Open Water Information Architecture (OWIA) Testbed Description Document (TDD) (Working Draft)

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1 Introduction

To be informed is to be prepared.[1]

1.1 Open Water Data Information Architecture (OWIA)

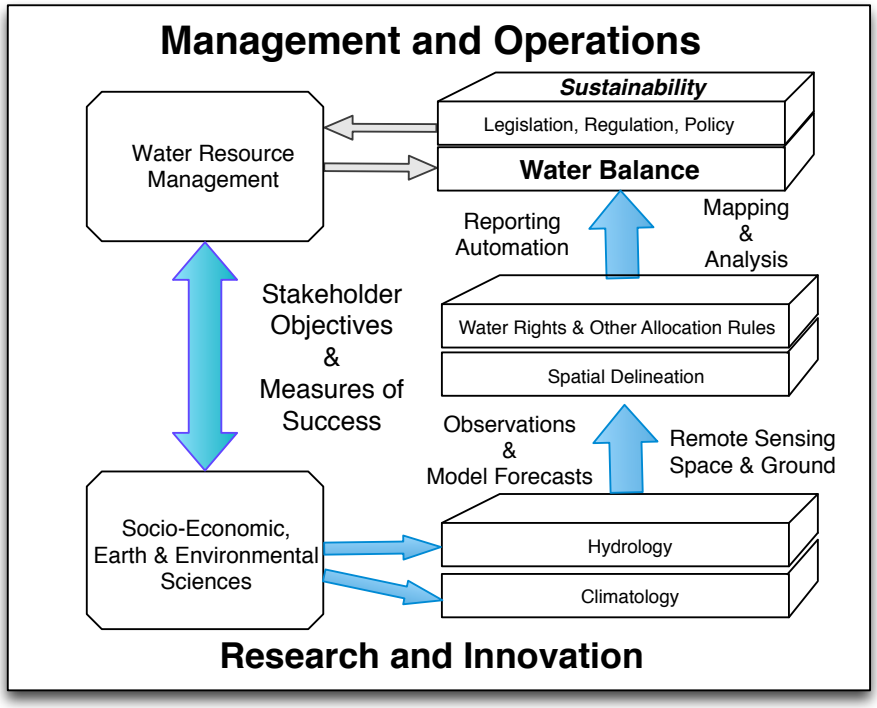

Figure 1: Open Water Data Information Architecture (OWIA) framework.

2 Project Management Plan

2.1 Concept of Operations

1. **Federated Data Nodes**
2. **Data Node Operators**: identify operators of testbed nodes and assignment of responsibility for specific data sources to be integrated into the OWIA federated nodes;
3. **Standard Operating Procedures (SOPs)**: identify responsible individuals for the development of SOPs addressing use-cases.

2.2 Testbed Governance Structure

The testbed governance structure is depicted in Figure 2.

1. General Partners (GP): Project manager acting.
2. Technical Working Group (TWG): As current.
3. Stakeholder Working Group (SWG): Represented by stakeholder use cases document.

[1] Count Rostov, A Gentleman in Moscow, Amor Towles

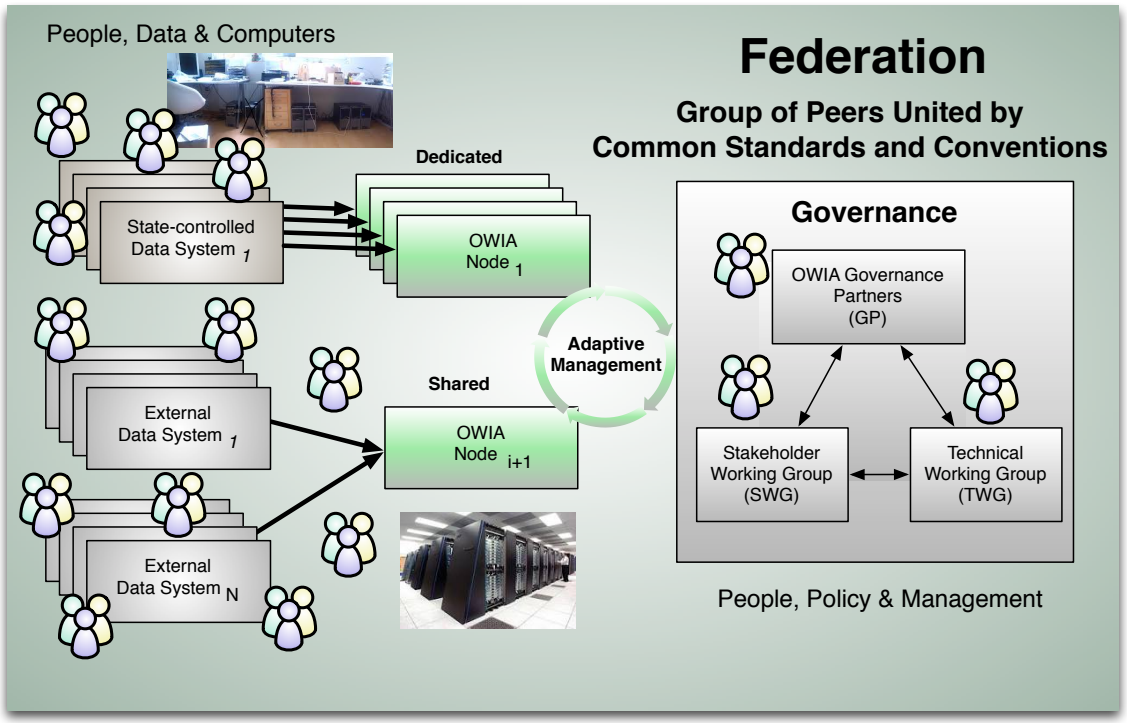

Figure 2: Testbed design (placeholder).

2.3 Requirements Baseline

1. **System Requirements (SRD):** Completed draft of System Requirements Document (SRD) Technical Requirements Chapter.
2. **Stakeholder Use Cases**: two (2) families of Use Cases from the CLEE report (https://www.law.berkeley.edu/wp-content/uploads/2018/01/DFWD-Use-Cases.pdf).
   (a) **Input**: Family A: use cases 1, 4, 17 and 20
   (b) **Input**: Family B: use cases 10 and 19
   (c) **Output**: Defined set of figures, tables and analyses required to support these Families.
3. **Node Designs**: One or more candidate *data node* designs for implementation based on the requirements baseline,

2.4 Risk Assessment

3 Initial Operating Capability (IOC) Definition

Problem Statement			Methodology			Measure of Success
Use-case	**Domain**	**Sectors**	**Data Node(s)**	**Input Data Source**	**SOPs**	**Output Information Products**
Water Balance	California WY2010-2015	All	CCA, Regional Offices, CKAN, WaDE	Regional Office Spreadsheets	QC-1000,2000,3000 series	Water Plan Document Elements + Published Data
Water Budget	San Diego	Urban	CCA, CKAN	DWR UWMP Tables + TBD	QC-1000,2000,3000 series	UWMP Document Elements + Published Data
	Tulare Lake	Agriculture, Environmental	CCA, LBNL, NASA	DWR Appendix A, + TBD	QC-1000,2000,3000 series	Water Budget Example + Published Data
	Central Coast	Agriculture, Environmental	CCA, LBNL, NASA	DWR Appendix A, + TBD	QC-1000,2000,3000 series	Water Budget Example + Published Data
Water Quality	San Joaquin River	Agriculture	CEDEN	CEDEN Data Templates	QC-1000,2000,3000 series	Published data in association with use-case
Water Quality(Use-case 8, Environmental)	Regional Water Board 1, 2, 5	Environmental	CWMW, LBNL	EcoAtlas, CIWQS, CRAM, USACOE	QC-1000,2000,3000 series	Compliance Reports for 401 and 404 programs + published data

Table 1: IOC definition regarding problem definition, methodology and measures of success.

3.1 Schedule

Task or Milestone	2018			2019											
	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
IOC															
Kickoff	X														
Preliminary Design Review				X											
Interim Demonstration							X								
Final Design Review										X					
Final Demonstration													X		

Figure 3: Preliminary schedule.

3.2 Design Alternatives

One or more design alternatives compliant with the *Requirements Baseline* and the *Concept of Operations*.

3.2.1 Alternative I: OWIA Data Node

An ***OWIA data node*** is the ***set of people and the SRD-compliant cyberinfrastructure*** used to service a specified set of use-cases by ingesting source data, transforming the data by executing ***SOPs*** and resulting in *Output Information Products* such as those of Table 1 and Figures 5, 6. The ***scope of a Data Node*** is bounded by the use-cases that it is responsible for: in whole or in part.

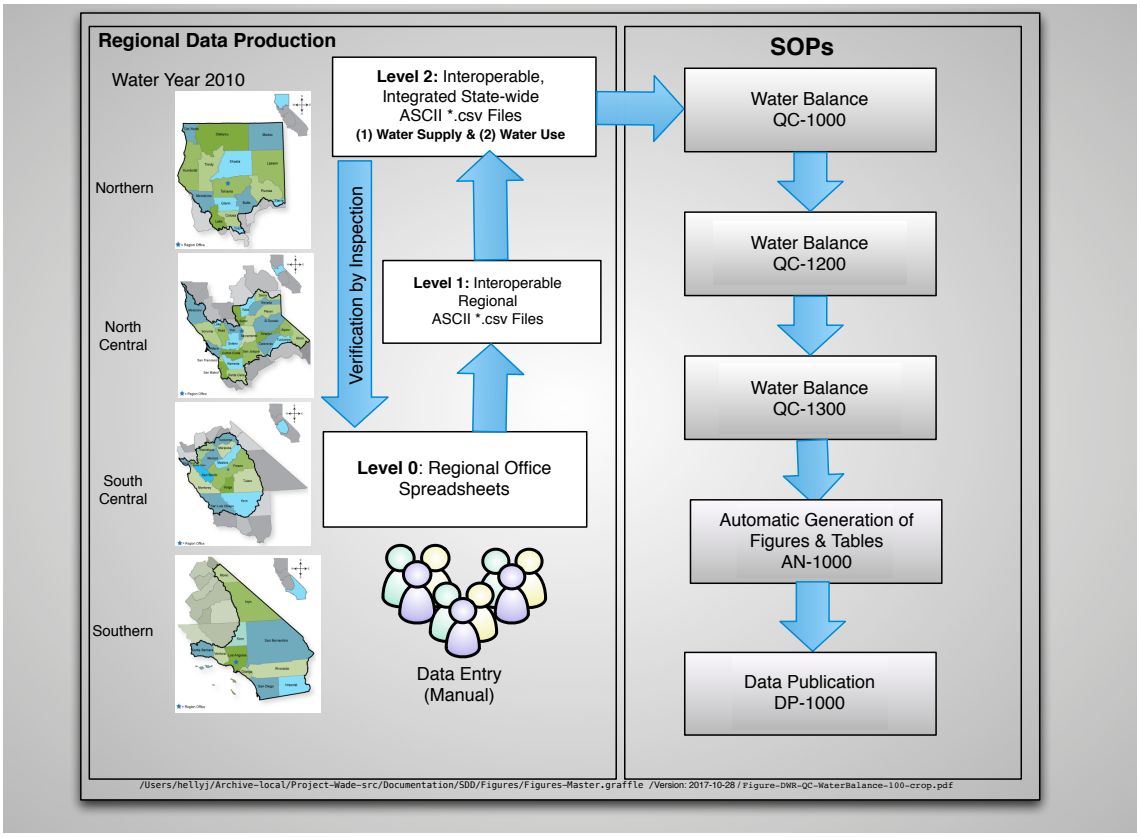

Figure 4: SOPs for the water balance use-case.

3.3 Measures of Success

The role of measures of success is illustrated in Figure 1 and defined for this project in Table 1.

3.4 Water Balance

3.4.1 California Water Plan: WY2010-2015

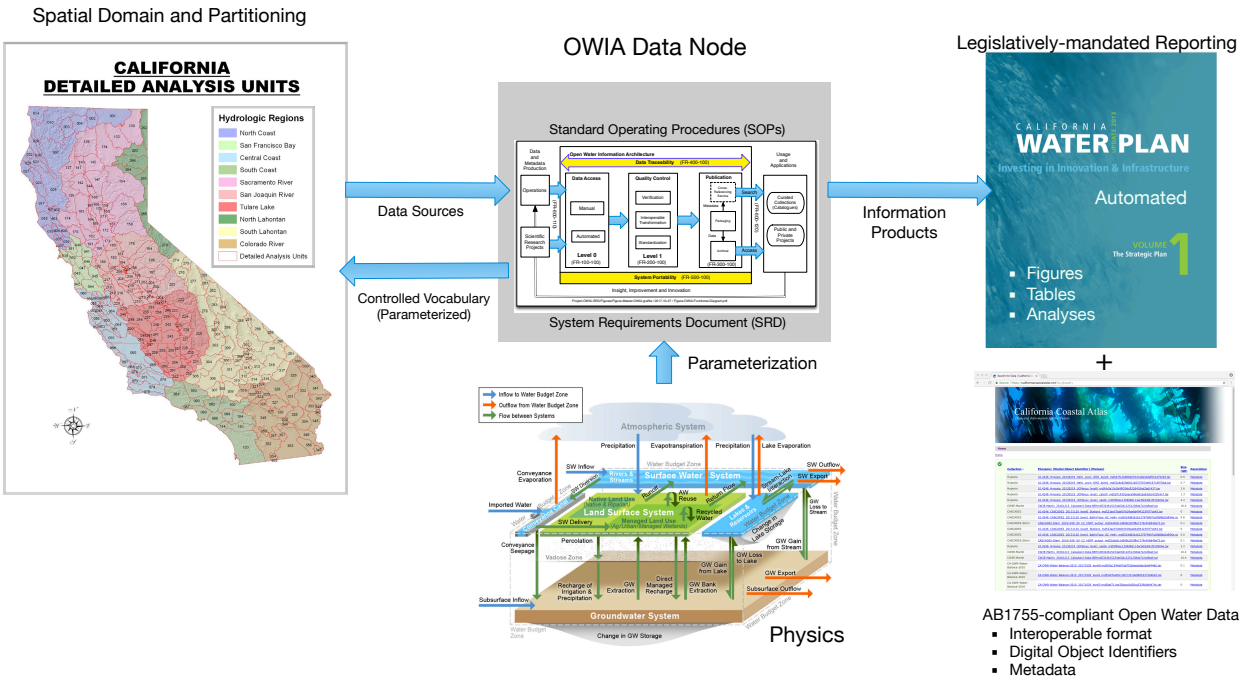

Figure 5: Workflow for California Plan WY2010-2015 example.

3.4.2 WaDE Integration: WY2010-2015

		Year																					
		2011				2012				2013				2014				2015					
		CategoryE				CategoryE				CategoryE				CategoryE				CategoryE					
		AWU	DEP	NW1	NW2	AWU	DEP	NW1	NW2	AWU	DEP	NW1	NW2	AWU	DEP	NW1	NW2	AWU	DEP	NW1	NW2		
HR_NAME	CategoryA	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt	KAcreFt
		sum	sum	sum	sum	sum	sum	sum	sum	sum	sum	sum	sum	sum	sum	sum	sum	sum	sum	sum	sum	sum	sum
Central Coast	Agriculture	922.0	818.4	818.4	818.4	1012.4	902.3	902.3	902.3	1258.9	1088.2	1088.2	1088.2	1269.6	1033.6	1033.6	1033.6	1088.4	975.2	975.2	975.2		
	Instream Flow Requirements	25.4	0.0	0.0	0.0	25.2	0.0	0.0	0.0	24.5	0.0	0.0	0.0	12.0	0.0	0.0	0.0	13.2	0.0	0.0	0.0		
	Managed Wetlands	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4		
	Required Delta Outflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	Urban	254.3	141.6	141.7	141.6	276.9	164.0	164.0	164.0	284.2	161.5	162.3	161.5	277.1	171.3	171.3	171.3	244.9	137.5	137.8	137.5		
	Wild and Scenic River	154.8	0.0	0.0	0.0	31.3	30.1	30.1	30.1	43.4	0.0	0.0	0.0	13.4	13.2	13.2	13.2	28.7	0.0	0.0	0.0		
	All	1356.9	960.4	960.5	960.4	1345.8	1096.4	1096.4	1096.4	1611.4	1250.1	1250.9	1250.1	1572.5	1218.5	1218.5	1218.5	1375.6	1113.1	1113.4	1113.1		
Colorado River	Agriculture	3637.4	3150.1	3227.0	3227.0	4217.1	3664.6	3739.2	3739.2	4616.2	3856.5	4052.4	4052.4	4750.0	3963.0	4176.3	4176.3	3816.4	3308.9	3380.7	3380.7		
	Instream Flow Requirements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	Managed Wetlands	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	30.3	30.3	30.3	30.3	45.2	45.2	45.2	45.2	44.5	44.5	44.5	44.5		
	Required Delta Outflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	Urban	476.5	145.7	147.2	147.2	590.9	204.3	206.3	206.3	338.2	203.1	205.0	205.0	302.3	195.1	198.0	198.0	269.1	177.6	179.9	179.9		
	Wild and Scenic River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	All	4158.3	3340.2	3418.6	3418.6	4852.4	3913.3	3989.9	3989.9	4984.7	4089.9	4287.7	4287.7	5097.5	4203.3	4419.5	4419.5	4130.0	3531.0	3605.1	3605.1		
North Coast	Agriculture	732.2	524.9	621.0	621.0	794.6	657.8	700.2	700.2	782.3	661.8	686.5	686.5	771.3	651.5	672.6	672.6	729.2	614.3	636.5	636.5		
	Instream Flow Requirements	1816.6	1729.6	1729.6	1729.6	1612.5	1506.4	1506.4	1506.4	1450.4	1379.1	1379.1	1379.1	1256.8	1225.3	1225.3	1225.3	1258.9	1222.6	1222.6	1222.6		
	Managed Wetlands	186.9	138.9	180.9	180.9	203.9	146.0	172.4	172.4	192.0	124.6	140.9	140.9	131.0	83.7	98.5	98.5	121.4	76.4	96.8	96.8		
	Required Delta Outflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	Urban	139.1	64.9	64.9	64.9	140.4	65.0	65.2	65.2	148.8	73.2	73.2	73.2	136.7	71.2	71.4	71.4	125.0	65.7	65.7	65.7		
	Wild and Scenic River	23250.6	23250.6	23250.6	23250.6	15692.8	15692.8	15692.8	15692.8	12873.2	12873.2	12873.2	12873.2	7824.6	7824.6	7824.6	7824.6	11650.6	11650.6	11650.6	11650.6		
	All	26125.4	25708.9	25847.0	25847.0	18444.2	18068.0	18137.0	18137.0	15446.7	15111.9	15152.9	15152.9	10120.4	9856.3	9892.4	9892.4	13885.1	13629.6	13672.2	13672.2		
North Lahontan	Agriculture	295.1	252.9	253.3	253.3	331.9	285.4	286.2	286.2	353.6	301.1	301.7	301.7	362.4	306.4	306.9	306.9	292.1	249.3	249.7	249.7		
	Instream Flow Requirements	82.9	82.9	82.9	82.9	84.4	84.4	84.4	84.4	84.5	84.5	84.5	84.5	81.1	81.1	81.1	81.1	40.9	40.9	40.9	40.9		
	Managed Wetlands	18.8	10.8	12.5	12.5	22.4	15.2	15.7	15.7	22.0	15.0	15.4	15.4	22.5	15.7	15.9	15.9	21.3	14.4	14.9	14.9		
	Required Delta Outflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	Urban	29.8	9.1	9.1	9.1	31.6	9.5	9.5	9.5	31.4	9.2	9.2	9.2	29.7	8.1	8.1	8.1	25.8	7.6	7.6	7.6		
	Wild and Scenic River	470.8	124.9	124.9	124.9	129.3	37.4	37.4	37.4	147.6	39.1	39.1	39.1	95.8	27.4	27.4	27.4	93.1	22.7	22.7	22.7		
	All	897.4	480.6	482.7	482.7	599.6	431.9	433.2	433.2	639.1	448.9	449.9	449.9	591.5	438.7	439.4	439.4	473.2	334.9	335.8	335.8		
Sacramento River	Agriculture	6594.4	4551.4	5449.3	5449.3	7558.1	5456.8	6241.6	6241.6	7928.2	5745.1	6633.6	6633.6	7166.9	5553.1	6043.2	6043.2	6791.8	5545.6	5852.4	5852.4		
	Instream Flow Requirements	5051.9	0.0	2804.6	2804.6	4642.8	0.0	2813.3	2813.3	4568.8	0.0	2804.6	2804.6	4058.8	0.0	2718.4	2718.4	3827.6	0.0	2716.3	2716.3		
	Managed Wetlands	578.2	146.4	370.3	370.3	637.0	177.9	401.7	401.7	613.9	193.6	392.4	392.4	641.5	202.6	402.9	402.9	612.6	197.8	390.5	390.5		
	Required Delta Outflow	7384.5	7384.5	7384.5	7384.5	5295.9	5295.9	5295.9	5295.9	4498.5	4498.5	4498.5	4498.5	3998.7	3998.7	3998.7	3998.7	3709.8	3709.8	3709.8	3709.8		
	Urban	920.8	362.3	694.6	694.6	965.5	353.3	731.1	731.1	1004.0	372.8	762.0	762.0	886.8	309.5	669.7	669.7	784.0	226.9	599.2	599.2		
	Wild and Scenic River	5458.8	0.0	514.9	514.9	2734.4	0.0	177.4	177.4	2436.1	0.0	145.5	145.5	1455.6	0.0	72.9	72.9	1642.3	0.0	74.4	74.4		
	All	25988.6	12444.6	17218.2	17218.2	21833.7	11283.9	15661.0	15661.0	21049.5	10810.0	15236.6	15236.6	18208.3	10063.9	13905.8	13905.8	17368.1	9680.1	13342.6	13342.6		
San Francisco Bay	Agriculture	114.2	100.1	103.3	100.1	154.2	126.6	133.8	126.6	136.2	118.7	122.1	118.8	146.4	130.3	134.5	130.3	151.0	133.0	136.7	133.0		
	Instream Flow Requirements	21.8	21.8	21.8	21.8	19.9	19.9	19.9	19.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9		
	Managed Wetlands	53.3	53.3	53.3	53.3	60.4	60.4	60.4	60.4	58.3	58.3	58.3	58.3	60.6	60.6	60.6	60.6	59.1	59.1	59.1	59.1		
	Required Delta Outflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	Urban	1137.3	733.2	737.2	737.2	1193.6	787.2	791.2	791.2	1206.4	774.1	778.1	778.1	1169.0	816.5	816.9	816.9	1056.9	757.8	759.6	759.6		
	Wild and Scenic River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	All	1326.6	908.4	915.6	912.4	1428.1	994.1	1005.3	998.1	1413.8	964.0	971.4	968.1	1388.9	1020.3	1024.9	1020.7	1279.9	962.8	968.3	964.6		
San Joaquin River	Agriculture	7755.8	6064.0	6668.8	6668.8	8703.7	7263.6	8010.6	8010.6	8502.5	7252.2	7966.0	7966.0	8457.5	7314.5	8060.4	8060.4	10503.6	9076.4	9917.0	9917.0		
	Instream Flow Requirements	983.1	0.0	385.2	385.2	596.4	0.0	171.2	171.2	569.2	0.0	167.3	167.3	333.3	0.0	121.6	121.6	374.8	0.0	121.4	121.4		
	Managed Wetlands	500.6	219.0	500.2	500.2	529.9	250.2	529.5	529.5	533.8	251.9	529.4	529.4	535.6	261.4	531.5	531.5	546.4	241.3	500.2	500.2		
	Required Delta Outflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	Urban	647.8	246.1	340.2	340.2	685.1	261.8	395.8	395.8	685.8	267.3	373.9	373.9	654.6	247.2	382.0	382.0	617.4	229.1	310.0	310.0		
	Wild and Scenic River	3860.3	0.0	2220.3	2220.3	911.6	0.0	551.5	551.5	1092.1	0.0	684.9	684.9	581.5	0.0	378.3	378.3	528.2	0.0	379.4	379.4		
	All	13747.6	6529.1	10114.7	10114.7	11426.7	7775.6	9658.6	9658.6	11383.4	7771.4	9721.5	9721.5	10562.5	7823.1	9473.8	9473.8	12570.4	9546.8	11228.0	11228.0		
South Coast	Agriculture	654.9	610.4	610.1	610.4	679.9	634.4	634.9	634.4	985.4	856.3	856.8	856.3	1060.5	920.2	922.0	920.2	690.6	646.4	645.7	646.4		
	Instream Flow Requirements	5.7	0.0	0.0	0.0	5.7	0.0	0.0	0.0	5.8	0.0	0.0	0.0	5.8	0.0	0.0	0.0	5.8	0.0	0.0	0.0		
	Managed Wetlands	33.0	33.0	33.0	33.0	35.4	35.4	35.4	35.4	31.7	31.7	31.7	31.7	34.0	34.0	34.0	34.0	31.1	31.1	31.1	31.1		
	Required Delta Outflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	Urban	3530.1	2610.0	2610.3	2610.0	3793.8	2860.0	2859.5	2860.0	3966.5	3015.5	3015.0	3015.5	3992.2	3072.5	3070.7	3072.5	3438.7	2581.5	2582.3	2581.5		
	Wild and Scenic River	202.3	0.0	187.7	0.0	27.1	0.0	26.2	0.0	12.3	0.0	11.8	0.0	26.0	0.0	25.6	0.0	12.7	0.0	12.3	0.0		
	All	4426.0	3253.4	3441.1	3253.4	4541.9	3529.8	3556.0	3529.8	5001.7	3903.5	3915.3	3903.5	5118.5	4026.7	4052.3	4026.7	4178.9	3259.0	3271.4	3259.0		
South Lahontan	Agriculture	332.5	287.3	286.3	287.3	355.7	308.1	307.9	308.1	453.2	351.5	351.4	351.5	444.2	343.3	343.3	343.3	329.9	284.5	284.5	284.5		
	Instream Flow Requirements	99.0	80.2	80.2	80.2	68.6	49.8	49.8	49.8	73.6	47.9	47.9	47.9	67.3	49.7	49.7	49.7	62.9	45.5	45.5	45.5		
	Managed Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	Required Delta Outflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	Urban	217.8	112.1	113.1	112.1	240.1	125.3	125.3	125.3	227.7	134.4	134.5	134.4	224.6	117.5	117.5	117.5	179.6	93.0	93.0	93.0		
	Wild and Scenic River	4.3	0.0	4.3	0.0	0.9	0.0	0.9	0.0	0.8	0.0	0.8	0.0	1.5	0.0	1.5	0.0	1.5	0.0	1.5	0.0		
	All	653.6	479.6	483.9	479.6	665.3	483.2	483.9	483.2	755.3	533.8	534.6	533.8	737.6	510.5	512.0	510.5	573.9	423.0	424.5	423.0		
Tulare Lake	Agriculture	11616.7	9186.6	9186.6	9186.6	12124.1	10341.6	10341.6	10341.6	11659.7	10109.8	10109.9	10109.8	11572.3	10146.3	10145.9	10146.3	11223.3	9897.8	9897.8	9897.8		
	Instream Flow Requirements	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	Managed Wetlands	84.8	48.6	48.6	48.6	92.8	57.0	57.0	57.0	93.7	61.0	61.0	61.0	95.8	63.9	64.0	63.9	91.8	57.6	57.6	57.6		
	Required Delta Outflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	Urban	571.2	194.9	193.5	194.9	599.4	200.8	200.8	200.8	584.5	199.5	199.0	199.5	596.7	203.5	203.0	203.5	468.9	158.1	157.9	158.1		
	Wild and Scenic River	3101.1	0.0	0.0	0.0	650.7	0.0	32.8	0.0	524.7	0.0	0.0	0.0	506.4	0.0	0.0	0.0	287.3	0.0	0.0	0.0		
	All	15373.8	9430.1	9428.7	9430.1	13468.7	10599.4	10632.2	10599.4	12864.3	10370.3	10369.9	10370.3	12771.2	10413.7	10412.9	10413.7	12071.3	10113.5	10113.3	10113.5		

Table 2: Information product example for California Plan WY2010-2015 (Working Draft).

3.5 Water Budget

3.5.1 South Coast Hydrologic Region: (PA404, DAU12037), San Diego County Water Authority Urban Water Management Plan (UWMP)

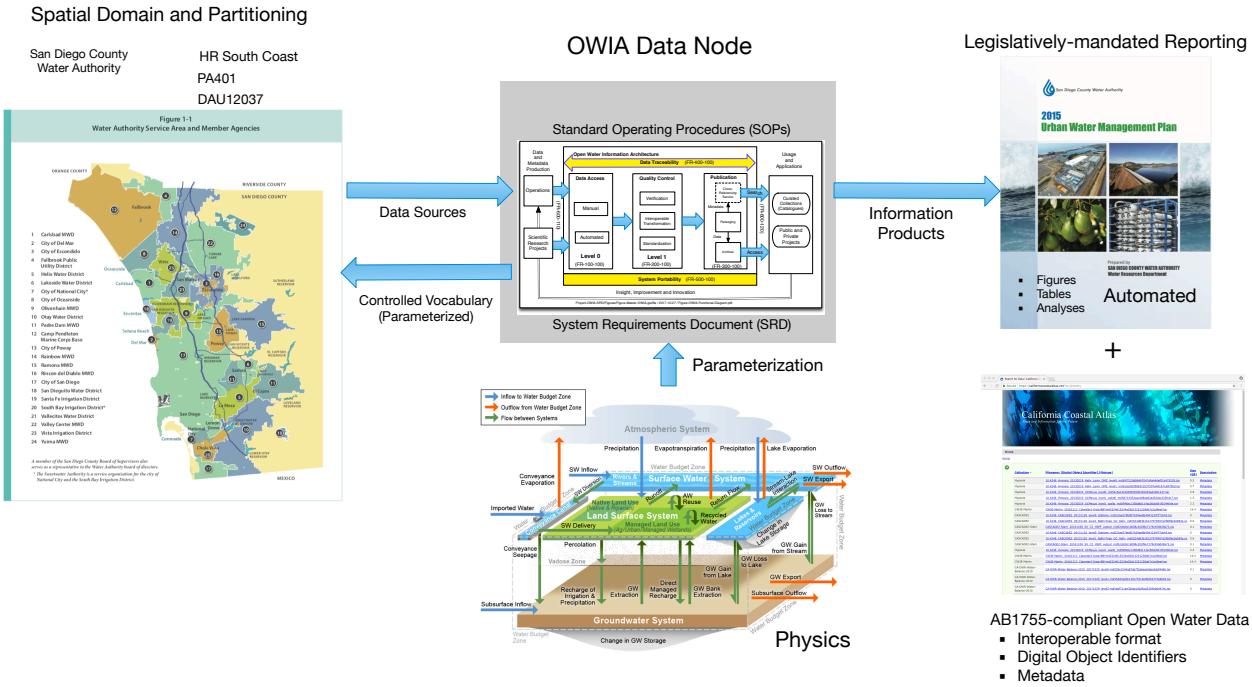

Figure 6: Workflow for UWMP use-case with the San Diego County Water Authority example.

3.5.2 Tulare Lake

3.5.3 Central Coast

4 Analysis of Uncertainty

Guidance for the analysis of uncertainty is gleaned from [2, 3] and [1].

4.1 Accuracy and Precision

4.1.1 Significant Digits

There are three rules on determining how many significant figures there are in a number [4]:

1. Non-zero digits are always significant.
2. Any zeros between two significant digits are significant.
3. A final zero or trailing zeros, *in the decimal portion only*, are significant.

All numbers are based upon measurements except for a very few that are defined and all measurements are uncertain, we must only use those numbers that are meaningful.

4.2 Propagation of Uncertainty in Calculations

$$In = A \pm \alpha \tag{1}$$

$$Out = B \pm \beta \tag{2}$$

$$Net = (A - B) \pm \sqrt{\alpha^2 \pm (\alpha\beta) + \beta^2} \tag{3}$$

105 ### 4.3 Uncertainty in Estimates from Numerical Models

106 #### 4.3.1 Verification and Validation

107 ##### 4.3.1.1 Irreproducible Results Across Computing Platforms

108 #### 4.3.2 Statistics from Ensembles

109 # 5 Full Operating Capability (FOC) Definition

Appendix A Water Balance SOP Example Implementation: QC-1000.R

```
# ====================================================================
# Filename: QC-1000.R
# Author: John Helly (hellyj@ucsd.edu)
# Purpose: Ingest *.csv files from DWR water balance spreadsheets
# ====================================================================
rm(list = ls())
library(ggplot2)
library(plyr)
library(reshape2)
library(tables)
#
graphics.off()
# ========================================================================
# Set directories
# ========================================================================
PROJECT_ROOT              ='/Users/hellyj/Archive-local'
SRC_ROOT                  = paste(PROJECT_ROOT,      '/Project-OWIA-WaterBalance-src/R', sep='')
DATA_INPUT_ROOT           = paste(PROJECT_ROOT,      '/Project-OWIA-WaterBalance-data/level1', sep='')
DATA_OUTPUT_ROOT          = paste(PROJECT_ROOT,      '/Project-OWIA-WaterBalance-data/level2', sep='')
SPATIAL_METADATA          = paste(DATA_INPUT_ROOT,  '/Spatial-Assignments-Georeferencing.csv', sep='')
OUTPUT_STANDARDIZED       = paste(DATA_OUTPUT_ROOT,'/CA-DWR-WaterBalance-QC-1000-2011-2015-Standardized.csv', sep='
TABLE_OUTPUT_HOME         = paste(PROJECT_ROOT,      '/Project-OWIA-WaterBalance-Documentation/Tables',
sep='')
FIGURE_OUTPUT_HOME        = paste(PROJECT_ROOT,      '/Project-OWIA-WaterBalance-Documentation/Figures', sep='')
CONTROLLED_VOCABULARY     = paste(PROJECT_ROOT,       '/Project-OWIA-WaterBalance-data/level0/CV/CV-100.csv', sep='')
# ====================================================================
# Metadata
# ====================================================================
COPYRIGHT    = paste("hellyj@ucsd.edu", expression(copyright), Sys.time())
OUTPUT_HOME = FIGURE_OUTPUT_HOME
SOURCE_FILE = paste(SRC_ROOT,'/QC-1000.R', sep='')
METADATA_01 = paste(SOURCE_FILE,' / ', COPYRIGHT)
# ========================================================================
# Functions
# ========================================================================
source(paste(SRC_ROOT,'/functions/f_QC_1000_Reshape.R',                sep=''))
source(paste(SRC_ROOT,'/functions/f_CategoryB.R',                      sep=''))
source(paste(SRC_ROOT,'/functions/f_QC_1000_PlotDelta.R',              sep=''))
source(paste(SRC_ROOT,'/functions/f_QC_1000_Table_100.R',              sep=''))
source(paste(SRC_ROOT,'/functions/f_QC_1000_Table_200.R',              sep=''))
source(paste(SRC_ROOT,'/functions/f_QC_1000_PlotDelta_DAU_PA_YEAR.R', sep=''))
source(paste(SRC_ROOT,'/functions/f_ControlledVocabulary.R',           sep=''))
# ========================================================================
# Define data sources and reshape the data
# ========================================================================
source(paste(SRC_ROOT,'/Input-QC-1000-Level1-2015.R', sep=''),echo=FALSE)
source(paste(SRC_ROOT,'/Input-QC-1000-Level1-2014.R', sep=''),echo=FALSE)
source(paste(SRC_ROOT,'/Input-QC-1000-Level1-2013.R', sep=''),echo=FALSE)
source(paste(SRC_ROOT,'/Input-QC-1000-Level1-2012.R', sep=''),echo=FALSE)
source(paste(SRC_ROOT,'/Input-QC-1000-Level1-2011.R', sep=''),echo=FALSE)
source(paste(SRC_ROOT,'/Input-QC-1000-level1-2010.R', sep=''),echo=FALSE)
# ========================================================================
# 1. Concatenate the data by rows (i.e., rbind)
# 2. Populate the HR,PA fields from the reference list of [HR, PA, DAU]
# 3. Georeference DAUs
# 4. Standardize nomenclature
# ========================================================================
source(paste(SRC_ROOT,'/Input-QC-1000-Rbind-2015.R', sep=''))
source(paste(SRC_ROOT,'/Input-QC-1000-Rbind-2014.R', sep=''))
source(paste(SRC_ROOT,'/Input-QC-1000-Rbind-2013.R', sep=''))
source(paste(SRC_ROOT,'/Input-QC-1000-Rbind-2012.R', sep=''))
source(paste(SRC_ROOT,'/Input-QC-1000-Rbind-2011.R', sep=''))
source(paste(SRC_ROOT,'/Input-QC-1000-Rbind-2010.R', sep=''))
# ========================================================================
# Controlled Vocabulary standardization
```

```
# ========================================================================
MASTER                  = rbind(MASTER_2010,MASTER_2011,MASTER_2012,MASTER_2013,MASTER_2014,MASTER_2015)
MASTER                  = subset(MASTER, CategoryC != "") # Miscoded values of CategoryC (and CategoryA)
MASTER                  = subset(MASTER, DAU != 'X')
MASTER$KAcreFt          = as.numeric(MASTER$KAcreFt)
MASTER[is.na(MASTER)] = 0 # Set 'NA' to 0
# ========================================================================
SPATIAL                       = read.table(SPATIAL_METADATA, sep=',', skip=0,header=TRUE, stringsAsFactors=FALSE)
SPATIAL                       = SPATIAL[, (names(SPATIAL) %in% c('DAU','DAU_NAME','DAU_COUNTY',
                                                                 'PA',
                                                                 'HR_CODE','HR_NAME',
                                                                 'Longitude','Latitude'))]
SPATIAL        = SPATIAL[order(SPATIAL$DAU),]
SPATIAL_NODUP = SPATIAL[!duplicated(SPATIAL[,
                  c('DAU','DAU_NAME','PA','HR_CODE','HR_NAME','Longitude','Latitude')
                  ]),]
Duplicates = tabular(Factor(DAU)~ (n=1), data=SPATIAL_NODUP)
#
# Add missing PA
#
MISSING             = data.frame('DAU20824','Turlock',       '608','6',       'San Joaquin River','-999',
'-999')
names(MISSING)      =           c('DAU',      'DAU_NAME',      'PA', 'HR_CODE', 'HR_NAME',          'Longitude','Lati
df_DAU20850         = data.frame('DAU20850','Turlock',       '608','6',       'San Joaquin River','-999',
'-999')
df_DAU20924         = data.frame('DAU20924','Turlock Lake', '608','6',       'San Joaquin River','-999',
'-999')
df_DAU20950         = data.frame('DAU20950','Turlock Lake', '608','6',       'San Joaquin River','-999',
'-999')
names(df_DAU20850) = c('DAU',      'DAU_NAME',      'PA', 'HR_CODE', 'HR_NAME',          'Longitude','Latitude')
names(df_DAU20924) = c('DAU',      'DAU_NAME',      'PA', 'HR_CODE', 'HR_NAME',          'Longitude','Latitude')
names(df_DAU20950) = c('DAU',      'DAU_NAME',      'PA', 'HR_CODE', 'HR_NAME',          'Longitude','Latitude')

MISSING = rbind(MISSING, df_DAU20850, df_DAU20924, df_DAU20950)
SPATIAL_NODUP_608 = rbind(SPATIAL_NODUP, MISSING)
# ========================================================================
MASTER_GC                     = merge(SPATIAL_NODUP_608, MASTER, by = 'DAU' ) # Note to eliminate wrong assignments
#
MASTER_GC[grepl('Scenic',          MASTER_GC$CategoryA),]$CategoryA = 'Wild and Scenic River'
MASTER_GC[grepl('Delta',           MASTER_GC$CategoryA),]$CategoryA = 'Required Delta Outflow'
MASTER_GC[grepl('Water_Supplies', MASTER_GC$CategoryA),]$CategoryA = 'Water Supplies'
MASTER_GC[grepl('Instream',        MASTER_GC$CategoryA),]$CategoryA = 'Instream Flow Requirements'
MASTER_GC[grepl('Wetlands',        MASTER_GC$CategoryA),]$CategoryA = 'Managed Wetlands'
#
MASTER_GC[grepl('Applied Water',  MASTER_GC$CategoryC) &
          grepl('Groundwater'  ,  MASTER_GC$CategoryC),]$CategoryC = 'Applied Water - Groundwater'
MASTER_GC$CategoryC = gsub("_", "-",   MASTER_GC$CategoryC)
MASTER_GC$CategoryC = gsub("::", "-",  MASTER_GC$CategoryC)
MASTER_GC$CategoryC = gsub("Wild &", "Wild and", MASTER_GC$CategoryC)
#
#
# ========================================================================
# Delete computed rows and non-balance CategoryA rows
# ========================================================================
A = subset(MASTER_GC,  !grepl('Total',                          CategoryC) &
                       !grepl('Applied Water Use',              CategoryC) &
                       !grepl('Net Water Use',                  CategoryC) &
                       !grepl('Depletion',                      CategoryC) &
                       !grepl('Conveyance Applied Water Use',CategoryC) &
                       !grepl('Conveyance Net Water Use',    CategoryC) &
                       !grepl('Conveyance Depletion',        CategoryC) &
                       !grepl('Urban Waste Water Produced',  CategoryA) &
                       !grepl('Water Use Totals',            CategoryA) &
                       !grepl('Portfolio',                   CategoryA) &
                       !grepl('Precipitation',               CategoryC))
# ========================================================================
# Read Controlled Vocabulary
# ========================================================================
```

```
CV = read.table(CONTROLLED_VOCABULARY, sep=',', header=TRUE, stringsAsFactors=FALSE)
#
A  = subset(A, CategoryA != '') # Null values in manual conversion effort
A[A$CategoryA=='Urban'                        & A$CategoryB=='15',]$CategoryB='15a' # QC-2500.R corrections from ro
A[A$CategoryA=='Urban'                        & A$CategoryB=='18',]$CategoryB='18a' # QC-2500.R corrections from ro
A[A$CategoryA=='Managed Wetlands'             & A$CategoryB=='17',]$CategoryB='17a' # QC-2500.R corrections from ro
A[A$CategoryA=='Managed Wetlands'             & A$CategoryB=='8',]$CategoryB='8a' # QC-2500.R corrections from roll
A[A$CategoryA=='Instream Flow Requirements' & A$CategoryB=='3',]$CategoryB='3a' # QC-2500.R corrections from roll
#
C  = merge(A, CV, by=c('CategoryA','CategoryB'))  # Merge in CategoryD based on CV
C$CategoryC = C$CategoryC.y

# ============================================================================
# Write the data out for subsequent procedures
# ============================================================================
write.table(C,OUTPUT_STANDARDIZED,          sep=',',row.names=FALSE, quote=TRUE)
# ============================================================================
# Debugging
# ============================================================================
D = subset(C, DAU=='DAU33936')
D$CategoryABCD    = paste(D$CategoryA,'/', D$CategoryB,'/', D$CategoryC, '/', D$CategoryD)
Table_Summary_DAU = tabular(Factor(Year) * (Factor(CategoryABCD)+1) ~
                            (1 + Factor(HR_NAME) *
                             Factor(PA))     * KAcreFt*sum,
                             data=D)
```

Appendix B Action Items

1: Figure for Regulatory framework and operations (Sara)
2: JH Edit TDD to reflect table changes and provide a revised TDD to Kamyar after TWG review
3: Consider for describing vested interests (i.e. public, private, NGO, quasi-governmental) (Gary)
4: How to implement an SWG (Gary)
5: How to engage other interested parties (Sara mentions MOUs in other national activities) (Gary)
6: David H., JH: Data and metadata (schema,..)
7: Forest, JH: Remote sensing + NASA directions
8: Paul H, JH: Reconcile, unify Water Balance and Water Budget
9: UWMP and AGWMP considered as a joint problem in terms of Water Budget use-case (JH)
10: Regional offices as data nodes? (JH)
11: Common parameterization and controlled Vocab (Sara)
12: Re-visit use-cases in smaller conversation (Charu)

References

[1] Eugene W. Rice and Roger B. Baird and Andrew D. Eaton and Lenore S. Clesceri (ed.), *Standard Methods for the Examination of Water and Wastewater*, vol. 22nd Edition, American Public Health Association, American Water Works Association, Water Environment Federation, 2012.

[2] NIST, *Engineering statistics handbook*, National Institute of Science and Technology (NIST) U. S. Department of Commerce, 2012.

[3] _____, *NIST/SEMATECH e-Handbook of Statistical Methods*, (2012).

[4] The Chem Team, *Significant digits*, http://www.chemteam.info/ChemTeamIndex.html.