Accessibility and open-source initiatives within water data governance frameworks: A mixed methods survey and focus group of ICWP member and non-member organizations

By Daisy Schaub, Spring 2025 Intern

July 1st, 2025

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[1] Paul Marsh, "Comment: Dreaming the Possible – Data and the Future of Water | Envirotec," Envirotecmagazine.com, October 16, 2022, https://envirotecmagazine.com/2022/10/16/comment-dreaming-the-possible-data-and-the-future-of-water/.

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Background

Water governance is historically fragmented across the United States[2], with each organization approaching it according to differing geographic and ecological concerns, authority, data systems, types of data, and target end-users. Water data governance can be defined by two components: water data, the measurements "of basic properties relating to the planning and management of water resources, including streamflow, precipitation, groundwater, soil moisture, snow, evaporation, water quality, and water use in agriculture, industry, natural systems, and municipal uses",[3] and its governance, or the "collective decisions and choices" made with this data that emerges through formal and informal institutions.[4]

Water data is similarly fragmented due to the use of multiple sources and methodologies. This fragmented data sharing makes for an "incomplete data coverage".[5] Water governance is commonly fragmented around different realms such as water allocation, water quality, endangered species protection, storage and distribution systems, and hydropower production, making it difficult to measure, prioritize, and standardize water data.[6]

With no holistic water data governance framework for resource management across the country to follow, it can be characterized as a "pragmatic federalism" built on collaborative partnerships, adaptable management strategies, and a problem and process focus.[7] Increasing water sharing through these partnerships is important not only to mitigate the disastrous effects of flooding, drought, and water scarcity, but also to improve efficiency and collaboration between different water users at the national level.

Defining Water Data Accessibility and Its Considerations

The Interstate Council on Water Policy (ICWP)'s priority for Water Data Governance Research Spring 2025 is to enhance understanding of existing and potential efforts aimed at developing and publishing accessible, standardized, high-quality data among its member and prospective member organizations. These considerations are more important than ever in the face of funding uncertainties, future drought, and other hazardous climate events. Through a survey and focus group, this research intends to facilitate discussion between agencies on their challenges and progress regarding data sharing. It also supports the Internet of Water (IoW)'s mission for "open water".

The Internet of Water (IoW) Coalition is one crucial organization advocating for nationwide data sharing. Their mission for "open water" aims to strengthen data infrastructure, open-source technology, and outcomes for resilient, sustainable, and equitable

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[2] Adam Reimer, "US Water Policy: Trends and Future Directions" (Pennsylvania: National Agricultural & Rural Development Policy Center, October 13, 2013), 28.
[3] Melanie Ann, "Text - H.R.7792 - 117th Congress (2021-2022): Water Data Act," Congress.gov, 2021, https://www.congress.gov/bill/117th-congress/house-bill/7792/text.
[4] Samuel Gallaher and Tanya Heikkila, "Challenges and Opportunities for Collecting and Sharing Data on Water Governance Institutions," *Journal of Contemporary Water Research & Education* 153, no. 1 (April 2014): 66–78, https://doi.org/10.1111/j.1936-704x.2014.03181.x, 67.
[5] Melinda Laituri and Faith Sternlieb, "Water Data Systems: Science, Practice, and Policy," *Journal of Contemporary Water Research & Education* 153, no. 1 (April 2014): 1–3, https://doi.org/10.1111/j.1936-704x.2014.03174.x, 1.
[6] Gallaher and Heikkila, "Challenges and Opportunities," 66.
[7] Andrea Gerlak, "Federalism and U.S. Water Policy: Lessons for the Twenty-First Century," *Oxford Journal* 36, no. 2 (2006): 231–57, https://www.jstor.org/stable/4624743, 233.

water stewardship.[8] With a vast water network, their efforts focus on improving the "findability" and "accessibility" of organizations' water data. As the coalition defines, findability is how data is published on the web with best practices to be found more easily by other users. The accessibility of water data, how available full data sets are to the public or authorized users for download in machine-readable, non-proprietary formats, is an especially crucial component to water data sharing.[9]

Similar to research by the Internet of Water Coalition, this project aims to serve as an inventory of current or planned water data sharing efforts among ICWP members. In particular, the questions build upon the Open Data and Tools for Automated Data Analysis (TADA) research done by the Radical Open Science Syndicate (ROSS) at Colorado State University, the IoW, and the EPA.[10] ICWP's study centers on a better understanding of six main topics: initiatives for accessibility, funding, open-source development, tools for water sharing, user-driven design, and considerations for climate resilience.

Methods

This survey sampled 27 ICWP member and non-member organizations. There was an overall response rate of 81.48%, or 22 responses, with an 84.21% response rate from ICWP members and a 75% response rate from non-members surveyed.[11] Administered online, the questionnaire survey consisted of open and closed questions to yield both qualitative and quantitative findings. The survey intended to discover current initiatives for accessible and open-source data, including interest in accessibility, impacts, funding, impediments, target end-users, and plans for the future. Informed consent was acquired before completion of the survey.

Out of the organizations originally sampled, a group of four organizations, represented by six administrative and IT staff members, and two moderators came together for a virtual focus group discussion on Zoom.[12] A mix of one interstate and three state organizations, the focus group was designed to spark discussion of successful strategies for the following topics: accessibility initiatives, staff resources, funding, climate resilience, and social equity. Before the focus group was conducted, moderators informed participants of the purpose and obtained permission to record the meeting for this report.

Survey Name	Interstate Council on Water Policy (ICWP) Water Data Governance Survey
Sponsor	Interstate Council on Water Policy (ICWP)
Purpose	To improve water data center development and sharing among prospective and existing ICWP members. This survey aims to illuminate current initiatives regarding accessible and open-source data, including attitudes, impacts, funding, impediments, and plans for the future.
Date Started	April 4th, 2025

[8] "What We Do - Internet of Water," Internetofwater.org, 2025, https://internetofwater.org/what-we-do/.
[9] "Internet of Water Principles," Internetofwater.org (Internet of Water Coalition, November 2021), https://internetofwater.org/internet-of-water-principles/.
[10] Colorado State University, Department of Ecosystem Science and Sustainability, Radical Open Science Syndicate (ROSS), and Internet of Water Coalition, "Open-Source Collaborations for a Sustainable Water Future," Internet of Water Coalition - Policy Resources (Internet of Water Coalition, September 2024), https://internetofwater.org/policy-resources/, 5.
[11] Appendix 1.
[12] Appendix 2.

Target Population	ICWP Membership and Prospective Members
Sampling Frame	ICWP Membership and Prospective Members Contacts
Sampling Design	Non-Probability
Sample Size	19 member organizations/24 states, 8 prospective member organizations/8 states
Mode of Administration	Online via Qualtrics
Time Dimension	60 days
Frequency	One-time survey
Levels of Observation	Single-person
Web Link	https://qualtricsxmzzmrkdfls.qualtrics.com/jfe/form/SV_bdYUpIRL6JuakxU

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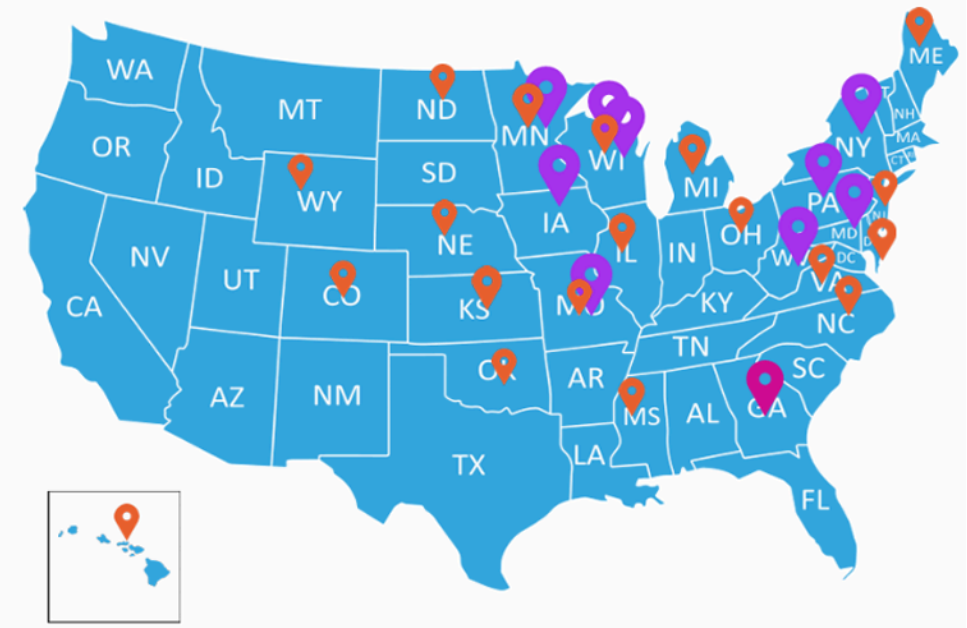
FINDINGS AND ANALYSIS: Survey

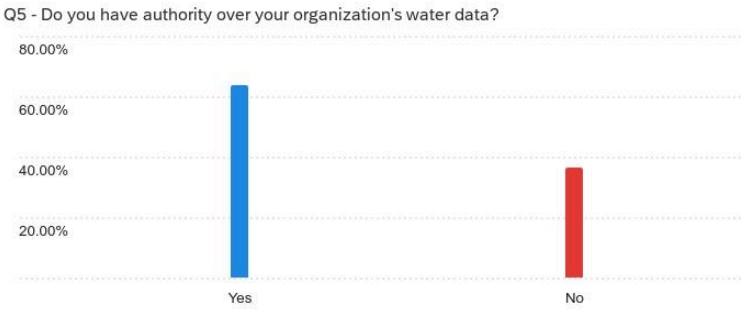


Q4 - Which best describes your organization level?

Field	State	Regional	Interstate
Which best describes your organization level?	16	1	5
Which best describes your organization level?	73.91%	4.35%	21.74%

[13] Sarah M Nusser, "Survey Methodology. Robert M. Groves, Floyd J. Fowler Jr., Mick P. Couper, James M. Lepkowski, Eleanor Singer, and Roger Tourangeau," *Quarterly Publications of the American Statistical Association* 101 (January 1, 2006): 1310–11.

Authority

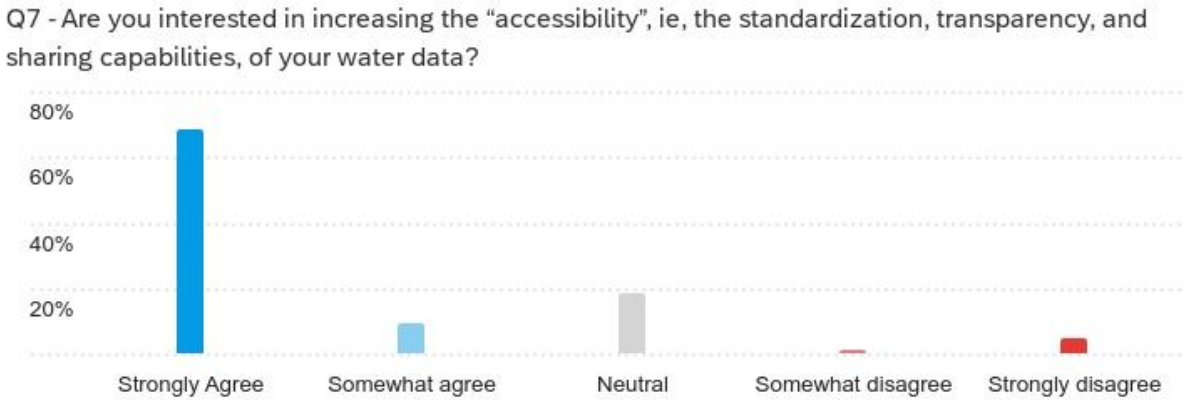


Authority is conceptualized as the performance of oversight or other regulatory functions over data collected by an organization, granted to them by a state statute or law. We then asked about the specific interactions each organization had with water data, regardless of authority. A little over 60% of respondents reported having authority over their water data, with about 39% reporting a lack of authority. For many state organizations, their priority in this interaction is to maintain a high-quality database according to a state or interstate compact, before submitting it to a national repository.

There is some nuance in the definition of authority and the responsibilities associated with it, however. Ownership over data and its monitoring is a specific complication. Since the Upper Mississippi River Basin Association is a 501(c)(3) nonprofit exempt from federal tax, it owns the monitoring plan but is without land or regulatory authority for its association of states. It coordinates and owns the plans to monitor the data, but does not have formal authority over data collection or analysis, instead relying on states and their resources.[14]

For the organizations that do not have authority over the water data they manage, they reported some data collection, but largely receive data from elsewhere. Some organizations allocate funding to other organizations to collect and analyze the data, such as Illinois' Lake Michigan Allocation program. The water office also funds the Illinois State Water Survey, with its water quality and environmental protection being evaluated by the Illinois EPA. Authority is further complicated for some interstate organizations that have both internal and external sources of data collection.

Interest in Improving Accessibility



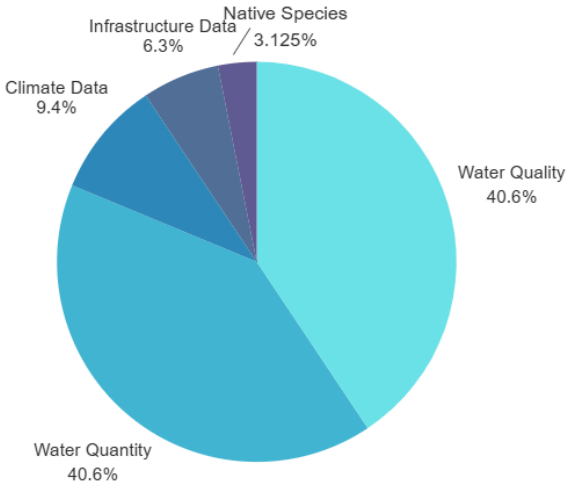
[14] Upper Mississippi River Basin Association (UMRBA).

For this study, accessibility consists of the standardization, transparency, and sharing capabilities of water data. Standardization can be defined as "the guidelines for the data, including how it is (1) structured (defining what data elements should be present); (2) populated (defining the kind and quality of information represented); (3) encoded in machine-readable formats; and (4) made interoperable for data exchange".[15] Transparency can be defined as "water data produced for the public to be findable, accessible, interoperable, and reusable (FAIR) for public use or authorized users".[16] Sharing capabilities is defined as "interoperability: data bulk download formats and application programming interfaces (APIs) that follow community standard patterns; metadata are included with data and of sufficient quality for users to make judgments as to what purposes the data is fit for use; and data content references including publicly available definitions, controlled vocabularies, and data standards appropriate to the data's subject matter".[17]

Out of all organizations surveyed, 75% reported a strong interest in increasing the accessibility of their water data. While many expressed some lack of knowledge about accessibility and open-source initiatives, overall, they expressed a desire to strengthen the sharing capabilities of their water data.

For the 19% of organizations neutral towards improving accessibility, they reported security concerns, quality of existing initiatives, or did not provide supplemental reasons. Two state organizations cited that increasing the availability of data via the internet or public websites was sufficient work towards accessibility. Another reported that the complexity of data impeded potential work towards accessible water data. The one organization strongly disinterested in accessibility does not have the authority to expand its water data sharing capabilities.

Types of Data

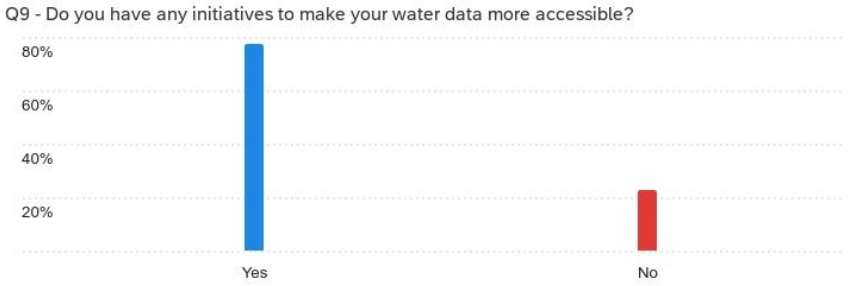


[18]

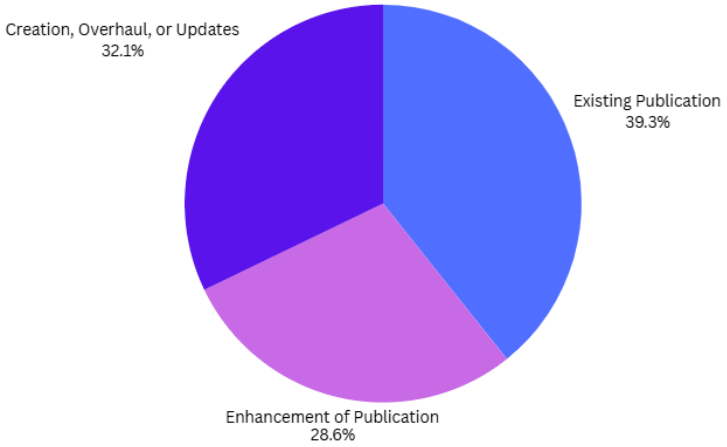
A diverse array of data was reported as part of existing accessibility initiatives. As categorized above, each organization focused on multiple types of water data, with water quality and water quantity being the most prevalent.

[15] "Internet of Water Principles".
[16] Ibid.
[17] Ibid.
[18] Appendix 6. See appendices for full list of data types reported.

Initiatives



Almost 80% of respondents report an existing data accessibility initiative. An initiative can be defined by the many forms respondents provided, including plans, general efforts, allocation of funds and staff resources, data platforms, tools, or specific programs. There are some responses about work done, such as "via the internet" and "data collection processes", that merit further exploration. The reported initiatives are categorized as follows: existing publication, enhancement of online communications, and the creation or overhaul of data management systems and platforms.



Existing Accessibility

The existing accessibility of water data is a reported initiative of many organizations, with diverse methods of publication. The Water Quality Index, an Open Data and Mapping Hub, a MapServices platform, OpenCDSS, and use of the EPA's Water Quality Database are a few initiatives that have already been established.[19] Maintaining the code via GitHub is reported among two agencies.[20] Organizations also ensure that accessible data is shared via StoryMaps, open-source software, API's, and for many, via the internet.[21]

Enhancement of Publication and Online Communications

Enhancement of publication and online communications to the public and other stakeholders is a similar initiative. Training and webinars with nonprofits to introduce

[19] Interstate Commission on the Potomac River Basin (ICPRB), Atlanta Regional Commission's (ARC) Metropolitan North Georgia Water Planning District, North Dakota Department of Water Resources (DWR), Colorado Water Conservation Board (CWCB), Delaware River Basin Commission (DRBC).
[20] ICPRB and CWCB.
[21] ICPRB, CWCB, North Carolina Department of Environmental Equality (DEQ), Nebraska Department of Natural Resources (DNR).

different types of data, where to find them, and how to use them is one initiative undertaken by an interstate organization.[22] One state organization is working on training opportunities through ESRI, such as Web App development and ArcPro Essential Workflows, that support the design of better data mapping applications.[23] Enhanced coordination with other external agencies to improve data sharing is another initiative.[24] Complying with best practices according to a House Bill regarding accessibility of websites is also a key effort.[25] Current work on policies to share "high capacity well information more readily and generating county-based water use reports that summarize water use data information" is also enhancing the shareability of this information.[26] Making a water resource collection available to the public for small streams that frequently flood is another initiative.[27] One state is also migrating interactive water data visualization tools into Power BI. The same state is also examining how "ArcGIS experiences and Apps may be incorporated into our data-sharing program to create better end-user experiences" to allow users to download source data from report visuals.[28]

Creation, Overhaul, and Updates of Data Systems and Platforms

A major initiative to improve accessibility is the creation, overhaul, and update of data management systems or publication platforms. Nine organizations have this work in progress. Many of the systems and platforms are created to aid the availability of data between agencies and water users. One interstate commission has developed a data portal for its member state agencies to improve coordination between the commission and member states.[29] Another River Basin commission has created an online water use record, the Water Rights Program, for use by citizens and permit holders.[30] The same organization intends to create, or track, the accessibility of enhanced water quality monitoring data to increase "greater access and use of agency-generated data in more accessible formats".[31] One interstate organization is creating a water resources database that includes both water quality and quantity.[32] Similarly, the Kansas Water Offices' Kansas Water Plan is focused on the implementation of new framework efforts to develop a statewide water dashboard to "encourage communities at risk to take stronger action to secure their water supply" and "serve as a transparent way for the state to measure its progress in meeting the rolling planning target, share best practices with communities about how to address their water needs, and connect communities with state resources, such as regional partnership opportunities".[33] Another organization is working on building a water availability assessment with help of funds from the Cooperative Institute for Research to Operations in Hydrology. [34] The Hawaii Commission on Water Resource Management's Planning Branch is pursuing similar work with Oceanit to make WRIMS data more accessible and user-friendly.[35]

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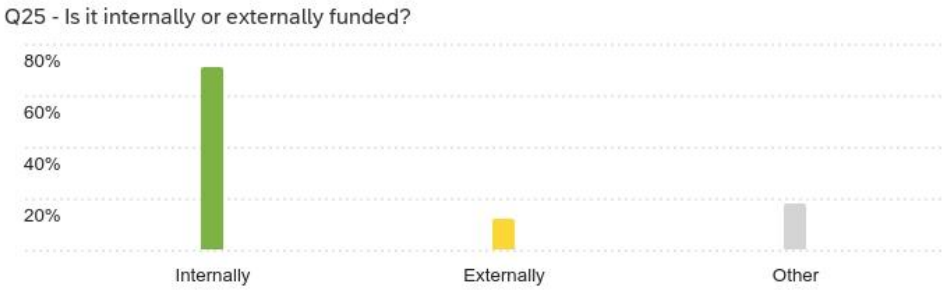
[22] DRBC.
[23] North Carolina DEQ.
[24] North Dakota Department of Water Resources (DWR).
[25] CWCB.
[26] Wisconsin Department of Natural Resources (DNR).
[27] Missouri Department of Natural Resources Water Resources Center (MoWRC).
[28] North Carolina DEQ.
[29] Susquehanna River Basin Commission (SRBC).
[30] Oklahoma Water Resources Board (OWRB).
[31] OWRB.
[32] UMRBA.
[33] Kansas Water Office (KWO).
[34] Minnesota Department of Natural Resources (MNDNR).
[35] Hawaii Commission on Water Resource Management (CWRM).

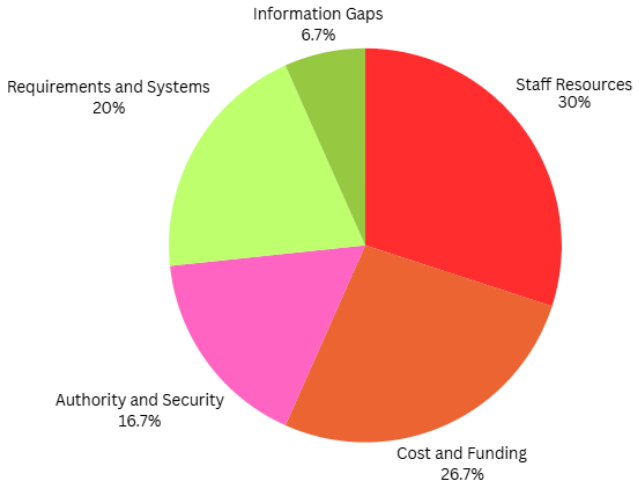
Other organizations are focused on updates to their data to improve accessibility, such as one project to add "more types of parameters and graphing, bulk downloading, and visual updates".[36] Another is undergoing a complete overhaul of the data management system so it's more readily available across programs, specifically enhancing data integration across monitoring programs to improve data analysis and availability to stakeholders.[37]

Funding



Around 75% of organizations reported internal funding for their accessibility initiatives. For most, these internal funds came from state or compact commission funding. Another 7% reported external funding, from federal or other stakeholders. The 18% who reported funds from other sources listed a mix of external or internal sources, such as the Delaware River Basin Commission, which is funded by their general budget, grants from the federal government, and other sources.[38] One state organization reported how the legislature controls their budget, but they have to work internally to prioritize funding to meet legislative mandates.[39]

Impediments to Accessibility



[36] MNDNR.
[37] Ohio River Valley Water Sanitation Commission (ORSANCO).
[38] DRBC.
[39] MNDNR.

Staff Resources

Nine of the organizations listed staff and staff resources as an impediment to accessibility work.[40] A lack of expertise and staff time are largely shared amongst respondents, specifically "in-house expertise to manage the data", and a "lack of coherent workgroup and IT support".[41] One staff member reported struggling to make their data complete due to the need for IT support.

For any accessibility work to be launched and successful, the durability and prioritization of staff expertise are needed. According to one state organization, "if the existing staff (and retired supervisor) were to leave, there would be no support or continuity for any of this data".[42] Staff time is an obstacle to performing this extra work. As one organization explains, more planning and modeling efforts are necessary to support platform development, as well as the ability to translate technical information into an easily interpretable format.[43] All of this requires additional staff time to plan and execute, when many staff are already swamped with day-to-day priorities.

Cost and Funding

A similar challenge to implementing or maintaining accessibility initiatives is the overall cost and funding of data management systems and information storage. Eight of the organizations cited cost or funding as the main impediment to this process.[44] Hosting and maintenance costs can be steep, not including the cost and capacity to design the technology. Steady funding to pay for these systems and IT staff to maintain them over time is also a limitation.

Authority and Security

Other impediments to water data accessibility initiatives include concerns over authority and security. Chain of command issues and authority over data collection prevent one organization from sharing its data between agencies.[45] One state organization faces statutory restrictions on sharing agricultural data.[46] Related to this authority, one organization provided data sharing agreements as an impediment to their initiative.[47]

One state organization cited security concerns as the principal challenge to this work. Privacy concerns over "public infrastructure" were reported by another two organizations.[48] In the experience of one respondent, private companies are not interested in sharing water with other agencies or end-users.[49] More research is needed on the impact of security on water sharing, including how it potentially ties to authority and private stakeholders.

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[40] OWRB, ORSANCO, UMRBA, MNDNR, MoWRC, Nebraska DNR, North Carolina DEQ, Michigan Department of Environment, Great Lakes, and Energy (DEGE), KWO.
[41] UMRBA and North Carolina DEQ.
[42] North Carolina DEQ.
[43] KWO.
[44] OWRB, UMRBA, MoWRC, DRBC, Hawaii Commission on Water Resource Management (CWRM), Michigan DEGE, KWO.
[45] ARC.
[46] Michigan DEGE.
[47] ICPRB.
[48] Wyoming Water Development Office, Wisconsin DNR, Virginia DEQ.
[49] Virginia DEQ.

Differing Agency Requirements and Systems

Similar to differences in authority and privacy limitations, many of the organizations sampled have different interstate compact and reporting requirements. For one interstate organization, cross-jurisdictional data compatibility was a main concern.[50] Grant requirements can similarly limit investments in new technology, such as UMRBA and Illinois' USEPA Exchange Network Grant, which requires them to reuse existing parts.

Reporting requirements are not uniform at times, according to one interstate commission.[51] Differing databases, operating systems, formats, and other requirements across organizations can also pose a challenge to sharing data easily, a challenge echoed in the focus group discussion. For example, some agencies might monitor water quantity daily, monthly, or by a 30-day average.[52] The complexity of financing the accessibility of different data also makes data sharing difficult, namely the "diverse nature of data types, formats, legacy data formats".[53] As another respondent provided, there are added risks of interpreting data without context between agencies and different users.[54]

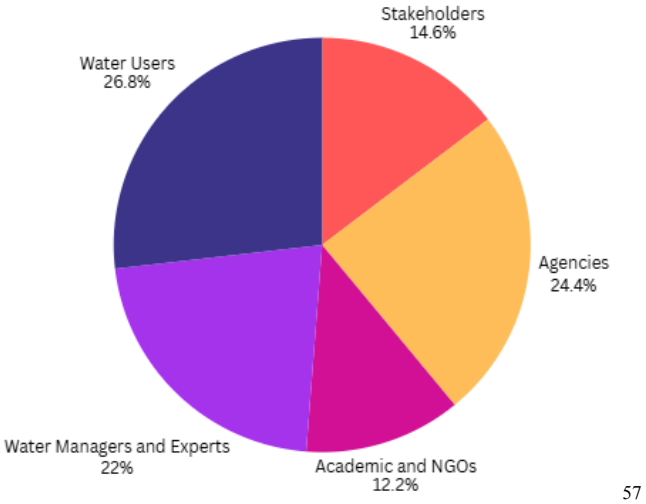
Information Gaps

Finally, a few organizations lack the proper information to share their water data. UMRBA, for example, is unaware of a shared database such as WQX, but for water quantity. Another struggles to make the data collected complete.[55] While most organizations report a lack of resources and funding for staff to start this endeavor, sharing information, tools, and other resources about accessibility via meetings, webinars, and websites can close information gaps.

Target End-Users and Intended Impact

Research from the IoW and other organizations recommends the inclusion of target end-users in the design of water data governance frameworks.[56] Prioritizing target end-users is crucial to an "open" water data framework, as it expands the number of decision-makers and fosters increased collaboration, ultimately forming a stronger network. A majority of study respondents include end-users in their program design. When asked who these target end-users were, respondents provided a diverse list of stakeholders, agencies, water experts, and water users.

[50] ICPRB.
[51] DRBC.
[52] SRBC.
[53] New Jersey Department of Environmental Protection (DEP).
[54] DRBC.
[55] Illinois DNR.
[56] "Open-Source Collaborations for a Sustainable Water Future," 5.



[57]

These various end-users were central to most organizations' responses regarding the intended impact of their initiative:

"To provide a framework where data can be compared across projects to make summaries and analyses more efficient" (Wyoming Water Development Office)

To better improve coordination between member states (SRBC)

"To make the data more readily available online" (Nebraska DNR)

To provide"flood warning, scientific information, planning information, etc." (Missouri DNR Water Resources Center)

"Real-time water data availability to increase understanding of ND's water resources. Additionally, the ability to provide disaster assistance during flooding events and identify areas where more water may be able to be appropriated" (North Dakota DWR)

"Increasing accessibility of our water data improves transparency and usability for our water users and constituents" (CWCB)

"Create tools that allow interested users to more intuitively view, search, and retrieve groundwater data to support groundwater research, groundwater resources management, and groundwater resource policy. " (North Carolina DEQ)

"Provide a user-friendly tool to help advance regional water supply planning efforts; provide a user-friendly tool to evaluate the overall effectiveness of a potential new rolling 10-year water investment program." (Kansas Water Office)

"To provide more types of data to the public, provide more tools in the website to look at the data, to make it easier for folks to download large volumes of data at once, to make everything accessible" (MNDNR)

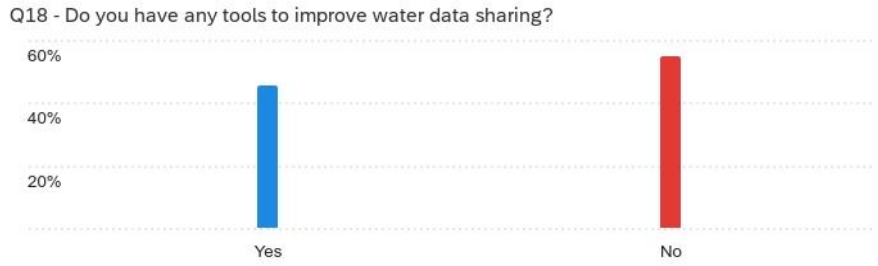
[57] Appendix 12. See appendices for full list of end-users reported.

"Allow other end users (various levels of government, consultants, etc.) more aware of what is going on with respect to water withdrawals in any specific region of the state" (Wisconsin DNR)

"Set IIFS, SY, ensure public trust resource is protected" (Hawaii Commission on Water Resource Management)

Open Source and Tools

Despite the high number of accessibility initiatives among respondents, only five open-source initiatives, with source code freely available for anyone to view, modify, and enhance, were reported. Two of the organizations make use of GitHub repositories for their data analysis or modeling software, along with open source licensing.[58] The sharing of tools and open-source code is another initiative.[59] One organization uses "wiski", a database that provides users access to data and the ability to download it. However, this database is not yet open to public users at the organization.[60] Another initiative is still being developed among one organization.[61]



Ten organizations use various websites, software, maps, and webinars as tools to share data. GitHub repositories, while being an approach to open-source code, are also a key tool reported by other respondents. Other software, such as TSTool and StateDMI, are also reported.[62] API's, or application programming interfaces, are used across many organizations for web access. Organizations also use ArcGIS and other map viewers to visualize water quantity and quality data.[63] StoryMaps are also used by two organizations to share maps, visuals, and other information.[64] The Minnesota Department of Natural Resources has extensive mapping and visualization tools, including their Watershed Health Assessment

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[58] CWCB.
[59] ICPRB.
[60] MNDNR.
[61] UMRBA.
[62] CWCB.
[63] CWCB and Wisconsin DNR.
[64] Hawaii CWRM and ICPRB.

Framework: Explorer, MN Climatology office Daily Climate and Climate Trends tools, Cooperative Stream Gaging (CSG), Cooperative Groundwater Monitoring Program (CGMP).[65] The Wisconsin Department of Natural Resources uses a web-based database query tool that allows users to search on various levels, such as county, watershed, and other parameters.[66] Others report general web and mobile app use to distribute and analyze data.[67]

Quality of Data

The survey also inquired how organizations were improving the quality of their data. For a few, this included manual QA and QC analysis and follow-up with data reporters and consultants.[68] One organization is implementing a USGS Water-Use Data and Research Program (WUDR) Grant specifically aimed at quality control/quality assurance of water use data, integrating historic water use data, and improving water use reporting data quality through flags and photodocumentation.[69] The Illinois Office of Water Resources is working to improve the completion of data collection through legislation.[70] One organization is working similarly to bridge gaps in data through initiatives to collect data from missing sectors.[71] Others are developing automation of data quality checks,[72] and Standard Operating Procedure (SOP) for data validation.[73] Sharing data that has been filtered and processed for "quirks" through Power BI, including data processing notes for end-users to understand the limits and exclusions of data they can view and retrieve.[74] Another organization similarly verifies data for quality in their system.[75]

Key Efforts:

- **Manual Analysis and Follow Up with Reporters and Consultants**
- **Aid from USGS WUDR Grant and Legislation**
- **Data Validation via Automation, Standard Operating Procedure, Power BI, and Existing Data System**

[65] MNDNR.
[66] Wisconsin DNR.
[67] CWCB and MoWRC.
[68] Michigan DEGE, Virginia DEQ, Wyoming Water Development Office, and Wisconsin DNR.
[69] Wisconsin DNR.
[70] Illinois DNR.
[71] SRBC.
[72] ORSANCO.
[73] MoWRC.
[74] North Carolina DEQ.
[75] Wyoming State Engineer's Office.

Future Plans for Accessibility

In addition to initiatives, tools, and quality of data, respondents were asked about their plans and ideas for water data accessibility. Their wide variety of responses includes increased data sharing between agencies and water users, funding, and overall prioritization of further development in their future operations:

"Program efficiency and additional staff time for other important program functions. Increased data sharing between state and federal agencies, in more usable formats," to provide more data-driven and informed decisions (OWRB)

Extending data access: To make historic water usage data accessible to water users (SRBC)

To continue to upgrade websites/tools to combine state agencies' data (MNDNR)

To pursue further grant opportunities (UMRBA)

" Develop products that summarize the data in the format our end users want it starting with county summary reports" (Wisconsin DNR)

"Developing a larger database to handle multiple data types and sources" (NJ DEP)

"Provide WRIMS data" (Hawaii Commission on Water Resource Management)

"Better data visualization and dissemination" (Michigan DEGE)

"Collecting new data from regional water supply plans" (Virginia DEQ)

"A special water legislative task force has been established, which will look at two main topics through January 2027. These include: • Funding • Recommendations on long-term structure, How the state water plan is created; • What the state water plan should prioritize; How the state water plan is implemented; How recommendations for state water plan appropriations are made; Any future studies that might be undertaken" (Kansas Water Office).

FINDINGS AND ANALYSIS: Focus Group

Following the survey results, we conducted a focus group to get more details on the topics introduced. Staff resources and cost of initiatives were the most highly reported impediments to furthering data accessibility. Almost all organizations chosen for this additional discussion reported a lack of staff resources and funding as impediments to accessibility in their survey responses. They also reported different approaches (data platform overhaul and enhancing online tools, for example) and progress with improving accessibility.

Focus group participants discussed upgrading and aggregating data for systems to be more user-friendly and accessible: "Power BI", putting siloed data to be commonplace, robust map services, "GEO Strat", and use of EPA's "WQX" and the Western States Water Council Water Data Exchange Program (WaDE).

Prioritizing staff time for each agency's higher priorities and implementing a realistic timeline are integral to sustaining this work long-term. Staff members are currently "running

at capacity" and busy with other priorities. When discussing how to address funding limitations, participants stressed the inconsistency of budgets. Keeping maintenance costs low and in-house to plan for funding uncertainties is a key strategy. One focus group member warns: "be wary of those super awesome solutions if there's a continuing cost associated with them when your budget is dependent on an unknown commodity… focus on keeping it simple as far as the systems we're providing and the storage and servers so that they're inexpensive and easily replaceable". Using commission or other funds is also helpful for funding these initiatives.

When asked about water data initiatives in support of flood mitigation and planning for future drought, two organizations discussed their successful deployment of soil moisture sensors. Through their PRESENS (Pushing REmote SENSors) Program, the North Dakota Department of Water Resources is working on remote sensors to collect soil moisture, temperature, and conductivity data to determine the "water equivalent of snowpack" and use soil temperature to help with flood warning for nearby streams. For emergency flooding events, they have also deployed remote and real-time data access and implementation to aid emergency response operations.[76] Missouri's Hydrology Information Center is also installing soil moisture and temperature sensors along with weather stations. Tied to their mobile app through ESRI and available to the public, its purpose is to help citizens respond to flooding in their area. In addition to this deployment and mobile app development, they are expanding stream gauge capability beyond USGS to submit the data to the National Weather Service, enhancing state and national flooding prediction efforts.[77]

KEY TAKEAWAYS

Limitations

The sample size for the ICWP Water Data Governance Survey is not comprehensive of all organizations across the US. It only represents 22 organizations and 28 states. The organizations sampled vary in size, authority, and types of data. For some, this directly impacted their interest and ability to improve water data accessibility, particularly their level of authority over water data. There are also some incomplete, short, or non-specific responses for the open-ended questions. The focus group was similarly limited in its duration and sample size. Limited to an hour and a half, some questions were prioritized for the sake of time. On the other hand, many respondents provided detailed data and links to resources as examples of their current initiatives. Each focus group participant also provided invaluable insights and a level of detail in their discussion.

Opportunities

Future research could explore the impact of differing authorities and types of data collected on the existence of accessibility initiatives. Impediments to water data sharing, such as security, privacy, and data sharing agreements, could also be further investigated. Clarification on how accessibility and open-source are qualified or quantified among organizations would be beneficial, in addition to organizations' interest and work on accessibility and open-source initiatives in states not sampled. Similarly, research on participation in collaborative efforts such as this one and its impact could be of value to ICWP and the IoW Coalition.

[76] North Dakota DWR.
[77] Missouri WRC.

Recommendation for ICWP

Further discussion is needed between agencies regarding strategies to update and create accessible data portals and software, such as open-source. Many respondents discussed the possibility of current or future technology becoming obsolete, due to either changing demands or a lack of staff resources and funding to maintain it. What is the most sustainable way to address the accessibility of data, while considering staff resources and funding limitations? What can ICWP do to help organizations plan for uncertainties in these realms, while also working towards "open water" with their frameworks? Developing a set of best practices for accessible and open-source development, along with resources to support this work, would benefit ICWP members.

Recommendations for ICWP:

- **Compile resources such as grants and workshops available to provide to ICWP members**
- **Advocating for funding for initiatives on the legislative level or from other stakeholders**
- **Further dialogue between agencies nationwide via webinars, conferences, or training**
- **Provide information and resources on sustainable and affordable open-source software**

Conclusion

A majority of respondents to this study have diverse initiatives to improve accessibility, and if not, most are in favor of improving it. In comparison, most organizations do not have open-source software. Some supplement this with tools to share water data, but the use of tools to share water data is mixed overall.

Funding and staff resources are two major challenges for improving accessibility, as well as security and grant requirements specific to each organization. Staff time and expertise are major challenges to developing both accessibility and open-source water data initiatives. For those knowledgeable in certain systems, staff turnover presents a vulnerability challenge, which is the case for many organizations surveyed. Maintenance costs and sustainable sources of funding also present a source of ongoing uncertainty.

While the complex challenges each organization faces are different, this research highlights the knowledge and resources that can be gained by coming together to discuss their processes and successes with data sharing. Multiple individuals in the survey expressed a desire to follow up and discuss further with ICWP and other organizations, indicating the desire for further collaboration and shared ideas on water data frameworks across the United States.

Shared struggles and insights on how to approach them in this study created a productive dialogue on what it means to govern water data in a dynamic technology and

policy landscape. As one focus group participant puts it, “This is just one of many competing things that’s going on, and our overall strategy here is to just keep chipping away at it… to put some piece of the staff time, budget, and people’s workload to keep moving it forward”.[78]

[78] Heidi Moltz, ICPRB.

Acknowledgements

Thank you to each individual who helped in the survey, whether it be help via email or willingness to jot down their answers, and thank you to each staff member who participated in our focus group on June 4th, 2025. We appreciate your enthusiasm, invaluable insights, and hard work paving the way forward in water data governance.

Thank you also to Faith Sternlieb and Gino Mbaigoto at the Internet of Water Coalition. We are grateful for your crucial research and the expertise you offered regarding the project.

Much thanks to Executive Director Beth Callaway for guiding and helping build this study. Thank you so much for your ideas, support, and leadership in this exciting endeavor to strengthen water data governance at ICWP and elsewhere.

Appendices

Appendix 1. Survey respondents: Organization, level, and state represented

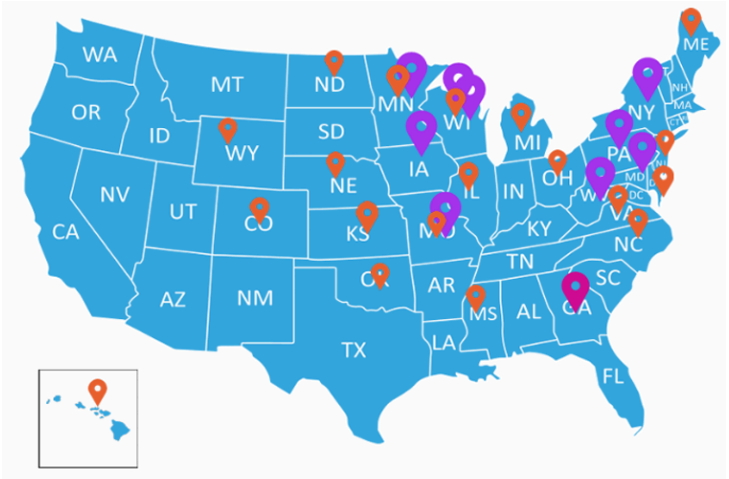
Organization	Organization Level	State(s)
Atlanta Regional Commission (ARC), Metropolitan North Georgia Water Planning District	Regional	Georgia
Colorado Water Conservation Board (CWCB)	State	Colorado
Delaware River Basin Commission (DRBC)	Interstate	Delaware, New Jersey, New York, Pennsylvania
Hawaii Department of Land and Natural Resources, Commission on Water Resource Management (Hawaii CWRM)	State	Hawaii
Illinois Department of Natural Resources, Office of Water Resources (Illinois DNR)	State	Illinois
Interstate Commission on the Potomac River Basin (ICPRB)	Interstate	Maryland, Pennsylvania, Virginia, West Virginia, and the District of Columbia
Kansas Water Office (KWO)	State	Kansas
Michigan Department of Environment, Great Lakes, and Energy (Michigan DEGE)	State	Michigan
Minnesota Department of Natural Resources (MNDNR)	State	Minnesota
Missouri Department of Natural Resources Water Resources Center (MoWRC)	State	Missouri
Nebraska Department of Natural Resources (Nebraska DNR)	State	Nebraska
New Jersey Department of Environmental Protection, Division of Water Monitoring, Standards, and Pest Control (NJ DEP)	State	New Jersey
North Carolina Department of Environmental Quality (North Carolina DEQ)	State	North Carolina
North Dakota Department of Water Resources (North Dakota DWR)	State	North Dakota

Oklahoma Water Resources Board (OWRB)	State	Oklahoma
Ohio River Valley Water Sanitation Commission (ORSANCO)	Interstate	Illinois, Indiana, Kentucky, Ohio, Pennsylvania, West Virginia
Upper Mississippi River Basin Association (UMRBA)	Interstate	Illinois, Iowa, Minnesota, Missouri, Wisconsin
Susquehanna River Basin Commission (SRBC)	Interstate	New York, Pennsylvania, and Maryland
Virginia Department of Environmental Quality, Office of Water Supply (Virginia DEQ)	State	Virginia
Wisconsin Department of Natural Resources (Wisconsin DNR)	State	Wisconsin
Wyoming Water Development Office	State	Wyoming
Wyoming State Engineer's Office	State	Wyoming

Appendix 2. Video link to focus group discussion

https://youtu.be/luDle8AmjgE?si=OSuW2mhkFP2p-QwY

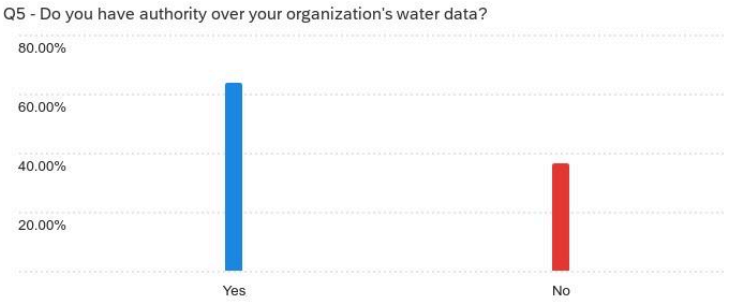
Appendix 3. Map of respondent organizations and level



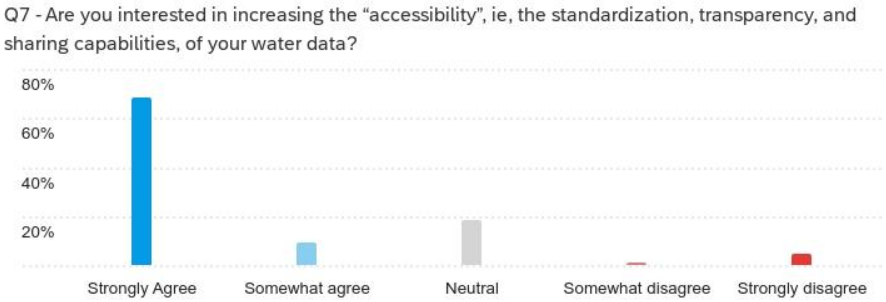
Q4 - Which best describes your organization level?

Field	State	Regional	Interstate
Which best describes your organization level?	16	1	5
Which best describes your organization level?	73.91%	4.35%	21.74%

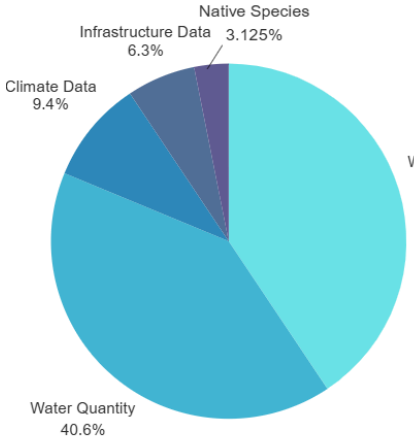
Appendix 4. Level of authority



Appendix 5. Interest in improving accessibility

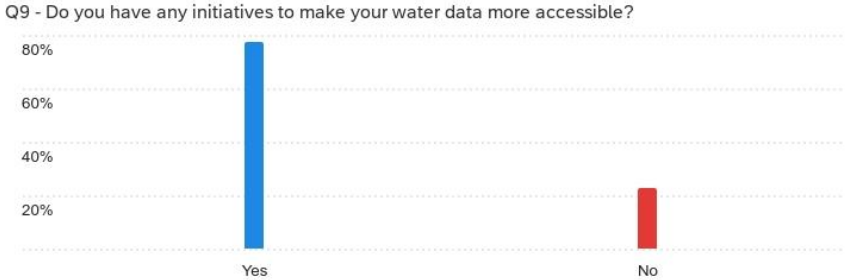


Appendix 6. List and categorization of types of water data reported in accessibility initiatives

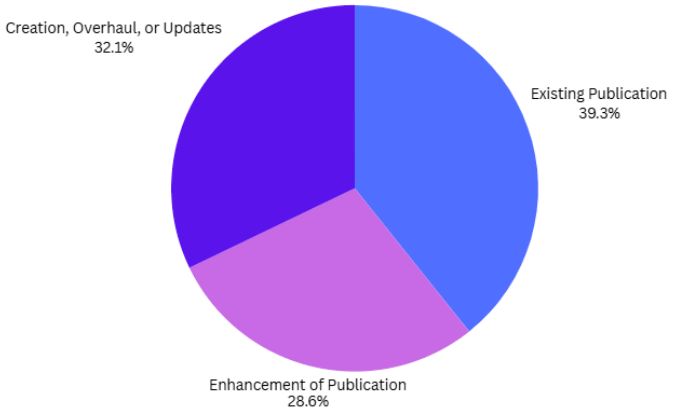


- Water quality
  - Project related monitoring data, for pollutants and indicators including: bacteria; chlorides; biomonitoring; dissolved oxygen and nutrients; emerging contaminants including 6ppdq, PFAS and PFOA, microplastics, 1,4-Dioxane; PCBs; temperature; specific conductance; turbidity; secchi depth; metals; chlorophyll-a; low level bromide and more, aquatic life use, recreation use, drinking water, and fish consumption, septic tank data, ambient groundwater quality, ambient freshwater and marine water data
- Water quantity/use
  - surface and groundwater withdrawal, streamgage flows, watershed boundaries, water levels, diversion records, reservoir data, groundwater pumping, lake level, wetland level, groundwater level, watershed boundaries, state water use information, intrawatershed transfer data, flow data, weather-associated parameters, "other components that are still in progress", and legally irrigable surface water right parcels
- Climate data/ climate station parameters
  - barometric pressure, soil moisture, soil temperature, precipitation, air temperature, AEM modeling, LiDAR, weather station data, call records
  - wind speed, precip, solar energy
- Municipal and agricultural infrastructure data
  - spatial footprint, condition, material, age, criticality etc. of conveyances and structures for potential construction and rehabilitation projects, hydrogeologic framework (e.g., drill logs, geophysical logs)
- Native species and their habitat
  - Biological data

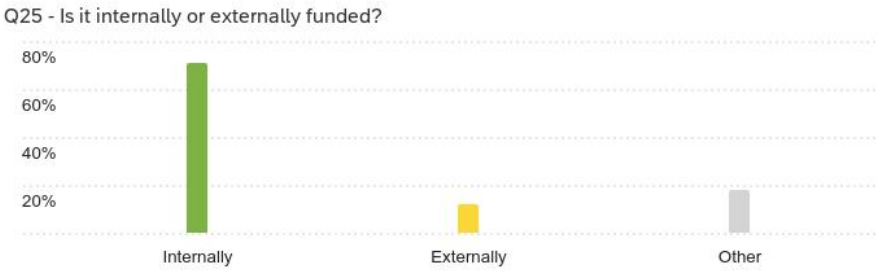
Appendix 7. Accessibility initiatives



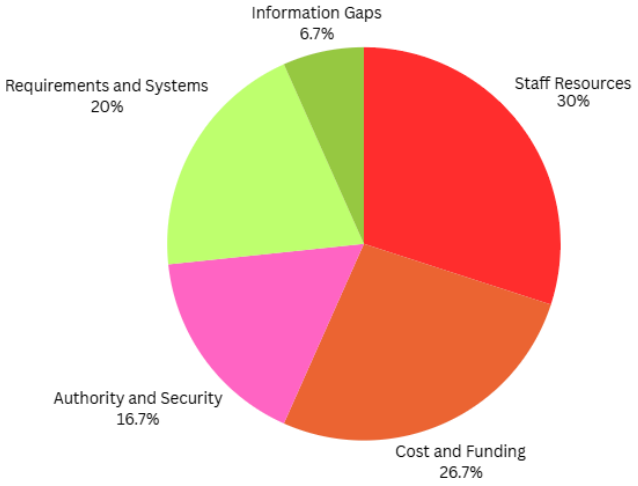
Appendix 8. Categorization of accessibility initiatives reported



Appendix 9. Funding

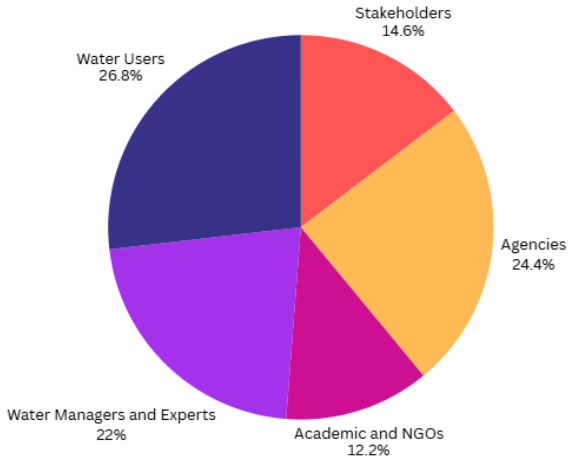


Appendix 10. Categorization of impediments to accessibility reported



Appendix 11. Target end-users in organizations' framework

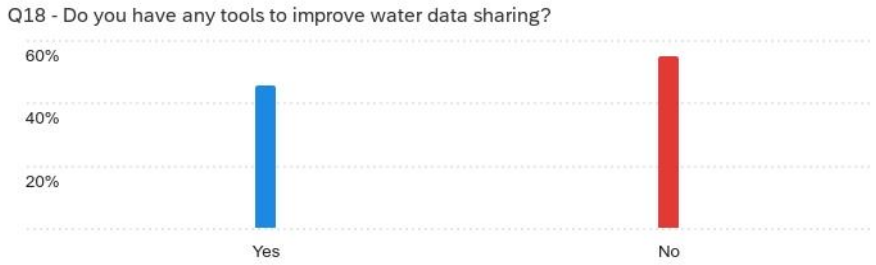
Appendix 12. List and categorization of target end-users in organizations' framework



- Stakeholders
  - Basin/project stakeholders, stakeholders, internal state partners, industry, drillers
- Member and Government agencies
  - Primarily partner agencies,member state agencies,local governments,government agencies,internal state partners, state, National Water Survey, local and federal government agencies
- Academic and ngo users
  - Scientists, NGOs, researcher
- Water Resource Managers and Experts
  - Water resources planners, consultants, county commissioners, consultants, consultants, attorneys, local and subregional government water managers, regulators, water purveyors
- Water Users
  - Internal users (towns, water districts, irrigators) historic and current water users, water right holders, Landowners, public users, Public, citizens, general public "everyone since we are a public agency"

Appendix 13. Initiatives to make data development "open-source"

Appendix 14. Tools to improve water data sharing



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