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Internet of Texas Water Data: Use Cases for Flood, Drought, and Surface Water –Groundwater Interaction

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LIST OF TABLES

ACRONYM DEFINITIONS

GCD	Groundwater Conservation District
IBWC	International Boundary and Water Commission
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
PUC	Public Utility Commission of Texas
SCAN	Soil Climate Analysis Network
TCEQ	Texas Commission on Environmental Quality
TIAER	Texas Institute for Applied Environmental Research
TNRCC	Texas Natural Resource Conservation Commission
TNRIS	Texas Natural Resources Information System
TWDB	Texas Water Development Board
USDA	United States Department of Agriculture
USGS	United States Geological Survey
UT	University of Texas
IBWC	International Boundary and Water Commission
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
PUC	Public Utility Commission of Texas
SCAN	Soil Climate Analysis Network
UI/UX	User interface/user experience

CONTENTS

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BACKGROUND

Texas' public and private companies, organizations, and agencies have collected water data for different purposes and at different scales for many years. These data are scattered across multiple platforms with different standards, often making important data sets inaccessible or incompatible. This leaves Texas' decision makers, industries, landowners, and communities with significant amounts of data of limited use to support real-time decision making, development of opportunities for water security, or for modeling an accurate picture of Texas' water future. To be useful in decision-making, water data must be open, transparent, and presented in ways that are relevant to the needs of decision makers.

On April 17, 2018, the Connecting Texas Water Data Workshop (Rosen and Roberts 2018[1]; Rosen etal. 2019[2]) brought together experts representative of Texas' water sectors to engage in the identification of critical water data needs and discuss the design of a data system that facilitates access to and use of public water data in Texas. Workshop participants identified "use cases" that list data gaps, needs, and uses for water data and answered questions on who needs data, what data do they need, in what form do they need the data, and what decisions need to be made about water in Texas. They described desires for future water data management and access. They articulated key attributes of a comprehensive, open access, public water data information system.

Next, steps were described to include a subset of workshop participants meeting regularly in an advisory capacity to further define the goals of a Texas water data initiative, develop a model for the hub's structure, characterize several use cases, and facilitate development of pilot projects to demonstrate the value of connected public water data for improved decision making.

This report presents results of the first meetings of the advisory group, as well as results of the group's first actions to define the goals of a Texas water data initiative and characterize its first use cases.

1 Rosen, R.A. and S.V. Roberts. 2018. Connecting Texas Water Data Workshop: Building an Internet for Water. Institute for Water Resources Science and Technology, Texas A&M University-San Antonio, San Antonio, TX 78224. (ISBN-13: 978-0-9986645-4-5) https://libguides.tamusa.edu/ld.php?content_id=42020932

2 Rosen, R.A., S.M. Hermitte, S. Pierce, S. Richards, and S.V. Roberts. 2019. An Internet for Water: Connecting Texas Water Data. Texas Water Journal 10(1):22-29. https://twj.media/wp-content/uploads/2019/02/Rosen_etal.pdf

SETTING THE STAGE FOR ACTION

Members of the Water Data Initiative Advisory Committee were selected and invited to their first meeting held on June 28, 2919, at the Cynthia and George Mitchell Foundation office in Austin. Members of the committee (Table 1) were presented an agenda and asked to review reference materials in advance of the meeting (Appendix I and II). Review materials and a website developed for the committee's use described previous work in Texas on the water data initiative and several preliminary use cases recommended for future consideration.

The meeting started with introductions by members and a summary of the purposes of the committee. Next, members heard about ongoing efforts to develop an internet of water nationally and in Texas. Members learned that the Texas Legislature had just funded development of a data hub for flood information, to include a flood data dashboard as the first area of focus for the hub. This project was seen by the group as an initial and important step forward for Texas on making important water data more accessible and usable.

Members were provided a description of outcomes of the April 2018 meeting, including a listing of use cases along with a description of how use cases are developed and their purpose (Appendix III). Seven desirable attributes were described for use cases: use cases should 1) be valuable, 2) involve known users, 3) be doable, 4) be scalable/replicable, 5) not be too controversial, 6) provide an opportunity for quick implementation, and 7) result in a viable product to users. Emphasis was placed on use cases not being politically sensitive, ensuring that early use cases not be too controversial. Use cases may also vary in nature along a continuum of usefulness, from simple tabulation of raw data to development of a fully featured decision support tool (Appendix IV).

Committee members then turned to a discussion of the most critical topics to be used as the basis for developing use cases for Texas water data. After listing a number of options, the committee arrived at recommending that two use cases be developed: 1) surface water – groundwater interaction data, and 2) development of a drought data dashboard.

The committee recommended that a subcommittee of subject matter experts be formed around each use case topic. Several members of the advisory committee volunteered to be on one, or both, of the subcommittees. The committee then recommended other candidates for the subcommittees, with direction to the project team to offer invitations to the candidates. Once the subcommittees are formed, the project team is to conduct workshops where the subcommittees are to develop a use case around each of the two topics. Once the workshops are completed, reports are to be provided to advisory committee members and a meeting of the committee is to be held.

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Table 1. Water Data Initiative Advisory Committee and Project Team members.

ADVISORY COMMITTEE		
FIRST NAME	LAST NAME	AFFILIATION
Kathy	Alexander	Texas Commission on Environmental Quality
Rob	Bruant	B3 Insight
Karen	Guz	San Antonio Water Systems
Sam	Hermitte	Texas Water Development Board
Erin	Keys	University of Texas
Cindy	Loeffler	Texas Parks and Wildlife Dept.
Leah	Martinsson	Texas Alliance of Groundwater Districts
Justin	Mcinnis	Hays County
Daniel	Pierson	US Geological Survey
Carlos	Rubinstein	RSAH2O
Sarah	Schlessinger	Texas Water Foundation
Farnaz	Seddighzadeh	Cynthia and George Mitchell Foundation
Darrel	Tremaine	UT Environmental Science Institute
Richard	Wade	Texas Water Development Board
Jennifer	Walker	National Wildlife Federation
Emily	Warren	Cynthia and George Mitchell Foundation
PROJECT TEAM		
FIRST NAME	LAST NAME	AFFILIATION
Robert	Mace	Meadows Center for Water and the Environment
Rudy	Rosen	Institute for Water Resources Science and Technology
Kathy	King	Redstone
Michelle	Lapinski	Earth Genome
Glenn	Low	Earth Genome

SUBCOMMITTEE WORKSHOPS, REPORTS, AND USE CASES

Subcommittees of subject matter experts were formed to develop use cases for 1) surface water - groundwater interaction data and 2) development of a drought data dashboard. The topics were assigned to the subcommittees by the Water Data Initiative Advisory Committee.

Subcommittee members were informed of ongoing efforts to develop an internet of water nationally and in Texas. They also received information about how use cases are developed and their purpose.

A workshop to develop a Texas Surface Water - Groundwater Interaction Use Case was held on August 26, 2019, at the Texas Water Development Board headquarters in Austin (Appendix V). A workshop to develop a Drought Data Dashboard Use Case was held on August 30, 2019, at the Cynthia and George Mitchell Foundation office in Austin (Appendix VI).

The reports and use cases developed by the subcommittees follow.

SURFACE WATER – GROUNDWATER INTERACTION USE CASE

Introduction

Experts on data for surface water – groundwater interactions in Texas were identified and invited to participate in a workshop to develop a use case on surface water – groundwater interactions (Table 2). In advance of the workshop, participants were asked to review reference materials about past efforts to develop an internet of Texas water data and to learn about developing use cases and using a template for assembling use case information. Also in advance of the workshop, participants were asked to fill in an online database of data available and data needs that could be used in a use case on surface water – groundwater interactions (Table 4). That database was used to develop the use case description.

Workshop

Workshop participants started by discussing and then listing use case topics related to the subject of surface water – groundwater interactions in Texas. Participants were provided with initial direction that the use case be applicable statewide, but that scaling it back geographical or by relevant project limits type could be done later pending available resources. They were also informed that while it may be appealing to recommend collection of new data or research, setting up projects to collect new data may be outside the practical scope of a use case for Texas at this time.

Participants developed an initial list of specific topics for the use case as a means to begin focusing discussion (Table 3). These topics were placed into general categories. While there were eight unique studies recommended as potential topics, six workshop participants recommended that the use case be directed at developing a data dashboard or a user accessible database for multiple surface water and groundwater data sets. The use case was formed around discussion on these recommended topics. It was clear there was general agreement that the use case be developed around the topic of a data dashboard for surface water, groundwater, and their interactions in Texas. Participants then defined specific objectives for the project, data requirements, and actions to design and build the dashboard. Participants also addressed the question of who would "own" the dashboard. There was a general feeling that such a dashboard would need to be held by Texas Water Development Board (TWDB). Many of the data sets that participants recommended for possible inclusion in the dashboard are already held by or accessible through the TWDB (Table 4).

The use case is described in Table 4.

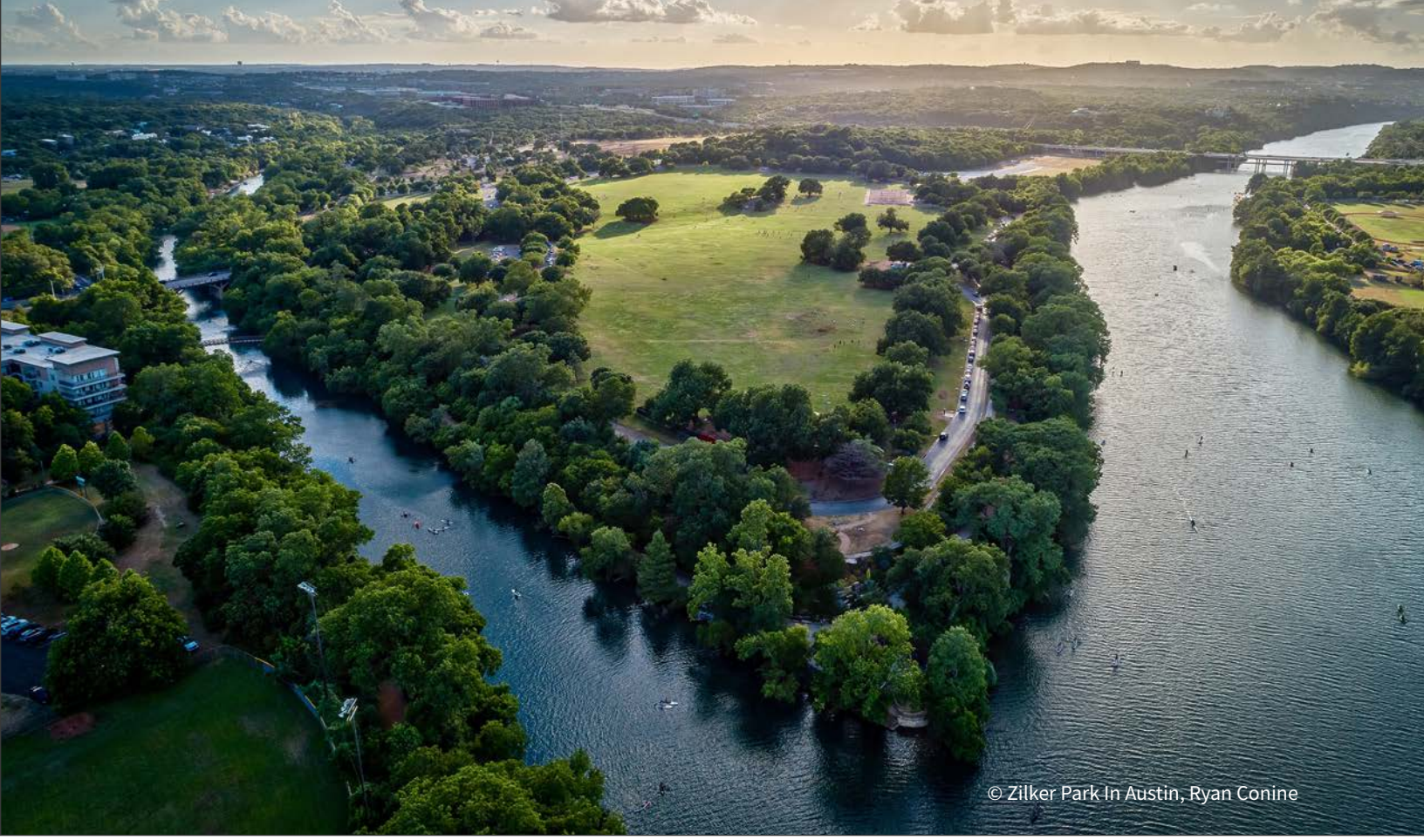

Table 2. Invited participant list for the surface water – groundwater interaction workshop.

FIRST NAME	LAST NAME	AFFILIATION
Aaron	Abel	Brazos River Authority
Kathy	Alexander	Texas Commission on Environmental Quality
Tim	Finley	Dow Chemical-Freeport
Larry	French	Texas Water Development Board
Marcus	Gary	Edwards Aquifer Authority
Ron	Green	Southwest Research Institute
Sam	Hermitte	Texas Water Development Board
Michelle	Lapinski	Earth Genome
Cindy	Loeffler	Texas Parks and Wildlife Dept.
Glen	Low	Earth Genome
Robert	Mace	Meadows Center
Leah	Martinsson	Texas Alliance of Groundwater Districts
Brooke	Mcgregor	Texas Commission on Environmental Quality
Ali	Saleh	Texas Institute for Applied Environmental Research
Sarah	Schlessinger	Texas Water Foundation
Raghavan	Srinivasan	Texas A&M AgriLife Blackland Research & Extension Center
Moore	Stephanie	Daniel B. Stephens & Associates
Darrel	Tremaine	University of Texas Environmental Science Institute
Andy	Weinberg	Texas Water Development Board
Mark	Wentzel	Texas Water Development Board
Gary	Westbrook	Post Oak GCD

Table 3. List of topics for a surface water – groundwater interaction use case, grouped by general topic area.

LIST OF RECOMMENDED TOPICS FOR A SURFACE WATER / GROUNDWATER INTERACTION USE CASE
A Use Case to develop a dashboard/database for surface water - groundwater interactions
Develop a surface water - groundwater interaction dashboard: use the relationship between groundwater withdrawals in Val Verde County on surface flows in Devils River, or a similar example, as a pilot in conjunction with building the surface water - groundwater interaction dashboard. Focus on similar hot topics that are geographically diverse.
Build a dashboard to display correlations of spring flow and groundwater level, by county or river basin.
Develop a groundwater - surface water dashboard: a use case that leads to a more efficient use of both groundwater and surface water.
Build a groundwater availability dashboard: a use case to view how much groundwater is available by desired future conditions, groundwater conservation districts' permits, pumping reports, and static groundwater levels.
Provide data storage (banking), maintenance, and accessibility/access for different users with specific needs and formats through a readily accessible internet-based user interface.
Combine groundwater level, streamflow, and extraction/use into a database.
A Use Case to develop a dashboard/database for surface water - groundwater interactions
Quantify spring flows and discrete recharge to the Middle Trinity and Edwards aquifers in the Blanco River basin using existing USGS gage data.
Estimate long-term trends of surface water and groundwater fluxes across alluvial aquifers in Texas.
Establish relationships between river flows and water surface elevation in connected aquifers (and vice versa), completing water budgets for specific systems.
Determine ground water quality and quantity as affected by surface water Delineate and quantify the recharge zones for all the major and minor aquifers.
Establish the relationship of groundwater basins versus surface water basins as a means to determine the impact of groundwater pumping on surface flow.
Quantify the potential of redirecting excess flood flows (surface water) to recharge aquifers (groundwater).
Identify stream gage locations relative to the outcrop areas of major and minor aquifers, and records of groundwater withdrawals in these areas.

Table 4. Surface water – groundwater interaction data use case details.

TITLE	Surface Water-Groundwater Interaction Data Repository and Dashboard for Texas: A use case to build a repository of existing surface water-groundwater interaction data and (1) make the data available to users by a robust indexing system and (2) continue working to make the data available to users in a FAIR, georeferenced data hub for interaction data to which (a) data sets and new data can be added over time; (b) there are means provided to hub users through a dashboard or viewer to access, view, and work with these data, along with user-added data to demonstrate interactions or other desired analysis, and; (c) allow users to add data or data sets where contributors' data are subject to review and verification.
OBJECTIVE(S)	To design and build a surface water-groundwater interaction data repository/hub and dashboard/viewer for Texas that thoroughly considers key stakeholder input in the design and build and uses of the hub and dashboard, including input from the general public to aid in making the hub/dashboard universally valuable in enabling users to make better decisions about managing their water resources.
DESCRIPTION	• The use case may collect, index and enable access to all available groundwater and surface water interaction data stratified by river basin, water planning region, groundwater management area, and groundwater conservation district. • The data may be housed first in a user accessible repository or data hub that may contain all available interaction data sets, indexed at a minimum as described immediately above. • In a next step, an interaction data dashboard and viewer can build on the repository/hub using FAIR data. Over time, the dashboard may add the capacity for users to conduct basic data comparison work and view interaction display functions. The dashboard may allow for the addition of more water data over time that may enable display of more and better interaction information and help identify future data needs. • The dashboard may be populated initially with data sets that focus on high-priority areas (for conservation or public benefit purposes) or high-profile river basins or locations, such as San Felipe Springs, Devils River, Blanco River, Brazos River, Colorado River near San Saba, or Balmorhea/San Solomon Springs. • Initial work may define who is expected to use the dashboard. These stakeholders or stakeholder groups may be identified and asked to provide input on what they need and how they would use the dashboard. The project may also develop an example dashboard, or mock-up, to start the discussion with stakeholders and help define and test needs and desires. This can help in the development of multiple entry points to data sets for different levels of users or users with different needs, including delivery of information synthesized for public use.
PARTICIPANTS	1. Groundwater conservation districts and other groundwater managers 2. River authorities and other surface water managers 3. Regional water planners 4. Water rights holders/ownership 5. Counties and major cities government and elected officials 6. Water providers 7. Texas Water Development Board (TWDB) and collaborating Texas state and federal agencies 8. Texas Commission on Environmental Quality 9. A representative group of the general public
REGULATORY CONTEXT	There are no regulatory matters involved in development of a data repository or dashboard. Development of public information portals is not subject to regulatory or statutory oversight. However, there is likely to be interest by elected officials at all levels of Texas government and agency regulators in having surface water - groundwater interaction information and predictive data about interactions affecting water availability made more widely accessible and understandable to local and state-wide decision makers and elected officials, water managers, water utility operators, regulated water users and permit holders, and to the general public.

Table 4 cont. Surface water – groundwater interaction data use case details.

SUGGESTED WORKFLOW

Identify potential funders and make initial contact where possible and appropriate.

Develop a framework work plan and budget for the use case. This plan may include items such as a detailed listing of sequential actions to be taken to develop the data repository and dashboard, and to add data sets and tools that will turn these data sets into information displays on interactions and water availability described as useful and needed for decision making by water managers and stakeholders. Using the plan and budget as a guide, develop a proposal for funding.
Develop the technical work plan to design and build the repository and dashboard, including architecture, function, tools, interface, and backend.

Develop a mock-up dashboard to provide a working example for stakeholder education, testing, and input.

Identify examples to serve as initial subjects for populating the dashboard with FAIR data. Focus the following efforts on each basin or location as work proceeds. Repeat as new basins or locations area added, with data fit for each new specific purpose adding to the evolution and iterative building of a comprehensive dashboard:

- Create and use a local stakeholder network or advisory group for project review and input on development of locally desired features and functionality of the dashboard by area, as opposed to relying only on technical experts and programmers.
- Gather and add data sets relevant to each location, gradually building a comprehensive dashboard with capacity to display decision support information about surface water and groundwater interactions and availability.
- Develop/adapt a mock-up dashboard for each new area to provide a working example for stakeholder education, testing and input.
- Develop a "marketing" plan to describe the benefits/results of better management of water by users of the decision support tools available on the dashboard.

DATA SOURCES

DATA CATEGORY	DESCRIPTION	AVAILABILITY	DATA SOURCE	ACCESS METHOD	ADDED CHARACTERISTICS
Weather, river stage	Real-time temp, precipitation, wind chill, heat index, humidity, wind, soil moisture, soil temp, river flow, river stage	Accessible	TWDB TexMesoNet	https://www.texmesonet.org/	
Groundwater levels	Daily water level (feet below ground surface) for 234 wells across the state	Accessible	TWDB	www.waterdatafortexas.org/groundwater/	Daily water levels (feet below ground surface) for 234 wells across the state; few (in any?) of these wells are in alluvial aquifers; Priority could be placed on instrumenting at least some wells in alluvial aquifers in the future.
Field studies of Colorado River and Carrizo-Wilcox Aquifer in Cen-tral Texas	Report prepared to support the update of the groundwater availability model of the Central Carrizo-Wilcox Aquifer	Accessible, data may not be readily interoper-able	TWDB	http://www.twdb.texas.gov/groundwater/models/gam/czwx_c/Final_BBASC_083117.pdf?d=1566575514973	

Table 4 cont. Surface water – groundwater interaction data use case details.

DATA CATEGORY	DESCRIPTION	AVAILABILITY	DATA SOURCE	ACCESS METHOD	ADDED CHARACTERISTICS
Surface water and aquifer relationships in the Brazos River Alluvium	Report prepared to document the conceptual model of the groundwater availability model of the Brazos River Alluvium	Accessible	TWDB	http://www.twdb.texas.gov/groundwater/models/gam/bzrv/BRAA_AQUIFER_GAM_REPORT_ALL.PDF	
Texas aquifers	Both major (9) and minor (22) aquifers as defined by TWDB	Accessible	TWDB	http://www.twdb.texas.gov/mapping/gisdata.asp	Available shapefiles; Website includes many other pertinent GIS data (e.g. river basins, rivers, reservoirs, etc.)
Summary report of groundwater-surface water interaction in Texas	Estimated groundwater flow to surface water based on historical baseflow data from nearly 600 USGS stream gauging stations.	Accessible	TWDB U.S. Geological Survey	http://www.twdb.texas.gov/groundwater/docs/studies/TexasAquifersStudy_2016.pdf?d=1566575164951	• Base flow from U.S. Geological Survey stream gauges, TWDB aquifer properties and map • Report prepared by TWDB at the direction of the 84th Texas Legislature (H.B. 1232)
Spring discharge	Stage/discharge relationships and time series groundwater elevation and spring discharge records	Limited availability	Limited; some springs included in TWDB groundwater database	https://www.twdb.texas.gov/groundwater/data/index.asp	• Few spring discharge values available • Spring rating curves linking stage and dis-charge generally not available
GW pumping data	Time series volume of water pumped by well (spatially explicit), covering all well types (including exempt wells)	Limited availability	TWDB Groundwater conservation districts Others		• Pumping data are scarce • Estimates by different agencies are mixed and use a number of assumptions to estimate
Potential areas with SW/GW interaction	SW/GW interaction evaluation for 22 Texas River Basins	Accessible but generally not in a database; many numbers/studies in published papers and reports	Texas Natural Resource Conservation Commission	https://www.twdb.texas.gov/publications/reports/contracted_reports/doc/Surface-Groundwa-ter_Interaction.pdf	• Assessment of SW/GW interaction for river segments. Points out areas of the state where interaction is expected to occur (and relative degree of interaction) • Data is dated (circa 1999). Qualitative more than quantitative

Table 4 cont. Surface water – groundwater interaction data use case details.

DATA CATEGORY	DESCRIPTION	AVAILABILITY	DATA SOURCE	ACCESS METHOD	ADDED CHARACTERISTICS
Soil moisture	Remotely sensed soil moisture products (e.g. soil moisture active passive products) and modelled soil moisture from the North American Land Data Assimilation System suite of models.	Accessible, variable coverage	TWDB Natural Resources Conservation Service, Soil Climate Analysis Network (NRCS-SCAN)	www.texmesonet.org; NRCS-SCAN sites	• Soil moisture data are currently available only from a few point measurements. The TexMesonet stations are collecting soil moisture. However, there needs to be a much wider spatial coverage of in-situ observations. • Remotely sensed soil moisture products (e.g. soil moisture active passive products products) and modelled soil moisture from the North American Land Data Assimilation System suite of models. These are available from National Aeronautics and Space Administration's Distributed Active Archive Center and from Mirador but it would be nice to collate the data and have it accessible as soil moisture maps and other value-added products (e.g. soil moisture anomalies for a given month or season). While these datasets are replacements for in-situ data they can be used in tandem with in-situ data. The plus point for the remotely sensed or modelled products is that they provide continuous surfaces and may provide useful information on soil moisture variability across the state.
Streamflow gain/loss	Streamflow measurements along a reach to define interactions between surface water and groundwater	Accessible, usability variable	U.S. Geological Survey	https://pubs.usgs.gov/of/2002/ofr02-068/	• Three-hundred sixty-six streamflow gain-loss studies in 249 unique reaches • Highly variable results • Snapshot in time measurements don't reflect groundwater dynamics • Data does not address bank storage; Existing methods are difficult and expensive; new methodologies needed. Doesn't include results from studies completed after 2000.

Table 4 cont. Surface water – groundwater interaction data use case details.

DATA CATEGORY	DESCRIPTION	AVAILABILITY	DATA SOURCE	ACCESS METHOD	ADDED CHARACTERISTICS
Stream and spring discharge	Real-time stream and spring discharge	Accessible	U.S. Geological Survey	https://waterdata.usgs.gov/tx/nwis/current/?type=flow	• Stream flow at 640+ sites. Spring flows for 10 springs including (Chalk Ridge Falls, Felps, Barton, San Marcos, Comal, Hueco, Jacobs Well, Giffin, San Solomon, and Las Moras) • Data do not exist for many springs in Texas
Groundwater levels	Real-time groundwater elevations	Accessible	U.S. Geological Survey	https://waterdata.usgs.gov/tx/nwis/current/?type=gw	• 15-minute data for water level for 35 wells across the state; Few (in any?) of these wells are in alluvial aquifers • Priority could be placed on instrumenting at least some wells in alluvial aquifers in the future.
Geodatabase	Geologic and hydrogeologic information for a geodatabase for the Brazos River Alluvium Aquifer	Accessible	U.S. Geological Survey	https://pubs.usgs.gov/of/2007/1031/ https://pubs.usgs.gov/sim/2989/	• Data were compiled primarily from drillers' and borehole geophysical logs from government agencies and universities, hydrogeologic sections and maps from published reports, and agency files • Provides estimate of alluvial aquifer extent and thickness for one alluvial aquifer in Texas. Much less data available for other alluvial aquifers in the state.
Streamflow gain/loss	Gain/loss study for Colorado River in Burnett and San Saba Counties	Accessible	U.S. Geological Survey	https://pubs.er.usgs.gov/publication/sir20155098	• Traditional gain/loss study on about 10 miles of the Colorado River • Typical gain loss study with use of an acoustic Doppler current profiler to make flow measurements. Example of study completed after #3 and #10 above.
Streamflow gain/loss	Gain/loss study for Guadalupe River in Gonzales County	Accessible	U.S. Geological Survey	https://pubs.er.usgs.gov/publication/fs20183057	• Gaining and losing sections of river determined using floating geophysical methods • Methods provide an indication of gaining or loosing but don't quantify the amount. Map the length of segment (not just individual points).

Table 4 cont. Surface water – groundwater interaction data use case details.

DATA CATEGORY	DESCRIPTION	AVAILABILITY	DATA SOURCE	ACCESS METHOD	ADDED CHARACTERISTICS
Streamflow gain/loss	Gain/loss study for the Brazos River from McLennan County to Ft. Bend County	Accessible	U.S. Geological Survey	https://pubs.er.usgs.gov/publication/sir20075286	Base flow (1966-2005) and streamflow gain and loss (2006) of the Brazos River, McLennan County to Fort Bend County, Texas
Streamflow gain/loss	Gain/loss study for the Brazos River from NM-Texas State Line to Waco, Texas	Accessible	U.S. Geological Survey	https://pdfs.semanticscholar.org/92e0/bbbaf13ceb477442ac9d9a2f966714151776.pdf?_ga=2.107396166.513298146.1566574470-913439901.1566574470	Base flow (1966-2009) and streamflow gain and loss (2010) of the Brazos River from the New Mexico–Texas State Line to Waco, Texas
Spring locations	U.S. Geological Survey database of Texas springs	Accessible	U.S. Geological Survey	https://doi.org/10.3133/ofr03315	
SW/GW relationship	Estimate of groundwater outflow versus Medina Lake stage	Accessible, unknown usability	U.S. Geological Survey	https://pubs.er.usgs.gov/publication/fs20173008	• Regression equations for GW outflow vs. stage based on measurements from 1955-64, 1995-96, and 2001-2002 • Example of the type of data that needs to be collected to estimate GW recharge from surface water bodies
Surface Water quantity/quality	Data related to surface water quality and quantity at field and watershed scales	Accessible	Texas Institute for Applied Environmental Research Tarleton State University	Contact at Saleh@tarleton.edu	• Over 25 years of water quality and quantity data collected from number of watersheds in Texas for data analysis and modeling • Data related to interaction of surface and ground water quality and quantity; Surface water quality and quantity data for many locations are of limited use
Overview of the im-pacts of GW/SW interactions on water quality and quantity	Groundwater-surface water interactions in Texas	Accessible, use limited by location	Bureau of Economic Geology University of Texas	http://www.beg.utexas.edu/staffinfo/pdf/scanlon_gwswr2005.pdf	Data limited to certain locations in state.

Table 4 cont. Surface water – groundwater interaction data use case details.

DATA CATEGORY	DESCRIPTION	AVAILABILITY	DATA SOURCE	ACCESS METHOD	ADDED CHARACTERISTICS
Spring flow	Spring flow targets where already specified	Accessible, where specified as desired future conditions			May be policy-oriented target value
Streamflow	Environmental flow targets	Available but not in a publicly accessible database	Texas Commission on Environmental Quality	Database in development with Texas Parks and Wildlife	May be policy-oriented target values, not collected data
	Desired future conditions	Available but not in a publicly accessible database	Texas Water Development Board	https://www.twdb.texas.gov/groundwater/management_areas/index.asp	May be policy-oriented target values, not collected data
Baseflow separation	Base flow separation using water chemistry and other tracers - better data than simple flow-based separation.	Isolated case studies	e.g. Rhodes and others, 2017, Water Resources Research, 53, 10,539–10,557. https://doi.org/10.1002/2017WR021619		• Data not now generally available • More intensive monitoring required • A data need
Groundwater	Groundwater availability and water availability models outputs as well as inputs	Available but not wholly FAIR	Texas Water Development Board and Texas Commission on Environmental Quality	https://www.twdb.texas.gov/groundwater/models/gam/index.asp	
Evapotranspiration rates	Remote sensing Evapotranspiration data over a period of time	Not generally available	OpenET is developing a platform for remote-sensed ET for the Western US	https://etdata.org/	• Data not now generally available • A data need • OpenET data products scheduled for release in 2021

DROUGHT DATA DASHBOARD FOR TEXAS USE CASE

Introduction

Experts on data for drought management decision making support in Texas were identified and invited to participate in a workshop to develop a use case for a drought data dashboard for Texas (Table 5). In advance of the workshop, participants were asked to review reference materials about past efforts to develop an internet of Texas water data and to learn about developing use cases and using a template for assembling use case information. Also in advance of the workshop, participants were asked to fill in an online database of data available and data needs that could be used in a drought data dashboard (Table 7). That database was used to develop the use case description.

Workshop

Workshop participants started by discussing and then listing various objectives and specific approaches for a use case to design or build a dashboard for drought data in Texas. Participants were provided with initial direction that the use case be applicable statewide, and that scaling it back geographically or by area type could be done later pending available resources. They also were informed that any dashboard should be a forward-looking tool, designed to initially use relevant public FAIR (F=Findable, A=Accessible, I=Interoperable, and R=Reusable) data, with addition over time of new relevant data that can be collected or of existing data that can be made usable. The dashboard should be formed to provide decision support data to experts and decision makers to answer technical questions about drought on a statewide, regional, and local basis. And, it should be formed to help answer more basic and universal questions, such as: Am I in a drought? How is what's happening impacting me and my area's water supplies? What do the weather projections suggest for duration or severity of drought where I live? What's happening to soil moisture on local ranches or farms?

Participants developed an initial list of objectives for the use case as a means to begin focusing discussion (Table 6). As discussion progressed, efforts of the TWDB on drought decision support became the central topic. Work on a drought dashboard by the TWDB has been anticipated, and at the time of the workshop work by TWDB appeared to be getting underway. As discussion continued, it became clear that objectives being discussed by workshop participants for a drought dashboard appeared similar to objectives anticipated to be considered by TWDB.

To avoid duplication of effort, yet support the TWDB's design/build work in areas where TWDB may value expert stakeholder support, a collaborative effort was proposed. The use case was formed around these discussions for a public-private collaborative effort. The drought data experts involved in the use case will focus their efforts on delivering expert opinion and assembling stakeholder user group input. This will include input relevant to design and use of a dashboard


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for decision support and general information statewide by the full range of potential users, from experts, to local decision makers, to the general public.

The use case is described in Table 7.

Table 5. Invited participant list for the drought data dashboard workshop.

FIRST NAME	LAST NAME	AFFILIATION
Kathy	Alexander	Texas Commission on Environmental Quality
Bryan	Anderson	Edwards Aquifer Authority
Rob	Bruant	B3 Insight
Anjani	Chaudhary	Meadows Center
Nelun	Fernando	Texas Water Development Board
Marcus	Gary	Edwards Aquifer Authority
Karen	Guz	San Antonio Water Systems
Sam	Hermitte	Texas Water Development Board
Ken	Kramer	Former Sierra Club
Michelle	Lapinski	Earth Genome
Glenn	Low	Earth Genome
Robert	Mace	Meadows Center
Leah	Martinsson	Texas Alliance of Groundwater Districts
Suzanne	Pierce	UT Advanced Computing Center
Carlos	Rubinstein	RSAH2O
Rosario	Sanchez	Texas Water Resources Institute
Bridget	Scanlon	Bureau of Economic Geology
Sarah	Schlessinger	Texas Water Foundation
John	Tracy	Texas Water Resources Institute
Darrel	Tremaine	UT Environmental Science Institute
Jennifer	Walker	National Wildlife Federation
Andy	Weinberg	Texas Water Development Board

Table 6. Participants' initial list of objectives for a drought data dashboard, with key characteristics highlighted

INITIAL LIST OF OBJECTIVES FOR A DROUGHT DATA DASHBOARD
Combine available datasets into a **decision support tool** that defines what if scenarios for users and helps them determine vulnerability, risk, and action.
Provide drought **decision-tools** that are tailored to meet the drought information needs of various users.
Create a decision support system that provides water managers and users **information on local conditions** and possible impacts to defined water sources under varying conditions.
Provide for **scalable** (state/river-basin/county) visualization of current drought-related data streams with **historical context** and trends.
Provide drought data in a **scalable** format to inform regulators and users of water resources of **current conditions** with ability to customize the **data visualization** and output/dissemination for any particular user.
Bring disparate data sets together on a single, **geographically-interfaced platform** for the purpose of providing **local decision makers** (utilities, county judges, etc.) with information that can improve understanding of **local conditions** and decision making.
Compile **localized** current drought-related data in the context of **historical trends** formatted and presented for community decision makers.
Inform the public, public utilities, agencies, and other policy makers of **past, current, and future hydrologic conditions** in relation to drought.
Develop a **multi-scale** dashboard that includes **real-time data** that represents an index of drought (i.e. index for wells, springs, environmental flows, etc.).
Create a **hyper local** drought dashboard that allows **local end users** to better predict and understand drought impacts on water availability.

Functionality is anticipated to be built in a sequence for different level users and advanced over time:

1. Initial development for the basic user: Entry level capabilities for basic functionality of dashboard:
    a) Basic level of decision support
    b) Accessible front-end site for viewing, but no access to back end
    c) Easy to understand visuals and UI/UX (user interface/user experience), e.g., defined with user needs in mind
    d) Accessible interoperable data
    e) Webpage for viewing/presentation/information sharing
    f) Data must be current and up-to-date
2. Next stage development for the super user: Advanced level capabilities for greater functionality and decision support
    a) Simple back-end for administrative and direct access by super users
    b) Stable host/site where either the application lives and/or the digital objects are stored
    c) Composable (components that can be selected and assembled in various combinations to satisfy specific user requirements)
    d) Authentication standards
    e) Portable across regions and scales
    f) Modular for data entry-transformation-loading
    g) Model-based
3. Future development and capabilities
    a) Strategic problem solving and decision support
    b) Composable and reproducible
    c) AI assistance, recommendation support
    d) Facilitator tools

Table 7. Drought dashboard data use case details.

TITLE	Texas Drought Dashboard: An initiative to define and develop a drought data dashboard for Texas
OBJECTIVE(S)	To initiate and complete development of a drought data dashboard collaboratively with the Texas Water Development Board (TWDB), to include support assembling and providing drought data expert stakeholder input in the design and build of the dashboard, and to include support assembling key end -user stakeholder group opinion and advice on dashboard design, needs for drought response decision support, and best use input, with design to include support for use by the general public.

DESCRIPTION	This use case is anticipated as a collaborative project with the TWDB to make a drought data dashboard for Texas by providing support to obtain expert advice and assembling key stakeholder group input to aid in the design and build of a data dashboard that may include the following characteristics:
	• Statewide and hyper-local applicability
	• Decision support tool for local decision makers and different levels of users, including decision support for the following as examples:
	  • Local and personal water conservation measures for use in the home and landscaping
	  • Media/public announcements and recommendations
	  • Business and industry water emergency planning
	  • Farming and ranching decisions
	• Scalable, multi-scale
	• Real-time data and historic trends
	• Means to verify data sets and maintain data sets
	• Geographic or map-based interface
	• Robust visualization and graphic presentation capability
	• Functionality built in a sequence for different level users and advanced over time:
	  1. Initial Development for the **basic user**: Entry level capabilities for basic functionality of dashboard:
	  a) Basic level of decision support
	  b) Accessible front-end site for viewing, but no access to back end
	  c) Easy to understand visuals and user experience/user interface (e.g., defined with specific user needs in mind)
	  d) Built with accessible interoperable data
	  e) Webpage for viewing/presentation/information sharing
	  f) Data must be current and up to date
	  2. Next Stage Development for the **super user**: Advanced level capabilities to meet greater level of functionality and robust decision support
	  a) Simple back end for administrative and direct access by users
	  b) Stable host/site where either the application lives and/or the digital objects are stored
	  c) End user customizable interface
	  d) Authentication standards
	  e) Portable across regions and scales
	  f) Modular for data entry-transformation-loading)
	  g) Model-based
	  3. Future Development and capabilities
	  a) Strategic problem solving and decision support
	  b) Composable and reproducible
	  c) Artificial intelligence assistance, recommendation support
	  d) Facilitator and user support tools
	  e) User-driven decision problem framing and diagnosis tools

Table 7 cont. Drought dashboard data use case details.

PARTICIPANTS	• TWDB, along with collaborating Texas state and federal agencies • Key statewide stakeholders: major local and statewide water stakeholder groups in Texas • A representative group of the general public
REGULATORY CONTEXT	There are no regulatory matters involved in development of an information dashboard. Development of public information portals is not subject to regulatory or statutory oversight. However, there will be interest by elected officials at all levels of Texas government and agency regulators in having drought status and predictive data about water availability made more widely accessible and understandable to local and statewide decision makers and elected officials, water managers, water utility operators, regulated water users and permit holders, and to the general public.
SUGGESTED WORKFLOW	Develop a proposal for funding (a quick operational plan of action linked to a realistic budget) and seek funding. Note: The following steps refer to anticipated potential operational and funded steps to be taken toward completion of the drought data dashboard use case project. The use case project may identify major key statewide and local stakeholder groups from which to solicit input and may identify a statewide or series of local (across the state) groups that can serve to represent general water-interest stakeholders. Work with TWDB to help clearly define roles and responsibilities in a collaborative arrangement. In general, the use case project may serve as a community of experts to provide advice to TWDB as requested and may manage multi-stakeholder input and review of the dashboard during the design-build phase of work. In general, any final decisions would have to be made by TWDB on data sets and dashboard function, build of the dashboard interface, and populating the dashboard with data or real-time data feeds. The use case project is anticipated to convene stakeholder input sessions online and in workshops (perhaps at stakeholder conferences). These sessions may be aimed at identifying and managing the diversity or needs and complexity of the many different dashboard user groups. In addition to typical efforts to solicit stakeholder input based on the general concept of a drought dashboard, the use case project may use innovative means to solicit information on decision support needs desired by stakeholders and may seek input on innovative dashboard tools: 1. The use case project may seek to focus stakeholder learning about dashboards and enhance the usefulness of their response by developing and having stakeholders test-use simulated drought dashboards. Test dashboards should have realistic functionality that can provide high-level hands-on understanding to stakeholders of how a dashboard works and its use to support decision making. This can provide a context for the stakeholders to understand the value of a dashboard as a decision support tool and make suggestions for improvement. Through input received during an iterative involvement process as the dashboard is built, stakeholders may help guide the design and functionality of the dashboard sequentially over time based on what they need, want and are found to use, in part as a result of using the dashboard simulation. 2. The TWDB may choose to use information received through the use case project to help design the dashboard to accommodate the needs of multiple users. Users may range in level of technical training from expert users to general public. Users may range in the scope of decision support from decision making affecting water use by large populations to water use at an individual user's home. Users may vary in geographic area of concern from statewide to hyper-local. 3. The use case project may help describe or design decision support visualization tools and graphic presentations or interfaces to determine best practices for delivering information to the various stakeholder groups. 4. The use case project can help support stakeholder feedback on potential innovative and enhanced dashboard design, such as use of artificial intelligence in decision support, virtual visualization tools, or 3-D representations of data sets. Such innovation in dashboard design can be tested in advance of spending time and money to overbuild or add advanced functionality that may or may not be used or needed. This could help allow public funding to be focused on the best and most useful dashboard design.

Table 7 cont. Drought dashboard data use case details.

DATA SOURCES					
DATA CATEGORY	DESCRIPTION	AVAILABILITY	DATA SOURCE	ACCESS METHOD	ADDED CHARACTERISTICS
Weather, river stage	Real-time temp, precipitation, wind chill, heat index, humidity, wind, soil moisture, soil temp, river flow, and river stage	Accessible	TWDB, TexMesoNet	https://www.texmesonet.org/	Also used by watermaster programs to determine surplus water for requested diversions and may impact environmental flow determinations both during low and high flow periods. Should also determine other real time monitoring systems that are relied upon by Texas Commission on Environmental Quality and others for similar determination - such as International Boundary and Water Commission stream flow stations, etc.
Drought impacts	Quantifiable losses attributable to drought	Variable	TWDB Texas Commission on Environmental Quality The National Drought Resilience Partnership United States Department of Agriculture Various other sources	https://www.drought.gov/drought/states/texas https://www.tceq.texas.gov/response/drought https://www.waterdatafortexas.org/drought https://droughtreporter.unl.edu/map/	• Difficult to quantify impacts, but no comprehensive reporting process • Annual agricultural statistics available for commodity crops, but no standardized process to separate drought impacts from other factors affecting the agricultural economy • Harder to justify resources for drought response when impacts are not comprehensively accounted for • Prolonged nature of drought and broad geographic distribution make it more difficult to assess impacts than in a discrete event such as a flood
Water use data	Real-time surface water and groundwater use	Accessible, but not real-time	TWDB Texas Commission on Environmental Quality	https://www.tceq.texas.gov/permitting/water_rights/wr-permitting/wrwud https://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/index.asp	TWDB water use data are annual and not available real time. Texas Commission on Environmental Quality data show monthly values but are only listed through 2014. Except for watermaster areas, where near real time diversion rate and authorizations are available.

Table 7 cont. Drought dashboard data use case details.

DATA CATEGORY	DESCRIPTION	AVAILABILITY	DATA SOURCE	ACCESS METHOD	ADDED CHARACTERISTICS
Soil moisture	Remotely sensed soil moisture products (e.g. soil moisture active passive products) and modelled soil moisture from the North American Land Data Assimilation System suite of models.	Accessible, variable coverage	TWDB Natural Resources Conservation Service (NRCS) Soil Climate Analysis Network (SCAN) National Aeronautics and Space Administration (NASA)	www.texmesonet.org; NRCS-SCAN sites	• Soil moisture data are currently available only from a few point measurements. The TexMesonet stations are collecting soil moisture. However, there needs to be a much wider spatial coverage of in-situ observations. • Remotely sensed soil moisture products (e.g. soil moisture active passive products products) and modelled soil moisture from the North American Land Data Assimilation System suite of models. These are available from NASA's Distributed Active Archive Center and from Mirador but it would be nice to collate the data and have it accessible as soil moisture maps and other value-added products (e.g. soil moisture anomalies for a given month or season). While these datasets are replacements for in-situ data they can be used in tandem with in-situ data. The plus point for the remotely sensed or modelled products is that they provide continuous surfaces and may provide useful information on soil moisture variability across Texas.
Planning group boundaries	Regional water planning group boundaries	Accessible	TWDB	http://www.twdb.texas.gov/waterplanning/rwp/index.asp	
Population data (census or state water plan)	Population data from the census or state water plan	Accessible	TWDB	http://www.twdb.texas.gov/waterplanning/swp/index.asp	
Groundwater and Reservoir level	Real time groundwater, reservoir level	Accessible	TWDB	https://waterdatafortexas.org/reservoirs/statewide	
Groundwater extraction rates	water extracted monthly for each aquifer		TWDB		

Table 7 cont. Drought dashboard data use case details.

DATA CATEGORY	DESCRIPTION	AVAILABILITY	DATA SOURCE	ACCESS METHOD	ADDED CHARACTERISTICS
Groundwater extraction rates	water extracted monthly for each aquifer		TWDB		
Topographic information	Digital Elevation Models and/or Lidar datasets	Accessible	Texas Natural Resources Information System	https://tnris.org/news/2017-06-12/tnris-lidar-data-now-available-download/	The refined LIDAR datasets are important for connecting various impact and vulnerability concerns
Instream flow requirements	Adopted ecological flow standards for stream segments where values have been set	Accessible	Texas Commission on Environmental Quality	https://www.tceq.texas.gov/permitting/water_rights/wr_technical-resources/eflows/rulemaking	
Water discharge per day	Real time water discharge rate per day		Texas Commission on Environmental Quality	Public Information Request or direct request form to Texas Commission on Environmental Quality and regional offices	If return flows from wastewater treatment plants, then utilities are required to measure and report this data to Texas Commission on Environmental Quality
US Drought Monitor	drought monitor (national, by state)	Accessible	United States Department of Agriculture National Oceanic and Atmospheric Administration	https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?TX	
Drought calculator for ranch/farm production	Predictive tool for assessing potential drought impacts on forage production	Accessible	Natural Resources Conservation Service	https://www.nrcs.usda.gov/wps/portal/nrcs/detail/nd/technical/landuse/pasture/?cid=nrcs141p2_001670	
USGS dashboard for TX	stream gage data	Accessible	United States Geological Survey	https://txpub.usgs.gov/txwaterdashboard/	
Streamflow	River streamflow statewide	Accessible	United States Geological Survey	https://waterdata.usgs.gov/tx/nwis/current/?type=flow	

Table 7 cont. Drought dashboard data use case details.

DATA CATEGORY	DESCRIPTION	AVAILABILITY	DATA SOURCE	ACCESS METHOD	ADDED CHARACTERISTICS
Groundwater level monitoring	Static groundwater level measurements from different times of year, with data on impact of drought on those levels and groundwater availability	Accessible, variable	Groundwater Conservation districts	Groundwater Conservation Districts	These data sets are variable; difficult to access in real time; data sets may not be readily interoperable
Groundwater availability	groundwater availability. How much water is available to be permitted. How much water has already been permitted	Accessible, variable	Groundwater conservation districts	Groundwater conservation districts	
Lithology-geological data	Drilling reports, electrical reports, seismic	Accessible, variable	TWDB Railroad Commission of Texas		

WATER DATA INITIATIVE ADVISORY COMMITTEE REVIEW AND PATH FORWARD

The Water Data Initiative Advisory Committee was reconvened on October 10, 2019, to receive reports from the two subcommittees, review the use case proposals that were developed, hear an update from TWDB on development of a flood data dashboard, and then make decisions on next steps forward (Appendix VI).

FLOOD DATA DASHBOARD

Advisory committee members first heard a report on current efforts by the TWDB to develop a flood dashboard and data hub. The TWDB is working to add staff and is collaborating with other entities that have relevant data, in addition to assessing the data needs of various stakeholders and potential users. This is being done in an effort to gain efficiency and better ensure the usability of the data.

Goals set now for the flood data dashboard and data hub include the following:

- To establish a data hub that identifies water data information from across water data-producing entities, not just the TWDB. (The hub will not house all data. Instead, the hub will connect users to the original source of the data and may index datasets based on criteria to be identified as the project develops).

- To generate an index of authoritative named data sources.

- To enable output of data layers and statistics through a viewer customizable by the user. (The capability for users to customize output will ensure users see and get what they want from the data hub, including allowing users to save customization settings for their data view and to integrate their own data as a working layer.) This is a multi-year, long-term goal for the project.

Initial suggestions for development of the dashboard and data hub were discussed by committee members. Discussions included the following areas of hub design and function:

- To help ensure against duplication of effort there was discussion about how hub designers might collaborate with the National Weather Service, US Army Corps of Engineers, US Geological Survey, and others on linking with those agencies' existing efforts on water hubs.

- To reduce need for local servers there was discussion about possibly using a cloud infrastructure for the hub to ensure scalability over time. Participants suggested a cloud infrastructure might help ensure that the system would remain functional in the event of a major event resulting in extremely high levels of use.

- Committee members discussed a general suggestion that data hub designers seek means to help ensure access to data remains constant and consistent 24/7. There were suggestions about building in self-checks and instant status reports should errors in function be detected for the main server and resident data, as well as for all linked servers and data layers.

Advisory committee members asked if there was a role for the committee to support the TWDB in this effort. Support for the overall effort was encouraged and appreciated. Encouragement included an invitation to committee members to provide comments or specific guidance as appropriate and as the data hub project progresses. In particular, committee members who know of or learn of other data hubs or data sources that might be significant to the project were encouraged to provide that information to TWDB project managers. Finally, TWDB staff committed to keeping the committee informed of progress and providing continued opportunity for input.

DROUGHT DATA DASHBOARD USE CASE

Committee members next heard a report on the subcommittee workshop to develop a drought data dashboard use case. Members heard that while the subcommittee's assignment of use case topic was well defined in advance, the subcommittee took considerable time to focus discussion until the point the subcommittee learned about a new evolving effort by TWDB to design a drought data hub. After hearing about the TWDB effort, the subcommittee developed the use case that was placed before advisory committee members for consideration. That use case proposes a collaborate effort between TWDB and the Water Data Initiative Advisory Committee to share resources, provide expertise, and otherwise help the TWDB design and build a drought data hub and dashboard. The committee can provide the greatest help to TWDB by assisting in obtaining expert input and advice and soliciting stakeholder survey and input to the data hub design, build, and use evaluation.

The advisory committee felt that funding should be raised for technical support to assist TWDB on a part-time basis on constructing the dashboard after reviewing the workflow proposed in the use case and then hearing of TWDB's needs for developing the drought dashboard. This support would be in addition to providing help with expert and stakeholder input. The committee also recognized that ownership of results of work on the use case would fall to TWDB. The committee's effort will be in support of TWDB, not independent of it. However, specific roles, responsibilities, and actions must be defined. To do so should be the subject of future planning supported by TWDB and committee members working together.

SURFACE WATER/GROUNDWATER INTERACTION USE CASE

Committee members heard a report on the subcommittee workshop to develop a surface water - groundwater interaction use case. Members heard that the subcommittee's initial consideration of use case direction varied considerably, but that there appeared a consensus around a use case to design and build a data dashboard of primarily surface water data and groundwater data in several high profile areas where some interaction data are also available or highly desirable. Committee members considered this use case, but felt that the initial direction that the use case focus on interactions between surface water and groundwater is preferred.

Committee members provided justification and details for a use case. They felt that a data system offering access to and focusing on interaction data would provide information of great overall value to decisions makers, including regional water planning groups, GCDs, and elected officials. They also recognized that interaction data may be more difficult to assemble than surface water and groundwater data as there has been little or no consolidation of interaction data sets. Although interaction data sets do exist, they may be difficult to locate, with some data residing in non-digital formats as legacy data that will need to be converted to make it available. Despite these limitations, committee members felt the assembly of these data to be critically important for use by Texas' water managers.

They suggested starting by adding available data sets to a data repository or hub having a strong search function as the first step. The hub was envisioned as evolving over time into a more robust data dashboard as interaction data sets are compiled, added, and user needs become better defined. Besides aiding decision makers, compilation of existing interaction data will assist water managers and researchers seeking to fill data gaps while not duplicating existing data. Without a data repository as described, existing data of interest can be invisible to searchers, inaccessible, or entirely forgotten. A comprehensive and accessible data repository will allow water workers to collect new interaction data with confidence that they are not duplicating past studies and help build the interaction data hub.

The committee recognized that initial compilation and hosting of the data repository will need to be undertaken by a nongovernmental organization or university, because the TWDB may not be in a position to take on the project at this time. However, they also agreed that ultimate ownership of the data repository, data hub, or dashboard should be by a government agency, and specifically that agency should be the TWDB. In the interim, the Meadows Center for Water and the Environment at Texas State University is an option to consider.

NEXT STEPS

Advisory committee members acknowledge and strongly support the current work by the TWDB to develop data hubs and dashboards for flood and drought, and they committed to assist the agency as may be possible. Current work on data dashboards by TWDB will serve as use cases that demonstrate the value of Texas data hubs to decision makers. A surface water - groundwater interaction data repository and hub will add to this demonstration. Future steps may be to piece or link these data hubs together, enabling the hubs to provide an even more complete picture of Texas water data.

Committee members also suggested developing a communications infrastructure to keep members informed of progress on data initiatives and share related information.

REFERENCES

Rosen R.A. and S.V. Roberts. 2018. Connecting Texas Water Data Workshop. Institute for Water Resources Science and Technology. San Antonio (Texas): Texas A&M University-San Antonio. 87 p. Available from: https://libguides.tamusa. edu/ld.php?content_id=42020932.

Rosen R.A., S.M. Hermitte, S. Pierce, S. Richard and S.V. Roberts. 2019. An Internet for Water: Connecting Texas Water Data. Texas Water Journal 10(1):22-29.

APPENDIX I: WATER DATA INITIATIVE ADVISORY COMMITTEE AGENDA - JUNE 28

agenda

June 28, 2019; 10 am to noon

Mitchell Foundation, 1300 Guadalupe Street, Austin, Texas; (512) 502-5182
metered parking on the street
call-in information: 1-877-820-7831; passcode 527307

goals

(1) status update
(2) chose two case studies to advance
(3) discuss plans for rest of year

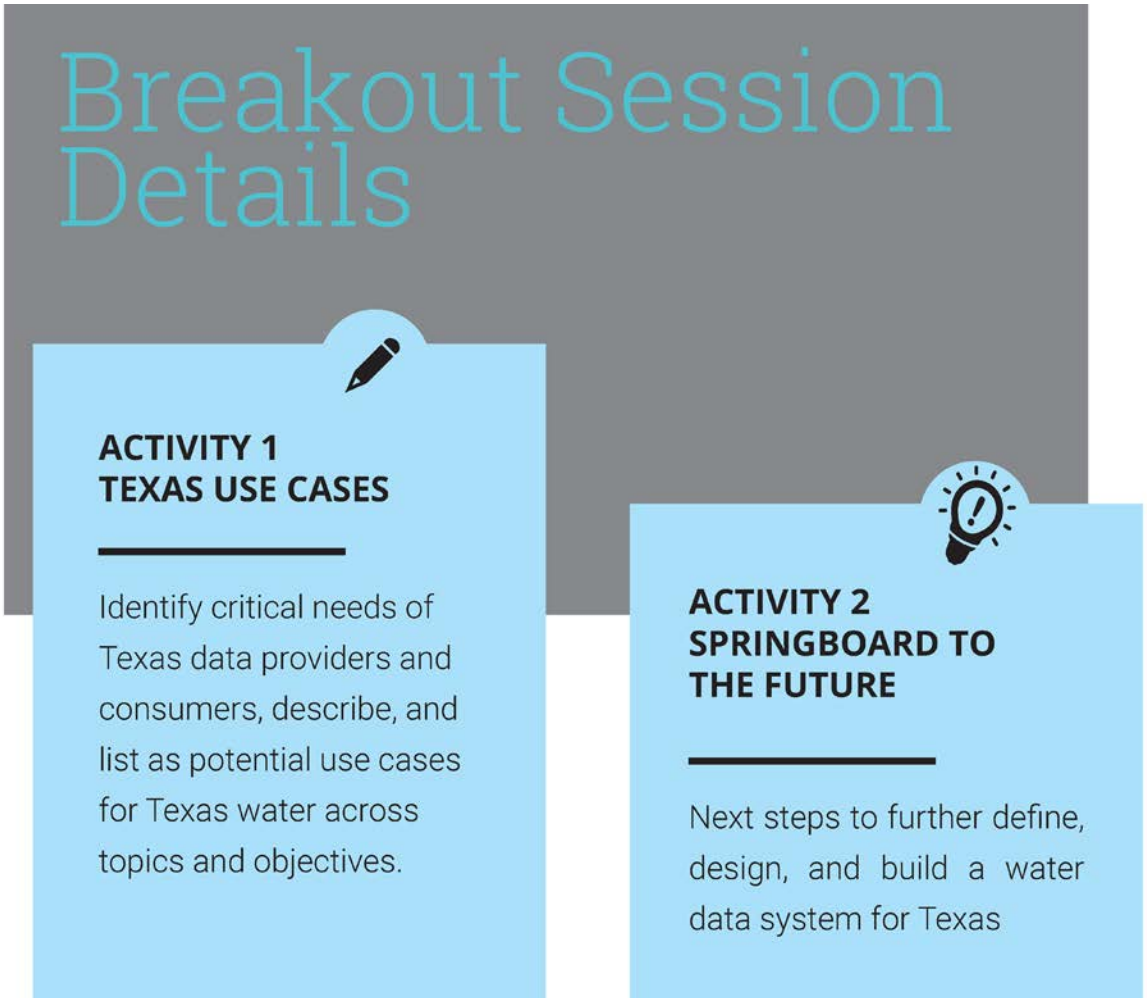
details

1. Welcome! (5m; Robert Mace, Meadows Center, and Emily Warren, Mitchell Foundation)
2. Introductions (10m; all)
3. Background and purpose (10m; Mace)
4. Status of the national effort (10m; Peter Colohan, Internet of Water)
5. Status of Texas Water Development Board efforts (10m; Sam Hermitte, TWDB)
6. Review of possible use cases (15m; Rudy Rosen, TAMU-SA)
7. Break (10m; all)
8. Selection of two use cases in addition to flood (40m; Mace+all)
9. Schedule meetings to evaluate the use cases (10m; Rosen+all)
10. Plans for rest of the year (10m; Mace)
11. Adjourn!

preparation

Please review the attachment (Appendix III, Texas Use Cases) from the "Connecting Texas Water Data Workshop." For more detail, you can view a paper summarizing the workshop at the Texas Water Journal (https://twj.media/internet-water-data-texas/) and, for even more detail, read the full workshop report (https://libguides.tamusa.edu/ld.php?content_id=42020932). Materials may also be accessed through https://staging3.data.water-texas.org/ UserName: pilot; Password: #1UseCase

APPENDIX II: TEXAS USE CASES – SPRINGBOARD TO THE FUTURE: BREAKOUT SESSION DETAILS



GROUP A

TEXAS USE CASE

WATERSHED PLANNING, WATER ALLOCATION, FLOODING

Participants formed three subgroups to work on Group A's top three recommendations.

Subject	**Watershed planning**
Objective	To develop a water budget for a river basin using science-based planning
Participants	TWDB, public utilities
Data	Land use over time and water use, actual groundwater and surface water use, metered data, water quality, endangered species data, surface water diversions, discharges, stream gauges, geologic data, soil moisture
Sources	Cities, counties, Natural Resources Conservation Service, Texas Natural Resources Information System, Google Earth, planning firms/organizations

Subject	**Water allocation**
Objective	To ensure that basic water needs are met, then use above that will be charged at full cost
Participants	Groundwater Conservation Districts, Texas Water Development Board, Texas Commission on Environmental Quality, businesses
Description	The more one pays, the more one cares

Subject	**Flooding**
Objective	To develop a collection of data sets that can be used to reduce risk, increase response, and set priorities on projects
Participants	Federal Emergency Management Agency, US Environmental Protection Agency, Texas Water Development Board, local public works agencies
Description	Flood mapping, reservoir levels and discharge

SPRINGBOARD TO THE FUTURE – NEXT STEPS

Next steps to move toward open data for Texas were listed. First is to gain legislative support, such as gain funding support or a policy mandate. Next is to identify the network structure, who will do what, determine partners, who will pay, and who will take leadership roles. Another is to pick an interesting use case or two that came from the workshop, and then form pilot projects around the use cases and actually do something that shows the value an open data system. The participants also recognized that Texas does have existing open data sources in place and operating. They suggested sharing information about the existing open data experiences and best practices, thus getting the word out about the value of open data sources. Finally, participants discussed establishing standards or guidance for open data sources so that people understand how and in what form to make data available, so it can be integrated better, and so people who may be apprehensive about open data can better understand what it means. This could help reduce barriers, along with meeting opponents of open data to help address fears.

GROUP B

TEXAS USE CASE

WATER UTILITY REPORTING TO THE TWDB

Subject	**Water utility reporting to the Texas Water Development Board (TWDB)**
Objective	To provide enhanced open access to water utility reporting data already sent to and logged into databases by the TWDB.
Description	Water utilities are legally required to submit three reports to TWDB: (1) Water use Survey, (2) Water Loss Audit, and (3) a Conservation Report. Those data are reviewed and processed, and entered in database format on the TWDB website. A PDF is then generated. However, if anyone wants to use the data across Texas they need to get all of the reports, read through the relevant ones and select desired data, and then reprocess the information into digital data for any kind of actionable use (i.e., data that were originally actionable, actionable again). This use case will be to make these data sets searchable and downloadable. There will be no privacy issues because all the data are public information to start with, it goes directly to a public agency, and it's being collected in database format. The use case project would make this data readily accessible through an open interface or interactive application. Emphasis will be on raw data, as opposed to exact uses of the data. Then those who access the data would synthesize the data as they felt most appropriate to meet their own needs.
Uses	• Industrial water use during drought • Better decision making on water-related investments • Higher visibility for addressing water loss and conservation actions • Explore utility billing structures • Many users for general research into and analysis of water use in Texas: o Innovation; Target setting for science and policy; Real-time data source; Engagement for education and consumer information sharing
Participants	TWDB, public utilities
Regulatory	• Legislative statutes and agency rules trigger reporting • Standardized by regulation
Workflow	• Utilities upload reports online • Design-build open access user interface • Determine extent of historical data to include for access • Translate data from forms to new accessible interface
Sources	• Public utilities, Texas Commission on Environmental Quality, water rights use, water sales, water flows, climate related, recharge rates • TWDB Water Use Survey, Water Loss Audit, and Conservation Report

SPRINGBOARD TO THE FUTURE – NEXT STEPS

Participants had several ideas for moving forward, including the recognition that droughts are a key driver of innovation, that an inventory of where data now resides would be a natural first step, that an advisory task force for next steps could be useful, and that a clearing house for water quality information would be welcome. A final idea was mentioned by participants that may be implemented immediately. This was taking immediate initiative to write editorial and opinion items to the public and water community stakeholders about the internet of water. In discussing the idea, use of Texas+Water and the Texas Water Journal, were suggested as currently available venues for such outreach and communication to stakeholders.

GROUP C

TEXAS USE CASE

ENVIRONMENTAL FLOW TRANSACTIONS

Subject	**Environmental flow transactions**
Objective	To have the greatest positive impact on environmental flows at the lowest cost
Data Gaps	Environmental flow study raw data, cost data for transactions, biological data, water availability (what's on the market), historical data at temporal and spatial levels
Participants	Lawyers, Texas Commission on Environmental Quality (TCEQ), Texas Water Development Board (TWDB), Texas Parks and Wildlife, river authorities, purchasers, sellers
Workflow	1. Identify potential funding sources 2. Identify possible sellers 3. Identify areas of need, e.g., threatened species 4. Compare historic to current flows Additional actions in no order that may be taken: • Review water rights seniority • Do cost-benefit analysis • Study prior cases • Assess water quality and impacts • Review predictive models • Review TCEQ process for amending water rights • Identify existing environmental flow rights • Estimate flows needed to make a difference
Sources	US Geological Survey, TCEQ, regulations/requirements, river authorities, wa-ter rights, environmental flow studies, stream flow including historical data (SB 2), water quality, existing environmental flow rights, water availability models, threatened species

SPRINGBOARD TO THE FUTURE – NEXT STEPS

Participants had a series of potential next steps, lead off by a need to identify funding sources for establishing the data hub, followed by an identification of "anchor tenants" which would be the key users and supporters of the hub. There was also discussion about creating an initial support group called, "Cooperating Agencies for the Temporal and Spatial Management of Environmental Occurrences of Water," or as participants affectionately labeled it, the CATS MEOW. But whatever it may be called, the idea participants voiced is to create a group or organization to work on data standards and communicate on data in Texas. Related to that was the notion of creating a users' forum to allow for feedback discussions between super users, help with general education, and use it to create a community of users at all levels. Participants also discussed the need to address barriers to participation for certain institutions, better understand what the barriers are, identify resistance (including who may be opposed), and address the barriers. This effort may include identifying a neutral broker for data to support whichever entity takes the lead on the overall effort, and find and motivate political champions so that some barriers may be reduced or removed by statute, for example by requiting some kinds of data from some sources be openly available.

Finally, participants considered which agency, or "who," would be best suited to lead in developing and hosting the key data hub. The conclusion of the group was that the TWDB's Texas Natural Resources Information System (TNRIS). Reasons for the choice included that TNRIS is neutral, public, supported by statute, and has a stable source of funding.

GROUP D

TEXAS USE CASE

FLOOD WATER MANAGEMENT IN EPHEMERAL STREAMS

Subject	**Flood water management in ephemeral streams**
Objective	To better prepare for flood water management and emergency response in ephemeral streams in Texas
Description	Flash floods occur in ephemeral streams, sometimes even at low levels of rainfall. Emergency and natural resource managers need to prepare of unanticipated flood scenarios.
Data Gaps	Need rain map for the ground (i.e., how water moves and accumulates once it hits ground)
Uses	• Produce data for immediate use in emergency • Many data resources must work together immediately and flawlessly on public health and safety • Way to access real-time inundation conditions, spatially and temporally • Understand how waters will recede • Determine opportunities to divert water off-channel for storage and flood reduction • Placement of flood control structures • Identify biological areas that benefit from flooding • Post-flood damage assessment • Baseline data on impacts on soils (erosion) and nutrients
Participants	County government, National Weather Service, US Geological Survey, citizens, local media, first responders, Texas Water Development Board, Texas Water Development Board, Texas Division of Emergency Management, Federal Emergency Management Agency, flood management districts, Natural Resources Conservation Service, cities, landowners, nongovernmental organizations, conservation districts, engineering consulting firms, river authorities, water utilities, wastewater facilities, resorts
Regulatory	• FEMA flood plain mapping drives insurance • Tort law • Federal and state designation of "State of Emergency" • Legally required reporting, including industrial spills from treatment facilities • Local codes and ordnances • Local, state and federal determinations of evacuation and other orders for health and safety
Workflow	• Need a mechanism to bring together data from many sources immediately • Need an organization (assigned or created) to answer data questions for Texas flood emergencies
Sources	Same as Participants (above)

SPRINGBOARD TO THE FUTURE – NEXT STEPS

Participants emphasized developing examples of how people have used data for practical decisions, i.e., real world examples of benefits to people. The suggested conducting a survey to determine, "who has what data already." Participants stated that there may be more data available than generally assumed, possibly because there may be few or no incentives for collectors of data to share with others what data they have and to support making data sets available. Participants asked, "what are the incentives for organizations to share given already strained budgets and a lack of time to do basic work?" They also asked about disincentives to sharing access to data, especially for the private sector. There was even discussion about how some public organizations may be reluctant to open and share data because of fear of legal action against the agency. All this discussion focused on addressing incentives and disincentives as an important step forward. One idea even involved awarding a prize, or public challenge, to use TWDB data and demonstrate positive impacts to decision making for a project in Texas.

Finally, participants concluded that the agency in Texas best suited to lead in developing and hosting the key data hub is the TWDB's Texas Natural Resources Information System.

GROUP E

TEXAS USE CASE

INTEGRATE AND UPDATE THE TEXAS WAM AND GAM

Subject	**Integrate and update the Texas Water Availability Models (WAM) and Groundwater Availability Models (GAM)**
Objective	To integrate and update the WAM and GAM to better understand water availability across surface water and groundwater, and across the interface between the two.
Description	Separate models are often outdated, sometimes reverse engineered, and lead to suboptimal results by design. Current models for surface water and groundwater in Texas can be integrated for better results leading to better decision making about water in Texas.
Data Gaps	Need rain map for the ground (i.e., how water moves and accumulates once it hits ground)
Users	All users of state, regional, and local water management plans
Uses	• Provide better tools for decision making and reduce/avoid some costs • Improve state water planning and plans • Provide for more adaptive management • Assist real-estate planning and reduce costs
Participants	See sources
Regulatory	State, regional, and local water management planning
Workflow	• Need a mechanism to bring together data from many sources immediately • Need an organization (assigned or created) to answer data questions for Texas flood emergencies
Sources	Groundwater conservation districts, Texas Water Development Board State Water Plan and Texas Natural Resources Information System, US Geological Survey, floodplain mapping, US Geological Survey Texas water dashboard, Texas Commission on Environmental Quality, The Nature Conservancy Living Waters, Texas Railroad Commission, Texas General Land Office, Texas Department of Licensing and Regulation well licensing, Lower Colorado River Authority Hydromet, TexMesonet, National Weather Service river forecast, US Bureau of Reclamation, US Army Corps of Engineers
Characteristics	Data are available and ready for use today dispersed across many agencies and organizations. These data may be hard to find for most potential users.

SPRINGBOARD TO THE FUTURE – NEXT STEPS

Participants first listed existing data sources and then, considering the list, asked, "what can we do to or with this existing data to improve outcomes for Texans the most." Their answer was to integrate and update the Texas Water Availability Models (WAM) and Groundwater Availability Models (GAM). Participants summed up their reasoning with a problem statement: separate models are often outdated, sometimes reverse engineered, and lead to suboptimal results by design. Thus, the key for the group was not to just have more data, but to have more research, more models, better models, better data sets, maps, and a tool. That tool will allow people to see water availability across surface water and groundwater, and across the interface between the two. This interface is where the greatest optimization of the models will be achieved. With that, the data sets will be optimized and the improvement sought by the participants will be achieved.

The end result is that there will be updated WAM and GAM, and with better models over time the end users, including policy makers, regulators, and water rights holders, will be served better. Participants stated that it is important that this effort be positioned as not changing how water is regulated in Texas. This project would be framed to honor and protect property rights and how water is already being managed in Texas. The tool would allow for better evaluations and decisions; better state, regional, and local water planning and plans; more adaptive and integrated management, and; better tools to avoid costs. This would be a tool that serves a specific purpose. It would also drive traffic to existing data portals from which data will be drawn.

GROUP F

TEXAS USE CASE

PROBABILITY OF RESERVOIR WATER SUPPLIES FALLING

Subject	**Risk management of the probability of reservoir water supplies falling below criteria at 3, 6 , 9, and 12 months**
Objective	Risk management: identify risk of communities' water supplies falling below critical levels
Participants	Primary users: Water Resource Managers, utilities, power agencies – any group that may need to take action based on risk and "triggers"
Regulatory	Water rights in reservoirs and placed in Water Management Plan. The plan is stochastic with water rights defined by TCEQ oversight of court-based adjudication. Focus on permission with constraints.
Workflow	1. Identify potential funding sources 2. Identify possible sellers 3. Identify areas of need, e.g., threatened species 4. Compare historic to current flows Additional actions in no order that may be taken: • Review water rights seniority • Do cost-benefit analysis • Study prior cases • Assess water quality and impacts • Review predictive models • Review TCEQ process for amending water rights • Identify existing environmental flow rights • Estimate flows needed to make a difference
Sources	Texas Commission on Environmental Quality, water rights use, water State river flows and related data sets. Water sources = run of river data

SPRINGBOARD TO THE FUTURE – NEXT STEPS

Participants observed that two key questions need to be addressed in order to form a "springboard" to the future of Texas water data management:

- What agency will be the overseeing entity?
- What entity is going to pay for changes to the existing data management systems?

Participants discussed TWDB and TCEQ, with TWDB's Texas Natural Resources Information System (TNRIS), to lead in developing and hosting the key data hub. USGS was also suggested.

Possible process to form the "springboard" might entail the following:

- Pick one topic / one need that drives an open, connected system.
- Start with the current responsible data agency.
- Build data and metadata of similar quality.
- Survey Texas water agencies and users to find coalescing point and "bundle" an approach to connecting currently unconnected data sets and databases.

COMPLETE LIST OF POTENTIAL USE CASE SUBJECTS

GROUP A

1. Regional water planning
2. Allocation of surface water during drought
3. Flooding (catastrophic) impacts – ecological, economic, social
4. Watershed protection planning (e.g., Rio Grande and interboundary)
5. Options for community water supplies
6. Interbasin water transfer (i.e., San Antonio Water Systems Vista Ridge Project) vs. brackish groundwater desalination vs. new reservoirs
7. Industrial water use during drought
8. Need for more data and transparency of data
9. Water rights - priority of contracts, seniority of right, supply variability, diversion, beneficial use
10. Sales transactions
11. Harris-Galveston Subsidence District and integrated support from regulatory agencies
12. Conservation data
13. Utilities connections

GROUP B

1. Water utility reporting to the Texas Water Development Board (TWDB)

GROUP C

1. Environmental flow transactions
2. Nonpoint source pollution
3. Determination of appropriate groundwater withdrawal and impact on aquifers
4. Best management practices for conservation
5. Recreational use attainability analysis
6. Flood prediction and emergency response
7. Desired future condition for groundwater and predictions
8. Estimation of groundwater availability
9. Impervious cover and regulation

GROUP D

1. Flood water management in ephemeral streams
2. Planning for drought
3. Environmental flows
4. Climate impacts to Texas hydrology
5. Water quality in the context of consumptive use

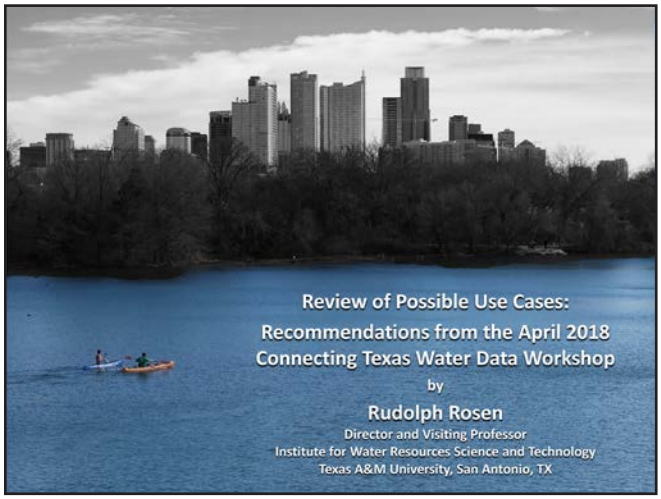
GROUP E

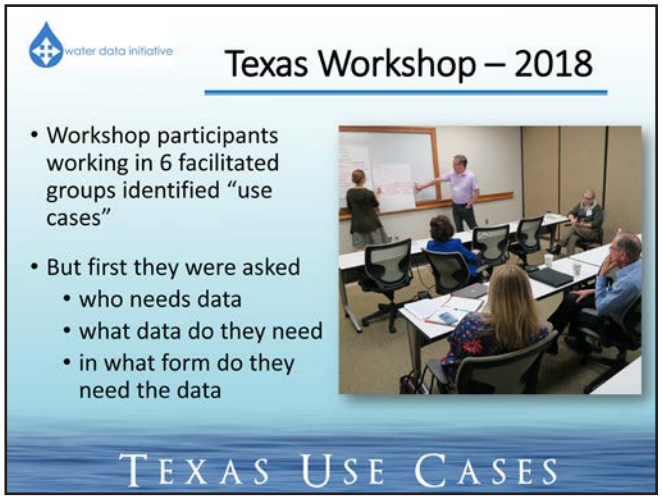
1. Integrate and update the Texas Water Availability Models (WAM) and Groundwater Availability Models (GAM)

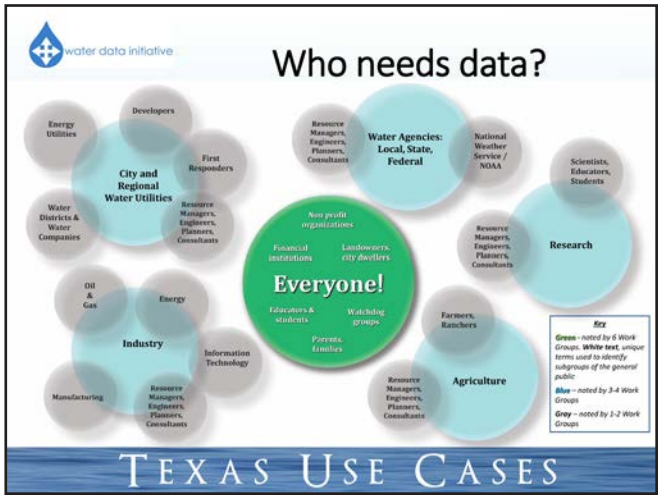
GROUP F

1. Water rights model for instream flows
2. Flood observations: crowd-source for different water sources and water quality
3. Groundwater Conservation District dashboard
4. Standardization - leverage between data sources using other sectors' knowledge and experience
5. Climate indicators study – how to fund its connectivity to statewide water resources concerns
6. Comprehensive lead (or other potential contaminants) across the state

APPENDIX III: APRIL 2019 CONNECTING TEXAS WATER DATA WORKSHOP PRESENTATION







water data initiative

What data do they need?

TEXAS USE CASES

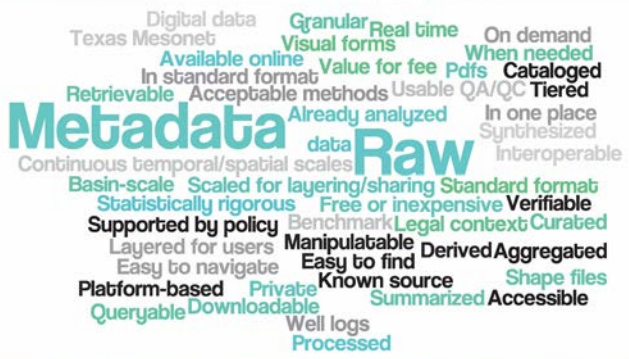
water data initiative

In what form?

TEXAS USE CASES

water data initiative

In what form?



TEXAS USE CASES

water data initiative

Identify Use Cases

- Ready models to inform development of open data systems
- Short summary organizing, in a concise and consistent format, the data gaps, needs, uses, users, regulatory requirements, and workflow for a particular objective
- Tool for organizing and assessing user-stakeholder data needs and for communicating those needs to decision-makers
- Template for assembling information and design

TEXAS USE CASES

Objective	The objective is the decision, goal, or desired action to be achieved. The objective describes what is to be accomplished.
Description	The description is any defining information about context and background that might help a reader understand the objective or added details of the topic in general.
Participants	The participants section provides a list of the main decision-maker (s) and other key parties involved or affected. Attributes or contact information for participants may be listed here, if desired.
Regulatory Context	The regulatory context lists any laws, statutes, rules, regulations, reporting requirements, legal operational constraints, and governmental agency programs either existing or under development. This category may also include boundaries, for example geographic borders, time-based reporting requirements, and financial limits.
Workflow	Workflow describes the steps, listed as specific actions and in order of occurrence if possible, to be taken by the participants in order to accomplish the objective.
Data Sources	Data sources are the repositories, locations and holders of recorded measurements or properties collected and assembled about water. Data sources may be well defined and assembled or largely unconsolidated. Data gaps desired to be filled may be listed here as well as existing data. The sources should be listed in sufficient detail to be identified and located. Here is a table format that can be used for this purpose and nested here or added as a separate table.

Data Category	Description	Data source	Access Method
Water	Water availability	USGS web site for gage data	https://wdr.water.usgs.gov/
Agriculture	Evapotranspiration	Texas Water Development Board Precipitation and Lake Evaporation Data	http://www.twdb.texas.gov/ surface water/conditions/evaporation/
Infrastructure and utilities	Records of electricity used for pumping	Data collected by permittee	Not available at aggregate level—data collected for each individual case
Land use	Aerial photos	Satellite imagery - Google Earth	https://www.google.com/earth/

Data Characteristics	Data characteristics includes notes about the type, form, and format of data that would be most useful for making decisions, including anything out of the ordinary about the data.

Workshop Participant Name	
Objective	
Description	
Participants	
Regulatory Context	
Workflow	
Data Sources	
Data Characteristics	

Data Category	Description	Data source	Access

water data initiative

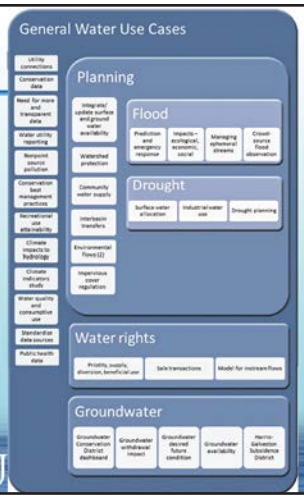
Use Cases

- Participants identified 35 potential use cases
- Major categories were
  - water event planning
    - (a) flood planning
    - (b) drought planning
  - water rights
  - groundwater

TEXAS USE CASES

water data initiative

- Participants identified 35 potential use cases
- Major categories were
  - water event planning
    - (a) flood planning
    - (b) drought planning
  - water rights
  - groundwater



TEXAS U

water data initiative

Use Cases

Top use cases recommended for Texas by consensus in five of the workgroups.
• Water utility reporting to the Texas Water Development Board
• Environmental flow transactions
• Flood water management in ephemeral streams
• Integrate and update the Texas Water Availability Models (WAM) and Groundwater Availability Models (GAM)
• Risk management of the probability of reservoir water supplies falling below criteria at 3, 6, 9, and 12 months

Final Group
- **Watershed planning**
- **Water allocation**
- **Flooding**

TEXAS USE CASES

TEXAS USE CASE

FLOOD WATER MANAGEMENT IN EPHEMERAL STREAMS

Subject	**Flood water management in ephemeral streams**
Objective	To better prepare for flood water management and emergency response in ephemeral streams in Texas
Description	Flash floods occur in ephemeral streams, sometimes even at low levels of rainfall. Emergency and natural resource managers need to prepare of unanticipated flood scenarios.
Data Gaps	Need rain map for the ground (i.e., how water moves and accumulates once it hits ground)
Uses	• Produce data for immediate use in emergency • Many data resources must work together immediately and flawlessly on public health and safety • Way to access real-time inundation conditions, spatially and temporally • Understand how waters will recede • Determine opportunities to divert water off-channel for storage and flood reduction • Placement of flood control structures • Identify biological areas that benefit from flooding • Post-flood damage assessment • Baseline data on impacts on soils (erosion) and nutrients
Participants	County government, National Weather Service, US Geological Survey, citizens, local media, first responders, Texas Water Development Board, Texas Water Development Board, Texas Division of Emergency Management, Federal Emergency Management Agency, flood management districts, Natural Resources Conservation Service, cities, landowners, nongovernmental organizations, conservation districts, engineering consulting firms, river authorities, water utilities, wastewater facilities, resorts
Regulatory	• FEMA flood plain mapping drives insurance • Tort law • Federal and state designation of "State of Emergency" • Legally required reporting, including industrial spills from treatment facilities • Local codes and ordinances • Local, state and federal determinations of evacuation and other orders for health and safety
Workflow	• Need a mechanism to bring together data from many sources immediately • Need an organization (assigned or created) to answer data questions for Texas flood emergencies
Sources	Same as Participants (above)

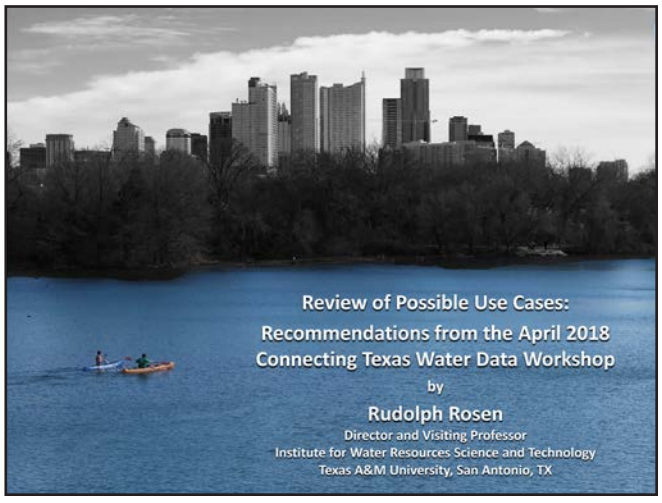
water data initiative

Classes of Use Cases

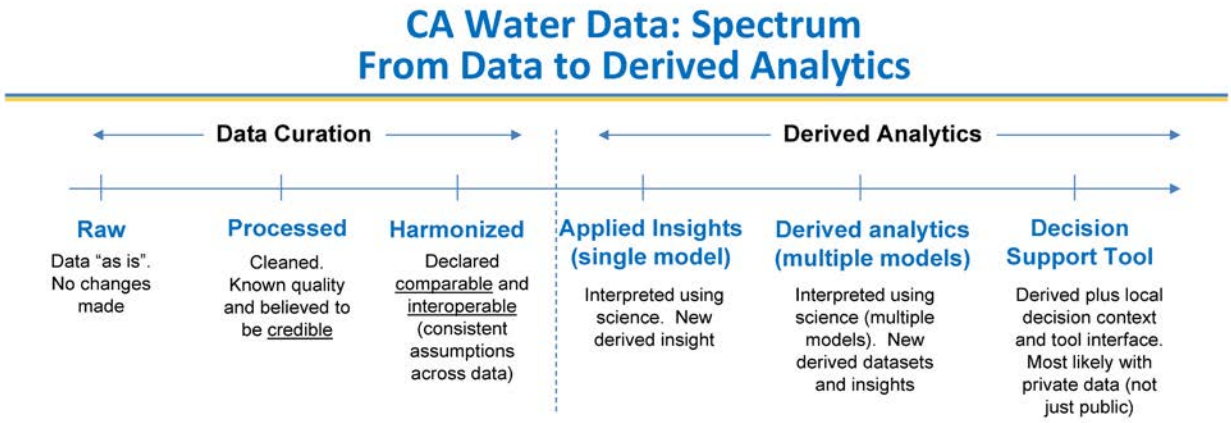
Potential classes of use cases for future development

1. ***Events***, such as floods, droughts, and water supply ups and downs.
2. ***Markets***, can market forces be used directly or indirectly to drive new data and more access?
3. ***Unusual to the water sector, but important users,*** such as insurance companies, real estate developers, and banks.
4. ***Better decisions on costs or investments***, such as building new infrastructure and timing of reservoir releases.
5. ***Public engagement***, such as user-friendly dashboards and delivery of personal or neighborhood water usage information.
6. ***Uses already underway*** where improvements or additions to existing data will provide quick results.
7. ***Conflicts*** emerging or ongoing, including a use case associated with legal action contemplated or ongoing.
8. ***Locally-relevant successes*** showing where a small amount of data was used to change decisions affecting a local area or group.

TEXAS USE CASES



APPENDIX IV: CONTINUUM OF USEFULNESS FROM RAW DATA TO DERIVED ANALYTICS



Examples

Groundwater					
GW tabular data (local well data)	Graphs of water levels over time	DWR CASGEM public portal (maps/visuals)	GW contour maps (GICIMA)	Conjunctive water use for GW/SW (texture model, numerical model)	TBD: Flood-MAR DST to estimate GW recharge via flood waters
Water Quality					
Water sample	WQ report	MyWaterQuality.ca.gov	WQ/ ecological mapping	Environmental flow/ ecology/ quality	TBD: Environmental flows DST to optimize strategies (WQ/eflows benefits)

APPENDIX V: SURFACE WATER – GROUNDWATER SUBCOMMITTEE WORKSHOP AGENDA - AUGUST 26

SURFACE WATER / GROUNDWATER INTERACTIONS WORKSHOP

AGENDA

August 26, 2019
1:00 - 4:30 PM

Texas Water Development Board
Room 540E, 1700 Congress Ave
Austin, Texas

1. Introduction and Workshop Process - Rosen. (approx. 15 min)
2. Data Haves, Wants, and Needs: Data and Data Gaps for Texas Surface Water / Groundwater Interactions. *Review of listed information.* (approx. 15 min)
3. Detailing the Use Case:
   A. Define the exact subject matter of the Texas Surface Water / Groundwater Interactions Use Case. *Guidance: Participants at the 2018 workshop advised that Use Cases must address water data sources that are FAIR: F=Findable, A=Accessible, I=Interoperable, and R=Reusable. At a recent advisory group meeting Glen Low discussed seven desirable attributes for Use Cases based on experience in other states. They should address something that (1) has an obviously* ***valuable end****, (2) is a* ***viable/usable product****, (3) is* ***doable****, (4) is* ***scalable/replicable****, (5) is* ***not too controversial****, (6) would* ***provide an early win****, and (7) addresses* ***known users and uses****.* (approx. 45 min)
      i. Title. *Focused statement of the Surface Water / Groundwater Interactions Use Case project/Initiative/pilot.*
      ii. Objective. *Once we have the focused statement of the project/initiative/pilot, the objective(s) of that should become clear.*
      iii. Description. *With the title and objective stated, the description of the project/initiative/pilot should be easily stated.*
   B. Participants. *Who must be participants and who would we like to see be participants in the Use Case project/Initiative/pilot.* (approx. 30 min)
   C. Regulatory Context. *Policy and legal realities or desired conditions for implementing the Use Case project/Initiative/pilot.* (approx. 30 min)
   D. Implementation Discussion/Workflow. *Open recommendations and discussion on implementing the Use Case project/Initiative/pilot, including practical considerations. This discussion will be used to fill in "workflow," including listing initial essential actions and their sequence to the extent possible.* (approx. 1 hr)

APPENDIX VI: DROUGHT DATA DASHBOARD SUBCOMMITTEE WORKSHOP AGENDA - AUGUST 30

DROUGHT DATA DASHBOARD WORKSHOP

AGENDA

August 30, 2019
8:30 AM – 12:00 PM

Mitchell Foundation offices
1300 Guadalupe Street
Austin, Texas

1. Introduction and Workshop Process. (approx. 15 min)
2. Data Haves, Wants, and Needs: Data and Data Gaps for application in a Drought Data Dashboard. *Review of listed information.* (approx. 15 min)
3. Detailing the Use Case:
   A. Define the exact subject matter and data needs of the Drought Data Dashboard. *Guidance: Participants at the 2018 workshop advised that Use Cases must address water data sources that are FAIR: F=Findable, A=Accessible, I=Interoperable, and R=Reusable. At a recent advisory group meeting Glen Low discussed seven desirable attributes for Use Cases based on experience in other states. They should address something that (1) has an obviously **valuable end**, (2) is a **viable/usable product**, (3) is **doable**, (4) is **scalable/replicable**, (5) is **not too controversial**, (6) would **provide an early win**, and (7) addresses **known users and uses**.* (approx. 45 min)
      i. Title: Drought Data Dashboard. *Title defined previously.*
      ii. Objective (s). *Brief listing of the objective(s) of the Use Case project to define and develop the dashboard. This will help focus the exact nature of the Dashboard.*
      iii. Description. *With the title and objective stated, the description of the project/initiative/pilot should be easily stated, still further defining the Dashboard, what it will provide, and for who.*
   B. Participants. *Who must be participants, and who would we like to see be participants in the Use Case project/Initiative/pilot.* (approx. 30 min)
   C. Regulatory Context. *Policy and legal realities (constraints or drivers) or desired conditions for implementing the Use Case project/initiative/pilot.* (approx. 30 min)
   D. Implementation Discussion/Workflow. *Open recommendations and discussion on implementing the Use Case project/initiative/pilot, including practical considerations. This discussion will be used to fill in "workflow," including listing initial essential actions, actors, and sequence of events to the extent possible.* (approx. 1 hr)

APPENDIX VI: WATER DATA INITIATIVE ADVISORY COMMITTEE AGENDA - OCTOBER 10

water data initiative
advisory committee

agenda

October 10, 2019; 8:30 am to 10:30 am

Mitchell Foundation, 1300 Guadalupe Street, Austin, Texas; (512) 502-5182
metered parking on the street
call-in information: see attached

goals

(1) status of Texas Water Development Board (TWDB) efforts
(2) discussion of stakeholder meetings on the two case studies
(3) strategy for next year

details

1. Welcome and introductions! (5m; Robert Mace, Meadows Center)
2. Purpose/goals of the meeting (5m; Mace)
3. Status of TWDB efforts (20m; Richard Wade, TWDB)
4. Discussion of the stakeholder meeting on the Drought Dashboard (25m; Rudy Rosen, TAMU-SA + all)
5. Break (10m; all)
6. Discussion of the stakeholder meeting on surface water/groundwater interaction (25m; Rudy Rosen, TAMU-SA + all)
7. Strategy for next year (30m; Mace)
8. Adjourn!

preparation

Please review the attached summaries of the stakeholder meetings on the use cases.

The Meadows Center
for Water and the Environment
Texas State University

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