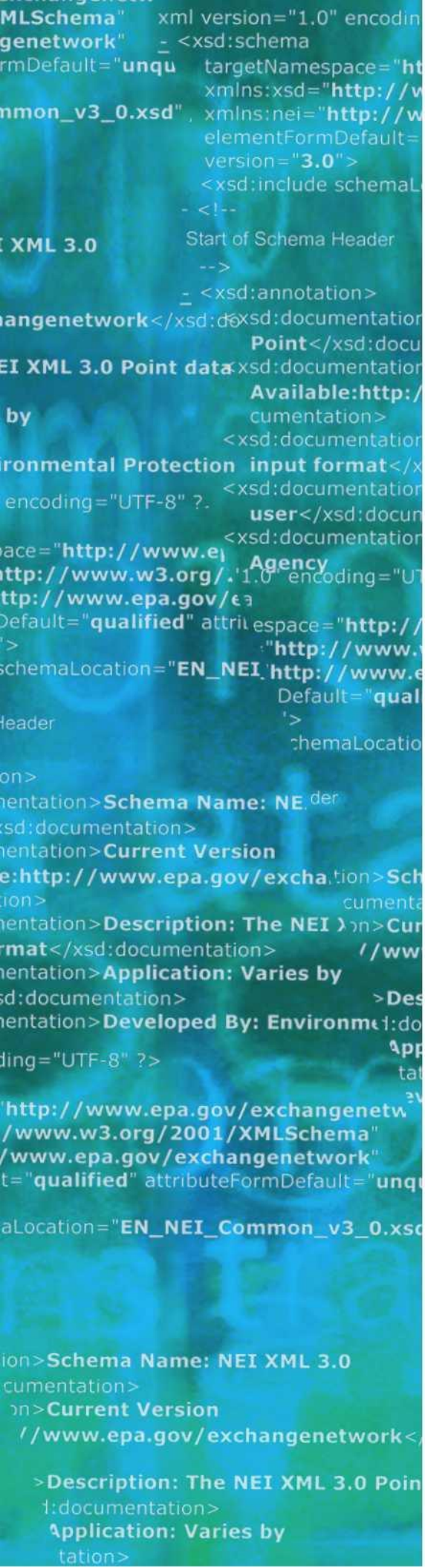

Water Data Exchange (WaDE)

Flow Configuration Document

Version: 0.2
Revision Date: July 15, 2014

Environmental Information eXchange Network

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Component Alignment

Flow Component Versions Currently Supported

Component	Version(s) Supported	Explanation (optional)
FCD	**0.2**	**Draft Release**
Schema	**0.2**	**Draft Release**
DET	**0.2**	**Draft Release**
WaDE	**0.2**	**Beta Development**

1 Introduction

1.1 Flow Identification

Flow Name:

Water Data Exchange (WaDE)

Flow Owner:

Sara Larsen, Water Data Exchange Program Manager, Western States Water Council

Flow Owner Contact Information:

Sara Larsen
Western States Water Council

Phone: (801) 685-2555
Email: saralarsen@wswc.utah.gov

1.2 Background

The Water Data Exchange (WaDE) is a project led by the Western States Water Council (WSWC), in coordination with the Western Governors' Association (WGA), the U.S. Department of Energy National Labs, and the Western States Federal Agency Support Team (WestFAST). The purpose of the project is to better enable the exchange of water availability, water planning, and water use data between the states, federal agencies, and the public. The project will also focus on working with federal agencies to make federal data more available to state water planners, to assist in the development of their water plans.

These data are not only critical to water supply planners, but also to water quality managers. The amount of water available at a given time, and how that water is allocated, is critical information to someone developing a Total Maximum Daily Load (TMDL), someone evaluating a discharge permit, or someone reviewing or developing water quality standards (to name a few). These data have historically not been available in any type of consistent format, making it difficult to do any regional-scale analysis of water availability. In the arid West, water availability is becoming increasingly important as population is growing and water is being seen as a critical component to continued economic growth.

Numerous entities (including federal agencies, universities, and industry) are trying to better understand water availability, and how that availability may influence future investment. The WSWC has identified the need for these entities to be able to access state agency data for their studies. By making state agency water data available to the public in a common format and via common services, the WaDE project hopes to achieve this goal. Conversely, many federal agencies are the stewards for data sets that are critical to state water managers. Some examples of these data include, but are not limited to, snow depth data (SNOTEL), stream gaging data, precipitation data, and reservoir height data.

All of these are similar in that they measure a given parameter, or set of parameters at a specific location, at a defined interval, over a period of time (for the purposes of this document, these data will be referred to as 'sensor' data. Currently there are several diverse methods and formats that the federal agencies use to publish these datasets. Efforts have been initiated to try to consolidate these methodologies and formats into a common format or several common formats. A secondary goal of the WaDE project is to promote the idea of the federal agencies adopting a common approach for sharing this information.

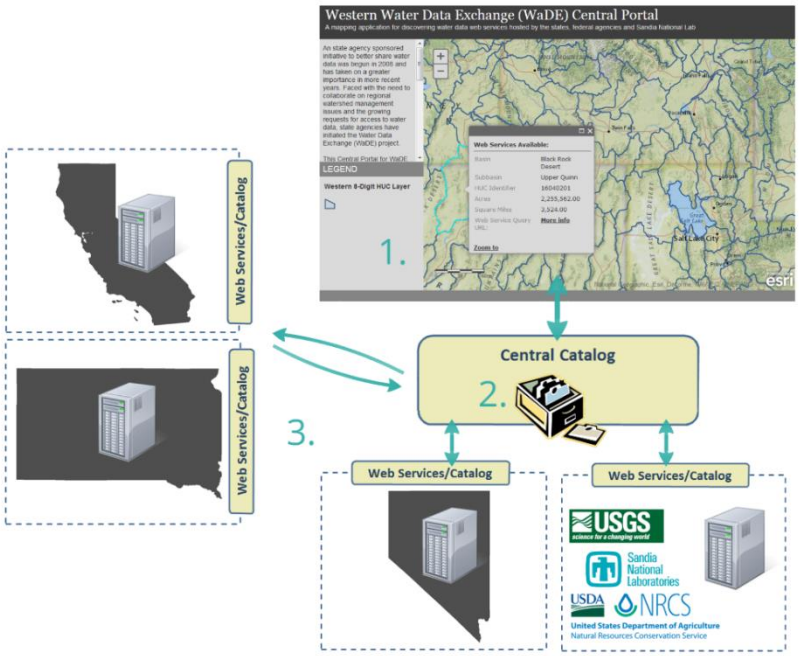

Figure 1. Generalized System Architecture Diagram for States' In-House WaDE Applications

WaDE will provide a state-to-state, state-to-fed, and fed-to-state data exchange. The data exchanged will better support water planners in developing and implementing their water plans. The design of the system is such that data should flow seamlessly in a computer-to-computer fashion when automated to do so, whether the application is deployed on premises at the partner agency or using a cloud solution implementation (See Figure 2).

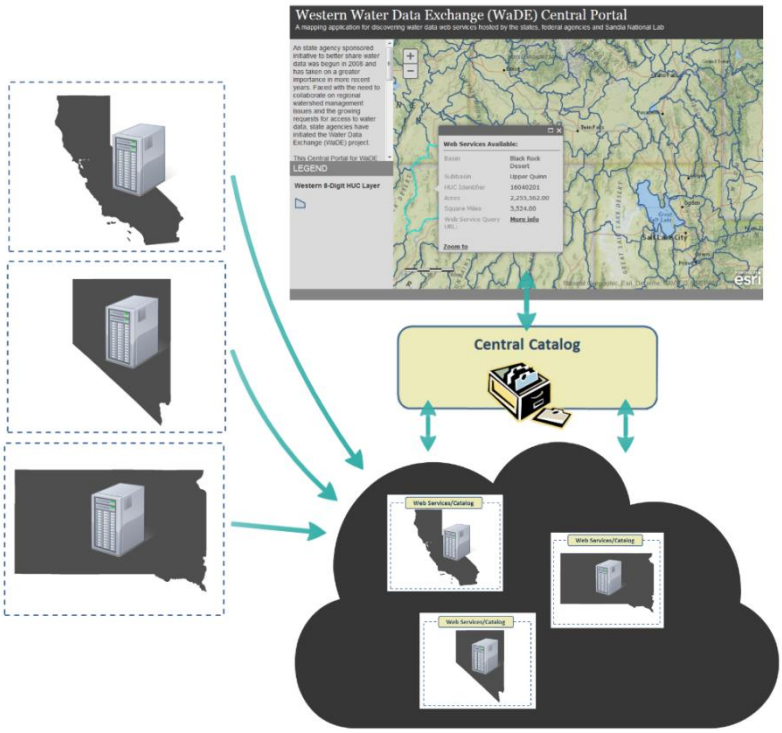

Figure 2. Generalized System Architecture Diagram for Partners' "Cloud" WaDE Applications

Participants in the data exchange should not need to wait for a manual step in order to receive the data that is being requested. Data owners should also be able to control what data are shared and with whom. Participants benefit from being able to access the data from other partners following this seamless approach. Participants also benefit by having their data published via a central system, thereby avoiding the need to invest in additional public access systems.

1.3 Flow Configuration Document Scope

The initial release of the WaDE schema, databases, cloud implementation, and web services (v0.2) is now available. The WaDE Flow Configuration Document (FCD) is intended to provide partners with information to participate in further development efforts and in accessing/testing the existing WaDE components. With the assistance of a technical development workgroup comprised of a diverse group of experts from states, federal agencies, and the private sector, WSWC has developed a preliminary schema and web services code that partners can now implement either on premises or as a cloud application. As partners implement WaDE as described in this FCD, a log of needed and/or suggested changes will be maintained by the WSWC. This version of the FCD is not intended to be used for production development by partners, but as a “roadmap” or guide to how the WaDE data exchange functions on a conceptual level. Upon completion of the component development and testing period, the WSWC has released version 0.2 of WaDE, the WaDE schema, and this FCD. WSWC is working with its partner states at this time to develop a beta/prototype portal for the first set of states to produce WaDE dataflows.

This FCD describes the WaDE schema for water availability, planning, use, and allocation data. It also provides background information on some proposed approaches for the sharing of sensor data. WaDE uses primarily Representational State Transfer or REST-based web services for the exchange of information. This FCD describes these services and under what circumstances these services would be used.

This FCD covers the exchange of the following types of information:

Summarized Water Data: Water quantity-related estimates that are summarized by a geospatial unit, usually by watershed, hydrologic unit code (HUC), a customized basin delineation, or county, for:

- Water Availability Estimates (as either an volume amount or a relative metric)
- Physical or Technical Water Supply Estimates
- Water Allocation by Beneficial Use Category
- Water Use Estimates (as either a summary of water withdrawals, consumptive use, or both)
- Institutional or Regulatory Restrictions

Detailed Water Data: Water quantity-related estimates that are site-specific within a watershed, HUC, customized basin delineation, or county, for:

- Water Allocations (water rights and/or permits)
- Water Diversions (actual amounts of water withdrawn for the allocation)
- Consumptive Use (actual amounts of water utilized, i.e., lost to the natural hydrologic system)
- Return Flows (actual amounts returned to the natural hydrologic system)

1.4 Data Flow Overview

WaDE defines data services that will be used by trading partners to exchange water quantity information with one another. Data are made available by state or tribal partners via REST publishing services.

Whatever shared services that are available from each state will be published and accessible using the Exchange Network's Discovery Service (ENDS).

It is intended that the WaDE REST services will follow the Exchange Network specifications. The preliminary release of the EN's REST specifications can be found here (http://www.exchangenetwork.net/wp-content/uploads/2013/05/REST_Guidance_v1.1.pdf). The WaDE web services URL query format adheres to this specification, but also includes a version number in the base URL for service life-cycle tracking by partners and those wishing to access specific versions of the WaDE schema. The inclusion of the version number in the URL clarifies which version of the WaDE data schema is being accessed, given the future release of version 0.3 or 1.0 and so on. If any of the WaDE services transition to SOAP, or non-RESTful web services, these will adhere to version 2.0 of the Exchange Network's node web service specifications for all transactions. For example, if the WaDE technical workgroups recommend that a subset of the shared data not be publicly available some time in the future, the exchange of that information will be implemented via an Exchange Network Query web service.

1.5 Flow Access and Security

All REST service requests are open to the public, and as such do not require any accompanying authentication token. No data made available via WaDE should be sensitive or confidential. Trading partners should consider this as they determine what datasets to make available via WaDE and ensure that no information transferred to WaDE databases or cloud applications are sensitive.

For any and all services that are not REST-based, WaDE will require that those requests be accompanied with a valid NAAS security token per the Exchange Network's Node specification. All partners implementing these non-REST services must be authorized to NAAS and receive a valid security token before these services can be invoked. For Node 2.0 implementations, users must authenticate against NAAS 3.0.

1.6 Flow-Level Business Rules

Current Business Rules: The WaDE Data Exchange Template (DET) contains a list of the targeted data elements, along with their respective business rules. It is recommended that users familiarize themselves with the WaDE DET as a quick reference to help them understand the WaDE XML structure and to understand the business rules that are being applied. This document will also assist with the initial data-mapping phase and transfer from partners' native databases to the WaDE implementation databases.

Fault Follow-up Actions: All requests for a partner's catalog information will be validated against the business rules. A summary of errors will be returned to the partner via email or other agreed upon method. A partner's services cannot be registered in WaDE until a catalog request has been successful in retrieving information. Trading partners are responsible for ensuring that REST outputs match the WaDE XML schema and business rules prior to registering their WaDE services.

1.7 Additional Flow Tools and Resources

This FCD is intended to define the supported data services, as well as the approaches and processes that are used to exchange information. This FCD is intended to be used in conjunction with the following support documents:

WaDE Data Exchange Template (DET)

The DET provides a full list of all of the data elements being exchanged via WaDE as well as the relevant business rules. Data partners should familiarize themselves with the DET prior to enabling WaDE services. The DET is available at: http://www.westernstateswater.org/wade/draft-items/.

2 Submission Composition

2.1 Implementation of the Header/Payload for the WaDE Network Exchange

2.1.1 Overview

WaDE has not implement the Exchange Network Submit web service since data are maintained only in the trading partners' systems and not copied to a central system (with the one exception to this being the catalog web service request). As such, WaDE has not made use of the Exchange Network Header or payload operations. Each catalog request replaces the entire catalog for that trading partner.

3 Registering with WaDE and ENDS

WaDE supports REST-based services at this time. In order to make these services available to other partners, a trading partner must first register these services within ENDS and/or make information about these services available via a GetServices request. WaDE relies on the concept of a catalog being maintained that contains the list of services that each node provides, along with the types of data, the relevant dates of the data, and how much of each type of data are available on each node. These additional elements are unique to WaDE and are an extension of the information already contained within ENDS. The process for making data available via WaDE is as follows:

1. A trading partner stands up the GetCatalog web service.
2. The WaDE GetCatalog service is registered within ENDS.
3. The trading partner verifies that GetCatalog request results are available for external partners, including the WaDE Central Catalog, maintained by WSWC.
4. The Central Catalog initiates a request against the trading partner for the GetCatalog web service. The GetCatalog service responds to the requestor with all of the relevant data available on that node, along with the REST endpoints for the available services.
5. REST services are registered via the GetCatalog service, as well as the REST endpoint itself (within ENDS).
6. REST services can also be registered via ENDS once a standard Exchange Network protocol has been established, however, it is not expected that ENDS will accommodate all of the functionality of the WaDE catalog.

4 Data Access

4.1 Data Access Services

The WaDE data flow provides the ability for Exchange Network (EN) partner nodes (i.e., node clients and full nodes) to request and receive WaDE catalog data in XML payloads. WaDE makes extensive use of

REST-based web services to provide access to a trading partner's data via a defined set of services. Whereas Query web services require a NAAS authentication, the WaDE REST services do not.

4.1.1 Registration / Authorization

Users of any future Query services must be registered with NAAS and must have NAAS policies to perform these services on the Node on which the request is made. If the partner implements any Query services, the Administrator for that Node will need to grant the requested privileges. REST services do not require any registration or authorization.

4.2 Data Publishing Services using REST

This FCD defines the WaDE REST publishing services that would need to be implemented by a trading partner in order to participate in WaDE. These services provide access to data on a trading partner's implementation of the WaDE application. A user will have access to the most current data that are being provided by a trading partner.

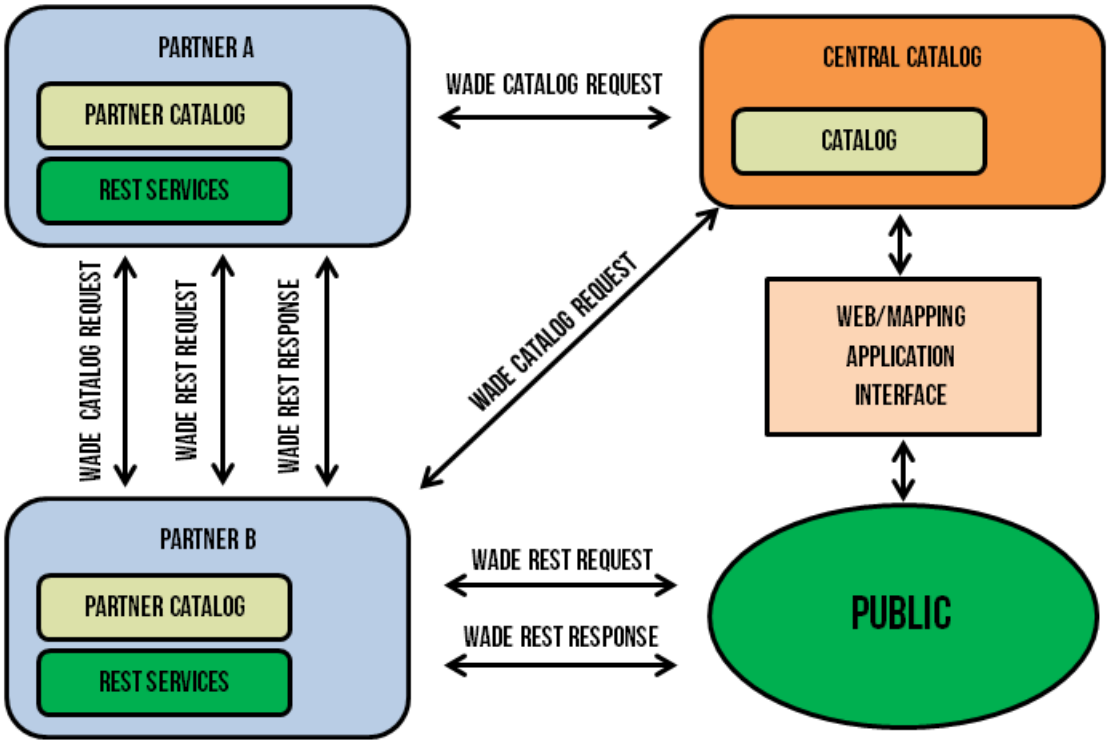

Figure 3. WaDE Requests between Partners and Clients

4.2.1 Access / Authorization

A username and password is not required to obtain data using the REST interface as only public data is made available.

4.2.2 Services

All REST services have a base URL defined by the trading partner and registered via the WaDE catalog services and within ENDS. WaDE URLs should be structured as follows:

Base_URL/dataflow/versionnumber/servicename/operation?Parameter1=Value1&Parameter2=Value2&Parameter3=Value3*Parameter4=Value4

An example URL following this structure would be as follows:

http://www.westernstateswater.org/WADE/v0.2/GetSummary/GetSummary.php?loctype=HUC&loctxt=16020204&orgid=UTDWRE&state=46

All trading partners should implement the services in the same manner, with the only variation being the base URL.

At the time that this FCD was originally developed, the Exchange Network REST specifications were still under development. When the REST specification was released in 2013, adjustments were made to the web service URL format and structure to accommodate the new proposed EN format.

As the REST web services are intended to respond in a synchronous manner, trading partners will need to monitor the performance of their services to ensure that they are responding reliably and in an acceptable manner. It is likely that access rules and protocols will also be required to prevent malicious access to the REST web service endpoints.

4.2.2.1 WaDE REST Services Descriptions

The GetCatalog is the gateway service offered by WaDE as a preliminary index to the other datasets hosted by the partner. The purpose of this service is to request a summary of data made available. Any client can request catalog information from any partner node. Aside from an index of the available datasets provided by the partner, the GetCatalog request also retrieves the available datasets' web service endpoints so that the client can quickly access those from the retrieved catalog.

Service Name: GetCatalog
Security Token: None
Dataflow: WADE
Return Schema: WaDE v0.2 GetCatalog Schema
Associated DET File: http://www.westernstateswater.org/wade/draft-items/
Description: Returns a catalog for the requested locations provided by organizations/states. "ALL" states and organizations is the default parameter, but the user can subselect for data from specific organizations or states (e.g. if the location is a HUC and crosses multiple state boundaries, the user can select for data in only one state.)
Parameters: loctype, loctxt, orgid, state

Parameter Name	Description	Parameter Type	Required?
Location Type (loctype=)	The type of location for which the catalog should be retrieved (allowed values include: HUC, COUNTY, REPORTUNIT)	varchar	Yes
Location Text (loctxt=)	Text of the location identifier for which the catalog should be retrieved (e.g. a HUC identifier, such as 17030108 or a county FIPS code such as 41358). The service will return the catalog only for the area specified.	varchar	Yes
Organization Identifier (orgid=)	Unique identifier for an organization (owner of the data). "ALL" is the default setting for this parameter, and this will retrieve catalogs for all organizations in the specified location. If a specific organization's datasets are desired, this can be specified by the client.	varchar	Yes
State Identifier (state=)	A unique identifier for a state's data retrieval. "ALL" is the default setting for this parameter, and this will retrieve catalogs for all states in the specified location. If a specific state's datasets are desired, this can be specified by the client using the state's numeric code (e.g. UT=46). For example, this should be used if the loctype=HUC that crosses state boundaries, but the client is only interested in returning the catalog from one of the states.	varchar	Yes

If error occurs the partner will return following errors:

• Invalid service request or parameter
• Node system error
Notes:

- Mandatory parameters must always be passed

Service Name: GetSummary
Security Token: None
Dataflow: WADE
Return Schema: WaDE v0.2 Schema
Associated DET File: http://www.westernstateswater.org/wade/draft-items/
Description: Returns data that has been summarized by a specific geospatial location, organization, and time period. Summaries can include allocation summaries, water use summaries, water supply summaries, regulatory restriction summaries, and water availability summaries.
Parameters: loctype, loctxt, orgid, reportid, datatype

Parameter Name	Description	Parameter Type	Required?
Location Type (loctype=)	The type of location for which the catalog should be retrieved (allowed values include: HUC, COUNTY, REPORTUNIT)	varchar	Yes
Location Text (loctxt=)	Text of the location identifier for which the catalog should be retrieved (e.g. a HUC identifier, such as 17030108 or a county FIPS code such as 41358). The service will return the catalog only for the area specified.	varchar	Yes
Organization Identifier (orgid=)	Unique identifier for an organization (owner of the data). "ALL" is the default setting for this parameter, and this will retrieve catalogs for all organizations in the specified location. If a specific organization's datasets are desired, this can be specified by the client. Allowed values are found in the Catalog.	varchar	Yes
Report Identifier (reportid=)	Unique identifier for the report (which specifies the time frame for the data to be returned). Allowed values are found in the Catalog.	varchar	Yes
Datatype (datatype=)	Type of summary data to be returned. Allowed values are found in the Catalog, although the client can input "ALL" to retrieve all summary data for the above specified parameters.	varchar	Yes

Service Name: GetDetail
Security Token: None
Dataflow: WADE
Return Schema: WaDE v0.2 Schema
Associated DET File: http://www.westernstateswater.org/wade/draft-items/
Description: Returns detailed data for a specified location, organization, and time period. Detailed data are organized by water allocations (water rights), and contain information on diversions, consumptive (non-returned) uses, and return flows.
Parameters: loctype, loctxt, orgid, reportid, datatype

Parameter Name	Description	Parameter Type	Required?
Location Type (loctype=)	The type of location for which the catalog should be retrieved (allowed values include: HUC, COUNTY, REPORTUNIT)	varchar	Yes
Location Text (loctxt=)	Text of the location identifier for which the catalog should be retrieved (e.g. a HUC identifier, such as 17030108 or a county FIPS code such as 41358). The service will return the catalog only for the area specified.	varchar	Yes
Organization Identifier (orgid=)	Unique identifier for an organization (owner of the data). "ALL" is the default setting for this parameter, and this will retrieve catalogs for all organizations in the specified location. If a specific organization's datasets are desired, this can be specified by the client. Allowed values are found in the Catalog.	varchar	Yes
Report Identifier (reportid=)	Unique identifier for the report (which specifies the time frame for the data to be returned). Allowed values are found in the Catalog.	varchar	Yes
Datatype (datatype=)	Type of summary data to be returned. Allowed values are found in the Catalog, although the client can input "ALL" to retrieve all summary data for the above specified parameters.	varchar	No

Service Name: GetMethod
Security Token: None
Dataflow: WADE
Return Schema: WaDE v0.2 GetMethod Schema
Associated DET File: http://www.westernstateswater.org/wade/draft-items/
Description: Returns methodology information based on the method name and organization.
Parameters: methodid, methodname

Parameter Name	Description	Parameter Type	Required?
Method Indentifier (methodid=)	The organization that is using the method associated with the retrieval. Allowed values are provided in the WaDE GetSummary and GetDetail web service queries.	varchar	Yes
Method Name (methodname=)	Text of the name of the method used for the particular data retrieval. Allowed values are provided in the WaDE GetSummary and GetDetail web service queries.	varchar	Yes

4.2.2.2 Future REST Services for Consideration

The WaDE technical development workgroup is also considering the implementation of some additional services that may be included in future releases of the WaDE schema that would provide additional functionality and more specific dataset retrieval. These services are for discussion only, and are not currently implemented as part of the WaDE v0.2 release.

Service Name: DrawDiversions
Return Schema: WaDE v0.3?
Description: Returns a subset of the WaDE schema sufficient to draw the diversion points that would be within a user specified boundary (i.e. lat/long box or other polygon). This service would be used to support mapping applications that need to draw the diversion locations to allow the user to interact with individual diversions.
Parameters: latlong, orgid, reportid, butype

Parameter Name	Description	Parameter Type	Required?
Latitude and Longitude (latlong=)	A series of latitude and longitude coordinates, separated by a ',' that defines the vertices of a polygon. The service will return all diversion contained within the polygon. Requests that return too many diversions (>10,000) will return an error that would require the user to narrow the search criteria. Lat/long coordinates to define the polygon would be as follows: "latitude longitude, latitude longitude, …."	varchar	Yes
Organization Identifier (orgid=)	Unique identifier for an organization (owner of the data). "ALL" is the default	varchar	Yes

	setting for this parameter, and this will retrieve catalogs for all organizations in the specified location. If a specific organization's datasets are desired, this can be specified by the client. Allowed values are found in the Catalog.		
Report Identifier (reportid=)	Unique identifier for the report (which specifies the time frame for the data to be returned). Allowed values are found in the Catalog.	varchar	Yes
Beneficial Use Type (butype=)	Text describing the uses for which the water can be diverted. If provided, then only the diversions which are allowed to divert for that use will be returned. Otherwise all diversions will be returned.	varchar	No

Water Mark-up Language (WaterML 2.0)
A portion of the WaDE project will also focus on improving the exchange of in-situ hydrologic data (i.e. streamgaging, snow depth, reservoir height, precipitation, etc.) The Open Geospatial Community (OGC) has reviewed and has now endorsed Water Mark-up Language v. 2.0 (WaterML2.0) as an international standard for sharing these types of data. As this evolves, WaDE will adopt and implement the schema and services as part of the WaDE data flow. For more information on WaterML 2.0 see: http://www.opengeospatial.org/projects/groups/waterml2.0swg

Geo-Services
Many trading partners define their own reporting units (areas by which they summarize their water information). WaDE will need to display these reporting units on a map. Additionally, places of use (locations where water is used) is a geographic data set that would be valuable to share via WaDE. The most effective way to share these types of data are to use standard geospatial services (i.e. a Web Feature Service). In WaDE v0.2, the partner supplying data can add the web service address for a particular data summary or detailed dataset that is accessible to the client and can be investigated further. The partner can also supply the "FeatureID" for each relevant data element returned by a WaDE web service request. Using the WFS and the FeatureID in combination, the client can access the geospatial component of all returned data elements for which that data is available, whether points, lines or polygons. This is a remedial way of accessing geospatial datasets related to the targeted WaDE data elements, without slowing data retrieval with extensive geospatial results retrievals that would significantly slow response time. In the future, the WaDE technical workgroup and/or the related EN IPT will need to review best practices for returning large geospatial datasets using XML (or some other format), determine the best approach for sharing these data, and figure out how to tie them to the data being made available in the WaDE schema without impacting performance.

4.2.3 Error Handling

In case of an error, REST service requests will respond with either an HTTP Error Code from the partner's website, or an XML error containing messages to assist the client.

Sample HTTP error with XML response:

HTTP/1.1 403 Forbidden

Date: Wed, 31 Oct 2012 16:03:03 GMT
Content-Type: application/xml
Content-Length: 160

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<Error>
<Code>E_RestServiceUnavailable</Code>
<Message>REST Service currently unavailable</Message>
</Error>
```

Error Codes:

HTTP Error Code	Error Code	Message
400	E_RestNotSupported	REST currently not supported
403	E_RestUnavailable	REST currently unavailable
403	E_RestServiceUnavailable	REST Service currently unavailable
500	E_TechnicalDifficulties	Partner is experiencing technical difficulties

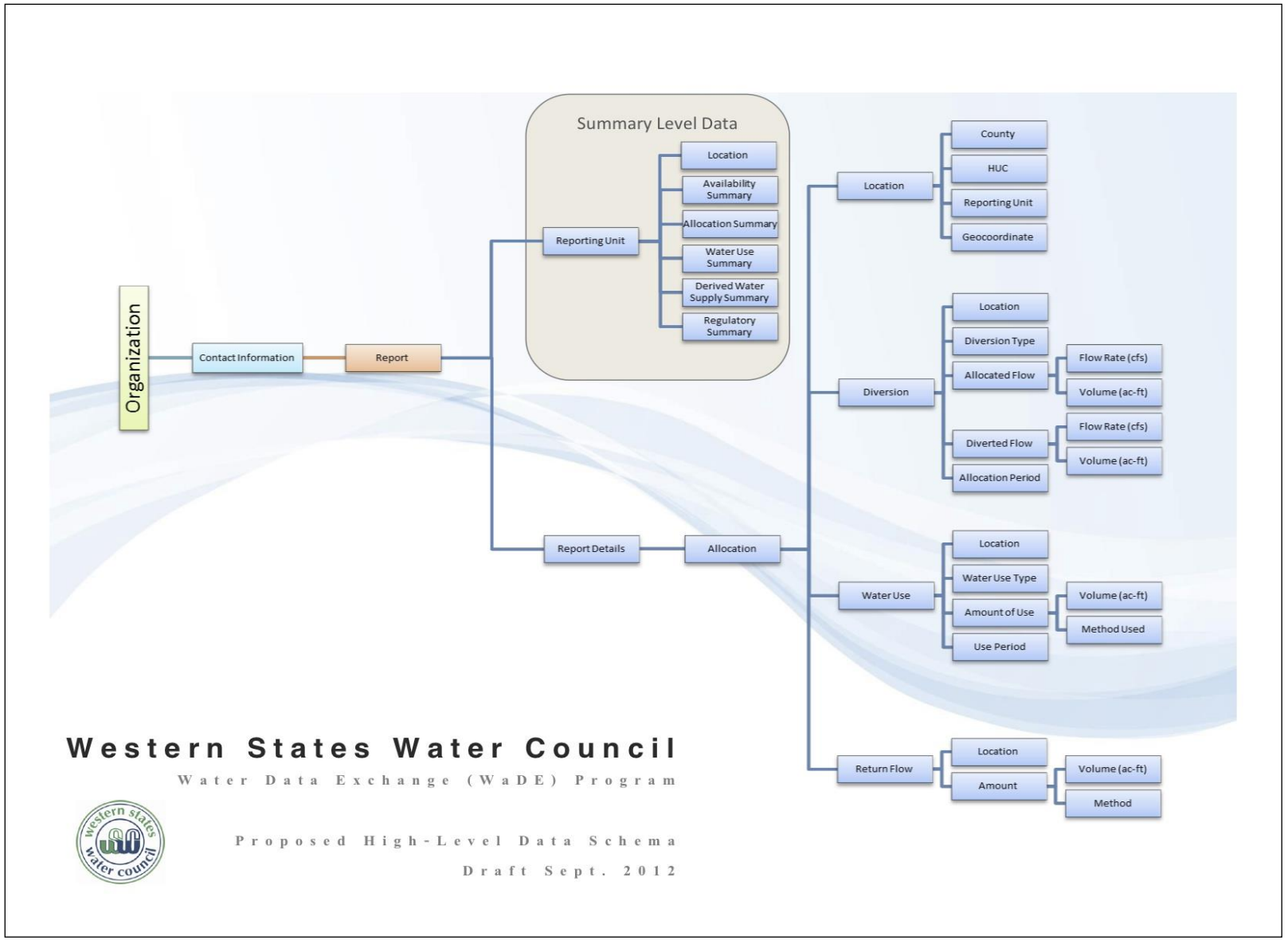

Figure 4. High-Level WaDE v0.2 Schema Diagram