Humboldt Bay Municipal Water District
Urban Water Management Plan
2015

Appendix

Appendix A
Urban Water Management Plan checklist, organized by Water Code Section and Subject

Appendix B

1. 60 Day Notification of UWMP Review and Adoption Hearing
2. Certificate of Publication of the Legal Notice of Public Hearing
    i. The Times-Standard
    ii. Mad River Union
    iii. North Coast Journal Inc.
3. District's Board Agenda Item to Conduct Public Hearing for the District's 2015 UWMP
4. Board Resolution Adopting the District's 2015 UWMP (Resolution No. 2016-06)
5. Proof of Plan Submittal to DWR and other agencies
6. Documentation showing that Adopted UWMP was available for public review
7. Sample 2015 UWMP Municipal Work Group Meeting Agenda and Attendance (Sample Meeting from April 2016)
8. Notification of Public Hearing to Agencies with Land Use Planning Authority and the District's Municipal Customers

Appendix C
HBMWD- Water Resource Planning: Implementation Plan to Consider, Evaluate and as appropriate, Advance Recommended Water-use Options (Adopted August 11, 2011)

Appendix D
State Water Resources Control Board- Order WRO – 2004 – 0038: In the Matter of Permits 11714 and 11715 Regarding Diversions by HBMWD

Appendix E
HBMWD Ground Water Management Plan (April 2006)

Appendix F
Sample Resolution of the HBMWD Board of Directors Declaring a Water Shortage Emergency and Implementing the District's Water Shortage Contingency Plan

Appendix G
North Coast Integrated Regional Water Management Plan – Phase III (August 2014), Appendix N "Climate Change Vulnerability Assessment"

Appendix H
HBMWD Resolutions (2014-2015) enacting Prohibited Activities in Promotion of Water Conservation

Appendix I
2015 Water Audit

Appendix A

Appendix A

UWMP Checklist

Humboldt Bay Municipal Water District

2015 UWMP

This checklist is developed directly from the Urban Water Management Planning Act and SB X7-7. It is provided to support water suppliers during preparation of their UWMPs. Two versions of the UWMP Checklist are provided – the first one is organized according to the California Water Code and the second checklist according to subject matter. The two checklists contain duplicate information and the water supplier should use whichever checklist is more convenient. In the event that information or recommendations in these tables are inconsistent with, conflict with, or omit the requirements of the Act or applicable laws, the Act or other laws shall prevail.

Each water supplier submitting an UWMP can also provide DWR with the UWMP location of the required element by completing the last column of eitherchecklist. This will support DWR in its review of these UWMPs. The completed form can be included with the UWMP.

If an item does not pertain to a water supplier, then state the UWMP requirement and note that it does not apply to the agency. For example, if a water supplier does not use groundwater as a water supply source, then there should be a statement in the UWMP that groundwater is not a water supply source.

Checklist Arranged by Water Code Section

CWC Section	UWMP Requirement	Subject	Guidebook Location	UWMP Location *(Optional Column for Agency Use)*
10608.20(b)	Retail suppliers shall adopt a 2020 water use target using one of four methods.	Baselines and Targets	Section 5.7 and App E	**n/a**
10608.20(e)	Retail suppliers shall provide baseline daily per capita water use, urban water use target, interim urban water use target, and compliance daily per capita water use, along with the bases for determining those estimates, including references to supporting data.	Baselines and Targets	Chapter 5 and App E	**n/a**
10608.22	Retail suppliers' per capita daily water use reduction shall be no less than 5 percent of base daily per capita water use of the 5 year baseline. This does not apply is the suppliers base GPCD is at or below 100.	Baselines and Targets	Section 5.7.2	**n/a**
10608.24(a)	Retail suppliers shall meet their interim target by December 31, 2015.	Baselines and Targets	Section 5.8 and App E	**n/a**
1608.24(d)(2)	If the retail supplier adjusts its compliance GPCD using weather normalization, economic adjustment, or extraordinary events, it shall provide the basis for, and data supporting the adjustment.	Baselines and Targets	Section 5.8.2	**n/a**
10608.26(a)	Retail suppliers shall conduct a public hearing to discuss adoption, implementation, and economic impact of water use targets.	Plan Adoption, Submittal, and Implementation	Section 10.3	**Page 52**
10608.36	Wholesale suppliers shall include an assessment of present and proposed future measures, programs, and policies to help their retail water suppliers achieve targeted water use reductions.	Baselines and Targets	Section 5.1	**Page 12-13**
10608.40	Retail suppliers shall report on their progress in meeting their water use targets. The data shall be reported using a standardized form.	Baselines and Targets	Section 5.8 and App E	**n/a**
10620(b)	Every person that becomes an urban water supplier shall adopt an urban water management plan within one year after it has become an urban water supplier.	Plan Preparation	Section 2.1	**Page 2**
10620(d)(2)	Coordinate the preparation of its plan with other appropriate agencies in the area,	Plan Preparation	Section 2.5.2	**Page 3-4**

	including other water suppliers that share a common source, water management agencies, and relevant public agencies, to the extent practicable.			
10620(f)	Describe water management tools and options to maximize resources and minimize the need to import water from other regions.	Water Supply Reliability Assessment	Section 7.4	**Page 25-26**
10621(b)	Notify, at least 60 days prior to the public hearing, any city or county within which the supplier provides water that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan.	Plan Adoption, Submittal, and Implementation	Section 10.2.1	**Page 50, Appendix B-1**
10621(d)	Each urban water supplier shall update and submit its 2015 plan to the department by July 1, 2016.	Plan Adoption, Submittal, and Implementation	Sections 10.3.1 and 10.4	**Page 52**
10631(a)	Describe the water supplier service area.	System Description	Section 3.1 & 3.2	**Page 4-5**
10631(a)	Describe the climate of the service area of the supplier.	System Description	Section 3.3	**Page 6-8**
10631(a)	Indicate the current population of the service area.	System Description and Baselines and Targets	Sections 3.4 and 5.4	**Page 8-9**
10631(a)	Provide population projections for 2020, 2025, 2030, and 2035.	System Description	Section 3.4	**Page 9**
10631(a)	Describe other demographic factors affecting the supplier's water management planning.	System Description	Section 3.4	**Page 8-9**
10631(b)	Identify and quantify the existing and planned sources of water available for 2015, 2020, 2025, 2030, and 2035.	System Supplies	Chapter 6	**Page 14-19**
10631(b)	Indicate whether groundwater is an existing or planned source of water available to the supplier.	System Supplies	Section 6.2	**Page 14-15**
10631(b)(1)	Indicate whether a groundwater management plan has been adopted by the water supplier or if there is any other specific authorization for groundwater management. Include a copy of the plan or authorization.	System Supplies	Section 6.2.2	**Page 14, Appendix E**
10631(b)(2)	Describe the groundwater basin.	System Supplies	Section 6.2.1	**Page 14, Appendix E**
10631(b)(2)	Indicate if the basin has been adjudicated and include a copy of the court order or decree and a description of the amount of water the supplier has the legal right to pump.	System Supplies	Section 6.2.2	**Page 14**
10631(b)(2)	For unadjudicated basins, indicate whether or not the department has identified the basin as overdrafted, or projected to become	System Supplies	Section 6.2.3	**Page 14**

	overdrafted. Describe efforts by the supplier to eliminate the long-term overdraft condition.			
10631(b)(3)	Provide a detailed description and analysis of the location, amount, and sufficiency of groundwater pumped by the urban water supplier for the past five years	System Supplies	Section 6.2.4	**n/a**
10631(b)(4)	Provide a detailed description and analysis of the amount and location of groundwater that is projected to be pumped.	System Supplies	Sections 6.2 and 6.9	**n/a**
10631(c)(1)	Describe the reliability of the water supply and vulnerability to seasonal or climatic shortage.	Water Supply Reliability Assessment	Section 7.1	**Page 21-22**
10631(c)(1)	Provide data for an average water year, a single dry water year, and multiple dry water years	Water Supply Reliability Assessment	Section 7.2	**Page 22-23**
10631(c)(2)	For any water source that may not be available at a consistent level of use, describe plans to supplement or replace that source.	Water Supply Reliability Assessment	Section 7.1	**n/a**
10631(d)	Describe the opportunities for exchanges or transfers of water on a short-term or long-term basis.	System Supplies	Section 6.7	**Page 15-16**
10631(e)(1)	Quantify past, current, and projected water use, identifying the uses among water use sectors.	System Water Use	Section 4.2	**Page 9-10**
10631(e)(3)(A)	Report the distribution system water loss for the most recent 12-month period available.	System Water Use	Section 4.3	**Page 10-11, Appendix I**
10631(f)(1)	Retail suppliers shall provide a description of the nature and extent of each demand management measure implemented over the past five years. The description will address specific measures listed in code.	Demand Management Measures	Sections 9.2 and 9.3	**n/a**
10631(f)(2)	Wholesale suppliers shall describe specific demand management measures listed in code, their distribution system asset management program, and supplier assistance program.	Demand Management Measures	Sections 9.1 and 9.3	**Page 45-50**
10631(g)	Describe the expected future water supply projects and programs that may be undertaken by the water supplier to address water supply reliability in average, single-dry, and multiple-dry years.	System Supplies	Section 6.8	**Page 16**
10631(i)	Describe desalinated water project opportunities for long-term supply.	System Supplies	Section 6.6	**Page 15**
10631(j)	CUWCC members may submit their 2013-2014 CUWCC BMP annual reports in lieu of, or in addition to, describing the DMM implementation in their UWMPs. This option is only allowable if the supplier has been	Demand Management Measures	Section 9.5	**n/a**

	found to be in full compliance with the CUWCC MOU.			
10631(j)	Retail suppliers will include documentation that they have provided their wholesale supplier(s) – if any - with water use projections from that source.	System Supplies	Section 2.5.1	**n/a**
10631(j)	Wholesale suppliers will include documentation that they have provided their urban water suppliers with identification and quantification of the existing and planned sources of water available from the wholesale to the urban supplier during various water year types.	System Supplies	Section 2.5.1	**Page 3-4, Appendix B-1**
10631.1(a)	Include projected water use needed for lower income housing projected in the service area of the supplier.	System Water Use	Section 4.5	**n/a**
10632(a) and 10632(a)(1)	Provide an urban water shortage contingency analysis that specifies stages of action and an outline of specific water supply conditions at each stage.	Water Shortage Contingency Planning	Section 8.1	**Page 27-37**
10632(a)(2)	Provide an estimate of the minimum water supply available during each of the next three water years based on the driest three-year historic sequence for the agency.	Water Shortage Contingency Planning	Section 8.11	**Page 41-42**
10632(a)(3)	Identify actions to be undertaken by the urban water supplier in case of a catastrophic interruption of water supplies.	Water Shortage Contingency Planning	Section 8.10	**Page 41**
10632(a)(4)	Identify mandatory prohibitions against specific water use practices during water shortages.	Water Shortage Contingency Planning	Section 8.4 & 8.5	**Page 37-39**
10632(a)(5)	Specify consumption reduction methods in the most restrictive stages.	Water Shortage Contingency Planning	Section 8.6	**Page 39-40**
10632(a)(6)	Indicated penalties or charges for excessive use, where applicable.	Water Shortage Contingency Planning	Section 8.5	**Page 37-38**
10632(a)(7)	Provide an analysis of the impacts of each of the actions and conditions in the water shortage contingency analysis on the revenues and expenditures of the urban water supplier, and proposed measures to overcome those impacts.	Water Shortage Contingency Planning	Section 8.8	**Page 40-41**
10632(a)(8)	Provide a draft water shortage contingency resolution or ordinance.	Water Shortage Contingency Planning	Section 8.9	**Page 41, Appendix F**
10632(a)(9)	Indicate a mechanism for determining actual reductions in water use pursuant to the water shortage contingency analysis.	Water Shortage Contingency Planning	Section 8.7	**Page 40**
10633	For wastewater and recycled water, coordinate with local water, wastewater,	System Supplies (Recycled	Section 6.5.1	**Page 15, n/a**

	groundwater, and planning agencies that operate within the supplier's service area.	Water)		
10633(a)	Describe the wastewater collection and treatment systems in the supplier's service area. Include quantification of the amount of wastewater collected and treated and the methods of wastewater disposal.	System Supplies (Recycled Water)	Section 6.5.2	**n/a**
10633(b)	Describe the quantity of treated wastewater that meets recycled water standards, is being discharged, and is otherwise available for use in a recycled water project.	System Supplies (Recycled Water)	Section 6.5.2.2	**n/a**
10633(c)	Describe the recycled water currently being used in the supplier's service area.	System Supplies (Recycled Water)	Section 6.5.3 and 6.5.4	**n/a**
10633(d)	Describe and quantify the potential uses of recycled water and provide a determination of the technical and economic feasibility of those uses.	System Supplies (Recycled Water)	Section 6.5.4	**n/a**
10633(e)	Describe the projected use of recycled water within the supplier's service area at the end of 5, 10, 15, and 20 years, and a description of the actual use of recycled water in comparison to uses previously projected.	System Supplies (Recycled Water)	Section 6.5.4	**n/a**
10633(f)	Describe the actions which may be taken to encourage the use of recycled water and the projected results of these actions in terms of acre-feet of recycled water used per year.	System Supplies (Recycled Water)	Section 6.5.5	**n/a**
10633(g)	Provide a plan for optimizing the use of recycled water in the supplier's service area.	System Supplies (Recycled Water)	Section 6.5.5	**n/a**
10634	Provide information on the quality of existing sources of water available to the supplier and the manner in which water quality affects water management strategies and supply reliability	Water Supply Reliability Assessment	Section 7.1	**Page 21-22**
10635(a)	Assess the water supply reliability during normal, dry, and multiple dry water years by comparing the total water supply sources available to the water supplier with the total projected water use over the next 20 years.	Water Supply Reliability Assessment	Section 7.3	**Page 25-26**
10635(b)	Provide supporting documentation that Water Shortage Contingency Plan has been, or will be, provided to any city or county within which it provides water, no later than 60 days after the submission of the plan to DWR.	Plan Adoption, Submittal, and Implementation	Section 10.4.4	**Page 52**
10642	Provide supporting documentation that the water supplier has encouraged active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the	Plan Preparation	Section 2.5.2	**Page 3-4**

	preparation of the plan.			
10642	Provide supporting documentation that the urban water supplier made the plan available for public inspection, published notice of the public hearing, and held a public hearing about the plan.	Plan Adoption, Submittal, and Implementation	Sections 10.2.2, 10.3, and 10.5	**Page 51-53**
10642	The water supplier is to provide the time and place of the hearing to any city or county within which the supplier provides water.	Plan Adoption, Submittal, and Implementation	Sections 10.2.1	**Page 51-52**
10642	Provide supporting documentation that the plan has been adopted as prepared or modified.	Plan Adoption, Submittal, and Implementation	Section 10.3.1	**Page 52**
10644(a)	Provide supporting documentation that the urban water supplier has submitted this UWMP to the California State Library.	Plan Adoption, Submittal, and Implementation	Section 10.4.3	**Page 52**
10644(a)(1)	Provide supporting documentation that the urban water supplier has submitted this UWMP to any city or county within which the supplier provides water no later than 30 days after adoption.	Plan Adoption, Submittal, and Implementation	Section 10.4.4	**Page 52**
10644(a)(2)	The plan, or amendments to the plan, submitted to the department shall be submitted electronically.	Plan Adoption, Submittal, and Implementation	Sections 10.4.1 and 10.4.2	**Page 52**
10645	Provide supporting documentation that, not later than 30 days after filing a copy of its plan with the department, the supplier has or will make the plan available for public review during normal business hours.	Plan Adoption, Submittal, and Implementation	Section 10.5	**Page 53**

Checklist Arranged by Subject

CWC Section	UWMP Requirement	Subject	Guidebook Location	UWMP Location *(Optional Column for Agency Use)*
10620(b)	Every person that becomes an urban water supplier shall adopt an urban water management plan within one year after it has become an urban water supplier.	Plan Preparation	Section 2.1	**Page 2**
10620(d)(2)	Coordinate the preparation of its plan with other appropriate agencies in the area, including other water suppliers that share a	Plan Preparation	Section 2.5.2	**Page 3-4**

	common source, water management agencies, and relevant public agencies, to the extent practicable.			
10642	Provide supporting documentation that the water supplier has encouraged active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the preparation of the plan.	Plan Preparation	Section 2.5.2	**Page 3-4**
10631(a)	Describe the water supplier service area.	System Description	Section 3.1	**Page 4-5**
10631(a)	Describe the climate of the service area of the supplier.	System Description	Section 3.3	**Page 6-8**
10631(a)	Provide population projections for 2020, 2025, 2030, and 2035.	System Description	Section 3.4	**Page 9**
10631(a)	Describe other demographic factors affecting the supplier's water management planning.	System Description	Section 3.4	**Page 8-9**
10631(a)	Indicate the current population of the service area.	System Description and Baselines and Targets	Sections 3.4 and 5.4	**Page 8-9**
10631(e)(1)	Quantify past, current, and projected water use, identifying the uses among water use sectors.	System Water Use	Section 4.2	**Page 9-10**
10631(e)(3)(A)	Report the distribution system water loss for the most recent 12-month period available.	System Water Use	Section 4.3	**Page 10-11, Appendix I**
10631.1(a)	Include projected water use needed for lower income housing projected in the service area of the supplier.	System Water Use	Section 4.5	**n/a**
10608.20(b)	Retail suppliers shall adopt a 2020 water use target using one of four methods.	Baselines and Targets	Section 5.7 and App E	**n/a**
10608.20(e)	Retail suppliers shall provide baseline daily per capita water use, urban water use target, interim urban water use target, and compliance daily per capita water use, along with the bases for determining those estimates, including references to supporting data.	Baselines and Targets	Chapter 5 and App E	**n/a**
10608.22	Retail suppliers' per capita daily water use reduction shall be no less than 5 percent of base daily per capita water use of the 5 year baseline. This does not apply is the suppliers base GPCD is at or below 100.	Baselines and Targets	Section 5.7.2	**n/a**
10608.24(a)	Retail suppliers shall meet their interim target by December 31, 2015.	Baselines and Targets	Section 5.8 and App E	**n/a**
1608.24(d)(2)	If the retail supplier adjusts its compliance GPCD using weather normalization, economic adjustment, or extraordinary	Baselines and Targets	Section 5.8.2	**n/a**

	events, it shall provide the basis for, and data supporting the adjustment.			
10608.36	Wholesale suppliers shall include an assessment of present and proposed future measures, programs, and policies to help their retail water suppliers achieve targeted water use reductions.	Baselines and Targets	Section 5.1	**Page 12-13**
10608.40	Retail suppliers shall report on their progress in meeting their water use targets. The data shall be reported using a standardized form.	Baselines and Targets	Section 5.8 and App E	**n/a**
10631(b)	Identify and quantify the existing and planned sources of water available for 2015, 2020, 2025, 2030, and 2035.	System Supplies	Chapter 6	**Page 14-19**
10631(b)	Indicate whether groundwater is an existing or planned source of water available to the supplier.	System Supplies	Section 6.2	**Page 14-15**
10631(b)(1)	Indicate whether a groundwater management plan has been adopted by the water supplier or if there is any other specific authorization for groundwater management. Include a copy of the plan or authorization.	System Supplies	Section 6.2.2	**Page 14, Appendix E**
10631(b)(2)	Describe the groundwater basin.	System Supplies	Section 6.2.1	**Page 14, Appendix E**
10631(b)(2)	Indicate if the basin has been adjudicated and include a copy of the court order or decree and a description of the amount of water the supplier has the legal right to pump.	System Supplies	Section 6.2.2	**Page 14**
10631(b)(2)	For unadjudicated basins, indicate whether or not the department has identified the basin as overdrafted, or projected to become overdrafted. Describe efforts by the supplier to eliminate the long-term overdraft condition.	System Supplies	Section 6.2.3	**Page 14**
10631(b)(3)	Provide a detailed description and analysis of the location, amount, and sufficiency of groundwater pumped by the urban water supplier for the past five years	System Supplies	Section 6.2.4	**n/a**
10631(b)(4)	Provide a detailed description and analysis of the amount and location of groundwater that is projected to be pumped.	System Supplies	Sections 6.2 and 6.9	**n/a**
10631(d)	Describe the opportunities for exchanges or transfers of water on a short-term or long-term basis.	System Supplies	Section 6.7	**Page 15-16**
10631(g)	Describe the expected future water supply projects and programs that may be undertaken by the water supplier to address water supply reliability in average, single-dry, and multiple-dry years.	System Supplies	Section 6.8	**Page 16**
10631(i)	Describe desalinated water project	System Supplies	Section 6.6	**Page 15**

	opportunities for long-term supply.			
10631(j)	Retail suppliers will include documentation that they have provided their wholesale supplier(s) – if any - with water use projections from that source.	System Supplies	Section 2.5.1	**n/a**
10631(j)	Wholesale suppliers will include documentation that they have provided their urban water suppliers with identification and quantification of the existing and planned sources of water available from the wholesale to the urban supplier during various water year types.	System Supplies	Section 2.5.1	**Page 3-4, Appendix B-1**
10633	For wastewater and recycled water, coordinate with local water, wastewater, groundwater, and planning agencies that operate within the supplier's service area.	System Supplies (Recycled Water)	Section 6.5.1	**Page 15, n/a**
10633(a)	Describe the wastewater collection and treatment systems in the supplier's service area. Include quantification of the amount of wastewater collected and treated and the methods of wastewater disposal.	System Supplies (Recycled Water)	Section 6.5.2	**n/a**
10633(b)	Describe the quantity of treated wastewater that meets recycled water standards, is being discharged, and is otherwise available for use in a recycled water project.	System Supplies (Recycled Water)	Section 6.5.2.2	**n/a**
10633(c)	Describe the recycled water currently being used in the supplier's service area.	System Supplies (Recycled Water)	Section 6.5.3 and 6.5.4	**n/a**
10633(d)	Describe and quantify the potential uses of recycled water and provide a determination of the technical and economic feasibility of those uses.	System Supplies (Recycled Water)	Section 6.5.4	**n/a**
10633(e)	Describe the projected use of recycled water within the supplier's service area at the end of 5, 10, 15, and 20 years, and a description of the actual use of recycled water in comparison to uses previously projected.	System Supplies (Recycled Water)	Section 6.5.4	**n/a**
10633(f)	Describe the actions which may be taken to encourage the use of recycled water and the projected results of these actions in terms of acre-feet of recycled water used per year.	System Supplies (Recycled Water)	Section 6.5.5	**n/a**
10633(g)	Provide a plan for optimizing the use of recycled water in the supplier's service area.	System Supplies (Recycled Water)	Section 6.5.5	**n/a**
10620(f)	Describe water management tools and options to maximize resources and minimize the need to import water from other regions.	Water Supply Reliability Assessment	Section 7.4	**Page 25-26**
10631(c)(1)	Describe the reliability of the water supply and vulnerability to seasonal or climatic shortage.	Water Supply Reliability Assessment	Section 7.1	**Page 21-22**

10631(c)(1)	Provide data for an average water year, a single dry water year, and multiple dry water years	Water Supply Reliability Assessment	Section 7.2	**Page 22-23**
10631(c)(2)	For any water source that may not be available at a consistent level of use, describe plans to supplement or replace that source.	Water Supply Reliability Assessment	Section 7.1	**n/a**
10634	Provide information on the quality of existing sources of water available to the supplier and the manner in which water quality affects water management strategies and supply reliability	Water Supply Reliability Assessment	Section 7.1	**Page 21-22**
10635(a)	Assess the water supply reliability during normal, dry, and multiple dry water years by comparing the total water supply sources available to the water supplier with the total projected water use over the next 20 years.	Water Supply Reliability Assessment	Section 7.3	**Page 25-26**
10632(a) and 10632(a)(1)	Provide an urban water shortage contingency analysis that specifies stages of action and an outline of specific water supply conditions at each stage.	Water Shortage Contingency Planning	Section 8.1	**Page 27-37**
10632(a)(2)	Provide an estimate of the minimum water supply available during each of the next three water years based on the driest three-year historic sequence for the agency.	Water Shortage Contingency Planning	Section 8.11	**Page 41-42**
10632(a)(3)	Identify actions to be undertaken by the urban water supplier in case of a catastrophic interruption of water supplies.	Water Shortage Contingency Planning	Section 8.10	**Page 41**
10632(a)(4)	Identify mandatory prohibitions against specific water use practices during water shortages.	Water Shortage Contingency Planning	Section 8.4 & 8.5	**Page 37-39**
10632(a)(5)	Specify consumption reduction methods in the most restrictive stages.	Water Shortage Contingency Planning	Section 8.6	**Page 39-40**
10632(a)(6)	Indicated penalties or charges for excessive use, where applicable.	Water Shortage Contingency Planning	Section 8.5	**Page 37-38**
10632(a)(7)	Provide an analysis of the impacts of each of the actions and conditions in the water shortage contingency analysis on the revenues and expenditures of the urban water supplier, and proposed measures to overcome those impacts.	Water Shortage Contingency Planning	Section 8.8	**Page 40-41**
10632(a)(8)	Provide a draft water shortage contingency resolution or ordinance.	Water Shortage Contingency Planning	Section 8.9	**Page 41, Appendix F**
10632(a)(9)	Indicate a mechanism for determining actual reductions in water use pursuant to the water shortage contingency analysis.	Water Shortage Contingency Planning	Section 8.7	**Page 40**

10631(f)(1)	Retail suppliers shall provide a description of the nature and extent of each demand management measure implemented over the past five years. The description will address specific measures listed in code.	Demand Management Measures	Sections 9.2 and 9.3	**n/a**
10631(f)(2)	Wholesale suppliers shall describe specific demand management measures listed in code, their distribution system asset management program, and supplier assistance program.	Demand Management Measures	Sections 9.1 and 9.3	**Page 45-50**
10631(j)	CUWCC members may submit their 2013-2014 CUWCC BMP annual reports in lieu of, or in addition to, describing the DMM implementation in their UWMPs. This option is only allowable if the supplier has been found to be in full compliance with the CUWCC MOU.	Demand Management Measures	Section 9.5	**n/a**
10608.26(a)	Retail suppliers shall conduct a public hearing to discuss adoption, implementation, and economic impact of water use targets.	Plan Adoption, Submittal, and Implementation	Section 10.3	**Page 52**
10621(b)	Notify, at least 60 days prior to the public hearing, any city or county within which the supplier provides water that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan.	Plan Adoption, Submittal, and Implementation	Section 10.2.1	**Page 50, Appendix B-1**
10621(d)	Each urban water supplier shall update and submit its 2015 plan to the department by July 1, 2016.	Plan Adoption, Submittal, and Implementation	Sections 10.3.1 and 10.4	**Page 52**
10635(b)	Provide supporting documentation that Water Shortage Contingency Plan has been, or will be, provided to any city or county within which it provides water, no later than 60 days after the submission of the plan to DWR.	Plan Adoption, Submittal, and Implementation	Section 10.4.4	**Page 52**
10642	Provide supporting documentation that the urban water supplier made the plan available for public inspection, published notice of the public hearing, and held a public hearing about the plan.	Plan Adoption, Submittal, and Implementation	Sections 10.2.2, 10.3, and 10.5	**Page 51-53**
10642	The water supplier is to provide the time and place of the hearing to any city or county within which the supplier provides water.	Plan Adoption, Submittal, and Implementation	Sections 10.2.1	**Page 51-52**
10642	Provide supporting documentation that the plan has been adopted as prepared or modified.	Plan Adoption, Submittal, and Implementation	Section 10.3.1	**Page 52**
10644(a)	Provide supporting documentation that the urban water supplier has submitted this UWMP to the California State Library.	Plan Adoption, Submittal, and Implementation	Section 10.4.3	**Page 52**
10644(a)(1)	Provide supporting documentation that the	Plan Adoption,	Section 10.4.4	**Page 52**

	urban water supplier has submitted this UWMP to any city or county within which the supplier provides water no later than 30 days after adoption.	Submittal, and Implementation		
10644(a)(2)	The plan, or amendments to the plan, submitted to the department shall be submitted electronically.	Plan Adoption, Submittal, and Implementation	Sections 10.4.1 and 10.4.2	**Page 52**
10645	Provide supporting documentation that, not later than 30 days after filing a copy of its plan with the department, the supplier has or will make the plan available for public review during normal business hours.	Plan Adoption, Submittal, and Implementation	Section 10.5	**Page 53**

Appendix B

HUMBOLDT BAY MUNICIPAL WATER DISTRICT

828 SEVENTH STREET, PO BOX 95 • EUREKA, CALIFORNIA 95502-0095

OFFICE 707-443-5018 ESSEX 707-822-2918

FAX 707-443-5731 707-822-8245

EMAIL OFFICE@HBMWD.COM

January 13, 2016

To: Kevin Hamblin, Humboldt County Community Development Services Dept.
Robert Wall, Humboldt County Planning Dept.
Mark Andre, City of Arcata
Brian Gerving, City of Eureka
David Hull, Humboldt CSD
Greg Orsini, McKinleyville CSD
Vicki Hutton and John Berchtold, City of Blue Lake
Rebecca Crow & Rick Hanger, Fieldbrook-Glendale CSD
Chris Drop, Manila CSD

Re: 60-Day Notice Regarding Review of HBMWD's Urban Water Management Plan

California Water Code (CWC) 10621(b) requires an urban water supplier preparing an Urban Water Management Plan (UWMP) to notify any city or county within which the supplier provides water supplies that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan. CWC further requires each urban water supplier to coordinate the preparation of its UWMP with other appropriate area agencies including other water suppliers that share the same water sources, water management agencies, and other relevant public agencies.

This letter is the Humboldt Bay Municipal Water District's (HBMWD) notice to your agency that HBMWD is in the process of reviewing and updating its UWMP. As with the 2010 UWMP, HBMWD is preparing its 2015 UWMP in collaboration with the City of Arcata, the City of Eureka, Humboldt Community Services District, and McKinleyville Community Services District. If your agency would like to provide input or be involved in the review process you are encouraged to contact myself or any of the above named agencies to coordinate your participation.

If you have any questions please feel free to call me at (707) 443-5018.

Sincerely,

Thavisak Syphanthong
Program & Regulatory Analyst

cc: Paul Helliker and John Friedenbach, HBMWD
Mary Lou Cotton, Kennedy/Jenks Consultants

The Times-Standard
PO Box 3580
Eureka, CA 95502
707-441-0571
legals@times-standard.com

2096953

HUMBOLDT BAY MUNICIPAL WATER DISTRICT - LEGAL
PO BOX 95
EUREKA, CA 95502

Legal No. **0005734944**

PROOF OF PUBLICATION (2015.5 C.C.P.)

STATE OF CALIFORNIA County of Humboldt

I am a citizen of the United States and a resident of the County aforesaid; I am over the age of eighteen years, and not a party to or interested in the above-mentioned matter. I am the principal clerk of the printer of THE TIMES-STANDARD, a newspaper of general circulation, printed and published daily in the City of Eureka, County of Humboldt, and which newspaper has been adjudged a newspaper of general circulation by the Superior Court of the County of Humboldt, State of California, under the date of June 15, 1967, Consolidated Case Numbers 27009 and 27010; that the notice, of which the annexed is a printed copy (set in type not smaller than nonpareil), has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to-wit,

05/25/2016, 06/01/2016

I certify (or declare) under penalty of perjury that the foregoing is true and correct.

Dated at Eureka, California,
This 2nd day of June, 2016

Notice of Public Hearing

The Humboldt Bay Municipal Water District (HBMWD) will hold a public hearing on Thursday, June 9th, 2016, at 10:00 am, at the District Office, 828 7th Street in Eureka. The meeting will include discussion on the HBMWD 2015 Urban Water Management Plan (UWMP). The UWMP was prepared for the State of California Department of Water Resources in accordance with the California Urban Water Management Planning Act of 1983 (AB 797) (UWMP Act) as amended and the Water Conservation Bill of 2009. The UWMP will establish HBMWD's compliance with California Water Code, Division 6, Part 2.6, for all urban water suppliers who provide municipal water to more than 3,000 customers or supply its customers with more than 3,000 acre-feet of water. The UWMP describes the District's water supplies and conservation efforts. The purpose is to ensure that adequate water supplies are available to meet existing and future demands over a 20-year planning horizon. Plans are available for public review at the District Office. Please direct comments or questions to:

Paul Helliker, General Manager
PO Box 95
Eureka CA 95502
(707) 443-5018 / Fax (707) 443-5731
office@hbmwd.com 5/25 & 6/1/2016

STATE OF CALIFORNIA
County of Humboldt

MAD RIVER UNION
MADRIVERUNION.COM ✣ (707) 826-7000

PROOF OF PUBLICATION

Proof of Publication of: HBMWD
Notice of Hearing

I am a citizen of the United States and a resident of the County aforesaid; I am over the age of eighteen years, and not a party to or interested in the matter referred to herein. I am the "principal" clerk of the publisher of the MAD RIVER UNION a newspaper of general circulation, published once a week, Wednesdays, in the City of Arcata, county of Humboldt, and which has been adjudged a newspaper of general circulation by the Superior Court of the County of Humboldt, State of California, under the date of Oct. 29, 2013, Court Decree Number CV130613; that the notice of which the annexed is a printed copy (set in type not smaller than nonpareil), has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to wit:

Run Dates 5/25

_____ all in the year 2016

I certify (or declare) under penalty of perjury that the foregoing is true and correct.

Dated at Arcata, Humboldt County, California

this 25th day of May 2016

Signature: _____
Kevin Hoover, Jack Durham or Lauraine Leblanc
(707) 826-7000

This space is for the County Clerk's Filing Stamp

LEGAL NOTICE
HUMBOLDT BAY MUNICIPAL WATER DISTRICT
NOTICE OF PUBLIC HEARING

The Humboldt Bay Municipal Water District (HBMWD) will hold a public hearing on Thursday, June 9th, 2016, at 10:00 am, at the District Office, 828 7th Street in Eureka. The meeting will include discussion on the HBMWD 2015 Urban Water Management Plan (UWMP). The UWMP was prepared for the State of California Department of Water Resources in accordance with the California Urban Water Management Planning Act of 1983 (AB 797) (UWMP Act) as amended and the Water Conservation Bill of 2009. The UWMP will establish HBMWD's compliance with California Water Code, Division 6, Part 2.6, for all urban water suppliers who provide municipal water to more than 3,000 customers or supply its customers with more than 3,000 acre-feet of water. The UWMP describes the District's water supplies and conservation efforts. The purpose is to ensure that adequate water supplies are available to meet existing and future demands over a 20-year planning horizon. Plans are available for public review at the District Office. Please direct comments or questions to:
Paul Helliker, General Manager
PO Box 95
Eureka CA 95502
(707) 443-5018
Fax (707) 443-5731
office@hbmwd.com 5/25

North Coast Journal Inc.
310 F Street
Eureka, CA 95501
(707)442-1400

This space is for the County Clerk's Filing Stamp

PROOF OF PUBLICATION
(2015.5 C.C.P.)

STATE OF CALIFORNIA }
County of Humboldt } ss

I am a citizen of the United States and a resident of the County aforesaid. I am over the age of eighteen years, and not a party to or interested in the above-entitled matter. I am the principal clerk of the publisher of the North Coast Journal, a newspaper of general circulation, printed and published weekly in the County of Humboldt, and which newspaper has been adjudged a newspaper of general circulation as defined by the laws of the State of California by the Superior Court of the County of Humboldt, State of California, under the date of Feb. 16, 2000, Case Number CV000010. That the notice of which the annexed is a printed copy (set in a type not smaller than nonpareil), has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to-wit:

5/26

all in the year

2016

I certify (or declare) under penalty of perjury that the foregoing is true and correct.

May 26, 2016

Dated at Eureka, California,

Mark a Boyd

Signature

Humboldt Bay Municipal Water District
Notice of Public Hearing

The Humboldt Bay Municipal Water District (HBMWD) will hold a public hearing on Thursday, June 9th, 2016, at 10:00 am, at the District Office, 828 7th Street in Eureka. The meeting will include discussion on the HBMWD 2015 Urban Water Management Plan (UWMP). The UWMP was prepared for the State of California Department of Water Resources in accordance with the California Urban Water Management Planning Act of 1983 (AB 797) (UWMP Act) as amended and the Water Conservation Bill of 2009. The UWMP will establish HBMWD's compliance with California Water Code, Division 6, Part 2.6, for all urban water suppliers who provide municipal water to more than 3,000 customers or supply its customers with more than 3,000 acre-feet of water. The UWMP describes the District's water supplies and conservation efforts. The purpose is to ensure that adequate water supplies are available to meet existing and future demands over a 20-year planning horizon. Plans are available for public review at the District Office. Please direct comments or questions to:
Paul Helliker, General Manager
PO Box 95
Eureka CA 95502
(707) 443-5018 / Fax (707) 443-5731
office@hbmwd.com

5/26 (16-126)

PROOF OF PUBLICATION

Humboldt Bay Municipal Water District

District's Board Agenda June 9, 2016

Item I.1. Urban Water Management Plan (UWMP) –

Public Hearing and possible approval of UWMP and Resolution 2016-6 Adopting the District's 2015 UWMP (10:00 AM)

HUMBOLDT BAY MUNICIPAL WATER DISTRICT
828 7th Street, Eureka

Agenda for Meeting of Board of Directors

June 09, 2016, 9:00 a.m.

Time Set Items:

10:00 a.m. Public Hearing UWMP –Item I1

11:00 a.m. Reports - Engineering Report - Item J1

A. **ROLL CALL**

B. **FLAG SALUTE**

C. **ACCEPT AGENDA**

D. **MINUTES**
Minutes of April 12, 2016 and May 12, 2016 Regular Meetings and May 13 Special Meeting – approve*

E. **PUBLIC COMMENT**
Members of the public are invited to address the Board on items *not* listed on the agenda that are within the scope and jurisdiction of the District. At the discretion of the President, comments may be limited to three minutes per person. The public will be given the opportunity to address items that are on the agenda at the time the Board takes up that item.

F. **CONSENT AGENDA**
It is recommended that these items, which are informational or routine in nature, be received and filed by the Board at the beginning of the meeting. If any Board member or interested party requests that an item be removed from the Consent Agenda, it will be considered separately.

1. Letter from District transmitting Grant Agreement and Board Resolution for Quagga Prevention Grant*
2. General Manager employee agreement modification – approve*
3. Newspaper articles of local/water interest (given the large number, organized by topic)*

G. **CORRESPONDENCE**

1. Joint letter from HBMWD and Ruth Lake CSD inviting Ruth-area parties to joint Board meeting and draft meeting agenda – discuss agenda *
2. Samoa Peninsula CSD- update*

H. **CONTINUING BUSINESS**

1. Water Conservation Regulations –Status update*
2. Water Resource Planning - status report and discussion re: water-use options under consideration (local sales, transport, and in-stream flow dedication)*
   a. status report re: activities to advance the transport option
   b. status report re: local sales
   c. status report re: activities to advance instream flow dedication

* Supporting material included in Director books

HUMBOLDT BAY MUNICIPAL WATER DISTRICT
828 7th Street, Eureka

Agenda for Meeting of Board of Directors

June 09, 2016, 9:00 a.m.

I. **NEW BUSINESS**

1. Urban Water Management Plan (UWMP)- public hearing and possible approval of UWMP and Resolution 2016-6 Adopting the District's 2015 UWMP * **(10:00 am)**

2. Agenda Review Committee- discuss and possibly approve changes*

3. Ruth Fires, Landslide Investigation of Matthews Dam Vicinity- report from Six Rivers National Forest, Mad River Ranger District*

J. **REPORTS (from Staff)**

1. Engineering (11:00 a.m.)

a) Ranney Collector 1 Lateral Replacement Project (partially funded by Prop 84 NCIRWMP grant) – status report and possible approval of any Change Orders/Progress Payments*

b) Blue Lake-FG CSD Water Line Replacement over Mad River (funded by Prop 84 NCIRWMP grant and FEMA Hazard Mitigation Grant) – status report and approval of project scope for environmental review*

c) FEMA Hazard Mitigation Grant and Pre-Disaster Mitigation Grant Submittals- status report*

d) Potential Exposure of Pipeline on New Navy Base Road-status report

e) Coonrod development- status report

f) Status report re: other engineering work in progress

2. **Financial**

a) Limit for Appropriations from Taxes – adopt Resolution 2016-5 establishing limitation for appropriations from taxes *

b) FY 2015/16 Project Budget – approve budget reallocation for specific projects (with no impact on total Municipal costs) *

c) FY 2016/17 Budget – presentation of proposed total budget and revenue estimates *

d) Financial Report – approve May 2016 financial statement &vendor detail report*

e) Audit RFP- receive recommendation from Audit Committee and possible approval of auditing firm*

3. **Operations**

a) Monthly report on projects and operations*

b) PG&E Statement of Electric Energy Purchased and hydro related summaries*

4. **Management**

a) FERC Part 12 PFMA and Dam Inspection-status report

* Supporting material included in Director books

HUMBOLDT BAY MUNICIPAL WATER DISTRICT
828 7th Street, Eureka

Agenda for Meeting of Board of Directors

June 09, 2016, 9:00 a.m.

K. **DIRECTOR REPORTS & DISCUSSION**

1. General

a) General comments or reports from Directors

2. ACWA – JPIA

a) Report re: JPIA activities (if any) *

3. ACWA

a) Report on ACWA Activities *

b) Update on Priority Issues*

4. Organizations on which HBMWD Serves: RCEA, RREDC, NCRP *

a) Status reports*

ADJOURNMENT

ADA compliance statement: In compliance with the Americans with Disability Act, if you need special assistance to participate in this meeting, please contact the District office at (707) 443-5018. Notification 48 hours prior to the meeting will enable the District to make reasonable arrangements to ensure accessibility to this meeting.

(Posted and mailed June 3, 2016)

* Supporting material included in Director books

Resolution No. 2016-06

Resolution of the Humboldt Bay Municipal Water District Board of Directors Adopting the District's 2015 Urban Water Management Plan

Whereas, the Urban Water Management Planning Act of 1983, as amended (California Water Code Division 6, Part 2.6) requires the preparation and submission to the California Department of Water Resources of an Urban Water Management Plan by all water suppliers that qualify as urban water suppliers as defined by the act; and

Whereas, the Humboldt Bay Municipal Water District qualifies as an urban water supplier as defined by the Urban Water Management Planning Act; and

Whereas, the Urban Water Management Planning Act as amended requires retail urban water suppliers to address components of the Water Conservation Bill of 2009 (SBX7-7), which sets an overall goal of reducing the state's per capita urban water use by 20% by December 31, 2020, for which the Humboldt Bay Municipal Water District must provide support; and

Whereas, the Urban Water Management Planning Act requires the submission of Urban Water Management Plans in years ending in 5 and 0; and

Whereas, the Humboldt Bay Municipal Water District last prepared and submitted an Urban Water Management Plan in 2010; and

Whereas, the 2015 Urban Water Management Plan must be adopted by July 1, 2016, after public review and hearing, and filed with the Department of Water Resources within thirty days of adoption; and

Whereas, the Humboldt Bay Municipal Water District has therefore prepared and made available for public review a draft of the Urban Water Management Plan, and a properly noticed public meeting regarding the Plan was held by the Board of Directors on June 9, 2016.

Now therefore be it resolved, that the Directors of the Humboldt Bay Municipal Water District adopts the 2015 Urban Water Management Plan and authorizes its submission to the California Department of Water Resources.

PASSED and ADOPTED at a Regular Meeting of the Board of Directors of the Humboldt Bay Municipal Water District this 9th day of June, 2016 by the following roll call vote:

AYES: Directors Hecathorn, Latt, Laird, Rupp and Woo

NOES: None

ABSENT: None

Attest:

Barbara Hecathorn

Barbara Hecathorn, Board President

J. Bruce Rupp

J. Bruce Rupp, Board Secretary/Treasurer

HUMBOLDT BAY MUNICIPAL WATER DISTRICT

828 SEVENTH STREET, PO BOX 95 • EUREKA, CALIFORNIA 95502-0095
OFFICE 707-443-5018 ESSEX 707-822-2918
FAX 707-443-5731 707-822-8245
EMAIL OFFICE@HBMWD.COM
Website: www.hbmwd.com

June 17, 2016

To: California State Library
Government Publications Section
Water Use and Efficiency Branch
PO Box 942837
Sacramento, CA 94237-0001
Attention: Coordinator, Urban Water Management Plans

Re: 2015 Urban Water Management Plan – Humboldt Bay Municipal Water District

This letter transmits a CD and a hard copy of the Humboldt Bay Municipal Water District's 2015 Urban Water Management Plan, which was adopted by the HBMWD Board of Directors on June 9, 2016.

The checklist, which is organized by both Water Code Section and subject matter, is included as Appendix A for your convenience. The District uploaded the Plan to DWR's Water Use Efficiency (WUE) data online submittal tool today.

The District is also providing copies of the Plan to the Humboldt County Public Library, the Humboldt County Community Development Services Department, and to cities and municipalities within the District's service area.

Sincerely,

John Friedenbach
Business Manager

CC:

Humboldt County Public Library (Main Branch, hard copy)
Kevin Hamblin and Robert Wall, Humboldt County Community Development Services Department (CD only)
David Loya, City of Arcata Community Development Dept. (CD only)

Humboldt Bay Municipal Water District
2015 Urban Water Management Plan

To: 2015 UWMP File
From: Thavisak Syphanthong
Date: June 17, 2016
Subject: 2015 Urban Water Management Plan – Proof Adopted Plan was available for Public Review and Submitted to DWR and other agencies

Humboldt Bay Municipal Water District's 2015 Urban Water Management Plan was adopted by its Board of Directors on June 9, 2016 (Resolution No. 2016-06). Following adoption of the Plan, the District made the Plan available for Public review during normal business hours.

On June 17, 2016, the District uploaded the Plan to the California Department of Water Resources' Water Use Efficiency (WUE) data online submittal tool. Copies of the Plan were also sent to the California State Library, the Humboldt County Public Library, the Humboldt County Community Development Services Department, and to the municipalities within the District's service area.

Humboldt Bay Municipal Water District
2015 Urban Water Management Plan Group Meeting
Tuesday, April 19, 2016

Location: HBMWD Board Room
Time: 2pm

Agenda

1) Sign-in

2) Public Outreach- Conservation Info Table at Sequoia Park Zoo's Party for the Planet

Tasks	Time	Who
Sign-in and Setup	11:15-11:30 AM	Abram Crow & Rebecca
Staff Booth	11:30 AM-1:30 PM	Abram Crow & Rebecca
Staff Booth	1:30 PM -2:30 PM	
Staff Booth	2:30 PM- 3:30 PM	
Staff and Cleanup	3:30:00 PM - 4:30 PM	Rachel Hernandez & Zoo Volunteer

3) 2015 UWMP –
   a. Water use and population data for each agency
   b. UWMP Sections from District to Agencies
      - Chap: 6.3, 6.9, 6.10 (sent)
      - Chap. 7 (review)
      - Chap. 8 (sent)
   c. DMMs and public outreach
   d. Schedule for completion of UWMP
   e. Sample Public Hearing Notice for Newspapers
   f. Other Topics and Questions for UWMP?

4) Other Topics?

5) Next Meeting

SEQUOIA PARK ZOO FOUNDATION

Humboldt Bay Municipal Water District
Paul Helliker
PO Box 95
Eureka, CA, 95502

Dear Paul,

Sequoia Park Zoo is excited to announce our Party for the Planet. This community event is on Saturday April 24th and is a FREE day sponsored by Pacific Gas & Electric.

Our focus for this year water, and its value as a natural resource, both locally and globally. We are inviting community partners to come together to promote all aspects of water conservation and celebrate Earth Day.

We invite Humboldt Bay Municipal Water District to participate as one of our eco-exhibitors and share your water-related conservation messaging with visitors - young and old – in a fun and educational way.

Last year, over 4,000 guests partied for the planet, learned a lot of new conservation tips, created eco-friendly crafts, and engaged in a variety of educational activities. This year we will feature face painting and more community organizations than ever as we explore our relationship to water and ways in which we can conserve this essential resource.

Each eco-exhibitor will have an 8ft table to display information etc. and two chairs. As this is an informational event, we ask that no merchandize is sold but do recommend giveaway items.

Sequoia Park Zoo's Party for the Planet is an excellent way to reach a large and diverse audience to promote your organization's work, and by coming together create change in our community.

If your organization would like to participate as an eco-exhibitor at the 2016 Party for the Planet, please email or call Chelsa Green, Events Coordinator to confirm your participation. 707-442-5649 ext 203 or chelsa@sequoiaparkzoo.net

We will follow up with more details in the next few weeks.

Your support is greatly appreciated! We look forward to a fun and successful Party for the Planet. Thank you for being a generous community partner.

Julie Benbow, *Executive Director*

Sequoia Park Zoo Foundation is a California 501 (c)(3) non-profit organization, Tax ID: 56-2410108
Please check with your accountant to see if your donation is tax-deductible.

Humboldt Bay Municipal Water District
2015 UWMP Work Group Meeting
Attendance Roster
April 19, 2016

Name	Agency
Russ Avery	city of Eureka
David Hull	HCSD
Heidi Loving	HLOVIG@CITYOFARCATA.ORG City of Arcata
Thomas Sheets	HBMWD
Don Duncan	CoE
Omploe	Freshwater

HUMBOLDT BAY MUNICIPAL WATER DISTRICT

828 SEVENTH STREET, PO BOX 95 • EUREKA, CALIFORNIA 95502-0095
OFFICE 707-443-5018 ESSEX 707-822-2918
FAX 707-443-5731 707-822-8245
EMAIL OFFICE@HBMWD.COM
Website: www.hbmwd.com

BOARD OF DIRECTORS
BARBARA HECATHORN, PRESIDENT
ALDARON LAIRD, VICE-PRESIDENT
J. BRUCE RUPP, SECRETARY-TREASURER
SHERI WOO, DIRECTOR
NEAL LATT, DIRECTOR

GENERAL MANAGER
PAUL HELLIKER

May 27, 2016

To: Agencies with Land Use Planning Authority:
Kevin Hamblin, Director, Humboldt County Community Development Services Dept.
Robert Wall, Humboldt County Planning Dept.
David Loya, Director, City of Arcata Community Development Dept.
Rob Holmlund, Director, City of Eureka Community Development Dept.

Municipal Customer Representatives:
Mark Andre, City of Arcata
Brian Gerving, City of Eureka
David Hull, Humboldt CSD
Greg Orsini, McKinleyville CSD
Amanda Mager, City of Blue Lake
Rick Hanger & Rebecca Crow, Fieldbrook-Glendale CSD
Chris Drop, Manila CSD

Re: Notice of Public Hearing for HBMWD's 2015 UWMP

In a previous letter dated January 13, 2016 sent to the District's municipal customers, Humboldt Bay Municipal Water District gave notification that we were in the process of reviewing and updating our 2015 Urban Water Management Plan (UWMP). We have finished our draft 2015 UWMP and will hold a public hearing on Thursday, June 9th, 2016, at 10:00 am, at the District Office, 828 7th Street in Eureka.

The UWMP establishes HBMWD's compliance with California Water Code, Division 6, Part 2.6, for all urban water suppliers that provide municipal water to more than 3,000 customers or supply its customers with more than 3,000 acre-feet of water. The purpose of the UWMP is to support long-term resource planning and ensure adequate water supplies are available to meet existing and future water demands. Water suppliers are required to assess the reliability of their water sources over a 20-year planning horizon considering normal, dry, and multiple dry years. Some important sections of the UWMP include water supply reliability, water conservation and water shortage contingency planning.

The UWMP was prepared for the State of California Department of Water Resources in accordance with the California Urban Water Management Planning Act of 1983 (AB 797) (UWMP Act) and Water Conservation Bill of 2009 (SBX7-7) as amended. Requirements of SBX7-7 affect retail water suppliers more than wholesale water suppliers such as the District. Retail water suppliers are required to determine base daily per capita water use, urban water use targets, and interim water use targets. The District must support its municipal customers in their water conservation efforts and meeting their water use targets.

The District would like to thank its municipal customers and the agencies with land use planning authority within the District for working together in helping the District and its four larger municipal customers with our respective UWMPs. The District's UWMP has been available for public review at the District Office since May 25, 2016.

If you have any questions, please call me at 443-5018.

Sincerely,

Thavisak Syphanthong
Program & Regulatory Analyst

Cc: Jason Patton, McKinleyville CSD
Dan Duncan, City of Eureka
Rachel Hernandez, City of Arcata

Appendix C

Humboldt Bay Municipal Water District

Water Resource Planning

Implementation Plan
to Consider, Evaluate and as appropriate, Advance Recommended Water-use Options

Adopted by the HBMWD Board of Directors
August 11, 2011

This plan is based on and builds upon the significant public and stakeholder input the District received in 2009 and 2010.
The District is very grateful to the public, stakeholder groups and agencies for participating in a community-based planning process, and for very providing valuable and thoughtful comments and input.

Implementation Plan to Consider, Evaluate, and as appropriate, Advance Recommended Water-use Options

TABLE OF CONTENTS

HUMBOLDT BAY MUNICIPAL WATER DISTRICT

Water Resource Planning

Implementation Plan to Consider, Evaluate, and as appropriate, Advance Recommended Water-use Options

1) Introduction to the HBMWD

The Humboldt Bay Municipal Water District was formed in 1956 pursuant to the California Municipal Water District Act. The District was created to develop a regional water system that provides a reliable supply of drinking and industrial water to customers in the greater Humboldt Bay area of Humboldt County.

The District's Mission is to:

1. reliably deliver high quality drinking water to the communities and customers the District serves in the greater Humboldt Bay Area at a reasonable cost;
2. reliably deliver untreated water to the District's wholesale industrial customer(s) at a reasonable cost; and
3. protect the long-term water supply and water quality interests of the District in the Mad River watershed.

1.1 Customers

The District operates almost exclusively at the wholesale level. The District supplies drinking water to seven public agencies, who in turn, serve the residents, businesses and industries in the greater Humboldt Bay region. The District's wholesale municipal customers are the cities of Arcata, Eureka, Blue Lake, and four Community Service Districts - Fieldbrook-Glendale, Humboldt, Manila, and McKinleyville.

For almost 50 years, the District also supplied untreated water to two large industrial customers (pulp mills) on the Samoa Peninsula.

1.2 Operations and Facilities

Current operations of the District include: 1) Ruth Lake in southern Trinity County, which provides the reliable year-round water supply, 2) a hydro-electric power house at Matthews Dam on Ruth Lake, 3) diversion, pumping and control facilities on the Mad River at Essex (near Arcata), 4) storage and treatment facilities at various locations, and 5) pipeline systems that deliver either treated drinking water or untreated surface water to customers throughout the Humboldt Bay region.

The District operates and maintains two *separate and distinct* water delivery systems:

1. an Industrial Water System, capable of supplying 60 million gallons per day (MGD) of untreated water to industrial customer(s) on the Samoa Peninsula, and
2. a Domestic Water System capable of supplying about 20 MGD of treated drinking water for the municipal customers and community.

The distinction between the Domestic and Industrial systems is important in understanding the District's advantages and constraints in regards to planning future water uses:

- Given their relative capacities - 60 MGD industrial and 20 MGD municipal - 75% of the District's supply and delivery capacity is on the Industrial system.
- The systems are dedicated for their respective uses - ***the industrial system (in its current state) cannot supply drinking water.*** So although the District has ample water supply available under its permit from the State, the District can only provide about 20 MGD of drinking water unless significant infrastructure is added to the domestic water system.

1.3 Water Rights

The State of California – via the State Water Resources Control Board (SWRCB) – prescribes and authorizes allowed use of surface water within the state. The SWRCB accepts applications and issues permits to agencies or other parties who wish to "use" water for a specific public purpose.

The District has been granted water rights permits for municipal and industrial water use. The permits allow the District to store 48,030 acre-feet of water at Ruth Lake, and then divert up to116 cubic feet per second (cfs) at its diversion facilities on the Mad River located 75 miles downstream near Arcata. (Note: 116 cfs = 75 million gallons per day (MGD), the latter being the units in which HBMWD measures water delivery to its wholesale customers)

The physical facilities of the regional water system, plus these water rights, are what allow the District to provide a highly reliable, year-round water supply of 75 MGD.

Water law is also an important factor in understanding the District's advantages and constraints in regards to planning future water uses.

2) Key Challenges Facing the District

The key challenge facing the District is the loss of its entire industrial customer base. This has resulted in:

1. a significant loss in revenues which has shifted substantial costs to the District's municipal customers;
2. non-use of the Industrial Water System which is now sitting idled; and
3. under-utilization of the District's water rights which will be lost if not used once again.

From the early 1960's until 1999, the District had long-term contracts in place with one or two large industrial users (pulp mills) on the Samoa Peninsula. For much of this period, the entire 60 MGD capacity of the District's Industrial Water System was under contract to these mills. During this period, the two mills regularly used 40 to 50 MGD, which was *4 to 5 times greater* than the *total* municipal use for the entire Humboldt Bay region (Figure 1).

In the mid-1990's, the Simpson Pulp Mill ceased operation resulting in a significant reduction in District water deliveries (Figure 1). Shortly thereafter, the remaining pulp mill reduced its contract commitment to about half of what it had been historically. In 2009, that mill ceased operation and remains closed today with no prospect of resuming operation.

Over the last 30 years, total municipal use has been quite constant averaging about 10 MGD. Industrial water use is now zero.

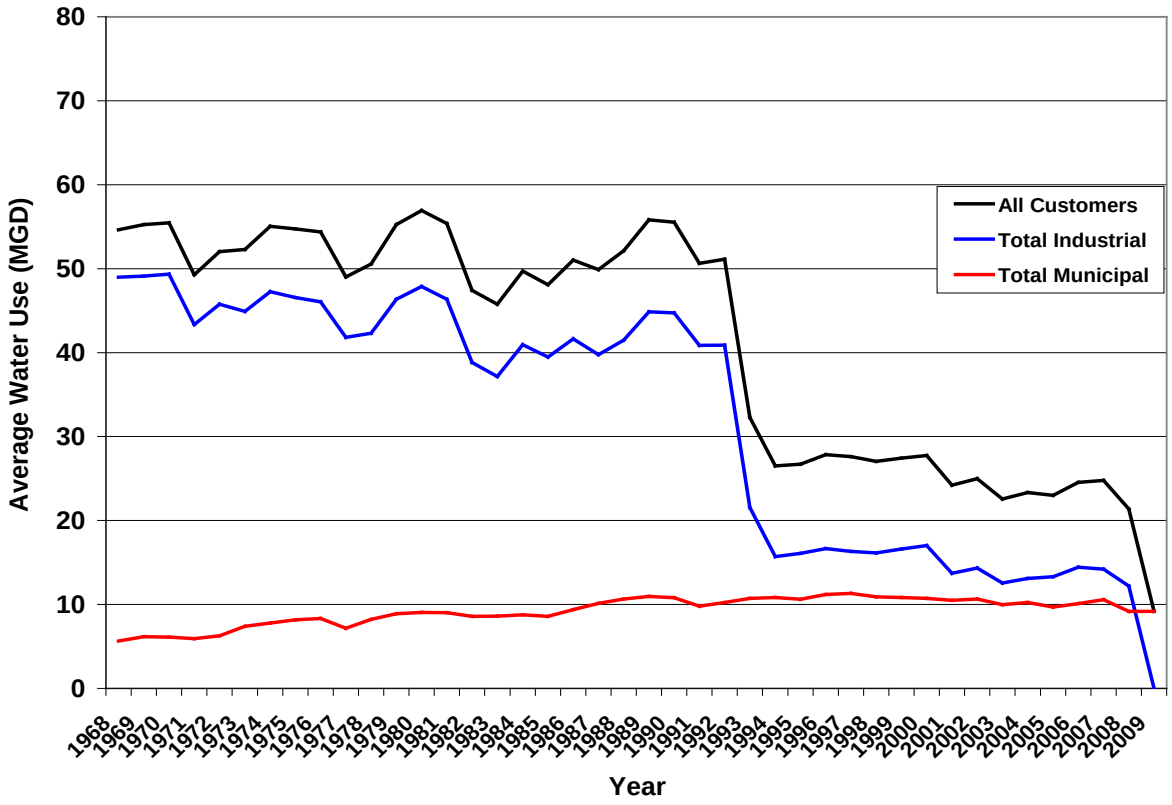

Figure 1. Annual average municipal and industrial water used (MGD)

3) Implications of this Loss

3.1 Financial

Loss of the industrial customers has created significant issues for the District and its municipal customers. Loss of the mills – which at one time paid 75% of the District's costs of operating, maintaining and improving the regional water system -- has triggered significant cost increases to the District's municipal customers. This in turn has triggered significant increases in retail water rates in all communities.

Additional revenues are desired to offset the current ratepayer burden of shouldering the entire cost of the regional water system. Furthermore, additional revenues are needed to fund costly infrastructure replacements given that most operational elements of the regional water system are 50 years old. Infrastructure replacements must be done to maintain the reliability and integrity of

the regional water system. Additional details regarding wholesale cost increases and impacts on retail water rates are presented in Appendix 1.

3.2 District Water Rights and Ability to Maintain Local Control

In addition to economic and ratepayer ramifications, loss of the industrial customer base has created a unique challenge with respect to the District's water rights.

As introduced above, the State prescribes and authorizes allowed use of all surface water within the state, and the District holds water rights permits which allow use within our District.

A key principle in California water law regarding utilization of a water right is how much control a permittee (like the District) will have compared to the SWRCB or others. As a general rule, if a permittee is complying with the terms of its permit (including any changes), then the permittee has full control over the water right. However, if a permittee fails to put all of the water under permit to use, then the SWRCB will, at the end of the permit period, reduce the quantity of water under the water right permit to the amount the permittee has *actually used*. It is in essence a "use it or lose it" mechanism. The failure to use that water creates the opportunity for new parties to try to obtain rights to the unused water.

Since the two pulp mills ceased operation, the District has faced an appreciable reduction in its permitted water use. Figure 2 presents the permitted diversion authorized in the District's water rights permits versus the District's actual diversions. There is a significant gap between the permitted use and that which the District is currently using. The District must put this available water to beneficial use during the current permit term (between now and 2029) or risk losing the unused amount.

Appendix 2 presents additional details regarding California water rights law and the District's water rights permits.

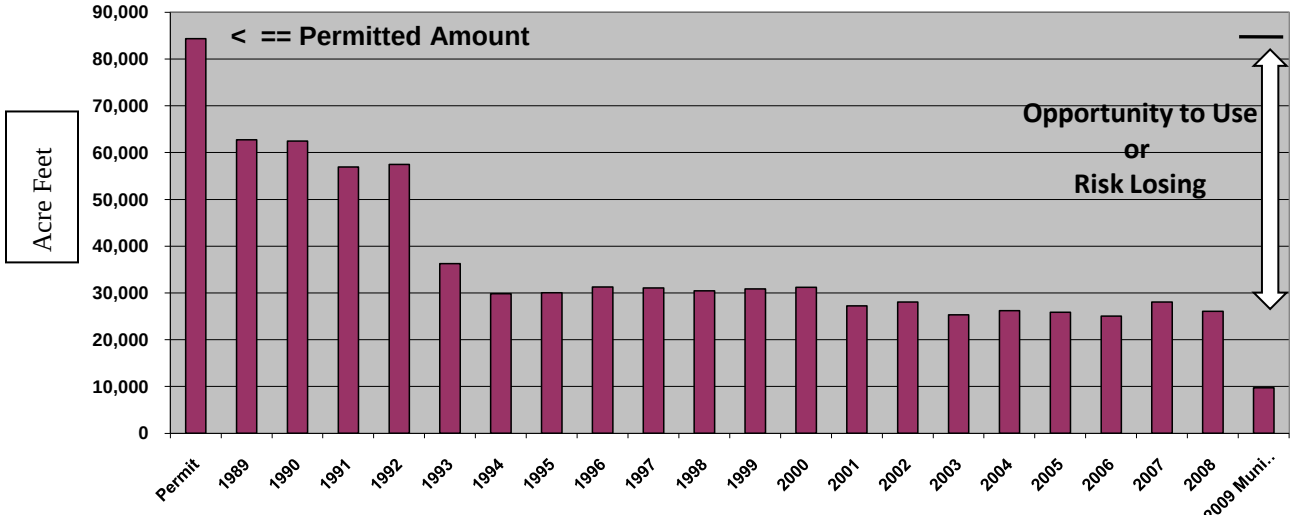

Figure 2. Annual permitted diversion versus actual diversion in acre-feet/year (AFY)

This fact has potentially significant consequences for the District in regards to supplying future municipal water supplies. If the District does not achieve additional "use" under its permits by 2029, the District will lose rights to all water over and above that which is actually in use by its seven Municipal Customers *at that time*.

Figure 3 illustrates this point. As in Figure 2, the District's permitted (e.g. authorized) annual diversions are shown to the far left. Historical use against the permits is shown from 1989 to 2010. Future municipal use is then projected using growth assumptions from the most recent Urban Water Management Plan (0.4% per year). In 2029, total municipal use under the District's permits is estimated to be approximately 11,600 acre-feet/year – just 14% of the permitted amount. After the permits expire on December 31, 2029, the District would lose rights to use anything above 11,600 acre-feet. From that point forward, the District would not have any water available to supply future municipal needs of any city or community service district within our District, absent obtaining a new permit from the State after a new water rights application is submitted and processed (which would take years and tens, if not hundreds, of thousands of dollars).

The District via this Water Resource Planning process is striving to protect municipal interests and future municipal supplies within Humboldt County.

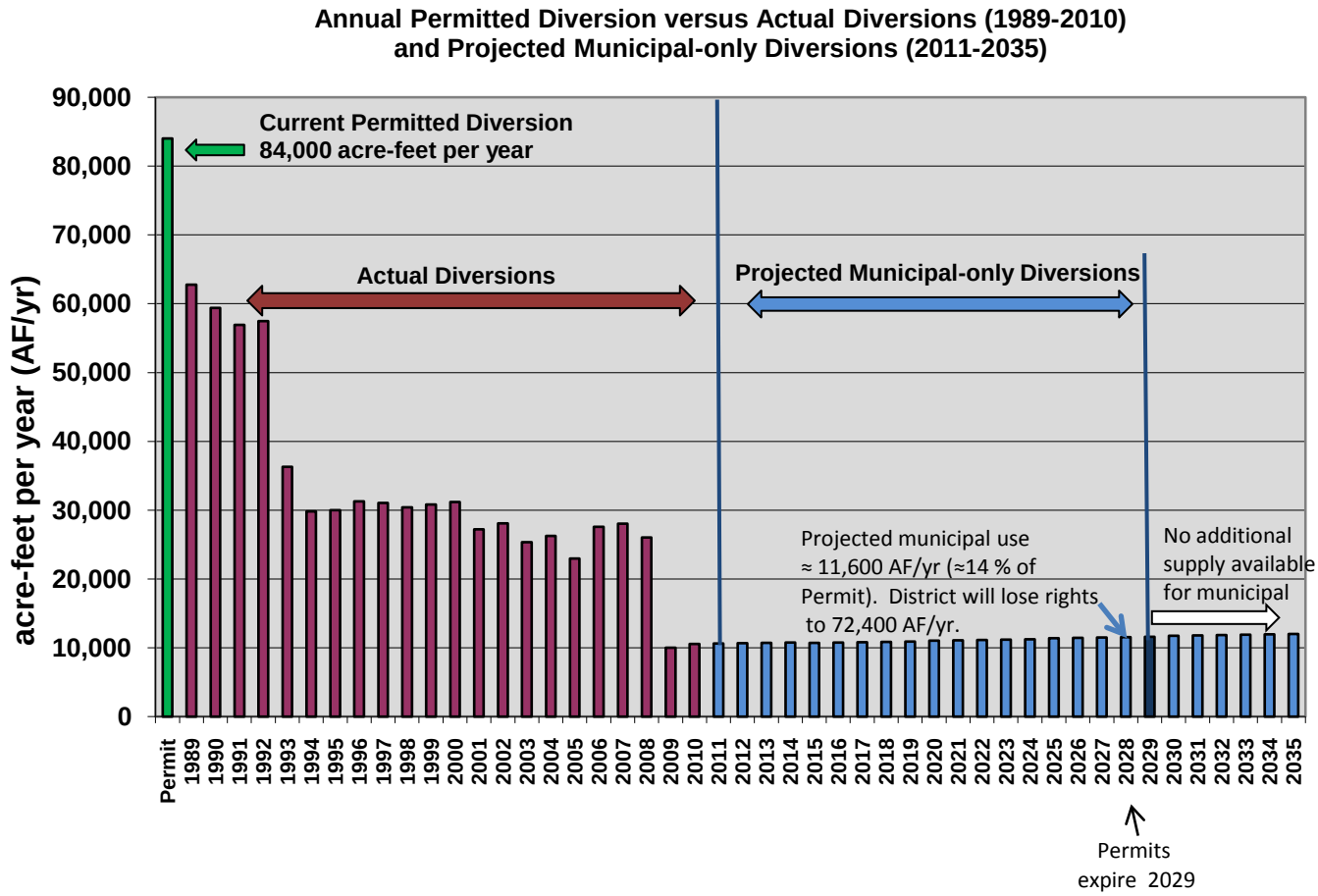

Figure 3: Annual permitted diversion versus actual diversion and projected Municipal-only diversion

4) Planning Process to Address the Loss of Customer Base

In 2005, the Board of Directors embarked on a planning process to address long-term issues of strategic importance to the District. The goal was to ensure the long-term integrity and viability of the regional water supply and system such that the District continues to meet its important service mission to the community. The Board agreed on two initiatives that warrant priority attention in the coming years - Infrastructure Planning and Water Resource Planning.

To address the significant revenue loss and to avoid the eventual loss of its water rights, the District must find additional water uses - up to 50 MGD. The District turned to the community to identify possible water use options and to provide input on important trade-offs that are inevitable.

The District's outreach to the community was wide-ranging and in-depth. To lead the process, the Board created an Advisory Committee comprised of three representatives from its Municipal Customer group, nine citizens representing multiple stakeholder perspectives, and two members of the Board. The Advisory Committee began its work in June 2009. During a 14-month process, they gathered input from the public at 11 meetings, conducted an educational Water Workshop, and formed a Citizen's Study Group comprised of stakeholders and citizens randomly selected and invited from voter rolls. The District used television, radio, print media, and the Internet to further communicate with the community. Over 30 articles appeared in eight newspapers or newsletters, and the District gave 22 presentations to various stakeholder groups throughout the County.

The Advisory Committee accomplished much work. They:

1. Created a "Framework for Evaluating Water Resource Planning Options"
2. Provided public outreach and education
3. Gathered public and stakeholder input on water-use options
4. Created descriptions and conducted initial research on possible water-use options
5. Analyzed the options
6. Provided recommendations to the District's Board of Directors

There are three broad categories in which the District can achieve increased water use:

(i) Use additional water *within* the District via projects that increase the consumptive use of water within the current District boundaries.

(ii) Transfer water for use *outside* of the District's existing service territory via projects that would generate revenues by selling water (not the underlying water right) to a Municipality or other party who would then put the water to "beneficial use." Such a transfer would only occur under a strictly defined contract which protects the District and local interests.

(iii) Transfer water for environmental benefit via projects that provides water for environmental restoration or enhancement.

Under these broad categories, the Advisory Committee generated 13 possible water-use options based on public and stakeholder input. Following their evaluation, they recommended 11 options to the District. The Advisory Committee presented their findings and recommendations to the District in a comprehensive report in August 2010.

Appendix 3 contains the title page, executive summary, and table of contents of their report, as well as the Framework for Evaluating Water Resource Planning Options. The complete report is available on-line (www.hbmwd.com) or may be obtained by calling (707)443-5018.

This thoughtful community-based planning process helped the District educate the public and raise awareness of the District's unique situation and its implications.

5) Water Use Goals

The Board of Directors accepted the Advisory Committee's report and water use recommendations. The next steps are to evaluate the most promising options and take appropriate steps towards implementation such that the District achieves additional water use. To guide this next phase of work, the Board established three goals:

- Protection of HBMWD's Water Rights – increase water use such that HBMWD maintains control of this water resource for the benefit of Humboldt and Trinity Counties
- Fiscal Sustainability – generate revenues to contribute to the current operation and maintenance of the regional water system, as well as upcoming costly capital replacement projects (given that the system is 50 years old)
- Environmental Sustainability – preserve the Mad River environment, and if possible, enhance it

6) Water-Use Options the District will Consider and Evaluate

The Board segmented the recommended water-use options into two tiers. The District intends to consider, evaluate, and as appropriate, pursue the top tier options.

Top Tier: Options the District will actively consider, evaluate, and as appropriate, pursue:

a) *Local* commercial, industrial or agricultural water sales. This option would include other viable water-use options within the District, such as aquaculture.

b) Transfer of water to another public agency outside of the District for an authorized beneficial use (e.g. municipal, industrial, environmental). Such a transfer would only occur under a strictly defined contract which protects the District and local interests. CA water law also would protect the District's underlying water right.

c) Dedicating some portion of the available water for in-stream flows in the Mad River. Such water would otherwise be in storage at Ruth reservoir for much of the year (i.e. summer and fall). This option is available pursuant to section 1707 of the California Water Code, which is intended to promote water transfers for the benefit of the environment. For such a transfer to occur there must be defined environmental benefit. This option will require studies to substantiate environmental benefit and address potential adverse effects, especially in the estuary. The District will pursue technical support and funding from Resource Agencies or other interested parties, to limit municipal customers (and therefore ratepayers) from funding costly studies.

Second Tier: Options the District will consider, and as appropriate support, if they are recommended or advanced by an interested party. This includes several water-use options recommended by the Advisory Committee, as well as any new option generated prospectively. Examples of such uses include: expanding the current District boundary; creating a lake in Blue Lake; using river water in lieu of well water at the Mad River hatchery; transferring water to a private entity for use outside of the District; and installation of micro-hydro.

Options Not Under Consideration: The Board decided two water-use options generated by the Advisory Committee will not be pursued – building a large diameter pipeline to Mendocino or Sonoma counties in the North Coast Railroad right-of-way, and transferring water from the Mad River to an adjacent watershed (Van Duzen or Trinity) just downstream of Ruth reservoir. They deemed these options too costly, too risky, and too permanent from the perspective of maintaining flexibility and control for local needs. Additionally, the pipeline option would be burdened with significant operations and maintenance costs, and would likely be fraught with the same stability issues in the Eel River canyon which plagued the railroad. The watershed transfer option would create an upstream out-of-basin transfer on the Mad River which would likely cause adverse impacts to the Mad River watershed.

7) Available Water Supply

The District has 40 to 50 million gallons per day (MGD) of untreated water available year-round. This is equivalent to 45,000- 56,000 acre-feet/year.

It is not likely that there will be one water-use option available which "uses" the available water supply similar to the situation when the District served the two pulp mills. The final outcome is likely to rely on a suite of water-use options.

To determine the volume of water available for a specific water-use proposal under options "b"(transfer to another public agency) or "c" (dedicating a portion for in-stream flows), the District will be very protective of local interests – both long-term municipal water supply needs, as well as any new commercial, industrial, agricultural or aquaculture needs.

The volume available for a longer-term use will be established in the context of the proposed use as well as proposed term. The District would generally be willing to offer a larger volume for a shorter term, but would limit the volume available for longer-terms so as to protect local interests. There may be opportunities to consider unique packages – for example combinations of short-term and long-term contracts (especially for option "b" – transfers to another public agency). Such packages would protect the water supplies needed to meet local demands (option "a") in a manner that is consistent with long-term, sustainable use of water in Humboldt County.

For option "b" (transfers to another public agency) and option "c" (dedicating a portion for in-stream flows), the District suggests consideration and evaluation of the feasibility, costs, benefits, and effects in discrete increments – say 5, 10 or 20 MGD. For option "b" (transfers to another public agency), the District will also pay particular attention to urban water conservation activities by that agency and, if appropriate, that agency's plans for environmental restoration measures.

8) Purpose of this Plan and How it Will be Used

The purpose of this Plan is to guide evaluation of the recommended water-use options and to define activities to advance, and hopefully pursue, a suite of options.

It is important that the District have such a plan to share with the State Water Resources Control Board and the Department of Water Resources (via the District's Urban Water Management Plan). It is also important with respect to continuing to build local and regional alliances to support eventual implementation.

The California Environmental Quality Act (CEQA) requires that all public agencies evaluate the potential effects on the environment of their discretionary activities before they undertake those activities. The District is still in the process of evaluating and formulating which project(s) may be a part of a final plan it intends to implement. Such preliminary planning needed to develop projects does not trigger the requirement to prepare an environmental analysis under CEQA, particularly where, as here, the District is committed to conducting a CEQA analysis of any project before proceeding.

Evaluation, and eventual pursuit, of water-use options which substantively increase the use of HBMWD's available water will be challenging and take time. Fortunately, in the absence of a third-party challenge, the District has time. Its water right permits do not expire until 2029. That being said, the District should address this matter expeditiously for several reasons:

- Revenues are necessary to offset the current municipal customer and ratepayer burden of shouldering the entire cost of the regional water system, as well as to fund costly infrastructure replacement projects which must be done soon to maintain the reliability and integrity of the regional system;

- The community – both public who participated in the planning process as well as stakeholder groups – better understand the issue and are supportive of what we are doing;

- It will take time to effectuate an increase in water use (unless a pulp-mill equivalent opportunity presents itself locally, which is not likely). It will likely take:
    - one-to-two years to complete preliminary studies;
    - three-to-five years to complete the necessary environmental studies pursuant to the California Environmental Quality Act (CEQA) and to obtain permits, including approval from the State Water Resources Control Board to change the District's water rights permits (which will be required for options b and c);
    - two-to-three years to obtain financing and implement a "project".

  In summary, it will likely take six to ten years to achieve an increase in water use, unless a new water-intensive business decides to locate within the District's service territory.

Activities defined in this plan are intended to guide consideration, evaluation, and eventual pursuit, of the recommended water-use options. The process the District envisions going forward is generally as follows:

1) Raise awareness of the District's situation – and the associated opportunity – and garner support, first locally, and then on an expanded scale.

2) Identify and pursue partners and resources to support and fund initial studies – whether market potential, economics, logistics, or environmental.

3) Conduct reconnaissance-level studies to assess the economic and environmental feasibility of specific options (especially options "b" and "c").

4) Based on the outcomes of the reconnaissance studies, define potential projects, or if necessary, in-depth studies (which the District intends would be primarily funded by interested parties)

5) Define specific project(s) and begin implementation activities:
    a. Pursue financing or funding partners;
    b. Develop and execute MOUs and/or contracts;
    c. Complete environmental studies (pursuant to CEQA);
    d. Petition the State Water Resources Control Board to change the District's water rights permit (required for options "b" and "c" and possibly some local water uses via option "a")
    e. Obtain permits;

During this next phase of Water Resource Planning work, the District will continue to provide numerous opportunities for stakeholder and community input, both formally (via public hearings) and informally like the District did during the community-planning phase.

9) Implementation Activities to Advance Top-Tier Options

9.1 Activities Common to All Options

9.1.1 Communication

Schedule briefings with local legislative representatives, agencies, stakeholders, tribes, and other parties who have an interest in the water-use options and/or may assist the District.

At the appropriate time, convene a series of "initial discussions" with key parties outside of Humboldt County to share: what we are trying to accomplish and why; water-use options under consideration; and for option "b" (transport) the process by which we will undertake consideration (e.g. issuance of an RFP vs. bilateral discussions vs. other process).

How the District communicates needs to be carefully crafted so as to protect the District and local interests, and preserve the process the District wishes to go through. This is especially true for consideration of options "b" and "c".

9.1.2 Identify Resources to Support Evaluation

Table 1 presents potential partners with whom the District should consult, and potential grant programs the District should explore to support evaluation of the water-use options.

Table 1 – Potential Partners and Resources	
Option A: **Local Sales**	What support can local economic development professionals/organizations or the business community provide? Potential grant programs: • Headwaters Fund • Economic development programs • Dept of Labor programs
Option B: **Transport to another Municipality outside District**	What support can the Harbor District, proponents of Short-Sea Shipping, local business, or economic development organizations provide? Potential grant programs: • Headwaters Fund • Economic development programs (e.g. EDA) • Dept of Labor programs • Harbor or maritime programs • Department of Water Resource programs
Option C: **Dedicating a portion of available water for in-stream flows**	What support can Resource Agencies (NOAA-Fisheries, CDF&G, USF&WS, USFS), Humboldt State University, California Cooperative Fish & Wildlife Research Unit (at HSU), CalTrout or Blue Lake Rancheria provide? Potential grant programs: • DFG's Fisheries Restoration Grant Program • NOAA-Fisheries grant programs • Coastal Conservancy • Humboldt Area Foundation

9.1.3 Public Involvement

The District will continue to solicit input from the public and stakeholder groups over the coming years as consideration and evaluation of the water-use options advance. At some point in the future, the District may initiate another community-focused education and outreach effort, similar to that which occurred in 2008-09, but with a focus on implementation activities.

Additionally, the Board of Directors will accept public comments and input at numerous regular Board meetings as well as formal public hearings.

9.2 Subsequent Activities for each Option

Proposed implementation activities have been defined for each water-use option. They are organized into three time periods as follows:

- Short-term: Actions the District intends to take between March and December, 2011
- Medium-term: Actions the District intends to take between 2012 and 2015
- Long-term: Actions the District intends to take – and outcomes it hopes to achieve – in 2015 and beyond

Actions defined in the medium and long-term categories will be shaped and adjusted based on outcomes of prior-period work.

The proposed actions are presented in the following Implementation Matrix for each time period.

Options	Short Term Actions (March – December, 2011)
N/A – Activities Necessary for all	❖ Coordinate discussion of Urban Water Management Plan requirements with proposed water-use options ❖ Capital Improvement Plan o Finalize CIP to identify revenue requirements over time o Evaluate potential increase in water rates to support capital replacement projects o Identify revenues needed from outside sources to enable District to issue bonds for needed replacements
<u>Option A:</u> Local Sales	❖ Write letter to retail water agencies in Humboldt County re: availability of water ❖ Write letter to local economic development organizations and Chambers of Commerce re: availability of water ❖ Initiate awareness campaign (including the media) ❖ Raise awareness and consult with regional and State organizations. Examples include: Farm Bureau or another agricultural organization; Ranchers, ACWA, Redwood Regional League of California Cities; and Upstate California.
<u>Option B:</u> Transport to another Municipality outside District	❖ Conduct a reconnaissance study to determine the feasibility of marine-based transport of water from Humboldt Bay. Determine volume capability, approximate time of travel to potential California markets, and a preliminary estimate of transportation costs. ❖ Develop a "term sheet" which outlines criteria under which the District would be willing to transfer water, e.g.: o Minimum price o Term (minimim/maximum) o Volume (minimum/maximum) o Water conservation standards (e.g., meet new 20% x 2020 requirements) o Environmental standards (e.g., addressing groundwater overdraft or providing fisheries benefits) ❖ Identify public agencies that have a need for additional water (e.g., those considering desalinization or suffering from reduced supply reliability) ❖ Initiate preliminary discussions with several (approximately three to five) potential purchasers for a combined total of 20 - 40 MGD

Options	Short Term Actions (March – December, 2011) Continued
Option C: **Dedicating a portion of available water for in-stream flows**	❖ Complete a Fisheries Restoration Program Grant (FRPG) application to establish a process and develop a plan that explores and evaluates the transfer of a portion of the District's available water (e.g., 20 - 40 MGD, like in option B) for environmental benefit in the Mad River and estuary. (Note – This grant application was completed and submitted to the California Department of Fish and Game in March 2011. If approved funding would not be available until mid- 2012.) ❖ Convene a series of "scoping workshops" with Resource Agencies and other knowledgeable parties to define: o the regulatory and permitting requirements of an instream flow option; o potential benefits of a water transfer to the Mad River; o potential adverse biological or physical impacts of such a transfer; o beneficial or adverse effects to the estuary, and o studies that would need to be done to determine benefits and effects. ❖ Define District Operations and what that "Means for the River" o Post-construction of HBMWD's regional water system, and operation with one or two mills (which is the operating mode addressed in the District's Habitat Conservation Plan) o Potential changes in flow release operations and bypass flows. Develop these such that they relate to species of interest and their life cycle stages. Consider: • late fall/early winter when Ruth is filling; • winter, and most often spring, when Ruth Lake is full and spilling (note – operational changes are not possible at this time); • summer and fall – can consider: o additional increment every day vs. o additional increment at certain times for certain duration

Options	Medium-Term Actions (2012-2015)
Option A: **Local Sales**	❖ Continue conversations with local economic development agencies/resources (but recognize not likely to "bear fruit") ❖ Assess likely effectiveness of advertising the availability of water in trade journals, the newspaper or via the internet ❖ Begin conversations with interested parties/stakeholders regarding additional use of water ❖ If nothing appears to be materializing, assess likely effectiveness and cost of a "business attraction" effort. If District decides to proceed, partner with appropriate agencies and organizations
Option B: **Transport to another Municipality outside District**	❖ Negotiate MOU(s) with one or more purchasers for feasibility and environmental studies (it is the District's intent that interested parties would pay for most if not all of the study costs) ❖ Complete feasibility study for transfer(s) which assesses viability, economics and environmental effects ❖ Depending on outcomes: o initiate environmental document and permitting activities o negotiate additional MOU(s) or option contract(s)
Option C: **Dedicating a portion of available water for in-stream flows**	❖ Complete activities defined in and funded by FRGP grant, and develop an Instream Flow Option Study Plan ❖ Create a Technical Review/Advisory Team and staff it with the appropriate resource specialties based on the outcomes of the assessment work and recommended studies in the Instream Flow Option Study Plan ❖ Apply for another FRGP grant (or secure other funding) to conduct the necessary studies and assessment work ❖ Conduct studies and assessment work and determine conclusions, outcomes and recommendations ❖ Based on outcomes, if enhancement or restoration activities on the Mad River are feasible: o negotiate an MOU with Resource Agencies or other appropriate parties to define preferred approach o explore potential and seek revenues for a transfer of water for in-stream purposes o initiate environmental document and permitting activities

Options	Long-Term Actions (2015 plus)
All	❖ Coordinate discussion of Urban Water Management Plan with water use options ❖ During this time period, the District intends to put up to 50 MGD of water to "beneficial use" pursuant to its water rights permits. The options below present possible ranges of water use, the total of which will not exceed 50 MGD.
Option A: **Local Sales**	❖ Continue medium-term actions ❖ Develop new demands for raw water: o 5 MGD by 2020 o 10 MGD by 2029 (Note - these demands reduce the amount of water that would be transferred via Options B and C)
Option B: **Transport to another Municipality outside District**	❖ Finalize environmental documents and permitting activities (resulting in issuance of permits for transfers) ❖ Execute transfer agreement(s) ❖ Issue bonds/other financial instruments based on revenues from water transfer(s) ❖ Construct necessary infrastructure ❖ Initiate transfers (pending status of local sales, goal is to transfer up to 40-50 MGD, this quantity in concert with environmental transfer pursuant to Option C) ❖ Continue transfers through SWRCB license period: o through 2035 for State Water project contractors o through 2045 for Central Valley Project contractors
Option C: **Dedicating a portion of available water for in-stream flows**	❖ Finalize environmental documents and permitting activities (resulting in issuance of permits for transfers) ❖ Initiate transfer (pending status of local sales, goal is to transfer 40-50 MGD, this quantity in concert with transfer pursuant to Option B) ❖ Continue transfers through SWRCB license period and probably for some period beyond 2029

Appendix D

STATE OF CALIFORNIA
STATE WATER RESOURCES CONTROL BOARD

ORDER WRO - 2004 - 0038

In the Matter of Permits 11714 and 11715
Regarding Diversions by
HUMBOLDT BAY MUNICIPAL WATER DISTRICT

SOURCE: Mad River

COUNTIES: Humboldt and Trinity

ORDER APPROVING AN EXTENSION OF TIME AND PARTIAL REVOCATION OF PERMITTED WATER RIGHTS

BY THE BOARD:

1.0 BACKGROUND

Permits 11714 and 11715 were issued to the Humboldt Bay Municipal Water District (District) on March 16, 1959, pursuant to water right applications 16454 and 17291, respectively. These permits allow diversion to storage of up to 120,000 acre-feet per annum (afa), plus direct diversion of up to 200 cubic feet per second (cfs). At present, the District has developed a reservoir storage capacity of 48,030 acre-feet (af) in Ruth Lake, and has diversion capacity of 116 cfs at the community of Essex on the Mad River. These facilities and capacities constitute Phase I of the District's project. The remaining diversion and storage capacities allowed by the permits, presently undeveloped, constitute Phase II of the project.

Permits 11714 and 11715 were subsequently amended three times to add additional time to allow full development of the water allowed to be beneficially used under the two permits. These time extensions, for ten years each, were granted on April 29, 1971; July 7, 1982; and March 2, 1992. The last time extension required the District to fully develop its water rights by December 31, 2002.

On March 18, 2002, the District filed a Petition for Extension of Time (Petition) for an additional ten years to complete development of its rights. By letter of June 20, 2002, the District requested the time extension be granted for 25 years, instead of ten years.

The State Water Resources Control Board (SWRCB) provided the public notice of the Petition on July 22, 2002. No protests to the proposed action were received.

The District has recognized that Phase II will not be developed for several decades, if ever, and will require preparation of an Environmental Impact Report prior to development, as part of the petition process. Therefore, as part of its Petition for Extension of Time, the District Board of Directors also approved submittal of a request that the SWRCB revoke authorization of Phase II of its project, thus limiting the scope of the Petition to the present facilities and capacities (combined direct diversion and storage of 132,030 afa). The District submitted this request on April 30, 2004. The District also submitted substantial evidence in support of its contention that Phase I could be developed to full beneficial use within the next 25 years.

In accordance with the California Environmental Quality Act, the District, as lead agency, has completed and certified a Mitigated Negative Declaration in connection with the proposed project. The SWRCB received no comments or protests to the proposed action.

2.0 DISCUSSION

Approval of Petitions for Extension of Time is normally delegated to the Chief of the Division of Water Rights (SWRCB Resolution No. 2002—0106, section 2.6.11), except when the requested period of extension, combined with all extensions previously granted under delegated authority, exceeds 25 years (section 2.6.11(c)(2)). The District has already been granted time extensions totaling 30 years, and is requesting an additional 25-year time extension. Therefore, the SWRCB must approve any additional extension of time for these permits.

2.1 Applicable Law

Water Code section 1396 requires a permittee to prosecute project construction and beneficial use of water with due diligence, in accordance with the Water Code, the SWRCB's regulations, and the terms specified in the permit. The SWRCB may approve a request for an extension of time if the SWRCB finds that there is good cause for the extension. (Wat. Code § 1398, subd. (a).) The SWRCB's regulations allow an extension of time to be granted only on such conditions as the SWRCB determines to be in the public interest, and on a showing to the SWRCB's satisfaction that (1) due diligence has been exercised, (2) failure to comply with previous time requirements has been occasioned by obstacles which could not reasonably be avoided, and (3) satisfactory progress will be made if an extension of time is granted. (Cal. Code Regs., tit. 23, § 844.) The SWRCB generally will not accept conditions incident to the person and not to the enterprise as good cause for delay. (Ibid.) After a hearing on a petition for an extension of time, the SWRCB may revoke the permit. (Wat. Code § 1398, subd. (b); § 1410, subd. (a) – (b)(1).)

2.1.1 Due Diligence

The District completed construction of the major Phase I components of its project within four years of the issuance of the permits.

2.1.2 Obstacles

Water usage in the District has developed at a slower rate than originally anticipated, particularly following the closure of a pulp mill near Eureka that had used a substantial amount of water for processing wood pulp. While in past years, prior to 1992, the District has diverted as much as 75,000 afa, it is currently using about 30,000 afa. The pulp mill closed, and the use of water was reduced for reasons beyond the District's control. The District has taken all actions within its power to put the water to reasonable and beneficial use.

2.1.3 Satisfactory Progress

The District has identified several municipal development projects within the authorized place of use of these permits. These projects are in various stages of authorization and development. The District anticipates that these developments will be served with water from Phase I of its project. (see Wat. Code § 106.5.)

3.0 FINDINGS

1. The permittee (District) has proceeded with due diligence, and good cause has been shown for an extension of time.

2. The SWRCB has determined that the petition for an extension of time neither constitutes the initiation of a new right nor operates to the injury of any other lawful user of water.

3. The permit conditions relating to the continuing authority and water quality objectives of the SWRCB should be updated to conform to Section 780 (a & b), Title 23 of the California Code of Regulations.

4. Fish, wildlife, and plant species have been or may be listed under the federal Endangered Species Act and/or the California Endangered Species Act. A condition should be added to the permits stating that the permits do not authorize any act that results in the taking of a threatened or endangered species.

5. The SWRCB is a responsible agency pursuant to the California Environmental Quality Act (CEQA). The SWRCB has considered the environmental effects of the Petition for Change as described by the petitioner in the Mitigated Negative Declaration prepared for this project. The proposed mitigation measures will reduce any potential impacts of the continued operation of Phase I of the project to less than significant levels.

6. The SWRCB has determined that the partial revocation of the District's water rights is consistent with a reasonable expectation of future demand in the District's place of use.

ORDER

IT IS HEREBY ORDERED THAT PERMITS 11714 AND 11715 ARE AMENDED AS FOLLOWS:

1. Condition 4 of the permits shall be deleted. Condition 5 shall be amended to read:

Construction work and complete application of the water to the authorized use shall be prosecuted with reasonable diligence and completed by December 31, 2029.

(0000009)

2. The continuing authority condition shall be updated to read as follows:

Pursuant to California Water Code sections 100 and 275 and the common law public trust doctrine, all rights and privileges under this permit and under any license issued pursuant thereto, including method of diversion, method of use, and quantity of water diverted, are subject to the continuing authority of the SWRCB in accordance with law and in the interest of the public welfare to protect public trust uses and to prevent waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion of said water.

The continuing authority of the SWRCB may be exercised by imposing specific requirements over and above those contained in this permit with a view to eliminating waste of water and to meeting the reasonable water requirements of permittee without unreasonable draft on the source. Permittee may be required to implement a water conservation plan, features of which may include but not necessarily be limited to: (1) reusing or reclaiming the water allocated; (2) using water reclaimed by another entity instead of all or part of the water allocated; (3) restricting diversions so as to eliminate agricultural tailwater or to reduce return flow; (4) suppressing evaporation losses from water surfaces; (5) controlling phreatophytic growth; and (6) installing, maintaining, and operating efficient water measuring devices to assure compliance with the quantity limitations of this permit and to accurately determine water use as against reasonable water requirements for the authorized project. No action will be taken pursuant to this paragraph unless the SWRCB determines, after notice to affected parties and

opportunity for hearing, that such specific requirements are physically and financially feasible and are appropriate to the particular situation.

The continuing authority of the SWRCB also may be exercised by imposing further limitations on the diversion and use of water by the permittee in order to protect public trust uses. No action will be taken pursuant to this paragraph unless the SWRCB determines, after notice to affected parties and opportunity for hearing, that such action is consistent with California Constitution article X, section 2; is consistent with the public interest; and is necessary to preserve or restore the uses protected by the public trust.

(0000012)

3. The water quality objectives condition shall be updated to read as follows:

The quantity of water diverted under this permit and under any license issued pursuant thereto is subject to modification by the SWRCB if, after notice to the permittee and an opportunity for hearing, the SWRCB finds that such modification is necessary to meet water quality objectives in water quality control plans which have been or hereafter may be established or modified pursuant to Division 7 of the Water Code. No action will be taken pursuant to this paragraph unless the SWRCB finds that: (1) adequate waste discharge requirements have been prescribed and are in effect with respect to all waste discharges which have any substantial effect upon water quality in the area involved, and (2) the water quality objectives cannot be achieved solely through the control of waste discharges.

(0000013)

4. Permits 11714 and 011715 shall be amended to include the following Endangered Species condition:

This permit does not authorize any act which results in the taking of a threatened or endangered species or any act which is now prohibited, or becomes prohibited in the future, under either the California Endangered Species Act (Fish and Game Code sections 2050 to 2097) or the federal Endangered Species Act (16 U.S.C.A. sections 1531 to 1544). If a "take" will result from any act authorized under this water right, the permittee shall obtain authorization for an incidental take prior to construction or operation of the project.

Permittee shall be responsible for meeting all requirements of the applicable Endangered Species Act for the project authorized under this permit.

(0000014)

5. Paragraph 1 of Permit 11714 is deleted in its entirety, and the following term is substituted:

The amount of water to be appropriated shall be limited to the amount that can be beneficially used and shall not exceed 48,030 afa by storage, to be collected from October 1 of each year to April 30 of the succeeding year. The maximum amount per annum to be stored under this permit and Permit 11715 shall not exceed 48,030 afa. The total annual diversion and use allowed under this permit and Permit 11715 shall not exceed 132,030 afa.

(0000005)

6. Term 1 of Permit 11715 is deleted in its entirety, and the following term is substituted:

The amount of water to be appropriated shall be limited to the amount that can be beneficially used and shall not exceed 116 cfs by direct diversion, year-round, and 20,000 afa by storage, to be collected from October 1 of each year to April 30 of the succeeding year. The maximum amount to be appropriated by direct diversion under this permit shall not exceed 84,000 afa. The maximum amount per annum to be stored under this permit and Permit 11714 shall not exceed 48,030 afa. The total annual diversion and use allowed under this permit and Permit 11714 shall not exceed 132,030 afa.

(0000005)

7. All other conditions of Permits 11714 and 11715 are still applicable.

CERTIFICATION

The undersigned Clerk to the Board does hereby certify that the foregoing is a full, true, and correct copy of an order duly and regularly adopted at a meeting of the State Water Resources Control Board held on August 26, 2004.

AYE: Peter S. Silva
Richard Katz
Gary M. Carlton

NO: None.

ABSENT: Arthur G. Baggett, Jr.
Nancy H. Sutley

ABSTAIN: None.

Debbie Irvin
Clerk to the Board

STATE OF CALIFORNIA—STATE WATER RIGHTS BOARD

PERMIT TERMS

Application No. 17291 Filled out by JTH Date 2/4/59

This is to certify that the application of which the foregoing is a true and correct copy has been considered and is hereby approved SUBJECT TO VESTED RIGHTS and the following limitations and conditions:

1 ~~2~~. The amount of water appropriated ~~under permit issued pursuant to Application 17291~~ shall be limited to the amount which can be beneficially used and shall not exceed 200 cubic feet per second by direct diversion, year-round, and 20,000 acre-feet per annum by storage to be collected from about October 1 of each year to about April 30 of the succeeding year.

2 ~~3~~. The maximum amounts herein stated may be reduced in the licenses if investigation so warrants.

3 ~~4~~. Actual construction work shall begin on or before December 1, 1960, and shall thereafter be prosecuted with reasonable diligence, and if not so commenced and prosecuted, these permits may be revoked.

4 ~~5~~. Said construction work shall be completed on or before July 1, 1967.

5 ~~6~~. Complete application of the water to the proposed use shall be made on or before July 1, 1970.

6 ~~7~~. Progress reports shall be filed promptly by permittee on forms which will be provided annually by the State Water Rights Board until license is issued.

7 ~~8~~. All rights and privileges under these permits including method of diversion, method of use, and quantity of water diverted are subject to the continuing authority of the State Water Rights Board in accordance with law and in the interest of the public welfare to prevent waste, unreasonable use, unreasonable

8 ~~8~~. For the protection, propagation and preservation of fish life permittee shall:

a. At all times by-pass or release minimum flow of five cubic feet per second into the natural stream bed of Mad River immediately below Ruth Dam.

b. During the periods herein specified, by-pass or release into the natural stream bed of Mad River immediately below Essex Diversion Dam the following minimum flows or the natural flow of Mad River as regulated by diversions now in existence, whichever is less:

October 1 through October 15	30 cfs
October 16 through October 31	50 cfs
November 1 through June 30	75 cfs
July 1 through July 31	50 cfs
August 1 through August 31	40 cfs
September 1 through September 30	30 cfs

9 ~~10~~. ~~These permits are~~ This permit is subject to the Memorandum of Understanding between Humboldt Bay Municipal Water District and County of Trinity, drafted on January 28, 1959, and duly approved by both agencies and on file with the State Water Rights Board.

deleted request & pson

~~10. A separate application for the approval of plans and specifications for construction of the dam shall be filed with and approved by the Department of Water Resources prior to commencement of construction of the dam described under this approved water right application.~~

The equivalent of such continuous flow allowance for any thirty day period may be diverted in a shorter time if there be no interference with vested rights.

2. The maximum amount herein stated may be reduced in the license if investigation so warrants.

3. Actual construction work shall begin on or before _____ and shall thereafter be prosecuted with reasonable diligence, and if not so commenced and prosecuted, this permit may be revoked.

4. Said construction work shall be completed on or before _____

5. Complete application of the water to the proposed use shall be made on or before _____

6. Progress reports shall be filed promptly by permittee on forms which will be provided annually by the State Water Rights Board until license is issued.

7. All rights and privileges under this permit including method of diversion, method of use and quantity of water diverted are subject to the continuing authority of the State Water Rights Board in accordance with law and in the interest of the public welfare to prevent waste, unreasonable use, unreasonable method of use or unreasonable method of diversion of said water.

MINIMUM FEE $5.00 FOR ALL PERMITS

~~IRRIGATION~~ Municipal			~~POWER~~		
SCHEDULE	ACRES	CHARGE	SCHEDULE	THEO. HORSE POWER	CHARGE
0 to 50 COVERED BY MINIMUM FEE	0	$5.00	0 to 50 COVERED BY MINIMUM FEE		$5.00
Over 50 to 100 @ 10¢			Over 50 to 100 @ 10¢		
Over 100 to 1000 @ 5¢			~~Over 100 to 1000 @ 5¢~~		
Over 1000 @ 3¢			Over 1000 @ 1¢		
TOTALS	0	$5.00			

Terms OK. L. W. Carter

Permit No. 11715

Date approved 3-16-59

FORM O-13 (REV.)
67148 12-57 1M ① SPO

Appendix E

04-1055-03.090

HUMBOLDT BAY MUNICIPAL WATER DISTRICT
GROUNDWATER MANAGEMENT PLAN

April 2006

Prepared for:
Humboldt Bay Municipal Water District
P.O. Box 95
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(707)443-5018

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WINZLER & KELLY
CONSULTING ENGINEERS
633 Third Street
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HUMBOLDT BAY MUNICIPAL WATER DISTRICT
GROUNDWATER MANAGEMENT PLAN

1.0 INTRODUCTION

The Humboldt Bay Municipal Water District (HBMWD) received a Local Groundwater Management Assistance Act grant from the California Department of Water Resources to study the groundwater supplying the HBMWD system, and to create a Groundwater Management Plan (GWMP) for the Mad River Basin. The Groundwater Management Act, California Water Code, Part 2.75, §10753, also known as Assembly Bill 3030 (AB 3030), provides public agencies with the authority to prepare groundwater management plans. The intent of AB3030 is to promote cooperative management of groundwater resources by local agencies and stakeholders within groundwater basins. In recognition of the importance of the groundwater resources to the overall water supply needs of water users and land owners in the Mad River region, the District's Board of Directors authorized the preparation of a GWMP with Resolution 2005-3, which was passed at an advertised public hearing in March 2005.

1.1 Groundwater Management Plan Scope

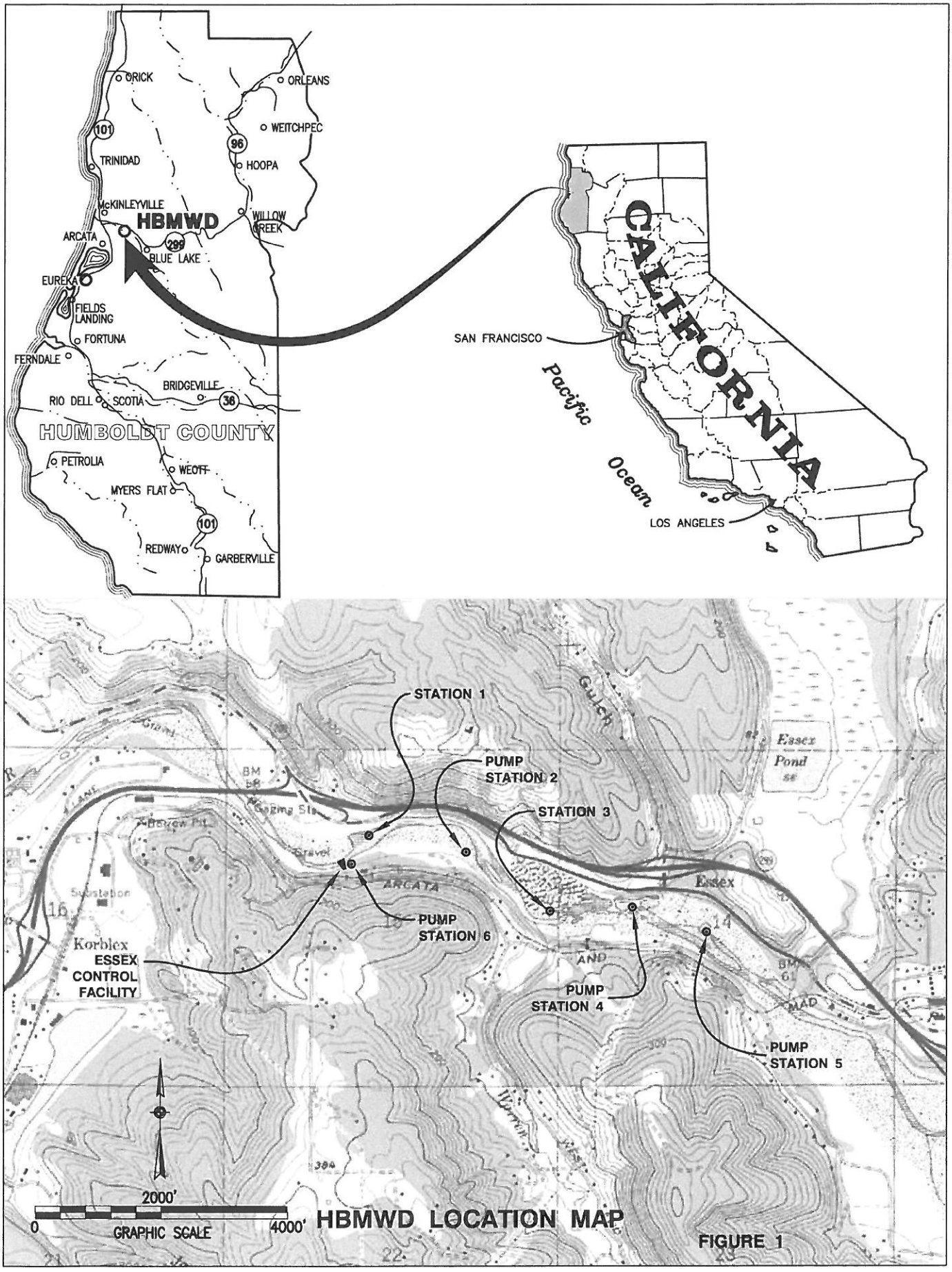
The scope of this GWMP addresses groundwater management issues impacting groundwater extraction in the Lower Mad River Area, in particular, the groundwater basin used by HBMWD. A large portion of Humboldt County's population uses groundwater from the Mad River Basin, mainly through HBMWD's system. This GWMP addresses specific issues as requested by AB 3030 as well as other issues relevant to the area. To address this groundwater management issues and develop management strategies, this document:

- Gives a brief background of the District
- States the goals of the GWMP
- Characterizes the Mad River Basin and Sub-basins sub-surface hydrology
- Presents a basin map
- Discusses a conceptual hydrogeologic model
- Discusses a numerical groundwater model
- Summarizes the groundwater management issues required by law and assesses the relevance to the Mad River Basin
- Presents five groundwater management strategies

1.2 District Background

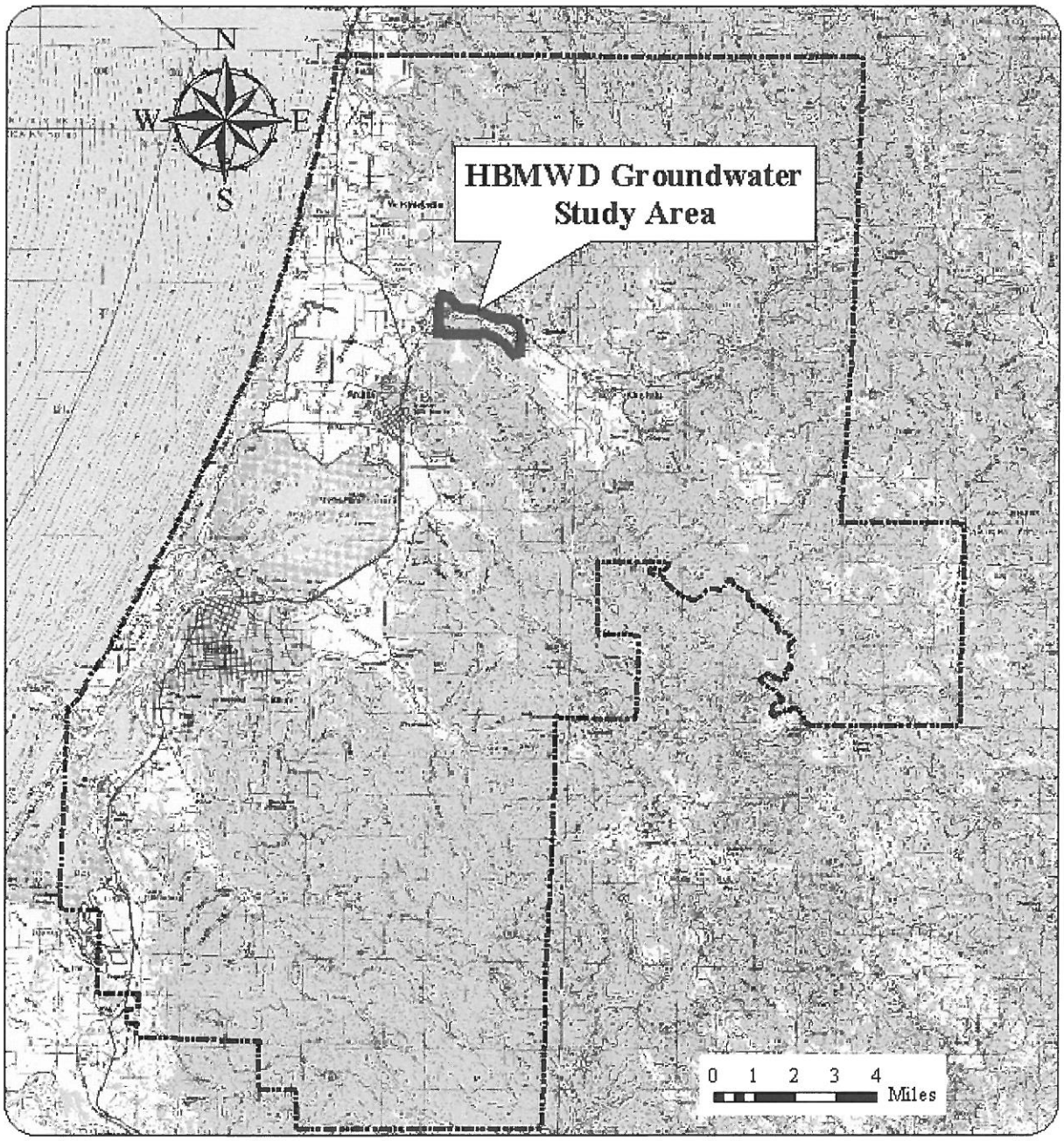
Humboldt Bay Municipal Water District produces water from four Ranney wells located near the District's Essex Control Center on the Mad River in Arcata. The location of HBMWD Essex Control Center facility and the Ranney wells are shown in Figure 1. The active Ranney wells are labeled Pump Stations 1 through 4. Also shown are Pump station 5 and 6. Pump Station 5 is a mothballed Ranney well that is not is production and Pump Station 6 is a raw water surface diversion. Up to 21 million gallons per day (MGD) is pumped from the Holocene River Deposits that underlie the Mad River channel. The HBMWD facilities provide water to the communities of McKinleyville, Arcata, Eureka, Manila, Blue Lake, Fieldbrook, Cutten, Samoa, Fairhaven, and the Humboldt Community Service District. The District was established in 1956 to provide domestic and industrial water for the area and includes the most heavily populated and developed

parts of the county. Based on data for the Census tract making up the District's service area (shown in Figure 2), the 2000 population of the District was approximately 75,911 or 60% of the population of Humboldt County. The projected population growth for the county has been estimated at 0.4% annually through the year 2030, which would yield a District population of 85,569 in 2030.



HBMWD LOCATION MAP

FIGURE 1



Map of Humboldt Bay Municipal Water District Boundary

Legend

District Boundary

Groundwater Study Area

Figure 2

1.3 Authority

The Groundwater Management Act, allows any local public agency which provides water service to all or a portion of its service area and whose service area includes all or a portion of a groundwater basin to adopt programs to manage groundwater. The law contains 12 components which may be included in a groundwater management plan. Each component may play some role in evaluating or operating a groundwater basin so that groundwater may be managed to maximize the total water supply while protecting the groundwater quality.

Having passed the Resolution to develop a Groundwater Management Plan, the District is authorized to adopt rules and regulations to implement and enforce the Groundwater Management Program.

2.0 GROUNDWATER BASIN PLAN OBJECTIVE AND GOALS

The HBMWD provides potable water for domestic and business use, through seven municipalities, to approximately 60% of the population in Humboldt County. The District also supplies untreated raw water to local industrial customers. The objective of this Groundwater Management Plan is to provide a plan for ensuring a reliable, long term, cost efficient, high quality water supply for HBMWD customers and other water users in the area. Additional inherent objectives of preventing inelastic land surface subsidence and minimizing changes in surface water flow and quality are obtained through mandated releases from Matthews Dam (see Section 4.1.8). To accomplish this objective the District intends to evaluate and implement programs which will meet the following goals:

- Improve understanding of basin hydrology
- Understand interactions between Ranney collectors and influence of pumping on turbidity
- Preserve and enhance the reliability of groundwater resources of the area.
- Ensure the long-term availability of high quality groundwater

3.0 MAD RIVER GROUNDWATER BASIN

The Mad River Groundwater Basin is located in the North Coast Hydrologic Region of California in Humboldt County. The Mad River Groundwater Basin is the principal groundwater basin in the Eureka area and consists of two sub-basins, Mad River Lowland (1-8.01) and Dows Prairie (1-8.02), as defined by the Department of Water Resources.

3.1 Climate

Humboldt County has moderate temperatures and considerable precipitation. Temperatures along the coast in July are usually in the 60's and vary only 10 degrees from summer to winter, although a greater range is found over inland areas. Temperatures of 32 degrees or lower are experienced nearly every winter throughout the area, and colder temperatures are common in the interior. Maximum readings for the year often do not exceed 80 on the coast, while 100 degree plus readings occur frequently in the mountain valleys.

Rainfall is commonly experienced each month of the year, although amounts are negligible from June through August. About 90 percent of the seasonal total rainfall falls in the seven months from October through April. Most of this is associated with storm fronts that move in from the Pacific Ocean. There are few thunder showers in the mountains during the summer, but they are not frequent. Seasonal totals average about 40 inches near Eureka, and exceed 100 inches in the zones of heavy precipitation. Rainfall in Trinity County, where the District operates the R.W. Matthews Dam, averages 70 inches of rainfall per year. The average relative humidity is high due to large amounts of moisture and moderate temperatures. Due to the proximity of the Pacific Ocean, the coastal area has a cool, stable temperature regime. The marine influence is less pronounced as distance from the ocean increases, and inland areas experience wider variations of temperature and lower humidity.

3.2 Basin Hydrology

3.2.1 Mad River Lowland Sub-basin Hydrology (1-8.01)

The Mad River Lowland Sub-basin includes the coastal floodplain from the Freshwater Fault north to the Mad River and the elevated terrace areas to the east, as shown in Figure 3. The basin is bounded by Arcata Bay to the south, the Mad River to the north, and mountains to the east, as shown in Figure 3. The basin also includes Blue Lake Valley to the east. Between Mad River and Arcata Bay, the coastal plain is dissected by flood stage channels of the Mad River that are 15- to 20-feet deep. The Mad River discharges to the ocean approximately 5 miles north of Arcata Bay and is tidal for about 1 mile inland (DWR 2003).

The Mad River Groundwater Basin in the Blue Lake Valley and in the Mad River floodplain is composed of alluvium and is underlain by the Hookton Formation. Sand dunes are present along the coastline edge of the basin. The upland areas to the north and east are above the alluvium of the river floodplain and are comprised solely of the Hookton Formation. The entire basin area is underlain by bedrock. Seawater intrusion has occurred in the shallow aquifers near the ocean and bay areas. However, seawater is not present to any appreciable extent landward of the coastline (DWR 2003).

3.2.1.1 Geology

There are 5 identified water bearing units in the Mad River Lowland Sub-basin. The aerial extent of each hydrologic unit is shown on the Mad River Basin Map in Figure 3. A summary of these formations is found in Table 1.

Holocene Dune Sand

The Holocene Dune Sand is a marine shoreline and aeolian deposit formation and is shown in orange in Figure 3, and identified with the label "Qd". It consists of gravel and sand deposits on terraces, beaches, and dunes along current shorelines. Holocene Dune Sand represents an unconfined aquifer of unconsolidated materials recharged by rainfall, ocean, and locally by river underflow. Saltwater in this aquifer underlies freshwater due to slightly increased density of salt water. Disruption of this density difference by groundwater pumping may affect aquifer water quality. This aquifer is used locally in basin # 1-8.01 for minor agricultural operations drawing groundwater from shallow wells.

Holocene River Channel Deposits

The Holocene River Channel Deposits consists of clay, silt, sand, gravel and boulders deposited in stream beds terraces, flood plains, ponds, and soils formed on these deposits. It is shown in yellow in Figure 3 and identified with the "RC" label. This aquifer unit produces water of excellent quality and yield. It includes alluvial river channel deposits in excess of 100 feet in thickness, which constitutes the aquifer tapped by the HBMWD Ranney wells. Recharge to the unconfined Holocene River Channel Deposit aquifer is primarily from rivers (in channel areas) with recharge from rainfall in the Arcata Bottoms, and Arcata areas. The river channel deposits of the Mad River at Essex provide the main potable water supply for Eureka, Arcata, Blue Lake, McKinleyville, and surrounding communities.

Holocene Alluvium

Holocene Alluvium consists of clay, silt, sand, gravel and boulders in stream beds, terraces, flood plains, and ponds, and soils formed on these deposits exclusive of river channel deposits. It is shown in blue in Figure 3 and identified with the "Qal" label. Recharge to the unconfined Holocene alluvium aquifer is primarily from rainfall in the Arcata Bottoms, Arcata, Sunnybrae, and Bayside areas. The Holocene alluvium aquifer supplies groundwater primarily to agricultural wells.

Pleistocene Terrace deposits

Pleistocene Terrace Deposits consists of undifferentiated non-marine terrace dissected deposits and also typically include uplifted deposits of gravel, sand, silt, and clay deposited in fluvial settings. It is represented in pink and with the "Pt" label on Figure 3. It includes the marine terrace deposit of the Hookton Formation. Recharge to Pleistocene Terrace deposit unconfined aquifers is primarily by rainfall. Perched aquifers in the Pleistocene terrace deposits supply well water to some residences and agricultural operations. These aquifers may contribute flow to fluvial systems via springs.

Pleistocene Hookton Formation

The Pleistocene Hookton Formation is a marine terrace deposit typically uplifted, and consists of clay, sand, and some gravel deposited in nearshore marine (beach) settings. It is represented in red with a "Ph" label in Figure 3. The Hookton Formation is thought to underlie much of the surficial alluvium and soil between Arcata Bay and the Mad River. This formation is exposed in the hills north of Essex and in Blue Lake. The Hookton Formation supplies groundwater to wells serving residences and agricultural operations. Recharge to Hookton Formation unconfined aquifers is primarily by rainfall.

3.2.2 Mad River Dows Prairie Sub-basin Hydrology(1-8.02)

The Dows Prairie Sub-basin is located on the coast north of the Mad River Lowland Sub-basin and is bounded by Little River to the north and Mad River to the south, as shown if Figure 3. The sub-basin is bounded to the east by bedrock outcroppings. The sub-basin is part of an elevated terrace drained by several small creeks. Development of groundwater is primarily in the western portion of the sub-basin. The Hookton Formation is the main geologic unit in the area. The Franciscan Formation underlies the Hookton Formation and is essentially a non-water-bearing unit. (DWR 2003)

3.2.2.1 Geology

There is only one water bearing unit identified in the Dows Prairie Sub-basin. The aerial extent of this hydrologic unit is shown on the Mad River Basin Map in Figure 3.

Pleistocene Hookton Formation

The Pleistocene Hookton Formation was described in the previous section but it extends into the Dows Prairie sub-basin. The Hookton Formation is mapped by Evenson as occupying most of the area encompassed by basin # 1-8.02. The Hookton Formation supplies groundwater to a very few low yield wells serving residences and agriculture. Recharge to Hookton Formation unconfined aquifers is primarily by rainfall.

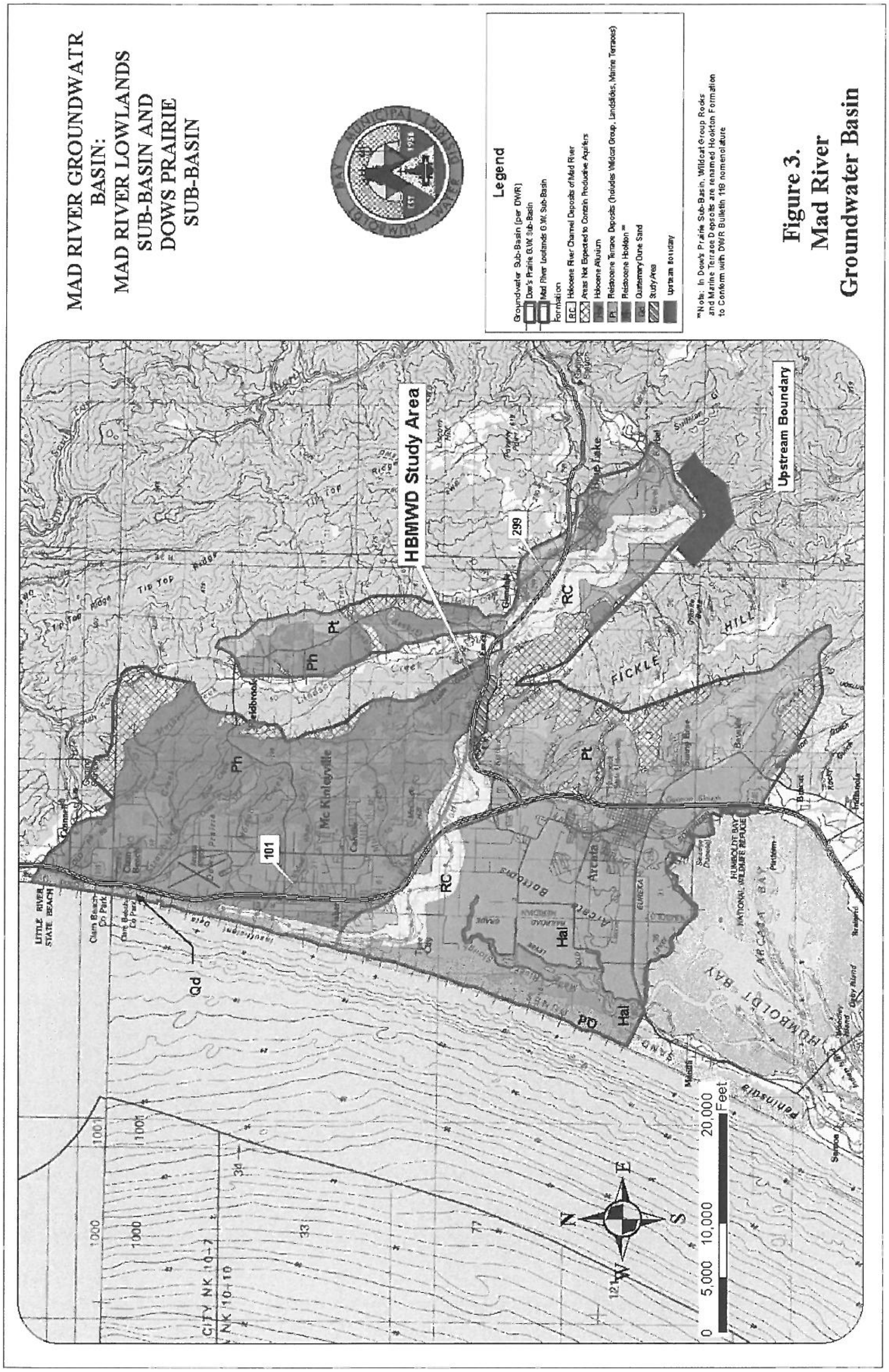


Figure 3.
Mad River
Groundwater Basin

Table 1. Summary of Hydrologic Units of Mad River Basin

Formation	Recharge Area	Production	Quality/Yield
Holocene Dune Sand	Local Precipitation	Domestic shallow wells	Variable
Holocene River Channel	Mad River	Municipal	Excellent
Holocene Alluvium	Mad River and Precipitation	Municipal and Domestic	Excellent
Pleistocene Terrace	Perched Water	Domestic wells	Variable
Pleistocene Hookton Formation 1-8.01	Upland Precipitation	Domestic wells	Fair
Pleistocene Hookton Formation 1-8.02	Precipitation	Domestic wells	Fair

3.2.3 Areas of the Mad River Basin Included in the Groundwater Management Plan

Based on the Authority, as outlined in Section 1.3 of this report, this GWMP seeks to focus the extent of management issues to areas related to the production of potable water by the HBMWD. While the GWMP evaluates and inventories the entire Mad River Basin, the management issues addressed in this GWMP are applicable only to hydrologic units and areas that are influenced by the operations of, or under the control of the HBMWD. The HBMWD study area includes the Holocene River Deposit from the upstream boundary where the Mad River crosses the basin boundary at the highest elevation to just below the Essex Control Center Facility. The study area is shown in Figure 3.

In areas outside of the GWMP study area, traditional water right, environmental, and water quality regulations apply. For traditional water rights, overlying landowners have a right to extract as much groundwater as they can put to beneficial use, and they do not need a water right permit from the State Water Resources Control Board. However, in regions such as California where water is scarce, groundwater supply may be insufficient to fully supply the requirements of all land owners. In these cases, the available supply must be equitably apportioned, and groundwater use is subject to management in accordance with court decrees adjudicating the groundwater rights within the basins. At this point there has been no adjudication of groundwater within the Mad River basin.

3.2.4 Groundwater Modeling

Effective management of groundwater systems requires a comprehensive knowledge of hydrologic processes, and effects of environmental conditions on water quality and quantity.

To evaluate these processes and conditions, a groundwater model was developed for the study area. The groundwater model was used as a management tool to assess existing and future conditions. Management scenarios included evaluation of: Impacts on the water table near the

Ranney wells due to pumping drawdown, down stream impacts on the Mad River due to pumping, determining maximum pumping rates from the system while maintaining water quality, and assessing the impacts of the interactions between production wells with respect to water quality, mainly turbidity.

In addition to simulating various groundwater management scenarios, the model results were used to evaluate impacts on the system. Model results were easily managed through a GIS interface which allowed for model result viewing and interpolation in conjunction with real time data.

As with any computer model, the results of a groundwater model are only as good as the information they use. Site and system information was compiled in a site conceptual model. Developing a detailed site conceptual model is essential to creating an accurate model. A detailed site conceptual model was created by spatially relating data from: site reconnaissance and investigations, field measurements, geophysics and geological assessment, and analysis of monitoring data. This information was then transformed to numerically represent the system. The model simulates the processes within the groundwater system to predict conditions, such as groundwater heads and velocity fields.

The construction of the site conceptual model for the Mad River basin near the Ranney wells was started based on an initial site investigation. This investigation included the evaluation of existing river, pumping, and water quality data, interviews with current system operators, the gathering climatic and flow data, and the analysis of aerial photos and maps.

The subsurface bedrock boundaries and site hydrologic conditions were defined based on geologic and geophysical investigations, including a seismic refraction study, and the installation of four new soil borings (groundwater monitoring wells). Data from the boring well logs for the new and existing soil borings was used to characterize the subsurface hydrogeology. Soil borings within the study area near the Ranney wells were converted to monitoring wells which are continually used to calibrate and validate the model.

To ensure meaningful results and predictive capability, a MODFLOW-based hydrologic modeling system, MODFLOW-SURFACT, was used. MODFLOW-SURFACT combines fully integrated hydrologic water quality subsurface flow and transport capabilities with GIS capabilities under a graphical user interface. MODFLOW-SURFACT was specifically designed to accurately simulate the interactions between surface and groundwater systems and achieve mass conservative results where simpler computer codes fail to produce mass conservative results.

MODFLOW uses the block-centered finite-difference approach to simulate groundwater flow. Fully or quasi 3-D simulations of confined and unconfined layers may be performed. MODFLOW-SURFACT provides an option for discretizing the domain using an axisymmetric geometry for efficient simulation of pumping tests, baildown/recovery tests, etc. External stresses normally allowed by MODFLOW include constant head, constant flux, areal recharge, evapotranspiration, drains, and streams. In addition, the model provides a rigorous well withdrawal package, unconfined recharge boundary conditions, and seepage face boundary

conditions. MODFLOW-SURFACT contains additional capabilities which include rigorous saturated-unsaturated moisture movement simulation capability, air flow simulation capability, and a Newton-Raphson linearization package for improved robustness. These capabilities improve the model accuracy for simulating the groundwater system near the Ranney wells because of the rapid hydraulic response in gravels and pumping rates from the Ranney wells.

4.0 GROUNDWATER MANAGEMENT PLAN ISSUES

The Groundwater Management Act outlines twelve specific components or issues that should be addressed in a groundwater management plan. Groundwater management plans developed with these components empower local agencies to adopt programs to manage groundwater. This groundwater management plan used the 12 recommended components as a guide for development. In this section of the GWMP each required groundwater management issue is described and the relevance to the Mad River Basin is assessed. The groundwater management issues that are addressed as recommended by AB3030 are:

- Control of saline water intrusion
- Identify and management of wellhead protection areas and recharge areas
- Regulation of the mitigation of contaminated groundwater
- Identification of well construction policies
- Administration of well abandonment and well destruction program
- Construction and operation of groundwater projects by the local agency including: groundwater cleanup, recharge, storage, conservation, water recycling, and extraction
- Review of land use plans and coordination with land use planning agencies to assess activities which create a reasonable risk of groundwater contamination
- Mitigation of conditions of overdraft
- Replenishment of groundwater extracted by water producers
- Monitoring groundwater levels and storage
- Facilitating conjunctive use operations
- Development of relationships with state and federal agencies

Additional issues not listed under AB3030 which are also considered in this Groundwater Management Plan are:

- Meeting the current and future drinking water quality standards
- Meeting the current and future drinking water demands

4.1 Groundwater Management Plan Issues Required by AB3030

In this section, the groundwater management issues identified in the previous section are discussed. Many of these issues have overlapping management actions as many of the issues are physically interrelated. A summary of the issues and associated management actions may be found in Table 2 at the end of this section.

4.1.1 Saline Water Intrusion

The control of saline water intrusion is directly related to maintaining groundwater quality. The possible causes of saline intrusion include:

- increase in salt content dissolved from earth material
- lateral or upward migration of saline water
- downward seepage of sewage
- agricultural or industrial waste
- downward migration of mineralized surface water
- inter-aquifer migration of saline water
- sea water intrusion.

In the case of HBMWD groundwater production, saline intrusion does not pose a significant threat to water quality. This is due to the location of the extraction wells with respect to saline water sources and the properties of the hydrologic unit. The extraction wells are located approximately 6 miles from the coast in the Holocene River Channel Deposits, far from the salt water lens. The recharge to the Holocene River Channel Deposits is relatively quick and is controlled by maintaining the Mad River levels via releases from Matthews Dam. Therefore, saline intrusion is not a threat to the HBMWD extraction wells.

4.1.2 Wellhead Protection

Wellhead protection entails the identification and management of wellhead and recharge areas. Typically the protection areas would include a groundwater travel time assessment and an evaluation of areas, that could allow contamination to reach the production wells within a given time period.

The existing HBMWD groundwater extraction wells are located in or near the Mad River primary channel and groundwater is extracted from the underlying river channel sediments Because of the rapid groundwater recharge rates of the Holocene River Deposit near the HBMWD extraction wells, the travel time approach for determining wellhead protection areas is not practical. The recharge areas are near the well head and may extend up the river channel. Therefore, the region that includes all areas within in the influence of the extraction wells are considered for wellhead protection.

Threats to wellhead and recharge areas come from two potential sources. The first is physical activities that may alter the channel, and the second is contaminants entering the recharge water. Activities pertaining to the alteration of the stream bed that may adversely impact water quality, wildlife, or habitat are regulated by Regional Water Quality Control Board (RWQCB), California Department of Fish and Game (DFG), and the Army Corp of Engineers. Possible contamination of the potable water produced by District is addressed by California Department of Health Services, Department of Toxic Substances Control, and RWQCB regulations. Therefore, threats to well head and recharge areas are already controlled by existing agencies.

4.1.3 Mitigation of Contaminated Groundwater

The downward migration or contaminants from sewage, agricultural, or industrial waste is a potential source of groundwater contamination. However, as with wellhead protection, current

local, state, and federal regulation restrict activities that could threaten the groundwater quality near the area of influence of the HBMWD extraction wells.

Threats to groundwater quality are regularly assessed by monitoring the water quality in the Mad River, which recharges the Holocene River Deposits. If a leak or a spill is identified, effective control and clean-up would be conducted by the appropriate parties. This would include coordinated efforts with the regulatory agencies involved, source control and containment, and contamination delineation. Regulatory agencies may include California Department of Health Services (DHS), RWQCB, DFG, Army Corp of Engineers, Department of Toxic Substances Control, EPA, and HBMWD. The level of involvement of each agency would depend upon the nature and extent of the threat.

4.1.4 Well Construction Policies

Well construction and abandonment are listed as separate items by the DWR, but in practicality they pose similar threats to groundwater and are governed by the same regulations. Therefore, they are considered together in this GWMP.

Improperly constructed or abandoned wells can adversely impact groundwater quality by creating a vertical conduit for the migration of contamination from the surface to groundwater or between groundwater units. All wells drilled in the Mad River Basin are regulated by the Humboldt County Environmental Health Department. Installation of wells must conform to the California Water Code §13700 through §13806 and must be installed by contactors with an active C-57 Contractor's license. In addition, a County drilling permit must be attained. A minimum standard for the construction and demolition of wells is specified in DWR Bulletins 74-81 and 74-90. Therefore, the threat from improperly constructed or abandoned wells is very small.

4.1.5 Well Abandonment Policies

Well abandonment policies are addressed in the previous section.

4.1.6 Construction of Groundwater Projects

Part of the GWMP is to evaluate the impact of the construction and operation of projects pertaining to groundwater quality and quantity within the groundwater basin. These projects include: groundwater contamination cleanup (covered in Section 4.1.3), groundwater storage, groundwater recharge, groundwater extraction, water conservation, and water recycling. These items re discussed further below.

4.1.6.1 Groundwater storage, recharge, and extraction

The storage, recharge, and extraction of groundwater at HBMWD facilities are closely related. The groundwater extracted by HBMWD is solely from the Holocene River Deposits. The recharge to the River Channel Deposits is primarily from the Mad River and is a function of the river stage or level.

The District operates Matthews Dam which impounds water in Ruth Lake. The District manages releases from the dam to insure sufficient groundwater recharge conditions throughout the year. The District currently has appropriative water rights to store water at Ruth Lake and divert 75 million gallons a day (MGD) from the Mad River at the Essex facility. This is approximately 8% of the total average Mad River Basin runoff.

Recharge to the Holocene River Deposits and any possible subsequent interactions with other hydrologic units is achieved through releases from Matthews Dam and by maintaining sufficient flows for the protection, propagation, and preservation of fish and wildlife.

4.1.6.2 Water Conservation Projects

Water conservation is an approach to reduce potable water demands, and is an essential component for basins that have water deficits. To mitigate the water deficits, conservation measures such as low flow toilets and fixtures, water saving clothes washers, and restrictions on outdoor irrigation may be implemented. The District currently has sufficient capacity to meet demands, thus mandatory conservation measures are unnecessary. Additionally, implementing conservation measures would be completely voluntary, as the District has no legal authority to implement such measures.

4.1.6.3 Water Recycling

Water recycling is another approach to reduce potable water demand. Recycled water requires a high degree of treatment and a parallel delivery system. Due to the sufficiency of current and water supplies a water recycling project is not warranted at this time.

The HBMWD is a regional water wholesaler and does not operate or have any authority over wastewater collection and treatment in the area.

4.1.7 Impact of Land Use Plans

The rapid recharge rates of the Holocene River Channel Deposits heighten the threat to groundwater posed by potential degradation of water quality in the Mad River caused by land use activities. Issues relating to these threats are primarily addressed by Humboldt County Community Development Service Department, Land Use Planning Department. Land use that may potentially impact the recharge areas are addressed through zoning ordinance and compliance. In addition, activities that may impact the Mad River are regulated by RWQCB, California Department of Fish and Game, Army Corp of Engineers, and EPA. The District regularly reviews plans and works in coordination with Humboldt County Community Development Service Department, Land Use Planning, to assess activities which may create a threat groundwater quality or quantity.

4.1.8 Mitigation of Overdraft Conditions

Overdraft of groundwater occurs when more groundwater is extracted from the basin than is returned. This can cause land subsidence, decreased water quality, and declining groundwater

level. As stated in the section on storage, recharge, and extraction, the recharge to the Holocene River Channel Deposits is managed by maintaining water levels in the Mad River. Therefore, the risks of overdraft are curtailed by balancing flows in the Mad River with groundwater extraction.

While the recharge to the Holocene River Deposits in the area of the HBMWD's wells is met by the balanced flows in the Mad River, the Mad River may also serve to recharge other hydrologic units within the basin. The interaction between the river and these units is complex and will vary with location. In some locations the river may gain water from the adjacent hydrologic units and in others it may recharge them. Regardless of the type of interaction, the minimum recharge or drainage conditions are satisfied by maintaining the flows required by the terms of the Domestic Water Supply Permit. Any actions that would impact the groundwater interactions between the river, river deposits, and adjacent hydrologic units would require a permit from DWR.

4.1.9 Replenishment of Extracted Groundwater

The replenishment of extracted groundwater entails returning water to the groundwater basin either through natural recharge or other anthropogenic means. This issue is addressed in the Storage, Recharge, and Extraction, and Mitigation of Overdraft sections.

4.1.10 Monitoring of Groundwater Production, Levels, Storage, and Water Quality

HBMWD produces water from four Ranney wells at the District's Essex Control Center just northeast of Arcata. Water is pumped from the Holocene River Deposits that underlie the Mad River channel. The Ranney wells withdraw water from approximately 60-90 feet deep.

HBMWD currently records the production and water levels from their wells and operations at the Essex facility. Additionally, water quality is constantly monitored and water quality samples are regularly taken. Water quality samples are sent to a certified analytical laboratory for assessment.

4.1.11 Facilitating Conjunctive Use Operations

Conjunctive use of water refers to the use of water resources where groundwater and surface water interface and influence each other. Rainfall, evaporation, runoff, percolation, and transpiration combine to influence the water available at a specific location at a particular point in time. The hydrologic cycle controls water available for use. The speed at which water moves among stages in the hydrologic cycle and the amount of time it spends in storage at any stage affects water availability to users.

Typically, this refers to the practice of storing excess surface water in groundwater during wet periods for use during dry period. In the Mad River Basin the amount of storage in hydrologic units is limited by the local soil conditions. Thus, conjunctive use in the Mad River Basin refers to the storage of surface water during wet periods and using surface water to control recharge to groundwater during dry periods.

The HBMWD conjunctive use of water is addressed in the storage, recharge, and extraction section. Any incidental conjunctive use between other hydrologic units is addressed by

maintaining the required flows for fish and wildlife. Any other groundwater exactions that may be considered as conjunctive use would require a permit from DWR.

4.1.12 Develop Relationship with Regulatory Agencies

The District maintains a positive working relationship with the regulatory agencies. Early participation of agencies and stakeholders will provide the opportunity to include their concerns in the GWMP.

5.0 GROUNDWATER MANAGEMENT STRATEGIES

In this section of the GWMP, five groundwater management strategies are identified described. A groundwater management strategy is a general approach to actions that address one or more of the management issues listed in Section 4. The Mad River Basin GWMP proposes five Groundwater Management Strategies to address the groundwater management issues listed in Section 4. The groundwater management issues addressed by each management strategy are shown in Table 2. The specific Groundwater Management Strategies are described below and include:

1. Groundwater, wellhead, and recharge area protection by adhering to existing permits, regulations, and laws.
2. Monitoring of the groundwater quality in the region of the Ranney wells.
3. Maintaining groundwater recharge by the operation of Matthews Dam and Ruth reservoir.
4. Groundwater modeling and studies.
5. Stakeholder involvement.

5.1 Groundwater Protection Through Existing Regulations and Permit Requirements

A management strategy for groundwater protection is to comply with existing regulations that relate to new construction or activities within the river channel. These regulatory requirements cover new construction activities and existing permit requirements.

The water quality of the Mad River and activities in the river channel, where groundwater recharge occurs, may have a direct impact on groundwater quantity and quality. Activities that have the possibility to impact the river, river channel, or groundwater are covered by existing regulations. These types of activities are regulated by several agencies, such as: RWQCB, Department of Fish and Game, Army Corp of Engineers.

Additionally, as a requirement of the Districts Domestic Water Supply Permit that is issued by DHS, Division of Drinking Water & Environmental Management, the District has performed and maintains a source water assessment as part of the Drinking Water Source Assessment and Protection Program. The assessment identifies the location of the drinking water source, delineates the source area and protection zones, establishes a physical barrier effectiveness checklist, inventories the possible contaminating activities (PCAs), ranks the PCAs based on vulnerability, establishes an assessment map, and creates an assessment summary.

5.2 Groundwater Monitoring Protocol

The District has monitored groundwater conditions for over 45 years. As a management strategy, the District will continue to monitor and analyze groundwater conditions near Essex groundwater production facilities. In accordance with the DHS Domestic Water Supply Permit and because it is the goal of the District to supply reliable high quality potable water, the District continuously monitors groundwater production (elevations and water quality) at the Essex facility. Additionally, water quality samples are sent to a certified analytical laboratory for testing and assessment as part of the DHS mandated Annual Chemical Monitoring Schedule in accordance with state and federal drinking water regulations. The following daily operational performance monitoring including groundwater monitoring is done:

- temperature, turbidity, and groundwater levels are continuously monitored through the SCADA system,
- particle counts are performed daily,
- bacteriological (Total Coliform & e. Coli) analysis are performed monthly, and
- total trihalomethanes and haloacetic acids (TTHM/HAA5), giardia, cryptosporidium, and nitrate analysis are performed at least yearly.

5.3 Operation of Matthews Dam and Ruth Lake

As a management strategy to address groundwater recharge, mitigation of potential overdraft, conjunctive use, and long term supply, the District operates Matthews Dam and Ruth Lake. Groundwater recharge is achieved by the inundation of the recharge areas in the Mad River channel.

During high-discharge periods the District does not control the amount of water released because water flows freely over the spillway structure. This only occurs when the elevation of Ruth Lake reaches 2654 feet. In this case the natural flow from the river may satisfy the demand requirement.

However, during the summer and fall low-flow periods, the District releases a sufficient amount of water from storage to meet its downstream demand requirement and its bypass flow requirement below Essex. If the District's demand for water increases (due to municipal growth or a new industrial customer) the amount of water released from storage would be increased to meet the new demand requirement.

The current withdrawal rate at the District's Essex diversion is approximately 25 to 30 MGD (28,000 to 34,000 acre-feet per year), which is only 3% of the total average runoff of the Mad River watershed. In prior years, the entire 75-MGD safe yield has been under contract, and up to 67 MGD has been withdrawn. A withdrawal rate of 75 MGD, (84,000 acre-feet per year) equates to approximately 8 percent of the total average annual runoff of the Mad River watershed.

5.4 Groundwater Modeling and Subsurface Studies

In an effort to better understand the subsurface hydrology and interactions between the Ranney Collectors the District will use a groundwater model and subsurface studies. The groundwater model is used as a management tool to assess actual or speculative scenarios under various conditions such as: impacts on the water table near the Ranney wells due to pumping drawdown,

determining maximum pumping rates from the system while maintaining water quality, and assessing the impacts of the interactions between production wells with respect to water quality. In addition to simulating various groundwater management scenarios, the model results may be used in communicating impacts on the system due to various management scenarios.

5.5 Stakeholder and Interagency Involvement Protocol

Stakeholder and interagency involvement is essential to a successful GWMP. As primarily a water wholesaler the Districts neighboring agencies are also customers. The protocol for interagency corporation and public and stakeholder involvement involves multiple levels. The HBMWD has a publicly elected Board and holds regular meetings that are open to the public. Public announcements about the proposed development of a GWMP have been made and the proposed GWMP has been discussed at several meetings. As a water wholesaler, the District also holds regular meetings with its seven municipal customers where the GWMP has been presented and discussed.

Table 2. Management Strategies and Issues

Management	Strategy					
Issue	Mandated by AB3030	Ground-water Protection	Ground-water Monitoring	Matthews Dam Operation	Ground-water Modeling	Stakeholder Involvement
Saline Intrusion	Yes		X		X	
Wellhead & Recharge Area Protection	Yes	X	X			X
Mitigation of Contamination	Yes	X	X		X	X
Well Construction Policy	Yes	X				
Well Abandonment Policy	Yes	X				
Construction Projects	Yes	X			X	X
Land Use Coordination	Yes	X			X	X
Mitigation of Overdraft	Yes	X	X	X	X	X
Groundwater Recharge & Replenishment	Yes	X	X	X	X	X
Monitoring Groundwater Levels & Storage	Yes		X	X		
Conjunctive Use	Yes	X		X		
Agency Relationship	Yes	X	X	X	X	X
Water Quality	No	X	X	X	X	X
Water Demands	No	X	X	X	X	X

6.0 SUMMARY

The Mad River Basin Groundwater Management Plan was developed by the HBMWD to support their efforts at providing a reliable, long term, cost efficient, high quality water supply for the community. The District is a wholesale water producer that currently provides treated potable water for domestic and business use, through seven municipalities, to approximately 60% of the population in Humboldt County. The potable water produced by the District is drawn from the Holocene River Channel Deposits. These deposits underlie the Mad River in the river channel. The Mad River GWMP is therefore focused on, and limited to, the Holocene River Channel Deposits that may impact the Districts potable water production. The Mad River GWMP lists five groundwater management strategies to address the required and relevant

groundwater management issues, as outlined in Section 4. The groundwater management strategies include: groundwater protection through existing regulations and permit requirements, continued groundwater monitoring, operation of Matthews Dam and Ruth Lake, groundwater modeling and studies, and stakeholder involvement.

REFERENCES:

Evenson, R. L. 1959, Geology and Ground-Water Features of the Eureka Area Humboldt County, California. Geological Survey Water-Supply Paper 1470

McLaughlin, S.D. et. al., 2000, Geology of the Cape Mendocino, Eureka, Garberville, and Southwestern part of the Hayfork 30X60 Minute Quadrangles and adjacent Offshore Areas, Northern California. United States Geological Survey Miscellaneous Field Studies MF-2336.

California Department of Water Resources, 2003, California's Groundwater. Bulletin 118, Northcoast Hydrologic Region, Mad River Lowland Groundwater Basin.

Appendix F

(Sample Resolution)

Resolution No._____

Resolution of the Humboldt Bay Municipal Water District Board of Directors Declaring a Water Shortage Emergency and Implementing the District's Water Shortage Contingency Plan

The Humboldt Bay Municipal Water District Board of Directors does hereby resolve as follows:

PURSUANT to California Water Code Section 350 et seq., the Board of Directors has conducted duly noticed public hearings to establish the criteria under which a water shortage emergency may be declared.

WHEREAS, the Board of Directors finds, determines and declares as follows:

- The District is the water purveyor for the municipalities and industry of the Humboldt Bay Area.
- The demand for water service is not expected to lessen.
- When the combined total amount of water supply available to the District from all sources falls at or below the Stage II triggering levels described in the District's 2010 Urban Water Management Plan, the District will declare a water shortage emergency. The water supply would not be adequate to meet the ordinary demands and requirements of water consumers without depleting the District's water supply to the extent that there may be insufficient water for human consumption, sanitation, fire protection, and environmental requirements. This condition is likely to exist until precipitation and inflow dramatically increases or until water system damage resulting from a disaster are repaired and normal water service is restored.

NOW, THEREFORE, BE IT RESOLVED that the Humboldt Bay Municipal Water District Board of Directors hereby finds, determines, declares and concludes that a water shortage emergency condition exists that threatens the adequacy of the water supply, until the water supply is deemed adequate. After the declaration of a water shortage emergency, the Board of Directors will implement the District's Water Shortage Contingency Plan and determine the appropriate Action Stage of the plan to implement.

FURTHERMORE, the Board of Directors shall periodically conduct proceedings to determine additional restrictions and regulations which may be necessary to safeguard the adequacy of the water supply for domestic, sanitation, fire protection, and environmental requirements.

Passed, approved and adopted this _____ day of _____, _____ by the following votes:

Ayes:

Nays:

Absent:

_____

President

Attest:

_____

Secretary/Treasurer

Appendix G

NORTH COAST INTEGRATED REGIONAL WATER MANAGEMENT PLAN

PHASE III
August 2014

APPENDIX N
CLIMATE CHANGE VULNERABILITY ASSESSMENT

APPENDIX N
CLIMATE CHANGE VULNERABILITY ASSESSMENT

N.1 PROCESS TO DETERMINE POTENTIAL VULNERABILITIES

Approach to Climate Change Vulnerability Assessment

The assessment process and results will provide North Coast water resource managers with a clearer understanding of the combined relative sensitivity and adaptability North Coast sectors to potential future climate impacts. Detail and precision of this assessment is designed to match the information available as well as the likely resources available for these types of assessments in this Region. Because many climate change impacts involve complex system responses to projected climate changes, detailed studies often involving numeric models of other systems (hydrologic, ecologic, vegetation, fire) that use climate projections as inputs are often used to determine and quantify impacts. These modeling studies — combined with regional climate projection data and region-specific information relevant to the sectors defined such as topography, land-use, crop values, water supply source, water quality issues, etc. — formed the core of knowledge for identifying impacts and determining sensitivity and adaptive capacity which combine to specify vulnerability[1].

The development of the CCVA per DWR recommended processes (below) has been supplemented by information provided during NCRP interviews with local professional water and/or land planners. Interviews reveal an array of concerns related to specific local climate vulnerabilities (Figure E4 "Climate Change Vulnerabilities"). Interviewee-identified data gaps related to climate change and climate uncertainty (Figure E6 "Data Gaps: Climate Change"). As it is directly related to climate change mitigation and energy independence, data gaps related to energy efficiency are also provided (Figure E5 "Data Gaps: Energy Efficiency").

Overview of Steps to Develop North Coast CCVA

The NCIRWMP framework for determination of North Coast regional vulnerability to climate change includes the following steps (discussed in turn):

1) Identify a suite of sectors comprising regional water-related systems (built/ economic and natural/ ecosystem);
2) Use available data, scenarios, and models to create projections of regional climatic and hydrologic variables (by applying GHG emission scenarios and publically available data);
3) Analyze projected variables to determine likely regional impacts of climate and hydrology on the sectors
4) Determine sensitivity and adaptive capacity of sectors to projected changes in climatic/ hydrologic variables; and
5) Co-analyze sensitivity and adaptive capacity to determine and rank overall vulnerability of each sector.

Per recommendations of the DWR's 2012 IRWM Guidelines, the USEPA/ DWR's "Climate Change Handbook for Regional Water Planning" (2011), and others, the next steps for developing this preliminary CCVA into fuller Climate Analysis (per) include vetting the preliminary list of vulnerability rankings with the NCRP and other stakeholders; identifying priority sectors for further analysis; develop local strategies to reduce sensitivity and/or increase adaptive capacity of these priority sectors; and conducting ongoing refinement of CCVA and climate analyses (e.g. using new downscaled data sufficient to provide high-resolution information) to inform local planning and implementation.

1 Other resources relevant to local climate change assessment as part of IRWM planning include: an academic report about how various IRWM regions are addressing climate vulnerability http://www.acwa.com/news/climate-change/new-report-examines-climate-change-and-irwm-regions; a case study from Sonoma County Water Agency www.water.ca.gov/climatechange/docs/Front%20Matter-Final.pdf; a Vulnerability Assessment from East Bay Municipal Utility District http://ofmpub.epa.gov/eims/eimscomm.getfile?p_download_id=498020; and the "Tribal Communities Climate Change Vulnerability Matrix" currently in development with DWR at erin.chappell@water.ca.gov

Determinations of sensitivity, adaptive capacity, and vulnerability necessarily contain a degree of subjectivity based on the availability of relevant literature, understanding of cause and effect processes relating future climatic conditions to the current and future state of the systems involved. However, a relative scale from high to low along with a consistently applied process should provide reasonable scoring precision and accuracy. The steps taken to complete the vulnerability assessment are described briefly and in general terms in the sections below.

STEP 1) Identify a suite of "sectors" comprising regional water-related systems

A regional characterization had been created in the form of the Phase 1 NCIRMWP (NCIRWMP 2007), which provides the physical, and water resource context for defining sectors and assessing impacts to specific components of each sector. The NCIRWMP includes descriptions of the physical and biological characteristics, sensitive habitats, special designations, and current water management issues; (e.g. Section 5 "North Coast Region Description" and Section 6 "Local and Regional Water-Related Issues"). The North Coast CCVA considered all these attributes in the vulnerability assessment, via definition of a list of sectors for analysis, that together subsume these descriptions to represent the Region's preparedness for potential climate change effects.

Sectors have been defined in this assessment to readily align with existing resource management frameworks so that the information can be most efficiently integrated with statewide planning processes, as necessary and appropriate. Assessment of sectors herein includes consideration of the current status of the sector, how it changes over time, and what drives those changes. Sectors sometimes are closely related or may directly or indirectly feedback on one another. As outlined in Table 56 ("Sectors Assessed for Climate Change Vulnerability"), the sectors can be grouped into two broad systems: Natural/Ecological (with sectors representing "green" infrastructure/resources and ecosystem function) and Built/Human/ Economic (with sectors representing "gray" infrastructure/resources and economic viability).

The list of sectors chosen for this preliminary vulnerability assessment is intended to be representative of the suite of North Coast attributes that support its waters, habitats, communities, and economies. A number of sources were referenced during CCVA planning to ensure the NCIRWMP list of sectors is representative, compatible, and meaningful[2].

TABLE 56 SECTORS ASSESSED FOR VULNERABILITY TO CLIMATE CHANGE

SYSTEM	SECTOR	DESCRIPTION
Natural/ Ecological	Forests	Forests are areas of the region with high densities of trees, which make up the largest type of land cover of the region by area. This sector includes consideration of the natural ecosystems that compose the forest environment.
	Rangelands	Rangelands are natural landscapes in the form of grasslands, shrublands, woodland, and wetlands, and in this context also include pasture lands (which are grasslands that also function as open spaces and working landscapes). This sector includes consideration of the natural ecosystems that compose the different rangeland types.
	Riparian	The riparian zone or riparian area is the interface between land and a river or stream. They are important natural biofilters, protecting aquatic environments from excessive sedimentation, pollutants, and erosion and provide shelter for aquatic animals and they shade the stream which regulates water temperatures. This sector includes consideration of the ecosystems that compose the riparian zone, with special consideration to cold water fish species. Several of the streams and rivers throughout region are federally designated 'Wild and Scenic' rivers.
	Coastal	The coastal zone can be defined by the area of interaction of land and sea processes. This sector includes systems such as coastal lagoons, the intertidal zone, near shore currents, sea cliffs, and developed areas along the coast. It includes Critical Coastal Areas, Areas of Special Biological Significance, State Water Quality Protection Areas, and Water Management Areas across the North Coast Region.

2 Guidance for development of list of sectors provided by: "Climate Change Handbook for Regional Water Planning" (USEPA, DWR 2011)"California Adaptation Planning Guide: Defining Regional and Local Impacts" (CalEMA, CNRA, FEMA 2012); "Adapting to Climate Change: A Planning Guide for State Coastal Managers" (NOAA 2010); and "Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments" (Climate Impacts Group, Univ WA, et al. 2007).

SYSTEM	SECTOR	DESCRIPTION
Built/ Human / Economic	Forestry	Forestry includes the management, use, and conservation of forest for human benefit. This sector includes natural resource management and economic activities related to the forest environment.
	Urban	Urban areas of the region are characterized by higher population and structure density and extensive impervious surface coverage. This sector includes consideration of impacts on property, infrastructure, and development.
	Fisheries	Fish harvesting from the ocean and rivers is an important economic activity on the region. This sector includes consideration how ecological impacts may affect the activities or economics of fish harvesting in the region.
	Water supply/ demand	Water supply is physical and programmatic infrastructure that exists in the region to meet residential, industrial, and agricultural water demands. This sector includes consideration of impacts on water supply sources, storage, and conveyance; and changes in patterns of needs based on seasonal temperatures and land-use.
	Energy capacity/ demand	Energy capacity refers to the amount of energy that power plants are able to generate to meet the needs of customers. This sector includes consideration of climate change impacts on energy sources such as hydropower and changes to overall demands and timing.
	Recreation	Abundant natural landscapes and waterways in the region provide excellent aquatic recreation opportunities. This sector includes consideration of how impacts may limit those opportunities for direct experience in the regions coastal ocean, rivers, and wetlands as well as appreciation of wildlife that depend on these resources.

STEP 2) Use available data, models, and scenarios to create projections of regional climatic/ hydrologic variables

Available data were used to determine the direction and degree of change for regional climatic and hydrologic variables. Projected changes to climatic variables, and related responses in hydrologic variables, are presented in Table 57 and Table 58 (below) for the Region's counties and WMAs, respectively.

Climate Models

Climate science and associated models have historically been focused on large spatial scales, but have been more recently been applied to estimating future climatic conditions and expected hydrologic responses at regional and local scales (e.g. county, basin/WMA; Thorne et al. 2012a). There are numerous widely applied global climate models, each with variations in representation of the physical and chemical processes and interactions that drive climate patterns. Therefore, climate scientists often use multiple models (rather than a single model) to evaluate potential future climate patterns and trends, since there is a large amount of uncertainty in the ability to model complex and dynamic systems such as climate. In this CCVA, projections of both climate and hydrologic changes have been derived from a number of different sources that have been published in the scientific literature (e.g. those cited in Table 63 ("Climate Change Vulnerability Assessment of the North Coast Region"). Analyses incorporate two global climate models: the Parallel Climate Model (PCM) and the Geophysical Fluid Dynamics Laboratory (GDFL) Model. Climate projections have been regionally downscaled by independent studies to better represent future conditions in California and specific regions within the state including the North Coast using bias correction and special downscaling (BCSD) for a suite of several models and emissions scenarios made available by the California Energy Commission were downloaded for this assessment (available at www.caladapt.org) which are reported in Maurer et al., 2002.

Emission Scenarios

All projections of future climate, hydrology, and sea level by global climate models are very sensitive to future carbon and greenhouse gas emissions scenarios, which produce a range of projected change. Emissions scenarios are plausible descriptions, without likelihoods, of the future states of the world and are used to estimate future greenhouse gas emissions. They vary based on assumptions about the nature of population growth and economic development in the future and the resultant estimated rates of fossil fuel and greenhouse gas (GHG) emissions. The two most commonly used emissions scenarios are the A2 and B1 scenarios, which provide a reasonable range of potential future emissions. A2 assumes a continued exponential increase in GHG emissions over the next 100-yrs, with some reduction relative to current rates. B1 assumes a significant global reduction in GHG emissions from industrialized and developing nations with the peak in global carbon emission reached in the middle of 21st century and then declining back to carbon emission rates of the 1970s. For the majority of references cited in this synthesis, the A2 and B1 emissions scenarios are used to bracket the high and low projections. Climatic model outputs are expressed in summary metrics that represent an overall shift in certain climate variables over decadal time scales (e.g., mean annual precipitation), changes in spatial patterns (e.g., temperature gradients), or 'extreme event' changes (e.g., magnitude, frequency, and return intervals).

TABLE 57 PROJECTED CHANGES TO CLIMATE & HYDROLOGY OF NORTH COAST COUNTIES

CLIMATIC & HYDROLOGIC VARIABLES	DEL NORTE	GLENN	HUMBOLDT	LAKE	MARIN	MENDOCINO	MODOC	SISKIYOU	SONOMA	TRINITY	REGION
Actual evapotranspiration	-0.24	+0.52	-0.09	-1.03	-1.69	-1.45	+0.16	+0.54	-2.00	+1.42	+3.42
Climatic Water Deficit	+4.64	+5.50	+4.76	+5.76	+5.61	+5.74	+7.60	+6.95	+6.31	+6.20	-0.11
Excess water	-12.57	-12.64	-10.99	-8.54	-3.68	-8.71	-3.02	-7.88	-5.98	-12.41	-6.43
Fire Risk	+0.05	+0.07	+0.05	+0.07	+0.05	+0.06	-0.02	+0.03	+0.06	+0.07	+0.01
Maximum July Temperature	+11.22	+10.39	+9.86	+9.78	+4.30	+9.39	+11.17	+11.88	+6.62	+10.12	+3.50
Minimum January Temp	+5.25	+5.91	+5.18	+5.62	+6.69	+5.88	+6.76	+5.27	+6.56	+5.43	-1.13
Potential Evapotranspiration	+3.34	+3.82	+3.15	+3.90	+3.33	+3.47	+3.78	+3.49	+3.73	+3.46	-0.27
Recharge	-5.57	-0.21	-6.41	-1.87	-0.98	-4.82	-1.18	-3.09	-2.27	-7.03	-4.76
Runoff	-6.43	-12.16	-4.08	-7.70	-3.90	-4.29	-0.13	-2.35	-4.77	-3.77	+1.00
Snowfall	-3.56	-4.61	-4.62	-0.85	-0.09	-1.82	-3.14	-7.94	-0.20	-11.08	-10.88
Snowmelt	-3.05	-3.67	-4.06	-0.57	-0.03	-1.44	-2.23	-6.81	-0.10	-9.69	-9.59
Snowpack	-3.46	-6.62	-8.87	-0.65	0.00	-1.28	-9.00	-25.23	0.00	-25.31	-25.31
Soil water storage	-5.86	-3.25	-14.56	-4.64	-8.33	-9.70	-2.86	-6.03	-11.00	-5.72	+5.28
Sublimation	-0.51	-0.95	-0.56	-0.29	-0.06	-0.39	-0.84	-1.10	-0.10	-1.33	-1.23
Total precipitation	-13.11	-13.06	-11.37	-11.54	-7.14	-11.29	-2.49	-6.45	-9.61	-11.03	-1.42

Source: United States Geological Survey, California Energy Commission after Thorne et al. 2012a

TABLE 58 PROJECTED CHANGES TO CLIMATE & HYDROLOGY OF NORTH COAST WMAS

CLIMATIC & HYDROLOGIC VARIABLES	EEL	HUMBOLDT	KLAMATH	N. COAST RIVERS	RUSSIAN/ BODEGA	TRINITY	REGION
Actual evapotranspiration	-0.31	+0.39	+0.43	-1.36	-2.07	+1.34	+3.41
Climatic Water Deficit	+5.45	+4.74	+6.78	+5.58	+6.16	+5.95	-0.21
Excess water	-11.19	-11.30	-7.54	-9.18	-5.55	-11.91	-6.36
Fire Risk	+0.07	+0.04	+0.02	+0.06	+0.06	+0.07	+0.01
Maximum July Temp	+9.59	+9.01	+11.68	+10.28	+6.67	+10.28	+3.61
Minimum January Temp	+5.59	+5.07	+5.53	+5.62	+6.38	+5.34	-1.04
Potential Evapotranspiration	+3.49	+3.08	+3.49	+3.51	+3.50	+3.34	-0.16
Recharge	-5.61	-7.91	-3.07	-5.15	-2.38	-6.33	-3.95
Runoff	-5.51	-2.62	-2.22	-4.39	-4.18	-3.93	+0.25
Snowfall	-4.44	-5.72	-6.86	-1.42	-0.26	-10.89	-10.63
Snowmelt	-3.75	-5.05	-5.81	-1.19	-0.13	-9.53	-9.40
Snowpack	-6.96	-12.25	-20.48	-2.34	-0.01	-24.60	-24.59
Soil water storage	-11.21	-19.90	-5.41	-8.60	-11.13	-5.45	+5.68
Sublimation	-0.70	-0.64	-1.01	-0.24	-0.13	-1.29	-1.16
Total precipitation	-12.39	-10.95	-6.31	-11.46	-9.25	-10.58	-1.33

Source: United States Geological Survey, California Energy Commission after Thorne et al. 2012

Incorporating Uncertainty

Because climate model outputs have a range of uncertainty and agreement among individual studies, this CCVA provides a measure of "confidence" associated with each of the climate/hydrology projections considered herein (Table 63 "Climate Change Vulnerability Assessment of the North Coast Region). Confidence in the

final "vulnerability" rankings (and priorities identified thereby) is limited by the quality and availability of region-specific data and peer-reviewed literature that were used to score the elements of vulnerability (as described below, vulnerability is a combination of each sector's "sensitivity" and "adaptive capacity." It must be noted that these determinations for both sensitivity and adaptive capacity are somewhat subjective; the credibility of results herein and strength of the CCVA conclusions is supported by the step-wise development process that includes definition of rankings (High, Moderate, Low) and the systematic application of matrices to produce a consistent assessment of the entire (and varied) Region. Table 59 ("Definitions for Climate Change Projection Confidence Ratings") defines the confidence ratings used for the CCVA.

TABLE 59 DEFINITIONS FOR CLIMATE CHANGE PROJECTION CONFIDENCE RATINGS

CONFIDENCE RANKING	DEFINITION
High	General agreement of modeling studies has created consensus in the scientific literature. Available information is directly relevant and applicable to local systems.
Moderate	Scientifically supported but consensus is not present due to lack of information, moderate differences between studies, or limitations for drawing general conclusions from limited scientific information. Accessibility or application of information to local systems may be somewhat limited.
Low	Limited information or conflicting results between studies, model outputs, or research findings. Accessibility or application of information to local systems is very limited.

STEP 3) Analyze projected variables to determine likely regional impacts of climate and hydrology on the sectors

A suite of 48 potential impacts to sectors resulting from changes in climatic and hydrologic variables in North Coast Region were identified using the most credible and recently local and regional scientific literature and publically available datasets. Impacts are evidenced and documented as changes to the state, function, or structure of natural and human systems in the North Coast Region that are thought to be linked to climate (directly) and/or hydrology (indirectly). Such changes have already been detected at global to local scales and are expected to continue (Moser et al. 2009), albeit in largely unpredictable ways. The potential climate-associated impacts listed in Table are not comprehensive, but instead focus on responses related to the health of watershed and aquatic systems in the North Coast Region for which there is a developed body of scientific information. Whenever possible, supporting information has been collated specific to the North Coast Region (or even to the county-level), and in other cases inference is drawn from anticipated impacts throughout the state and for neighboring regions.

STEP 4) Determine sensitivity and adaptive capacity of sectors to projected changes in climatic/ hydrologic variables

Sensitivity

For each impact identified, the sensitivity of sectors to projected impacts was determined via examination of the scientific literature, analysis of climate change projection data, and other sources specific to California or within the North Coast IRWM Region boundary. "Sensitivity" is the degree to which system components within each sector (e.g., wildfire regimes, salmonid populations, or stormwater conveyance) respond to climatic/hydrologic conditions (e.g., temperature and precipitation), including to potential system impacts (e.g., stream temperature increases or snowmelt timing changes). If the sector or sector component is likely to be affected by future climatic conditions then it is considered sensitive (on a relative scale). Table 60 ("Definitions for Sensitivity to Climate Change Impacts") presents the definitions of the relative sensitivity scale. Questions considered when determining the relative degree of sensitivity include:

- What is the degree of exposure to climate change? For example, coastal areas are more exposed to sea level rise related impacts compared to inland areas.
- Would the existing stressors in the system and future climatic conditions exacerbate these stressors? For example, the degree of urban encroachment on forests may be a stressor that promotes greater frequency of wildfire ignitions.
- Is the existing balance of resource demand and supply such that climate may increase demand and/or reduce supply for water-related resources?

TABLE 60 DEFINITIONS FOR SENSITIVITY TO CLIMATE CHANGE IMPACTS

SENSITIVITY	DEFINITION
High	System components are expected to respond measurably to an impact based on historical observations or modeling studies.
Moderate	The response of system components to an impact has not necessarily been measured, but based on our understanding system function there are likely to be direct or indirect responses.
Low	System components do not respond measurably to impacts and based on understanding of system function there are not likely to be direct or indirect responses.

Adaptive Capacity

For each impact identified, the adaptive capacity of sectors was determined via literature review and data analysis. Projected climate/ hydrologic data sources are state or Region-specific. "Adaptive capacity" is the inherent natural ability of a sector or sector component to accommodate an impact that results from projected climate or hydrologic changes. For natural systems, the CCVA assesses the intrinsic ability of system components to adapt without any human intervention such as policy or management action changes. For assessment of human/built/ economic sectors, adaptive capacity assessment may include consideration of the timeframe and level of effort or cost associated with management actions to increase resiliency to a climate change impact. Table 61 ("Definitions for Adaptive Capacity to Climate Change Impacts") presents the definitions of the relative adaptive capacity scale. In determining how adaptable a sector is to altered climatic/ hydrologic regime, the following questions are considered:

- What are current level of stressors and flexibility to respond to future stressors? Can or has the system adapted to historic climatic changes or inclement conditions?
- Are there limiting factors that restrict the system's ability to adapt? For example, sub-alpine species' ability to adjust to future climate can be limited by elevation if they currently exist at the top of the existing elevations.
- Are there any barriers to the system's abilities to accommodate adjustments (legal, physical, biological) in response to future climate?
- How do timescales of adaptation rate compare to the rate of climate changes?
- Are there efforts currently underway that would increase adaptability from human/built/economic sectors?

TABLE 61 DEFINITIONS FOR ADAPTIVE CAPACITY TO CLIMATE CHANGE IMPACTS

ADAPTIVE CAPACITY	DEFINITION
High	System components are expected to accommodate climate changes and expected impacts in ways that avoid negative consequences.
Moderate	The system has some capacity to adjust, and the degree of negative consequences will depend on the magnitude of individual and cumulative impacts.
Low	The system has little or no capacity to accommodate expected impacts so that negative impacts cannot be avoided.

STEP 5) Co-analyze sensitivity with adaptive capacity to determine and rank overall vulnerability of each sector

In the context of this CCVA, "vulnerability" is the susceptibility of a sector to possible detrimental impacts due to changed climate. The vulnerability of systems to specific climate change impacts is determined for this assessment by combining the sensitivity and adaptive capacity ratings in the manner outlined in the matrix below (Table 62 "Matrix to Determine Climate Change Vulnerability"). Sectors that have high sensitivity to climate changes and a low capacity to adapt are considered to be most highly vulnerable to climate change impacts. As sensitivity decreases the weighting of the adaptive capability is preserved, such that even a system component that is considered not sensitive to climate change but has a low ability to adapt is considered moderately vulnerable. The column labeled 'Comments' in Table 63 ("Climate Change Vulnerability Assessment of the North Coast Region") briefly documents specific elements of each sector's sensitivity and adaptive capacity that lead to the final determination of vulnerability. The elements that were considered include physical exposure to the impact, existing stressors, observed or modeled responses, and barriers to adaptation strategies and actions.

TABLE 62 MATRIX TO DETERMINE CLIMATE CHANGE VULNERABILITY

ADAPTIVE CAPACITY	SENSITIVITY			
	RANK	High	Moderate	Low
	High	Moderate	Low	Low
	Moderate	High	Moderate	Low
	Low	High	High	Moderate

N.2 SECTORS ASSESSED FOR VULNERABILITY TO CLIMATE CHANGE

Checklist for Developing the List of Potentially Vulnerable Sectors

DWR developed the following checklist to guide preliminary development of a climate change vulnerability assessment framework; the checklist represents a "minimum" effort at climate assessment per DWR IRWM Guidelines (DWR 2012). It will continue to serve as a discussion tool and to help identify data gaps, for questions that cannot be answered at this time. In the following list, ***bold italics*** indicate the question was considered of particular relevance (or was answered in the affirmative) during determination of vulnerability of the North Coast Region sectors.

I. DWR Checklist Sector: Water Demand

NCIRWMP CCVA Sector(s): Water Supply/ Demand

- Are there major industries that require cooling/process water in your planning region?
- Does water use vary by more than 50% seasonally in parts of your region?
- ✔ ***Are crops grown in your region climate-sensitive? Would shifts in daily heat patterns, such as how long heat lingers before night-time cooling, be prohibitive for some crops?***
- ✔ ***Do groundwater supplies in your region lack resiliency after drought events?***
- Are water use curtailment measures effective in your region?
- ✔ ***Are some instream flow requirements in your region either currently insufficient to support aquatic life, or occasionally unmet?***

II. DWR Checklist Sector: Water Supply

NCIRWMP CCVA Sector(s): Water Supply/ Demand

- ✔ ***Does a portion of the water supply in your region come from snowmelt?***
- ✔ ***Does part of your region rely on coastal aquifers? Has salt intrusion been a problem in the past?***
- ✔ ***Would your region have difficulty in storing carryover supply surpluses from year to year?***
- Has your region faced a drought in the past during which it failed to meet local water demands?
- Does your region have invasive species management issues at your facilities, along conveyance structures, or in habitat areas?

III. DWR Checklist Sector: Water Quality

NCIRWMP CCVA Sector(s): Riparian, Fisheries, Recreation, Water Supply/Demand

- ✔ ***Are increased wildfires a threat in your region? If so, does your region include reservoirs with fire-susceptible vegetation nearby which could pose a water quality concern from increased erosion?***
- Does part of your region rely on surface water bodies with current or recurrent water quality issues related to eutrophication, such as low dissolved oxygen or algal blooms? Are there other water quality constituents potentially exacerbated by climate change?

- ✔ ***Are seasonal low flows decreasing for some waterbodies in your region? If so, are the reduced low flows limiting the waterbodies' assimilative capacity?***
- ✔ ***Are there beneficial uses designated for some water bodies in your region that cannot always be met due to water quality issues?***
- Does part of your region currently observe water quality shifts during rain events that impact treatment facility operation?

IV. DWR Checklist Sector: Sea Level Rise

NCIRWMP CCVA Sector(s): Coastal, Urban, Agriculture

- ✔ ***Has coastal erosion already been observed in your region?***
- ✔ ***Are there coastal structures, such as levees or breakwaters, in your region?***
- ✔ ***Is there significant coastal infrastructure, such as residences, recreation, water and wastewater treatment, tourism, and transportation) at less than six feet above mean sea level in your region?***
- ✔ ***Are there climate-sensitive low-lying coastal habitats in your region?***
- Are there areas in your region that currently flood during extreme high tides or storm surges?
- ✔ ***Is there land subsidence in the coastal areas of your region?***
- Does part of your region lie within the Sacramento-San Joaquin Drainage District?
- ✔ ***Does aging critical flood protection infrastructure exist in your region?***
- Have flood control facilities (such as impoundment structures) been insufficient in the past?
- Are wildfires a concern in parts of your region?

V. DWR Checklist Sector: Ecosystem and Habitat Vulnerability

NCIRWMP CCVA Sector(s): Forest, Rangeland, Riparian, Coastal, Forestry, Fisheries

- ✔ ***Does your region include inland or coastal aquatic habitats vulnerable to erosion and sedimentation issues?***
- ✔ ***Does your region include estuarine habitats which rely on seasonal freshwater flow patterns?***
- ✔ ***Do climate-sensitive fauna or flora populations live in your region?***
- ✔ ***Do endangered or threatened species exist in your region? Are changes in species distribution already being observed in parts of your region?***
- ✔ ***Does the region rely on aquatic or water-dependent habitats for recreation or other economic***
- ✔ ***Are there rivers in your region with quantified environmental flow requirements or known water quality/quantity stressors to aquatic life?***
- ✔ ***Do estuaries, coastal dunes, wetlands, marshes, or exposed beaches exist in your region? If so, are coastal storms possible/frequent in your region?***
- ✔ ***Does your region include one or more of the habitats described in the Endangered Species Coalition's Top 10 habitats vulnerable to climate change (http://www.itsgettinghotoutthere.org)?***
- ✔ ***Are there areas of fragmented estuarine, aquatic, or wetland wildlife habitat within your region?***
- Are there movement corridors for species to naturally migrate? Are there infrastructure projects planned that might preclude species movement?

VII. DWR Checklist Sector: Hydropower

NCIRWMP CCVA Sector(s): Energy Demand/ Capacity

- ✔ ***Is hydropower a source of electricity in your region?***
- ✔ ***Are energy needs in your region expected to increase in the future?***
- If so, are there future plans for hydropower generation facilities or conditions for hydropower generation in your region?

N.3 PROJECTED CHANGES TO CLIMATIC & HYDROLOGIC CONDITIONS

Climatic & Hydrologic Variables for the Region, Basins, and Counties

Projected changes in climate (Table 57) and hydrologic (Table 58) variables are adapted from USGS 2012 at California Climate Commons and Thorne et al. 2012a. The GFDL A2 scenario was used to generate projected values. Variables are defined at http://climate.calcommons.org/dataset/10 and listed in Section 6.2.7 ("Distribution and Magnitude of Climatic & Hydrologic Changes").

N.4 PRELIMINARY RESULTS OF CLIMATE CHANGE VULNERABILITY ASSESSMENT

This appendix presents full and summarized results of the Climate Change Vulnerability Assessment (CCVA) that is being conducted for the NCIRWMP. Where appropriate, formal assessment results are supplemented with results from interviews conducted with a diversity of local professional planners throughout the Region. Refinements will be ongoing.

N.4.1 FINDINGS FROM VULNERABILITY ASSESSMENT

Via analyses of the climatic and hydrologic variables described previously, vulnerability (=sensitivity X adaptive capacity) to 48 inter-related impacts was assessed. Table 45 lists these impacts by sector and provides supporting evidence from the recent peer-reviewed scientific literature, a confidence rating, and a recommended (preliminary) vulnerability rating for each sector X impact combination. Vulnerability to projected climatic/hydrologic conditions ranges throughout Region sectors (as well as spatially) from High to Low. Results suggest that the Region's natural/ecological systems (particularly riparian, coastal, and forest systems) are more vulnerable than its built/human/economic systems; however, of the latter, vulnerabilities exist: in fisheries, forestry, infrastructure (e.g. water provision/treatment, flood management), and recreation. Conversely, agricultural sectors, including rangelands, may respond somewhat favorably to projected climate change "impacts." For example, longer growing season and increased forage can be beneficial; however, complicating co-factors (e.g. reduced surface flows, increased drought frequency) may reduce the expression of these theoretical benefits.

The list below summarizes preliminary findings for "vulnerability" of North Coast sectors. Full results follow (Table 45). Note that in the list below, **bold** indicates a sector is leaning strongly toward an end of the spectrum. Refinement of the preliminary results in will ultimately allow the NCRP to direct North Coast resources toward implementation projects that directly or indirectly address regional climate change goals and objectives (while providing additional local benefits).

- *Natural/ Ecological Systems*
  - Riparian: High
  - Coastal: Moderate-High
  - Forests: Moderate-High
  - Rangelands: Moderate
- *Built/ Human/Economic Systems*
  - Agriculture: Moderate-High
  - Fisheries: Moderate-High

- Forestry: Moderate-High
- Recreation: Moderate-High
- Urban/ Infrastructure: Moderate-High
- Water Supply & Demand: Low-Moderate
- Energy Capacity & Demand: Low

N.4.2 FINDINGS FROM TARGETED INTERVIEWS

Interviews[3] conducted in 2013 indicate uncertainty among local planning professionals about forecasting regional vulnerability to climate. The issue is exacerbated by data gaps related to sea level rise (28% identified), climate modeling (18%), and planning (15%); Figure E6 "Data Gaps: Climate Change".

The NCRP includes allowances for improved energy efficiency in its approach to climate change mitigation. Figure E5 ("Data Gaps: Energy Efficiency") indicates data gaps that may hinder progress toward local and regional energy efficiency and independence. Energy-related data gaps identified by respondents primarily concerned renewable energy (35% identified), historic and projected energy consumption (18%), and energy grid transmission capacity and disaster readiness (17%).

Interviews suggest that "climate change" *per se* is not a major concern shared by professional planners in the Region (5% identified; Figure E3 "Data Gaps: Local Planning"). However, of those who did express concern for vulnerabilities to climate change (Figure E7 "Climate Change Vulnerabilities"), the majority of responses were related to sea level rise (28%), followed by flooding, fires, and agriculture (11% each).

TABLE 63 CLIMATE CHANGE VULNERABILITY ASSESSMENT (CCVA), NORTH COAST REGION

*"Drivers Of Change" are listed for each impact to which they are most directly connected: Average maximum air temperatures (AMT), Air temperature variability (ATV), Annual precipitation totals (APT), Precipitation variability (PV), Sea Level (SL), Droughts (D), Potential evapotranspiration (PET), Groundwater recharge (GWR), Potential evapotranspiration (PET), Annual runoff (AR), Runoff variability (RV), Snow Pack (SP), Flooding (F).

SECTOR	DRIVER* OF CHANGE	EXPECTED IMPACTS	SUPPORTING EVIDENCE	SENSITIVITY	ADAPTIVE CAPACITY	OVERALL VULNERABILITY	CONFIDENCE RATING	COMMENTS
Forest	AMT ATV PV D PET	Increased wildfire frequency, extent, and intensity	Fried et al. 2004 FRAP, 2010; Flannigan et al., 2000 Westerling et al. 2006 Westerling and Bryant , 2008 Lenihan et al., 2008	High	Moderate	High	High	Forests are extensive throughout the region indicating high exposure to this impact. Current stressors include encroachment at the urban –wildland interface. Forests will adapt to shifting wildfire regimes over the long term but may not do so quickly enough to avoid harm ecosystems.
Forest	AMT ATV PV D PET	Shift from conifer dominance to mixed evergreen hardwood species	FRAP, 2010 Lenihan et al., 2006 PRBO, 2011 Lenihan et al., 2008 Barr et al. 2010	High	Low	High	High	The majority of forests in the North Coast region are conifer dominated, indicating high exposure. Modeling studies generally show that forest composition will shift to mixed evergreen hardwoods rather than adaptation of the conifers indicating low adaptive capacity to this impact.

3 NCRP Partner and Stakeholder Interview Synthesis 2013. Counties, municipalities, Resource Conservation Districts, and non-profits were represented in the interviews. (71 professional planners contacted; 41 interviewed by December 2013.) http://www.northcoastirwmp.net/docs.php?oid=1000009380&ogid=1000002207. See also Appendix L "Stakeholder Analysis & Integration."

SECTOR	DRIVER* OF CHANGE	EXPECTED IMPACTS	SUPPORTING EVIDENCE	SENSITIVITY	ADAPTIVE CAPACITY	OVERALL VULNERABILITY	CONFIDENCE RATING	COMMENTS
Forest	AMT ATV PV D PET	Shift in forest species ranges towards higher elevations, loss of subalpine habitat	Lenihan et al., 2006 PRBO, 2011	Moderate	Low	High	High	Primarily mountainous portions of the region will be affected. Habitat fragmentation may limit adaptation in some areas as will the highest elevations that occur in the region. This impact may affect several rare, threatened, or endangered species that live in the region's forests.
Forest	AMT ATV PV D PET	Increased tree mortality due to combined effects to insects, disease and drought	Hansen and Weltzin, 2000 Shugart, 2003 Barr et al., 2010	High	Moderate	High	High	Forests are extensive throughout the region indicating high exposure. Forests will adapt to changes over the long term but may not do so quickly enough to avoid harm to ecosystems.
Forest	AMT ATV PV D PET	Reduction of coastal redwood forest habitat	Flint and Flint, 2012	High	Low	High	Moderate	Large portions of the region provide redwood habitat that exists in a very narrow zone of climate tolerance indicating high exposure. Simulation studies indicate dramatic contractions in the geographic envelope that will support redwood forest in simulation studies indicating low adaptive capacity. Severity of the reduction in suitable habitat is dependent on CO2 emissions scenario, which adds uncertainty to this impact.
Forest	AMT ATV PV D PET	Vegetation production increases and timing changes	FRAP, 2010 Shugart, 2003 Hansen and Weltzin, 2000	Moderate	Moderate	Moderate	Low	Forests are extensive throughout the region indicating high exposure. Complex interactions of enhanced CO2, temperature increases, and hydrologic changes contribute to uncertainty of changes.
Rangeland	AMT ATV PV D PET	Conversion of scrublands and woodland to grasslands	FRAP, 2010 Pierson et al., 2008	Moderate	Moderate	Moderate	Low	Scrublands and woodlands are a smaller portion of the region compared to forests indicating moderate exposure. Modeling studies indicate conversion may occur in some areas rather than adaptation. Limited information and contributes to low confidence for this impact. Complex interactions of enhanced CO_2, temperature increases, and hydrologic changes contribute to uncertainty of changes.
Rangeland	AMT ATV PV D PET	Increased stress on drought intolerant plant species and inundation by invasive grasses	Cayan et al., 2006 Thorne, et al., 2012a	Moderate	Moderate	Moderate	Moderate	Drought tolerant invasive species will have a competitive advantage during summer months in the future. No specific modeling evidence for the region was identified but this impact is directly tied to future temperatures contributing to moderate confidence. Complex interactions of enhanced CO_2, temperature increases, and hydrologic changes contribute to uncertainty of changes.

SECTOR	DRIVER* OF CHANGE	EXPECTED IMPACTS	SUPPORTING EVIDENCE	SENSITIVITY	ADAPTIVE CAPACITY	OVERALL VULNERABILITY	CONFIDENCE RATING	COMMENTS
Rangeland	AMT ATV PV D PET	Vegetation production increases and timing changes	FRAP, 2010 Shaw et al., 2009 Chaplin-Kramer, 2012 Cornwall et al., 2012 Ekstrom and Moser, 2012	Moderate	Moderate	Moderate	Low	Rangelands are a smaller portion of the region compared to forests indicating moderate exposure. Complex interactions of enhanced CO_2, temperature increases, and hydrologic changes contribute to uncertainty of changes.
Riparian	AMT ATV D RV SP GWR	Reduced aquatic habitat extent and quality with reduced summer base flows, stream temperature increases, and increased pollutant concentrations.	Moyle et al., 2012a Moyle et al., 2012b Ekstrom and Moser, 2012 PRBO, 2011 NMFS, 2012 Medellín-Azuara et al., 2008 Barr et al., 2010 NCIRWMP, 2007	High	Low	High	High	The North Coast region has the highest amount of high priority riparian zones in the state: locations where high value water supply coincides with other threats which are areas that should be prioritized for restoration. Riparian areas provide habitat for several rare, threatened, or endangered species. Smith River and tributaries, Klamath River and tributaries, Scott River, Salmon River, Trinity River, Eel River, and Van Duzen River are all federally designated Wild and Scenic Rivers. These factors indicate high exposure. Surplus moisture delivered in winter is not expected to provide a sufficient buffer to avoid summer low flow reductions indicating low adaptive capacity. Water bodies that drain approximately fifty-nine percent of the area in the North Coast Region are listed as impaired due to sediment under Section 303(d) of the Clean Water Act.
Riparian	AMT ATV	Increased thermal stress on cold water fish, amphibian, and invertebrate species and a shift in thermal spawning conditions to earlier in the year	Porinchu et al., 2010 Melack et al., 1997 Parker et al., 2008 PRBO, 2011 Barr et al., 2010 NCIRWMP, 2007	High	Low	High	High	Salmonids live within a narrow water temperature range directly correlated to air temperatures, outside of which survival is affected. Current stressors include riparian degradation with loss of shade cover and reduced baseflow which will limit adaptive capacity in the future. Several rare, threatened and endangered species may be negatively impacted such as the Northern Red Legged Frog.
Riparian	RV F	Increased landslides and sediment loading to streams following wildfires and high intensity rainfall events	FRAP, 2010 NCIRWMP, 2007	High	Low	High	Moderate	Large proportions of the region's watersheds are forested and thus exposed to this impact that results from wildfire regime shifts. Some of the most sensitive beneficial uses are currently impacted by sediment. Those uses are associated with the migration, spawning, reproduction, and early development of coldwater fish such as coho salmon and steelhead trout. Uncertainty in rainfall projections contributes to lack reduced confidence in this impact.

SECTOR	DRIVER* OF CHANGE	EXPECTED IMPACTS	SUPPORTING EVIDENCE	SENSITIVITY	ADAPTIVE CAPACITY	OVERALL VULNERABILITY	CONFIDENCE RATING	COMMENTS
Riparian	AMT ATV D RV SP GWR	Decreased native fish habitat distribution and population declines	Knapp et al., 2001, Pope et al., 2009 Moyle et al., 2012a Moyle et al., 2012b Ekstrom and Moser, 2012 NCIRWMP, 2007	High	Low	High	Moderate	Populations of these fish currently are low and habitat conditions generally are poor; these circumstances are likely to deteriorate further with projected climate change. Coho salmon have experienced a significant decline in the past 40 to 50 years. Coho salmon abundance, including hatchery stocks, has declined at least 70% since the 1960s, and is currently 6 to 15% of its abundance during the 1940s. Current stressors include riparian degradation, sediment delivery from logging roads, dams and other hydro modifications. These stressors can affect the migration, spawning, reproduction, and early development of coldwater fish such as coho salmon and steelhead trout. Dependence of salmonids populations on ocean dynamics adds to uncertainty to this impact.
Coastal	SL	Increased coastal erosion	Cayan et al., 2008a Cayan, et al., 2009 Bromirski et al., 2005 Laird, 2013	High	Low	High	Moderate	A substantial portion of the region lies adjacent to a coastline, indicating exposure to erosion increases with sea level rise. In the absence of coastal armoring, there is very little natural adaptive capacity that can mitigate beach erosion or seacliff retreat. No specific estimates of increased coastal erosion rates were identified for the region.
Coastal	SL	Landward migration of intertidal marine species with sea level rise	Cayan et al., 2008a Laird, 2013	High	Moderate	High	High	If the coastal plains are not developed, landward migration of intertidal species with sea level is possible. The regions beaches are rugged and mountains or steep hills often extend to the shoreline. In several areas there are limited low-lying areas where intertidal marine species can migrate. Additionally many of the coastal low lying areas such as Humboldt Bay and Crescent City have been urbanized thus limiting adaptive capacity near these locations.
Coastal	SL	Reduced extent of tidal marshlands and other wetlands	PRBO, 2011 Langley et al., 2009 Stralberg et al., 2011 Ekstrom and Moser, 2012 Laird, 2013	High	Moderate	High	High	Tidal marshlands throughout the region provide essential habitat for fish, amphibians and migratory sea birds in addition to buffering developed areas from flooding indicating exposure to this impact. Where landward migration of tidal marshlands in not possible due to local topography or urbanization, tidal marshlands will disappear.
Coastal	AMT RV D SL	Shifts in sea bird species migration patterns	PRBO, 2011	High	Moderate	High	Low	The region is home to several species of seabirds that use coastal wetlands of the region for breeding, foraging and resting indicating exposure to this impact. Earlier onset of summer, habitat and food availability changes will affect migration patterns. Complex interactions of seasonal temperature changes with dynamics of the California current (also subject to climate impacts) contribute uncertainty of the severity of changes.

SECTOR	DRIVER* OF CHANGE	EXPECTED IMPACTS	SUPPORTING EVIDENCE	SENSITIVITY	ADAPTIVE CAPACITY	OVERALL VULNERABILITY	CONFIDENCE RATING	COMMENTS
Coastal	SL	Increased frequency and spatial extent of flooding of coastal lowlands	PRBO, 2011 Bromirski et al., 2012	High	Low	High	High	Since a large portion of the region is coastline including several developed areas there is substantial to exposure to the increase of sea level driven flooding risks.
Coastal	-	Reduction in shell forming ability of mollusks due to higher ocean pH	Michaelidis et al., 2005 Shirayama & Thornton 2005 Kleypas et al., 1999 Riebesell et al., 2000 Feely et al., 2004 Harley et al., 2006	High	Low	High	High	Shellfish are abundant in the region and there is substantial evidence to indicate that they will not be able to adapt to ocean chemistry changes quickly enough to avoid negative effects on species populations.
Coastal	AMT ATV	Changes to the timing and intensity of coastal upwelling	Cayan, et al., 2009 Bromirski et al., 2012 Pisias et al., 2001 Snyder et al., 2003	Moderate	Moderate	Moderate	Low	Proximity of the region to coastal currents indicates exposure to this impact. Increasing temperatures will stratify ocean waters, while the current dynamics and winds will promote upwelling. These two forces work counter to one another contributing uncertainty to the timing and severity of changes to the California Current dynamics.
Forestry	AMT ATV PV D PET	Increased tree mortality due to combined effects to insects, disease and drought	Hansen and Weltzin, 2000 Shugart, 2003 Barr et al., 2010	High	Moderate	High	Moderate	A large portion of the region's area is subject to forest management indicating exposure to this impact. Timber harvest is a current stressor that may exacerbate consequences of this impact. Complex interactions of enhanced CO2, temperature increases, and hydrologic shifts contribute to uncertainty of changes.
Forestry	AMT ATV PV D PET	Reduced conifer timber harvest	Hannah et al., 2011	High	High	Moderate	Moderate	Timber is in the top 2 grossing agricultural industries in 5 of 7 of the North Coast Counties indicating exposure to this impact. Current stressors include wildfires, human encroachment into forests, insects and disease. Timber harvest practices can be altered to mitigate changes indicating high adaptive capacity.
Forestry	AMT ATV PV D PET	Increased costs of fuels management and fire suppression	Joyce et al., 2008	High	Moderate	High	Moderate	Increasing wildfire risks and human encroachment to forests exposes the forest management to increased costs to manage ignitions and damage from fires. Enhanced practices resulting from new research may reduce costs and increase adaptive capacity.

SECTOR	DRIVER* OF CHANGE	EXPECTED IMPACTS	SUPPORTING EVIDENCE	SENSITIVITY	ADAPTIVE CAPACITY	OVERALL VULNERABILITY	CONFIDENCE RATING	COMMENTS
Agriculture	AMT ATV PV D PET	Crop type changes and geographic pattern shifts	Moser et al., 2009 Jackson et al., 2012a Thorne, et al., 2012a Ekstrom and Moser, 2012 Jackson et al., 2012b Diffenbaugh et al., 2011 Jones et al., 2010 Barr et al., 2010	High	Moderate	High	High	Climate is likely to become unsuitable for high value crops such as grapes, fruits and nuts indicating exposure to this impact. Zones of suitability for fruits and nuts will be reduced with rising temperatures, especially wine grapes. New or modified farming techniques may mitigate the need to change growing locations to some degree.
Agriculture	AMT ATV PV D PET	Enhanced forage production but reduced forage reliability during drought years	Shaw et al., 2009; Chaplin-Kramer, 2012 Cornwall et al., 2012 Ekstrom and Moser, 2012	Moderate	Low	High	Low	Cattle ranching are one of the top 5 grossing agriculture industries in 6 of the 7 North Coast counties that depend on reliable forage production indicating exposure to this impact. Complex interactions of enhanced CO_2, temperature increases, and hydrologic changes contribute to uncertainty of changes.
Agriculture	AMT	Longer growing season with shift towards longer summers	Thorne, et al., 2012	High	High	Moderate	High	While many crops in the region are affected by this impact, growers can adjust to changes simply by planting earlier in the season.
Agriculture	AMT ATV PV D PET	Increased wine grape yields but reduced quality	Chaplin-Kramer, 2012 Ekstrom and Moser, 2012 Jones et al., 2010 Diffenbaugh et al., 2011 Jones et al., 2010	High	Moderate	High	High	Climate changes will alter the economics of wine producing regions. Willamette valley in Oregon may become like Napa is today. Exposure to this impact is based on economic importance of these crops. Growers can adapt with grape breeding, but climate that will be as warm as Napa will be in 2050 would be a table grape region today rather than some of the varieties that the Napa region is currently known for.
Agriculture	AMT PET	Increased irrigation water demand during summer	Jackson et al., 2012a Thorne et al., 2012a Jackson et al., 2012b	High	High	Moderate	High	Hotter, longer summers will mean that that most crops will require more water indicating exposure to this impact. Current water demands for crops and ecosystem services are the key existing stressors that will be exacerbated with projected climate changes. Conservation practices or crop type changes contribute to adaptive capacity.
Agriculture	SL RV	Increased risk of field damage from flooding in coastal low lying areas	Laird, 2013 Cayan et al., 2008a	Moderate	Moderate	Moderate	Moderate	The greatest increase in the risk of damage due to floods is in coastal low lying areas. Only 2% of land is dedicated to agriculture and urban land uses. Land use maps indicate that much of the agriculture in the region occurs in coastal lowland areas such as Arcata and Crescent City with some degree of exposure to flood damage, but is a small percent of land use in the region. Flooding damage will also be dependent on rainfall pattern changes which are less certain than sea level rise

SECTOR	DRIVER* OF CHANGE	EXPECTED IMPACTS	SUPPORTING EVIDENCE	SENSITIVITY	ADAPTIVE CAPACITY	OVERALL VULNERABILITY	CONFIDENCE RATING	COMMENTS
Urban	SL RV	Increased risk of property and infrastructure damage from flooding	Moritz and Stephens, 2008 Jones and Goodrich, 2008 Laird, 2013	Moderate	Moderate	Moderate	Moderate	Low lying communities in the region are anticipated to suffer an increase in acreage flooded by 2100 by approximately 17-18%. Relative to other California coastal areas this is a moderate increase, when compared to more populous coastal areas of the state which have projected inundation increases of ranging from 30-46%
Urban	AMT ATV PV D PET	Increased risk of property and infrastructure damage from wildfires	Thorne et al., 2012b Moritz and Stephens, 2008 Jones and Goodrich, 2008	High	Moderate	High	Moderate	Population increase in the future will mean further pressure for development to encroach into forests and greater damage to property with increasing wildfire occurrence and extent risks. Land-use planning policies are a means of increasing adaptive capacity to climate change and altered fire regimes to mitigate risks of property damage.
Urban	SL RV	Increased erosion risk for coastal development	Cayan et al., 2008a Cayan, et al., 2009 Bromirski et al., 2005 Laird, 2013	High	Low	High	Moderate	The region contains about 400 miles of shoreline all of which are at risk to erosion with projected sea level rise. The major developed areas on the coast in the North Coast region include Santa Rosa, Arcata, and Crescent City which are all exposed to this impact. However, much of the coastline is sparsely populated and undeveloped relative to other coastal regions of the state.
Urban	RV	Increased winter stormwater conveyance requirements	Jones and Goodrich, 2008 Cayan et al., 2009	Moderate	Moderate	Moderate	Low	The possibility of more frequent intense rainfall events may require greater capacity requirements for urban infrastructure. Adaptation actions such as retrofitting culverts, bridges, and storm drains would be a high cost endeavor is required. Uncertainty surrounding rainfall projections contributes to low confidence.
Urban	AMT ATV PV D PET SL RV	Greater constraints on land-use and new development	Moritz and Stephens, 2008 Jones and Goodrich, 2008	Moderate	Moderate	Moderate	Low	Increasing population creates greater development pressure on ecosystems at the urban-wildland interface. Increased flooding and wildfire risks may crate the need to place constraints on development to avoid unnecessary risks to life and property.
Water supply/ demand	SP	Reduced spring snowpack water supply storage	Cayan et al., 2009 FRAP, 2010 Anderson, 2008 Mote et al., 2005 Hayhoe et al., 2004	Low	Low	Moderate	High	Reduced snowpack is expected but majority of watersheds in the region are rain fed. While a snowpack loss of 73 to 90% (estimated in the PCM model in the Sierras) may stress aquatic ecosystems with lower base flows in summer months, much water supply in the region is met with groundwater sources and groundwater fed springs.

SECTOR	DRIVER* OF CHANGE	EXPECTED IMPACTS	SUPPORTING EVIDENCE	SENSITIVITY	ADAPTIVE CAPACITY	OVERALL VULNERABILITY	CONFIDENCE RATING	COMMENTS
Water supply/ demand	GWR RV D AMT SP	Increased risk of water conflicts between urban, agriculture, and ecosystems	Barr et al., 2010 PRBO, 2011 Elkind et al., 2012 NC RWQCB, 2011	High	High	Moderate	High	Major water supply projects in the region include the U.S. Bureau of Reclamation Klamath Project, the U.S. Army Corps of Engineers Russian River Project, the Humboldt Bay Municipal Water District Ruth Reservoir, and the U.S. Bureau of Reclamation Trinity Lake Reservoir. The Klamath Project has been extremely controversial because to maintain adequate instream fishery flow to ensure the survival of endangered salmonid populations, coordination between many jurisdictions is necessary. Water to farms has at times been cut off to prevent harm to the fisheries, resulting in extreme controversy, and in some cases, violence. Currently, surplus surface water is exported out of the region for use elsewhere in the state, but reduced snowpack storage may tax existing resources are require changes to satisfy all existing water supply needs in the region.
Water supply/ demand	GWR RV D AMT SP	Increased dependence on groundwater supply in summer months	NC RWQCB, 2011 Ekstrom and Moser, 2012	High	High	Moderate	Moderate	Most basins within the region depend on groundwater or groundwater fed springs indicating exposure to this impact. Current resources are adequate to meet current and projected needs indicating resilience to changes and a high adaptive capacity.
Water supply/ demand	GWR SL	Increased seawater intrusion to coastal groundwater aquifers	PRBO, 2011 NC RWQCB, 2011	Low	Moderate	Low	Moderate	Rising sea level will increase the potential for seawater intrusion indicating exposure to this impact for coastal communities. Given the adequate groundwater basin recharge that occurs, saltwater intrusion is not generally a problem in North Coast groundwater basins.
Energy demand/ capacity	AMT ATV	Increased summer energy demand during heat waves	Hanuk and Lund 2008 FRAP, 2010 Barr et al., 2010 NCIRWMP, 2007	Low	High	Low	High	The Iron Gate Reservoir in Siskiyou County provides energy for a hydroelectric facility owned by Pacific Power and Light Company. Future electricity demand will rise due to increased population and needs for home cooling, refrigeration, water (which requires energy to transport), and power supplies for an ever-increasing number of small electronics. At the same time, efficiency and reliability of power transmission and delivery is likely to decline as power lines are stressed with higher ambient temperatures and increased risk from wildfires. As a result, more brownouts and blackouts are expected. Much of the region's climate is moderated by its proximity to the ocean, reducing seasonal temperature variation. Energy conservation and energy efficient development will be responses to mitigate increased demand.

SECTOR	DRIVER* OF CHANGE	EXPECTED IMPACTS	SUPPORTING EVIDENCE	SENSITIVITY	ADAPTIVE CAPACITY	OVERALL VULNERABILITY	CONFIDENCE RATING	COMMENTS
Energy demand/ capacity	SP	Reduced hydropower energy generation capacity in spring/summer	Madani and Lund, 2010 Vicuna et al., (2008) FRAP, 2010 Ekstrom and Moser, 2012 Spears et al., 2012 NC RWQCB, 2011 Barr et al., 2010	Low	Moderate	Low	Low	While hydropower is used in the region indicating exposure to this impact, it is not generated at high elevation dams. While lake levels may be reduced in summer months, the projected reductions in snowpack would primarily affect hydropower generation at higher altitudes.
Fisheries	AMT ATV	Shift in marine productivity patterns as a result of nutrient upwelling changes	Snyder et al., 2003	High	Low	High	Low	Fishing is an important industry in the region with economic exposure to climate induced changes of ocean dynamics and chemistry. Complex interactions of seasonal temperature changes with dynamics of the California current, and productivity changes that may occur in other fisheries contribute uncertainty of the severity of the economic impacts.
Fisheries	AMT ATV D RV SP GWR	Decreased terrestrial cold water fish yields associated with inland habitat degradation	Knapp et al., 2001 Pope et al., 2009 Moyle et al., 2012a Moyle et al., 2012b NMFS, 2012 Barr et al., 2010 Medellín-Azuara et al., 2008	High	Low	High	Low	Increased erosion is likely to impact the spawning of native fish such as lamprey, suckers, salmon, and trout that build their nests in areas of clean rocks and gravels. Greater levels of fine-sediment input will increase nutrient concentrations in aquatic systems and contribute to algae blooms. Current stressors on fish population will limit adaptive capacity in the future.
Fisheries	SL	Landward migration of salmonid rearing habitats	Cayan et al., 2008a Laird, 2013	High	High	Moderate	High	Rearing habitats will migrate landward with sea level rise. As long as there are not barriers near the coast to migration, rearing habitats should be able to shift upstream from their current locations.
Fisheries	-	Reduced oyster and clam farm productivity due to ocean chemistry changes	Michaelidis et al., 2005 Shirayama & Thornton 2005 Kleypas et al., 1999 Riebesell et al., 2000 Feely et al., 2004 Harley et al., 2006	High	Moderate	High	Low	Interference with the shell building ability of mollusks will expose oyster and clam farms to greater mortality in the future. Farms will may identify new or modify existing practice to adapt their businesses and remain viable.

SECTOR	DRIVER* OF CHANGE	EXPECTED IMPACTS	SUPPORTING EVIDENCE	SENSITIVITY	ADAPTIVE CAPACITY	OVERALL VULNERABILITY	CONFIDENCE RATING	COMMENTS
Recreation	RV SP GWR D	Shortened river rafting, boating, and sport fishing season and quality	Morris and Walls, 2009 Cayan et al. 2009	High	Moderate	High	Moderate	Recreation activities that depend on summer river flows and good water quality are exposed to impacts as summer low flows are reduced in rivers due to longer, hotter summers and less snowmelt. There is very little opportunity for adjustment of these activities other than altering dam release patterns upstream.
Recreation	RV SP GWR D	Shortened backcountry skiing season	Morris and Walls, 2009 Cayan et al., 2009 Goodstein and Matson, 2004	Moderate	Low	High	High	Opportunities for snow-dependent recreation will be reduced along with the snowpack decline. There is very little opportunity for adjustment of these activities with less snow pack available.
Recreation	RV SP GWR D	Reductions in hunting and wildlife viewing opportunities	Morris and Walls, 2009 Cayan et al., 2009	Moderate	Moderate	Moderate	Low	Hunting and wildlife viewing opportunities are dependent on healthy animal populations and associated habitats. Potential habitat degradation in the future exposes this recreation opportunity to impacts from changing climate and hydrologic conditions. New wild areas may become more suitable or made more accessible in response to changing conditions. The extent of limitations is uncertain since they depend on a host of complex system responses to changed climate conditions as well as human behavior patterns.
Recreation	RV SP GWR D	Reduced wildland recreation opportunities and viewshed quality	Morris and Walls, 2009 Cayan et al., 2009	Moderate	Moderate	Moderate	Low	Wetland, riparian, and mountain areas that support recreational fisheries and unique bird populations in the region exposed to climate change impacts such as sea level rise and longer, drier summers. New wild areas may become more suitable or made more accessible in response to changing conditions. The extent of limitations is uncertain since they depend on a host of complex system responses to changed climate conditions as well as human behavior patterns.

N.5 STRATEGIES TO REDUCE CLIMATE-RELATED VULNERABILITIES

Next steps[4] in North Coast Climate Change Analysis, per DWR IRWM Guidelines, are:

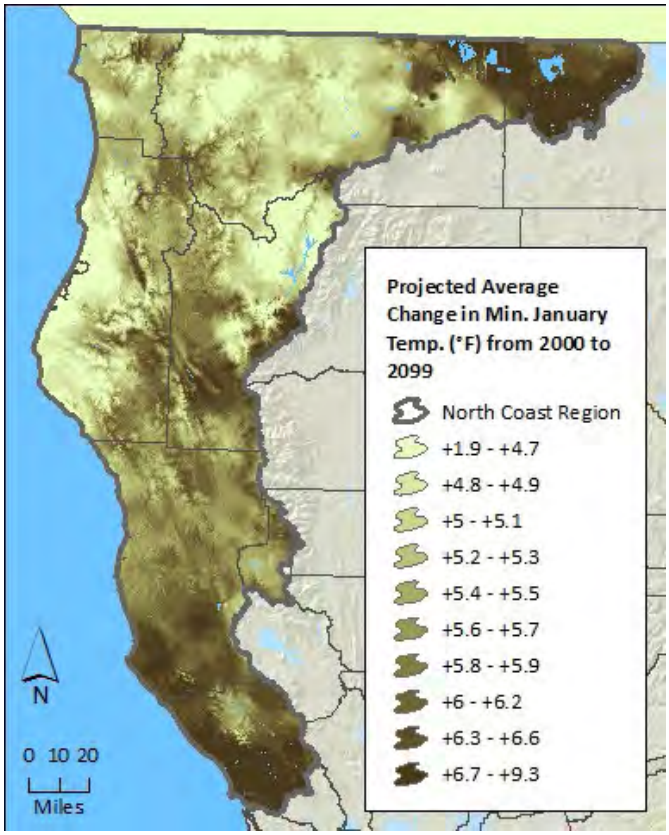
- Continue to refine list of vulnerabilities and prioritize list as feasible, based on NCRP and local stakeholder input
- Identify potential adaptation actions/ strategies for highly vulnerable components (sectors, geographic areas, other attributes) of the North Coast Region [*available late 2014*]
- Develop with the NCRP of a more formal process to explicitly incorporate specific climate change considerations into ongoing NCIRWM planning processes, project prioritization, and plan evaluation.

4 Proposed for further development during 2014/2015 by NCRP PRP, TPRC, ad hoc committees, project proponents, and other stakeholders with assistance from agency and other personnel with expertise in the field of Strategy Development as related to climate vulnerability in the North Coast Region.

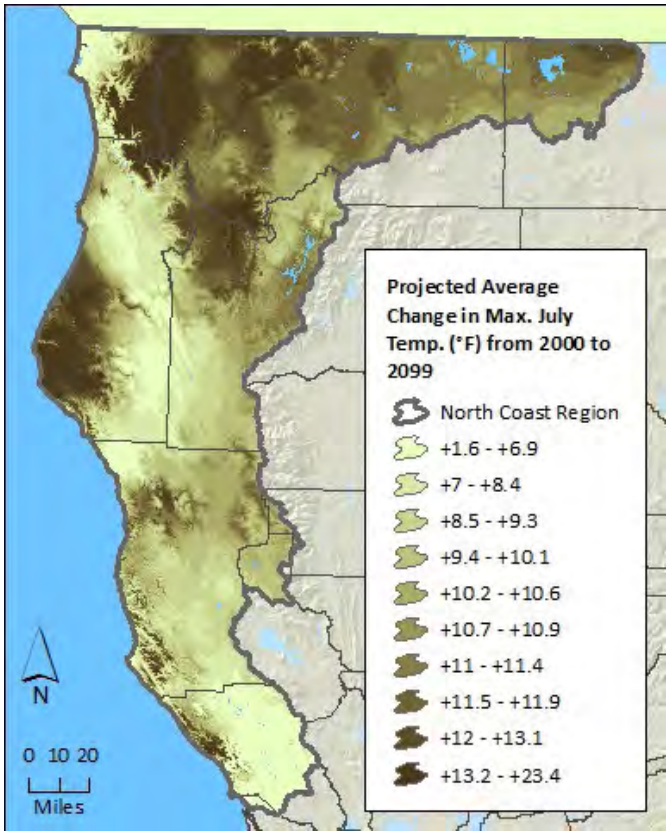
- Improve resolution of CCVA analyses. Refinement of this CCVA should include development of a comprehensive climate change adaptation/ mitigation plan that can be implemented strategically to suit the priorities of local stakeholders throughout the Region.
- Provide more precise (ideally quantitative) estimates of impacts and vulnerabilities in different areas, future analyses should incorporate climatic and hydrologic datasets, which provide high-resolution data for assessment results that accurately represent the wide range of anticipated climate change effects in areas of interest (e.g. counties, communities, basins, WMAs/watersheds, etc.).
- Identify and coordinate with existing and developing climate vulnerability studies that may already be occurring in the Region. For example, North Coast Tribes have developed a "Tribal Communities Climate Change Vulnerability Matrix" [5]that is compatible with the preliminary climate change vulnerability assessment developed by the NCRP.

N.6 SPATIAL DISTRIBUTION OF PROJECTED HYDROLOGIC & CLIMATIC CHANGES

A suite of 23 high-resolution maps were developed in association with the data analysis presented in Tables 57 and 58. The maps (N1-N23, below) may allow planners to better visualize past, current, and future conditions at the local level. Data for the climate maps are adapted from USGS 2012 and Thorne et al. 2012a. The definitions of each assessed variable are provided by the California Climate Commons6. Table 79 "Technical Sources, Resources, & Tools" compiles the map data sources.

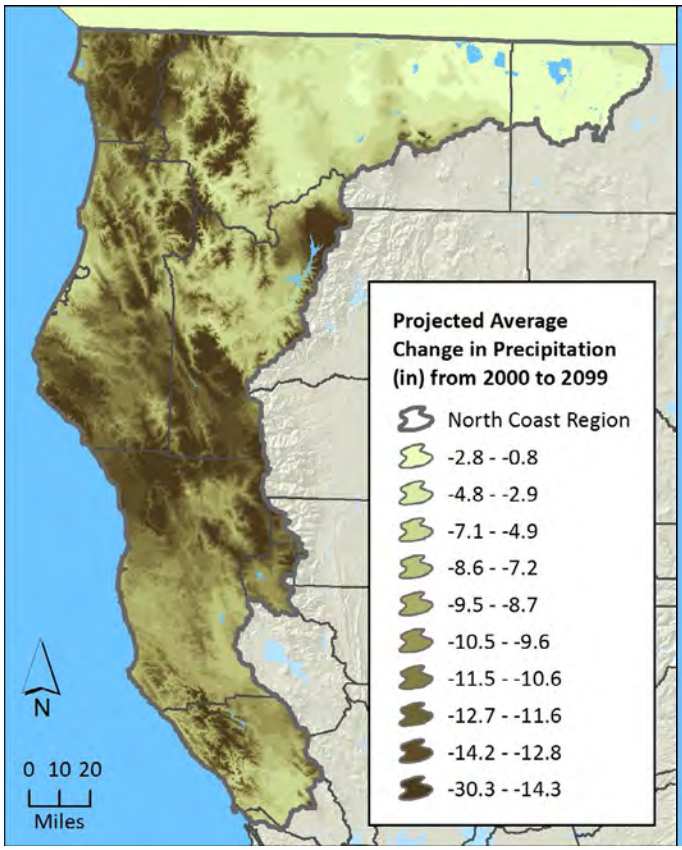


Map N1

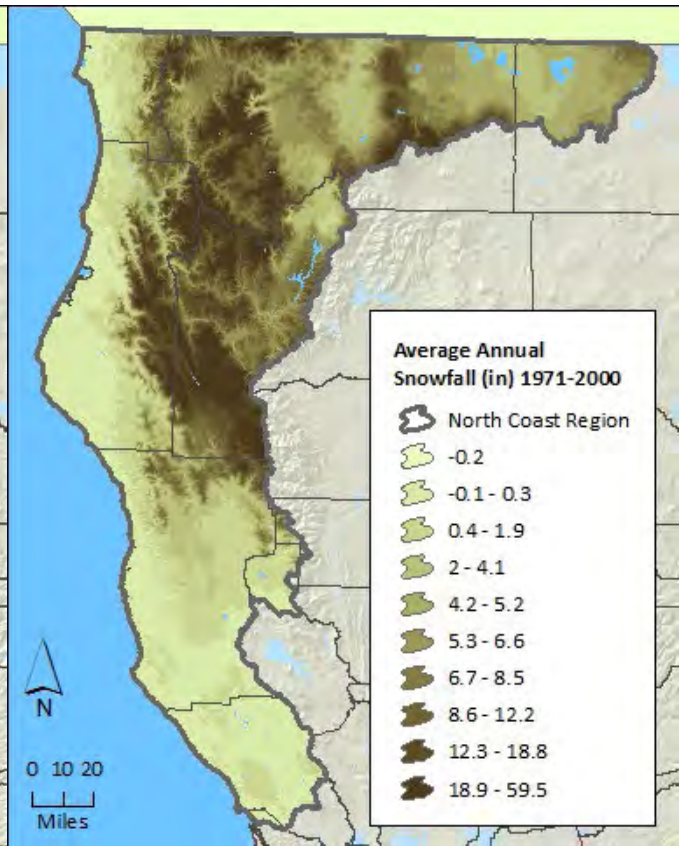


Map N2

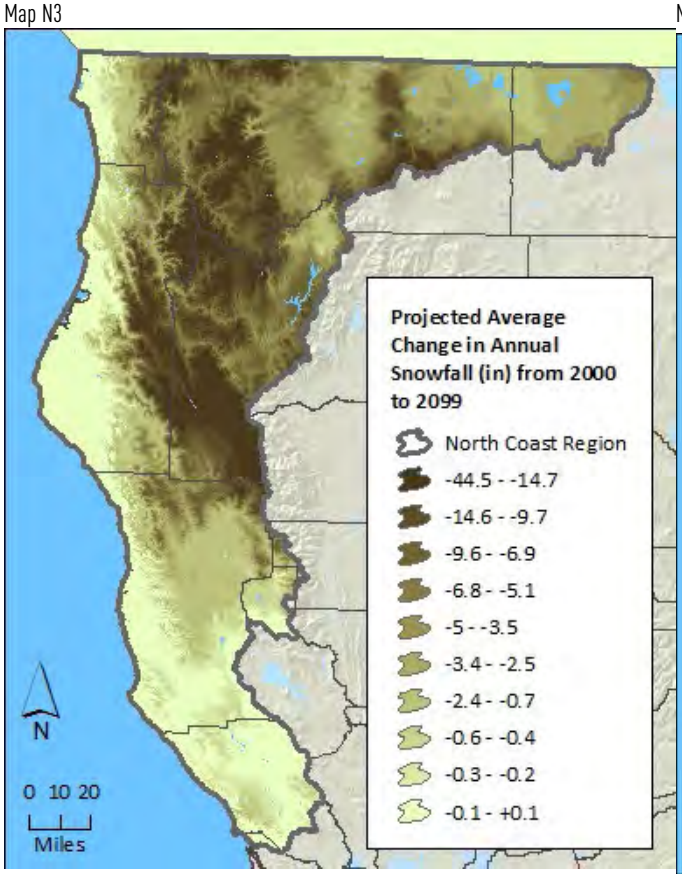
5 For more information on the Tribal climate change assessment (August 2013 Draft), contact Department of Water Resources erin.chappell@water.ca.gov
6 California Basin Characterization Model (BCM) downscaled climate and hydrology http://climate.calcommons.org/dataset/10



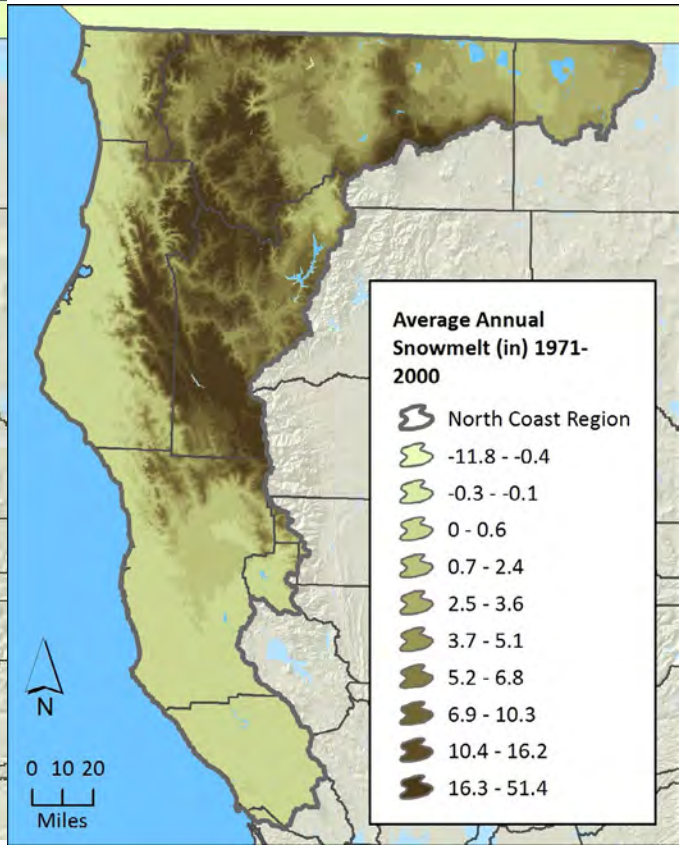
Map N3



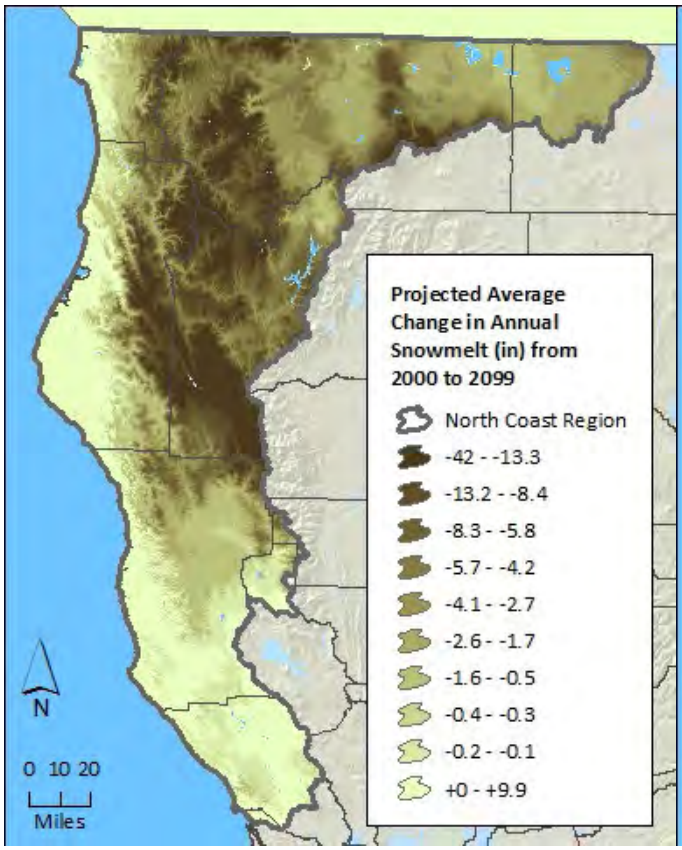
Map N4



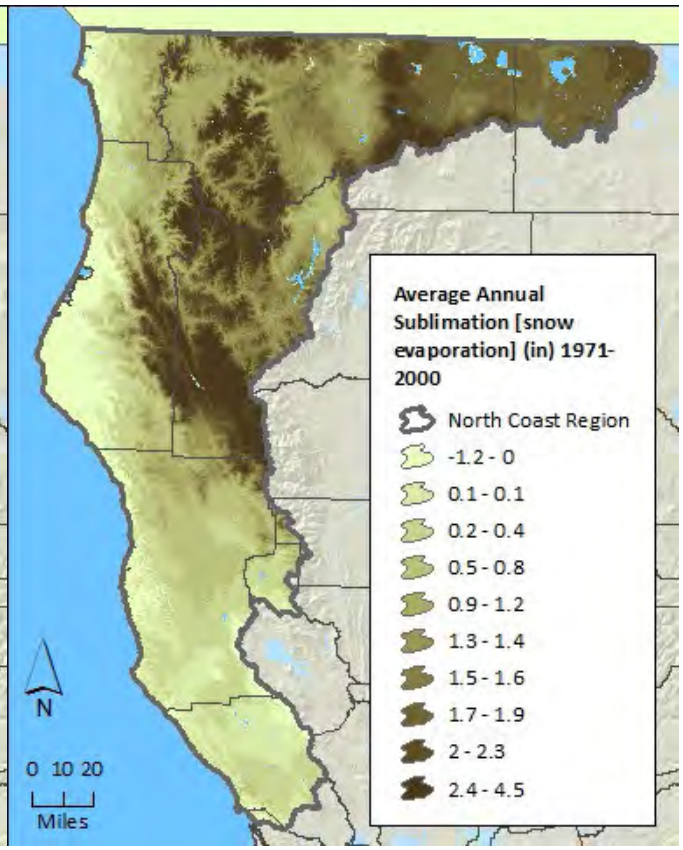
Map N5



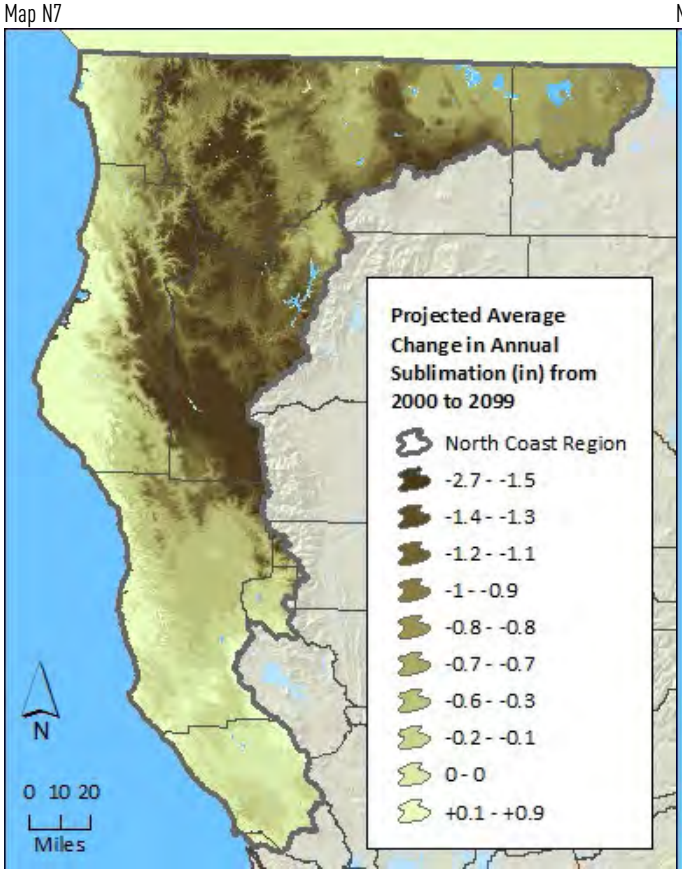
Map N6



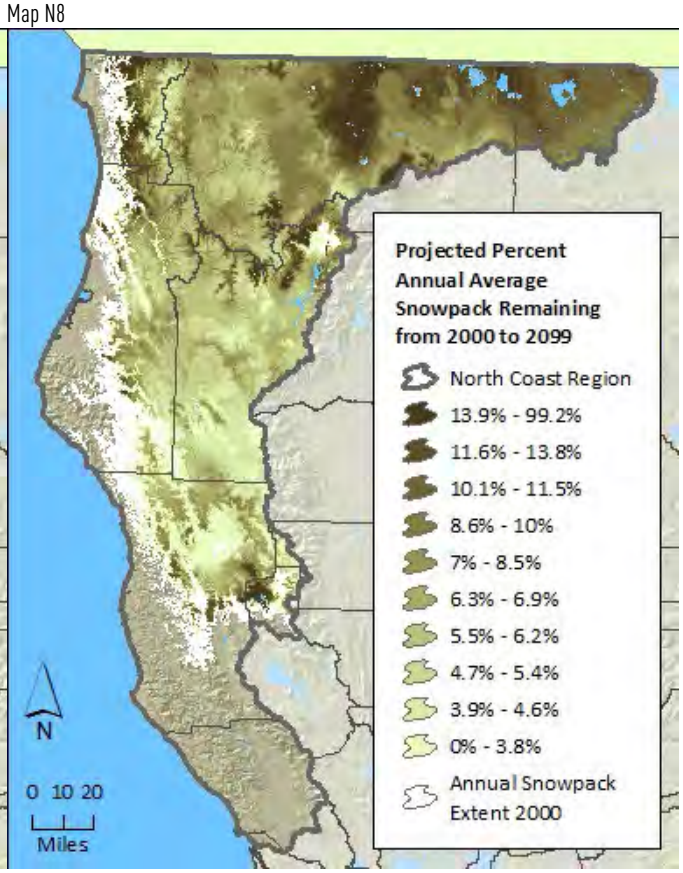
Map N7



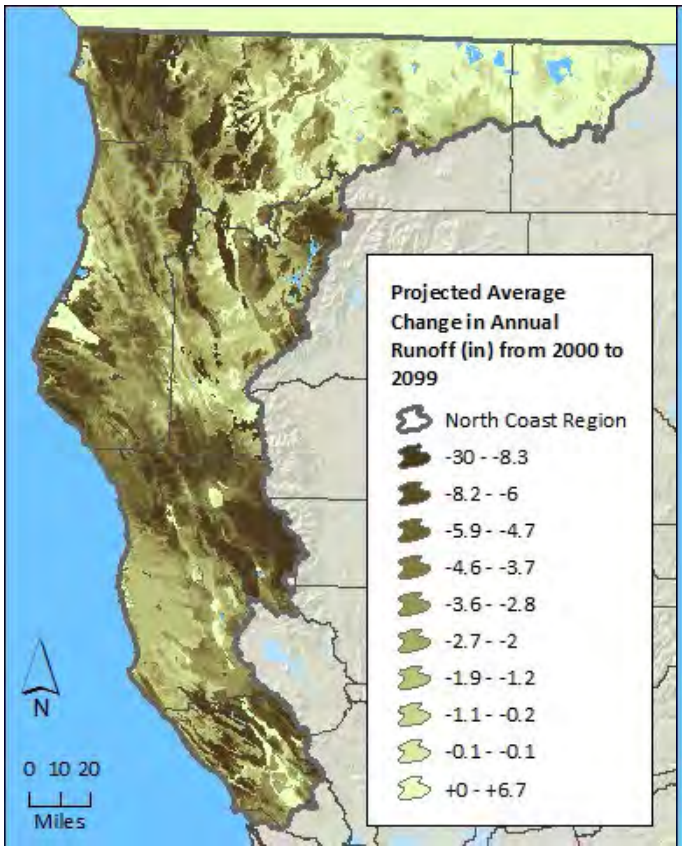
Map N8



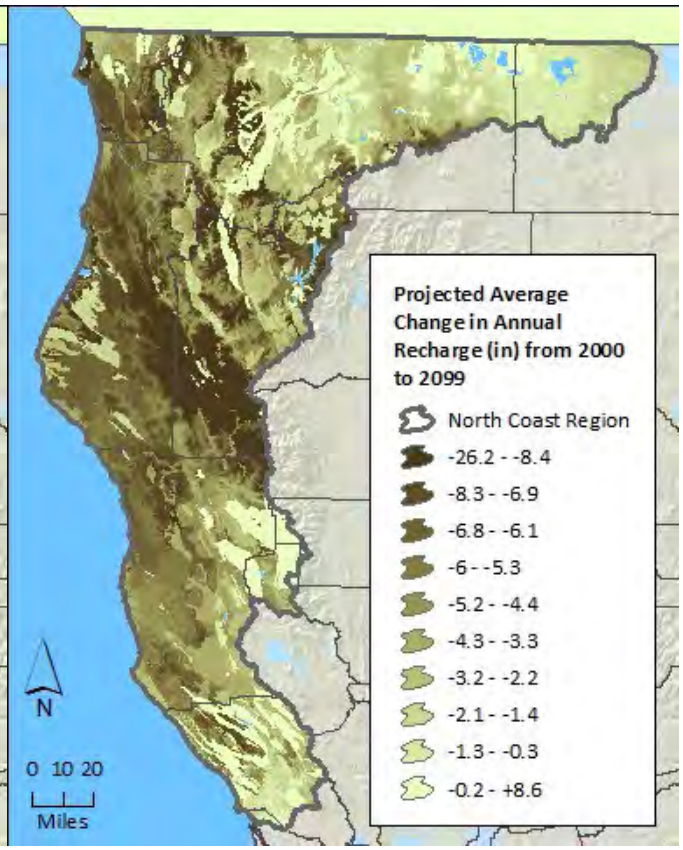
Map N9



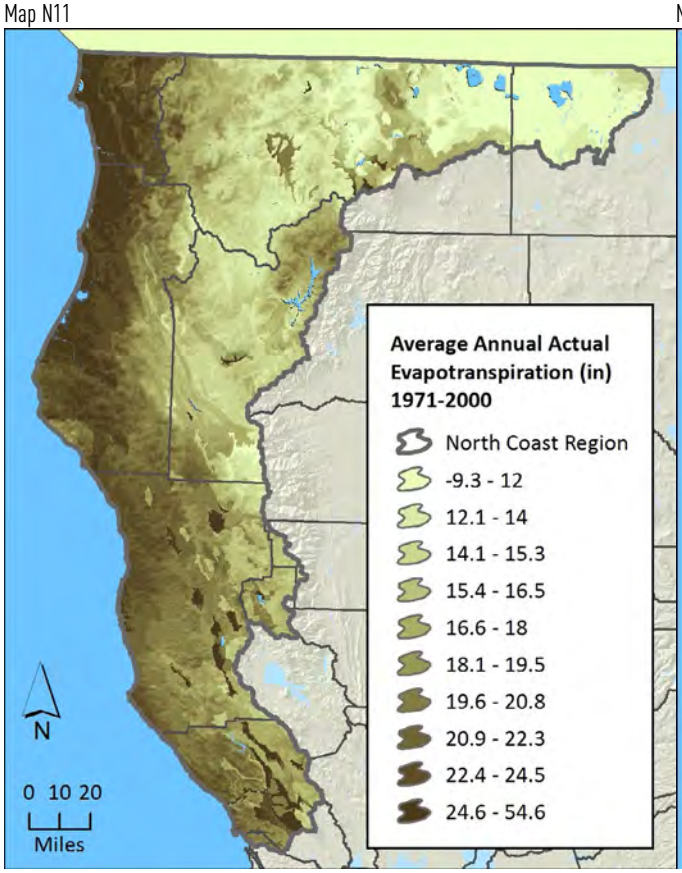
Map N10



Map N11



Map N12



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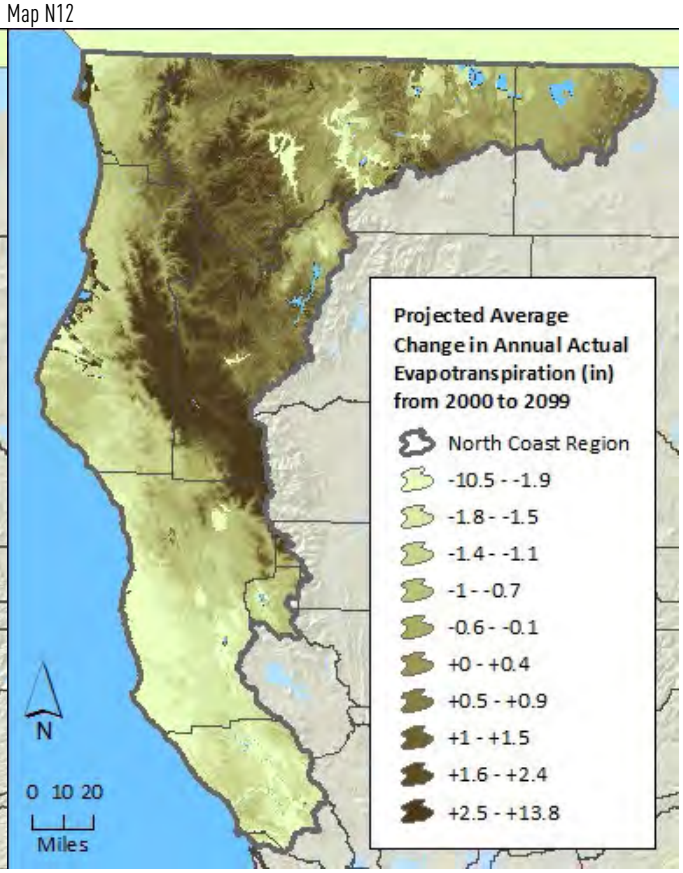

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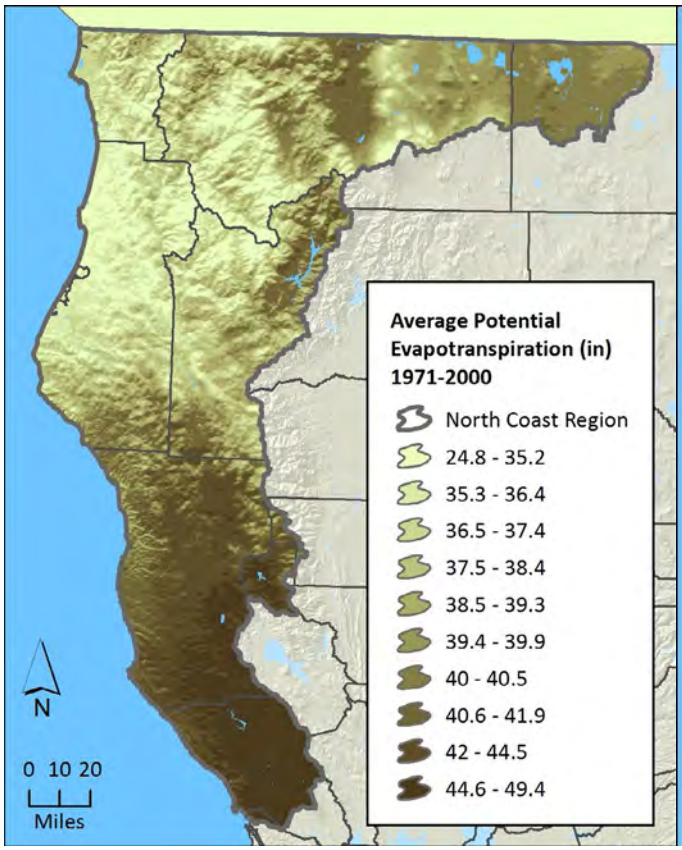

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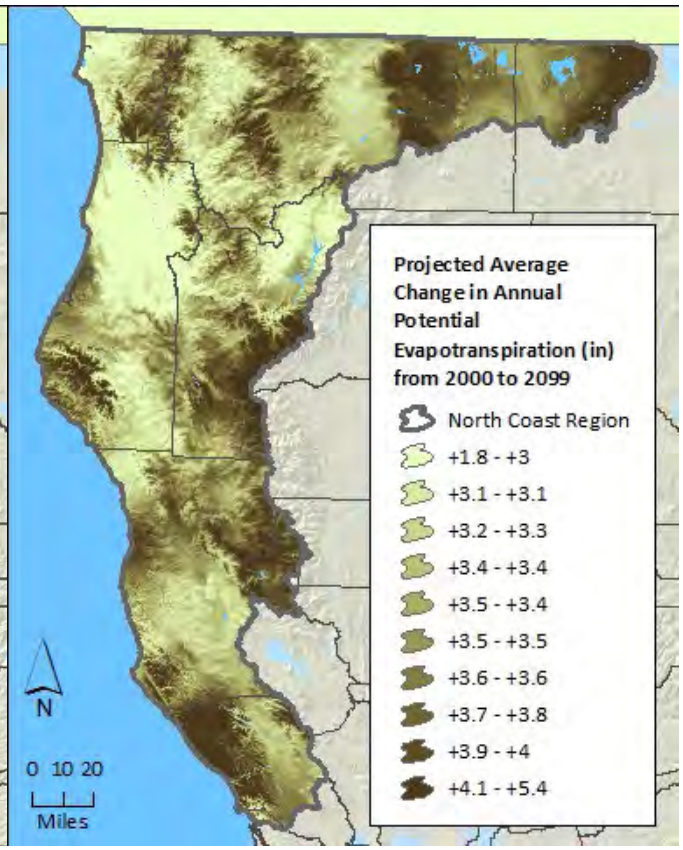
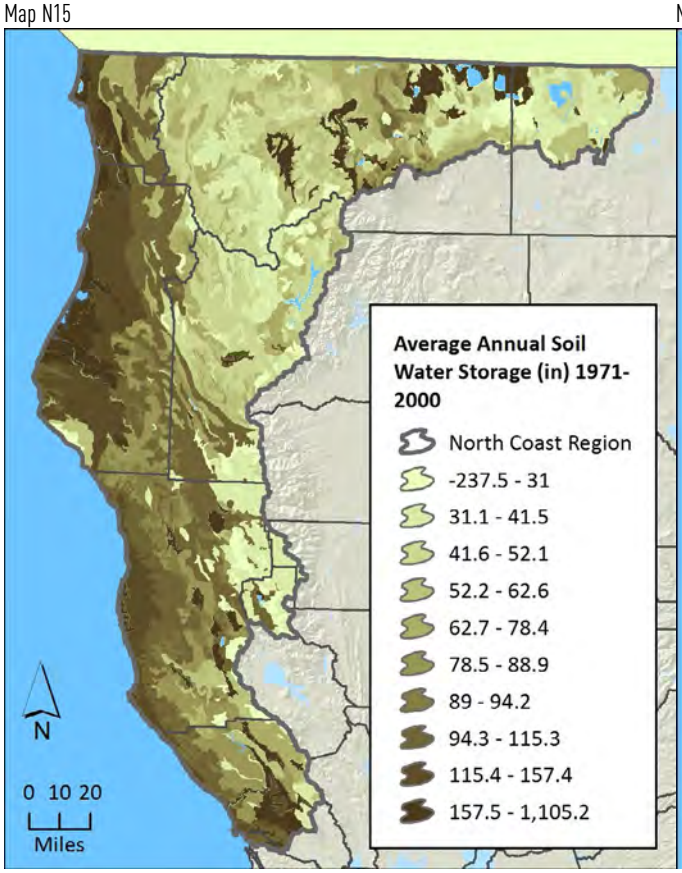
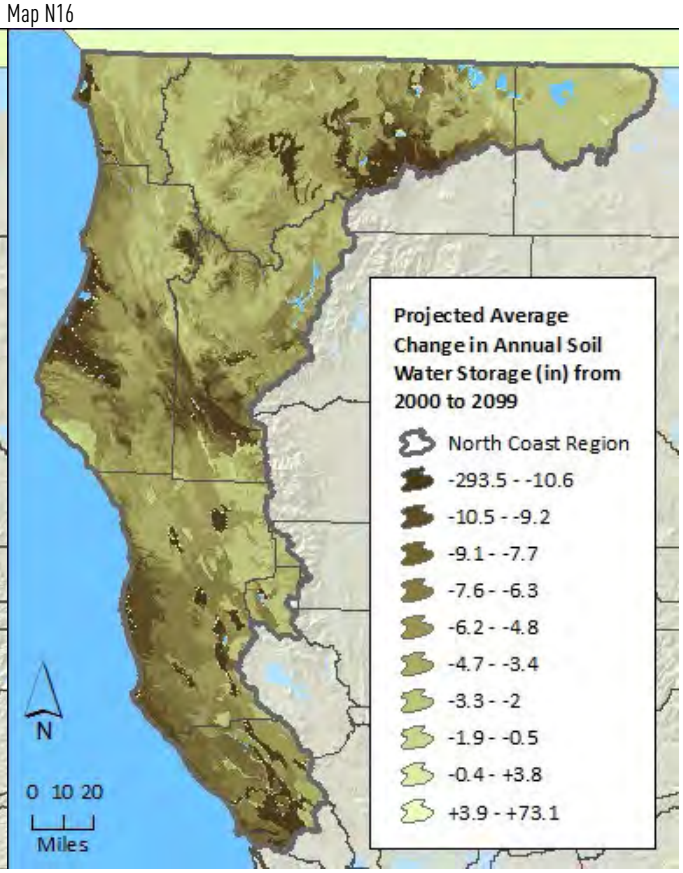


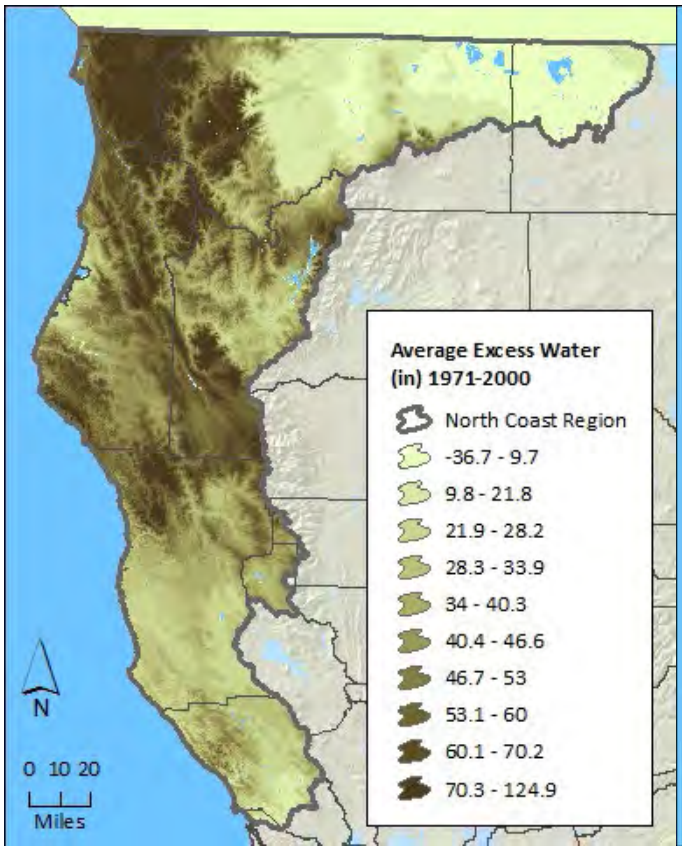
Map N16



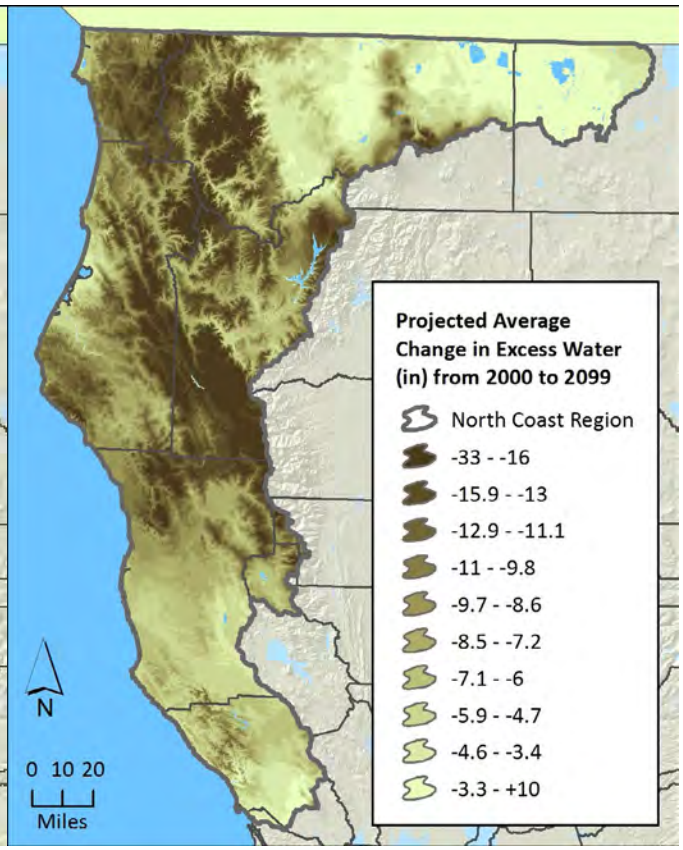
Map N17



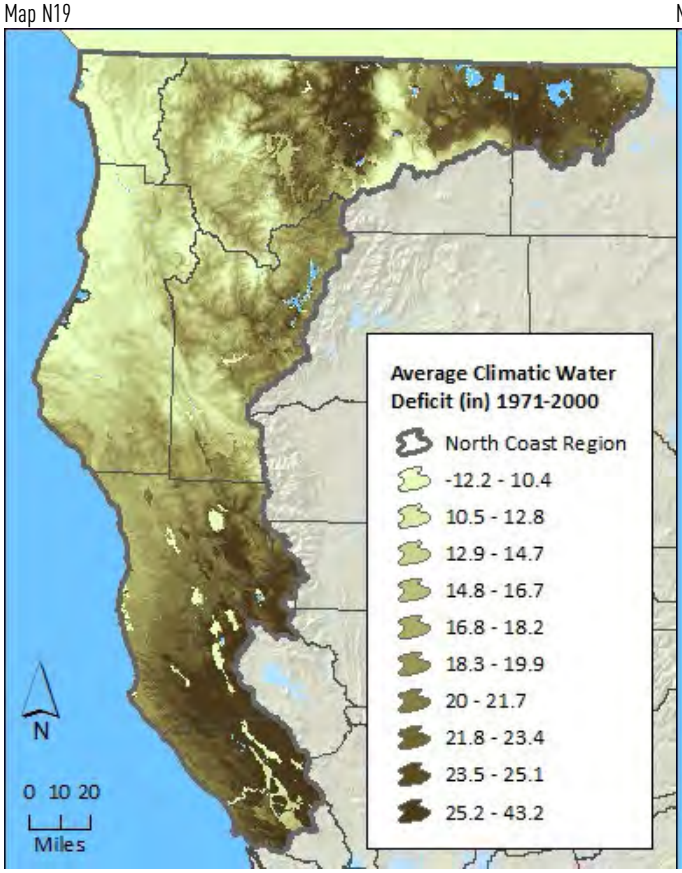
Map N18



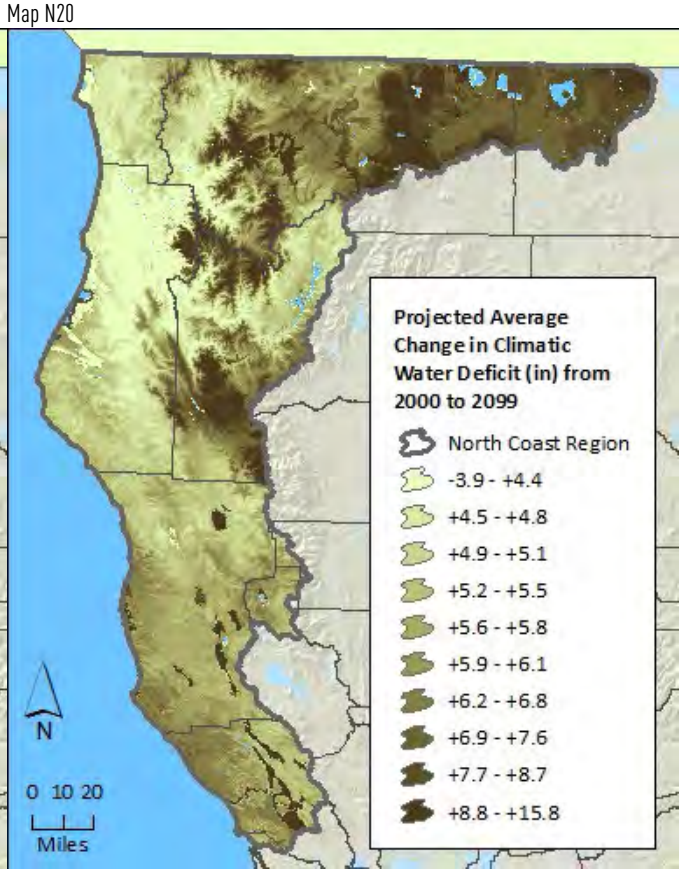
Map N19



Map N20



Map N21



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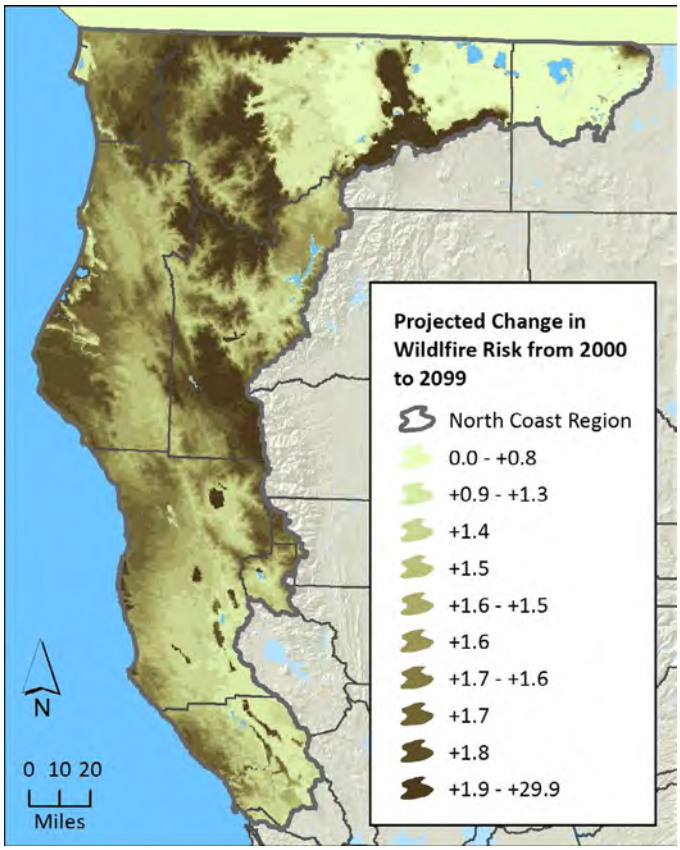

Projected Change in Wildlfire Risk from 2000 to 2099
North Coast Region
0.0 - +0.8
+0.9 - +1.3
+1.4
+1.5
+1.6 - +1.5
+1.6
+1.7 - +1.6
+1.7
+1.8
+1.9 - +29.9
N
0 10 20
Miles

Map N23

Appendix H

RESOLUTION NO. 2014-06

RESOLUTION OF THE
HUMBOLDT BAY MUNICIPAL WATER DISTRICT BOARD OF DIRECTORS

IMPLEMENTING THE STATE'S WATER SHORTAGE EMERGENCY REGULATIONS

WHEREAS, California is experiencing one of the most severe droughts on record; and

WHEREAS, Governor Brown declared a drought state of emergency on January 17, 2014, and called on all Californians to do their part to reduce their water use; and

WHEREAS, Governor Brown signed an Executive Order on April 25, 2014 calling on the State to redouble state drought actions; and

WHEREAS, extreme drought now covers nearly 80% of the state, and includes part of the Mad River Watershed, and these conditions will likely continue into the foreseeable future; and

WHEREAS, the District is in a unique situation with respect to its water supply. Ruth Reservoir filled to capacity and water demands have decreased significantly given loss of the pulp mills; therefore, the District has ample supply and is not experiencing a water supply shortage; and

WHEREAS, the Board of Directors recognize that water supplies elsewhere are low, and they adopted Resolution 2014-01 in May 2014 urging heightened awareness and water conservation efforts; and

WHEREAS, on July 15, 2014, the State Water Resources Control Board adopted Resolution No. 2014-0038 *"Adopting An Emergency Regulation for Statewide Urban Water Conservation"*; and

WHEREAS, the State requires water suppliers to activate their Water Shortage Contingency Plan to a level where outdoor irrigation restrictions are mandatory; and

WHEREAS, wholesalers are exempt from the requirements of the emergency regulations, but the District, in partnership with its wholesale Municipal Customers, supports the regulations prohibiting wasteful outdoor water practices.

NOW THEREFORE BE IT RESOLVED THAT THE BOARD OF DIRECTORS OF THE HUMBOLDT BAY MUNICIPAL WATER DISTRICT DO HEREBY:

I. Enact Stage 2 of the District's Water Shortage Contingency Plan to "Optimize Available Supply" by requesting voluntary water conservation measures with the municipalities.

II. Enact the following Prohibited Activities in Promotion of Water Conservation (Article 22.5. Sec. 864 Drought Emergency Water Conservation)

1) The application of potable water to outdoor landscapes in a manner that causes runoff such that water flows onto adjacent property, non-irrigated areas, private and public walkways, roadways, parking lots, or structures;
2) The use of a hose that dispenses potable water to wash a motor vehicle, except where the hose is fitted with a shut-off nozzle or device attached to it that causes it to cease dispensing water immediately when not in use;
3) The application of potable water to driveways and sidewalks; and
4) The use of potable water in a fountain or other decorative water feature, except where the water is part of a recirculation system.

III. This Resolution shall remain in effect for 270 days. Due to this State imposed time limit, this Resolution will sunset automatically 270 days from August 1, 2014, unless extended by the State or District Board of Director's action.

PASSED, APPROVED, and ADOPTED this 14th day of August 2014, on the following roll call vote:

AYES:
NOES:
ABSTAIN:
ABSENT:

ATTEST:

Aldaron Laird, Board President

J. Bruce Rupp, Secretary/Treasurer

RESOLUTION NO. 2015-03

RESOLUTION OF THE
HUMBOLDT BAY MUNICIPAL WATER DISTRICT BOARD OF DIRECTORS

IMPLEMENTING THE STATE'S UPDATED EMERGENCYWATER CONSERVATION REGULATIONS

WHEREAS, California is experiencing one of the most severe droughts on record; and

WHEREAS, Governor Brown declared a drought state of emergency on January 17, 2014, and called on all Californians to do their part to reduce their water use; and

WHEREAS, Governor Brown signed an Executive Order on April 25, 2014 calling on the State to redouble state drought actions; and

WHEREAS, last year, extreme drought covered nearly 80% of the state, and includes part of the Mad River Watershed, and these conditions will likely continue into the foreseeable future; and

WHEREAS, the District is in a unique situation with respect to its water supply. Ruth Reservoir filled to capacity last year and again this year, and water demands have decreased significantly given loss of the pulp mills; therefore, the District has ample supply and is not experiencing a water supply shortage; and

WHEREAS, the Board of Directors recognize that water supplies elsewhere are low, and they adopted Resolution 2014-01 in May 2014 urging heightened awareness and water conservation efforts; and

WHEREAS, on July 15, 2014, the State Water Resources Control Board adopted Resolution No. 2014-0038 *"Adopting An Emergency Regulation for Statewide Urban Water Conservation"*; and

WHEREAS, the State requires water suppliers to activate their Water Shortage Contingency Plan to a level where outdoor irrigation restrictions are mandatory; and

WHEREAS, wholesalers are exempt from the requirements of the emergency regulations, but the District, in partnership with its wholesale Municipal Customers, supports the regulations prohibiting wasteful outdoor water practices.

WHEREAS, drought conditions are continuing. As of March 3, 2015, snow water equivalents for the Northern, Central and Southern Sierra regions were at 16 percent, 20 percent and 21 percent of normal for that date, respectively. Additionally, most reservoirs are less than 60 percent full and January 2015 was one of the driest months ever recorded in California history. Moreover, many communities face the prospect of needing emergency drinking water supplies.; and

WHEREAS, on March 17, 2015, the State Water Resources Control Board adopted Resolution 2015-0013 *"To Adopt an Emergency Regulations for Statewide Urban Water Conservation"* that imposes further restrictions on water use and requires additional reporting requirements for urban water suppliers;

NOW THEREFORE BE IT RESOLVED THAT THE BOARD OF DIRECTORS OF THE HUMBOLDT BAY MUNICIPAL WATER DISTRICT DO HEREBY:

I. Enact the following Prohibited Activities in Promotion of Water Conservation (Article 22.5. Sec. 864 Drought Emergency Water Conservation)

1) The application of potable water to outdoor landscapes in a manner that causes runoff such that water flows onto adjacent property, non-irrigated areas, private and public walkways, roadways, parking lots, or structures;

2) The use of a hose that dispenses potable water to wash a motor vehicle, except where the hose is fitted with a shut-off nozzle or device attached to it that causes it to cease dispensing water immediately when not in use;

3) The application of potable water to driveways and sidewalks; and

4) The use of potable water in a fountain or other decorative water feature, except where the water is part of a recirculation system;

5) The use of outdoor irrigation during and 48 hours following measurable precipitation;

6) The use of outdoor irrigation of turf or ornamental landscapes is limited to no more than two days per week;

II. Commit to directly communicate with its 180 retail customers explaining the prohibited activities and emphasizing the importance of water conservation;

III. Commit to communicate to retail customers abnormally high water usage or determination of a leak within the customer's control.

IV. This Resolution shall remain in effect for 270 days. Due to this State imposed time limit, this Resolution will sunset automatically 270 days from March 27, 2015, unless extended by the State or District Board of Director's action.

PASSED, APPROVED, and ADOPTED this 9th day of April 2015, on the following roll call vote:

AYES:
NOES:
ABSTAIN:
ABSENT:

ATTEST:

Barbara Hecathorn, Board President

J. Bruce Rupp, Secretary Treasurer

RESOLUTION NO. 2015-07
(Amending Resolution 2015-03 Adopted April 9, 2015)

RESOLUTION OF THE
HUMBOLDT BAY MUNICIPAL WATER DISTRICT BOARD OF DIRECTORS

IMPLEMENTING THE STATE'S UPDATED
EMERGENCY WATER CONSERVATION REGULATIONS

WHEREAS, California is experiencing one of the most severe droughts on record; and

WHEREAS, Governor Brown declared a drought state of emergency on January 17, 2014, and called on all Californians to do their part to reduce their water use; and

WHEREAS, Governor Brown signed an Executive Order on April 25, 2014 calling on the State to redouble state drought actions; and

WHEREAS, last year, extreme drought covered nearly 80% of the state, and includes part of the Mad River Watershed, and these conditions will likely continue into the foreseeable future; and

WHEREAS, the District is in a unique situation with respect to its water supply. Ruth Reservoir filled to capacity last year and again this year, and water demands have decreased significantly given loss of the pulp mills; therefore, the District has ample supply and is not experiencing a water supply shortage; and

WHEREAS, the Board of Directors recognize that water supplies elsewhere are low, and they adopted Resolution 2014-01 in May 2014 urging heightened awareness and water conservation efforts; and

WHEREAS, on July 15, 2014, the State Water Resources Control Board adopted Resolution No. 2014-0038 *"Adopting An Emergency Regulation for Statewide Urban Water Conservation"*; and

WHEREAS, the State requires water suppliers to activate their Water Shortage Contingency Plan to a level where outdoor irrigation restrictions are mandatory; and

WHEREAS, wholesalers are exempt from the requirements of the emergency regulations, but the District, in partnership with its wholesale Municipal Customers, supports the regulations prohibiting wasteful outdoor water practices; and

WHEREAS, drought conditions are continuing. As of March 3, 2015, snow water equivalents for the Northern, Central and Southern Sierra regions were at 16 percent, 20 percent and 21 percent of normal for that date, respectively. Additionally, most reservoirs are less than 60 percent full and January 2015 was one of the driest months ever recorded in California history. Moreover, many communities face the prospect of needing emergency drinking water supplies.; and

WHEREAS, on March 17, 2015, the State Water Resources Control Board adopted Resolution 2015-0013 *"To Adopt an Emergency Regulations for Statewide Urban Water Conservation"* that imposes further restrictions on water use and requires additional reporting requirements for urban water suppliers; and

WHEREAS, on April 1, 2015, California's Governor issued an Executive Order that directed the State Water Resources Control Board to impose further restrictions on water suppliers to achieve a statewide twenty-five percent (25%) reduction in potable water usage through February 28, 2016;

NOW THEREFORE BE IT RESOLVED THAT THE BOARD OF DIRECTORS OF THE HUMBOLDT BAY MUNICIPAL WATER DISTRICT DO HEREBY:

I. A) Enact the following Prohibited Activities in Promotion of Water Conservation (Article 22.5. Sec. 864 Drought Emergency Water Conservation)

1) The application of potable water to outdoor landscapes in a manner that causes runoff such that water flows onto adjacent property, non-irrigated areas, private and public walkways, roadways, parking lots, or structures;

2) The use of a hose that dispenses potable water to wash a motor vehicle, except where the hose is fitted with a shut-off nozzle or device attached to it that causes it to cease dispensing water immediately when not in use;

3) The application of potable water to driveways and sidewalks; and

4) The use of potable water in a fountain or other decorative water feature, except where the water is part of a recirculation system;

5) The use of outdoor irrigation during and 48 hours following measurable precipitation;

6) The use of outdoor irrigation of turf or ornamental landscapes is limited to the following two days per week: Wednesday and Saturday;

B) The taking of any action prohibited in subdivision A of this section, in addition to any other applicable civil or criminal penalties, may be either an infraction, punishable by a fine or may be prosecuted as a misdemeanor, punishable by fine and imprisonment in the county jail or both, in accordance with Ordinance 21of the Humboldt Bay Municipal Water District.

II. Commit to directly communicate with its 180 retail customers explaining the prohibited activities and emphasizing the importance of water conservation;

III. Commit to communicate to retail customers abnormally high water usage or determination of a leak within the customer's control.

IV. This Resolution shall remain in effect for 270 days. Due to this State imposed time limit, this Resolution will sunset automatically 270 days from May 5, 2015, unless extended by the State or District Board of Director's action.

PASSED, APPROVED, and ADOPTED this 18th day of June 2015, on the following roll call vote:

AYES: Directors Hecathorn, Laird, Rupp, Sopoci-Belknap and Woo
NOES: None
ABSTAIN: None
ABSENT: None

ATTEST:

Barbara Hecathorn, Board President

J. Bruce Rupp, Secretary Treasurer

Appendix I

AWWA Free Water Audit Software v5.0

This spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water distribution systems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format, and is not meant to take the place of a full-scale, comprehensive water audit format.

Auditors are strongly encouraged to refer to the most current edition of AWWA M36 Manual for Water Audits for detailed guidance on the water auditing process and targetting loss reduction levels

The spreadsheet contains several separate worksheets. Sheets can be accessed using the tabs towards the bottom of the screen, or by clicking the buttons below.

Please begin by providing the following information

Name of Contact Person:	Thavisak Syphanthong
Email Address:	reportnotifications@hbmwd.com
Telephone | Ext.:	707-443-5018
Name of City / Utility:	Humboldt Bay Municipal Water District
City/Town/Municipality:	Eureka
State / Province:	California (CA)
Country:	USA
Year:	2015 Calendar Year
Audit Preparation Date:	4/25/2016
Volume Reporting Units:	Acre-feet
PWSID / Other ID:	CA1210013

The following guidance will help you complete the Audit

All audit data are entered on the ***Reporting Worksheet***

- Value can be entered by user
- Value calculated based on input data
- These cells contain recommended default values

Use of Option (Radio) Buttons: Pcnt: 0.25% Value:

Select the default percentage by choosing the option button on the left

To enter a value, choose this button and enter a value in the cell to the right

The following worksheets are available by clicking the buttons below or selecting the tabs along the bottom of the page

Instructions
The current sheet. Enter contact information and basic audit details (year, units etc)

Reporting Worksheet
Enter the required data on this worksheet to calculate the water balance and data grading

Comments
Enter comments to explain how values were calculated or to document data sources

Performance Indicators
Review the performance indicators to evaluate the results of the audit

Water Balance
The values entered in the Reporting Worksheet are used to populate the Water Balance

Dashboard
A graphical summary of the water balance and Non-Revenue Water components

Grading Matrix
Presents the possible grading options for each input component of the audit

Service Connection Diagram
Diagrams depicting possible customer service connection line configurations

Definitions
Use this sheet to understand the terms used in the audit process

Loss Control Planning
Use this sheet to interpret the results of the audit validity score and performance indicators

Example Audits
Reporting Worksheet and Performance Indicators examples are shown for two validated audits

Acknowledgements
Acknowledgements for the AWWA Free Water Audit Software v5.0

If you have questions or comments regarding the software please contact us via email at: wlc@awwa.org

AWWA Free Water Audit Software: Reporting Worksheet

WAS v5.0

? Click to access definition
+ Click to add a comment

Water Audit Report for: Humboldt Bay Municipal Water District (CA1210013)
Reporting Year: 2015 | 1/2015 - 12/2015

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

Master Meter and Supply Error Adjustments

WATER SUPPLIED

<---------- Enter grading in column 'E' and 'J' ---------->

					Pcnt:	Value:	
Volume from own sources:	10	9,961.072	acre-ft/yr	10			acre-ft/yr
Water imported:	n/a	0.000	acre-ft/yr				acre-ft/yr
Water exported:	10	9,282.008	acre-ft/yr				acre-ft/yr

Enter negative % or value for under-registration
Enter positive % or value for over-registration

WATER SUPPLIED: 679.064 acre-ft/yr

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

			Pcnt:	Value:	
Billed metered:	9	616.679	acre-ft/yr			
Billed unmetered:	1	0.000	acre-ft/yr			
Unbilled metered:	10	2.630	acre-ft/yr			
Unbilled unmetered:	9	0.353	acre-ft/yr		0.353	acre-ft/yr

Use buttons to select percentage of water supplied **OR** value

AUTHORIZED CONSUMPTION: 619.662 acre-ft/yr

WATER LOSSES (Water Supplied - Authorized Consumption) 59.402 acre-ft/yr

Apparent Losses

			Pcnt:	Value:	
Unauthorized consumption:	10	0.042	acre-ft/yr		0.042	acre-ft/yr
Customer metering inaccuracies:	10	0.005	acre-ft/yr		0.005	acre-ft/yr
Systematic data handling errors:	10	0.005	acre-ft/yr		0.005	acre-ft/yr

Apparent Losses: 0.052 acre-ft/yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: 59.350 acre-ft/yr

WATER LOSSES: 59.402 acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: 62.385 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	10	17.5	miles
Number of active AND inactive service connections:	8	210	
Service connection density:		12	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: (length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure: 10 90.0 psi

COST DATA

Total annual cost of operating water system:	10	$409,800	$/Year	
Customer retail unit cost (applied to Apparent Losses):	10	$1.77	$/100 cubic feet (ccf)	
Variable production cost (applied to Real Losses):	6	$661.33	$/acre-ft	☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

*** YOUR SCORE IS: 96 out of 100 ***

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Variable production cost (applied to Real Losses)
2: Billed metered
3: Number of active AND inactive service connections

AWWA Free Water Audit Software:
System Attributes and Performance Indicators

Water Audit Report for: Humboldt Bay Municipal Water District (CA1210013)
Reporting Year: 2015 | 1/2015 - 12/2015

*** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 96 out of 100 ***

System Attributes:

	Apparent Losses:	0.052	acre-ft/yr
+	Real Losses:	59.350	acre-ft/yr
=	Water Losses:	59.402	acre-ft/yr
?	Unavoidable Annual Real Losses (UARL):	See limits in definition	acre-ft/yr
	Annual cost of Apparent Losses:	$40	
	Annual cost of Real Losses:	$39,250	Valued at Variable Production Cost

Return to Reporting Worksheet to change this assumpiton

Performance Indicators:

Financial:	Non-revenue water as percent by volume of Water Supplied:	9.2%	
	Non-revenue water as percent by cost of operating system:	10.1%	Real Losses valued at Variable Production Cost
Operational Efficiency:	Apparent Losses per service connection per day:	0.22	gallons/connection/day
	Real Losses per service connection per day:	N/A	gallons/connection/day
	Real Losses per length of main per day*:	3,027.67	gallons/mile/day
	Real Losses per service connection per day per psi pressure:	N/A	gallons/connection/day/psi

	From Above, Real Losses = Current Annual Real Losses (CARL):	59.35	acre-feet/year
?	Infrastructure Leakage Index (ILI) [CARL/UARL]:		

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline

Use this worksheet to add comments or notes to explain how an input value was calculated, or to document the sources of the information used.

General Comment:	

Audit Item	Comment
Volume from own sources:	
Vol. from own sources: Master meter error adjustment:	
Water imported:	
Water imported: master meter error adjustment:	
Water exported:	
Water exported: master meter error adjustment:	
Billed metered:	
Billed unmetered:	
Unbilled metered:	

Audit Item	Comment
Unbilled unmetered:	
Unauthorized consumption:	
Customer metering inaccuracies:	
Systematic data handling errors:	
Length of mains:	
Number of active AND inactive service connections:	
Average length of customer service line:	
Average operating pressure:	
Total annual cost of operating water system:	
Customer retail unit cost (applied to Apparent Losses):	
Variable production cost (applied to Real Losses):	

AWWA Free Water Audit Software: Water Balance

WAS v5.0

Water Audit Report for:	**Humboldt Bay Municipal Water District (CA1210013)**	
Reporting Year:	**2015**	**1/2015 - 12/2015**
Data Validity Score:	**96**	

Water Exported
9,282.008

Billed Water Exported

Revenue Water
9,282.008

Own Sources
(Adjusted for known errors)
9,961.072

Water Imported
0.000

System Input
9,961.072

Water Supplied
679.064

Authorized Consumption
619.662

Billed Authorized Consumption
616.679

Billed Metered Consumption (water exported is removed)
616.679

Billed Unmetered Consumption
0.000

Revenue Water
616.679

Unbilled Authorized Consumption
2.983

Unbilled Metered Consumption
2.630

Unbilled Unmetered Consumption
0.353

Non-Revenue Water (NRW)
62.385

Water Losses
59.402

Apparent Losses
0.052

Unauthorized Consumption
0.042

Customer Metering Inaccuracies
0.005

Systematic Data Handling Errors
0.005

Real Losses
59.350

Leakage on Transmission and/or Distribution Mains
Not broken down

Leakage and Overflows at Utility's Storage Tanks
Not broken down

Leakage on Service Connections
Not broken down

AWWA Free Water Audit Software:
Dashboard

WAS v5.0

The graphic below is a visual representation of the Water Balance with bar heights propotional to the volume of the audit components

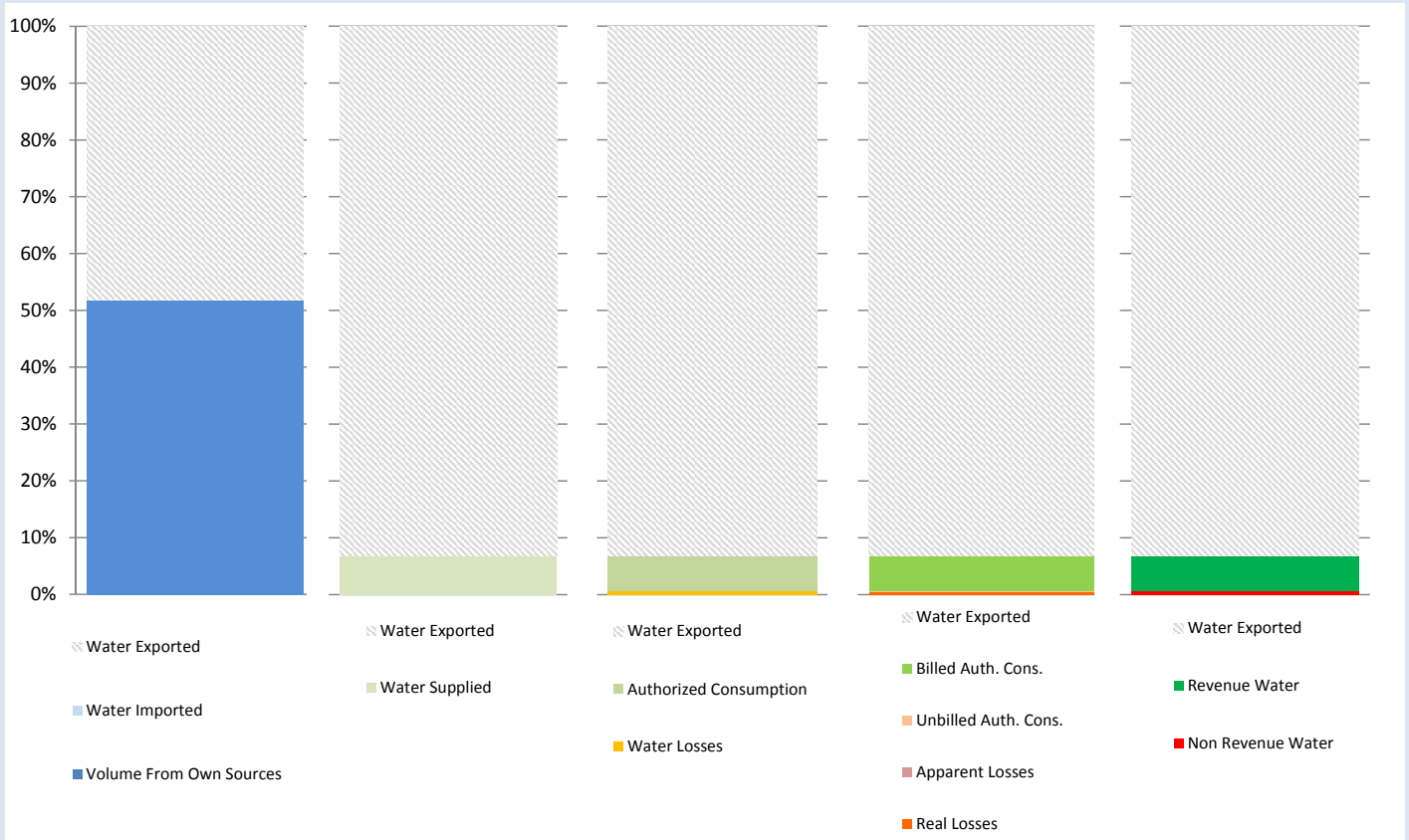
Water Audit Report for: **Humboldt Bay Municipal Water District (CA1210013)**

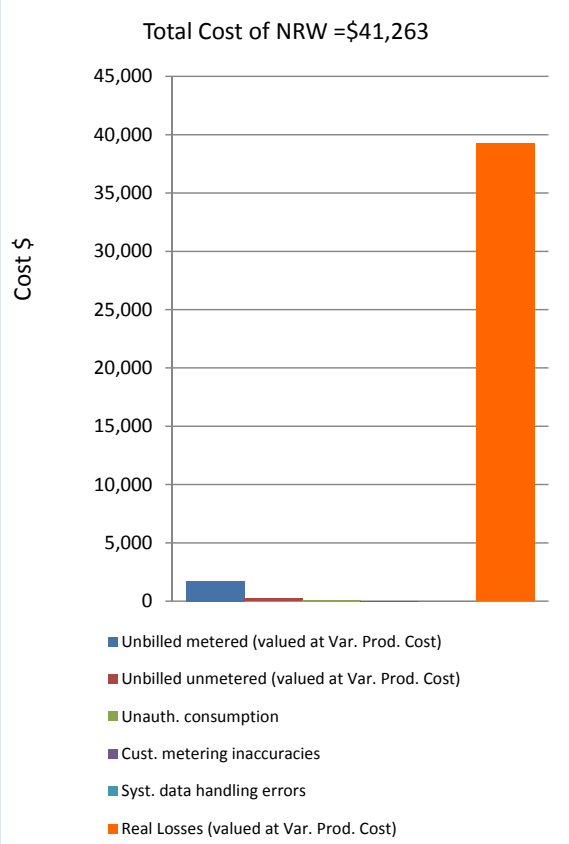
Reporting Year: **2015** **1/2015 - 12/2015**

Data Validity Score: **96**

○ Show me the VOLUME of Non-Revenue Water

◉ Show me the COST of Non-Revenue Water





AWWA Free Water Audit Software: Grading Matrix

WAS 5.0

The grading assigned to each audit component and the corresponding recommended improvements and actions are highlighted in yellow. Audit accuracy is likely to be improved by prioritizing those items shown in red

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
WATER SUPPLIED											
Volume from own sources:	Select this grading only if the water utility purchases/imports all of its water resources (i.e. has no sources of its own)	Less than 25% of water production sources are metered, remaining sources are estimated. No regular meter accuracy testing or electronic calibration conducted.	25% - 50% of treated water production sources are metered; other sources estimated. No regular meter accuracy testing or electronic calibration conducted.	Conditions between 2 and 4	50% - 75% of treated water production sources are metered, other sources estimated. Occasional meter accuracy testing or electronic calibration conducted.	Conditions between 4 and 6	At least 75% of treated water production sources are metered, or at least 90% of the source flow is derived from metered sources. Meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually. Less than 25% of tested meters are found outside of +/- 6% accuracy.	Conditions between 6 and 8	100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy	Conditions between 8 and 10	100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually, with less than 10% found outside of +/- 3% accuracy. Procedures are reviewed by a third party knowledgeable in the M36 methodology.
Improvements to attain higher data grading for "Volume from own Sources" component:		to qualify for 2: Organize and launch efforts to collect data for determining volume from own sources	to qualify for 4: Locate all water production sources on maps and in the field, launch meter accuracy testing for existing meters, begin to install meters on unmetered water production sources and replace any obsolete/defective meters.		to qualify for 6: Formalize annual meter accuracy testing for all source meters; specify the frequency of testing. Complete installation of meters on unmetered water production sources and complete replacement of all obsolete/defective meters.		to qualify for 8: Conduct annual meter accuracy testing and calibration of related instrumentation on all meter installations on a regular basis. Complete project to install new, or replace defective existing, meters so that entire production meter population is metered. Repair or replace meters outside of +/- 6% accuracy.		to qualify for 10: Maintain annual meter accuracy testing and calibration of related instrumentation for all meter installations. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to further improve meter accuracy.		to maintain 10: Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology.
Volume from own sources master meter and supply error adjustment:	Select n/a only if the water utility fails to have meters on its sources of supply	Inventory information on meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined	No automatic datalogging of production volumes; daily readings are scribed on paper records without any accountability controls. Flows are not balanced across the water distribution system: tank/storage elevation changes are not employed in calculating the "Volume from own sources" component and archived flow data is adjusted only when grossly evident data error occurs.	Conditions between 2 and 4	Production meter data is logged automatically in electronic format and reviewed at least on a monthly basis with necessary corrections implemented. "Volume from own sources" tabulations include estimate of daily changes in tanks/storage facilities. Meter data is adjusted when gross data errors occur, or occasional meter testing deems this necessary.	Conditions between 4 and 6	Hourly production meter data logged automatically & reviewed on at least a weekly basis. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and/or error is confirmed by meter accuracy testing. Tank/storage facility elevation changes are automatically used in calculating a balanced "Volume from own sources" component, and data gaps in the archived data are corrected on at least a weekly basis.	Conditions between 6 and 8	Continuous production meter data is logged automatically & reviewed each business day. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and/or results of meter accuracy testing. Tank/storage facility elevation changes are automatically used in "Volume from own sources" tabulations and data gaps in the archived data are corrected on a daily basis.	Conditions between 8 and 10	Computerized system (SCADA or similar) automatically balances flows from all sources and storages; results are reviewed each business day. Tight accountability controls ensure that all data gaps that occur in the archived flow data are quickly detected and corrected. Regular calibrations between SCADA and sources meters ensures minimal data transfer error.
Improvements to attain higher data grading for "Master meter and supply error adjustment" component:		to qualify for 2: Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature.	to qualify for 4: Install automatic datalogging equipment on production meters. Complete installation of level instrumentation at all tanks/storage facilities and include tank level data in automatic calculation routine in a computerized system. Construct a computerized listing or spreadsheet to archive input volumes, tank/storage volume changes and import/export flows in order to determine the composite "Water Supplied" volume for the distribution system. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps.		to qualify for 6: Refine computerized data collection and archive to include hourly production meter data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Use daily net storage change to balance flows in calculating "Water Supplied" volume. Necessary corrections to data errors are implemented on a weekly basis.		to qualify for 8: Ensure that all flow data is collected and archived on at least an hourly basis. All data is reviewed and detected errors corrected each business day. Tank/storage levels variations are employed in calculating balanced "Water Supplied" component. Adjust production meter data for gross error and inaccuracy confirmed by testing.		to qualify for 10: Link all production and tank/storage facility elevation change data to a Supervisory Control & Data Acquisition (SCADA) System, or similar computerized monitoring/control system, and establish automatic flow balancing algorithm and regularly calibrate between SCADA and source meters. Data is reviewed and corrected each business day.		to maintain 10: Monitor meter innovations for development of more accurate and less expensive flowmeters. Continue to replace or repair meters as they perform outside of desired accuracy limits. Stay abreast of new and more accurate water level instruments to better record tank/storage levels and archive the variations in storage volume. Keep current with SCADA and data management systems to ensure that archived data is well-managed and error free.
Water Imported:	Select n/a if the water utility's supply is exclusively from its own water resources (no bulk purchased/ imported water)	Less than 25% of imported water sources are metered, remaining sources are estimated. No regular meter accuracy testing.	25% - 50% of imported water sources are metered; other sources estimated. No regular meter accuracy testing.	Conditions between 2 and 4	50% - 75% of imported water sources are metered, other sources estimated. Occasional meter accuracy testing conducted.	Conditions between 4 and 6	At least 75% of imported water sources are metered, meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually for all meter installations. Less than 25% of tested meters are found outside of +/- 6% accuracy.	Conditions between 6 and 8	100% of imported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy	Conditions between 8 and 10	100% of imported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually for all meter installations, with less than 10% of accuracy tests found outside of +/- 3% accuracy.
Improvements to attain higher data grading for "Water Imported Volume" component: (*Note: usually the water supplier selling the water - "the Exporter" - to the utility being audited is responsible to maintain the metering installation measuring the imported volume. The utility should coordinate carefully with the Exporter to ensure that adequate meter upkeep takes place and an accurate measure of the Water Imported volume is quantified.*)		to qualify for 2: Review bulk water purchase agreements with partner suppliers; confirm requirements for use and maintenance of accurate metering. Identify needs for new or replacement meters with goal to meter all imported water sources.	To qualify for 4: Locate all imported water sources on maps and in the field, launch meter accuracy testing for existing meters, begin to install meters on unmetered imported water interconnections and replace obsolete/defective meters.		to qualify for 6: Formalize annual meter accuracy testing for all imported water meters, planning for both regular meter accuracy testing and calibration of the related instrumentation. Continue installation of meters on unmetered imported water interconnections and replacement of obsolete/defective meters.		to qualify for 8: Complete project to install new, or replace defective, meters on all imported water interconnections. Maintain annual meter accuracy testing for all imported water meters and conduct calibration of related instrumentation at least annually. Repair or replace meters outside of +/- 6% accuracy.		to qualify for 10: Conduct meter accuracy testing for all meters on a semi-annual basis, along with calibration of all related instrumentation. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to improve meter accuracy.		to maintain 10: Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Continue to conduct calibration of related instrumentation on a semi-annual basis. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology.

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Water imported master meter and supply error adjustment:	Select n/a if the Imported water supply is unmetered, with Imported water quantities estimated on the billing invoices sent by the Exporter to the purchasing Utility.	Inventory information on imported meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined Written agreement(s) with water Exporter(s) are missing or written in vague language concerning meter management and testing.	No automatic datalogging of imported supply volumes; daily readings are scribed on paper records without any accountability controls to confirm data accuracy and the absence of errors and data gaps in recorded volumes. Written agreement requires meter accuracy testing but is vague on the details of how and who conducts the testing.	Conditions between 2 and 4	Imported supply metered flow data is logged automatically in electronic format and reviewed at least on a monthly basis by the Exporter with necessary corrections implemented. Meter data is adjusted by the Exporter when gross data errors are detected. A coherent data trail exists for this process to protect both the selling and the purchasing Utility. Written agreement exists and clearly states requirements and roles for meter accuracy testing and data management.	Conditions between 4 and 6	Hourly Imported supply metered data is logged automatically & reviewed on at least a weekly basis by the Exporter. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and to correct for error confirmed by meter accuracy testing. Any data gaps in the archived data are detected and corrected during the weekly review. A coherent data trail exists for this process to protect both the selling and the purchasing Utility.	Conditions between 6 and 8	Continuous Imported supply metered flow data is logged automatically & reviewed each business day by the Exporter. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and/or results of meter accuracy testing. Any data errors/gaps are detected and corrected on a daily basis. A data trail exists for the process to protect both the selling and the purchasing Utility.	Conditions between 8 and 10	Computerized system (SCADA or similar) automatically records data which is reviewed each business day by the Exporter. Tight accountability controls ensure that all error/data gaps that occur in the archived flow data are quickly detected and corrected. A reliable data trail exists and contract provisions for meter testing and data management are reviewed by the selling and purchasing Utility at least once every five years.
Improvements to attain higher data grading for "Water imported master meter and supply error adjustment" component:		to qualify for 2: Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature. Review the written agreement between the selling and purchasing Utility.	to qualify for 4: Install automatic datalogging equipment on Imported supply meters. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps. Launch discussions with the Exporters to jointly review terms of the written agreements regarding meter accuracy testing and data management; revise the terms as necessary.		to qualify for 6: Refine computerized data collection and archive to include hourly Imported supply metered flow data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Make necessary corrections to errors/data errors on a weekly basis.		to qualify for 8: Ensure that all Imported supply metered flow data is collected and archived on at least an hourly basis. All data is reviewed and errors/data gaps are corrected each business day.		to qualify for 10: Conduct accountability checks to confirm that all Imported supply metered data is reviewed and corrected each business day by the Exporter. Results of all meter accuracy tests and data corrections should be available for sharing between the Exporter and the purchasing Utility. Establish a schedule for a regular review and updating of the contractual language in the written agreement between the selling and the purchasing Utility; at least every five years.		to maintain 10: Monitor meter innovations for development of more accurate and less expensive flowmeters; work with the Exporter to help identify meter replacement needs. Keep communication lines with Exporters open and maintain productive relations. Keep the written agreement current with clear and explicit language that meets the ongoing needs of all parties.
Water Exported:	Select n/a if the water utility sells no bulk water to neighboring water utilities (no exported water sales)	Less than 25% of exported water sources are metered, remaining sources are estimated. No regular meter accuracy testing.	25% - 50% of exported water sources are metered; other sources estimated. No regular meter accuracy testing.	Conditions between 2 and 4	50% - 75% of exported water sources are metered, other sources estimated. Occasional meter accuracy testing conducted.	Conditions between 4 and 6	At least 75% of exported water sources are metered, meter accuracy testing and/or electronic calibration conducted annually. Less than 25% of tested meters are found outside of +/- 6% accuracy.	Conditions between 6 and 8	100% of exported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy	Conditions between 8 and 10	100% of exported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually for all meter installations, with less than 10% of accuracy tests found outside of +/- 3% accuracy.
Improvements to attain higher data grading for "Water Exported Volume" component: *(Note: usually, if the water utility being audited sells (Exports) water to a neighboring purchasing Utility, it is the responsibility of the utility exporting the water to maintain the metering installation measuring the Exported volume. The utility exporting the water should ensure that adequate meter upkeep takes place and an accurate measure of the Water Exported volume is quantified.)*		to qualify for 2: Review bulk water sales agreements with purchasing utilities; confirm requirements for use & upkeep of accurate metering. Identify needs to install new, or replace defective meters as needed.	To qualify for 4: Locate all exported water sources on maps and in field, launch meter accuracy testing for existing meters, begin to install meters on unmetered exported water interconnections and replace obsolete/defective meters		to qualify for 6: Formalize annual meter accuracy testing for all exported water meters. Continue installation of meters on unmetered exported water interconnections and replacement of obsolete/defective meters.		to qualify for 8: Complete project to install new, or replace defective, meters on all exported water interconnections. Maintain annual meter accuracy testing for all exported water meters. Repair or replace meters outside of +/- 6% accuracy.		to qualify for 10: Maintain annual meter accuracy testing for all meters. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to improve meter accuracy.		to maintain 10: Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology.
Water exported master meter and supply error adjustment:	Select n/a only if the water utility fails to have meters on its exported supply interconnections.	Inventory information on exported meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined Written agreement(s) with the utility purchasing the water are missing or written in vague language concerning meter management and testing.	No automatic datalogging of exported supply volumes; daily readings are scribed on paper records without any accountability controls to confirm data accuracy and the absence of errors and data gaps in recorded volumes. Written agreement requires meter accuracy testing but is vague on the details of how and who conducts the testing.	Conditions between 2 and 4	Exported metered flow data is logged automatically in electronic format and reviewed at least on a monthly basis, with necessary corrections implemented. Meter data is adjusted by the utility selling (exporting) the water when gross data errors are detected. A coherent data trail exists for this process to protect both the utility exporting the water and the purchasing Utility. Written agreement exists and clearly states requirements and roles for meter accuracy testing and data management.	Conditions between 4 and 6	Hourly exported supply metered data is logged automatically & reviewed on at least a weekly basis by the utility selling the water. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and to correct for error found by meter accuracy testing. Any data gaps in the archived data are detected and corrected during the weekly review. A coherent data trail exists for this process to protect both the selling (exporting) utility and the purchasing Utility.	Conditions between 6 and 8	Continuous exported supply metered flow data is logged automatically & reviewed each business day by the utility selling (exporting) the water. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and any error confirmed by meter accuracy testing. Any data errors/gaps are detected and corrected on a daily basis. A data trail exists for the process to protect both the selling (exporting) Utility and the purchasing Utility.	Conditions between 8 and 10	Computerized system (SCADA or similar) automatically records data which is reviewed each business day by the utility selling (exporting) the water. Tight accountability controls ensure that all error/data gaps that occur in the archived flow data are quickly detected and corrected. A reliable data trail exists and contract provisions for meter testing and data management are reviewed by the selling Utility and purchasing Utility at least once every five years.

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Improvements to attain higher data grading for "Water exported master meter and supply error adjustment" component:		to qualify for 2: Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature. Review the written agreement between the utility selling (exporting) the water and the purchasing Utility.	to qualify for 4: Install automatic datalogging equipment on exported supply meters. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps. Launch discussions with the purchasing utilities to jointly review terms of the written agreements regarding meter accuracy testing and data management; revise the terms as necessary.		to qualify for 6: Refine computerized data collection and archive to include hourly exported supply metered flow data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Make necessary corrections to errors/data errors on a weekly basis.		to qualify for 8: Ensure that all exported metered flow data is collected and archived on at least an hourly basis. All data is reviewed and errors/data gaps are corrected each business day.		to qualify for 10: Conduct accountability checks to confirm that all exported metered flow data is reviewed and corrected each business day by the utility selling the water. Results of all meter accuracy tests and data corrections should be available for sharing between the utility and the purchasing Utility. Establish a schedule for a regular review and updating of the contractual language in the written agreements with the purchasing utilities; at least every five years.		to maintain 10: Monitor meter innovations for development of more accurate and less expensive flowmeters; work with the purchasing utilities to help identify meter replacement needs. Keep communication lines with the purchasing utilities open and maintain productive relations. Keep the written agreement current with clear and explicit language that meets the ongoing needs of all parties.
AUTHORIZED CONSUMPTION											
Billed metered:	n/a (not applicable). Select n/a only if the entire customer population is not metered and is billed for water service on a flat or fixed rate basis. In such a case the volume entered must be zero.	Less than 50% of customers with volume-based billings from meter readings; flat or fixed rate billing exists for the majority of the customer population	At least 50% of customers with volume-based billing from meter reads; flat rate billing for others. Manual meter reading is conducted, with less than 50% meter read success rate, remainding accounts' consumption is estimated. Limited meter records, no regular meter testing or replacement. Billing data maintained on paper records, with no auditing.	Conditions between 2 and 4	At least 75% of customers with volume-based, billing from meter reads; flat or fixed rate billing for remaining accounts. Manual meter reading is conducted with at least 50% meter read success rate; consumption for accounts with failed reads is estimated. Purchase records verify age of customer meters; only very limited meter accuracy testing is conducted. Customer meters are replaced only upon complete failure. Computerized billing records exist, but only sporadic internal auditing conducted.	Conditions between 4 and 6	At least 90% of customers with volume-based billing from meter reads; consumption for remaining accounts is estimated. Manual customer meter reading gives at least 80% customer meter reading success rate; consumption for accounts with failed reads is estimated. Good customer meter records eixst, but only limited meter accuracy testing is conducted. Regular replacement is conducted for the oldest meters. Computerized billing records exist with annual auditing of summary statistics conducting by utility personnel.	Conditions between 6 and 8	At least 97% of customers exist with volume-based billing from meter reads. At least 90% customer meter reading success rate; or at least 80% read success rate with planning and budgeting for trials of Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) in one or more pilot areas. Good customer meter records. Regular meter accuracy testing guides replacement of statistically significant number of meters each year. Routine auditing of computerized billing records for global and detailed statistics occurs annually by utility personnel, and is verified by third party at least once every five years.	Conditions between 8 and 10	At least 99% of customers exist with volume-based billing from meter reads. At least 95% customer meter reading success rate; or minimum 80% meter reading success rate, with Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) trials underway. Statistically significant customer meter testing and replacement program in place on a continuous basis. Computerized billing with routine, detailed auditing, including field investigation of representative sample of accounts undertaken annually by utility personnel. Audit is conducted by third party auditors at least once every three years.
Improvements to attain higher data grading for "Billed Metered Consumption" component:	If n/a is selected because the customer meter population is unmetered, consider establishing a new policy to meter the customer population and employ water rates based upon metered volumes.	to qualify for 2: Conduct investigations or trials of customer meters to select appropriate meter models. Budget funding for meter installations. Investigate volume based water rate structures.	to qualify for 4: Purchase and install meters on unmetered accounts. Implement policies to improve meter reading success. Catalog meter information during meter read visits to identify age/model of existing meters. Test a minimal number of meters for accuracy. Install computerized billing system.		to qualify for 6: Purchase and install meters on unmetered accounts. Eliminate flat fee billing and establish appropriate water rate structure based upon measured consumption. Continue to achieve verifiable success in removing manual meter reading barriers. Expand meter accuracy testing. Launch regular meter replacement program. Launch a program of annual auditing of global billing statistics by utility personnel.		to qualify for 8: Purchase and install meters on unmetered accounts. If customer meter reading success rate is less than 97%, assess cost-effectiveness of Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) system for portion or entire system; or otherwise achieve ongoing improvements in manual meter reading success rate to 97% or higher. Refine meter accuracy testing program. Set meter replacement goals based upon accuracy test results. Implement annual auditing of detailed billing records by utility personnel and implement third party auditing at least once every five years.		to qualify for 10: Purchase and install meters on unmetered accounts. Launch Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) system trials if manual meter reading success rate of at least 99% is not achieved within a five-year program. Continue meter accuracy testing program. Conduct planning and budgeting for large scale meter replacement based upon meter life cycle analysis using cumulative flow target. Continue annual detailed billing data auditing by utility personnel and conduct third party auditing at least once every three years.		to maintain 10: Continue annual internal billing data auditing, and third party auditing at least every three years. Continue customer meter accuracy testing to ensure that accurate customer meter readings are obtained and entered as the basis for volume based billing. Stay abreast of improvements in Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) and information management. Plan and budget for justified upgrades in metering, meter reading and billing data management to maintain very high accuracy in customer metering and billing.
Billed unmetered:	Select n/a if it is the policy of the water utility to meter all customer connections and it has been confirmed by detailed auditing that all customers do indeed have a water meter; i.e. no intentionally unmetered accounts exist	Water utility policy does not require customer metering; flat or fixed fee billing is employed. No data is collected on customer consumption. The only estimates of customer population consumption available are derived from data estimation methods using average fixture count multiplied by number of connections, or similar approach.	Water utility policy does not require customer metering; flat or fixed fee billing is employed. Some metered accounts exist in parts of the system (pilot areas or District Metered Areas) with consumption read periodically or recorded on portable dataloggers over one, three, or seven day periods. Data from these sample meters are used to infer consumption for the total customer population. Site specific estimation methods are used for unusual buildings/water uses.	Conditions between 2 and 4	Water utility policy does require metering and volume based billing in general. However, a liberal amount of exemptions and a lack of clearly written and communicated procedures result in up to 20% of billed accounts believed to be unmetered by exemption; or the water utility is in transition to becoming fully metered, and a large number of customers remain unmetered. A rough estimate of the annual consumption for all unmetered accounts is included in the annual water audit, with no inspection of individual unmetered accounts.	Conditions between 4 and 6	Water utility policy does require metering and volume based billing but established exemptions exist for a portion of accounts such as municipal buildings. As many as 15% of billed accounts are unmetered due to this exemption or meter installation difficulties. Only a group estimate of annual consumption for all unmetered accounts is included in the annual water audit, with no inspection of individual unmetered accounts.	Conditions between 6 and 8	Water utility policy does require metering and volume based billing for all customer accounts. However, less than 5% of billed accounts remain unmetered because meter installation is hindered by unusual circumstances. The goal is to minimize the number of unmetered accounts. Reliable estimates of consumption are obtained for these unmetered accounts via site specific estimation methods.	Conditions between 8 and 10	Water utility policy does require metering and volume based billing for all customer accounts. Less than 2% of billed accounts are unmetered and exist because meter installation is hindered by unusual circumstances. The goal exists to minimize the number of unmetered accounts to the extent that is economical. Reliable estimates of consumption are obtained at these accounts via site specific estimation methods.

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Improvements to attain higher data grading for "Billed Unmetered Consumption" component:		to qualify for 2: Conduct research and evaluate cost/benefit of a new water utility policy to require metering of the customer population; thereby greatly reducing or eliminating unmetered accounts. Conduct pilot metering project by installing water meters in small sample of customer accounts and periodically reading the meters or datalogging the water consumption over one, three, or seven day periods.	to qualify for 4: Implement a new water utility policy requiring customer metering. Launch or expand pilot metering study to include several different meter types, which will provide data for economic assessment of full scale metering options. Assess sites with access difficulties to devise means to obtain water consumption volumes. Begin customer meter installation.		to qualify for 6: Refine policy and procedures to improve customer metering participation for all but solidly exempt accounts. Assign staff resources to review billing records to identify errant unmetered properties. Specify metering needs and funding requirements to install sufficient meters to significant reduce the number of unmetered accounts		to qualify for 8: Push to install customer meters on a full scale basis. Refine metering policy and procedures to ensure that all accounts, including municipal properties, are designated for meters. Plan special efforts to address "hard-to-access" accounts. Implement procedures to obtain a reliable consumption estimate for the remaining few unmetered accounts awaiting meter installation.		to qualify for 10: Continue customer meter installation throughout the service area, with a goal to minimize unmetered accounts. Sustain the effort to investigate accounts with access difficulties, and devise means to install water meters or otherwise measure water consumption.		to maintain 10: Continue to refine estimation methods for unmetered consumption and explore means to establish metering, for as many billed remaining unmetered accounts as is economically feasible.
Unbilled metered:	select n/a if all billing-exempt consumption is unmetered.	Billing practices exempt certain accounts, such as municipal buildings, but written policies do not exist; and a reliable count of unbilled metered accounts is unavailable. Meter upkeep and meter reading on these accounts is rare and not considered a priority. Due to poor recordkeeping and lack of auditing, water consumption for all such accounts is purely guesstimated.	Billing practices exempt certain accounts, such as municipal buildings, but only scattered, dated written directives exist to justify this practice. A reliable count of unbilled metered accounts is unavailable. Sporadic meter replacement and meter reading occurs on an as-needed basis. The total annual water consumption for all unbilled, metered accounts is estimated based upon approximating the number of accounts and assigning consumption from actively billed accounts of same meter size.	Conditions between 2 and 4	Dated written procedures permit billing exemption for specific accounts, such as municipal properties, but are unclear regarding certain other types of accounts. Meter reading is given low priority and is sporadic. Consumption is quantified from meter readings where available. The total number of unbilled, unmetered accounts must be estimated along with consumption volumes.	Conditions between 4 and 6	Written policies regarding billing exemptions exist but adherence in practice is questionable. Metering and meter reading for municipal buildings is reliable but sporadic for other unbilled metered accounts. Periodic auditing of such accounts is conducted. Water consumption is quantified directly from meter readings where available, but the majority of the consumption is estimated.	Conditions between 6 and 8	Written policy identifies the types of accounts granted a billing exemption. Customer meter management and meter reading are considered secondary priorities, but meter reading is conducted at least annually to obtain consumption volumes for the annual water audit. High level auditing of billing records ensures that a reliable census of such accounts exists.	Conditions between 8 and 10	Clearly written policy identifies the types of accounts given a billing exemption, with emphasis on keeping such accounts to a minimum. Customer meter management and meter reading for these accounts is given proper priority and is reliably conducted. Regular auditing confirms this. Total water consumption for these accounts is taken from reliable readings from accurate meters.
Improvements to attain higher data grading for "Unbilled Metered Consumption" component:		to qualify for 2: Reassess the water utility's policy allowing certain accounts to be granted a billing exemption. Draft an outline of a new written policy for billing exemptions, with clear justification as to why any accounts should be exempt from billing, and with the intention to keep the number of such accounts to a minimum.	to qualify for 4: Review historic written directives and policy documents allowing certain accounts to be billing-exempt. Draft an outline of a written policy for billing exemptions, identify criteria that grants an exemption, with a goal of keeping this number of accounts to a minimum. Consider increasing the priority of reading meters on unbilled accounts at least annually.		to qualify for 6: Draft a new written policy regarding billing exemptions based upon consensus criteria allowing this occurrence. Assign resources to audit meter records and billing records to obtain census of unbilled metered accounts. Gradually include a greater number of these metered accounts to the routes for regular meter reading.		to qualify for 8: Communicate billing exemption policy throughout the organization and implement procedures that ensure proper account management. Conduct inspections of accounts confirmed in unbilled metered status and verify that accurate meters exist and are scheduled for routine meter readings. Gradually increase the number of unbilled metered accounts that are included in regular meter reading routes.		to qualify for 10: Ensure that meter management (meter accuracy testing, meter replacement) and meter reading activities for unbilled accounts are accorded the same priority as billed accounts. Establish ongoing annual auditing process to ensure that water consumption is reliably collected and provided to the annual water audit process.		to maintain 10: Reassess the utility's philosophy in allowing any water uses to go "unbilled". It is possible to meter and bill all accounts, even if the fee charged for water consumption is discounted or waived. Metering and billing all accounts ensures that water consumption is tracked and water waste from plumbing leaks is detected and minimized.
Unbilled unmetered:		Extent of unbilled, unmetered consumption is unknown due to unclear policies and poor recordkeeping. Total consumption is quantified based upon a purely subjective estimate.	Clear extent of unbilled, unmetered consumption is unknown, but a number of events are randomly documented each year, confirming existence of such consumption, but without sufficient documentation to quantify an accurate estimate of the annual volume consumed.	Conditions between 2 and 4	Extent of unbilled, unmetered consumption is partially known, and procedures exist to document certain events such as miscellaneous fire hydrant uses. Formulae is used to quantify the consumption from such events (time running multiplied by typical flowrate, multiplied by number of events).	Default value of 1.25% of system input volume is employed	Coherent policies exist for some forms of unbilled, unmetered consumption but others await closer evaluation. Reasonable recordkeeping for the managed uses exists and allows for annual volumes to be quantified by inference, but unsupervised uses are guesstimated.	Conditions between 6 and 8	Clear policies and good recordkeeping exist for some uses (ex: water used in periodic testing of unmetered fire connections), but other uses (ex: miscellaneous uses of fire hydrants) have limited oversight. Total consumption is a mix of well quantified use such as from formulae (time running multiplied by typical flow, multiplied by number of events) or temporary meters, and relatively subjective estimates of less regulated use.	Conditions between 8 and 10	Clear policies exist to identify permitted use of water in unbilled, unmetered fashion, with the intention of minimizing this type of consumption. Good records document each occurrence and consumption is quantified via formulae (time running multiplied by typical flow, multiplied by number of events) or use of temporary meters.
Improvements to attain higher data grading for "Unbilled Unmetered Consumption" component:		to qualify for 5: Utilize the accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of this use. to qualify for 2: Establish a policy regarding what water uses should be allowed to remain as unbilled and unmetered. Consider tracking a small sample of one such use (ex: fire hydrant flushings).	to qualify for 5: Utilize accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of this use. to qualify for 4: Evaluate the documentation of events that have been observed. Meet with user groups (ex: for fire hydrants - fire departments, contractors to ascertain their need and/or volume requirements for water from fire hydrants).		to qualify for 5: Utilize accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of all such use. This is particularly appropriate for water utilities who are in the early stages of the water auditing process, and should focus on other components since the volume of unbilled, umetered consumption is usually a relatively small quatity component, and other larger-quantity components should take priority.	to qualify for 6 or greater: Finalize policy and begin to conduct field checks to better establish and quantify such usage. Proceed if top-down audit exists and/or a great volume of such use is suspected.	to qualify for 8: Assess water utility policy and procedures for various unmetered usages. For example, ensure that a policy exists and permits are issued for use of fire hydrants by persons outside of the utility. Create written procedures for use and documentation of fire hydrants by water utility personnel. Use same approach for other types of unbilled, unmetered water usage.		to qualify for 10: Refine written procedures to ensure that all uses of unbilled, unmetered water are overseen by a structured permitting process managed by water utility personnel. Reassess policy to determine if some of these uses have value in being converted to billed and/or metered status.		to maintain 10: Continue to refine policy and procedures with intention of reducing the number of allowable uses of water in unbilled and unmetered fashion. Any uses that can feasibly become billed and metered should be converted eventually.
APPARENT LOSSES											

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Unauthorized consumption:		Extent of unauthorized consumption is unknown due to unclear policies and poor recordkeeping. Total unauthorized consumption is guesstimated.	Unauthorized consumption is a known occurrence, but its extent is a mystery. There are no requirements to document observed events, but periodic field reports capture some of these occurrences. Total unauthorized consumption is approximated from this limited data.	conditions between 2 and 4	Procedures exist to document some unauthorized consumption such as observed unauthorized fire hydrant openings. Use formulae to quantify this consumption (time running multiplied typical flowrate, multiplied by number of events).	Default value of 0.25% of volume of water supplied is employed	Coherent policies exist for some forms of unauthorized consumption (more than simply fire hydrant misuse) but others await closer evaluation. Reasonable surveillance and recordkeeping exist for occurrences that fall under the policy. Volumes quantified by inference from these records.	Conditions between 6 and 8	Clear policies and good auditable recordkeeping exist for certain events (ex: tampering with water meters, illegal bypasses of customer meters); but other occurrences have limited oversight. Total consumption is a combination of volumes from formulae (time x typical flow) and subjective estimates of unconfirmed consumption.	Conditions between 8 and 10	Clear policies exist to identify all known unauthorized uses of water. Staff and procedures exist to provide enforcement of policies and detect violations. Each occurrence is recorded and quantified via formulae (estimated time running multiplied by typical flow) or similar methods. All records and calculations should exist in a form that can be audited by a third party.
Improvements to attain higher data grading for "Unauthorized Consumption" component:		to qualify for 5: Use accepted default of 0.25% of volume of water supplied. to qualify for 2: Review utility policy regarding what water uses are considered unauthorized, and consider tracking a small sample of one such occurrence (ex: unauthorized fire hydrant openings)	to qualify for 5: Use accepted default of 0.25% of system input volume to qualify for 4: Review utility policy regarding what water uses are considered unauthorized, and consider tracking a small sample of one such occurrence (ex: unauthorized fire hydrant openings)		to qualify for 5: Utilize accepted default value of 0.25% of volume of water supplied as an expedient means to gain a reasonable quantification of all such use. This is particularly appropriate for water utilities who are in the early stages of the water auditing process.	to qualify for 6 or greater: Finalize policy updates to clearly identify the types of water consumption that are authorized from those usages that fall outside of this policy and are, therefore, unauthorized. Begin to conduct regular field checks. Proceed if the top-down audit already exists and/or a great volume of such use is suspected.	to quality for 8: Assess water utility policies to ensure that all known occurrences of unauthorized consumption are outlawed, and that appropriate penalties are prescribed. Create written procedures for detection and documentation of various occurrences of unauthorized consumption as they are uncovered.		to qualify for 10: Refine written procedures and assign staff to seek out likely occurrences of unauthorized consumption. Explore new locking devices, monitors and other technologies designed to detect and thwart unauthorized consumption.		to maintain 10: Continue to refine policy and procedures to eliminate any loopholes that allow or tacitly encourage unauthorized consumption. Continue to be vigilant in detection, documentation and enforcement efforts.
Customer metering inaccuracies:	select n/a only if the entire customer population is unmetered. In such a case the volume entered must be zero.	Customer meters exist, but with unorganized paper records on meters; no meter accuracy testing or meter replacement program for any size of retail meter. Metering workflow is driven chaotically with no proactive management. Loss volume due to aggregate meter inaccuracy is guesstimated.	Poor recordkeeping and meter oversight is recognized by water utility management who has allotted staff and funding resources to organize improved recordkeeping and start meter accuracy testing. Existing paper records gathered and organized to provide cursory disposition of meter population. Customer meters are tested for accuracy only upon customer request.	Conditions between 2 and 4	Reliable recordkeeping exists; meter information is improving as meters are replaced. Meter accuracy testing is conducted annually for a small number of meters (more than just customer requests, but less than 1% of inventory). A limited number of the oldest meters are replaced each year. Inaccuracy volume is largely an estimate, but refined based upon limited testing data.	Conditions between 4 and 6	A reliable electronic recordkeeping system for meters exists. The meter population includes a mix of new high performing meters and dated meters with suspect accuracy. Routine, but limited, meter accuracy testing and meter replacement occur. Inaccuracy volume is quantified using a mix of reliable and less certain data.	Conditions between 6 and 8	Ongoing meter replacement and accuracy testing result in highly accurate customer meter population. Testing is conducted on samples of meters of varying age and accumulated volume of throughput to determine optimum replacement time for various types of meters.	Ongoing meter replacement and accuracy testing result in highly accurate customer meter population. Statistically significant number of meters are tested in audit year. This testing is conducted on samples of meters of varying age and accumulated volume of throughput to determine optimum replacement time for these meters.	Good records of all active customer meters exist and include as a minimum: meter number, account number/location, type, size and manufacturer. Ongoing meter replacement occurs according to a targeted and justified basis. Regular meter accuracy testing gives a reliable measure of composite inaccuracy volume for the customer meter population. New metering technology is embraced to keep overall accuracy improving. Procedures are reviewed by a third party knowledgeable in the M36 methodology.
Improvements to attain higher data grading for "Customer meter inaccuracy volume" component:	If n/a is selected because the customer meter population is unmetered, consider establishing a new policy to meter the customer population and employ water rates based upon metered volumes.	to qualify for 2: Gather available meter purchase records. Conduct testing on a small number of meters believed to be the most inaccurate. Review staffing needs of the metering group and budget for necessary resources to better organize meter management.	to qualify for 4: Implement a reliable record keeping system for customer meter histories, preferably using electronic methods typically linked to, or part of, the Customer Billing System or Customer Information System. Expand meter accuracy testing to a larger group of meters.		to qualify for 6: Standardize the procedures for meter recordkeeping within an electronic information system. Accelerate meter accuracy testing and meter replacements guided by testing results.		to qualify for 8: Expand annual meter accuracy testing to evaluate a statistically significant number of meter makes/models. Expand meter replacement program to replace statistically significant number of poor performing meters each year.		to qualify for 9: Continue efforts to manage meter population with reliable recordkeeping. Test a statistically significant number of meters each year and analyze test results in an ongoing manner to serve as a basis for a target meter replacement strategy based upon accumulated volume throughput.	to qualify for 10: Continue efforts to manage meter population with reliable recordkeeping, meter testing and replacement. Evaluate new meter types and install one or more types in 5-10 customer accounts each year in order to pilot improving metering technology.	to maintain 10: Increase the number of meters tested and replaced as justified by meter accuracy test data. Continually monitor development of new metering technology and Advanced Metering Infrastructure (AMI) to grasp opportunities for greater accuracy in metering of water flow and management of customer consumption data.

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Systematic Data Handling Errors:	Note: all water utilities incur some amount of this error. Even in water utilities with unmetered customer populations and fixed rate billing, errors occur in annual billing tabulations. Enter a positive value for the volume and select a grading.	Policies and procedures for activation of new customer water billing accounts are vague and lack accountability. Billing data is maintained on paper records which are not well organized. No auditing is conducted to confirm billing data handling efficiency. An unknown number of customers escape routine billing due to lack of billing process oversight.	Policy and procedures for activation of new customer accounts and oversight of billing records exist but need refinement. Billing data is maintained on paper records or insufficiently capable electronic database. Only periodic unstructured auditing work is conducted to confirm billing data handling efficiency. The volume of unbilled water due to billing lapses is a guess.	Conditions between 2 and 4	Policy and procedures for new account activation and oversight of billing operations exist but needs refinement. Periodic, limited internal audits conducted and confirm with approximate accuracy the consumption volumes lost to billing lapses.	Conditions between 4 and 6	Policy and procedures for new account activation and oversight of billing operations is adequate and reviewed periodically. Computerized billing system is in use with basic reporting available. Any effect of billing adjustments on measured consumption volumes is well understood. Internal checks of billing data error conducted annually. Reasonably accurate quantification of consumption volume lost to billing lapses is obtained.	Conditions between 6 and 8	New account activation and billing operations policy and procedures are reviewed at least biannually. Computerized billing system includes an array of reports to confirm billing data and system functionality. Checks are conducted routinely to flag and explain zero consumption accounts. Annual internal checks conducted with third party audit conducted at least once every five years. Accountability checks flag billing lapses. Consumption lost to billing lapses is well quantified and reducing year-by-year.	Conditions between 8 and 10	Sound written policy and procedures exist for new account activation and oversight of customer billing operations. Robust computerized billing system gives high functionality and reporting capabilities which are utilized, analyzed and the results reported each billing cycle. Assessment of policy and data handling errors are conducted internally and audited by third party at least once every three years, ensuring consumption lost to billing lapses is minimized and detected as it occurs.
Improvements to attain higher data grading for "Systematic Data Handling Error volume" component:		to qualify for 2: Draft written policy and procedures for activating new water billing accounts and oversight of billing operations. Investigate and budget for computerized customer billing system. Conduct initial audit of billing records by flow-charting the basic business processes of the customer account/billing function.	to qualify for 4: Finalize written policy and procedures for activation of new billing acocunts and overall billing operations management. Implement a computerized customer billing system. Conduct initial audit of billing records as part of this process.		to qualify for 6: Refine new account activation and billing operations procedures and ensure consistency with the utility policy regarding billing, and minimize opportunity for missed billings. Upgrade or replace customer billing system for needed functionality - ensure that billing adjustments don't corrupt the value of consumption volumes. Procedurize internal annual audit process.		to qualify for 8: Formalize regular review of new account activation process and general billing practices. Enhance reporting capability of computerized billing system. Formalize regular auditing process to reveal scope of data handling error. Plan for periodic third party audit to occur at least once every five years.		to qualify for 10: Close policy/procedure loopholes that allow some customer accounts to go unbilled, or data handling errors to exist. Ensure that billing system reports are utilized, analyzed and reported every billing cycle. Ensure that internal and third party audits are conducted at least once every three years.		to maintain 10: Stay abreast of customer information management developments and innovations. Monitor developments of Advanced Metering Infrastructure (AMI) and integrate technology to ensure that customer endpoint information is well-monitored and errors/lapses are at an economic minimum.
SYSTEM DATA											
Length of mains:		Poorly assembled and maintained paper as-built records of existing water main installations makes accurate determination of system pipe length impossible. Length of mains is guesstimated.	Paper records in poor or uncertain condition (no annual tracking of installations & abandonments). Poor procedures to ensure that new water mains installed by developers are accurately documented.	Conditions between 2 and 4	Sound written policy and procedures exist for documenting new water main installations, but gaps in management result in a uncertain degree of error in tabulation of mains length.	Conditions between 4 and 6	Sound written policy and procedures exist for permitting and commissioning new water mains. Highly accurate paper records with regular field validation; or electronic records and asset management system in good condition. Includes system backup.	Conditions between 6 and 8	Sound written policy and procedures exist for permitting and commissioning new water mains. Electronic recordkeeping such as a Geographical Information System (GIS) and asset management system are used to store and manage data.	Conditions between 8 and 10	Sound written policy exists for managing water mains extensions and replacements. Geographic Information System (GIS) data and asset management database agree and random field validation proves truth of databases. Records of annual field validation should be available for review.
Improvements to attain higher data grading for "Length of Water Mains" component:		to qualify for 2: Assign personnel to inventory current as-built records and compare with customer billing system records and highway plans in order to verify poorly documented pipelines. Assemble policy documents regarding permitting and documentation of water main installations by the utility and building developers; identify gaps in procedures that result in poor documentation of new water main installations.	to qualify for 4: Complete inventory of paper records of water main installations for several years prior to audit year. Review policy and procedures for commissioning and documenting new water main installation.		to qualify for 6: Finalize updates/improvements to written policy and procedures for permitting/commissioning new main installations. Confirm inventory of records for five years prior to audit year; correct any errors or omissions.		to qualify for 8: Launch random field checks of limited number of locations. Convert to electronic database such as a Geographic Information System (GIS) with backup as justified. Develop written policy and procedures.		to qualify for 10: Link Geographic Information System (GIS) and asset management databases, conduct field verification of data. Record field verification information at least annually.		to maintain 10: Continue with standardization and random field validation to improve the completeness and accuracy of the system.
Number of active AND inactive service connections:		Vague permitting (of new service connections) policy and poor paper recordkeeping of customer connections/billings result in suspect determination of the number of service connections, which may be 10-15% in error from actual count.	General permitting policy exists but paper records, procedural gaps, and weak oversight result in questionable total for number of connections, which may vary 5-10% of actual count.	Conditions between 2 and 4	Written account activation policy and procedures exist, but with some gaps in performance and oversight. Computerized information management system is being brought online to replace dated paper recordkeeping system. Reasonably accurate tracking of service connection installations & abandonments; but count can be up to 5% in error from actual total.	Conditions between 4 and 6	Written new account activation and overall billing policies and procedures are adequate and reviewed periodically. Computerized information management system is in use with annual installations & abandonments totaled. Very limited field verifications and audits. Error in count of number of service connections is believed to be no more than 3%.	Conditions between 6 and 8	Policies and procedures for new account activation and overall billing operations are written, well-structured and reviewed at least biannually. Well-managed computerized information management system exists and routine, periodic field checks and internal system audits are conducted. Counts of connections are no more than 2% in error.	Conditions between 8 and 10	Sound written policy and well managed and audited procedures ensure reliable management of service connection population. Computerized information management system, Customer Billing System, and Geographic Information System (GIS) information agree; field validation proves truth of databases. Count of connections recorded as being in error is less than 1% of the entire population.
Improvements to attain higher data grading for "Number of Active and Inactive Service Connections" component:	**Note: The number of Service Connections does not include fire hydrant leads/lines connecting the hydrant to the water main**	to qualify for 2: Draft new policy and procedures for new account activation and overall billing operations. Research and collect paper records of installations & abandonments for several years prior to audit year.	to qualify for 4: Refine policy and procedures for new account activation and overall billing operations. Research computerized recordkeeping system (Customer Information System or Customer Billing System) to improve documentation format for service connections.		to qualify for 6: Refine procedures to ensure consistency with new account activation and overall billing policy to establish new service connections or decommission existing connections. Improve process to include all totals for at least five years prior to audit year.		to qualify for 8: Formalize regular review of new account activation and overall billing operations policies and procedures. Launch random field checks of limited number of locations. Develop reports and auditing mechanisms for computerized information management system.		to qualify for 10: Close any procedural loopholes that allow installations to go undocumented. Link computerized information management system with Geographic Information System (GIS) and formalize field inspection and information system auditing processes. Documentation of new or decommissioned service connections encounters several levels of checks and balances.		to maintain 10: Continue with standardization and random field validation to improve knowledge of system.
	Note: if customer water	Gradings 1-9 apply if customer properties are unmetered, if customer meters exist and are located inside the customer building premises, or if the water utility owns and is responsible for the entire service connection piping from the water main to the customer building. In any of these cases the average distance between the curb stop or boundary separating utility/customer responsibility for service connection piping, and the typical first point of use (ex: faucet) or the customer meter must be quantified. Gradings of 1-9 are used to grade the validity of the means to quantify this value. (See the "Service Connection Diagram" worksheet)									Either of two conditions can be met for a grading of 10:

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Average length of customer service line:	meters are located outside of the customer building next to the curb stop or boundary separating utility/customer responsibility, then the auditor should answer "Yes" to the question on the Reporting Worksheet asking about this. If the answer is Yes, the grading description listed under the Grading of 10(a) will be followed, with a value of zero automatically entered at a Grading of 10. See the Service Connection Diagram worksheet for a visual presentation of this distance.	Vague policy exists to define the delineation of water utility ownership and customer ownership of the service connection piping. Curb stops are perceived as the breakpoint but these have not been well-maintained or documented. Most are buried or obscured. Their location varies widely from site-to-site, and estimating this distance is arbitrary due to the unknown location of many curb stops.	Policy requires that the curb stop serves as the delineation point between water utility ownership and customer ownership of the service connection piping. The piping from the water main to the curb stop is the property of the water utility; and the piping from the curb stop to the customer building is owned by the customer. Curb stop locations are not well documented and the average distance is based upon a limited number of locations measured in the field.	Conditions between 2 and 4	Good policy requires that the curb stop serves as the delineation point between water utility ownership and customer ownership of the service connection piping. Curb stops are generally installed as needed and are reasonably documented. Their location varies widely from site-to-site, and an estimate of this distance is hindered by the availability of paper records of limited accuracy.	Conditions between 4 and 6	Clear written policy exists to define utility/customer responsibility for service connection piping. Accurate, well-maintained paper or basic electronic recordkeeping system exists. Periodic field checks confirm piping lengths for a sample of customer properties.	Conditions between 6 and 8	Clearly worded policy standardizes the location of curb stops and meters, which are inspected upon installation. Accurate and well maintained electronic records exist with periodic field checks to confirm locations of service lines, curb stops and customer meter pits. An accurate number of customer properties from the customer billing system allows for reliable averaging of this length.	Conditions between 8 and 10	a) Customer water meters exist outside of customer buildings next to the curb stop or boundary separating utility/customer responsibility for service connection piping. If so, answer "Yes" to the question on the Reporting Working asking about this condition. A value of zero and a Grading of 10 are automatically entered in the Reporting Worksheet . b). Meters exist inside customer buildings, or properties are unmetered. In either case, answer "No" to the Reporting Worksheet question on meter location, and enter a distance determined by the auditor. For a Grading of 10 this value must be a very reliable number from a Geographic Information System (GIS) and confirmed by a statistically valid number of field checks.
Improvements to attain higher data grading for "Average Length of Customer Service Line" component:		to qualify for 2: Research and collect paper records of service line installations. Inspect several sites in the field using pipe locators to locate curb stops. Obtain the length of this small sample of connections in this manner.	to qualify for 4: Formalize and communicate policy delineating utility/customer responsibilities for service connection piping. Assess accuracy of paper records by field inspection of a small sample of service connections using pipe locators as needed. Research the potential migration to a computerized information management system to store service connection data.		to qualify for 6: Establish coherent procedures to ensure that policy for curb stop, meter installation and documentation is followed. Gain consensus within the water utility for the establishment of a computerized information management system.		to qualify for 8: Implement an electronic means of recordkeeping, typically via a customer information system, customer billing system, or Geographic Information System (GIS). Standardize the process to conduct field checks of a limited number of locations.		to qualify for 10: Link customer information management system and Geographic Information System (GIS), standardize process for field verification of data.		to maintain 10: Continue with standardization and random field validation to improve knowledge of service connection configurations and customer meter locations.
Average operating pressure:		Available records are poorly assembled and maintained paper records of supply pump characteristics and water distribution system operating conditions. Average pressure is guesstimated based upon this information and ground elevations from crude topographical maps. Widely varying distribution system pressures due to undulating terrain, high system head loss and weak/erratic pressure controls further compromise the validity of the average pressure calculation.	Limited telemetry monitoring of scattered pumping station and water storage tank sites provides some static pressure data, which is recorded in handwritten logbooks. Pressure data is gathered at individual sites only when low pressure complaints arise. Average pressure is determined by averaging relatively crude data, and is affected by significant variation in ground elevations, system head loss and gaps in pressure controls in the distribution system.	Conditions between 2 and 4	Effective pressure controls separate different pressure zones; moderate pressure variation across the system, occasional open boundary valves are discovered that breech pressure zones. Basic telemetry monitoring of the distribution system logs pressure data electronically. Pressure data gathered by gauges or dataloggers at fire hydrants or buildings when low pressure complaints arise, and during fire flow tests and system flushing. Reliable topographical data exists. Average pressure is calculated using this mix of data.	Conditions between 4 and 6	Reliable pressure controls separate distinct pressure zones; only very occasional open boundary valves are encountered that breech pressure zones. Well-covered telemetry monitoring of the distribution system (not just pumping at source treatment plants or wells) logs extensive pressure data electronically. Pressure gathered by gauges/dataloggers at fire hydrants and buildings when low pressure complaints arise, and during fire flow tests and system flushing. Average pressure is determined by using this mix of reliable data.	Conditions between 6 and 8	Well-managed, discrete pressure zones exist with generally predictable pressure fluctuations. A current full-scale SCADA System or similar realtime monitoring system exists to monitor the water distribution system and collect data, including real time pressure readings at representative sites across the system. The average system pressure is determined from reliable monitoring system data.	Conditions between 8 and 10	Well-managed pressure districts/zones, SCADA System and hydraulic model exist to give very precise pressure data across the water distribution system. Average system pressure is reliably calculated from extensive, reliable, and cross-checked data. Calculations are reported on an annual basis as a minimum.
Improvements to attain higher data grading for "Average Operating Pressure" component:		to qualify for 2: Employ pressure gauging and/or datalogging equipment to obtain pressure measurements from fire hydrants. Locate accurate topographical maps of service area in order to confirm ground elevations. Research pump data sheets to find pump pressure/flow characteristics	to qualify for 4: Formalize a procedure to use pressure gauging/datalogging equipment to gather pressure data during various system events such as low pressure complaints, or operational testing. Gather pump pressure and flow data at different flow regimes. Identify faulty pressure controls (pressure reducing valves, altitude valves, partially open boundary valves) and plan to properly configure pressure zones. Make all pressure data from these efforts available to generate system-wide average pressure.		to qualify for 6: Expand the use of pressure gauging/datalogging equipment to gather scattered pressure data at a representative set of sites, based upon pressure zones or areas. Utilize pump pressure and flow data to determine supply head entering each pressure zone or district. Correct any faulty pressure controls (pressure reducing valves, altitude valves, partially open boundary valves) to ensure properly configured pressure zones. Use expanded pressure dataset from these activities to generate system-wide average pressure.		to qualify for 8: Install a Supervisory Control and Data Acquisition (SCADA) System, or similar realtime monitoring system, to monitor system parameters and control operations. Set regular calibration schedule for instrumentation to insure data accuracy. Obtain accurate topographical data and utilize pressure data gathered from field surveys to provide extensive, reliable data for pressure averaging.		to qualify for 10: Annually, obtain a system-wide average pressure value from the hydraulic model of the distribution system that has been calibrated via field measurements in the water distribution system and confirmed in comparisons with SCADA System data.		to maintain 10: Continue to refine the hydraulic model of the distribution system and consider linking it with SCADA System for real-time pressure data calibration, and averaging.

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
COST DATA											
Total annual cost of operating water system:		Incomplete paper records and lack of financial accounting documentation on many operating functions makes calculation of water system operating costs a pure guesstimate	Reasonably maintained, but incomplete, paper or electronic accounting provides data to estimate the major portion of water system operating costs.	Conditions between 2 and 4	Electronic, industry-standard cost accounting system in place. However, gaps in data are known to exist, periodic internal reviews are conducted but not a structured financial audit.	Conditions between 4 and 6	Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Data audited periodically by utility personnel, but not a Certified Public Accountant (CPA).	Conditions between 6 and 8	Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Data audited at least annually by utility personnel, and at least once every three years by third-party CPA.	Conditions between 8 and 10	Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Data audited annually by utility personnel and annually also by third-party CPA.
Improvements to attain higher data grading for "Total Annual Cost of Operating the Water System" component:		to qualify for 2: Gather available records, institute new financial accounting procedures to regularly collect and audit basic cost data of most important operations functions.	to qualify for 4: Implement an electronic cost accounting system, structured according to accounting standards for water utilities		to qualify for 6: Establish process for periodic internal audit of water system operating costs; identify cost data gaps and institute procedures for tracking these outstanding costs.		to qualify for 8: Standardize the process to conduct routine financial audit on an annual basis. Arrange for CPA audit of financial records at least once every three years.		to qualify for 10: Standardize the process to conduct a third-party financial audit by a CPA on an annual basis.		to maintain 10: Maintain program, stay abreast of expenses subject to erratic cost changes and long-term cost trend, and budget/track costs proactively
Customer retail unit cost (applied to Apparent Losses):	Customer population unmetered, and/or only a fixed fee is charged for consumption.	Antiquated, cumbersome water rate structure is used, with periodic historic amendments that were poorly documented and implemented; resulting in classes of customers being billed inconsistent charges. The actual composite billing rate likely differs significantly from the published water rate structure, but a lack of auditing leaves the degree of error indeterminate.	Dated, cumbersome water rate structure, not always employed consistently in actual billing operations. The actual composite billing rate is known to differ from the published water rate structure, and a reasonably accurate estimate of the degree of error is determined, allowing a composite billing rate to be quantified.	Conditions between 2 and 4	Straight-forward water rate structure in use, but not updated in several years. Billing operations reliably employ the rate structure. The composite billing rate is derived from a single customer class such as residential customer accounts, neglecting the effect of different rates from varying customer classes.	Conditions between 4 and 6	Clearly written, up-to-date water rate structure is in force and is applied reliably in billing operations. Composite customer rate is determined using a weighted average residential rate using volumes of water in each rate block.	Conditions between 6 and 8	Effective water rate structure is in force and is applied reliably in billing operations. Composite customer rate is determined using a weighted average composite consumption rate, which includes residential, commercial, industrial, institutional (CII), and any other distinct customer classes within the water rate structure.	Conditions between 8 and 10	Current, effective water rate structure is in force and applied reliably in billing operations. The rate structure and calculations of composite rate - which includes residential, commercial, industrial, institutional (CII), and other distinct customer classes - are reviewed by a third party knowledgeable in the M36 methodology at least once every five years.
Improvements to attain higher data grading for "Customer Retail Unit Cost" component:		to qualify for 2: Formalize the process to implement water rates, including a secure documentation procedure. Create a current, formal water rate document and gain approval from all stakeholders.	to qualify for 4: Review the water rate structure and update/formalize as needed. Assess billing operations to ensure that actual billing operations incorporate the established water rate structure.		to qualify for 6: Evaluate volume of water used in each usage block by residential users. Multiply volumes by full rate structure.	Launch effort to fully meter the customer population and charge rates based upon water volumes	to qualify for 8: Evaluate volume of water used in each usage block by all classifications of users. Multiply volumes by full rate structure.		to qualify for 10: Conduct a periodic third-party audit of water used in each usage block by all classifications of users. Multiply volumes by full rate structure.		to maintain 10: Keep water rate structure current in addressing the water utility's revenue needs. Update the calculation of the customer unit rate as new rate components, customer classes, or other components are modified.
Variable production cost (applied to Real Losses):	Note: if the water utility purchases/imports its entire water supply, then enter the unit purchase cost of the bulk water supply in the Reporting Worksheet with a grading of 10	Incomplete paper records and lack of documentation on primary operating functions (electric power and treatment costs most importantly) makes calculation of variable production costs a pure guesstimate	Reasonably maintained, but incomplete, paper or electronic accounting provides data to roughly estimate the basic operations costs (pumping power costs and treatment costs) and calculate a unit variable production cost.	Conditions between 2 and 4	Electronic, industry-standard cost accounting system in place. Electric power and treatment costs are reliably tracked and allow accurate weighted calculation of unit variable production costs based on these two inputs and water imported purchase costs (if applicable). All costs are audited internally on a periodic basis.	Conditions between 4 and 6	Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Pertinent additional costs beyond power, treatment and water imported purchase costs (if applicable) such as liability, residuals management, wear and tear on equipment, impending expansion of supply, are included in the unit variable production cost, as applicable. The data is audited at least annually by utility personnel.	Conditions between 6 and 8	Reliable electronic, industry-standard cost accounting system in place, with all pertinent primary and secondary variable production and water imported purchase (if applicable) costs tracked. The data is audited at least annually by utility personnel, and at least once every three years by a third-party knowledgeable in the M36 methodology.	Conditions between 8 and 10	Either of two conditions can be met to obtain a grading of 10: 1) Third party CPA audit of all pertinent primary and secondary variable production and water imported purchase (if applicable) costs on an annual basis. or: 2) Water supply is entirely purchased as bulk water imported, and the unit purchase cost - including all applicable marginal supply costs - serves as the variable production cost. If all applicable marginal supply costs are not included in this figure, a grade of 10 should not be selected.
Improvements to attain higher data grading for "Variable Production Cost" component:		to qualify for 2: Gather available records, institute new procedures to regularly collect and audit basic cost data and most important operations functions.	to qualify for 4: Implement an electronic cost accounting system, structured according to accounting standards for water utilities		to qualify for 6: Formalize process for regular internal audits of production costs. Assess whether additional costs (liability, residuals management, equipment wear, impending infrastructure expansion) should be included to calculate a more representative variable production cost.		to qualify for 8: Formalize the accounting process to include direct cost components (power, treatment) as well as indirect cost components (liability, residuals management, etc.) Arrange to conduct audits by a knowledgable third-party at least once every three years.		to qualify for 10: Standardize the process to conduct a third-party financial audit by a CPA on an annual basis.		to maintain 10: Maintain program, stay abreast of expenses subject to erratic cost changes and budget/track costs proactively

Average Length of Customer Service Line

The three figures shown on this worksheet display the assignment of the Average Length of Customer Service Line, Lp, for the three most common piping configurations.

Figure 1 shows the configuration of the water meter outside of the customer building next to the curb stop valve. In this configuration Lp = 0 since the distance between the curb stop and the customer metering point is essentially zero.

Figure 2 shows the configuration of the customer water meter located inside the customer building, where Lp is the distance from the curb stop to the water meter.

Figure 3 shows the configuration of an unmetered customer building , where Lp is the distance from the curb stop to the first point of customer water consumption, or, more simply, the building line.

In any water system the Lp will vary notably in a community of different structures, therefore the average Lp value is used and this should be approximated or calculated if a sample of service line measurements has been gathered.

Click for more information

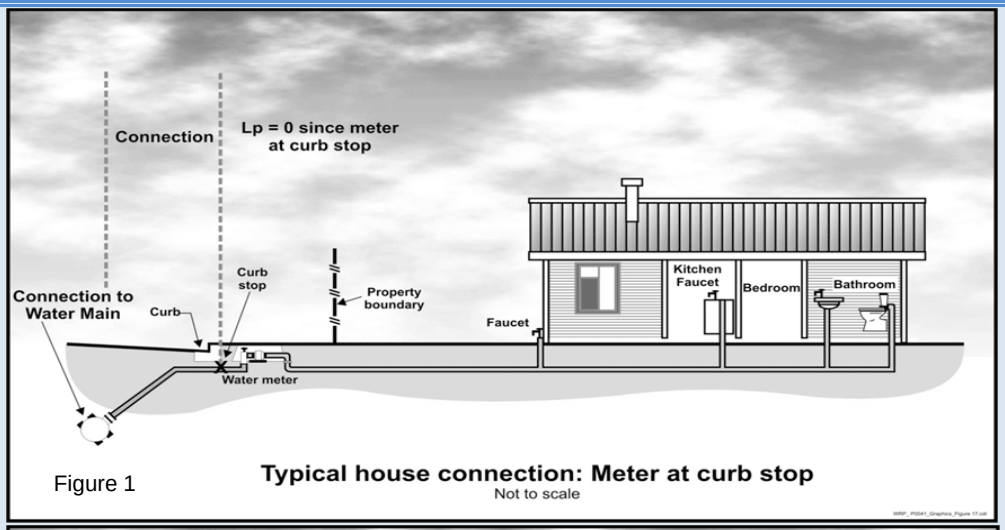


Figure 1 **Typical house connection: Meter at curb stop**
Not to scale

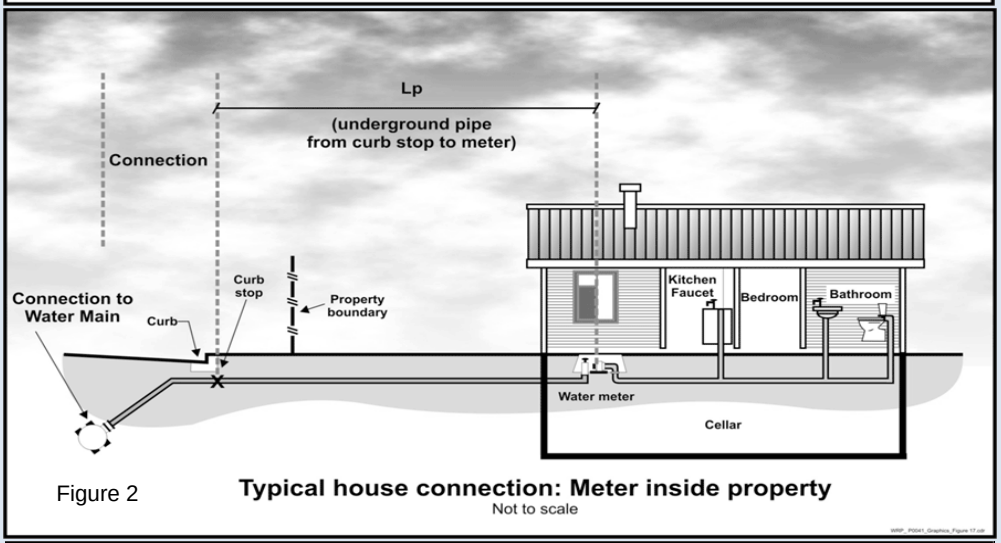


Figure 2 **Typical house connection: Meter inside property**
Not to scale

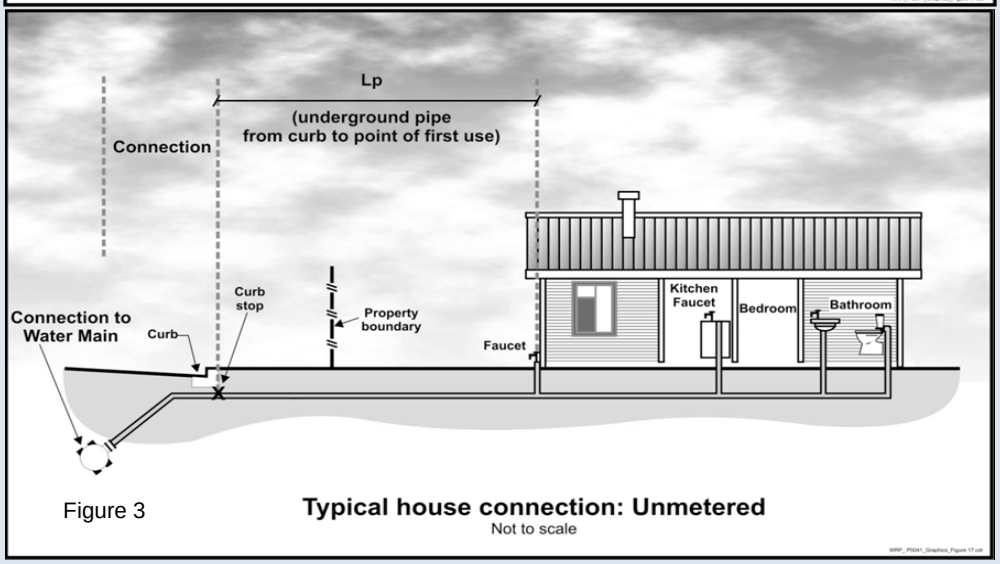
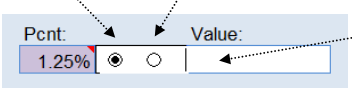


Figure 3 **Typical house connection: Unmetered**
Not to scale

Item Name	Description
Apparent Losses Find	= unauthorized consumption + customer metering inaccuracies + systematic data handling errors Apparent Losses include all types of inaccuracies associated with customer metering (worn meters as well as improperly sized meters or wrong type of meter for the water usage profile) as well as systematic data handling errors (meter reading, billing, archiving and reporting), plus unauthorized consumption (theft or illegal use). NOTE: Over-estimation of Apparent Losses results in under-estimation of Real Losses. Under-estimation of Apparent Losses results in over-estimation of Real Losses.
AUTHORIZED CONSUMPTION Find	= billed water exported + billed metered + billed unmetered + unbilled metered + unbilled unmetered consumption The volume of metered and/or unmetered water taken by registered customers, the water utility's own uses, and uses of others who are implicitly or explicitly authorized to do so by the water utility; for residential, commercial, industrial and public-minded purposes. Typical retail customers' consumption is tabulated usually from established customer accounts as billed metered consumption, or - for unmetered customers - billed unmetered consumption. These types of consumption, along with billed water exported, provide revenue potential for the water utility. **Be certain to tabulate the water exported volume as a separate component and do not "double-count" it by including in the billed metered consumption component as well as the water exported component.** Unbilled authorized consumption occurs typically in non-account uses, including water for fire fighting and training, flushing of water mains and sewers, street cleaning, watering of municipal gardens, public fountains, or similar public-minded uses. Occasionally these uses may be metered and billed (or charged a flat fee), but usually they are unmetered and unbilled. In the latter case, the water auditor may use a default value to estimate this quantity, or implement procedures for the reliable quantification of these uses. This starts with documenting usage events as they occur and estimating the amount of water used in each event. (See Unbilled unmetered consumption)
View Service Connection Diagram **Average length of customer service line** Find	This is the average length of customer service line, Lp, that is owned and maintained by the customer; from the point of ownership transfer to the customer water meter, or building line (if unmetered). The quantity is one of the data inputs for the calculation of Unavoidable Annual Real Losses (UARL), which serves as the denominator of the performance indicator: Infrastructure Leakage Index (ILI). The value of Lp is multiplied by the number of customer service connections to obtain a total length of customer owned piping in the system. The purpose of this parameter is to account for the unmetered service line infrastructure that is the responsibility of the customer for arranging repairs of leaks that occur on their lines. In many cases leak repairs arranged by customers take longer to be executed than leak repairs arranged by the water utility on utility-maintained piping. Leaks run longer - and lose more water - on customer-owned service piping, than utility owned piping. If the customer water meter exists near the ownership transfer point (usually the curb stop located between the water main and the customer premises) this distance is zero because the meter and transfer point are the same. This is the often encountered configuration of customer water meters located in an underground meter box or "pit" outside of the customer's building. The Free Water Audit Software asks a "Yes/No" question about the meter at this location. If the auditor selects "Yes" then this distance is set to zero and the data grading score for this component is set to 10. If water meters are typically located inside the customer premise/building, or properties are unmetered, it is up to the water auditor to estimate a system-wide average Lp length based upon the various customer land parcel sizes and building locations in the service area. Lp will be a shorter length in areas of high density housing, and a longer length in areas of low density housing and varied commercial and industrial buildings. General parcel demographics should be employed to obtain a composite average Lp length for the entire system. Refer to the "Service Connection Diagram" worksheet for a depiction of the service line/metering configurations that typically exist in water utilities. This worksheet gives guidance on the determination of the Average Length, Lp, for each configuration.
Average operating pressure Find	This is the average pressure in the distribution system that is the subject of the water audit. Many water utilities have a calibrated hydraulic model of their water distribution system. For these utilities, the hydraulic model can be utilized to obtain a very accurate quantity of average pressure. In the absence of a hydraulic model, the average pressure may be approximated by obtaining readings of static water pressure from a representative sample of fire hydrants or other system access points evenly located across the system. A weighted average of the pressure can be assembled; but be sure to take into account the elevation of the fire hydrants, which typically exist several feet higher than the level of buried water pipelines. If the water utility is compiling the water audit for the first time, the average pressure can be approximated, but with a low data grading. In subsequent years of auditing, effort should be made to improve the accuracy of the average pressure quantity. This will then qualify the value for a higher data grading.
Billed Authorized Consumption	All consumption that is billed and authorized by the utility. This may include both metered and unmetered consumption. See "Authorized Consumption" for more information.
Billed metered consumption Find	All metered consumption which is billed to retail customers, including all groups of customers such as domestic, commercial, industrial or institutional. **It does NOT include water supplied to neighboring utilities (water exported) which is metered and billed. Be sure to subtract any consumption for exported water sales that may be included in these billing roles. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.** The metered consumption data can be taken directly from billing records for the water audit period. The accuracy of yearly metered consumption data can be refined by including an adjustment to account for customer meter reading lag time since not all customer meters are read on the same day of the meter reading period. However additional analysis is necessary to determine the lag time adjustment value, which may or may not be significant.
Billed unmetered consumption Find	All billed consumption which is calculated based on estimates or norms from water usage sites that have been determined by utility policy to be left unmetered. This is typically a very small component in systems that maintain a policy to meter their customer population. However, this quantity can be the key consumption component in utilities that have not adopted a universal metering policy. **This component should NOT include any water that is supplied to neighboring utilities (water exported) which is unmetered but billed. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.**

Item Name	Description
Customer metering inaccuracies Find	Apparent water losses caused by the collective under-registration of customer water meters. Many customer water meters gradually wear as large cumulative volumes of water are passed through them over time. This causes the meters to under-register the flow of water. This occurrence is common with smaller residential meters of sizes 5/8-inch and 3/4 inch after they have registered very large cumulative volumes of water, which generally occurs only after periods of years. For meters sized 1-inch and larger - typical of multi-unit residential, commercial and industrial accounts - meter under-registration can occur from wear or from the improper application of the meter; i.e. installing the wrong type of meter or the wrong size of meter, for the flow pattern (profile) of the consumer. For instance, many larger meters have reduced accuracy at low flows. If an oversized meter is installed, most of the time the routine flow will occur in the low flow range of the meter, and a significant portion of it may not be registered. It is important to properly select and install all meters, but particularly large customer meters, size 1-inch and larger. The auditor has two options for entering data for this component of the audit. The auditor can enter a percentage under-registration (typically an estimated value), this will apply the selected percentage to the two categories of metered consumption to determine the volume of water not recorded due to customer meter inaccuracy. Note that this percentage is a composite average inaccuracy for all customer meters in the entire meter population. The percentage will be multiplied by the sum of the volumes in the Billed Metered and Unbilled Metered components. Alternatively, if the auditor has substantial data from meter testing activities, he or she can calculate their own loss volumes, and this volume may be entered directly. Note that a value of zero will be accepted but an alert will appear asking if the customer population is unmetered. Since all metered systems have some degree of inaccuracy, a positive value should be entered. A value of zero in this component is valid only if the water utility does not meter its customer population.
Customer retail unit cost Find	The Customer Retail Unit Cost represents the charge that customers pay for water service. This unit cost is applied routinely to the components of Apparent Loss, since these losses represent water reaching customers but not (fully) paid for. Since most water utilities have a rate structure that includes a variety of different costs based upon class of customer, a weighted average of individual costs and number of customer accounts in each class can be calculated to determine a single composite cost that should be entered into this cell. Finally, the weighted average cost should also include additional charges for sewer, storm water or biosolids processing, but only if these charges are based upon the volume of potable water consumed. For water utilities in regions with limited water resources and a questionable ability to meet the drinking water demands in the future, the Customer Retail Unit Cost might also be applied to value the Real Losses; instead of applying the Variable Production Cost to Real Losses. In this way, it is assumed that every unit volume of leakage reduced by leakage management activities will be sold to a customer. Note: the Free Water Audit Software allows the user to select the units that are charged to customers (either $/1,000 gallons, $/hundred cubic feet, or $/1,000 litres) and automatically converts these units to the units that appear in the "WATER SUPPLIED" box. The monetary units are United States dollars, $.
Infrastructure Leakage Index (ILI) Find	The ratio of the Current Annual Real Losses (Real Losses) to the Unavoidable Annual Real Losses (UARL). The ILI is a highly effective performance indicator for comparing (benchmarking) the performance of utilities in operational management of real losses.
Length of mains Find	Length of all pipelines (except service connections) in the system starting from the point of system input metering (for example at the outlet of the treatment plant). It is also recommended to include in this measure the total length of fire hydrant lead pipe. Hydrant lead pipe is the pipe branching from the water main to the fire hydrant. Fire hydrant leads are typically of a sufficiently large size that is more representative of a pipeline than a service connection. The average length of hydrant leads across the entire system can be assumed if not known, and multiplied by the number of fire hydrants in the system, which can also be assumed if not known. This value can then be added to the total pipeline length. Total length of mains can therefore be calculated as: Length of Mains, miles = (total pipeline length, miles) + [{(average fire hydrant lead length, ft) x (number of fire hydrants)} / 5,280 ft/mile] or Length of Mains, kilometres = (total pipeline length, kilometres) + [{(average fire hydrant lead length, metres) x (number of fire hydrants)} / 1,000 metres/kilometre]
NON-REVENUE WATER Find	= Apparent Losses + Real Losses + Unbilled Metered Consumption + Unbilled Unmetered Consumption. This is water which does not provide revenue potential to the utility.
Number of active AND inactive service connections Find	Number of customer service connections, extending from the water main to supply water to a customer. Please note that this includes the actual number of distinct piping connections, including fire connections, whether active or inactive. This may differ substantially from the number of customers (or number of accounts). **Note: this number does not include the pipeline leads to fire hydrants - the total length of piping supplying fire hyrants should be included in the "Length of mains" parameter.**
Real Losses Find	Physical water losses from the pressurized system (water mains and customer service connections) and the utility's storage tanks, up to the point of customer consumption. In metered systems this is the customer meter, in unmetered situations this is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks and overflows.
Revenue Water	Those components of System Input Volume that are billed and have the potential to produce revenue.
Service Connection Density Find	=number of customer service connections / length of mains

Item Name	Description
Systematic data handling errors Find	Apparent losses caused by accounting omissions, errant computer programming, gaps in policy, procedure, and permitting/activation of new accounts; and any type of data lapse that results in under-stated customer water consumption in summary billing reports. **Systematic Data Handling Errors result in a direct loss of revenue potential. Water utilities can find "lost" revenue by keying on this component.** Utilities typically measure water consumption registered by water meters at customer premises. The meter should be read routinely (ex: monthly) and the data transferred to the Customer Billing System, which generates and sends a bill to the customer. Data Transfer Errors result in the consumption value being less than the actual consumption, creating an apparent loss. Such error might occur from illegible and mis-recorded hand-written readings compiled by meter readers, inputting an incorrect meter register unit conversion factor in the automatic meter reading equipment, or a variety of similar errors. Apparent losses also occur from Data Analysis Errors in the archival and data reporting processes of the Customer Billing System. Inaccurate estimates used for accounts that fail to produce a meter reading are a common source of error. Billing adjustments may award customers a rightful monetary credit, but do so by creating a negative value of consumption, thus under-stating the actual consumption. Account activation lapses may allow new buildings to use water for months without meter readings and billing. Poor permitting and construction inspection practices can result in a new building lacking a billing account, a water meter and meter reading; i.e., the customer is unknown to the utility's billing system. Close auditing of the permitting, metering, meter reading, billing and reporting processes of the water consumption data trail can uncover data management gaps that create volumes of systematic data handling error. Utilities should routinely analyze customer billing records to detect data anomalies and quantify these losses. For example, a billing account that registers zero consumption for two or more billing cycles should be checked to explain why usage has seemingly halted. Given the revenue loss impacts of these losses, water utilities are well-justified in providing continuous oversight and timely correction of data transfer errors & data handling errors. If the water auditor has not yet gathered detailed data or assessment of systematic data handling error, it is recommended that the auditor apply the default value of 0.25% of the the Billed Authorized Consumption volume. However, if the auditor has investigated the billing system and its controls, and has well validated data that indicates the volume from systematic data handling error is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations and select an appropriate grading. Note: negative values are not allowed for this audit component. If the auditor enters zero for this component then a grading of 1 will be automatically assigned.
Total annual cost of operating the water system Find	These costs include those for operations, maintenance and any annually incurred costs for long-term upkeep of the drinking water supply and distribution system. It should include the costs of day-to-day upkeep and long-term financing such as repayment of capital bonds for infrastructure expansion or improvement. Typical costs include employee salaries and benefits, materials, equipment, insurance, fees, administrative costs and all other costs that exist to sustain the drinking water supply. Depending upon water utility accounting procedures or regulatory agency requirements, it may be appropriate to include depreciation in the total of this cost. This cost should not include any costs to operate wastewater, biosolids or other systems outside of drinking water.
Unauthorized consumption Find	Includes water illegally withdrawn from fire hydrants, illegal connections, bypasses to customer consumption meters, or tampering with metering or meter reading equipment; as well as any other ways to receive water while thwarting the water utility's ability to collect revenue for the water. Unauthorized consumption results in uncaptured revenue and creates an error that understates customer consumption. In most water utilities this volume is low and, if the water auditor has not yet gathered detailed data for these loss occurrences, it is recommended that the auditor apply a default value of 0.25% of the volume of water supplied. However, if the auditor has investigated unauthorized occurrences, and has well validated data that indicates the volume from unauthorized consumption is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations. Note that a value of zero will not be accepted since all water utilities have some volume of unauthorized consumption occurring in their system. Note: if the auditor selects the default value for unauthorized consumption, a data grading of 5 is automatically assigned, but not displayed on the Reporting Worksheet.
Unavoidable Annual Real Losses (UARL) Find	UARL (gallons)=(5.41Lm + 0.15Nc + 7.5Lc) xP, or UARL (litres)=(18.0Lm + 0.8Nc + 25.0Lc) xP where: Lm = length of mains (miles or kilometres) Nc = number of customer service connections Lp = the average distance of customer service connection piping (feet or metres) (see the Worksheet "Service Connection Diagram" for guidance on deterring the value of Lp) Lc = total length of customer service connection piping (miles or km) Lc = Nc X Lp (miles or kilometres) P = Pressure (psi or metres) The UARL is a theoretical reference value representing the technical low limit of leakage that could be achieved if all of today's best technology could be successfully applied. It is a key variable in the calculation of the Infrastructure Leakage Index (ILI). Striving to reduce system leakage to a level close to the UARL is usually not needed unless the water supply is unusually expensive, scarce or both. NOTE: The UARL calculation has not yet been proven as fully valid for very small, or low pressure water distribution systems. If, in gallons: (Lm x 32) + Nc < 3000 or P <35psi in litres: (Lm x 20) + Nc < 3000 or P < 25m then the calculated UARL value may not be valid. The software does not display a value of UARL or ILI if either of these conditions is true.

Item Name	Description
Unbilled Authorized Consumption	All consumption that is unbilled, but still authorized by the utility. This includes Unbilled Metered Consumption + Unbilled Unmetered Consumption. See "Authorized Consumption" for more information. For Unbilled Unmetered Consumption, the Free Water Audit Software provides the auditor the option to select a default value if they have not audited unmetered activities in detail. The default calculates a volume that is 1.25% of the Water Supplied volume. If the auditor has carefully audited the various unbilled, unmetered, authorized uses of water, and has established reliable estimates of this collective volume, then he or she may enter the volume directly for this component, and not use the default value.
Unbilled metered consumption Find	Metered consumption which is authorized by the water utility, but, for any reason, is deemed by utility policy to be unbilled. This might for example include metered water consumed by the utility itself in treatment or distribution operations, or metered water provided to civic institutions free of charge. **It does not include water supplied to neighboring utilities (water exported) which may be metered but not billed.**
Unbilled unmetered consumption Find	Any kind of Authorized Consumption which is neither billed or metered. This component typically includes water used in activities such as fire fighting, flushing of water mains and sewers, street cleaning, fire flow tests conducted by the water utility, etc. In most water utilities it is a small component which is very often substantially overestimated. **It does NOT include water supplied to neighboring utilities (water exported) which is unmetered and unbilled – an unlikely case.** This component has many sub-components of water use which are often tedious to identify and quantify. Because of this, and the fact that it is usually a small portion of the water supplied, it is recommended that the auditor apply the default value, which is 1.25% of the Water Supplied volume. Select the default percentage to enter this value. If the water utility has carefully audited the unbilled, unmetered activities occurring in the system, and has well validated data that gives a value substantially higher or lower than the default volume, then the auditor should enter their own volume. However the default approach is recommended for most water utilities. Note that a value of zero is not permitted, since all water utilities have some volume of water in this component occurring in their system.
Units and Conversions	The user may develop an audit based on one of three unit selections: 1) Million Gallons (US) 2) Megalitres (Thousand Cubic Metres) 3) Acre-feet Once this selection has been made in the instructions sheet, all calculations are made on the basis of the chosen units. Should the user wish to make additional conversions, a unit converter is provided below (use drop down menus to select units from the yellow unit boxes): Enter Units: 1 — Convert From… Million Gallons (US) = **Converts to…..** 3.06888329 Acre-feet (conversion factor = 3.06888328973723)
Use of Option Buttons	To use the default percent value choose this button To enter a value choose this button and enter the value in the cell to the right  **NOTE:** For Unbilled Unmetered Consumption, Unauthorized Consumption and Systematic Data Handling Errors, a recommended default value can be applied by selecting the Percent option. The default values are based on fixed percentages of Water Supplied or Billed Authorized Consumption and are recommended for use in this audit unless the auditor has well validated data for their system. Default values are shown by purple cells, as shown in the example above. If a default value is selected, the user does not need to grade the item; a grading value of 5 is automatically applied (however, this grade will not be displayed).
Variable production cost (applied to Real Losses) Find	The cost to produce and supply the next unit of water (e.g., $/million gallons). This cost is determined by calculating the summed unit costs for ground and surface water treatment and all power used for pumping from the source to the customer. It may also include other miscellaneous unit costs that apply to the production of drinking water. It should also include the unit cost of bulk water purchased as an import if applicable. It is common to apply this unit cost to the volume of Real Losses. However, if water resources are strained and the ability to meet future drinking water demands is in question, then the water auditor can be justified in applying the Customer Retail Rate to the Real Loss volume, rather than applying the Variable Production Cost. The Free Water Audit Software applies the Variable Production costs to Real Losses by default. However, the auditor has the option on the Reporting Worksheet to select the Customer Retail Cost as the basis for the Real Loss cost evaluation if the auditor determines that this is warranted.
Volume from own sources Find	The volume of water withdrawn (abstracted) from water resources (rivers, lakes, streams, wells, etc) controlled by the water utility, and then treated for potable water distribution. Most water audits are compiled for utility retail water distribution systems, so this volume should reflect the amount of treated drinking water that entered the distribution system. Often the volume of water measured at the effluent of the treatment works is slightly less than the volume measured at the raw water source, since some of the water is used in the treatment process. Thus, it is useful if flows are metered at the effluent of the treatment works. If metering exists only at the raw water source, an adjustment for water used in the treatment process should be included to account for water consumed in treatment operations such as filter backwashing, basin flushing and cleaning, etc. If the audit is conducted for a wholesale water agency that sells untreated water, then this quantity reflects the measure of the raw water, typically metered at the source.

Item Name	Description
Volume from own sources: Master meter and supply error adjustment Find	An estimate or measure of the degree of inaccuracy that exists in the master (production) meters measuring the annual Volume from own Sources, and any error in the data trail that exists to collect, store and report the summary production data. This adjustment is a weighted average number that represents the collective error for all master meters for all days of the audit year and any errors identified in the data trail. Meter error can occur in different ways. A meter or meters may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Data error can occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of inaccuracy in master meters and data errors in archival systems are common; thus a value of zero should not be entered. Enter a negative percentage or value for metered data under-registration; or, enter a positive percentage or value for metered data over-registration.
Water exported Find	The Water Exported volume is the bulk water conveyed and sold by the water utility to neighboring water systems that exists outside of their service area. Typically this water is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water utility that is selling the water: i.e. the exporter. If the water utility who is compiling the annual water audit sells bulk water in this manner, they are an exporter of water. Note: The Water Exported volume is sold to wholesale customers who are typically charged a wholesale rate that is different than retail rates charged to the retail customers existing within the service area. Many state regulatory agencies require that the Water Exported volume be reported to them as a quantity separate and distinct from the retail customer billed consumption. For these reasons - and others - the Water Exported volume is always quantified separately from Billed Authorized Consumption in the standard water audit. **Be certain not to "double-count" this quantity by including it in both the Water Exported box and the Billed Metered Consumption box of the water audit Reporting Worksheet. This volume should be included only in the Water Exported box.**
Water exported: Master meter and supply error adjustment Find	An estimate or measure of the volume in which the Water Exported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived exported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of error in their metered data, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived data. Thus, a value of zero should not be entered. Enter a negative percentage or value for metered data under-registration; or enter a positive percentage or value for metered data over-registration. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. Corrections to data gaps or other errors found in the archived data should also be included as a portion of this meter error adjustment.
Water imported Find	The Water Imported volume is the bulk water purchased to become part of the Water Supplied volume. Typically this is water purchased from a neighboring water utility or regional water authority, and is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water supplier selling the water to the utility conducting the water audit. The water supplier selling the bulk water usually charges the receiving utility based upon a wholesale water rate.
Water imported: Master meter and supply error adjustment Find	An estimate or measure of the volume in which the Water Imported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived imported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some level of meter inaccuracy, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived metered data. Thus, a value of zero should not be entered. Enter a negative percentage or value for metered data under-registration; or, enter a positive percentage or value for metered data over-registration. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment.
WATER LOSSES Find	= apparent losses + real losses Water Losses are the difference between Water Supplied and Authorized Consumption. Water losses can be considered as a total volume for the whole system, or for partial systems such as transmission systems, pressure zones or district metered areas (DMA); if one of these configurations are the basis of the water audit.

Water Audit Report for: Humboldt Bay Municipal Water District (CA1210013)
Reporting Year: 2015 1/2015 - 12/2015
Data Validity Score: 96

Water Loss Control Planning Guide

Functional Focus Area	Water Audit Data Validity Level / Score				
	Level I (0-25)	**Level II** (26-50)	**Level III** (51-70)	**Level IV** (71-90)	**Level V** (91-100)
Audit Data Collection	Launch auditing and loss control team; address production metering deficiencies	Analyze business process for customer metering and billing functions and water supply operations. Identify data gaps.	Establish/revise policies and procedures for data collection	Refine data collection practices and establish as routine business process	Annual water audit is a reliable gauge of year-to-year water efficiency standing
Short-term loss control	Research information on leak detection programs. Begin flowcharting analysis of customer billing system	Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc.	Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring	Refine, enhance or expand ongoing programs based upon economic justification	Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation
Long-term loss control		Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or Automatic Meter Reading (AMR) system.	Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process.	Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management	Continue incremental improvements in short-term and long-term loss control interventions
Target-setting			Establish long-term apparent and real loss reduction goals (+10 year horizon)	Establish mid-range (5 year horizon) apparent and real loss reduction goals	Evaluate and refine loss control goals on a yearly basis
Benchmarking			Preliminary Comparisons - can begin to rely upon the Infrastructure Leakage Index (ILI) for performance comparisons for real losses (see below table)	Performance Benchmarking - ILI is meaningful in comparing real loss standing	Identify Best Practices/ Best in class - the ILI is very reliable as a real loss performance indicator for best in class service

For validity scores of 50 or below, the shaded blocks should not be focus areas until better data validity is achieved.

Once data have been entered into the Reporting Worksheet, the performance indicators are automatically calculated. How does a water utility operator know how well his or her system is performing? The AWWA Water Loss Control Committee provided the following table to assist water utilities is gauging an approximate Infrastructure Leakage Index (ILI) that is appropriate for their water system and local conditions. The lower the amount of leakage and real losses that exist in the system, then the lower the ILI value will be.

Note: this table offers an approximate guideline for leakage reduction target-setting. The best means of setting such targets include performing an economic assessment of various loss control methods. However, this table is useful if such an assessment is not possible.

General Guidelines for Setting a Target ILI (without doing a full economic analysis of leakage control options)

Target ILI Range	Financial Considerations	Operational Considerations	Water Resources Considerations
1.0 - 3.0	Water resources are costly to develop or purchase; ability to increase revenues via water rates is greatly limited because of regulation or low ratepayer affordability.	Operating with system leakage above this level would require expansion of existing infrastructure and/or additional water resources to meet the demand.	Available resources are greatly limited and are very difficult and/or environmentally unsound to develop.
>3.0 -5.0	Water resources can be developed or purchased at reasonable expense; periodic water rate increases can be feasibly imposed and are tolerated by the customer population.	Existing water supply infrastructure capability is sufficient to meet long-term demand as long as reasonable leakage management controls are in place.	Water resources are believed to be sufficient to meet long-term needs, but demand management interventions (leakage management, water conservation) are included in the long-term
>5.0 - 8.0	Cost to purchase or obtain/treat water is low, as are rates charged to customers.	Superior reliability, capacity and integrity of the water supply infrastructure make it relatively immune to supply shortages.	Water resources are plentiful, reliable, and easily extracted.
Greater than 8.0	Although operational and financial considerations may allow a long-term ILI greater than 8.0, such a level of leakage is not an effective utilization of water as a resource. Setting a target level greater than 8.0 - other than as an incremental goal to a smaller long-term target - is discouraged.		
Less than 1.0	If the calculated Infrastructure Leakage Index (ILI) value for your system is 1.0 or less, two possibilities exist. a) you are maintaining your leakage at low levels in a class with the top worldwide performers in leakage control. b) A portion of your data may be flawed, causing your losses to be greatly understated. This is likely if you calculate a low ILI value but do not employ extensive leakage control practices in your operations. In such cases it is beneficial to validate the data by performing field measurements to confirm the accuracy of production and customer meters, or to identify any other potential sources of error in the data.		

Example 1a: Million Gallons: Reporting Worksheet | **Example 1b**: Million Gallons: Performance Indicators | **Example 2a**: Megalitres: Reporting Worksheet | **Example 2b**: Megalitres: Reporting Worksheet

Example Audit 1a:

AWWA Free Water Audit Software: Reporting Worksheet

WAS v5.0
American Water Works Association
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Click to access definition
Click to add a comment

Water Audit Report for: City of Asheville (01-11-010)
Reporting Year: 2013 7/2012 - 6/2013

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: MILLION GALLONS (US) PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

		<---------- Enter grading in column 'E' and 'J' ---------->		Master Meter Error Adjustments		
WATER SUPPLIED				Pcnt:	Value:	
Volume from own sources:	7	7,352.880	MG/Yr	3	285.450	MG/Yr
Water imported:	n/a	0.000	MG/Yr			MG/Yr
Water exported:	n/a	0.000	MG/Yr			MG/Yr
WATER SUPPLIED:		7,067.430	MG/Yr			

Enter negative % or value for under-registration
Enter positive % or value for over-registration

AUTHORIZED CONSUMPTION				Click here: for help using option buttons below	
Billed metered:	8	4,782.250	MG/Yr		
Billed unmetered:	n/a	0.000	MG/Yr		
Unbilled metered:	7	27.757	MG/Yr	Pcnt:	Value:
Unbilled unmetered:	8	157.790	MG/Yr		157.790 MG/Yr
Unbilled Unmetered volume entered is greater than the recommended default value					
AUTHORIZED CONSUMPTION:		4,967.797	MG/Yr		

Use buttons to select percentage of water supplied OR value

WATER LOSSES (Water Supplied - Authorized Consumption)		2,099.633	MG/Yr		
Apparent Losses				Pcnt:	Value:
Unauthorized consumption:		17.669	MG/Yr	0.25%	MG/Yr
Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed					
Customer metering inaccuracies:	7	111.220	MG/Yr	2.26%	MG/Yr
Systematic data handling errors:	5	11.956	MG/Yr	0.25%	MG/Yr
Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed					
Apparent Losses:		140.844	MG/Yr		
Real Losses (Current Annual Real Losses or CARL)					
Real Losses = Water Losses - Apparent Losses:		1,958.789	MG/Yr		
WATER LOSSES:		2,099.633	MG/Yr		

NON-REVENUE WATER			
NON-REVENUE WATER:		2,285.180	MG/Yr
= Water Losses + Unbilled Metered + Unbilled Unmetered			

SYSTEM DATA			
Length of mains:	4	1,236.5	miles
Number of active AND inactive service connections:	7	55,256	
Service connection density:		45	conn./mile main
Are customer meters typically located at the curbstop or property line?		Yes	
Average length of customer service line:			(length of service line, beyond the property boundary, that is the responsibility of the utility)
Average length of customer service line has been set to zero and a data grading score of 10 has been applied			
Average operating pressure:	4	145.3	psi

COST DATA				
Total annual cost of operating water system:	10	$33,630,676	$/Year	
Customer retail unit cost (applied to Apparent Losses):	10	$3.22	$/100 cubic feet (ccf)	
Variable production cost (applied to Real Losses):	6	$335.94	$/Million gallons	☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

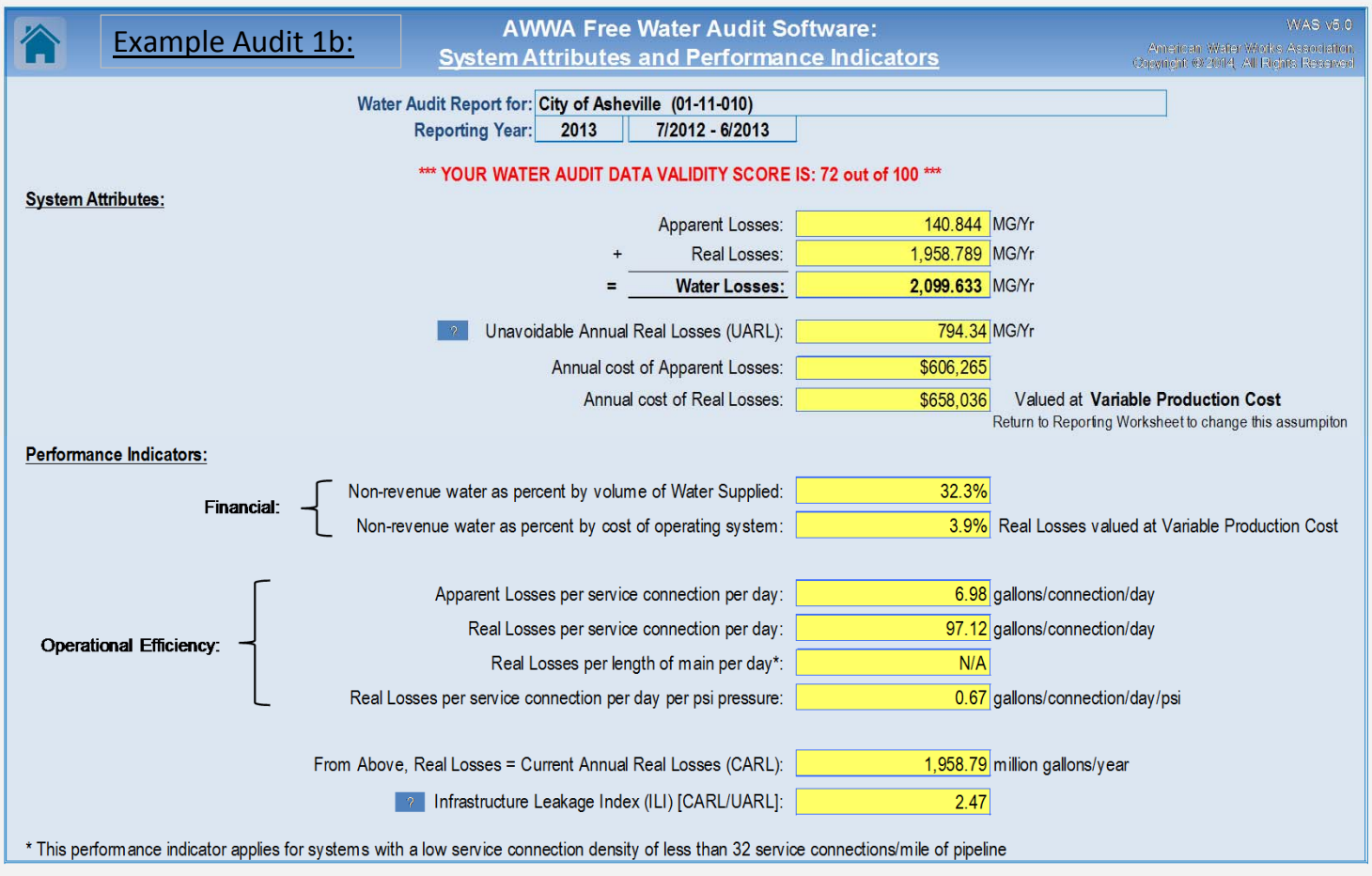
*** YOUR SCORE IS: 72 out of 100 ***

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Variable production cost (applied to Real Losses)
3: Unauthorized consumption



Example Audit 1b:

AWWA Free Water Audit Software:
System Attributes and Performance Indicators

WAS v5.0
American Water Works Association
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Water Audit Report for: City of Asheville (01-11-010)
Reporting Year: 2013 7/2012 - 6/2013

*** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 72 out of 100 ***

System Attributes:

	Apparent Losses:	140.844	MG/Yr
+	Real Losses:	1,958.789	MG/Yr
=	**Water Losses:**	**2,099.633**	MG/Yr
?	Unavoidable Annual Real Losses (UARL):	794.34	MG/Yr
	Annual cost of Apparent Losses:	$606,265	
	Annual cost of Real Losses:	$658,036	Valued at **Variable Production Cost**

Return to Reporting Worksheet to change this assumpiton

Performance Indicators:

Financial:	Non-revenue water as percent by volume of Water Supplied:	32.3%	
	Non-revenue water as percent by cost of operating system:	3.9%	Real Losses valued at Variable Production Cost
Operational Efficiency:	Apparent Losses per service connection per day:	6.98	gallons/connection/day
	Real Losses per service connection per day:	97.12	gallons/connection/day
	Real Losses per length of main per day*:	N/A	
	Real Losses per service connection per day per psi pressure:	0.67	gallons/connection/day/psi
	From Above, Real Losses = Current Annual Real Losses (CARL):	1,958.79	million gallons/year
?	Infrastructure Leakage Index (ILI) [CARL/UARL]:	2.47	

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline

Example Audit 2a:

AWWA Free Water Audit Software: Reporting Worksheet

WAS v5.0

Click to access definition
Click to add a comment

Water Audit Report for: The City of Calgary
Reporting Year: 2013 (1/2013 - 12/2013)

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: MEGALITRES (THOUSAND CUBIC METRES) PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

WATER SUPPLIED

<---------- Enter grading in column 'E' and 'J' ----------> | Master Meter Error Adjustments

	Grading	Value		Grading	Pcnt:	Value:
Volume from own sources:	7	174,324.000 ML/Yr		7	1.00%	ML/Yr
Water imported:	n/a	0.000 ML/Yr				ML/Yr
Water exported:	7	8,190.131 ML/Yr		7	1.00%	ML/Yr
WATER SUPPLIED:		**164,488.979** ML/Yr				

Enter negative % or value for under-registration
Enter positive % or value for over-registration

AUTHORIZED CONSUMPTION

Click here: for help using option buttons below

	Grading	Value	Pcnt:	Value:
Billed metered:	6	125,111.268 ML/Yr		
Billed unmetered:	8	3,503.386 ML/Yr		
Unbilled metered:	7	166.157 ML/Yr		
Unbilled unmetered:	6	1,444.000 ML/Yr		1,444.000 ML/Yr
AUTHORIZED CONSUMPTION:		**130,224.811** ML/Yr		

Use buttons to select percentage of water supplied OR value

WATER LOSSES (Water Supplied - Authorized Consumption)

34,264.168 ML/Yr

Apparent Losses

	Grading	Value	Pcnt:	Value:
Unauthorized consumption:		411.222 ML/Yr	0.25%	ML/Yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

Customer metering inaccuracies:	6	1,265.429 ML/Yr	1.00%	ML/Yr
Systematic data handling errors:		312.778 ML/Yr	0.25%	ML/Yr

Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed

Apparent Losses: **1,989.429** ML/Yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: **32,274.739** ML/Yr

WATER LOSSES: **34,264.168** ML/Yr

NON-REVENUE WATER

NON-REVENUE WATER: **35,874.325** ML/Yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	8	4,945.0 kilometers
Number of active AND inactive service connections:	8	312,075
Service connection density:		63 conn./km main
Are customer meters typically located at the curbstop or property line?		No
Average length of customer service line:	8	12.0 metres (length of service line, beyond the property boundary, that is the responsibility of the utility)
Average operating pressure:	8	50.8 metres (head)

COST DATA

Total annual cost of operating water system:	9	$169,973,759	$/Year
Customer retail unit cost (applied to Apparent Losses):	9	$2.35	$/1000 litres
Variable production cost (applied to Real Losses):	9	$73.54	$/Megalitre ☑ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

*** YOUR SCORE IS: 72 out of 100 ***

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Billed metered
3: Customer metering inaccuracies

Example Audit 2b:

AWWA Free Water Audit Software:
System Attributes and Performance Indicators

WAS v5.0

Water Audit Report for: The City of Calgary
Reporting Year: 2013 | 1/2013 - 12/2013

*** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 72 out of 100 ***

System Attributes:

	Apparent Losses:	1,989.429	ML/Yr
+	Real Losses:	32,274.739	ML/Yr
=	**Water Losses:**	**34,264.168**	ML/Yr
?	Unavoidable Annual Real Losses (UARL):	8,015.57	ML/Yr
	Annual cost of Apparent Losses:	$4,675,159	
	Annual cost of Real Losses:	$75,845,637	Valued at **Customer Retail Unit Cost**

Return to Reporting Worksheet to change this assumpiton

Performance Indicators:

Financial:

Non-revenue water as percent by volume of Water Supplied:	21.8%	
Non-revenue water as percent by cost of operating system:	49.6%	Real Losses valued at Customer Retail Unit Cost

Operational Efficiency:

Apparent Losses per service connection per day:	17.47	litres/connection/day
Real Losses per service connection per day:	283.34	litres/connection/day
Real Losses per length of main per day*:	N/A	
Real Losses per service connection per day per meter (head) pressure:	5.58	litres/connection/day/m
From Above, Real Losses = Current Annual Real Losses (CARL):	32,274.74	ML/year
? Infrastructure Leakage Index (ILI) [CARL/UARL]:	4.03	

* This performance indicator applies for systems with a low service connection density of less than 20 service connections/kilometre of pipeline

AWWA Water Audit Software Version 5.0 Developed by the Water Loss Control Committee of the American Water Works Association August, 2014

This software is intended to serve as a basic tool to compile a preliminary, or "top-down", water audit. It is recommended that users also refer to the current edition of the AWWA M36 Publication, Water Audits and Loss Control Programs, for detailed guidance on compiling a comprehensive, or "bottom-up", water audit using the same water audit methodology.

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- Kunkel, G. et al, 2003. Water Loss Control Committee Report: Applying Worldwide Best Management Practices in Water Loss Control. Journal AWWA, 95:8:65

- AWWA Water Audits and Loss Control Programs, M36 Publication, 3rd Edition, 2009

- Service Connection Diagrams courtesy of Ronnie McKenzie, WRP Pty Ltd.

VERSION HISTORY:

Version:	Release Date:	Number of Worksheets:	Key Features and Developments
v1	2005/ 2006	5	The AWWA Water Audit Software was piloted in 2005 (v1.0 beta). The early versions (1.x) of the software restricted data entry to units of Million Gallons per year. For each entry into the audit, users identified whether the input was measured or estimated.
v2	2006	5	The most significant enhancement in v2 of the software was to allow the user to choose the volumetric units to be used in the audit, Million Gallons or Thousand Cubic Metres (megalitres) per year. Two financial performance indicators were added to provide feedback to the user on the cost of Real and Apparent losses.
v3	2007	7	In v3, the option to report volumetric units in acre-feet was added. Another new feature in v3 was the inclusion of default values for two water audit components (unbilled unmetered and unauthorized consumption). v3 also included two examples of completed audits in units of million gallons and Megalitres. Several checks were added into v3 to provide instant feedback to the user on common data entry problems, in order to help the user complete an accurate water audit.
v4 - v4.2	2010	10	v4 (and versions 4.x) of the software included a new approach to data grading. The simple "estimated" or "measured" approach was replaced with a more granular scale (typically 1-10) that reflected descriptions of utility practices and served to describe the confidence and accuracy of the input data. Each input value had a corresponding scale fully described in the Grading Matrix tab. The Grading Matrix also showed the actions required to move to a higher grading score. Grading descriptions were available on the Reporting Worksheet via a pop-up box next to each water audit input. A water audit data validity score is generated (max = 100) and priority areas for attention (to improve audit accuracy) are identified, once a user completes the requied data grading. A service connection diagram was also added to help users understand the impact of customer service line configurations on water losses and how this information should be entered into the water audit software. An acknoweldgements section was also added. Minor bug fixes resulted in the release of versions 4.1 and 4.2. A French language version was also made available for v4.2.
v5	2014	12	In v5, changes were made to the way Water Supplied information is entered into software, with each major component having a corresponding Master Meter Error Adjustment entry (and data grading requirement). This required changes to the data validity score calculation; v5 of the software uses a weighting system that is, in part, proportional to the volume of input components. The Grading Matrix was updated to reflect the new audit inputs and also to include clarifications and additions to the scale descriptions. The appearance of the software was updated in v5 to make the software more user-friendly and several new features were added to provide more feedback to the user. Notably, a dashboard tab has been added to provide more visual feedback on the water audit results and associated costs of Non-Revenue Water. A comments sheet was added to allow the user to track notes, comments and to cite sources used.