the public interest. Proiving an assurance of HEC is one key aspect of such a determination. As such, the case specific context of a proposed beneficial use are circumscribed by the trust principles. Both aspects, connectivity and the public trust, however, remain to be actively promoted and integrated into policy and regulations, particularly those associated with administrative decision making.

Both topics, as applications in modern environmental law, originated in the United States. As repeatedly observed, issues pertaining to water and the ecosystems in which they occur are, *mutatis mutandis*, globally generic. Equally, the public trust is capable of translocation into and transformation within, different legal regimes. Both the trust and water resource protection will increasingly be developed and interact on platforms of connectivity.

The analysis provided in this chapter reveals that semblances of public trust principles do reside implicitly in the operational text of the NWA. However, their presence is considered to simply have arisen as a consequence of their intrinsic commonality in water resource assessment processes, and not as a result of their deliberate and purposeful inclusion. As such, authorisations of water uses are not evaluated explicitly from a public trust perspective — here regarded as inconsistent with the public trust backbone of the NWA. Only if the execution of Chapter 4 of the NWA is performed from a public trust perspective will the true value of Section 3 thereof be fulfilled. As illustrated above, the permanent loss or alteration of all or part of a water resource, protected under the trust principle of inalienability of the trust capital, is being condoned in General Authorisations[803] and Water Use Licences. The proposed sequence of beneficial use queries, as proposed in Figure 6.2, poses the question of whether a

[803] A General Authorisation (GA) constitutes a permitting process deemed to not require the rigour of a full licence application. It is questionable how a GA can be applied to any circumstances where the resource will be physically built over, such as in the Protea Village example provided in Chapter 6.

use will be tantamount to privatisation of portions of the trust capital, as the basis of the water use licencing process.

In order for the public trust, to become more than just an aspirational feature of the Act, it must undergo an exegesis in order to be actively and deliberately operationalised as a procedural component of water resource governance and administrative decision making. The trust principles encompass enormous and valuable scope for protecting water resources on which the nation depends. A 'water resources trust' approach is not an anti-development tool, rather it is a tool that allows water uses for development such that benefit accrues to all affected beneficiaries — the user, the resource and the nation's people.

The maintenance of HEC is of crucial importance to the ecosystem integrity of water resources — and hence for their protection and governance. Moreover, the recognition of environmental health, for which connectivity is a fundamental underpinning, has now at the close of this work been recognized as 'a human right for all' by unanimous vote at the United Nations.[804] Such acknowledgment will augment the role of all trust paradigms deployed towards arriving at an ecologically sustainable future. The CWR, which perhaps would have been better titled as the 'Connected Waters Rule,' provides an excellent example of a scientifically valid definitional regulatory framework upon which a similar South African protocol could easily be based. However, the introduction of a connectivity-assuring approach may trigger resistance from landowners, based on entrenched perceptions of private property rights. Obviating such push-back requires an enabling legal framework which can legitimately place limitations on private land use in favour of an assurance of aquatic ecosystem health. The principles of the PTD provide such a framework. Although the trust is already legislatively expressed in the NWA, it remains to be developed to provide clarity regarding how the trust principles may be used to enable legitimate restrictions on land uses which may impact negatively on linkages between components of an integrated aquatic ecosystem. Consequently, the law should be augmented to explain the functional architecture and principles underpinning of the public trust. This thesis has provided one example hereof as the integration of trust principles into a determination of beneficial water use.

[804] UN General Assembly announcement 28 July 2022. Downloaded from https://globalpactenvironment.org/en/the-un-general-assembly-recognizes-the-right-to-live-in-a-healthy-environment/ on 28 July 2022. This is a non-binding yet overtly political and symbolic message.

South African water law, mandated by the constitutional right to an environment that is not harmful to health or well-being, for both present and future generations,[805] has a clear ecosystem underpinning. Simply put, for those dependent on an essential, life-supporting resource such as water, the ecosystem which provides such water must itself be healthy.[806] In this context, 'dependents' refers to present and future generations *and* the water resource on which the dependence is vested. An ecosystem approach is primarily implemented through the concept of providing a combinative assurance of water flow, quality and timing necessary to sustain a desired condition in a particular fluvial hydrosystem. To this end the NWA creates statutory provisions whereby a defined set of beneficial water uses,[807] which bear the possibility of harming a water resource, must first be assessed and licenced. The terms of the licence are usually qualified with a set of conditions that are associated with the particular circumstances of the use, including the period of the licence and the interval at which the terms of the licence must be reviewed against whichever monitoring requirements were imposed.[808]

The NWA makes no mention of the need to have regard for HEC of a particular hydrosystem. While many river ecologists will automatically view a hydrosystem through a wide-angle lens that entrains the catchment, this is not a given. Specialists from other scientific disciplines and, particularly, administrative officials, may not of their own volition exercise a similar regard — in fact in own experience they are unlikely to do so. To this end procedural aide memoire protocols, which entrain a mandatory consideration of, and focus on, connectivity are essential. In South Africa, to-date, there has only been limited acknowledgment of the need to consider, explicitly, aspects of connectivity extending lateral to fluvial hydrosystems and, for the first time, 2021 saw the emergence of an acknowledgement that a sole focus on the linear hydrosystem, or on wetlands is, from a governance perspective, inadequate.[809]

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[805] Act 108 (1996) Section 24.
[806] In the context of a water resource, 'health' refers to the physical, chemical and biological functional integrity thereof.
[807] Ibid Section 21.
[808] Ibid Sections 27 & 29.
[809] Recommendations arising from the National Wetland Framework strategy meeting, held on 25 August 2021, included that the scope of wetland considerations should be 'broad[ened] to include rivers and other aquatic systems'. This is quite a surprising admission given the ecosystem-directed intentions for South African water resource governance and suggests that hitherto there has been an over-concentration on individual components - which may be loosely termed 'silo-science'. Equally, an analysis of Protected Areas in South Africa, which hitherto only concentrated on land-based environments, recommended that in future 'rivers, wetlands and estuaries' should also be included. Accounts for Protected Areas, 1900-2020 (2021) Statistics South Africa, Pretoria.

The CWR was found to provide a readily adaptable template that is deemed suitable for use in South Africa. The CWR, being definitional, simply serves to ensure that a water use determination considers all water resource components that are or maybe connected to the locus of determination — in particular how a proposed use may disrupt any or all of these linkages. Arising from this evaluation was the opportunity to test, using South African data, the CWR distance-based rule for determining where connected waters, in particular wetlands, are likely to occur lateral to the fluvial watercourse. This has usefully provided a provisional brightline rule for South African application — revealing that water resource components likely to have connections to others generally lie within a lateral distance of 1200 meters on either side of a water course.[810]

Integrally-connected complexes of streams, rivers and wetlands occur variously throughout a watershed on both public and private property. The riparian ecotones that fringe aquatic ecosystems have a widely-variable spatial extent that extends linearly, laterally and vertically and, vitally, encompasses areas of terrestrial land which, by virtue of the services provided to the water resource, must be regarded as part of the integrally-connected functional resource. The example of headwater streams, being the most abundant fluvial hydrosystems by stream order,[811] and potentially the least impacted overall, illustrates the ecological importance of these waters to their connected downstream environments.

Viewed in the context of water resources enfolded by uplands, property becomes qualified as providing of an ecological function — such function(s) in turn establishing a limitation on how water resource-associated portions of land may be utilised.

A basic common law principle of property law is that land uses may not infringe on the rights of others. As such, a land use imparting harm on an adjacent watercourse bears the risk of the harm being translocated to other components of the connected resource, both near and far, and thus extending the risk of harm to others, not least to the resource itself. Accordingly, land and water uses must be permitted only in circumstances which beneficially serve the greater public interest. Concomitantly, the fact that providing an assurance of HEC is likely to intrude on perceived land use rights in order to ensure the ecological functioning of watersheds, may incur confusion amongst, or resistance from, affected landowners.

[810] See Chapter 3.
[811] Measured in terms of linear length (see Chapters 2 & 3).

Into this arena of enabling HEC steps the legal instrument of the public trust.

The public trust is a function of the public interest. For the public interest to be served, the principles of the public trust, serve to rebalance individual and societal interests. Moreover, the public trust embodies an intergenerational focus which serves to temper short term societal needs which may have a future and negative outcome. As such the fiduciary obligations arising from the public trust dovetail with the present and future obligations imposed by Section 24 of the Constitution. Section 3(2) of the NWA establishes a clear requirement for the obligations of public trusteeship to be exercise in the public interest.

Although the public trusteeship of water resources is mandated in South African water law via Section 3(1) of the NWA, the entire expression and scope of the trust is limited to a single clause[812] — which aligns with the constitutionally-protected environmental right. Beneficial water uses, however, are centrally and directly drawn into the public trust provision by the same section,[813] underpinning the approach taken above to fold the public trust principles into the determination of whether or not a water use is indeed societally beneficial. Insofar as can be determined this is the first instance where this has been attempted.

While it has been shown herein that elements of public trust principles may be discerned from the language of Chapter 4 of the NWA, it is argued here that it is not enough to simply assume that this is sufficient. For the trust principles to have true value for water resource protection their origins, role, meaning and intended use should be explicitly enunciated, especially to the regulated community. The examples discussed would probably have had quite different outcomes — for the furtherance of a water resources trust — had a public trust-based determination been applied. Questions evaluating a proposed beneficial use should be asked from the perspective of the trust principles. While the drafters of the NWA were clearly aware of the underpinnings of the trust, they did not provide any explanation of its architecture or objectively relate its principled underpinnings to any section of the NWA. Furthermore, the ability to discern trust principles in the NWA did not stem from a prior objective analysis thereof and their deliberate infusion into the wording of its Chapter 4.

[812] 3(1) As the public trustee of the nation's water resources the National Government... must ensure that [water resources are] protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner, for the benefit of all persons and in accordance with its constitutional mandate.
[813] 3(2) Without limiting [3(1)], the Minister is ultimately responsible to ensure that water is allocated equitably and used beneficially in the public interest, while promoting environmental values.

This thesis argues that the extant wording of the trust in the NWA constitutes a weak form of expression and, in effect, absent any further operationalisation, condemns the trust to remaining little more than an aspirational principle. Significantly, no policy or protocols underpinning of a public trust determination have been formulated since the NWA was promulgated. Arguably, given the obligations to progressively develop and operationalise the NWA, plus the central role of the public trust as expressed in the NWPWP, regulators should, ideally, have crafted these important procedural instruments while the NWA was still in its infancy.

(b) Recommendations

This analysis has provided the basis for a much needed and novel environmental management instrument.[814] Any recommendations arising from this work should be tempered by the assumptions that (a) there will be limited appetite for a HEC approach — ie that this will, despite its obvious value, simply be regarded as an additional administrative burden, combined with push-back from the regulated community, and (b) that there is, currently, no semblance of a national 'public trust' ethos, ie that any proposal to develop the trust to its fullest potential may not attract national or even departmental support. Certainly, since promulgation of the NWA, the custodians have made no apparent effort to develop the public trust in accordance with the wishes of the late Kader Asmal. Accordingly, it will be necessary to first inculcate, foster and develop a supportive public dimension. If the public trust is to flourish, this will not emanate from the views or efforts of individuals, it will need to be borne on a broad-based groundswell of interest that is awake to the potential that the trust offers. It will, however, need to be driven by the efforts of a core group of people who view the potential of the trust as meriting of wider application.

While indeed innovative, the NWA has proven harder to implement than may have been envisaged, not least as a result of insufficient human resources and experience. One of the senior authors of the NWA has opined that the task of furthering the objectives of the water law would be best served by skills partnerships, entraining stakeholder input and integrating

[814] National Environmental Management Laws Amendment Act (NEMLAA) Act 02 of 2022 defines an environmental management instrument as:

> 1(d)(i) ...
> (iii) spatial tool
> (v) environmental risk assessment
> (vii) norm or standard:

The proposed public trust enfolded HEC approach conforms to this definition.

experience available outside of the national department.[815] The exigencies of introducing the proposed HEC approach, coupled with skills awareness to aid operationalisation of the public trust, are likely to benefit from broad-based involvement of stakeholders from early on in the process. There should be no hesitation to use all available human skills and resources.

Establishing a wider understanding of the potential role and value of HEC, or for the enfolding embrace of public trust principles, to the ultimate benefit of water resource governance, will optimally derive from a structured process. This should ideally commence with the crafting of position papers on both topics, intended to lead into colloquial interactions convened for the purpose of not only broadening general understanding but also, crucially, seeking input, advice and guidance from as broad a pool of stakeholders as is possible including representation from state departments responsible for water, urban and agricultural development. A focus on the formulation of legal indicators that can track the effectiveness of the application will be centrally useful. This process will not happen overnight and will need to be underpinned by progressive development and continuity. Ideally, it will achieve maximum value and momentum through the parallel hosting, over a sustained period, by a 'water law academy' located at a public law department at a tertiary institution. In this fashion not only will there be academic patronage, but also the sustained development of an institutional knowledge base and a range of supportive deliverables, inclusive of options to source practical legal and administrative experiential input from other countries.

An adjunctive approach would be for a professional body, such as the Environmental Law Association (ELA), to host a structured series of discursive webinars and workshops on both the development of HEC as a regulatory tool for the water law, and for the practical and pragmatic evolution of a discourse on the role of the public trust. The latter approach could consider inter-disciplinary collaboration on specific topics with local aquatic science professional bodies — such as the Southern African Society of Aquatic Scientists (SASAqS), the South African Wetland Society (SAWS) and/or the Freshwater Ecosystem Network (FEN).

The surface of the potential for a 'South African Public Trust in Water' has barely been scratched since its legislative invocation a quarter of a century ago. This approach suggested above will not only have the public interest in South African water resource governance at

[815] Schreiner B (2013) 'Why has the South African National Water Act been so difficult to implement?' 6 *Water Alternatives* 239-245. Schreiner notes that 'capacity resides in a number of places in society, not just in government.' at 244.

heart, but has the potential to ensure that many will, in the words of the late Kader Asmal '[a]wake every day, determined to ensure that the public trust is maintained'.[816]

(c) What next for WOTUS?

Subsequent to finaliastion of this thesis in late 2022, new WOTUS challenges and fresh attempts to define WOTUS took the stage. In a challenge that seeks to rely on the narrow plurality opinion in *Rapanos*, the matter of *Sackett v Env't Protection Agency*[817] (*Sackett*) was enrolled by the US Supreme Court. In parallel, on 30 December 2022, the Biden Administration released a new definitional rule for WOTUS (the '2022' rule)[818] which is the third attempt to define WOTUS since the CWR in 2015. This latest rule embodies the 1986 guidance, namely that wetlands are WOTUS when they are bordering, contiguous or neighbouring a WOTUS, even when separated from same by constructed dikes, natural river berms, barriers or beach dunes. As such it provides nothing new beyond codifying 30 years of post-1986 administrative practice. Insofar as the maintenance of connectivity is concerned, it is a step backwards from the intentions of the CWR.

In *Sackett* the issue devolves to whether a wetland, now separated by a road from a WOTUS, is itself a WOTUS. Seen in a hydroecological context, it is unlikely that the functional ecology of the WOTUS and the wetland are anything other than closely integrated — and that this connectivity would be borne out by a significant nexus determination. The courts below held that the wetland is WOTUS based on the *Rapanos* significant nexus guidance. The Supreme Court is now tasked with deciding whether the lower court was correct in choosing the significant nexus test. Thus, there is a chance that the *Sackett* decision may chose the narrow definition of WOTUS that will devalue, or might even discard, the significant nexus test, notwithstanding how radical such a determination might be. Additionally, it could invalidate the Biden administration's new definition before it has a chance to breathe. Alternatively, it may discard the narrow *Rapanos* plurality decision in favour of the significant nexus test. As was the case with the CWR, several Republican multistate challenges have already emerged to silence the latest attempt at WOTUS definition.[819]

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[816] See Chapter 5.
[817] *Michael Sackett, et ux., v Environmental Protection Agency* et al. US21-454.
[818] Revised Definition of "Waters of the United States". EPA-HQ-OW-2021-0602. 514 pp.
[819] eg *State of Texas et al v USEPA et al* 3:23-cv-00017; *State of West Virginia et al v USEPA et al* 3:23-cv-00032-DLH-ARS; *Kentucky Chamber of Commerce et al v USEPA et al* 3:23-cv-00008-GFVT.

It appears obvious that comprehensive water resource protection in the USA can only suceed if all small streams and intermittent and ephemeral waters are protected by federal law. This appears to be a highly unlikely scenario in the absence of a sustained period of Democrat leadership and a Congress that is led by the same party. Despite the very positive connectivity-directed approach of the CWR, water resources in the USA stand to remain disconnected and at risk of sustained harm for the foreseeable future.

(d) Conclusions

This thesis set out to evaluate the potential of the CWR as a template for a HEC-directed approach to water resource governance in South Africa. Adjunctively, the role of the public trust as a legal instrument for offsetting land expropriation challenges was examined using the example of protecting headwater streams. The value of an HEC approach is such that it providentially decreases the risk associated with decision making taken at too discrete a spatial scale, by expanding the decision to a system-wide consideration. Central here is that such a HEC approach will probably place restrictions on land uses undertaken on land hitherto perceived as being completely terrestrial, as opposed to ecotonal. To counter this the role of the public trust, which renders all elements (terrestrial and aquatic) of a water resource 'public', will separate such lands into a public trust title in parallel with that of property ownership. On this model no loss or expropriation of private land occurs, the use thereof is merely and legitimately limited. The public interest in, and future demands on, the water resource are thus accommodated.

Additionally, the key principles of the public trust have been clearly distilled out and formulated into the example of a procedure that positions them within a beneficial use determination. Here it is maintained that, in order for a water use to comply with the public interest, a public trust determination must be central to the decision making process. The proposed procedure could be applied to all new applications for WULs,[820] and also be inserted into existing licences at the review stage, given that the public trust accommodates the reconsideration of prior allocations.

The following conclusions are drawn:

[820] Such determinations should not be limited to water law but should take other environmental laws into consideration as well.

1. The concept of HEC provides a logical and scientifically-established approach to water resource governance, by requiring that the existence of any or all connections between resource components are considered as parts of an integrated whole;
2. The Clean Water Rule provides an 'off-the-shelf' template suitable for the creation of a South African regulatory equivalent;
3. The findings of an analysis to determine the proximity of wetlands to adjacent streams and rivers reveals that mere consideration of riparia and the 1:100 floodplain are likely to exclude a large number of connected components provisionally shown to be present within 1200 meters either side thereof. This provides a useful delineation of the potential spatial extent of HEC;
4. With (3) in mind, adoption of a connectivity approach to water resource governance is likely to be perceived as a legal over-reach and intrusion on private land uses. Here it is proposed that the public trust, viewed as a perpetual charitable trust, provides the legal instrument to overcome such challenges;
5. The expression of the public trust instrument in the NWA is regarded here as weak and insufficient. While the role of the public trust and its principles may be implied from the Act, this is considered to be far from sufficient. The Act, in particular Chapter 4 which deals with water uses, was constructed absent any foundation on specific public trust principles;
6. This is the first attempt since promulgation of the Act to distil out the principles of the public trust, including a determination of the intentions for the inclusion of the trust as in the minds of the drafters;
7. Ensuring that a water use is both societally-acceptable and sustainable in the long term is encapsulated in the concept of a beneficial use. The proposed protocol for a beneficial use determination is based on public trust principles. Within this model the public interest obligation is met if the public trust principles are complied with;
8. This assessment of the value of HEC has provided one example of how the public trust principles can be meaningfully integrated into a normative context. As such a new approach for water resource governance is exposed and highlighted and, at the same time, provides illustrative depth as to the nature and operative potential of the public trust;
9. The elucidation of the public trust principles and the architecture of the trust extends beyond water to other disciplines of environmental law (eg biodiversity, wildlife, marine and coastal zones and environmental law pertaining to essential renewable

natural resources in general). Similarly the operationalisation of the trust is likely to benefit from the evocation of an underpinning freshwater ethic.

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ANNEXURE 1: PTD FOUNDATION CASES

List of cases determined by this research to be foundational in establishing the traditional and modern versions of the Public Trust Doctrine (1774-2019) and which are variously drawn from in this thesis.

Case[1]	Year	Citation	Notable for...
Harrison v Sterett	1774	4H & McH. 540	Connection between Roman and Public Trust law
Palmer v Mulligan	1805	3 Cai. 307 (N.Y.)	Citation of Lord Hale's treatise re the seashore
Palmer v Mulligan	1805	3 Cai. R. 307	Rivers under the servitude of the public interest (Hale)
Carson v Blazer	1810	2 Binn. 475	Right to fish
Arnold v Mundy	1821	6 N.J.L. 1	Submerged lands
Martin v Waddell	1842	41 U.S. 367	Submerged lands (ratifies *Arnold*), Magna Carta origins
Pollard's Lessee	1845	44 U.S. 212	Recovery of submerged lands
Munn v Illinois	1876	94 U.S. 113	Regulation of industries that affect the common good[2]
Hardin v Jordan	1891	140 U.S. 371	Riparian rights to inland lakes
Illinois Central	1892	146 U.S. 387	Submerged lands are held in public trust[3]
Lamprey v Metcalf	1893	53 N.W. 1139	Recreational use establishes navigability[4]
Shively v Bowlby[5]	1894	152 U.S. 1	Protection of tidelands
Geer v Connecticut	1896	161 U.S. 519	Wildlife protection
Gibson v USA	1897	166 U.S. 269	No compensation for levees that restrict riparian access
Houston & T.C.Ry.Co	1904	81 S.W. 279 (Tex)	Scientific proof of link between ground- and surface water
Georgia v Tenn. Copper	1907	206 U.S. 230	Interests of the State independent of the titles of its citizens[6]
Hudson County Wat'r Co	1908	209 U.S. 349	Judge Oliver Wendell Holmes statements[7]
People v California Fish	1913	166 Cal. 576	Foundation case for the PTD in California
US v Chandler-Dunbar	1913	33 S.Ct. 667	Title of riparian owner to a streambed is qualified.
Diana Shooting Club	1914	145 N.W. 816	Right to hunt within the ordinary high water marks
Boone v Kingsbury	1928	206 Cal. 148	Removal of offshore oil drilling derricks.
New Jersey v New York	1931	283 U.S. 336	A river is a necessity of life..[8]
Muench v Pub Serv Comn	1952	53 N.W.2d 514	Requirement for broad-based decision making
Gould v Greylock	1966	215 N.E.2d 114	State may not permit trust assets to be transferred to private.[9]
Robbins v Public Works	1969	355 Mass. 328	PTD application to swamp wetlands
Marks v Whitney	1971	6 Cal.3d 251	First application of the PTD to ecological values[10]
Just v Marinette County	1972	201 N.W.2d 761	Wetland infilling
Borough of Neptune	1972	294 A.2d 47 (N.J.)	Beach access fees
Payne v Kassab	1973	312 A.2d (86) (Pa)	Requirement for reasonable effort to mitigate resource harm
United Plainsmen	1976	247 N.W. 2d 457	Requirement for comprehensive water planning
Kaiser Aetna v US	1979	444 U.S. 164	PTD does not apply to artificial waters.

[1] Cases in bold text are US Supreme Court judgments.
[2] Property that is devoted to a public use is subject to public regulation.
[3] PTD principles enable a prior and invalid allocation of trust resources to be undone by a subsequent government.
[4] Foundational case for the sovereign usufructuary Public Trust Doctrine — creating the 'anything that floats for recreation' created public waters — the decision expanded of the US definition of 'navigability' to include recreational and other uses. In *Lusher* (56 P.2d 1158) the court held that the term 'commerce' extended beyond 'pecuniary profit' to allow recreation on private lakes.
[5] Source of the notion that the PTD is a state doctrine.
[6] Judge Holmes: "[T]he State has an interest independent of and behind the titles of its citizens, in all the earth and air within its domain."
[7] Judge Holmes: "[F]ew public interests are more obvious, indisputable and in dependent of a particular theory than the interest of the public of a State to maintain the rivers... substantially undiminished." "[T]he private property of riparian proprietors cannot be supposed to have deeper roots" (than the right of the State to protect its rivers undiminished for public use." This statement was regarded by Joseph Sax as being "probably the most far-reaching statement of a public right in water... ever made in an American judicial opinion." Sax JL (1990) The Constitution, property rights and the future of water law. 61 *U. Colo L. Rev* 257. See also *Georgia v Tennessee Copper Company & New Jersey v New York.*
[8] Judge Holmes: "A river is... a necessity of life that must be rationed amongst those who have power over it".
[9] Expressing a PTD requirement for express legislative action.
[10] "...one of the most important public uses of tidelands... is the preservation of those lands in their natural state".

Berkley v Sup Ct Alameda	1980	26 Cal.3d 515	Tidal flats
US v 1.5 acres of land	1981	523 F. Supp. 120	Federal/State co-trusteeship of PTD obligations
National Audubon Soc[11]	1983	658 P.2d 709 (Cal)	Balancing & affirmative duty of continuing supervision[12]
State v Bleck	1983	338 N.W.2d 492 (Wis)	Riparian rights do not subsume public interest in the *res*
Kootenai Envtl. Alliance	1983	671 P.2d 1085	PTD provides boundaries to permissible government action
Matthews v Bay Head	1984	471 A.2d 355 (N.J)	Combining *jus publicum* with *jus privatum*[13]
Montana Coalition	1984	682 P.2D 163 (Mont)	Public right to recreational use of waters on private land
Shokal v Dunn	1985	707 P.2d 441 (Idaho)	Water appropriations must benefit the public[14]
US v State Water Res.	1986	227 Cal. Rptr. 161	Consideration of water quality to protect the resource.[15]
USA v SWRCB ('Delta')	1986	182 Cal.App.3d 82	Reversal of upstream diversions for downstream water qual.
Galt v State	1987	731 P.2d 912 (Mont)	All state waters are reserved for use by the people
Owischek v Alaska GLCB	1988	763 P.2d 488 (Alaska)	Anti-monopoly role of PTD via "common use" clause
East Bay MUD	1989	No. 425955	Protection of fisheries, riparia and recreation.[16]
Loyola	1990	742 F. Supp. 441	Privtisation of water resource violates trust principles.
Waiahole Ditch	2000	9 P.3d (Hawai'i)	Public trust *res* includes groundwater[17]
McQueen v SCCC	2000	340 S.C. 65	Denial to backfill wetlands does not constitute a taking.
Idaho v United States	2001	533 U.S. 262	Tribal ownership of streambeds in tribal lands
Avenal v State	2004	886 So. 2d 1085	Protection of shoreline to enhance wildlife and fisheries
Marion County v Greene	2009	5 So. 3d 775 (Fla)	PTD = criterion for a regulated riparian permit
Lake Beulah Mgmt Dis't	2011	335 Wis.2d 47	Demonstrating substantive and procedural role of the PTD
PPL Montana	2012	565 U.S. 576	Public trust obligations pre-date constitutions
Bonser-Lain v Texas Com	2012	WL 2940641 (Texas)	Air and atmosphere are natural resources of the State[18]
Rock-Koshkonong	2013	833 N.W. 2d 800	Setting of lake water levels
Robinson Township[19]	2015	83 A.3d 901	Fracking. Groundwater and ambient air are PTD resources[20]
San Francisco Baykeeper	2015	242 Cal. App. 4th 202	PTD applies to mining and dredging leases[21]
Juliana v US	2016	217 F.Supp.3d 1224	Atmospheric trust litigation (ATL)[22]
Foster v Washington[23]	2017	200 Wash. App. 1035	Linked atmosphere to the hydrological cycle (water *res*)[24]
Morvich v Lobermeier	2018	379 Wis.2d 269	Ownership of riparian lands subservient to PTD[25]
Urgenda v Netherlands	2018	ECLI:NL:RBDHA	Implementation force for an international treaty[26]
Chernaik v Brown	2019	295 Or App 584	International customary law role of the PTD[27]

[11] Importance of resource protection for trust resources.
[12] Groundwater is equivalent to a tributary of a lake or river or wetland and tributaries are of vital importance to the whole of a riverine aquatic ecosystem. The ruling stressed the evolving role of the PTD and that such adaptation of the doctrine forms part of the responsibilities and duties of the doctrine. Affirmation of a public trust easement.
[13] This case has been pivotal in asserting public access rights to the seashore and to the dry sands adjacent thereto. Reaffirmed by *Raleigh Avenue Beach Association* 879 A.2d 112 (N.J. 2005) - an accommodation between beach access and private ownership.
[14] "Trust interests include property values, 'navigation, fish and wildlife habitat, aquatic life, recreation, aesthetic beauty and water quality'".
[15] This is the only Californian case since *Nat'l Audubon* (1983) in which the PTD was successfully raised in litigation by the year 2012.
[16] Diversions and dewatering of a river by appropriators is subject to the public trust.
[17] Ruling provides a methodology for assessing stream abstractions and diversions in the public interest.
[18] The PTD is constitutionally provided for in Article XV1 s59 of the Texas Constitution.
[19] Very important recent PTD case.
[20] The legislature must "act affirmatively to protect the environment... has a duty to refrain from permitting or encouraging the degradation, diminution or depletion of public resources... [either[through direct state action or indirectly... through failure to restrain the actions of private parties.
[21] The state trustee has an "affirmative duty to take the public trust into account in the planning and allocation of [trust] resources, and to protect public trust uses whenever feasible".
[22] PTD applies to both the federal and state governments.
[23] Washington State Court of Appeals (*Foster II*)
[24] "The navigable waters and the atmosphere are intertwined and to argue a separation of the two, or to argue that GHG emissions do not affect navigable waters is nonsensical".
[25] This case provided access rights to a river in the absence of riparian rights to a man-made waterbody. Access by the public to privately-owned lakes is currently being tested in *Kramer v Lake Oswego* 2017 WL 6605507.
[26] Non-US caselaw.
[27] Brief of *amici curiae* law professors in support of petitioners. Oregon Supreme Court No. S066564 at 7.

APPENDIX 2: DEFINITION OF WATERS OF THE UNITED STATES (CWR 2015)

Annotated to show comparison with the Navigable Waters Protection CWR (2020) and the Waters of the United States (1986). [1]

Authority 33 U.S.C. 1251 et seq

§ 328.3 Definitions.

(a) For purposes of the Clean Water Act, 33 U.S.C. 1251 *et seq.* and its implementing regulations, subject to the exclusions in paragraph (b) of this section, the term ''waters of the United States'' means:

(1) *All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;*

(2) *All interstate waters, including interstate wetlands*;

(3) The territorial seas;

(4) All impoundments of waters otherwise identified as waters of the United States under this section;

(5) All tributaries, as defined in paragraph (c)(3) of this section, of waters identified in paragraphs (a)(1) through (3) of this section;

(6) All waters adjacent to a water identified in paragraphs (a)(1) through (5) of this section, including [adjacent] wetlands, ponds, lakes, oxbows, impoundments, and similar waters;

(7) All waters in paragraphs (a)(7)(i) through (v) of this section where they are determined, on a case-specific basis, to have a significant nexus to a water identified in paragraphs (a)(1) through (3) of this section. The waters identified in each of paragraphs (a)(7)(i) through (v) of this section are similarly situated and shall be combined, for purposes of a significant nexus analysis, in the watershed that drains to the nearest water identified in paragraphs (a)(1) through (3) of this section. Waters identified in this paragraph shall not be combined with waters identified in paragraph (a)(6) of this section when performing a significant nexus analysis. If waters identified in this paragraph are also an adjacent water under paragraph (a)(6), they are an adjacent water and no case-specific significant nexus analysis is required.

(i) *Prairie potholes.* Prairie potholes are a complex of glacially formed wetlands, usually occurring in depressions that lack permanent natural outlets, located in the upper Midwest.

[1] Text removed by the 2020 Navigable Waters Protection CWR (NWPR) is shown underlined; relevant text inserted by the NWPR shown in [parentheses]; text comparable with the 1986 guidance shown in *italics*.

(ii) Carolina bays and Delmarva bays. Carolina bays and Delmarva bays are ponded, depressional wetlands that occur along the Atlantic coastal plain.

(iii) Pocosins. Pocosins are evergreen shrub and tree dominated wetlands found predominantly along the Central Atlantic coastal plain.

(iv) Western vernal pools. Western vernal pools are seasonal wetlands located in parts of California and associated with topographic depression, soils with poor drainage, mild, wet winters and hot, dry summers.

(v) Texas coastal prairie wetlands. Texas coastal prairie wetlands are freshwater wetlands that occur as a mosaic of depressions, ridges, intermound flats, and mima mound wetlands located along the Texas Gulf Coast.

(8) All waters located within the 100-year floodplain of a water identified in paragraphs (a)(1) through (3) of this section and all waters located within 4,000 feet of the high tide line or ordinary high water mark of a water identified in paragraphs (a)(1) through (5) of this section where they are determined on a case-specific basis to have a significant nexus to a water identified in paragraphs (a)(1) through (3) of this section. For waters determined to have a significant nexus, the entire water is a water of the United States if a portion is located within the 100-year floodplain of a water identified in paragraphs (a)(1) through (3) of this section or within 4,000 feet of the high tide line or ordinary high water mark. Waters identified in this paragraph shall not be combined with waters identified in paragraph (a)(6) of this section when performing a significant nexus analysis. If waters identified in this paragraph are also an adjacent water under paragraph (a)(6), they are an adjacent water and no case-specific significant nexus analysis is required.

(b) The following are not ‘‘waters of the United States’’ even where they otherwise meet the terms of paragraphs (a)(4) through (8) of this section.

(1) Waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of the Clean Water Act.

(2) Prior converted cropland. Notwithstanding the determination of an area’s status as prior converted cropland by any other Federal agency, for the purposes of the Clean Water Act, the final authority regarding Clean Water Act jurisdiction remains with EPA.

(3) The following ditches:

(i) Ditches with ephemeral flow that are not a relocated tributary or excavated in a tributary.

(ii) Ditches with intermittent flow that are not a relocated tributary, excavated in a tributary, or drain wetlands.

(iii) Ditches that do not flow, either directly or through another water, into a water identified in paragraphs (a)(1) through (3) of this section.

(4) The following features:

(i) Artificially irrigated areas that would revert to dry land should application of water to that area cease;

(ii) Artificial, constructed lakes and ponds created in dry land such as farm and stock watering ponds, irrigation ponds, settling basins, fields flooded for rice growing, log cleaning ponds, or cooling ponds;

(iii) Artificial reflecting pools or swimming pools created in dry land;

(iv) Small ornamental waters created in dry land;

(v) Water-filled depressions created in dry land incidental to mining or construction activity, including pits excavated for obtaining fill, sand, or gravel that fill with water;

(vi) Erosional features, including gullies, rills, and other ephemeral features (and streams) that do not meet the definition of tributary, non-wetland swales, and lawfully constructed grassed waterways; and

(vii) Puddles.

(5) Groundwater, including groundwater drained through subsurface drainage systems.

(6) Stormwater control features constructed to convey, treat, or store stormwater that are created in dry land.

(7) Wastewater recycling structures constructed in dry land; detention and retention basins built for wastewater recycling; groundwater recharge basins; percolation ponds built for wastewater recycling; and water distributary structures built for wastewater recycling.

(c) *Definitions.* In this section, the following definitions apply:

(1) *Adjacent. The term adjacent means bordering, contiguous, or neighboring* a water identified in paragraphs (a)(1) through (5) of this section, *including waters separated by constructed dikes or barriers, natural river berms, beach dunes, and the like.* For purposes of adjacency, an open water such as a pond or lake includes any wetlands within or abutting its ordinary high water mark. Adjacency is not limited to waters located laterally to a water identified in paragraphs (a)(1) through (5) of this section. Adjacent waters also include all waters that connect segments of a water identified in paragraphs (a)(1) through (5) or are located at the head of a water identified in paragraphs (a)(1) through (5) of this section and are bordering, contiguous, or neighboring such water. Waters being

used for established normal farming, ranching, and silviculture activities (33 U.S.C. 1344(f)) are not adjacent.

[(i) Abut, meaning to touch at least at one point or side of a water as identified...;

(ii) Are inundated by flooding from a water as identified... in a typical year;

(iii) Are physically separated from a water as identified... only by a natural berm, bank, dune, or similar natural feature; or

(iv) Are physically separated from a water as identified... only by an artificial dike, barrier, or similar artificial structure so long as that structure allows for a direct hydrologic surface connection between the wetlands and the water as identified... in a typical year, such as through a culvert, flood or tide gate, pump, or similar artificial feature. An adjacent wetland is jurisdictional in its entirety when a road or similar artificial structure divides the wetland, as long as the structure allows for a direct hydrologic surface connection through or over that structure in a typical year].

(2) *Neighboring.* The term *neighboring* means:

(i) All waters located within 100 feet of the ordinary high water mark of a water identified in paragraphs (a)(1) through (5) of this section. The entire water is neighboring if a portion is located within 100 feet of the ordinary high water mark;

(ii) All waters located within the 100- year floodplain of a water identified in paragraphs (a)(1) through (5) of this section and not more than 1,500 feet from the ordinary high water mark of such water. The entire water is neighboring if a portion is located within 1,500 feet of the ordinary high water mark and within the 100-year floodplain;

(iii) All waters located within 1,500 feet of the high tide line of a water identified in paragraphs (a)(1) or (a)(3) of this section, and all waters within 1,500 feet of the ordinary high water mark of the Great Lakes. The entire water is neighboring if a portion is located within 1,500 feet of the high tide line or within 1,500 feet of the ordinary high water mark of the Great Lakes.

(3) *Tributary* and *tributaries.* The terms *tributary* and *tributaries* each mean a water that contributes flow, either directly or through another water (including an impoundment identified in paragraph (a)(4) of this section), to a water identified in paragraphs (a)(1) through (3) of this section that is characterized by the presence of the physical indicators of a bed and banks and an ordinary high water mark. These physical indicators demonstrate there is volume, frequency, and duration of flow sufficient to create a bed and banks and an ordinary high water mark, and thus to qualify as a tributary. A tributary can be a natural, man-altered, or man-made water and includes waters such as rivers, streams, canals, and ditches not excluded under paragraph (b) of this section. A water that otherwise

qualifies as a tributary under this definition does not lose its status as a tributary if, for any length, there are one or more constructed breaks (such as bridges, culverts, pipes, or dams), or one or more natural breaks (such as wetlands along the run of a stream, debris piles, boulder fields, or a stream that flows underground) so long as a bed and banks and an ordinary high water mark can be identified upstream of the break. A water that otherwise qualifies as a tributary under this definition does not lose its status as a tributary if it contributes flow through a water of the United States that does not meet the definition of tributary or through a non- jurisdictional water to a water identified in paragraphs (a)(1) through (3) of this section.

[The term *tributary* means a river, stream, or similar naturally occurring surface water channel that contributes surface water flow to a water as identified... in a typical year either directly or through one or more waters as identified... . A tributary must be perennial or intermittent in a typical year. The alteration or relocation of a tributary does not modify its jurisdictional status as long as it continues to satisfy the flow conditions of this definition. A tributary does not lose its jurisdictional status if it contributes surface water flow to a downstream jurisdictional water in a typical year through a channelized non- jurisdictional surface water feature, through a subterranean river, through a culvert, dam, tunnel, or similar artificial feature, or through a debris pile, boulder field, or similar natural feature. The term *tributary* includes a ditch that either relocates a tributary, is constructed in a tributary, or is constructed in an adjacent wetland as long as the ditch satisfies the flow conditions of this definition].

(4) *Wetlands. The term wetlands means those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.*

(5) *Significant nexus.* The term *significant nexus* means that a water, including wetlands, either alone or in combination with other similarly situated waters in the region, significantly affects the chemical, physical, or biological integrity of a water identified in paragraphs (a)(1) through (3) of this section. The term ''in the region'' means the watershed that drains to the nearest water identified in paragraphs (a)(1) through (3) of this section. For an effect to be significant, it must be more than speculative or insubstantial. Waters are similarly situated when they function alike and are sufficiently close to function together in affecting downstream waters. For purposes of determining whether or not a water has a significant nexus, the water's effect on downstream paragraph (a)(1) through (3) waters shall be assessed by evaluating the aquatic functions identified in paragraphs (c)(5)(i) through (ix) of this section. A water has a significant nexus when any single function or combination of functions performed by the water, alone or together with similarly situated waters in the region, contributes significantly to the chemical, physical, or biological integrity of the nearest water identified in paragraphs (a)(1) through (3) of this section. Functions relevant to the significant nexus evaluation are the following:

(i) Sediment trapping,

(ii) Nutrient recycling,

(iii) Pollutant trapping, transformation, filtering, and transport,

(iv) Retention and attenuation of flood waters,

(v) Runoff storage,

(vi) Contribution of flow,

(vii) Export of organic matter,

(viii) Export of food resources, and

(ix) Provision of life cycle dependent aquatic habitat (such as foraging, feeding, nesting, breeding, spawning, or use as a nursery area) for species located in a water identified in paragraphs (a)(1) through (3) of this section.

(6) *Ordinary high water mark. The term ordinary high water mark means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.*

(7) *High tide line. The term high tide line means the line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm.*