State of Oregon
Department of Environmental Quality Memorandum

Date: April 5, 2011

To: Environmental Quality Commission

From: Dick Pedersen, Director

Subject: Agenda item E, Rule adoption: Amending water quality standards for arsenic
April 21-22, 2011, EQC meeting

Why this is important

This rule amendment revises Oregon's water quality criteria for arsenic and adds an arsenic reduction policy.

DEQ recommendation and EQC motion

The Department of Environmental Quality recommends that the commission amend Oregon's water quality standards for arsenic as presented in attachments A and B. The amendments to OAR 340-041-0033 include revisions to the numeric arsenic criteria and adoption of an arsenic reduction policy. DEQ also recommends that the revised arsenic criteria and the arsenic reduction policy become applicable under state law only after the numeric arsenic criteria are approved by EPA and become effective under the federal Clean Water Act. Language to this effect is included in the rule language and in Table 20.

DEQ further recommends that the agency not submit the revised arsenic criteria to EPA for approval until the Commission acts on the larger human health toxics criteria rulemaking. The recommended arsenic criteria are based on a fish consumption rate of 175 grams per day, the same rate being used to revise Oregon's human health criteria. DEQ is currently considering and responding to public comment on the larger rulemaking with the intent of bringing the proposed criteria to the Commission in June of 2011. By waiting to submit the arsenic criteria, DEQ can ensure that there will be consistency in the fish consumption rate used for arsenic and the other human health criteria,

Background and need for rulemaking

The commission adopted the current arsenic criteria in the late 1980s when it adopted all of EPA's 1986 recommended toxics criteria. In response to public comment in October 2008, EQC directed DEQ to review the science behind the human health criteria for naturally occurring metals. DEQ's review, which is summarized in attachment E, led to this proposed rule amendment. DEQ also recommended revisions to the human health criteria for iron and manganese, which the EQC adopted in December 2010.

Oregon's current human health criteria for arsenic are not attainable in many Oregon waters, due at least in part to natural sources. Trying to implement criteria that are below natural background levels can result in unreasonable costs to the state and regulated entities without yielding meaningful environmental results such as

measurably reduced in-stream concentrations. The human health risks associated with natural arsenic concentrations are not new; they have been present since people have been drinking water and eating fish from Oregon streams, lakes and coastal waters.

Affected parties requested that DEQ fast-track the arsenic, iron and manganese criteria rulemaking separate from the larger human health toxics and implementation tools rulemaking process. The commission adopted iron and manganese revisions in December 2010. DEQ delayed the arsenic rulemaking to allow time to receive additional public comment and to consider and respond to the comments. DEQ expects that several National Pollutant Discharge Elimination System permits due for renewal in the near future will need permit limits under the current criteria. As a result of the accelerated rulemaking, DEQ may be able to use the revised criteria to determine whether limits are necessary and to develop any subsequent limits.

Effect of rule

The rule amendment revises the numeric arsenic human health criteria as shown in the table below and adds a new arsenic reduction policy to the water quality standards rules. The changes are shown in attachment A as redline/strikeout changes to OAR 340-041-0033 and Table 20 for the arsenic criteria.

Human Health Criteria for Arsenic (µg/l)			
	Water + Fish Ingestion	Fish Consumption Only - Freshwater	Fish Consumption Only - Saltwater
Current criteria (total arsenic)	0.0022	0.0175 [a]	0.0175[a]
Criteria proposed Aug 2010 (inorganic arsenic)	2.3	2.7[a]	2.7[a]
Recommended criteria (inorganic arsenic)	2.1	2.1	1.0

[a] The current and initially proposed fish consumption only criteria applied to all waters.

The arsenic reduction policy requires industrial sources that discharge arsenic and are within proximity to drinking water sources to develop arsenic reduction plans if they have the potential to impact the source water of a public drinking water supplier. The objective of the policy is to minimize human health risk associated with human sources of arsenic to the extent feasible where background arsenic concentrations are lower than the numeric criteria. The policy targets potential risks to drinking water supplies because the water and fish ingestion criterion is based on a 10^{-4} risk level, which is much greater than the risk level used for other

human health criteria.

Commission authority

The commission has authority to take this action under ORS 468.020, 468B.010 and 468B.035.

Stakeholder involvement

During DEQ's arsenic criteria review, DEQ informed and obtained input from the Toxics Standards Rulemaking Workgroup, a stakeholder committee that DEQ assembled to provide input on the toxics standards rulemaking. The membership of this group is provided in the issue paper in attachment E. DEQ discussed the issue paper findings and its recommendations with the rulemaking workgroup prior to the formal public comment period and the group supported DEQ's recommendations at that time.

Public comment

DEQ accepted public comment from Aug. 25 to Sept. 30, 2010, and held public hearings in Portland and Pendleton. DEQ invited additional public comment on the proposed rule, including revised proposed numeric criteria, from Feb. 1 to 23, 2011. A summary and response to public comment is provided in attachment B; hearing reports are provided in attachment C. DEQ received comments from 28 individuals or organizations, which presented a variety of perspectives. Overall, commenters support adopting less stringent criteria together with an arsenic reduction policy. Commenters from areas of the state with background arsenic concentrations that are higher than the proposed criteria, however, expressed concerns that the criteria do not adequately account for the conditions of their waters. The issues are summarized in the following "Key issues" section and in further detail in attachment B.

Key issues

1. *Meeting commission and agency goals*
An objective of DEQ's water quality toxics standards work has been to meet the commission's goals to protect public health, reduce toxic pollutants and achieve meaningful environmental results for the costs expended. Specifically in the development of the arsenic criteria, DEQ sought to ensure protection of public health and while recognizing the presence of naturally occurring arsenic in Oregon waters. The proposed rule amendments for arsenic are an incremental step toward meeting this goal.

2. *Creating criteria based on relevant and available science*
DEQ must ensure that Oregon's water quality criteria are based on relevant and available science. The recommended arsenic criteria are based on EPA's human health toxics criteria calculation method with several adjusted factors to make the criteria more appropriate for Oregon:

- The fish consumption rate based on 175 grams per day
- The bioconcentration factor - a factor describing how much of a pollutant goes from the water column into fish tissue

- An inorganic proportion factor - a factor describing how much of the arsenic accumulation in fish tissue is inorganic arsenic, arsenic's most toxic form
- The cancer risk level

DEQ used up-to-date data, information and studies to determine the values of the factors used. The arsenic issue paper provided as attachment E contains detailed discussion of DEQ's evaluation of the scientific information and rationale used to derive the recommended criteria. Key aspects of DEQ's approach are summarized below relative to the fish consumption rate and the bioconcentration factor.

The proposed arsenic criteria are based on a fish consumption rate of 175 grams per day. The current arsenic criteria are based on a rate of 6.5 grams per day. This increased consumption rate has been the subject of substantial review and public debate. EQC directed DEQ to use this rate as the basis for developing human health toxics criteria in October 2008. Using a rate of 175 grams per day protects the ability of Oregonians to consume fish and shellfish from Oregon's waters on a regular basis without incurring unacceptable health risk.

The current arsenic criteria are based on a bioconcentration factor of 44. DEQ used a bioconcentration factor of one in its initial proposal based on an approach other states' used to develop arsenic criteria. Based on public comment that additional data should be considered, including saltwater species, DEQ did further review of the available science and used additional bioconcentration factor data. After the additional review, DEQ developed proposed criteria based on a bioconcentration factor of 14 for the freshwater criteria and a bioconcentration factor of 26 for the saltwater criterion. Rather than having one set of criteria that apply to both fresh and salt waters, the proposed criteria reflect the significantly higher bioconcentration rates of marine mollusks. The saltwater criterion incorporates the high bioconcentration rates of mollusks because people do eat marine mollusks, such as oysters and clams, and the freshwater criteria are based on the bioconcentration rates of finfish. DEQ has no data indicating that people in Oregon eat mollusks from fresh water.

While DEQ evaluated all available BCF data, uncertainties remain, particularly for saltwater species. However, after reviewing natural ocean arsenic concentrations and conducting two calculations based on a range of BCFs pertinent for inorganic arsenic, DEQ concludes the recommended saltwater criterion is a reasonable and protective value.

3. *The cancer risk levels used to develop standards*
DEQ's proposed arsenic criteria are based on higher cancer risk levels than DEQ generally uses for criteria or risk assessment. DEQ uses a risk level of 1×10^{-6} for

all the other current and proposed water quality toxics criteria. DEQ proposes a 1×10^{-4} risk level for the water and fish ingestion criterion and a 1.1×10^{-5} risk level for the fish consumption only criteria. The proposed criteria represent an appropriate balance of human health protection and recognition that arsenic is present in Oregon waters from natural sources in the range of concentrations associated with these risk levels due to the state's geology and soils. The human health risk associated with natural arsenic levels has been present since people have been drinking water and eating fish from Oregon streams. In addition, natural sources of arsenic cannot be practicably controlled. To list waters, including the ocean, as impaired and develop water quality improvement plans, known as TMDLs, in these circumstances is not a prudent use of public resources. According to EPA guidance, a higher risk level of up to 10^{-4} is acceptable when paired with a fish consumption rate that represents subsistence level consumption rather than the per capita consumption of the general population. Please see attachment E for additional discussion of the risk factors used.

4. *Communities with high background concentrations of arsenic*
The recommended freshwater criteria are 2.1micrograms per liter. While this is much less stringent than the current criteria, there are waters in the state with higher natural arsenic concentrations, particularly in areas of eastern and southern Oregon. Cities and residents in these areas have expressed concern that they will not be able to meet the new criteria and that the implementation tools that will be available to them will be costly to achieve and will amount to a "paper exercise" that results in no real water quality improvements. DEQ acknowledges the validity of these concerns and will work with these communities to identify appropriate solutions, whether that is to adopt site-specific water quality standards or use a permitting tool. In some cases, if arsenic levels are very high, drinking water supply may not be an appropriate use of the water body. In the meantime, it is a DEQ's priority to move ahead with adoption of the revised statewide criteria.

5. *Adding an arsenic reduction policy to the standard*
DEQ recommends an arsenic reduction policy to minimize human health risk associated with human-caused sources of arsenic. Where water bodies in Oregon have background levels below the proposed criteria, members of the stakeholder workgroup suggested that arsenic additions from human activity be reduced where feasible in order to minimize human health risk. The arsenic reduction policy will require dischargers with the potential to affect a drinking water supply to develop an arsenic reduction plan and take feasible steps to reduce arsenic loading.
The reduction plan requirement applies to individual industrial NPDES permit holders because municipalities are subject to similar requirements under Senate Bill 737. The arsenic reduction policy includes a policy statement that nonpoint sources should also reduce inorganic arsenic pollution through erosion and runoff control. Additional discussion of the arsenic reduction policy is provided in the

issue paper in attachment E.

Next steps

If adopted by the commission, the rule amendments will be filed with the Secretary of State and submitted to EPA for approval.

DEQ proposes that the criteria revisions and the arsenic reduction policy not be applicable under state law until the criteria are approved by EPA and effective under federal law. DEQ has included language in Table 20 and the arsenic reduction policy to this effect. Once EPA approves the criteria, DEQ will post an updated Table 20 on DEQ's website where it is available to the public and affected permittees. In addition, standards program staff will notify all DEQ staff and managers that implement water quality standards of the rule change.

DEQ will develop internal guidance for permit writers to implement the arsenic reduction policy for industrial dischargers. Finally, DEQ will communicate the commission's policy on arsenic reduction to other state agencies and federal land managers.

Attachments

A. Proposed rule revisions to OAR 340-041-0033
B. Proposed criteria revisions in Table 20
C. Summary of public comments and agency responses
D. Presiding Officer's report on public hearings
E. Water Quality Standards Review and Recommendations: Arsenic
F. Statement of Need and Fiscal and Economic Impact and Addendum

Available upon request

1. Relationship to Federal Requirements questions
2. Land Use Evaluation Statement
3. Legal notice of hearing
4. Cover memorandum from public notice
5. Written comment received
6. Rule implementation plan

Approved:

Division: _____

Section: _____

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Proposed Rule Amendment

340-041-0033

Toxic Substances

(1) Toxic substances may not be introduced above natural background levels in waters of the state in amounts, concentrations, or combinations that may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediments or bioaccumulate in aquatic life or wildlife to levels that adversely affect public health, safety, or welfare or aquatic life, wildlife, or other designated beneficial uses.

(2) Levels of toxic substances in waters of the state may not exceed the applicable criteria listed in Tables 20, 33A, and 33B. Tables 33A and 33B, adopted on May 20, 2004, update Table 20 as described in this section.

(a) Each value for criteria in Table 20 is effective until the corresponding value in Tables 33A or 33B becomes effective.

(A) Each value in Table 33A is effective on February 15, 2005, unless EPA has disapproved the value before that date. If a value is subsequently disapproved, any corresponding value in Table 20 becomes effective immediately. Values that are the same in Tables 20 and 33A remain in effect.

(B) Each value in Table 33B is effective upon EPA approval.

(b) The arsenic criteria in Table 20 established by this rule do not become applicable for purposes of ORS chapter 468B or the federal Clean Water Act unless and until they are approved by EPA pursuant to 40 CFR 131.21 (4/27/2000).

(c) The department will note the effective date for each value in Tables 20, 33A, and 33B as described in this section.

(3) To establish permit or other regulatory limits for toxic substances for which criteria are not included in Tables 20, 33A, or 33B, the department may use the guidance values in Table 33C, public health advisories, and other published scientific literature. The department may also require or conduct bio-assessment studies to monitor the toxicity to aquatic life of complex effluents, other suspected discharges, or chemical substances without numeric criteria.

(4) Arsenic Reduction Policy: The inorganic arsenic criterion for the protection of human health from the combined consumption of organisms and drinking water is 2.1 micrograms per liter. While this criterion is protective of human health and more stringent than the federal maximum contaminant level (MCL) for arsenic in drinking water, which is 10 micrograms per liter, it nonetheless is based on a higher risk level than the Commission has used to establish other human health criteria. This higher risk level recognizes that much of the risk is due to

naturally high levels of inorganic arsenic in Oregon's waterbodies. In order to maintain the lowest human health risk from inorganic arsenic in drinking water, the Commission has determined that it is appropriate to adopt the following policy to limit the human contribution to that risk.

(a) The arsenic reduction policy established by this rule section does not become applicable for purposes of ORS chapter 468B or the federal Clean Water Act unless and until the numeric arsenic criteria established by this rule are approved by EPA pursuant to 40 CFR 131.21 (4/27/2000).

(b) It is the policy of the Commission that the addition of inorganic arsenic from new or existing anthropogenic sources to waters of the state within a surface water drinking water protection area be reduced the maximum amount feasible. The requirements of this rule section [OAR 340-041-0033(4)] apply to sources that discharge to surface waters of the state with an ambient inorganic arsenic concentration equal to or lower than the applicable numeric inorganic arsenic criteria for the protection of human health.

(c) The following definitions apply to this section [OAR 340-041-0033(4)]:

(A) "Add inorganic arsenic" means to discharge a net mass of inorganic arsenic from a point source (the mass of inorganic arsenic discharged minus the mass of inorganic arsenic taken into the facility from a surface water source).

(B) A "surface water drinking water protection area," for the purpose of this section, means an area delineated as such by DEQ under the source water assessment program of the federal Safe Drinking Water Act, 42 U.S.C. § 300j-13. The areas are delineated for the purpose of protecting public or community drinking water supplies that use surface water sources. These delineations can be found at DEQ's drinking water program website.

(C) "Potential to significantly increase inorganic arsenic concentrations in the public drinking water supply source water" means:

(i) to increase the concentration of inorganic arsenic in the receiving water for a discharge by 10 percent or more after mixing with the harmonic mean flow of the receiving water; or

(ii) as an alternative, if sufficient data are available, the discharge will increase the concentration of inorganic arsenic in the surface water intake water of a public water system by 0.021 micrograms per liter or more based on a mass balance calculation.

(d) Following the effective date of this rule, applications for an individual NPDES permit or permit renewal received from industrial dischargers located in a surface water drinking water protection area and identified by DEQ as likely to add inorganic arsenic to the receiving water must include sufficient data to enable DEQ to determine whether:

(A) The discharge in fact adds inorganic arsenic; and

(B) The discharge has the potential to significantly increase inorganic arsenic concentrations in the public drinking water supply source water.

(e) Where DEQ determines that both conditions in subsection (d) of this section (4) are true, the industrial discharger must develop an inorganic arsenic reduction plan and propose all feasible measures to reduce its inorganic arsenic loading to the receiving water. The proposed plan, including proposed measures, monitoring and reporting requirements, and a schedule for those actions, will be described in the fact sheet and incorporated into the source's NPDES permit after public comment and DEQ review and approval. In developing the plan, the source must:

(A) Identify how much it can minimize its inorganic arsenic discharge through pollution prevention measures, process changes, wastewater treatment, alternative water supply (for groundwater users) or other possible pollution prevention and/or control measures;

(B) Evaluate the costs, feasibility and environmental impacts of the potential inorganic arsenic reduction and control measures;

(C) Estimate the predicted reduction in inorganic arsenic and the reduced human health risk expected to result from the control measures;

(D) Propose specific inorganic arsenic reduction or control measures, if feasible, and an implementation schedule; and

(E) Propose monitoring and reporting requirements to document progress in plan implementation and the inorganic arsenic load reductions.

(f) In order to implement this section, DEQ will develop the following information and guidance within 120 days of the effective date of this rule and periodically update it as warranted by new information:

(A) A list of industrial sources or source categories, including industrial stormwater and sources covered by general permits, that are likely to add inorganic arsenic to surface waters of the State.

(i) For industrial sources or source categories permitted under a general permit that have been identified by DEQ as likely sources of inorganic arsenic, DEQ will evaluate options for reducing inorganic arsenic during permit renewal or evaluation of Stormwater Pollution Control Plans.

(B) Quantitation limits for monitoring inorganic arsenic concentrations.

(C) Information and guidance to assist sources in estimating, pursuant to paragraph (d) (C) of this section, the reduced human health risk expected to result from inorganic arsenic control measures based on the most current EPA risk assessment.

(g) It is the policy of the Commission that landowners engaged in agricultural or development practices on land where pesticides, fertilizers, or soil amendments containing arsenic are

currently being or have previously been applied, implement conservation practices to minimize the erosion and runoff of inorganic arsenic to waters of the State or to a location where such material could readily migrate into waters of the State.

[ED. NOTE: Tables referenced are available from the agency.]

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03; DEQ 3-2004, f. & cert. ef. 5-28-04; DEQ 17-2010, f. & cert. ef. 12-21-10

Table 20 – Revised ~~June 2010~~[date of EPA approval]
WATER QUALITY CRITERIA SUMMARY
(Applicable to all Basins)[1]

The concentration for each compound listed in this chart is a criteria or guidance value* not to be exceeded in waters of the state for the protection of aquatic life and human health. Specific descriptions of each compound and an explanation of values are included in Quality Criteria for Water (1986). Selecting values for regulatory purposes will depend on the most sensitive beneficial use to be protected, and what level of protection is necessary for aquatic life and human health.

This June 2010 table includes the revisions DEQ adopted in 2004 and EPA approved June 1, 2010. This table therefore shows the effective criteria under state and federal law.
Note: The arsenic criteria revisions established by OAR 340-041-0033 and shown below do not become applicable for purposes of ORS chapter 468B or the federal Clean Water Act until approved by EPA pursuant to 40 CFR 131.21 (4/27/2000).

Compound Name (or Class)	Priority Pollutant	Carcinogen	Concentration in Micrograms Per Liter for Protection of Aquatic Life				Concentration in Units Per Liter for Protection of Human Health		
			Fresh Acute Criteria	Fresh Chronic Criteria	Marine Acute Criteria	Marine Chronic Criteria	Water and Fish Ingestion	Fish Consumption Only	Drinking Water M.C.L.
ACENAPTHENE	Y	N	*1,700	*520	*970	*710			
ACROLEIN	Y	N	*68	*21	*55		320ug	780ug	
ACRYLONITRILE	Y	Y	*7,550	*2,600			0.058ug**	0.65ug**	
ALDRIN	Y	Y	3.0		1.3		0.074ng**	0.079ng**	
ALKALINITY	N	N		20,000					
AMMONIA	N	N	CRITERIA ARE pH AND TEMPERATURE DEPENDENT — SEE DOCUMENT USEPA JANUARY 1985 (Fresh Water) CRITERIA ARE pH AND TEMPERATURE DEPENDENT — SEE DOCUMENT USEPA APRIL 1989 (Marine Water)						
ANTIMONY	Y	N	*9,000	*1,600			146ug	45,000ug	
ARSENIC (INORGANIC)	Y	Y					~~2.2ng~~** 2.1 µg	~~17.5ng~~** 2.1 µg freshwater 1.0 µg saltwater	~~0.05mg~~ 10 µg[1]
ARSENIC (PENT)	Y	Y	*850	*48	*2,319	*13			
ARSENIC (TRI)	Y	Y	360	190	69	36			
ASBESTOS	Y	Y					7.0E+06 fibers/L		
BARIUM	N	N					1mg		1.0mg
BENZENE	Y	Y	*5,300		*5,100	*700	0.66ug**	40 ug**	
BENZIDINE	Y	Y	*2,500				0.12ng	0.53ng**	
BERYLLIUM	Y	Y	*130	*5.3					
BHC	Y	N	*100		*0.34				
CADMIUM	Y	N	3.9+	1.1+	43	9.3			0.010mg
CARBON TETRACHLORIDE	Y	Y	*35,200	*50,000	0.4ug**	6.94ug**			
CHLORDANE	Y	Y	2.4	0.0043	0.09	0.004	0.46ng**	0.48ng**	
CHLORIDE	N	N	860 mg/L	230 mg/L					
CHLORINATED BENZENES	Y	Y	*250	*50	*160	*129	488 ug		
CHLORINATED NAPHTHALENES	Y	N	*1,600		*7.5				
CHLORINE	N	N	19	11	13	7.5			
CHLOROALKYL ETHERS	Y	N	*238,000						
CHLOROETHYL ETHER (BIS-2)	Y	Y					0.03 ug	1.36 ug**	
CHLOROFORM	Y	Y	*28,900	*1,240			0.19ug**	15.7ug**	
CHLOROISOPROPYL ETHER (BIS-2)	Y	N					34.7ug	4.36mg	

[1] The arsenic value is shown here for informational purposes only and is not a water quality criterion.

WATER QUALITY CRITERIA SUMMARY (Continued)

Compound Name (or Class)	Priority Pollutant	Carcinogen	Concentration in Micrograms Per Liter for Protection of Aquatic Life				Concentration in Units Per Liter for Protection of Human Health		
			Fresh Acute Criteria	Fresh Chronic Criteria	Marine Acute Criteria	Marine Chronic Criteria	Water and Fish Ingestion	Fish Consumption Only	Drinking Water M.C.L.
CHLOROMETHYL ETHER (BIS)	N	Y					0.00000376ng**	0.00184ug**	
CHLOROPHENOL 2	Y	N	*4,380	*2,000					
CHLOROPHENOL 4	N	N			*29,700				
CHLOROPHENOXY HERBICIDES (2,4,5,-TP)	N	N					10ug		
CHLOROPHENOXY HERBICIDES (2,4-D)	N	N					100ug		
CHLORPYRIFOS	N	N	0.083	0.041	0.011	0.0056			
CHLORO-4 METHYL-3 PHENOL	N	N	*30						
CHROMIUM (HEX)	Y	N	16	11	1,100	50			0.05mg
CHROMIUM (TRI)	N	N	1,700.+	210.+	*10,300				0.05mg
COPPER	Y	N	18.+	12.+	2.9	2.9	1300 H		
CYANIDE	Y	N	22	5.2	1	1	200ug		
DDT	Y	Y	1.1	0.001	0.13	0.001	0.024ng**	0.024ng**	
(DDE) DDT METABOLITE	Y	Y	*1,050		*14				
(TDE) DDT METABOLITE	Y	Y	*0.06		*3.6				
DEMETON	Y	N		0.1		0.1			
DIBUTYLPHTHALATE	Y	N					35mg	154mg	
DICHLOROBENZENES	Y	N	*1,120	*763	*1,970		400ug	2.6mg	
DICHLOROBENZIDINE	Y	Y					0.01ug**	0.020ug**	
DICHLOROETHANE 1,2	Y	Y	*118,000	*20,000	*113,000		0.94ug**	243ug**	
DICHLOROETHYLENES	Y	Y	*11,600		*224.000		0.033ug**	1.85ug**	
DICHLOROPHENOL 2,4	N	N	*2,020	*365			3.09mg		
DICHLOROPROPANE	Y	N	*23,000	*5,700	*10,300	*3,040			
DICHLOROPROPENE	Y	N	*6,060	*244	*790		87ug	14.1mg	
DIELDRIN	Y	Y	2.5	0.0019	0.71	0.0019	0.071ng**	0.076ng**	
DIETHYLPHTHALATE	Y	N					350mg	1.8g	
DIMETHYL PHENOL 2,4	Y	N	*2,120						
DIMETHYL PHTHALATE	Y	N					313mg	2.9g	
DINITROTOLUENE 2,4	N	Y					0.11ug**	9.1ug**	
DINITROTOLUENE	Y	N					70ug	14.3mg	
DINITROTOLUENE	N	Y	*330	*230	*590	*370			
DINITRO-O-CRESOL 2,4	Y	N					13.4g	765ug	
DIOXIN (2,3,7,8-TCDD)	Y	Y	*0.01	*38pg/L			0.000013ng**	0.000014ng**	
DIPHENYLHYDRAZINE	Y	N					42ng**	0.56ug**	

WATER QUALITY CRITERIA SUMMARY (Continued)

	Priority Pollutant	Carcinogen	Concentration in Micrograms Per Liter for Protection of Aquatic Life				Concentration in Units Per Liter for Protection of Human Health		
			Fresh Acute Criteria	Fresh Chronic Criteria	Marine Acute Criteria	Marine Chronic Criteria	Water and Fish Ingestion	Fish Consumption Only	Drinking Water M.C.L.
DIPHENYLHYDRAZINE 1,2	Y	N	*270						
DI-2-ETHYLHEXYL PHTHALATE	Y	N					15mg	50mg	
ENDOSULFAN	Y	N	0.22	0.056	0.034	0.0087	74ug	159ug	
ENDRIN	Y	N	0.18	0.0023	0.037	0.0023	1ug		0.0002mg
ETHYLBENZENE	Y	N	*32,000		*430		1.4mg	3.28mg	
FLUORANTHENE	Y	N	*3,980		*40	*16	42ug	54ug	
GUTHION	N	N		0.01		0.01			
HALOETHERS	Y	N	*360	*122					
HALOMETHANES	Y	Y	*11,000		*12,000	*6,400	0.19ug**	15.7ug**	
HEPTACHLOR	Y	Y	0.52	0.0038	0.053	0.0036	0.28ng**	0.29ng**	
HEXACHLOROETHANE	N	Y	*980	*540	*940		1.9ug	8.74ug	
HEXACHLOROBENZENE	Y	N					0.72ng**	0.74ng**	
HEXACHLOROBUTADIENE	Y	Y	*90	*9.3	*32		0.45ug**	50ug**	
HEXACHLOROCYCLOHEXANE (LINDANE)	Y	Y	2.0	0.08	0.16				0.004mg
HEXACHLOROCYCLOHEXANE-ALPHA	Y	Y					9.2ng**	31ng**	
HEXACHLOROCYCLOHEXANE-BETA	Y	Y					16.3ng**	54.7ng**	
HEXACHLOROCYCLOHEXANE-GAMA	Y	Y					18.6ng**	62.5ng**	
HEXACHLOROCYCLOHEXANE-TECHNICAL	Y	Y					12.3ng** J	41.4ng** J	
HEXACHLOROCYCLOPENTADIENE	Y	N	*7	*5.2	*7		206ug		
IRON	N	N		1,000			0.3mg K		
ISOPHORONE	Y	N	*117,000		*12,900		5.2mg	520mg	
LEAD	Y	N	82.+	3.2+	140	5.6			0.05mg
MALATHION	N	N		0.1		0.1			
MANGANESE	N	N					50ug K	100ug	
MERCURY	Y	N	2.4	0.012	2.1	0.025			0.002mg
METHOXYCHLOR	N	N		0.03		0.03	100ug J		0.1mg
MIREX	N	N		0.001		0.001			
MONOCHLOROBENZENE	Y	N					488ug		
NAPHTHALENE	Y	N	*2,300	*620	*2,350				
NICKEL	Y	N	1,400.+	160+	75	8.3	13.4ug	100ug	
NITRATES	N	N					10mg J		10mg
NITROBENZENE	Y	N	*27,000		*6,680		19.8mg		
NITROPHENOLS	Y	N	*230	*150	*4,850				

WATER QUALITY CRITERIA SUMMARY (Continued)

Compound Name (or Class)	Priority Pollutant	Carcinogen	Concentration in Micrograms Per Liter for Protection of Aquatic Life				Concentration in Units Per Liter for Protection of Human Health		
			Fresh Acute Criteria	Fresh Chronic Criteria	Marine Acute Criteria	Marine Chronic Criteria	Water and Fish Ingestion	Fish Consumption Only	Drinking Water M.C.L.
NITROSAMINES	Y	Y	*5,850		*3,300,000		0.8ng** J	1,240ng** J	
NITROSODIBUTYLAMINE N	Y	Y					6.4ng**	587ng**	
NITROSODIETHYLAMINE N	Y	Y					0.8ng** J	1,240ng** J	
NITROSODIMETHYLAMINE N	Y	Y					1.4ng**	16,000ng**	
NITROSODIPHENYLAMINE N	Y	Y					4,900ng**	16,100ng**	
NITROSOPYRROLIDINE N	Y	Y					16ng**	91,900ng**	
PARATHION	N	N	0.065	0.013					
PCB's	Y	Y	2.0	0.014	10	0.03	0.079ng**	0.079ng**	
PENTACHLORINATED ETHANES	N	N	*7,240	*1,100	*390	*281			
PENTACHLOROBENZENE	N	N					74ug	85ug	
PENTACHLOROPHENOL	Y	N	***20	***13	13	*7.9	1.01mg		
PHENOL	Y	N	*10,200	*2,560	*5,800		3.5mg		
PHOSPHORUS ELEMENTAL	N	N				0.1			
PHTHALATE ESTERS	Y	N	*940	*3	*2,944	*3.4			
POLYNUCLEAR AROMATIC HYDROCARBONS	Y	Y			*300		2.8ng**	31.1ng**	
SELENIUM	Y	N	260	35	410	54	10ug		0.01mg
SILVER	Y	N	4.1+	0.12	2.3				0.05mg
SULFIDE HYDROGEN SULFIDE	N	N		2		2			
TETRACHLORINATED ETHANES	Y	N	*9,320						
TETRACHLOROBENZENE 1,2,4,5	Y	N					38ug	48ug	
TETRACHLOROETHANE 1,1,2,2	Y	Y		*2,400	*9,020		0.17ug**	10.7ug**	
TETRACHLOROETHANES	Y	N	*9,320						
TETRACHLOROETHYLENE	Y	Y	*5,280	*840	*10,200	*450	0.8ug**	8.85ug**	
TETRACHLOROPHENOL 2,3,5,6	Y	N				*440			
THALLIUM	Y	N	*1,400	*40	*2,130		13ug	48ug	
TOLUENE	Y	N	*17,500		*6,300	*5,000	14.3mg	424mg	
TOXAPHENE	Y	Y	0.73	0.0002	0.21	0.0002	0.71ng**	0.73ng**	0.005mg
TRICHLORINATED ETHANES	Y	Y	*18,000						
TRICHLOROETHANE 1,1,1	Y	N			*31,2000				
TRICHLOROETHANE 1,1,2	Y	Y		*9,400			0.6ug**	41.8ug**	
TRICHLOROETHYLENE	Y	Y	*45,000	*21,900	*2,000		2.7ug**	80.7ug**	
TRICHLOROPHENOL 2,4,5	N	N					2,600ug		
TRICHLOROPHENOL 2,4,6	Y	Y		*970			1.2ug**	3.6ug**	

WATER QUALITY CRITERIA SUMMARY (Continued)

Compound Name (or Class)	Priority Pollutant	Carcinogen	Concentration in Micrograms Per Liter for Protection of Aquatic Life				Concentration in Units Per Liter for Protection of Human Health		
			Fresh Acute Criteria	Fresh Chronic Criteria	Marine Acute Criteria	Marine Chronic Criteria	Water and Fish Ingestion	Fish Consumption Only	Drinking Water M.C.L.
VINYL CHLORIDE	Y	Y					2ug**	525ug**	
ZINC	Y	N	120+	110+	95	86			

Footnotes:
H This value is based on a Drinking Water regulation.
J No bioconcentration factor was available; therefore, this value is based on that published in the 1986 EPA Gold Book.
K Human health criterion is for "dissolved" concentration based on the 1976 EPA Red Book conclusion that adverse effects from exposure at this level are aesthetic rather than toxic.

MEANING OF SYMBOLS:

g	=	grams	M.C.L	=	Maximum Contaminant Level
mg	=	milligrams	+	=	Hardness Dependent Criteria (100 mg/L used).
ug	=	micrograms	*	=	Insufficient data to develop criteria; value presented is the L.O.E.L – Lower Observed Effect Level.
ng	=	nanograms	**	=	Human health criteria for carcinogens reported for three risk levels. Value presented is the 10-6 risk level, which means the probability of one concern case per million people at the stated concentration.
pg	=	picograms	***	=	pH Dependent Criteria (7.8 pH used).
f	=	fibers			
Y	=	Yes			
N	=	No			

1 = Values in Table 20 are applicable to all basins as follows:.

Basin	Rule	Basin	Rule
North Coast	340-041-205(p)	Umatilla	340-041-645(p)
Mid Coast	340-041-245(p)	Walla Walla	340-041-685(p)
Umpqua	340-041-285(p)	Grande Ronde	340-041-725(p)
South Coast	340-041-325(p)	Powder	340-041-765(p)
Rogue	340-041-365(p)	Malheur River	340-041-805(p)
Willamette	340-041-445(p)	Owyhee	340-041-845(p)
Sandy	340-041-485(p)	Malheur Lake	340-041-885(p)
Hood	340-041-525(p)	Goose & Summer Lakes	340-041-925(p)
Deschutes	340-041-565(p)	Klamath	340-041-965(p)
John Day	340-041-605(p)		

Water and Fish Ingestion: Values represent the maximum ambient water concentration for consumption of both contaminated water and fish or other aquatic organisms.
Fish Ingestion: Values represent the maximum ambient water concentrations for consumption of fish or other aquatic organisms

Summary of Public Comment and Agency Response

Title of Rulemaking: Amending Oregon's Water Quality Standards: Revising Human Health Criteria for Arsenic (OAR 340-041-0033 and Table 20)

Prepared by: Debra Sturdevant
Date: March 7, 2010

Comment period

DEQ first invited public comment from Aug. 25, 2010 to Sept. 30, 2010. DEQ held two public hearings, one on Sept. 21, 2010, 5 p.m., at the DEQ headquarters office, 811 SW 6th Ave. in Portland; and the second on Sept. 23, 7 p.m., at St. Anthony's Hospital in Pendleton. One person attended the Portland hearing, no one testified. Five people attended the Pendleton hearing; one person testified. Seventeen people submitted written comment.

Due to the substantive nature of the comment received on the arsenic criteria, DEQ re-opened the public comment period from Feb. 1 to Feb. 23, 2011.

Organization of comments and responses

Summaries of the individual comments received during both the initial and re-opened comment period and DEQ's responses are provided below. Comments are summarized by topic. The persons who provided each comment are referenced by number. A list of commenters and their reference numbers is provided at the end of the document.

Comments and responses are organized in the following categories:

1. Water quality, metals or toxics generally
2. Arsenic generally
3. The proposed arsenic criteria
4. The fish consumption rate
5. Elevated natural background levels
6. Other comment on how the criteria were calculated
7. Implementation and measurement
8. The arsenic reduction policy
9. The issue paper

Some commenters noted that we did not respond to all of their comments in our revised documents. DEQ acknowledges did not respond to all comment at that time. DEQ reopened the public comment period specifically to invite additional public comment on revised proposed arsenic criteria, which were calculated using different BCFs and, in the case of the water + fish ingestion criteria, a different risk level than the initial proposed criteria. DEQ waited until the comment period closed on February 23, 2011 to develop this summary and response to all comments received. DEQ notes in the response where an earlier comment is superseded by subsequent revisions.

1. Comments on water quality, metals or toxics generally	
Comment 1.1	Oppose changing criteria for water to be less stringent and allow higher levels of pollution in our water. These pollutants accumulate over time. DEQ's responsibility is the health and safety of the public, not to benefit industry or ease guidelines for dischargers. DEQ should require pristine water quality. (3) (4) (8)
	Response DEQ has evaluated the relevant health effects information and data showing arsenic occurs naturally in Oregon waters. Where naturally occurring levels are higher than the criteria, there is no way to reduce those levels and they do not present new or human caused risk. DEQ is trying to balance the policy objectives of protecting human health and not requiring public or private expenditures that will not result in meaningful environmental benefit. DEQ concludes that the proposed criteria revisions will continue to appropriately protect human health and will allow state and industry resources to be targeted toward achievable and truly needed and beneficial environmental results.
Comment 1.2	NWPPA views the successful adoption of the proposed arsenic standards as a key component to our support of the overall toxics rulemaking package.
	Response DEQ acknowledges the importance of the arsenic standard revision to the Northwest Pulp and Paper Association.
Comment 1.3	NWPPA is committed to working with DEQ and others on viable implementation measures for the additional water quality criteria under consideration. Our support of the rulemaking on the 114 toxics pollutants depends on the specifics of the proposal and the viability, feasibility and cost effectiveness of NPDES permit implementation measures and we continue to have grave concerns about that.(25)
	Response DEQ acknowledges that implementation issues are critical to NWPPA and that they have remaining concerns. This comment pertains to the human health toxics criteria rulemaking, not to the proposed arsenic rule, and as such, is not responded to here.
Comment 1.4	Due to EPA approval of iron and manganese footnote K in June, 2010, DEQ should revise Table 20 and 33B to prevent confusion. (16)
	Response A table of "Effective Human Health Criteria" (June 2010), is available on DEQ's website. This table shows the effective human health criteria, including footnote K and the other revisions EPA approved in June, 2010.
Comment 1.5	Brief comment about building a playground over a spill site. (21)
	Response The comment does not provide sufficient information for DEQ to understand how it is relevant to the proposed rule.

2. Comments relating to arsenic generally	
Comment 2.1	Additional effort is needed over the long term to reduce arsenic in Oregon's waters. (7)
	Response This comment addresses DEQ's overall efforts to reduce arsenic and does not directly address the proposed rule revisions. As a general matter, reducing toxics in Oregon's water and air is also a priority for DEQ where those levels are not from naturally occurring sources.
Comment 2.2	Samples from commercial trash dumpsters have found arsenic and other chemicals. Trash companies should be required to clean their equipment in a way that does not allow toxic water to be discharged. Liquid drains from commercial dumpsters and they are often near storm drains. (1)
	Response DEQ appreciates the commenters concern for a cleaner environment and notes that the comment addresses a topic that is outside the proposed rule revisions. This comment was forwarded to staff developing DEQ's toxics reduction strategy.
Comment 2.3	Commenters from a small water district near Prospect, Oregon support the increase in allowable arsenic levels. Their water is from a well and met the drinking water standards for arsenic when it was installed. The standards were changed and they cannot meet the new standards. It would cost far too much to treat all the water and they do not have the option to change their source of water. (5) (6) (13)
	Response This comment pertains to the drinking water maximum contaminant level for arsenic set by EPA under the Safe Drinking Water Act. DEQ is proposing to revise Oregon's surface water criteria for arsenic under the Clean Water Act. The proposed criteria do not apply to drinking water providers or to groundwater wells.
3. Comments relating to the proposed arsenic criteria	
Comment 3.1	Support the proposed arsenic criteria. (7) (16) (19) (20)
Comment 3.2	The existing arsenic criteria (0.0022) are unreasonably low and should be revised. (15) (28)
Comment 3.3	Thanks to the workgroup for its hard work reconciling the protection of human health and the naturally high levels of arsenic is some Oregon waters into the proposed criteria. (14)
Comment 3.4	The proposed criteria recognize and account for both the higher fish consumption rates of Oregonians who consume relatively large amounts of fish and the high natural background concentrations of arsenic in Oregon waterbodies. (16) (20)
Comment 3.5	Support for the intent of the changes; for the goal to establish scientifically-based criteria to protect human health while accounting for the presence of naturally-occurring arsenic in state waters. (7) (15) (17)

Comment 3.6	Support the approach to adopt arsenic criteria that preclude DEQ having to develop TMDLs where arsenic levels are natural. (12)
Comment 3.7	Appreciate DEQ's careful and thorough (and reasoned) review of the relevant technical data and public health considerations. (16) (20)
Comment 3.8	General support for the proposed rule package for arsenic. DEQ made important adjustments to re-tailor the criteria using locally appropriate values based on comments (i.e. proposed modifications to the cancer risk factor and the bioconcentration factor). Locally derived criteria are appropriate because of the naturally high background levels of arsenic from natural, geologic sources that are much higher than national criteria. (25)
Comment 3.9	Support DEQ's proposed changes to the water quality standards for arsenic, noting: • The rule implements the October 2008 EQC charge to find innovative solutions to the complex problems posed by toxins in Oregon waters; to develop standards that are environmentally meaningful and cost-effective to implement. • The changes are appropriate given the natural sources and background levels. (7) (11) (16)
Comment 3.10	The commenter appreciates the substantial amount of time and creative thinking DEQ and the workgroup members develop to the development of the proposed rule. The fact that there was consensus support from a very diverse group of stakeholders is testimony to the Department's perseverance and the willingness of workgroup members to work together to achieve a result that is in everyone's interest. (16)
Comment 3.11	NWPPA supports setting criteria applicable to inorganic arsenic, the form more toxic to humans. (11)
	Response to 3.1 through 3.11 DEQ acknowledges and appreciates the supporting comments above. DEQ also concludes that the proposed revisions are responsive to the EQC directive and are appropriate given the natural levels of arsenic in Oregon waters. DEQ very much appreciates the work and assistance of the rulemaking workgroup. It is a better proposal for having had their involvement.
Comment 3.12	City of Ontario is very concerned about the proposed amendment to the water quality standards for arsenic. (26)
	Response DEQ acknowledges Ontario's concern, which is detailed in additional comments below.
Comment 3.13	The proposed arsenic criteria are too low. The fish rate consumed is not well founded. Fish from fresh water do not likely have a bioconcentration factor of 14. (28)
	Response DEQ's responses to comments on fish consumption rate and bioconcentration factor may be found in Sections 4 and 6 below.
Comment	The proposed arsenic criteria will negatively impact selected cities and

3.14	businesses. They will impede business from locating in Malheur County. How is a business to discharge water three times cleaner than the environment provides? (28)
	Response DEQ understands that affected parties in the Snake and Malheur River basins feel they will be impacted by the criteria due to elevated natural arsenic levels in that part of the state. Additional comment and DEQ responses may be found in Section 5 below.
Comment 3.15	Reducing the inorganic arsenic criterion to 2.3 µg/l versus the federal standard of 10 µg/l is excessive and unnecessary. (9)
	Response DEQ's proposed criteria are less stringent than the current federal criteria under the Clean Water Act, which are 0.018 and 0.0022 µg/l. The drinking water maximum contaminant level (MCL) under the Safe Drinking Water Act is 10 µg/l.
Comment 3.16	DEQ should consider a criterion of 10µg/l, as Idaho and other states have done. This concentration would protect the use of the rivers as drinking water. It is also appropriate because inorganic arsenic is not readily bio-accumulative in fish tissue. (15) (16) (26)
	Response DEQ considered adopting the MCL value (10 µg/l); see the discussion in Chapter 2 Section 6 of the Arsenic Issue Paper (DEQ 2011). DEQ evaluated and discussed this options with the stakeholder group and concluded that using EPA's human health criteria equation with variable values appropriate for Oregon would result in the most scientifically defensible statewide criteria. Also, because many waters in the state have background levels ranging from 1 to 3 µg/l or less, a criterion of 10 µg/l could allow significant pollution loading from human sources in those water bodies. The arsenic MCL established under the Safe Drinking Water Act takes into consideration treatment cost and feasibility in addition to health risk, which is not part of the development of criteria under the Clean Water Act. While inorganic arsenic does not bioaccumulate as readily as organic arsenic, some inorganic arsenic does end up in fish tissue. See the discussions of the bioconcentration and the inorganic proportion factor in the Issue Paper Chapter 2, Section 5.
Comment 3.17	NWEA objects to the meaningless and objectionable observation that Oregon's proposed criteria are more stringent than the federal MCL for arsenic in drinking water. It is not in the least relevant that the water quality criteria are far below the MCL established under the Safe Drinking Water Act. EPA may use factors such as technology and costs, economic impact in setting MCLs. MCLs do not protect public health. The Commission should urge EPA to revise its MCLs. (12)
	Response DEQ is not proposing to adopt the MCL as the water quality criterion for arsenic. DEQ understands why the public finds it perplexing that water that

	can be used for drinking under one federal law may not be discharged into a river under another federal law.
Comment 3.18	Option 2 in the issue paper would use an approach that combines the MCL for drinking water and the EPA criteria calculation method for exposure through fish tissue. NWEA urges the Commission not to consider this approach. Setting a CWA criterion based on a SDWA MCL is legally impermissible. The fact that other states have done this and EPA has approved those criteria is irrelevant. (12)
	Response DEQ's proposed criterion is not based on option 2.
Comment 3.19	This proposal has been prepared in an extremely rushed and sloppy manner. It is not ready to be finalized and thus will need to be sent out for public comment again. Items of concern involve, at a minimum: 1) figures in the reduction policy that were not corrected when DEQ changed the criteria, 2) the calculation of the 2.1 µg/l criterion for freshwater organisms, and 3) the now untrue statement in the arsenic reduction policy that the criterion for the consumption of organisms only is based on the same risk level as Oregon's other human health toxics criteria. (12)
	Response DEQ reopened public comment to invite comment on updated proposed numeric arsenic criteria and the basis for those updates. The arsenic reduction policy was not revised during the interim so cross-references in the arsenic reduction policy language were overlooked. DEQ does not agree that this oversight results in a need to re-propose the rule for additional public comment. Comments and DEQ responses on the arsenic reduction policy may be found in Section 8 below.
4. Comments on the fish consumption rate	
Comment 4.1	CTUIR commends DEQ for implementing the new fish consumption rate of 175 grams/day. Making Oregon's water cleaner and fish safer for all fish consumers will continue to take time, collaboration and persistent effort. By using the new consumption rate DEQ is taking a major step forward to meet this goal. (7)
	Response DEQ acknowledges CTUIR's support for the use of a 175 grams/day fish consumption rate for the arsenic criteria.
Comment 4.2	CTUIR recognizes technical infeasibility of treating all discharge water to achieve lower levels of arsenic and agrees that arsenic poses a unique problem due to its prevalence in Oregon waters as a naturally occurring earth metal. DEQ has proposed a satisfactory solution that should be used exclusively for arsenic – the use of a risk level less protective than commonly applied in Oregon. This solution should be limited to this one rulemaking. (7)
	Response DEQ appreciates the understanding and support of the Tribe for the solution

	to the complexities of arsenic.
Comment 4.3	The proposed criteria protect human health, particularly because they are based on a fish consumption rate that is higher than most consumers of fish in Oregon. The lower risk level of $1X10^{-6}$ is generally appropriate if the consumption rate is based on the general population. (20)
	Response DEQ acknowledges the commenter's support for DEQ's use on an alternate risk level given the specific circumstances presented by arsenic. The arsenic issue paper describes the factors that DEQ considered in concluding that a higher risk level is appropriate in this circumstance, including the level of protection provided by the increased fish consumption rate.
Comment 4.4	NWPPA supports the proposed criteria for arsenic that reflect the higher fish consumption rate of 175 grams per day and that DEQ has adjusted based on locally appropriate variables. (11)
	Response DEQ acknowledges this supportive comment.
Comment 4.5	On page 10, the draft report is unclear about what EPA would require of Oregon. EPA refers to the EQC's 2008 determination to use 175 grams/day, but EPA did not foreclose Oregon's ability to use a lower fish consumption rate in appropriate circumstances. (16)
	Response EPA did not specify the fish consumption rate that Oregon must use. EPA did conclude that the rate of 17.5 grams/day, the basis of the 2004 criteria, was too low and they recognized that at rate of 175 would protect Oregon fish consumers.
Comment 4.6	NWPPA is submitting information about problems in overestimation of risk associated with arsenic and, in particular, using default generic risk assessment procedures. The paper submitted is: *Probabilistic Analysis of Human Health Risks Associated with Background Concentrations of Inorganic Arsenic: Use of a Margin of Exposure Approach*, Boyce et al, 2008, Human and Ecological Risk Assessment, 14:1159-1201. (11)
	Response DEQ appreciates receiving additional scientific literature. However, DEQ is not re-evaluating the toxicity information used to develop the criteria. We rely on the cancer slope factor EPA has published in its IRIS database. EPA is currently reviewing that data. DEQ only reviewed variables that may vary geographically or for which the state has some policy discretion in order to make the criteria appropriate for Oregon waters and populations.
Comment 4.7	The proposed arsenic criteria are too low. The fish rate consumed is not well founded. Fish from fresh water do not likely have a bioconcentration factor of 14. (28)
	Response DEQ has evaluated available and relevant data in developing arsenic criteria

	that protect human health and reflect naturally-occurring arsenic concentrations that exist in the majority of state waters. DEQ's evaluation of this data and information is contained in the issue paper supporting this rulemaking. The commenter did not provide data or references to support the claim that a bioconcentration rate of 14 is too high for freshwater fish. .
Comment 4.8	When we set standards for a certain ethnic group, we set ourselves up for continued changes based on a few, not the majority of Oregonians. The proposed standards could cripple point sources and nonpoint sources such as cities and farming communities. Should 90% of the population be jeopardized in order to protect the choices of 10% of the population? (22) (23) (24)
	Response With regard to the commenter's concern regarding the economic effect of the proposed rule, DEQ points out that the proposed revisions to the arsenic criteria are significantly less stringent than the existing criteria. Therefore, the arsenic criteria changes are not expected to have an economic impact to cities or farming communicates. Please see DEQ's Statement of Need and Fiscal and Economic Impact, which was published when the rule was proposed for public comment and is available on DEQ's website. DEQ recognizes that the above comment also pertains to the larger human health toxics rulemaking and asks the commenters to refer to the response to comments for the human health criteria rulemaking as well. In establishing water quality criteria to protect public health, DEQ seeks to also protect sport (recreational) fishers; subsistence fishers; women of childbearing age; and children. This ensures that individuals who have an average or "typical" exposure are protected in addition to those populations that are more highly exposed or susceptible. With this objective in mind, between 2006 and 2008, DEQ conducted an extensive outreach and information gathering project in collaboration with EPA and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). It held seven public workshops to solicit broad public input and consulted with two advisory groups; one focused on evaluating public health data and information and the other focused on evaluating economic impacts and implementation strategies. From these workgroup discussions and analysis of fish consumption studies, DEQ concluded that a fish consumption rate of 175 grams per day (g/day), or about 23 8-oz fish meals per month, is a reasonable and protective rate to use as the basis for Oregon's human health criteria. The EPA, the CTUIR, and DEQ issued a joint recommendation to the Environmental Quality Commission on Oct. 23, 2008 to revise Oregon's toxics criteria for human health based on a fish consumption rate of 175 g/day. The commission agreed with this recommendation and directed DEQ to proceed with a rulemaking process to revise the criteria.

	175 grams perday represents the 95th percentile value from a comprehensive study of Columbia River Tribes (the Columbia River Inter-Tribal Fish Commission study) and is within the range of the 90th percentile values from other Northwest studies and one national study. The 175 g/day rate is consistent with public health experts' recommendations to: • Use 90th or 95th percentile values to represent the proportion of the population the criteria should be designed to protect, • Use a fish consumption rate that represents fish consumers, rather than a per capita rate derived from the overall population including both consumers and non-consumers of fish, and • Include salmon and other marine species in the rate.
Comment 4.9	Most of the fish eaten by the tribes live in the ocean and the toxins come from the ocean, where Oregon toxic standards do not affect this equation. (22) (23) (24)
	Response The toxicity of pollutants that cause effects other than cancer is related to a person's total dose from all sources. DEQ evaluated a number of different studies and approaches to account for exposure from sources other than freshwater fish. Some approaches included salmon in the consumption rate, and others did not include salmon and accounted for people's exposure to pollutants in salmon through other means (i.e. relative source contribution). DEQ's Human Health Focus Group concluded that the relative source contribution method to account for exposure from marine fish, including salmon, has significant uncertainty and is less scientifically based at this time than including salmon and marine species in the consumption rate. DEQ and the Human Health Focus Group recommended that salmon be included in the fish consumption rate for several reasons, including: • Salmon are a large portion of the locally caught fish diet, • The cultural significance of salmon, particularly for the tribes, • Salmon spend a portion of their lifecycle in Oregon fresh and coastal waters, • Uncertainty about how much toxics accumulation occurs in salmon in fresh vs. estuarine vs. marine waters, and • The potential for pollutants to be carried to estuaries and important near coastal salmon habitats by rivers and streams. Please see the Human Health Focus Group Report available on DEQ's website. EPA guidance[1] supports States' and Tribes' decision to include anadromous and/or marine fish in the fish consumption rate when appropriate for protecting the population of concern. Consequently, other states and Tribes that use fish consumption rates that are higher than EPA's 17.5 g/day value (including Maine, New York, the Warm Springs Tribe, and the Confederated

[1] EPA. October 2000. Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health. EPA 822-B-00-004

	Tribes of the Umatilla Indian Reservation) have also included marine species to provide protection for a high percent of the population and to reflect consumption of species eaten by the general population.
Comment 4.10	Marine fish consumption would best be dealt with by a fish consumption advisory. Salmon and marine fish get most of their arsenic from the ocean, which will not be affected by Oregon's rules or land management practices. (28)
	Response DEQ's responsibility to develop water quality standards that protect human health are independent from the program administered by the Oregon Department of Human Services, which issues advisories when fish are found to have contaminants at high levels. The Clean Water Act requires states to set water quality standards that, if met, assure protection of human health. As a result, they serve as a basis for other regulatory controls that serve a preventative role to ensure water bodies and fish do not become contaminated to such an extent that a fish advisory becomes necessary. If waters exceed the water quality standards or a fish advisory is issued, DEQ programs work to identify and reduce the sources of the pollutant of concern. Please see also the response to comment 4.9 above.
Comment 4.11	What is the percentage of fish eaten by all Oregonians in a month to a year? Why is Oregon using Washington data? (22) (23) (24)
	Response DEQ does not understand the first question. In general, however, DEQ recommended and the Commission agreed that Oregon's water quality criteria should protect the ability of people to eat fish on a regular basis for cultural, health or economic reasons rather than be based on a general population per capita rate. EPA guidance directs states to use local or regional fish consumption data when available. DEQ enlisted a group of public health experts known as the Human Health Focus Group to assist DEQ in identifying studies relevant to Oregon. Their findings are summarized in the Human Health Focus Group Report, and it identifies five relevant studies that Oregon used to inform its decision to use 175 grams per day as a fish consumption rate. Because only one study had been conducted in Oregon we looked at other studies conducted in the Pacific Northwest region as well as one national study.
5. Comments on elevated natural background levels of arsenic	
Comment 5.1	Due to the geology of eastern Oregon, including geothermal activity, historic volcanic activity and gold deposits, natural occurring arsenic levels above the DEQ proposed standards are common. Several commenters submitted or referred to data showing this. (15) (22) (23) (24) (26) (28)
Comment 5.2	Based on Bureau of Reclamation data, Snake River arsenic levels range from 5 to 10 µg/l. Based on EPA data, levels in the Malheur River basin range from 3 to 10 µg/l. Ground water levels are much higher due to geologic conditions

	and there are publications showing this. (28)
	Response to comments 5.1 and 5.2 DEQ acknowledges and appreciates the data that was collected and submitted to help us better understand arsenic levels Eastern and Southern Oregon. We understand that Oregon has natural geologic sources of arsenic, which is a primary reason we are proposing to revise the arsenic criteria and recently revised the iron and manganese criteria as well.
Comment 5.3	The proposed arsenic criteria do not solve the problem or achieve the stated goal for the Klamath Basin or other areas of the state where naturally-occurring levels of arsenic exceed the proposed criteria. (15)
	Response DEQ's first priority is to establish statewide criteria that protect human health and at the same time account for natural conditions in the majority of Oregon waters. DEQ believes that the proposed standard achieves this balance from a statewide perspective. Dischargers are unlikely to be able to achieve calculated limits based on the current, very stringent criteria. They have asked DEQ to review and revise the criteria as quickly as possible. DEQ also understands, however, that there are some waters where the proposed criteria do not achieve the stated objectives. In these cases, DEQ is willing to consider the options and the data and work with local communicates to develop an appropriate resolution. This could include revisions to water quality standards applicable to specific waterbodies and/or using a permit implementation tool for cities or industries that cannot meet limits based on the revised criteria until the issue is resolved.
Comment 5.4	Requiring a permittee to eliminate constituents in its discharge that are naturally in a water body could alter the natural integrity of the receiving water body. Such actions would be inapposite to the fundamental purpose of the CWA, to "***restore and maintain*** the chemical, physical and biological integrity of the Nation's waters. The object of the Act is not to remove natural constituents from the Nation's waters. (15)
	Response DEQ acknowledges the commenter's concern about permit limits that could be established based on the proposed criteria. DEQ notes that the proposed criteria are less stringent than existing criteria and were developed in consideration of concern about natural levels as well as the Clean Water Act requirement to ensure that water quality criteria protect human health.
Comment 5.5	How is DEQ's rule at OAR 340-041-007(2), the natural conditions narrative, being considered in this rulemaking? (26)
	Response The proposed rulemaking revises only the arsenic standard. The natural conditions narrative remains in place and may not be appropriate to invoke for human health criteria in most cases. Please see the discussion of options considered in Chapter 2 Section 6 of the Arsenic Issue Paper.

Comment 5.6	DEQ's report states that DEQ may pursue site specific criteria where a water body has natural background levels above the statewide criteria. What is DEQ's plan and schedule to develop site specific arsenic criteria for the Snake River. The statewide standards should not apply to the Snake River when known concentrations of natural background arsenic exceed the proposed standard. (26)
	Response DEQ's current priority is to establish appropriate statewide criteria. The proposed criteria are less stringent than the existing criteria that apply to the Snake River. In evaluating revisions to water quality standards applicable to specific waterbodies, DEQ would further evaluate the levels of arsenic that occur naturally and whether the designated uses (i.e. domestic water supply) for the Snake River should be revised.
Comment 5.7	DEQ should include an explicit natural conditions provision in the criteria or adopt basin specific adjustments to the arsenic water quality criteria. This would be consistent with OAR 340-041-0007(2), the state's natural condition provision, and OAR 340-041-0033(1), which states that toxic substances may not be introduced above natural background levels in waters of the state. The City proposes rule language text. (15)
	Response While DEQ is not proposing revisions to its narrative criteria, it appreciates the city's effort to provide alternative rule language. Please see DEQ's response to other comments in Section 5 related to site specific conditions. DEQ will work with the City to develop an appropriate solution for the Link/Klamath River and the City of Klamath Falls.
Comment 5.8	It may be appropriate to re-evaluate the drinking water supply use designation for some waters. There are no public water suppliers in Oregon below the Link River. (15)
	Response DEQ agrees that removing domestic water supply as a beneficial use is one option to consider for the Link River and other waterbodies that cannot attain the water + fish consumption criterion.
Comment 5.9	There is no reason why DEQ cannot recognize basin specific adjustments to the arsenic criteria for the Klamath basin. If resources are a barrier, DEQ can exercise its receipts authority to allow outside parties to assist financially through a transparent process. The City of Klamath Falls is willing and able to provide the necessary data. (15)
	Response Please see the response to comment 5.3 above. DEQ can consider basin specific adjustments to the arsenic criteria. In the meantime, however, DEQ believes it is important to complete the statewide rulemaking.
Comment 5.10	DEQ should include a flexible risk factor approach that would provide the flexibility needed to set criteria consistent with naturally-elevated background levels of arsenic. This approach would include the option to develop permit

	limits based on adjustments to the risk factor, within a range. This approach would save DEQ and permittees the resources required to develop site specific criteria. (15)
	Response The proposed 'water and fish ingestion' criterion is based on a risk factor of 1×10^{-4}. The suggested approach could be considered where public domestic water supply (drinking water) is not a designated use and only the 'fish consumption' criterion applies. Removing the domestic water supply use would require subsequent rulemaking. DEQ believes it would be more appropriate to consider this suggestion in the context of such a subsequent rulemaking.
Comment 5.11	Ontario receives its drinking water from the Snake River, which has a natural background level (about 5µg/l) that is well below the safe drinking water standard but higher than DEQ's recommended outfall limit for the wastewater treatment plant. Arsenic is reduced at the water treatment plant, by customers and through land application of effluent during the growing season (May 1 to Oct 30) of each year. On an annual basis there is a net reduction of arsenic in the Snake River by the City of Ontario. This rule does not recognize this. (26)
	Response The proposed rule revises Oregon's statewide ambient water quality standard for arsenic. It does not set an outfall limit for any specific discharger or revise requirements related to the development and calculation of effluent limits. Please see the responses to comments 5.3 above and in section 7 below.
Comment 5.12	If there were no removal of arsenic through either the water or wastewater treatment processes, Ontario would discharge about 1 ounce per day, which would cause no measurable change in the background of the Snake River, which flows at about 10,000 cfs. (26)
	Response The proposed rule only revises Oregon's statewide ambient water quality standard for arsenic. In implementing the criteria, DEQ will analyze data for individual sources, establish appropriate permits limits and work with sources that need site specific solutions.
Comment 5.13	Are there options available that can deal with the natural geology of the region? Is it necessary to create a water quality standard for arsenic lower than natural background levels that will then require regulatory variance for compliance? Variances will be duration-specific, and are intended to be short term and temporary. If DEQ does grant a variance to the community, does this mean it will have to be reviewed and reissued during every permit cycle? (28)
	Response Please see the response to comment 5.3 and other comments in this section. DEQ is proposing revisions to the variance rule as part of the human health criteria rulemaking.

6. Comments on how the proposed criteria were calculated	
Comment 6.1	Commend DEQ for proposing a science-based approach to revising the arsenic water quality criteria for the protection of human health. I have published several articles that support DEQ's approach. (27)
	Response DEQ appreciates the comment. It is very important to us to develop water quality criteria that are scientifically credible and defensible.
Comment 6.2	NWPPA supports the proposed criteria for arsenic that reflect the higher fish consumption rate of 175 grams per day and that DEQ has adjusted based on locally appropriate variables. (11)
	Response DEQ acknowledges this supportive comment.
Comment 6.3	DEQ failed to conduct an adequate technical analysis of its proposal. (12)
	Response The comment pertains to the initial criteria proposal. DEQ acknowledges that additional technical analysis has improved the scientific basis of the proposed criteria. DEQ did additional technical analysis, requested additional information from EPA and revised the proposed criteria based on that work. The 'Arsenic Issue Paper' has been updated to reflect the additional information and method used to develop the proposed criteria.
Comment 6.4	The proposed arsenic criteria are too low. Fish from fresh water do not likely have a bioconcentration factor of 14. (28)
	Response The commenter did not provide data or information supporting the claim that DEQ used inappropriate values. DEQ based the bioconcentration factor on an analysis of available studies that it identified with the assistance of EPA.
Comment 6.5	EPA's "Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000) outlined methods for estimating bioaccumulation factor (BAF) values to be used in driving water quality criteria and encouraged states and tribes to use the revised methodology to develop or revise criteria to reflect local conditions. Oregon should follow the methodology in EPA's "Site-Specific Technical Support Document" and calculate site-specific BAFs to use in modifying national toxics criteria. DEQ has not referenced the 2000 Methodology or EPA guidance on arsenic bioaccumulation or explained why this national guidance is not relevant to the current arsenic criteria revision. (12)
	Response While the 'Human Health Methodology' (EPA 2000) suggests that site specific BAFs would be preferable, EPA recognizes that this data is generally not available and that the BAFs are too variable to use this approach for establishing statewide criteria. Please see addition discussion in the arsenic issue paper Chapter 2 Section 5.

Comment 6.6	EPA has recommended a BCF of 44 for arsenic; DEQ chose to use a BCF of 1. DEQ's choice and rationale are not supported by the latest science on arsenic BCFs and are therefore inconsistent with the 2000 methodology. It is arbitrary for DEQ to apply a BCF of 1 just because that has been used by other states. (12)
	Response This comment pertains to DEQ's initial proposed criteria. DEQ did additional analysis and revised the proposed criteria using a BCF of 14 for freshwater and a BCF of 26 for saltwater. Please see the 'Arsenic Issue Paper" Chapter 2, Section 5 for additional information.
Comment 6.7	There appears to be an inverse relationship between the BCF and the ambient concentration of arsenic (cite Williams et al., 2006). Therefore, it is essential to have site-specific data on ambient arsenic levels to derive an appropriate and scientifically sound BCF. (12)
	Response DEQ appreciates the submittal of the Williams et al (2006) paper. Because there appears to be an inverse relationship between bioconcentration and water concentration, DEQ based the BCF value we used to derive the proposed criteria on studies conducted at background concentrations of less than 50µg/l and excluded studies conducted at higher concentrations (i.e. 100 to 1000µg/l or more), which would be more appropriate for evaluating contaminated sites. DEQ has added to the data and discussion in the 'Arsenic Issue Paper" Chapter 2, Section 5 on bioconcentration. While uncertainties remain in understanding arsenic bioaccumulation, the transformation of arsenic between forms, and physiological responses to inorganic arsenic, DEQ is updating the statewide criteria based on the data available to us at this time. DEQ concludes that the proposed criteria and the BCFs we used to derive them are more scientifically appropriate for Oregon and represent more recent science than the national criteria. DEQ may pursue site specific arsenic criteria for certain waters if information is available that indicates the statewide criterion is not appropriate.
Comment 6.8	Commenter participated in an assessment of arsenic bioaccumulation in freshwater fish and co-authored an article on this topic published in the journal Human Ecological Risk Assessment (Williams et al, 2006). The research suggests that ambient arsenic concentrations in surface water have little influence on total arsenic concentrations in fish. Commenter supports DEQ's proposal to reduce the BCF (from the 44 used in EPA's criteria). Note that ongoing research will provide additional insight to arsenic bioaccumulation and DEQ may want to revisit this issue in the future. (27)
	Response DEQ appreciates the authors comment and support. DEQ agrees that when the available data and understanding of organism responses to inorganic arsenic improve, DEQ may want to revisit this issue in the future.
Comment 6.9	For areas of the state where waters have significantly higher levels of arsenic, it would be appropriate to pursue further data collection to identify site-

	specific BCFs. (12)
	Response DEQ acknowledges that developing site specific BCFs could be an approach to developing site specific criteria in future rulemakings. Please see also the response to comment 5.3 above.
Comment 6.10	EPA's national BCF includes freshwater and saltwater organisms. In contrast, Oregon eliminated all saltwater organisms in deriving its criteria. EPA guidance notes that the concentration of arsenic in marine bivalve mollusks is substantially higher than their freshwater counterparts. DEQ has provided no evidence that its criteria will provide public health protection from the consumption of saltwater species. (12)
	Response This comment pertains to DEQ's initial proposed criteria. DEQ has subsequently revised its proposal to include a separate criterion for saltwater. The saltwater criterion is based on a BCF that incorporates the marine mollusk data together with the finfish data.
Comment 6.11	DEQ should not have relied on EPA Region 6 Interim Guidance or the draft Great Lakes Initiative BCF. They are outdated. (12)
	Response This comment pertains to DEQ's initial proposed criteria. DEQ has subsequently revised its proposed criteria such that it no longer relies on the BCF value from these documents.
Comment 6.12	Pleased that DEQ revised the BCF in its revised proposed arsenic rule. It is an improvement. (12)
	Response Comment acknowledged.
Comment 6.13	DEQ does not explain how the proposed BCFs were derived. DEQ must better explain its scientific basis. (12)
	Response DEQ has added information to the Arsenic Issue Paper to better explain the scientific basis for the BCFs used to derive the proposed criteria.
Comment 6.14	If DEQ is going to use a BCF based on the fact that people eat a mixture of finfish and shellfish from marine waters for deriving criteria for marine waters, they should use the same ratio of fresh- to salt-water organisms in both calculations. (12)
	Response DEQ assumes that by "both calculations" the commenter means the calculations to derive both the freshwater and saltwater fish consumption only criteria. DEQ has improved the explanation of the proposed BCFs in the Arsenic Issue Paper Chapter 2, Section 5. DEQ based the BCF for saltwater on the fact that people eat a mixture of finfish (vertebrates), such as salmon, halibut, tuna, etc., and mollusks

	(invertebrates), such as oysters, from marine waters. The available bioconcentration data for mollusks (1 study) is much higher than the BCF data for finfish. In the absence of BCF data for marine finfish, DEQ relied on the finfish data as the best indicator of bioconcentration in marine finfish, which also represent an important exposure pathway. DEQ has no information indicating that people eat mollusks from freshwaters in Oregon. Further, given the species of mollusks found in freshwaters, DEQ concludes that people are unlikely to consume freshwater mollusks. Therefore, the BCF for the freshwater criteria are based exclusively on finfish (vertebrate) species.
Comment 6.15	DEQ does not explain the proportions of consumption used as the basis for the BCF. DEQ says mollusks comprise a small portion of the 175 gram/day consumption rate but does not cite the data to support this. (12)
	Response In the CRITFIC study of fish consumption by Columbia River Tribes, the only study of consumption used that was conducted in Oregon, none of the reported consumption was shellfish. In studies of native Americans in the Puget Sound area, shellfish consumption was much greater. Schoof and Yager (2007; reference provided in the arsenic issue paper) provided a summary of seafood consumption in the U.S. population (data from the USEPA, 2002 and relying on the 1994096 and 1998 USDA surveys of food intake) showing that estuarine mollusks (oyster, clam and scallop) comprised about 3 percent and all estuarine and marine mollusks together (oyster, clam, scallop, mussels, squid and octopus) represent about 13 percent of total fish and shellfish consumption.
Comment 6.16	DEQ's report states that EPA uses a cancer risk level of 10^{-6} when it develops recommended human health criteria for carcinogens. This is inaccurate with respect to arsenic where EPA has used a cancer risk level of 10^{-4} in establishing Safe Drinking Water Act arsenic standards for potable water. (See EPA document 815-R-00-013, "*Proposed Arsenic in Drinking Water Rule Regulatory Impact Analysis*." (26)
	Response DEQ' statement refers to EPA's recommended human health criteria under the federal Clean Water Act; those are the criteria being evaluated in this rulemaking. EPA EPA used the 10^{-6} risk level to establish recommended Clean Water Act (section 304a) criteria for carcinogens. When EPA establishes MCLs under the Safe Drinking Water Act, they may publish drinking water standards at a different risk rate, based on the consideration other factors, such as the feasibility of treatment.
Comment 6.17	It appears that DEQ selected different risk factors for the water + fish and fish consumption only criteria in order to result in the same criterion for both categories. It may be more appropriate and consistent to select the same risk factor of 10^{-4} for both categories. This would be consistent with the SDWA criterion and avoid a criterion that is below natural levels in the Snake River. (26)

	Response DEQ did base the two criteria on different risk levels and acknowledges the suggestion to set both criteria based on a 10^{-4} risk level. A fish consumption only criterion based on 10^{-4} would be 19 µg/l. As a general matter, DEQ establishes its water quality criteria based upon a 10^{-6} risk level. DEQ is choosing to use an alternate risk level of 10^{-4} for the fish consumption only criterion and a 10^{-5} risk level for the water + fish ingestion criterion due to the unique fact set presented by high naturally-occurring levels of arsenic. DEQ's policy objective is to protect public health. For much of the state, natural levels are well below the criteria level. The stakeholder group had already concluded that the MCL of 10 µg/l was too high for a statewide criterion.
Comment 6.18	Regarding the inorganic proportion factor applied to the BCF, the commenter evaluated available data as of 2006 and concluded that 10% is a health protective factor for freshwater fish. A similar evaluation yielded 2% as an appropriate proportion for marine fish and crustaceans, and 3% for mollusks. The commenter recommends reducing the inorganic factor for saltwater to 2%. The commenter published an article on this topic in the journal Human Ecological Risk Assessment and submitted the citation and abstract for that article. (27)
	Response DEQ appreciates receiving this information and the support for using a 10 percent inorganic factor for the freshwater criteria. DEQ reviewed the commenter's publication and additional data on speciation and transformation of arsenic in the marine environment and used it in further analysis, which has been added to the issue paper. There is uncertainty in the bioconcentration of arsenic in marine fish, so DEQ also calculated what a criterion would be using a higher BCF (i.e. 350) and a lower inorganic proportion (one percent). DEQ concludes that given the 2 calculation scenarios and data on natural ocean levels, the proposed criterion of 1.0 µg/l is scientifically supported.
Comment 6.19	EPA has done a draft toxicological review and may change the toxicity slope factor it uses to calculate the human health criteria for inorganic arsenic. NWEA supports moving ahead to revise Oregon's criteria but urges the Commission to direct DEQ to swiftly revise the criteria again if the IRIS cancer slope factor is revised. In addition, NWEA asks the Commission to direct DEQ to include reference to the national level discussions in the DEQ issue paper about this rulemaking. (12)
	Response Should EPA revise the cancer slope factor for arsenic, DEQ would need to evaluate the updated toxicity information and determine whether the arsenic criteria should be revised. However, DEQ recommends that the Commission allow the agency to prioritize this need with other water quality standards rulemaking needs and available resources. DEQ will include reference to EPA's review of the IRIS information in the Issue Paper.

7. Comments on implementation and measurement	
Comment 7.1	The City of Ontario supports efforts to improve water quality where there is a measurable and positive impact on the environment and provides examples of water quality improvements they have made. (26)
	Response DEQ appreciates the City of Ontario's water quality improvements.
Comment 7.2	To further the goal of protecting human health, DEQ should control all sources of anthropogenic arsenic and require a higher level of drinking water treatment to limit public exposure to arsenic. (12)
	Response The proposed rule revises the instream water quality criteria, which are then implemented through a variety of Clean Water Act and state regulatory and non-regulatory programs. As a general matter, DEQ agrees that its efforts are best focused on anthropogenic sources of arsenic. DEQ does not regulate drinking water treatment.
Comment 7.3	DEQ should move forward cautiously and make sure any required community investment has a positive impact on water quality and is not just a paper exercise. (26)
	Response The proposed rule revises the statewide ambient water quality criteria for arsenic to be less stringent than existing criteria. The only additional implementation requirements are those associated with the arsenic reduction policy, which applies to waters with arsenic concentrations lower than the proposed criteria. DEQ acknowledges the commenter's desire to avoid administrative costs that do not benefit water quality. DEQ is separately considering this issue as part of the human health toxics rulemaking.
Comment 7.4	Criteria that result in a permittee having to treat wastewater to a level below that naturally present in the facility influent would be exceedingly costly and is an inappropriate use of public resources. (15)
	Response DEQ notes the proposed rule revises the statewide ambient water quality criteria for arsenic to be less stringent than existing criteria. DEQ agrees that additional work may be needed in some waterbodies to take into account the presence of higher levels of naturally occurring arsenic. Some options, such as revising water quality standards and granting variances to permittees, are available under DEQ's current rules and additional options, including intake credits and the background pollutant allowance have been proposed as part of the human health toxics rulemaking.
Comment 7.5	DEQ must explain how the proposed criteria will be translated into permit limits for facilities with naturally-elevated levels of arsenic. The rules do not provide the certainty needed for cities to make long term decisions. DEQ needs to ensure that municipalities can plan, schedule, finance and operate

	improvements to their treatment works in an orderly and practical manner. Municipal wastewater treatment providers rely on limited public funds to make long-term investments and require long-term certainty as to what criteria they will be expected to meet. (15)
	Response The proposed rules revise the statewide ambient water quality criteria for arsenic to be less stringent than the existing criteria. They do not change how DEQ develops permit limits. DEQ acknowledges municipalities' preference for long term solutions, such as water quality standards revisions, to address situations where natural concentrations exceed the proposed criteria.
Comment 7.6	The uncertainty causes concern for the city. (26)
	Response See response to the comment above.
Comment 7.7	ACWA supports the definitions in the proposed rule, including using harmonic mean flow of the receiving water to determine contributions of inorganic arsenic in reasonable potential calculations. (17)
	Response The definition in the proposed rule language is part of the arsenic reduction policy; it does not pertain to developing permit limits. However, it is DEQ's practice, in accordance with EPA guidance, to use this flow metric for conducting reasonable potential analysis for human health criteria.
Comment 7.8	Under the proposed rule, DEQ and permittees will face substantial and unnecessary resource burdens. Permittees may need to file requests for variances, intake credits or background pollution allowances simply because they discharge into rivers with naturally-elevated levels of arsenic. (15)
	Response See response to comment 7.4 above.
Comment 7.9	As a variant of the intake credit rule, DEQ should credit facilities that collect and filter naturally occurring arsenic if the arsenic would otherwise naturally reach surface waters. (15)
	Response The intake credit rule is not part of this rule proposal. DEQ will reply to this comment as part of the human health toxics criteria rulemaking.
Comment 7.10	The rule should provide a pathway for intake and discharge of naturally occurring arsenic that does not require an arsenic reduction plan or variance. Suggested rule language provided. (26)
	Response This comment and suggested revisions appear to address the intent of the intake credit rule being proposed as part of the human health toxics criteria rulemaking and will be responded to as part of that rulemaking process.
Comment 7.11	The city of Ontario seeks an exclusion from the proposed arsenic rulemaking for naturally occurring arsenic present in the effluent discharge. The City

	would like to avoid pursuing arsenic reduction plans, background pollutant allowances, intake credits or water quality variances to account for naturally occurring arsenic in the city's effluent discharge to the Snake River. (26)
	Response Water quality standards apply to the water body and as such cannot exclude a specific discharger. DEQ must set criteria based on designated beneficial uses, in this case, drinking water and fish consumption. The city's request that DEQ consider the natural arsenic contained in the effluent differently is the objective of the implementation tools being proposed as part of the human health toxics rulemaking package. Please see also the response to comment 7.4 above.
Comment 7.12	The "background pollutant allowance" is one flexible permitting mechanism being considered by DEQ. The City supports this concept but the rule should recognize that a background pollutant could be groundwater if a facility's influent originates from wells. (15)
	Response The background pollutant allowance is not part of this proposed rule. DEQ will respond to this comment as part of the human health toxics rulemaking process.
Comment 7.13	The background pollutant allowance appears to be restricted such that it would not apply for the arsenic water + fish criterion, which is based on a 10^{-4} risk level. (26)
	Response The background pollutant allowance is not part of this proposed rule. DEQ will respond to this comment as part of the human health toxics rulemaking process.
Comment 7.14	The background pollutant allowance may be a useful alternative. I have been told it is available only for industries, not cities. Why is this that? (26)
	Response The background pollutant allowance is not part of this proposed rule. DEQ will respond to this comment as part of the human health toxics rulemaking process.
Comment 7.15	There appear to be options for DEQ to consider that are less cumbersome than the variance process. Ontario strongly encourages DEQ to consider a strategy to deal with background conditions on a region or watershed basis, rather than for each permittee individually. (26)
	Response Variances, and alternatives to variances, are not part of this proposed rule. DEQ will respond to this comment as part of the human health toxics rulemaking process.
Comment 7.16	The revised standards should include provisions that preclude DEQ having to list waterbodies and develop TMDLs due to the presence of naturally elevated levels of arsenic. This is a waste of public funds where the pollution

	is natural and cannot be controlled. (15) (17) (26)
	Response DEQ acknowledges the comment and agrees that, in general, the focus of our water quality programs should be to control anthropogenic sources of arsenic. Please see responses to comments 7.3 and 7.4 and comments in section 5 of this document for additional information.
Comment 7.17	If waters of the Klamath basin are listed as impaired, sources that discharge to listed waters are not allowed a mixing zone and must meet the criteria in the effluent, even though arsenic may naturally be in their intake water. The city and DEQ would face substantial and unnecessary resource burdens to request and grant variances in these situations. (15)
	Response DEQ acknowledges the commenter's concern regarding discharges to waters identified as "impaired" by naturally elevated levels of arsenic. The intake credit rule and background concentration allowance provisions that have been proposed for comment as part of the human health toxics rule package are intended to be used in such situations. DEQ will respond to this comment as part of that rulemaking. As discussed in the responses to comments in section 5 of this document, further revisions to water quality standards applicable to specific waterbodies may be appropriate in this case.
Comment 7.18	An arsenic level of 2.3 µg/l is difficult for labs to even assess reliably and an increase of 10% is difficult to reliably quantify at these low levels. Please reconsider the actual value of the time and expense this represents to business owners. (9)
	Response DEQ is unclear what 10 percent the commenter is referring to. Measurement or quantification levels are evaluated through a separate process at DEQ. If water quality criteria are below quantitation limits, the quantitation limit becomes the functional compliance measurement.
Comment 7.19	It would be better to study, test and establish best management practices for stormwater rather than pretreatment. The arsenic numbers in the pretreatment program annual reports are so low most labs have difficulty detecting the numbers. (18)
	Response The comment is beyond the scope of the proposed rule. The proposed rule revises the instream arsenic water quality criteria and does not establish pretreatment requirements.
Comment 7.20	WWPI believes that two modest clarifications of the criteria's applicability would help prevent unreasonable applications of the criteria to stormwater discharges. 1. The rule should make clear that the arsenic and other human health criteria do not apply to waterbodies such as drainage ditches and stormwater detention ponds and swales that contain only stormwater runoff and wastewater. These waterbodies would not be a source of drinking water or

	fish/shellfish that might be consumed by humans. The commenter provides suggested language for the Table 20 preamble stating that the criteria are not to be exceeded in waters of the state "other than waterbodies that contain only stormwater and wastewater." 2. The human health criteria should expressly be defined as long-term averages. Suggest addition language to Table 20 stating that "the human health criteria for carcinogens are annual average concentrations." (20)
	Response The suggested revisions would pertain to all the human health criteria and are outside the scope of this rulemaking. This proposed rulemaking is focused on revisions to the arsenic criteria.
8. Comments on the arsenic reduction policy	
Comment 8.1	NWPPA expresses appreciation for DEQ efforts to move this rule forward with appropriate implementation measures for point sources, including a focus on whether actual potential exists to increase inorganic arsenic in drinking water. If the facility is adding inorganic arsenic and impacting a drinking water supply then the permittee shall develop an arsenic reduction plan. (11) (25)
	Response DEQ acknowledges this supportive comment.
Comment 8.2	The monitoring and pollutant minimization plans associated with the rule will have positive effects. (11)
	Response DEQ appreciates the comment.
Comment 8.3	WWPI supports DEQ's proposed arsenic reduction policy with the understanding that it is not intended to impose extraordinary arsenic reduction requirements on facilities that meet the arsenic human health criteria. Rather, the policy requires an evaluation of whether there are additional *feasible* measures that could be undertaken to reduce arsenic discharges that have the potential to significantly increase inorganic arsenic concentrations in public drinking water. (16) (20)
	Response The commenter's description of the intent of this policy is consistent with the intent as described in the Arsenic Issue Paper.
Comment 8.4	ACWA supports DEQ's plan to implement an arsenic reduction program for municipalities through the SB737 requirements as outlined in DEQ's draft report "Water Quality Standards Review and Recommendations: Arsenic" (February 1, 2011). (17)
	Response DEQ acknowledges this supportive comment.
Comment 8.5	The proposed rule amendment does not include a specific reference that differentiates between Publicly Owned Treatment Works (POTWs) and

	industrial dischargers. The rules should specify that POTWs will be regulated under the provisions of SB737 as follows: OAR 340-041-0033 (4) (d) (F). For publicly owned treatment works, the arsenic pollution prevention plan developed under ORS 468B.140 (SB737- 2007 Legislature) and approved by the Department shall be the arsenic reduction plan. Publicly owned treatment works in compliance with the approved arsenic portion of the pollution prevention plan shall be deemed to be in compliance with the applicable water quality standard for arsenic. (17)
	Response DEQ revised the rule to clarify that the requirement to develop an arsenic reduction plan under 340-041-0033 (4) (e) applies to industrial dischargers. DEQ did not add the proposed language above for three reasons. First, we believe the rule language, with the change noted here, is clear that the requirements in (4) (d) and (e) to submit data and develop an arsenic reduction plan apply to industrial dischargers. Second, the issue paper explains that DEQ's intent is that the arsenic reduction policy will be implemented through the requirements under the Senate Bill 737. Even though the SB737 plans are not exactly analogous, they meet the intent to require feasible steps to reduce arsenic where it exceeds a level of concern and DEQ did not want to duplicate existing requirements with the same intention as the reduction policy. Third, DEQ does not agree that we can say in rule that a POTW that has developed and is implementing an arsenic reduction plan "shall be deemed to be in compliance with the applicable water quality standard for arsenic." Development of the plan does not replace water quality-based effluent limits where those are determined to be needed. The reduction policy applies to discharges to waters that are lower than the standard and preventing polluting up to the criteria, it does not exempt any source from requirements associated with the numeric criteria
Comment 8.6	The arsenic reduction policy language should be updated to be consistent with the revised proposed arsenic criteria. Specific edits suggested, include: The 1% change that defines a potential to significantly increase arsenic concentrations in the drinking water supply source is based on the previously proposed criteria. It should be changed from 0.023 to 0.021 µg/l. Other suggested revisions included. (16) (17) (20) (25)
	Response DEQ has made the suggested changes.
Comment 8.7	In the proposed rule language and in the Issue Paper, comparisons between the proposed criteria and the MCL are not correct because the MCL is based on total recoverable arsenic while the proposed criteria are for inorganic arsenic. 737 testing did not analyze for arsenic III, but for total recoverable arsenic, because the initiation level is based on the MCL. Most municipalities do not test for inorganic arsenic and have no data on inorganic arsenic levels in their effluent. (17)
	Response The MCL is for total recoverable arsenic, but it is 10µg/l. The criteria are for inorganic arsenic, but they are 2.1µg/l. The portion of inorganic to total

	arsenic in a water body or effluent varies, but for purposes of the arsenic reduction policy, DEQ concludes that the SB737 requirements serve the purpose. However, per the state's regulations, any required monitoring will need to address inorganic arsenic once the DEQ's water quality criteria revisions become effective and incorporated into permit issuance or renewal.
Comment 8.8	ACWA believes that the proposal for implementing the policy to control non-point sources of arsenic to the State's waters should be presented to the EQC for adoption at the same time the final rule is proposed, not at some unspecified later date. Quotes section (4) (f) of the proposed rule. (17)
	Response DEQ will not be able to submit such a proposal to the EQC at the time the arsenic rule is proposed, which is planned for April 2011.
Comment 8.9	Support focusing DEQ resources on anthropogenic sources of arsenic, both point and nonpoint. This policy balances the acceptability of using a higher risk level for the criteria. (12)
	Response DEQ acknowledges this comment.
Comment 8.10	Because the fish consumption only criterion is now also based on a risk level greater than 10^{-6}, the arsenic reduction policy falls short of filling the gap allowed by the adoption of high-risk numeric criteria and its narrow focus is nonsensical. (12)
	Response DEQ disagrees; sources of drinking water remain the appropriate focus for the arsenic reduction policy. The final proposed water + fish ingestion criterion continues to be based on a risk level of 10^{-4}. The fish consumption only criterion is now based on a risk level of 1.1×10^{-5} which continues to represent an appropriate level of protection for the general population, considering that naturally-occurring concentrations are high throughout the state. In addition, DEQ does not believe that an expansion of the arsenic reduction policy is needed to further augment the antidegradation policy, which may be used to limit or prevent new or increased sources of arsenic in waterbodies that have concentrations of arsenic lower than the criteria
Comment 8.11	The language of the arsenic reduction policy was based on the premise that consumption of fish carried zero risk of harm to human health from arsenic. That premise is now false and should be discarded. It violates the integrity of the committee process for DEQ to continue to rely on language that was negotiated on a false premise. (12)
	Response DEQ disagrees with the commenter's assertion that the proposed arsenic reduction policy was based on a premise that consumption of fish carries zero risk. Rather, DEQ's initial proposed criteria for the consumption of fish was based on a cancer risk level of 1×10^{-6}. The original proposed criterion of 2.3 (water + fish criterion) was based on a risk level of 10^{-4} and the revised proposed criterion of 2.1 is based on the same risk level. DEQ continues to

	believe that minimizing potential risk associated with exposure from drinking water is a higher priority and should continue to be the focus for the arsenic reduction policy to reduce risk to drinking water sources.
Comment 8.12	The arsenic reduction policy should not be expanded beyond facilities with the potential to impact public drinking water supplies. (16) (20)
	Response DEQ has not made any revisions to expand the arsenic reduction policy.
Comment 8.13	The revised arsenic criterion based on 1.1×10^{-5} is protective of human health given that the criterion is also based on a fish consumption rate of 175.grams/day. (16)
	Response DEQ agrees with this statement given the presence of naturally occurring arsenic in Oregon waters.
Comment 8.14	The arsenic reduction policy should be considered a water quality standard. It is a key part of Oregon's choice to use a higher risk level. The intent of the policy is to alter the numeric criteria when those criteria include human contributions.DEQ should pursue this with EPA and make revisions as necessary to achieve this outcome. (12)
	Response DEQ agrees that the arsenic reduction policy is an important component of our standards rules for drinking water areas due to the fact that the standard is based on a risk level of 10^{-4}. DEQ disagrees that the intent of the arsenic reduction policy is to alter the numeric criteria. The policy applies to specific sources and circumstances and requires that feasible reduction steps be taken. If the arsenic reduction policy is adopted by the EQC, it will be effective and applicable as a state rule approval whether or not EPA acts upon the provision under its Clean Water Act section 303(d) authority. Please see the arsenic issue paper for additional information on the arsenic reduction policy.
Comment 8.15	The arsenic reduction policy should be clarified to ensure that permittees understand when and where it applies. • "Applicable numeric…criteria" refers to the statewide criteria, not any subsequent basin level criteria. • The policy does not apply to facilities that do not discharge into designated drinking water protection areas • Correct the proposed criteria reference (15)
	Response DEQ has made the suggested changes.
Comment 8.16	The policy should be revised to conform to DEQ's revised proposed numeric arsenic criteria. Suggested revisions included. (20)
	Response DEQ agrees with the commenter and has made the suggested corrections to

	make the reduction policy consistent with the revised proposed numeric criteria.
9. Comments on the Arsenic Issue Paper	
Comment 9.1	DHS staff provided suggestions for the Issue Paper: First, the listings for human health v. aquatic life criteria on p. 11 should be shown separately. Second, a correction to the cancer slope units on page 18. (14)
	Response The cancer slope factor unit correction has been made. DEQ evaluates listings based on the most stringent criteria—so if it's listed, it's listed based on the HH criteria. Listings are not further evaluated to see whether it also exceeds other criteria for the same pollutant.
Comment 9.2	DEQ should review and revise the issue paper to ensure it conforms to the final rule proposal. Chapter 3 of the draft report should be revised to reflect the revised numeric criteria proposals and the revisions in the policy itself. • P. 15 – proposed criterion is now 2.1µg/l and the proposed criteria for organisms only consumption is no longer based on the same risk level as Oregon's other human health toxics criteria. P. 17 - Whether a discharge has the potential to significantly increase inorganic arsenic in a public drinking water supply source water is based on a 10 percent increase, not a 2 percent increase. (16)
	Response DEQ has reviewed and updated the issue paper.

List of commenters and reference numbers

Ref #	Name	Organization	Address	Comment date
1	Shelia Herrera	None stated	1338 Woodland Drive, Bloomfield, New Mexico 87413	Aug. 25, 2010 & Feb. 2, 2011
2	Keith Nelson	Iron Overload Support Forums Online	keith@ironoverloadsupport.com	Sept.7, 2010
3	Cary Weigand	None stated	Troyweigand@aol.com	Sept. 11, 2010
4	Christina Shetterly	None stated	2844 Yvonne Road, Medford, OR 97504	Sept.13, 2010
5	Shirley VanLeuven	Evergreen Meadows Water Improvement District	Prospect, Oregon sdayvl@hughes.net	Sept. 15, 2010
6	Paul Neussl	Evergreen Meadows Water Improvement District	paulneussl@live.com	Sept. 22, 2010
7	William H. Burke, Chairman, Tribal Water Commission	Confederated Tribes of the Umatilla Indian Reservation	46411 Timine Way, Pendleton, OR 97801	Sept. 21, 2010
8	Susan Hansen	None stated	Ashland, OR she@opendoor.com	Sept. 26, 2010
9	Cheryl Moore	None stated	cmoore@mendoco.com	Sept. 27, 2010

10	Ray Suek & Geri Johnson	None stated	25570 Valley View Lane, Sheridan, Oregon 97378 gerijohnson@live.com	Sept. 28, 2010
11	Llewellyn Matthews, Executive Director	Northwest Pulp & Paper	7900 S.E. 28th Street, Suite 304, Mercer Island, WA 98040	Sept. 30, 2010
12	Nina Bell	Northwest Environmental Advocates	PO Box 12187 Portland, OR 97212	Sept. 30, 2010, Feb. 16 & 23, 2011
13	Cari Hinesly	Evergreen Meadows Water Improvement District	Prospect, OR hineslyc@huges.net	Sept. 29, 2010
14	Barbara Stifel, Ken Kauffman, David Farrer	Oregon Health Authority	800 NE Oregon St., Portland, OR 97232-2162 Barbara.l.stifel@state.or.us	Sept. 27, 2010 & Feb. 23, 2011
15	Mark Willrett, P.E., Director of Public Works	City of Klamath Falls	PO Box 237, Klamath Falls, OR 97601 gmjohnson@ci.klamath-falls.or.us	Sept. 29, 2010 & Feb 22, 2011
16	Michael Campbell, Stoel Rives, LLP	Oregon Water Quality Standards Group (industrial facilities that hold NPDES permits)	900 SW Fifth Ave, Suite 2600, Portland, OR 97204	Sept. 30, 2010 & Feb. 23, 2011
17	Janet Gillaspie, Executive Director	Oregon Association of Clean Water Agencies	537 SE Ash St., Suite 12, Portland, OR 97214	Sept. 30, 2010 & Feb. 23, 2011
18	Randy Watson, Pretreatment Coord.	City of Wilsonville	watson@ci.wilsonville.or.us	Feb. 2, 2011
19	Sandry and Randy Turner	None stated	the2andies@gmail.com	Feb 8, 2011
20	Ted LaDoux, Executive Director	Western Wood Preservers Institute	7017 N.E. Hwy 99, Suite 108 Vancouver, WQ 98665 ted@wwpinstitute.org	Feb. 18, 2011
21	Glen D. White	None stated	Gkdaw_usa@msn.com	Feb 18, 2011
22	Darrell Standage, Board member	Malheur County SWCD	2925 SW 6th Ave, Suite 2 Ontario, OR 97914 Linda.Rowe@or.nacdnet.net	Feb. 22, 2011
23	Martin Andre, Board member	Malheur County SWCD	2925 SW 6th Ave, Suite 2 Ontario, OR 97914 Linda.Rowe@or.nacdnet.net	Feb. 22, 2011
24	Tim Newton, Board member	Malheur County SWCD	2925 SW 6th Ave, Suite 2 Ontario, OR 97914 Linda.Rowe@or.nacdnet.net	Feb. 22, 2011
25	Kathryn VanNatta, Governmental Affairs Manager	Northwest Pulp & Paper	7900 S.E. 28th Street, Suite 304, Mercer Island, WA 98040 kathrynvannatta@frontier.com	Sept. 30, 2010 & Feb 23, 2011
26	Charles Mickelson, Public Works Director	City of Ontario	444 SW 4th Street Ontario, OR 97914 Chuck.Mickelson@ontarioregion.org	Feb 23, 2011
27	Rosalind Schoof, PhD., Principal	ENVIRON	605 First Ave., Suite 300 Seattle, WA 98104 rschoof@Environcorp.com	Feb. 23, 2011

28	Clint Shock	Private citizen	1059 SW 2nd Ave. Ontario, Oregon	Feb 7, 2011 public hearing testimony

State of Oregon
Department of Environmental Quality **Memorandum**

Presiding Officer's Report

Date: Oct. 5, 2010

To: Environmental Quality Commission

From: Andrea Matzke

Subject: Presiding Officer's Report for Rulemaking Hearing

Title of proposal: Amendments to Water Quality Standards: Arsenic, Iron, and Manganese
Hearing date and time: Sept. 21, 2010; 5-7 p.m.
Hearing location: DEQ headquarters, 811 SW 6th Ave., Portland, room EQC-A (10th floor)

DEQ convened the rulemaking hearing on the proposal referenced above at 5 p.m. and closed it at 7 p.m. One member of the public attended, but no one submitted testimony, either oral or written, at this hearing.

State of Oregon
Department of Environmental Quality **Memorandum**

Presiding Officer's Report

Date: Sept. 28, 2010

To: Debra Sturdevant, DEQ headquarters, Portland, OR

From: Don Butcher, DEQ, Eastern Region, Pendleton, OR

Subject: Presiding Officer's Report for Proposed Amendments to the Water Quality Standard Criteria for Iron, Manganese and Arsenic

Hearing date and time: Sept. 28, 2010; 7 p.m.
Hearing location: Blues Room, Saint Anthony's Hospital, Pendleton, OR

On Sept. 23, 2010, I acted as Presiding Officer at the public hearing for the subject proposed amendments. Prior to receiving comments, I briefly explained the procedures to be followed during the hearing. The audience was informed that the purpose of the hearing was to gather comments pertaining to the proposed amendments. The audience was also informed that written comments would be accepted until 5 p.m., Sept. 30, 2010.

As an introduction to the hearing, Debra Sturdevant gave a presentation describing the proposed amendments and their informational basis. Members of the audience asked questions and technical and policy issues were discussed. Interest was expressed with regard to natural background levels of arsenic, criteria implementation planning and timelines.

The public hearing on the above titled proposal was convened at 7:05 p.m. People were asked to sign registration forms if they wished to present comments, and were advised that the hearing was being recorded. Seven people attended, including two DEQ staff. The hearing was closed at approximately 8:00 p.m. after one person gave testimony.

The comments of the individual who provided testimony are here summarized as appreciation for DEQ's efforts in developing the proposed amendments, including appropriate involvement of stakeholders. DEQ’s responses to all comments received during the comment period will be included in a staff report.

Oregon Department of Environmental Quality
COMMENT REGISTRATION FORM

DEQ

NAME: Kathryn VanNatta

REPRESENTING: Northwest Pulp and Paper Assn.

ADDRESS: 2191 SE Oak Crest DR

CITY: Hillsboro **STATE:** OR **ZIP CODE:** 97123

I request approximately 3 **minutes to address the subject of** As, Mg, Fe WQS Rulemaking

☑ **Check here if you wish to be added to the mailing list about this subject. Be sure your complete mailing address is listed above.**

DEQ\WQ\PPPD\WC15\WC15620.doc (4/00)

Water Quality Standards

Oregon Department of Environmental Quality
Public Hearing Attendance Form

DEQ

For: Public Hearing Date: Sept. 23, 2010

	Name	Representing	Mailing Address
46.	Robin Harris	CTUIR	robinharris@ctuir.org
47.	MaryLou Soscia	EPA	
48.	Anthony Barber	EPA	barber.anthony@epa.gov
49.	Kathryn Vanlutto	NWPPA	
50.	Rick George	CTUIR	
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Water Quality Standards Review and Recommendations: Arsenic

State of Oregon Department of Environmental Quality

Attachment E
April 21-22, 2011, EQC meeting

By: Debra Sturdevant, DEQ Water Quality Standards Program
DRAFT: April 4, 2011.

This report prepared by:

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State of Oregon Department of Environmental Quality

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Executive Summary

The Department of Environmental Quality (DEQ) is proposing to revise Oregon's human health water quality criteria for arsenic as shown in Table 1 below. This issue paper contains discussion of the proposed criteria, the scientific basis and rationale for the proposed revisions and the process DEQ used to review these criteria.

Table 1. Proposed Human Health Water Quality Criteria for Inorganic Arsenic (µg/l)

Water body type	Water + Fish Ingestion		Fish Consumption Only	
	Current Criteria	Proposed Criteria	Current Criteria	Proposed Criteria
Freshwater	0.0022	2.1	0.0175	2.1
Saltwater	NA	NA	0.0175	1.0

Notes:
1) Current criteria are from Table 20 (OAR 340-041-0033).
2) All proposed criteria are based on a fish consumption rate of 175 g/d.

Recommendations:

1. Establish separate human health "fish consumption" criteria for freshwater and saltwater because marine shellfish (oysters) have much higher bioconcentration rates for arsenic than freshwater finfish.

2. Revise the freshwater criterion for "water + fish ingestion" to 2.1 µg/l as inorganic arsenic.
- This criterion is calculated using a bioconcentration factor (BCF) of 14 L/kg, which is the geometric mean of the available freshwater fish bioconcentration data.
- The bioconcentration factor is based on three studies; two for trout and one for bluegill. DEQ used all three studies in selecting the bioconcentration factor because the fish consumption rate also includes a combination of species.
- These bioconcentration studies were conducted at relatively low water concentrations of arsenic (below 50µg/l). DEQ did not use studies conducted at higher concentrations (i.e. greater than 50 up to 1000µg/l), since the results are not reflective of arsenic concentrations in Oregon surface waters, which range from less than 0.5 to 16 µg/l.
- This criterion represents a 1 in 10,000 (i.e. 1×10^{-4}) risk level and is within the acceptable risk ranges established by the federal Environmental Protection Agency.

3. Revise the freshwater criterion for "fish consumption only" to 2.1 µg/l as inorganic arsenic.
   - DEQ recommends using the same value for "fish consumption only" and "water + fish consumption" as a statewide criterion.
   - DEQ evaluated a "fish consumption only" criterion using a bioconcentration factor of 14 L/kg and a risk level of10^{-5}, which resulted in a value of 1.9 µg/l. Using this value would result in a criterion to protect eating fish that is more conservative than the criterion to protect both eating fish and drinking water.
   - A "fish consumption only" criterion of 2.1 µg/l is consistent with the "water + fish ingestion criterion" and is protective at a risk rate only slightly greater than 10^{-5}, which is within the acceptable risk range established by EPA.
   - DEQ also recommends establishing site specific criteria based on natural conditions in the future for waterbodies where information demonstrates that the arsenic concentration in the water body due to natural sources is greater than 2.1 µg/l.

4. Adopt a "fish consumption only" saltwater criterion of 1µg/l as inorganic arsenic.
   - This criterion represents a 1 to 1.3 in 100,000 (i.e. 1 to 1.3 $\times 10^{-5}$) risk level, which is within the acceptable risk ranges established by EPA.
   - The separate arsenic saltwater criterion incorporates the marine shellfish bioconcentration factor data.
   - Use multiple lines of evidence to establish a saltwater criterion. One approach uses the geometric mean of the available freshwater and saltwater bioconcentration factor data to calculate a saltwater criterion, recognizing that the amount of data representing the variety of saltwater species are very limited. Because this approach is based on assumptions regarding the applicability of the freshwater bioconcentration factor data to saltwater finfish species, DEQ also conducted an analysis based on the higher oyster bioconcentration factor combined with a lower inorganic arsenic proportion factor. Finally, DEQ also evaluated these results against natural ocean arsenic concentrations cited in the scientific literature, which are approximately 1.7 to 2 µg/l total arsenic and 1µg/l inorganic arsenic.
   - The 'water + fish ingestion" criterion does not apply to saltwater because saltwater is not used for drinking water (domestic water) supply.

Background

DEQ derived the proposed arsenic criteria using EPA's calculation method. However, DEQ adapted the calculation for Oregon by using locally appropriate values rather than national default values for specific variables. All the proposed criteria are based on a fish consumption rate of 175 grams per day. The risk level used for each proposed criterion varies as follows: the water + fish ingestion criterion is based on a cancer risk level of 10^{-4}, the freshwater fish consumption only criterion, which is the same value, represents a risk level slightly higher than 10^{-5}, and the saltwater fish consumption only criterion is based on a risk level of 10^{-5}. In addition, the proposed arsenic criteria use bioconcentration factors of 14 and 26 for the freshwater and saltwater criteria, respectively, and a 10 percent inorganic arsenic factor. An alternate calculation for saltwater is also conducted using a bioconcentration factor of 350 and an inorganic proportion of 1 percent. Further explanation of these variables and the criteria calculations is provided in section 5 of this paper.

DEQ proposes adopting locally derived criteria rather than EPA's nationally recommended criteria values because the natural background levels of arsenic in many Oregon waters are much higher than the national criteria. Naturally-occurring arsenic in Oregon comes from geologic sources and levels are often higher in ground water than in surface waters. DEQ's proposed criteria for inorganic arsenic are consistent with EPA recommendations. While inorganic arsenic is the form of arsenic that is toxic to humans, it does not bio-accumulate in fish tissue as readily

as total arsenic. While DEQ's proposed water + fish ingestion value is significantly higher than EPA's recommended criteria under the Clean Water Act (CWA), it is lower than the maximum contaminant level established by EPA as protective of finished drinking water under the Safe Drinking Water Act.

DEQ concludes that the proposed criteria represent an appropriate balance of human health protection and recognition that many Oregon waters contain arsenic from natural geologic sources, commonly at levels of 1-3 µg/l, and in some water bodies significantly higher. These natural levels do not represent new or added health risk to the environment. Setting criteria that would trigger widespread identification of Oregon waters as impaired for arsenic, the subsequent development of total maximum daily loads and other Clean Water Act implementation activities would incur large costs for actions that would rarely result in reducing arsenic levels in the water or in fish. Similarly, establishing an arsenic criteria for saltwater below the natural levels of unpolluted coastal and ocean waters would suggest that it is not safe to eat fish from those waters, which is not a conclusion supported by the scientific literature.

DEQ proposes to include an arsenic reduction policy in the state's water quality regulations. This rule establishes a policy to reduce human sources of arsenic that are likely to impact a public drinking water supply and includes requirements for industrial permittees to evaluate data and develop arsenic reduction plans. This provision would apply in instances where the ambient arsenic level is below the numeric criteria in order to minimize the amount of arsenic added to surface waters from human sources.

Chapter 1. Introduction and Background

The Oregon Department of Environmental Quality (DEQ) reviewed the science behind the human health water quality criteria for some of the naturally occurring earth metals in response to concerns expressed to the Oregon Environmental Quality Commission (EQC) at their October 2008 meeting. Arsenic, iron and manganese are the three metals that DEQ selected to review in more detail. These three earth metals are naturally occurring and are found in Oregon waters at natural background levels greater than the current human health criteria. There are 107 water body segments listed as impaired for these three metals on the 2004/06 303(d) list. In addition, stakeholders point out that the arsenic criteria under the Clean Water Act are much more stringent than the maximum contaminant level for drinking water established under the Safe Drinking Water Act.

At the October 2008 meeting, the EQC directed DEQ to revise Oregon's human health criteria for toxic pollutants based on the recommended increased fish consumption rate of 175 grams per day. DEQ is in the process of conducting that rulemaking. DEQ adopted revisions to the iron and manganese criteria in December 2010 and is now proposing revisions to the arsenic criteria in advance of the full human health criteria rulemaking for several reasons. First, the timeframe for the larger package targets EQC adoption in mid-2011 and the revised criteria associated with that rulemaking will not likely be effective until late 2011 at the earliest, possibly not until mid-2012 or later. Second, the scientific review and early stakeholder review of these revisions are complete and the proposal is ready for adoption. Third, the changes are significant for several NPDES permits that will be renewed over the next year to 18 months. And lastly, 22 stream segments are listed for arsenic. If the proposed revisions are adopted by the EQC in late 2010 or early 2011, they should be effective for use in the 2012 water quality assessment. This will help DEQ to target its resources and those of dischargers to address priority environmental improvements.

Chapter 2. Arsenic Human Health Criteria Review and Recommendations

Section 2.1. Concerns about Oregon's Human Health Criteria for Arsenic

DEQ reviewed the science behind the human health water quality criteria for arsenic in response to several concerns, which were expressed to the Oregon Environmental Quality Commission at the October 2008 meeting. First, arsenic is a naturally occurring earth metal found in Oregon waters at natural background levels much greater than the current human health criteria. Second, the human health water quality criteria for arsenic that currently apply in surface waters under the Clean Water Act are much lower than the maximum contaminant level (MCL) developed under the Safe Drinking Water Act for finished drinking water delivered to people's homes.

DEQ's current arsenic criteria are shown in Table 3 and described below. Having arsenic criteria that are well below widespread natural background levels of the pollutant presents several problems for the state and for cities and industries that discharge to waters of the state. First, this situation has resulted in 303(d) listings of water bodies as impaired (currently 22 segments) and DEQ expects many more will be identified as more data are collected, even though the arsenic levels are predominantly due to natural geologic sources. DEQ must then address the listings by developing a total maximum daily load (TMDL) or providing an explanation or plan for situations where the source of arsenic is natural and cannot be controlled. This is not a meaningful use of public resources.

Another result of a water body being listed as "impaired" or having a background pollutant concentration above the water quality criterion is that there is no assimilative capacity or mixing available to cities and industries that discharge to the water body. Therefore, the facility must meet the water quality criterion at the "end-of-pipe," prior to discharging into the river. DEQ expects that under the current arsenic criteria or new criteria based on changing only the fish consumption rate, many municipal wastewater treatment plants and a number of industrial facilities would not be able to meet their resultant permit limits. In some cases, a facility would not be able to discharge the same amount of arsenic they brought into the facility from the river via their intake water. Even if the facility adds no arsenic to its wastewater, if it concentrates the arsenic, which occurs, for example, when the water is used for non-contact cooling, the facility would not be able to achieve the effluent quality necessary to meet the receiving water's arsenic criteria.

While DEQ's standards contain a "natural condition" provision, EPA has stated that this type of provision should not apply to human health criteria. The criteria need to protect the uses, which are fishing (i.e. fish consumption) and domestic water supply. For aquatic life, natural conditions are reasoned to support native aquatic species which have acclimated or adapted to the natural conditions. This same reasoning does not necessarily hold true for humans at the risk levels and life span targeted for human health protection. Therefore, if DEQ proposes to set human health criteria based on natural background levels, DEQ must demonstrate that those levels are protective of human health.

Another concern that has been expressed to DEQ is the fact that the current arsenic criteria and any revised criteria that would based only on an increased fish consumption rate are significantly

lower than the maximum contaminant level (MCL). The MCL is the regulatory limit set under the Safe Drinking Water Act to protect public drinking water supplies and applies to finished drinking water delivered to people's homes.

For these reasons, DEQ pursued development of revised arsenic criteria with the objective of protecting human health along with the ability to use waters with natural levels of arsenic for domestic water supply where those arsenic levels do not present an unacceptable human health risk. DEQ also recognized the considerable costs associated with meeting requirements based on the current criteria.

Section 2.2. Arsenic in Oregon

Background Levels. Based on the available data, most Oregon waters have natural background levels of arsenic in the range of less than 1 microgram per liter (µg/l) up to 3 µg/l. There are limited data available on arsenic concentrations in surface waters, partly because until recently DEQ used 5.0 µg/l as the laboratory method quantitation limit. Therefore, much of the data collected by DEQ or permittees report "non-detectable" levels of arsenic. In 2008, DEQ reduced the quantitation limit for arsenic to 0.5 µg/l.

DEQ data from approximately 1979-1981 indicate that much higher arsenic levels (greater than 5-10 µg/l) may be present in some south central and southeastern Oregon basins. More recent data also show a range of arsenic levels of less than 1 µg/l to greater than 10 µg/l in upper Klamath basin streams. It is not known whether these levels represent solely natural geologic sources or are elevated due to anthropogenic activity. Some of the samples, which were taken from spring fed creeks and locations upstream of human activity, clearly measured natural levels.

Natural Sources. There are natural geologic sources of arsenic in Oregon. The City of Portland has found arsenic levels in the Bull Run reservoir, a primary source of Portland's drinking water that is upstream of human activity in a protected watershed, ranging from less than 1 µg/l (their minimum reporting level) up to 3 µg/l. Data from other Oregon streams show arsenic levels in this range as well, including the Crooked River upstream of Prineville, the Little Deschutes River and some streams in the upper Klamath basin. A spring in the upper Klamath basin had an arsenic concentration of 16 µg/l (Newton Consultants Inc., for City of Klamath Falls, 2008). Samples from the upper Santiam basin were mostly below the 0.5 µg/l detection level.

A 1998 U.S. Geological Survey report on arsenic concentrations in ground water of the Willamette Basin found concentrations ranging from less than 1 to 2,000 µg/l. The report concludes:

1. Regional patterns of arsenic occurrence in the Willamette Basin indicate that the sources of arsenic in ground water are not human related. Arsenic-containing metal oxides, volcanic glass in volcanic rocks of rhyolitic to intermediate composition, and clays are likely sources.
2. High arsenic concentrations (concentrations exceeding the current MCL established by EPA) appear to be associated with particular associations of rock in some areas and with alluvial deposits in others (i.e. the Tualatin basin). (paraphrased)
3. For alluvial ground water of the Tualatin Basin, (1) presence of competing anions and (2) occurrence of reducing conditions may be important controlling factors in arsenic adsorption/desorption reactions. Dissolution of iron oxides, with subsequent release of adsorbed and (or) co-precipitated arsenic, also may play an important role in arsenic mobility in ground water of the Tualatin Basin.

A 1998 arsenic study by the Washington Department of Ecology (Ecology), that included data collection from the Columbia River, reported:

> the recent data suggest that total recoverable arsenic concentrations in local rivers and streams are typically in the range of 0.2 - 1.0 µg/L, while concentrations greater than 2 to 5 µg/L may indicate contamination from anthropogenic sources. Arsenic levels in most 303(d) listed waterbodies are not clearly different from waterbodies that have no apparent sources, and some are comparable to rainwater. (Results and Recommendations from Monitoring Arsenic Levels in 303(d) Listed Rivers in Washington, WDOE, 2002)

Human Sources. A document titled *Toxicological Profile for Arsenic* (ATSDR, 2007) describes the various means by which people have affected the fate and transport of arsenic in the environment, including the following:

- When ores that contain copper or lead are heated in smelters, "most of the arsenic goes up the stack and enters the air as a fine dust. Smelters may collect this dust and take out the arsenic as a compound called arsenic trioxide (As2O3)."
- Presently, about 90% of all arsenic produced is used as a preservative for wood to make it resistant to rotting and decay. The preservative is copper chromated arsenate (CCA) and the treated wood is referred to as "pressure-treated." In 2003, U.S. manufacturers of wood preservatives containing arsenic began a voluntary transition from CCA to other wood preservatives that do not contain arsenic in wood products for certain residential uses, such as play structures, picnic tables, decks, fencing, and boardwalks. This phase out was completed on December 31, 2003; however, wood treated prior to this date could still be used and existing structures made with CCA-treated wood would not be affected. CCA-treated wood products continue to be used in industrial applications. It is not known whether, or to what extent, CCA-treated wood products may contribute to exposure of people to arsenic.
- In the past, inorganic arsenic compounds were predominantly used as pesticides, primarily on cotton fields and in orchards. Inorganic arsenic compounds can no longer be used in agriculture. However, organic arsenic compounds, namely cacodylic acid, disodium methylarsenate (DSMA), and monosodium methylarsenate (MSMA), are still used as pesticides, principally on cotton. Some organic arsenic compounds are used as additives in animal feed.
- Small quantities of elemental arsenic are added to other metals to form metal mixtures or alloys with improved properties. The greatest use of arsenic in alloys is in lead-acid batteries for automobiles.
- Another important use of arsenic compounds is in semiconductors and light-emitting diodes. (ATSDR, 2007)

Arsenic Impaired Waters. The streams shown in the table below are currently 303(d) listed for exceeding arsenic criteria. There are 107 water body segments listed for arsenic, which is 43% of the 249 stream segments on the 2004/06 303d list for a toxic pollutant.

Basin	River	River Miles	Year listed
Multi	Columbia	0-142	1998
Willamette	Willamette	175 – 186	2002
Upper Willamette	A-3 drain	---	2002
Upper Willamette	Amazon Cr.	0-23	2002
Upper Willamette	Willow Cr.	0-3	2002
North Umpqua	N. Umpqua	35-52	2002

North Umpqua	Sutherlin Cr.	0-16	2002
North Umpqua	Unnamed Cr.	---	2002
South Umpqua	Middle Cr.	0-13	2004
South Umpqua	S. Umpqua R.	0-16	2002
Warner Lakes	Twentymile Cr.	0-29	2002
Owyhee	Owyhee River	71-200	2004
Jordan	Jordan Cr	0-95	2004
Mid Col-Hood	Lenz Cr	0-1.5	2004
Mid Col-Hood	Neal Cr.	0-6	2004
Molalla-Pudding	Zollner Cr	0-8	2004

Section 2.3. Potential Health Impacts of Arsenic

Arsenic is a known carcinogen that may cause cancer in skin or internal organs such as the liver, kidneys, lungs and bladder. Other potential health impacts from arsenic include cardiovascular, kidney, central nervous system and hyper pigmentation or keratosis effects (USEPA, 2000). Factors for how to represent these effects in the criteria equations are included in EPA's Integrated Risk Information system (IRIS) database. The EPA recommended arsenic criteria are based on a cancer endpoint and are based on inorganic arsenic.

Section 2.4. Current Human Health Criteria for Arsenic: State and Federal

The current Oregon and EPA arsenic criteria are shown in the table below.

Table 3. Current Arsenic Criteria

	Water and fish ingestion (µg/L)	Fish consumption only (µg/L)
Currently effective Oregon criteria (Table 20)	0.0022	0.0175
Criteria adopted by Oregon in 2004	0.018*	0.14*
Current EPA criteria	0.018*	0.14*

* Inorganic arsenic

Oregon's currently effective criteria (OAR 340-041-0033, Table 20) are based on EPA's 1986 recommended criteria and are based on a fish consumption rate of 6.5 g/d. Table 20 does not specify whether the human health criteria are for inorganic arsenic or total arsenic. The toxicity data EPA used to calculate the 1986 recommended criteria were for inorganic arsenic.

EPA's current arsenic criteria for human health and the criteria adopted by the EQC in 2004 are based on a fish consumption rate of 6.5 g/d and a cancer slope factor of 1.75, and are specifically identified as criteria for inorganic arsenic. In 1992, EPA promulgated these arsenic criteria in the National Toxics Rule (USEPA, 1992). Although EPA has since changed the cancer slope factor in its IRIS database to 1.5 (4/10/1998) and changed its recommended fish consumption rate to 17.5 (EPA, 2000), it has not revised the nationally recommended arsenic criteria accordingly. EPA is currently reviewing the cancer slope factor and has released an increased IRIS value for comment.

EPA did not promulgate human health criteria for arsenic in the California Toxics Rule (CTR) in 2000, stating that "a number of issues and uncertainties existed at the time of the CTR proposal

concerning the health effects of arsenic." Neither did EPA include arsenic criteria in its promulgation of criteria for the Great Lakes states in 1995.

Other states have human health arsenic criteria ranging from a low of the current federal criteria to a high of 50 µg/l. Almost half of the states have criteria of 10 or 50 µg/l based on the current or previous Safe Drinking Water Act maximum contaminant level (MCL). About 10 states do not have a "water & organism" arsenic criterion and several do not have a "fish consumption only" criterion. A few states have recalculated their arsenic criteria using EPA equations but altering some of the variables in those equations. The variables states have revised include the bioconcentration factor (BCF), the EPA cancer slope factor (using the current IRIS value of 1.5), the fish consumption rate, and/or the risk level (using 10^{-5} rather than 10^{-6}). In addition, some states have applied an inorganic proportion to the calculation since the criteria apply to inorganic arsenic.

How the Federal Arsenic Criteria Were Calculated. The following two equations and accompanying table describe the variables that were used to calculate EPA's current national human health criteria for arsenic.

$$\text{Water + fish ingestion Criterion (µg/L)} = 1000 \times \frac{RF \times BW}{q1^*[DW + (BCF \times FCR)]}$$

$$\text{Org Only Criterion (µg/L)} = 1000 \times \frac{RF \times BW}{q1^*[BCF \times FCR]}$$

Table 4. Variables for Calculating Arsenic Criteria

Symbol	Description	Value Used for Federal Criteria	Value Used for Oregon Freshwater Criteria	Value Used for Oregon Saltwater Criteria
RF =	risk level factor (dimensionless)	$1x10^{-6}$	fish only $1.1x10^{-5}$ water + fish $1x10^{-4}$	fish only $1x10^{-5}$
BW =	body weight (kg)	70	70	70
q1* =	cancer potency factor (mg/kg/day)-1	1.75	1.5[a]	1.5[a]
DW =	Drinking water consumption (L/day)	2	2	2
BCF =	bioconcentration factor (L/kg)	44	14	26
FCR =	fish consumption rate (**kg**/day)	0.0065	0.175	0.175
IF =	Inorganic proportion factor	No factor	10%	10%

[a] The current cancer potency factor published by EPA in their IRIS data base.

Section 2.5. DEQ Proposed Revised Arsenic Criteria

DEQ proposes to adopt separate criteria for Oregon freshwater and saltwater due to the apparent differences in bioconcentration and arsenic species and transformations in the marine environment. DEQ proposes to revise the arsenic criteria for freshwater using EPA's calculation method, substituting values in the criteria equation that have been updated or are more appropriate for Oregon. The proposed criteria are shown in Table 5. DEQ concludes that the proposed criteria protect human health while recognizing that Oregon has widespread natural background levels of arsenic higher than EPA's recommended criteria. DEQ's Toxics Standards Review Rulemaking Workgroup, a group of stakeholders that provided input to DEQ on this

rulemaking, supported revising the arsenic criteria based on Oregon appropriate variables and a higher risk level because of the natural background levels of arsenic found in Oregon waters.

Table 5. Proposed Arsenic Criteria (as inorganic arsenic)			
	Water + fish ingestion	**Fish consumption only: freshwater**	**Fish consumption only: saltwater**
Proposed Criterion	2.1 µg/l	2.1 µg/l	1.0 µg/l
Values used to calculate criteria	FCR=175 BCF=14 IF=10% CSF=1.5 Risk level=$1x10^{-4}$	FCR=175 BCF=14 IF=10% CSF=1.5 Risk level=$1.1x10^{-5}$	FCR=175 BCF=26 IF=10% CSF=1.5 Risk level=$1x10^{-5}$

The Oregon specific variables, shown in Tables 4 and 5 above and discussed in more detail below, include the fish consumption rate (FCR), the bioconcentration factor (BCF), a percent inorganic arsenic factor (IF) and the risk level. In addition, DEQ uses the current IRIS cancer slope factor of 1.5.

Section 2.5.1 Inorganic Arsenic Criteria for Freshwaters

The proposed inorganic arsenic criteria, shown in Table 5, are based on a fish consumption rate of 175 grams/day, a bioconcentration factor of 14, an inorganic proportion of 10% and a risk level of about one in 100,000 (1×1^{-5}). DEQ's rational and supporting information for these variables is discussed here.

Fish Consumption Rate. DEQ calculated the proposed criteria using 175 g/d as the fish consumption rate (DEQ, 2008a). The current federal arsenic criteria are based on a consumption rate of 6.5 g/d. Using this higher rate is responsive to EPA's disapproval of Oregon's 2004 human health criteria which was based on their conclusion that criteria based on 17.5 g/d is not sufficient to protect fish consumers in Oregon.

In advance of EPA's action and based on earlier concerns expressed by EPA on this issue, DEQ looked at multiple studies of fish consumption rates with the assistance of experts in toxicology and public health (the Human Health Focus Group), focusing on five studies conducted in Oregon and Washington as well as the national survey used by EPA. The rate of 175 g/d represents the 90^{th} to 95^{th} percentile of Oregon fish consumers as indicated by these studies (DEQ, 2008b). This value represents the total amount of fish consumed, regardless of species or origin, because it was found that different populations, depending on access and culture, will eat different species of fish. As a result, DEQ, with the support of the Confederated Tribes of the Umatilla Indian Reservation and EPA Region 10, selected 175 g/day as an appropriate value to use for the calculation of human health criteria.

Risk Level. When EPA develops recommended human health criteria for carcinogens, it uses a cancer risk level of 10^{-6}, one in one million additional incidents of cancer, which it characterizes as an appropriate level of risk for the general population. However, EPA guidance allows that risk levels of 10^{-6} or 10^{-5} are acceptable for the general population and that highly exposed populations should not exceed10^{-4}. Within this range, the risk level is a policy decision for States to make when they establish water quality criteria. To date, DEQ has used the 10^{-6} risk factor for water quality human health criteria and in other environmental protection programs that are based

on human health risk, such as the clean-up of contaminated sites. DEQ is not re-evaluating the risk level used for Oregon's human health criteria generally. However, because of the particular fact set associated with arsenic as described throughout this issue paper, DEQ is recommending criteria based on alternate risk levels as shown in Tables 4 and 5 above. The primary reason is because naturally occurring arsenic concentrations in many Oregon waters exceed values based lower risk levels. The risk associated with natural levels of arsenic has been present since people have been drinking water and eating fish from Oregon streams and lakes. Criteria that are exceeded due to natural conditions on a widespread basis around the state may lead to the expenditure of public and private resources to implement Clean Water Act programs that will not result in reduced water concentrations of arsenic. Communities that obtain their water supply from groundwater are likely to be exposed to higher arsenic levels. Groundwater is not regulated by the Clean Water Act and not subject to water quality criteria.

DEQ concludes that using the higher risk levels for the arsenic criteria is supported and consistent with EPA guidance (EPA, 2000) because Oregon used a fish consumption rate and, subsequently, derived criteria which protect highly exposed populations. The Oregon consumption rate of 175 g/d represents the 95^{th} percentile of consumers within the state and protects people who eat fish on a regular basis. This is more inclusive that the rate used in EPA's criteria, which is based on the general per capita population and includes people that do not eat fish, or eat it only occasionally. Moreover, DEQ's consumption rate includes anadromous and marine fish.

As with the freshwater criteria, DEQ used a risk level of 10^{-5} rather than 10^{-6} to calculate the saltwater criterion for two reasons: 1) the criterion is also based on a fish consumption rate of 175 g/d, a high exposure rate, and 2) the presence of naturally occurring arsenic in marine waters (Tanaka, 1995; National Academy of Sciences, 1972; EPA, 2003). See additional discussion of the saltwater criterion and natural arsenic concentrations in seawater in Section 2.5.2 below.

DEQ's proposed criteria balance the objectives of minimizing human health risk and accounting for natural sources of arsenic. Some waterbodies will have natural background levels above the proposed statewide criteria. In these cases, DEQ may pursue site specific water quality standards at a later date.

Bioconcentration. Bioconcentration refers to the uptake and retention of a chemical by an aquatic organism from water. A bioconcentration factor (BCF) is the ratio of the concentration of a substance in the tissue of an aquatic organism to its concentration in the ambient water in situations where the organism is exposed through the water only and the ratio does not change substantially over time.

EPA's current BCF of 44 for arsenic is described in *Ambient Water Quality Criteria for Arsenic* (USEPA, 1980). EPA calculated the BCF using data from two species, the eastern oyster (BCF=350) and bluegill (BCF=4). Because it was based on only two species and one of those is the eastern oyster, which has a much greater BCF (350 versus 4), the BCF of 44 most likely overestimates the health risks associated with freshwater finfish consumption (USEPA Region 6, mid-1990s). In addition, the data sets used to establish the BCFs were relatively small (USEPA, 1980).

A more recent analysis by EPA (EPA Headquarters, personal communication, November 2010) incorporated more recent BCF data for rainbow trout with the prior data for bluegill and oysters to provide Oregon several scientifically defensible BCF options, shown in Table 6 below, for use in setting Oregon's criteria. The BCF options are based on geometric means of data from the following four studies, which include five BCF test values reported. EPA used the first two studies listed to derive the BCF of 44 in the early 1980s; the second two studies are more recent. (see Appendix A for more detail on the results of these studies.

- Ambient Water Quality Criteria for Arsenic (EPA, 1985), which refers to Barrows et al., 1980, Ann Arbor Science Pub., Inc., Ann Arbor MI. pp. 379-392. Whole-body measurement of total arsenic in immature bluegill.
- Ambient Water Quality Criteria for Arsenic (EPA, 1985), which refers to Zaroogian and Hoffman, 1982, Environmental Monitoring and Assessment 1:345-358. BCF value for arsenic eastern oysters.
- McGeachy and Dixon, 1990. Canadian Journal of Fisheries and Aquatic Sciences. 47:2228-2223. Two studies of whole body total arsenic in immature rainbow trout.
- Rankin and Dixon, 1994. Canadian Journal of Fisheries and Aquatic Sciences. 51: 372-380. Whole-body measurement of total arsenic in immature rainbow trout.

Table 6. Bioconcentration Factor (L/kg total arsenic) Options

Species	BCF	# of Studies	Range of values
All freshwater finfish	14	4	4-27
Coldwater fish (trout)	21	3	17-27
Saltwater (eastern oyster)	350	1	350
All freshwater and saltwater species	26	5	4-350

The above studies were selected because they tested species consumed by humans and were conducted with water concentrations below 50µg/l inorganic arsenic. Studies done at higher concentrations (i.e. 100 to 1000 µg/l) were not included. This segregation is appropriate because natural surface waters in Oregon are in the range of less than 0.5 to 16 µg/l. Studies conducted at higher background concentrations would be more appropriate for evaluating contaminated sites. BCFs from studies conducted at lower arsenic water concentrations tend to be higher and vice versa. Fish can bio-regulate arsenic as they do other metals, which are trace nutrients (DeForest et al, 2007). Organisms are able to take in less and eliminate excess when an abundant supply of the metal is available.

All of the values in Table 6 are the result of measuring total arsenic in the whole body rather than fillet or muscle tissue tests. EPA notes that BCFs for muscle tissue, the portion of the fish typically eaten, should be lower than those for the whole body (Stephan, 1993). Azcue and Dixon (1994; IN USEPA, mid 1990s) conducted a study that exemplifies this. The study measured arsenic in rock bass and found the highest concentrations in bone and scales, followed (in decreasing concentration) by intestines and contents, muscle and liver. A BCF of 0.71 was calculated for muscle tissue whereas the BCF based on whole body concentration was 2.3, three times greater than the muscle tissue BCF. Because the data being used by DEQ to derive a BCF value is based on whole-body testing, DEQ's value may be conservative. It is likely that most of the fish consumption captured by Oregon's rate of 175 g/d is muscle tissue rather than whole body. According to EPA's 2000 Human Health Methodology, data for arsenic in edible tissue of fish and shellfish are preferred over whole body data since that is the portion typically ingested.

One approach to deriving a criterion is to follow EPA's past practice when they derived the BCF of 44. Given the limited data, EPA combined the two data points and developed one recommended criterion to apply to all waters. DEQ pursued an alternative approach and developed separate criteria for fresh and salt waters. EPA stated in a 2003 review of arsenic bioaccumulation in aquatic organisms that estuarine and marine data indicate a possible need for deriving separate BAFs for saltwater systems (EPA 2003, p.7). Given that additional freshwater fish BCF data are now available, with values much lower than the BCF for the oyster, and given the presence of naturally occurring arsenic in Oregon waters, DEQ is recommending the adoption of separate arsenic 'fish consumption only' criteria for freshwater and saltwater.

DEQ proposes using a BCF of 14 for arsenic human health criteria that apply to freshwaters of the state. This BCF is the geometric mean of the data from four finfish studies, which tested rainbow trout (three studies in two publications) and bluegill (one study), as shown in Table 6. A summary of the data from these studies is provided in Appendix A. DEQ's proposed criteria are calculated using a fish consumption rate of 175 g/d, which represents a mixture of fish species. Nearly all of the fish consumed from freshwater, will consist of the muscle tissue of finfish. Therefore, DEQ concludes that a BCF of 14 is a reasonable and protective value to use in calculating arsenic criteria for Oregon's freshwaters. Further discussion of the BCF used for the saltwater criterion is provided in section 2.5.2 below.

Inorganic Proportion. Arsenic is present in the environment and in fish tissue in organic and inorganic species. Inorganic arsenic, specifically arsenite (trivalent or As III), is toxic to humans and EPA developed its toxicity data for cancer and other end points based on inorganic arsenic. EPA's recommended human health criteria are for inorganic arsenic, however, the BCF value (44 L/kg) that EPA used in deriving the human health criteria for arsenic are based on total arsenic, not inorganic arsenic. Therefore, some states have also elected to multiply the BCF value by what might be called an "inorganic proportion" factor. For example, the EPA Region 6 Interim Strategy and the State of Colorado use a 30% inorganic variable; Maryland used 4% inorganic in its criteria recalculation.

An EPA (2002) study on fish contaminants in the Columbia River reported the following findings from a TetraTech fish tissue study done in 1996 related to proportion of inorganic arsenic found in fish tissue: (p. 5-78)

- Overall arithmetic average for all composite samples: 6.5%
- Average % inorganic by species ranged from 0.5% in carp to 9.2% in sturgeon
- Anadromous species: about 1.0% on average
- Resident species: about 9% on average

The EPA study also reported that a study of fish tissue in the Willamette River (EVS, 2000) found that an average of 4.2% of the arsenic in carp (whole body) and 3.8 % of the arsenic in bass (fillet) was inorganic arsenic. A risk assessment performed as part of the EPA (2002) study assumed 10% of total arsenic was inorganic for all species.

EPA (2003) states that the consensus in the literature is that approximately 10% of the arsenic found in edible portions of marine fish and shellfish is inorganic arsenic. They also note that because each arsenic species exhibits different toxicities, it may be important to take into account the fraction of total arsenic present in the inorganic and organic forms when estimating the potential risk posed to human health through the consumption of arsenic-contaminated fish and shellfish.

Schoof and Yager (2007) looked at data from 20 studies and found that in freshwater finfish inorganic arsenic was 10% of total arsenic at the 75th percentile of the data, with a mean of 7.2%.

DEQ proposes to use a 10% inorganic arsenic fraction to calculate freshwater criteria based on the Columbia River fish contaminant and health risk assessment study (EPA, 2002) and the other information noted above. Recent recommendations on arsenic bioconcentration from EPA also assumed that 10% of the accumulated arsenic was inorganic (arsenic III and V) (personal communications, EPA Headquarters, Nov. 2010). The criteria that result are shown in Table 5 (recommended criteria) above and Table 6 (options considered) below. DEQ observed that the calculation of the water + fish ingestion criterion is not very sensitive to the % inorganic fraction value. Whether DEQ uses a % inorganic fraction of 1, 10 or 30 does not change the water + fish ingestion criterion value. The % inorganic factor does significantly affect the calculated criterion for the fish consumption only criterion.

To incorporate the inorganic factor (IF) into the calculation, DEQ used the revised equations:

$$\text{Water + fish ingestion Criterion } (\mu g/L) = 1000 \times \frac{RF \times BW}{q1^*[DW + (BCF \times FCR \times \mathbf{IF})]}$$

$$\text{Org Only Criterion } (\mu g/L) = 1000 \times \frac{RF \times BW}{q1^*[BCF \times FCR \times \mathbf{IF}]}$$

Toxicity Factors. DEQ did not review the toxicity data or re-evaluate the cancer slope factor used to derive human health criteria for arsenic. DEQ relies on EPA research to provide toxicity information for its human health criteria. DEQ proposes to use the cancer slope factor in EPA's Integrated Risk Information System (IRIS) data base as of the date of this review, which is $1.5(mg/kg/day)^{-1}$. EPA nationally recommended Clean Water Act criteria have not been updated and continue to be based on a cancer slope factor of $1.75(mg/kg/day)^{-1}$.

Section 2.5.2. Inorganic Arsenic Criteria for Saltwater

As with the freshwater criteria, the policy objective for DEQ's proposed arsenic water quality criterion for saltwater is to protect the ability of people to consume fish and shellfish and to reconcile criteria generated by a calculation method, given the limited data, with the presence of naturally occurring levels of arsenic in marine waters. There are uncertainties in the scientific community's current knowledge of the fate and transformation of various species of arsenic in the saltwater environment and in marine and estuarine species. In addition, some forms of arsenic are toxic to humans and others are not. DEQ evaluated the values resulting from two calculation scenarios against the scientific literature describing naturally occurring marine arsenic levels. DEQ concludes that there does not appear to be an unacceptable human health risk associated with eating fish from an unpolluted marine environment, and as a result, it is not desirable to establish an arsenic water quality criterion for saltwater that is below natural marine levels.

Because of the limited data available to calculate criteria for marine waters, DEQ analyzed potential arsenic criteria by considering natural arsenic levels and arsenic cycling in the marine environment and by using EPA's calculation method to estimate potential arsenic risk in 2 ways. In calculating an arsenic criterion for saltwater, the variables used for fish consumption, risk level and toxicity are the same as discussed above for the freshwater criteria. In the two scenarios, DEQ used different bioconcentration and inorganic portion factors for marine waters as summarize here and discussed further below.

Summary of analyses for inorganic arsenic criterion for saltwater:

Estimate of natural inorganic arsenic in saltwater	1.0 µg/l
Calculated based on BCF 26, inorganic portion 10%	1.0 µg/l
Calculated based on BCF 350, inorganic portion 1%	0.8 µg/l

Using EPA's calculation method with a BCF of 26 and an inorganic factor of 10% yields an inorganic arsenic criterion of 1.0 µg/l. Using the same calculation method with a BCF of 350 and 1% inorganic factor yields an inorganic arsenic criterion of 0.76 at 10^{-5} risk level. Because the BCF of 350 for the eastern oyster is based on whole body and people generally eat the muscle tissue of marine fish, which accumulated less arsenite, it is a conservative value. A criterion of 1.0 µg/l based on a BCF of 350, an inorganic proportion of 1% and a fish consumption rate of 175 g/d, represents a risk level of 1.3×10^{-5}.

Natural ocean levels and complexities in the marine environment. The scientific literature consistently reports natural total arsenic levels of the oceans in the range of 1 to 3 µg/l. (Borak and Hosgood, 2007; EPA, 1976; EPA, 2003; Neff 1997; Tanaka and Santosa, 1995) In a review of arsenic in the marine environment by Neff (1997), the author notes that the concentration of total arsenic in clean coastal and ocean waters is 1 to 3 µg/l with a mean of about 1.7 µg/l. The

dominant form of arsenic in oxygenated marine waters is inorganic arsenic, predominantly arsenate (AsV). The more toxic and potentially carcinogenic arsenite (AsIII) rarely accounts for more than 20% total arsenic in seawater. "In most oxygenated, productive marine ecosystems, arsenite usually represents less than one to no more than about 10-20% of the total arsenic." (Neff, 1997, p. 923)

Tanaka and Santosa provided coastal sea and ocean data for several species of arsenic, including As(V), As(III), total inorganic and total organic. They conclude that in general As(V) is more abundant than As(III), that as much as 50% of the total arsenic in the near shore environment is organic arsenic and that less than 20% of total arsenic is organic in the open ocean. In the northwest Pacific Ocean, average concentrations were 1.1 µg/l inorganic arsenic and 0.1 µg/l organic arsenic. In the southwest Pacific, the concentrations were 1.2 µg/l inorganic and 0.04 µg/l organic arsenic.

Neff (1997) and Tanaka and Santosa (1995) noted that in near shore waters, the concentration of dissolved inorganic arsenic varied seasonally due to biological processes (uptake by phytoplankton). The transformation of arsenic between the metal species also varies based on biological and physical processes.

In a review of seafood arsenic and the implications for human risk, Borak and Hosgood (2007) summarized:

> Based on consideration of anticipated dose and anticipated metabolism, it is likely that seafood arsenic does not contribute significantly to arsenic-associated carcinogenicity. The vast majority of arsenic in finfish and crustaceans is in the forms of arsenobetaine, a compound that is essentially inert, non-toxic and excreted without transformation. (p.209)

DEQ has not measured arsenic in Oregon marine waters. From the information available, it would be reasonable to conclude that inorganic arsenic concentrations in Oregon salt waters are likely to be 1.0 µg/l inorganic arsenic and at 1.5 to 2.0 µg/l total arsenic or higher. Therefore, the proposed inorganic arsenic criterion for saltwater of 1.0 µg/l meets the objective that the water quality criterion not be significantly below naturally present inorganic arsenic concentrations.

Bioconcentration. DEQ proposed for public comment a fish consumption criterion of 1.0 µg/l inorganic arsenic for saltwater that was calculated using a BCF of 26 and an inorganic proportion factor of 10%. This BCF value incorporates the BCF data for the eastern oyster, the only saltwater species data available, and BCF data for freshwater finfish. DEQ's intent was to represent the fact that people eat a mixture of finfish and shellfish from saltwater. However, there is no BCF data available for saltwater finfish. In the absence of this data, DEQ analyzed two scenarios to represent bioconcentration for all marine finfish and shellfish; one uses a combination of all the BCF data available (BCF = 26) and the second uses only the eastern oyster data (1 study BCF value = 350; see Table 6 above). DEQ concluded that it is reasonable to use the combined freshwater finfish (vertebrate) and marine oyster (invertebrate) data to represent the variety of species consumed from saltwater systems in Oregon. Because the BCF values are for whole body tests, they are a conservative representation of consumption of inorganic arsenic from primarily muscle tissue consumption of saltwater finfish. In addition, because the BCF values are for total arsenic, DEQ also applied an inorganic proportion factor. The inorganic portion used for the saltwater criterion is discussed in the next sub-section.

Part of DEQ's hesitation to rely solely on the oyster data to represent the bioconcentration in marine finfish is that the oyster is an invertebrate. In freshwater, scientific literature indicates an apparent difference in bioconcentration between invertebrates and vertebrates. Mean BCFs for freshwater invertebrates (trophic level 2 species) ranged from 2 to 22 L/kg, while for freshwater fish, mean BCFs ranged from 0.048 to 14 L/kg (EPA, 2003). Also, EPA (2003) notes that one

BAF study done for a marine fish species (mullet) showed a BAF of 3.3 wet weight for total arsenic (Lin et al. 2001). This study may have been done at a high water arsenic concentration.

Data from Neff (1997) also indicates a potential difference in total arsenic between bivalves and finfish, but also shows a high degree of variability. Table 1 from the Neff (1997) paper summarizes total arsenic concentrations (µg/g dry weight) in the whole body or muscle tissues of marine organisms, including the following:

	No. Samples	Geometric mean	Range
Bivalves	151	10.44	<0.6 - 214
Fish	156	5.59	0.05-449.5

The highest concentrations of arsenic appear to be present in tissues of marine animals that feed primarily on phytoplankton or macroalgae, including planktonic crustaceans, bivalve mollusks, herbivorous snails and some polychaete worms. (Neff, 1997)

Because there may be a difference in bioconcentration between mollusks (invertebrates) and finfish, and because mollusks represent a small portion of total seafood consumption, relying solely on the oyster BCF data is likely to be overly conservative. Schoof and Yager (2007) provide a summary of seafood consumption in the U.S. population (data from the USEPA, 2002 relying on the 1994-96 and 1998 USDA surveys of food intake) showing that estuarine mollusks (oyster, clam and scallop) comprised about 3 percent and all estuarine and marine mollusks together (oyster, clam, scallop, mussels, squid and octopus) represent about 13 percent of total fish and shellfish consumption.

In a review of information on bioaccumulation of arsenic in aquatic organisms, EPA recognizes that the hypothesis that BAFs based on total arsenic may not represent all freshwater ecosystems, *and especially saltwater ecosystems.* Due to variations in the species of arsenic present in the water and tissues of organisms, this remains an issue requiring further consideration. (EPA, 2003, p. 34)

Schoof and Yager (2007) looked at 20 studies that provided data on total and inorganic arsenic in seafood. They found that mean concentrations of inorganic arsenic were approximately 10 to 20 ng/g wet weight for freshwater, anadromous and marine fish, whereas crustaceans and mollusks had mean inorganic arsenic concentrations of 40 to 50 ng/g. This data indicates that crustaceans and mollusks tend to accumulate more inorganic arsenic than anadromous or marine fish.

Marine animals take up very little inorganic arsenic from seawater but can bioaccumulate organic arsenic from their food. (Neff 1997; Borak 2007). While marine invertebrates and fish may contain high concentrations of arsenic, nearly all the arsenic in the tissues of marine animals is organic, particularly arsenobetaine. (Neff 1977, p.923; Borak and Hosgood 2007) Arsenobetaine, the most abundant organoarsenic compound in seafoods, is not toxic or carcinogenic to mammals. Little of the organoarsenic accumulated by humans from seafood is converted to toxic inorganic arsenite. In addition, arsenobetaine and other organoarsenic compounds are excreted rapidly by mammals, and are not toxic to human consumers of fishery products. Therefore, marine arsenic represents a low risk to human consumers of fishery products.

Neff (1997) suggested that the USEPA "…criterion should be revised to reflect the actual concentrations of total and arsenite arsenic in the ocean and in the tissues of marine organisms consumed by humans." While EPA did revise their recommended arsenic criteria for human health to inorganic arsenic, the BCF data is still for total arsenic.

Inorganic proportion. There is a growing body of literature indicating that while saltwater organisms may contain more total arsenic than freshwater fish, the dominant form in marine species is organic arsenic as opposed to inorganic arsenic. (EPA 2003; Neff 1997; Schoof and Yager 2007; Tanaka and Santosa 1995; TetraTech 1996, IN EPA 2002; Williams et.al. 2006).

Tissues of marine invertebrates and fish contain high concentrations of arsenic, usually in the range of about 1 to 100 µg/g dry weight, most of it in the form of organoarsenic compounds, particularly arsenobetaine. (Neff, 1997)

Inorganic arsenic, found mainly as arsenate and to a much lesser extent as arsenite, is the predominant form of arsenic in seawater but inorganic compounds comprise only a small proportion of the total arsenic in seafood. An analysis of five types of ocean finfish and shrimp found that inorganic arsenic was less than 0.1% of the total arsenic (Schoof et. al., 1999 in Borak and Hosgood, 2007). Other literature has reported values less than 3% and more recently surveys report values less than 1%. (Borak and Hosgood, 2007)

An EPA (2002) study on fish contaminants in the Columbia River summarized the findings of a TetraTech fish tissue study (1996) that found the following related to proportion of inorganic arsenic found in fish tissue: (p. 5-78)

- Overall arithmetic average for all composite samples: 6.5%
- Average % inorganic by species ranged from 0.5% in carp to 9.2% in sturgeon
- Anadromous species: about 1.0% on average
- Resident species: about 9% on average

DEQ notes that the inorganic portion for the anadromous fish (salmon), which spend most of their life and gain most of their growth in marine waters, was lower than the portion in resident, freshwater species. EPA noted that these findings were consistent with the literature, which shows low percentages of inorganic arsenic levels for most saltwater fish species.

EPA (2003) recognized that because each arsenic species exhibits different toxicities, it may be important to take into account the fraction of total arsenic present in the inorganic and organic forms when estimating the potential risk posed to human health through the consumption of arsenic-contaminated fish and shellfish. The document states, "Clearly only a very small percentage of inorganic arsenic exists in the soft tissues of these organisms [marine bivalve mollusks]…," most often less than 1%; the bulk of the arsenic being arsenobetaine. EPA cites several studies. EPA also states that it is increasingly evident that methylation is critical in controlling biological fate and effects of arsenic.

Neff (1997) states,

> *"Inorganic arsenic represents between about 0.5 and 1% of the total arsenic in the edible portions of most marine invertebrates and fish examined to date (Francesconi and Edmonds, 1993). The fraction of total arsenic that is inorganic tends to decrease as the concentration of total arsenic in the tissues increases. Concentrations of inorganic arsenic in the edible portions of marine invertebrates and fish from uncontaminated marine environments generally range from less than 0.001 to about 0.5 µg/g wet weight (Francesconi and Edmonds, 1993). These concentrations are below the MPCs for total arsenic in seafoods set by most countries."* (p. 922)

In marine waters, portions of organic and inorganic arsenic may be influenced by biological activity temperature and other variables. (Neff; Tanaka, 1995). Tanaka shows seasonal variation in the inorganic and organic proportions of total arsenic.

Schoof & Yager, 2007. Authors looked at 20 studies that provided data on total and inorganic arsenic in seafood, noting that a number of recent had become available. Their findings are summarized in the following table.

Inorganic arsenic as a % of total arsenic in seafood measured as ng/g wet weight

	Mean	Range
Freshwater	7.2	0.5-26.6
Anadromous fish	1.1	0.03-3.04
Marine fish	1.0	0.001-6.9
Crustaceans	1.3	0.001-7.3
Mollusks	1.8	0.04-6.5

DEQ concludes that the above information supports using an inorganic proportion of 1% to calculate an inorganic criterion for saltwater based on the oyster BCF of 350. The results of this calculation are shown at the beginning of this section.

Section 2.6. Options Considered for Revising the Arsenic Criteria

DEQ initially considered three primary alternatives for deriving arsenic criteria as an alternative to EPA's current recommended criteria:

1. Re-calculation of the federal criteria using Oregon appropriate variables,
2. Use of the MCL value for drinking water in some manner, and a
3. Natural background based approach.

Table 7 shows the possible criteria values under these three approaches.

Table 7. Arsenic Criteria Options Considered
(µg/l, inorganic arsenic)

Approach	Estimated Water + fish ingestion (freshwater only)	Estimated Fish consumption only
OR recalculation: BCF=14, FCR=175, % inorganic=10, CSF=1.5, risk=$1x10^{-6}$	0.021	0.19 for freshwater
OR recalculation: BCF=14, FCR=175, % inorganic=10, CSF=1.5, risk=$1x10^{-4}$	2.1	19 for freshwater
OR recalculation: BCF=26, FCR=175, % inorganic=10, CSF=1.5, risk=$1x10^{-5}$	Not applicable	1.0 for saltwater
OR recalculation: BCF=350, FCR=175, % inorganic=1, CSF=1.5, risk=$1x10^{-5}$	Not applicable	0.8 for saltwater
OR recalculation: BCF=350, FCR=175, % inorganic=1, CSF=1.5, risk=$1.3x10^{-5}$	Not applicable	1.0 for saltwater
Use the water + fish value for both freshwater criteria	2.1	2.1
MCL fraction: MCL × 0.25	2.5	2.5
Statewide default natural background for freshwater	1-3 total arsenic	1-3 total arsenic
Natural background for saltwater	Not applicable	2 total arsenic 1 inorganic arsenic

Notes: 1. MCL = 10 µg/l total arsenic. 2. HHC will be for inorganic arsenic.
3. The current IRIS CSF is $1.5(mg/kg/day)^{-1}$.

Option 1: Re-calculated Criteria using Oregon Appropriate Variables. Option 1 is Oregon's proposed approach, as discussed in the preceding sections and shown in Table 5. DEQ concludes that by using EPA's calculation formulas with locally appropriate values, this option provides a rationale for deriving criteria that is scientifically defensible and can be clearly explained to the public.

DEQ's initial proposal was based on limited data and followed a recalculation method that had been used by other states and described by one EPA Regional office. DEQ received comment that the bioconcentration factor (1) used in that recalculation was not supportable for Oregon. In considering the comment and relooking at the information, DEQ decided that the BCF of 1 was indeed too low for Oregon and not supported by the currently available literature.

DEQ is proposing separate fish consumption only criterion for saltwater, as discussed in the preceding section. Bioconcentration is much greater in marine mollusks than freshwater finfish and therefore a different BCF is appropriate. As with the freshwater criteria, DEQ used a higher risk level (10^{-5} rather than 10^{-6}) to calculate the fish consumption only saltwater criterion because 1) the fish consumption rate represents high exposure, and 2) arsenic occurs in marine waters due to natural sources (Tanaka, 1995; National Academy of Sciences, 1972; EPA, 2003).

Option 2: Use a Fraction of the Maximum Contaminant Level from the Safe Drinking Water Act to Derive Oregon's Arsenic Criteria.

The second approach DEQ considered was to use a combination of the maximum contaminant level (MCL) for drinking water and the EPA criteria calculation method to represent exposure through fish tissue. Nearly half of the states have utilized the MCL value of 10 for their arsenic criterion in place of EPA's national criteria recommendations. DEQ believes that using a fraction of the MCL (10) as the water quality criteria is preferable over adoption of the MCL due to the additional exposure to arsenic through consumption of fish tissue.

An MCL is the maximum level of a contaminant allowed in drinking water delivered to the tap (post treatment). MCLs are enforceable standards developed by EPA under the Safe Drinking Water Act. MCLs are set as close to maximum contaminant level goals (MCLGs) as feasible using the best available treatment technology and taking cost into consideration. MCLGs are non-enforceable public health goals that describe the level of a contaminant in drinking water below which there is no known or expected risk to health and allow for a margin of safety. For all carcinogens, MCLGs are set to zero. On January 22, 2001, EPA revised its maximum contaminant level (MCL) for arsenic from 50 to 10 µg/L, and established a date of January 23, 2006, for all public water supply systems to achieve compliance with the revised MCL.

Option 3: Natural Background

Under this approach based, DEQ would establish a "default" statewide natural background level using the best currently available information on natural background levels of arsenic in the State. The human health criteria for arsenic would then be set at that level. This would prevent widespread identification of waters as "impaired" due to natural sources. This approach could reasonably lead to a water + fish ingestion criterion of 1to 3µg/l. This criterion would be well below the drinking water MCL of 10 µg/l, and is near the 2.1 µg/l value calculated to protect fish consumption at a consumption rate of 175 g/d and a risk level of 1×10^{-4}.

A variation on this approach would be to add to the default natural background level, a *de minimis* or insignificant increment for assimilative capacity, making the criterion slightly higher (for example, 1.5 to 2.5). The purpose of setting the criteria slightly above natural background would be to provide some assimilative capacity for mixing in localized areas. This would allow some discharge of arsenic at concentrations that have been increased due to evaporative cooling, for example, which can occur even if there has been no addition of mass. The discharge would be required to meet the criteria at the edge of an assigned mixing zone.

A natural background option for saltwater would lead to a criterion of approximately 2µg/l total arsenic or 1µg/l inorganic arsenic. Natural background levels for saltwater are discussed in section 2.5.2 above.

While DEQ did not base its criteria on natural background levels, it was part of our policy objective to account for natural arsenic levels as we selected arsenic criteria, particularly for the organism only criteria established to protect the consumption of fish from Oregon waters. We cannot control natural sources of arsenic and the health risks are not sufficiently high to suggest that people should not eat fish from Oregon streams or coastal waters.

Additional Considerations

The following additional alternatives could be used for specific water bodies or regions and combined with the three statewide options discussed above. These options are available regardless of what statewide criteria are adopted.

1. Where natural conditions exceed the revised arsenic criteria, DEQ may find it appropriate to develop site specific criteria.
2. Apply the fish consumption only criterion where public domestic water supply is not a designated use and revise beneficial uses in a follow up rulemaking to more narrowly designate water bodies considered suitable for drinking water supply.

Chapter 3. DEQ's Proposed Arsenic Reduction Policy

DEQ proposes to adopt the following arsenic reduction policy into its water quality standards in addition to the numeric criteria discussed in Chapter 2 above. The goal of this provision is to ensure that Oregon's proposed numeric water + fish ingestion criterion for arsenic, which is intended to account for natural conditions, does not unintentionally allow preventable human health risk due to anthropogenic loading of arsenic from existing or new sources.

DEQ is proposing revised numeric arsenic criteria of 2.1 µg/l for both the fish + water ingestion and fish consumption only criteria for freshwater and a fish ingestion criterion of 1.0 for saltwater. While these proposed numeric criteria protect human health at an acceptable level given the presence of natural sources of arsenic in the state, it is the state's policy to maintain the lowest added human health risk from anthropogenic sources of inorganic arsenic practicable, even when ambient inorganic arsenic concentrations are below the numeric criteria. This policy is targeted to dischargers that add inorganic arsenic to Oregon waters and have the potential, due to their location, to impact a public drinking water supply.

The proposed criteria are based on a fish consumption rate of 175 g/day, which is protective of Oregon fish consumers and risk levels that are considered acceptable and protective. However, the criteria and especially the fish + water criterion are based on a higher risk level than Oregon uses for the rest of its human health criteria (10^{-6}). Due to concerns about drinking water exposure, the approach proposed below is targeted to address sources that impact drinking water supplies.

Section 3.1. Proposed Rule Language:

(4) Arsenic Reduction Policy: The inorganic arsenic criterion for the protection of human health from the combined consumption of organisms and drinking water is 2.1 micrograms per liter. While this criterion is protective of human health and more stringent than the federal maximum contaminant level (MCL) for arsenic in drinking water, which is 10 micrograms per liter, it nonetheless is based on a higher risk level than the Commission has used to establish other human health criteria. This higher risk level recognizes that much of the risk is due to naturally high levels of inorganic arsenic in Oregon's waterbodies. In order to maintain the lowest human health risk from inorganic arsenic in drinking water, the Commission has determined that it is appropriate to adopt the following policy to limit the human contribution to that risk.

(a) The arsenic reduction policy established by this rule section does not become applicable for purposes of ORS chapter 468B or the federal Clean Water Act unless and until the numeric arsenic criteria established by this rule are approved by EPA pursuant to 40 CFR 131.21 (4/27/2000).

(b) It is the policy of the Commission that the addition of inorganic arsenic from new or existing anthropogenic sources to waters of the state within a surface water drinking water protection area be reduced the maximum amount feasible. The requirements of this rule section [OAR 340-041-0033(4)] apply to sources that discharge to surface waters of the state with an ambient inorganic arsenic concentration equal to or lower than the applicable numeric inorganic arsenic criteria for the protection of human health.

(c) The following definitions apply to this section [OAR 340-041-0033(4)]:

(A) "Add inorganic arsenic" means to discharge a net mass of inorganic arsenic from a point source (the mass of inorganic arsenic discharged minus the mass of inorganic arsenic taken into the facility from a surface water source).

(B) A "surface water drinking water protection area," for the purpose of this section, means an area delineated as such by DEQ under the source water assessment program of the federal Safe Drinking Water Act, 42 U.S.C. § 300j-13. The areas are delineated for the purpose of protecting public or community drinking water supplies that use surface water sources. These delineations can be found at DEQ's drinking water program website.

(C) "Potential to significantly increase inorganic arsenic concentrations in the public drinking water supply source water" means:

(i) to increase the concentration of inorganic arsenic in the receiving water for a discharge by 10 percent or more after mixing with the harmonic mean flow of the receiving water; or

(ii) as an alternative, if sufficient data are available, the discharge will increase the concentration of inorganic arsenic in the surface water intake water of a public water system by 0.021 micrograms per liter or more based on a mass balance calculation.

(d) Following the effective date of this rule, applications for an individual NPDES permit or permit renewal received from industrial dischargers located in a surface water drinking water protection area and identified by DEQ as likely to add inorganic arsenic to the receiving water must include sufficient data to enable DEQ to determine whether:

(A) The discharge in fact adds inorganic arsenic; and

(B) The discharge has the potential to significantly increase inorganic arsenic concentrations in the public drinking water supply source water.

(e) Where DEQ determines that both conditions in subsection (d) of this section (4) are true, the industrial discharger must develop an inorganic arsenic reduction plan and propose all feasible measures to reduce its inorganic arsenic loading to the receiving water. The proposed plan, including proposed measures, monitoring and reporting requirements, and a schedule for those actions, will be described in the fact sheet and incorporated into the source's NPDES permit after public comment and DEQ review and approval. In developing the plan, the source must:

(A) Identify how much it can minimize its inorganic arsenic discharge through pollution prevention measures, process changes, wastewater treatment, alternative water supply (for groundwater users) or other possible pollution prevention and/or control measures;

(B) Evaluate the costs, feasibility and environmental impacts of the potential inorganic arsenic reduction and control measures;

(C) Estimate the predicted reduction in inorganic arsenic and the reduced human health risk expected to result from the control measures;

(D) Propose specific inorganic arsenic reduction or control measures, if feasible, and an implementation schedule; and

(E) Propose monitoring and reporting requirements to document progress in plan implementation and the inorganic arsenic load reductions.

(f) In order to implement this section, DEQ will develop the following information and guidance within 120 days of the effective date of this rule and periodically update it as warranted by new information:

(A) A list of industrial sources or source categories, including industrial stormwater and sources covered by general permits, that are likely to add inorganic arsenic to surface waters of the State.

(i) For industrial sources or source categories permitted under a general permit that have been identified by DEQ as likely sources of inorganic arsenic, DEQ will evaluate options for reducing inorganic arsenic during permit renewal or evaluation of Stormwater Pollution Control Plans.

(B) Quantitation limits for monitoring inorganic arsenic concentrations.

(C) Information and guidance to assist sources in estimating, pursuant to paragraph (d) (C) of this section, the reduced human health risk expected to result from inorganic arsenic control measures based on the most current EPA risk assessment.

(g) It is the policy of the Commission that landowners engaged in agricultural or development practices on land where pesticides, fertilizers, or soil amendments containing arsenic are currently being or have previously been applied, implement conservation practices to minimize the erosion and runoff of inorganic arsenic to waters of the State or to a location where such material could readily migrate into waters of the State.

Section 3.2. Implementation of the Arsenic Reduction Policy

This section describes how DEQ intends to implement the above proposed rule. Nothing in this arsenic reduction policy replaces or supersedes technology-based permit requirements, permit limits based on numeric arsenic criteria or antidegradation requirements. All of these otherwise applicable criteria and policies continue to apply.

DEQ recognizes that we have not specified an analytical method for inorganic arsenic or the quantitation limit (QL) that will be required for permittee monitoring. Because the proposed numeric criteria for arsenic are for the inorganic form, this information will need to be developed regardless of whether or not this reduction policy is adopted.

<u>Point Sources – Industrial Sources:</u>

1. Applications for new or renewed individual NPDES permits submitted to DEQ after the effective date of this rule by industrial dischargers that are required to submit arsenic data with their permit application, or are otherwise identified by DEQ as likely to add inorganic arsenic to their wastewater, **and** that discharge to a water body within a drinking water protection area delineated by DEQ for a surface water intake, shall submit with their permit application sufficient data to allow DEQ to make the determinations described in #3 below. This will include source water and effluent inorganic arsenic concentration and flow data and may also include ambient river data.
    a. A discharger that has sufficient effluent data to demonstrate that its effluent concentration of inorganic arsenic is below DEQ's quantitation limit or below the

ambient river concentration immediately upstream of the discharge may use that information to demonstrate that the discharge does not have the potential to impact the arsenic concentration in a downstream public water supply.

2. DEQ will use the data to determine:
    a. whether the discharger is adding a quantifiable load of inorganic arsenic to their wastewater (i.e. a quantifiable concentration of inorganic arsenic in the discharge is greater that the inorganic arsenic load taken in from a surface water intake source); **and**
    b. whether the added load has the potential to increase the concentration of inorganic arsenic in a downstream public drinking water supply. DEQ will determine that a discharge has the potential to increase the concentration of inorganic arsenic in a downstream drinking water supply intake if the source increases the concentration of inorganic arsenic in the river after dilution (near field/point of discharge mixing analysis) by 3% or more, unless the source can demonstrate that their arsenic contribution will not increase the arsenic concentration in the downstream water supply by more than 0.023 µg/l.
3. If the Department finds that the facility is adding inorganic arsenic and that the added load is impacting a public drinking water supply, the permittee shall develop an arsenic reduction plan, which will be incorporated into its NPDES permit subject to DEQ review and public comment. The source shall include the following in their plan:
    a. Identify how much it can minimize its arsenic discharge through pollution prevention measures, process changes, wastewater treatment, alternative water supply sources or other possible pollution prevention and/or control measures.
    b. Evaluate the costs, technical and economic feasibility and environmental impacts of the identified arsenic reduction and control measures.
    Note 1: It is important to evaluate whether a potential arsenic reduction measure, such as a chemical substitution, represents an equal or worse environmental risk or other environmental impact.
    Note 2: DEQ recognizes that evaluating water supply options and the environmental impacts of those is complex and there are many issues to consider other than the arsenic loading. If the source of arsenic is groundwater, there may be few if any feasible options for reduction.
    c. Estimate the reduced arsenic load and human health risk expected to result from the control measures.
    d. Propose specific inorganic arsenic reduction or control measures, if feasible, and a schedule for implementing them.
    e. Specify monitoring and reporting requirements related to implementing the plan and the resulting effluent arsenic load reductions.
4. DEQ will identify factors that the permittee and the agency should consider in weighing the technical and economic feasibility of an inorganic arsenic reduction measure against the reduced human health risk that is expected to result and deciding which measures to implement.
5. If the timing of a permit renewal is such that the facility has not had sufficient time to collect the required data or develop an arsenic reduction plan prior to permit issuance, the permit will include the data collection and/or planning requirements and a reopener clause, which will allow DEQ to incorporate the proposed plan/measures into the permit prior to the next renewal.
6. Arsenic reduction plans and their implementation will be reviewed at each permit renewal to evaluate progress in implementation actions and inorganic arsenic reductions and determine whether and new measures are feasible and/or proposed.
7. There are existing procedures for requesting the re-consideration of a permit that can be used by persons who have grounds to believe that either the data and analysis or the reduction measures included in the permit are inadequate.

Point sources – Publicly Owned Treatment Works (POTWs)

1. All major POTWs are required to analyze their effluent for arsenic and submit that data to DEQ as part of their permit renewal application.
2. Arsenic III (the primary inorganic from) is included on Oregon's Priority Persistent Pollutant list developed under SB737. DEQ will rely on the water quality criteria and the "SB 737" requirements to address potential arsenic contributions from POTWs. Under "SB 737," the 52 largest POTWs, including all major municipal dischargers, will be required to test for arsenic III in their effluent. If the effluent concentration exceeds the initiation level specified in rule, the facility will be required to develop and implement a pollutant reduction plan for arsenic.

Point Sources – Other

1. Wood treating facilities – DEQ will incorporate the following into our renewal of industrial stormwater permits for wood treating facilities:
   - Review data on arsenic levels in stormwater runoff
   - Determine the sources of the arsenic on the site
   - Require the facility to identify measures that could be taken to reduce arsenic loading, including chemical substitution, stormwater management and erosion control practices, stormwater treatment, soil testing and remediation, chemical storage and disposal practices, and others.
   - Evaluate the measures, considering: a) potential for reduction of arsenic discharge, b) cost and c) potential environmental impacts (particularly for chemical substitutions), and incorporate appropriate measures into the permit.

2. Municipal stormwater management – DEQ will incorporate the following into our municipal stormwater permitting program:
   - DEQ will review data on inorganic arsenic levels in stormwater runoff and/or UIC wells to determine whether municipal stormwater is a significant source of inorganic arsenic.
   - If it is determined to be a significant source, DEQ will determine whether it is possible to identify the source(s) of the arsenic and whether additional measures or best management practices could be implemented that would reduce the arsenic loading.

Nonpoint Source Options:

1. Use the agency-wide Toxics Reduction Strategy to evaluate whether any of the following actions would be: a) likely to reduce inorganic arsenic concentrations in surface water drinking water protection areas, or in waters that exceed the water quality criteria for arsenic, and b) cost effective:
   - a limit on the amount of arsenic in fertilizers, pesticides and/or wood treating chemicals, or a ban on products containing arsenic if there are still such products in use;
   - treated wood and/or chemical collection/take back programs,
   - stormwater management in areas with large amounts of treated wood present, and/or
   - enhanced erosion control practices on lands where soil inorganic arsenic levels are elevated.
2. Recommend that adequate control of runoff and erosion from urban development and agricultural lands be implemented for multiple benefits. One benefit would be to prevent arsenic and other toxic pollutants that adhere to soil particles from entering waterways. Some contaminants, such as arsenic, are no longer widely used, but may have built up in soils in certain locations from past use. In addition, such controls would also reduce nutrient (i.e.

phosphorus) and sediment loading from urban and agricultural lands and therefore provide multiple benefits to fish and aquatic life and the quality of Oregon waters.

3. Construction stormwater general permit. Erosion and stormwater control practices should be employed to reduce loading of sediment and chemicals attached to sediments to the stream.

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Appendix A. Bioconcentration Factor Data

Bioconcentration data and bioconcentration factor (BCF) options used to derive water quality criteria for Oregon.

Water type	Species	BCF
All freshwater and saltwater BCFs		
Freshwater	Bluegill, *lepomis macrochirus*	4
Freshwater	Trout, *oncorhynchus mykiss*	10
Freshwater	Trout, *oncorhynchus mykiss*	17
Freshwater	Trout, *oncorhynchus mykiss*	27
Saltwater	Eastern oyster, *crossostrea virginica*	350
	Geometric mean	26
All freshwater fish BCFs		
Freshwater	Bluegill, *lepomis macrochirus*	4
Freshwater	Trout, *oncorhynchus mykiss*	10
Freshwater	Trout, *oncorhynchus mykiss*	17
Freshwater	Trout, *oncorhynchus mykiss*	27
	Geometric mean	14
Saltwater (Eastern oyster) BCF		
Saltwater	Eastern oyster, *crossostrea virginica*	350

From EPA, 2010. Personal communication, EPA Headquarters staff, November 2010.

Ambient Water Quality Criteria for Arsenic – EPA 440/5-80-021 and Ambient Water Quality Criteria for Arsenic – 1984, published 1985 refers to Barrows, et al. 1980, Ann Arbor, MI. pp. 379-392. Three different populations of immature bluegill; BCF of 4 reported.

Ambient Water Quality Criteria for Arsenic – EPA 440/5-80-021 and Ambient Water Quality Criteria for Arsenic – 1984, published 1985 refers to Zaroogian and Hoffman, 1982, Environmental Monitoring and Assessment 1:345-358. EPA document refers to BCF value for oyster of 350.

Rainbow Trout studies		
McGeachy and Dixon, 1990	Total arsenic water concentration in µg/l	Total arsenic BCF (wet weight)
At 5.3°C	10	20
At 15.3°C	10	17
Rankin and Dixon, 1994.		
At 5.3°C	10	27

From EPA, 2010. Personal communication, EPA Headquarters staff, November 2010.

Appendix B. Supplemental Information on Arsenic

From: *Impact of Land Disturbance on the Fate of Arsenical Pesticides*, Carl E. Renshawa,*, Benjamin C. Bosticka, Xiahong Fenga, Christine K. Wonga, Elizabeth S. Winstona, Roxanne Karimib, Carol L. Foltb and Celia Y. Chenb. 2005.

Fate and transport in the environment

Inorganic arsenic (As) occurs in two dominant redox states, arsenate (As(V)) and arsenite (As(III)), both highly toxic and carcinogenic (Hopenhayn 2006; Vaughan 2006). The oxidized form, arsenate, behaves chemically similarly to phosphate (P(V)) in the environment, as the two species display similar coordination chemistry and both readily bond with soil solids like iron oxides and clay particles (Stollenwerk 2003). Lab and field studies show that arsenate, like phosphate, sorbs to iron plaques that form on plant roots (Blute, Brabander et al. 2004; Liu, Zhu et al. 2006). Plants generate these plaques by pumping oxygen from the atmosphere to their roots, creating microoxic regimes in otherwise anoxic sediments (Taylor, Crowder et al. 1984).

However, a number of factors interfere with our ability to predict the mobility of As when plants are present. Arsenate, unlike phosphate, easily and commonly shifts redox states in the environment. The reduced form of As, arsenite, tends to be more mobile than arsenate and does not as strongly bond with iron oxides or natural organic matter at low and neutral pH (Stollenwerk 2003; Buschmann, Kappeler et al. 2006). In the root zone, dissolved organic carbon (DOC) exuded by plants will create high oxygen demand that result in anoxic conditions where DOC could then reduce arsenate to arsenite. Additionally, natural organic matter may compete with arsenate for sorption sites on iron oxides (Redman, Macalady et al. 2002). Both As reduction and competitive sorption may lead to greater As mobility. Conversely, both species of inorganic As sorb to natural organic matter, indicating that plants may enhance As retention up to some threshold (Buschmann, Kappeler et al. 2006).

Potential nonpoint sources of arsenic

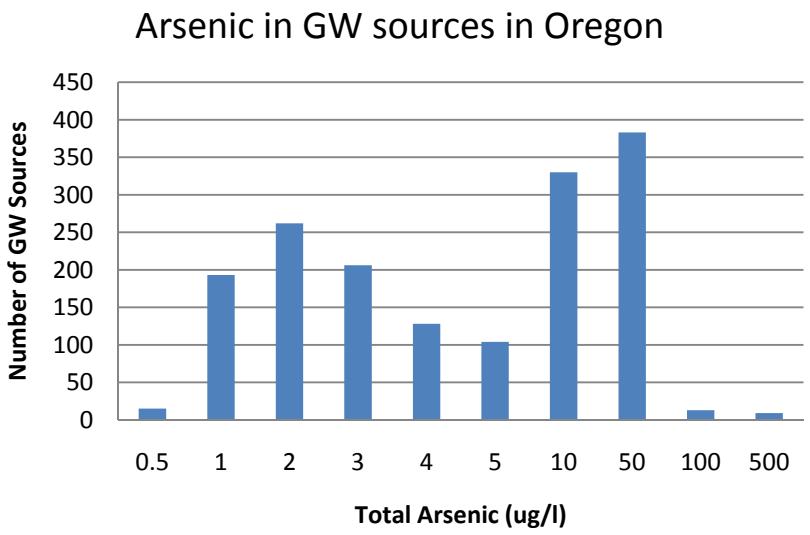
Our observation of high As and Pb concentrations in the drainages down gradient of the tilled orchard is consistent with a recent regional analysis of stream sediment As and Pb concentrations that found a positive association between stream sediments that contain high As and Pb concentrations and areas inferred to have used arsenical pesticides extensively (Robinson and Ayuso, 2004). Our work extends this regional analysis by demonstrating that: (i) at least below the tilled field the As and Pb were transported to the drainage in two discrete events, with the later mobilization event occurring well after the application of the arsenical pesticides; and (ii) the masses of As and Pb apparently missing from the tilled field and present in the down gradient drainage are consistent with transport due to physical erosion associated with tilling. Most previous work investigating As mobilization due to physical erosion has focused on As contamination due to the erosion of As-rich ores (Black et al., 2004; Oyarzun et al., 2004; Savage et al., 2000). However, tilling-induced mobilization similar to postulated here has recently been documented for other strongly sorbing pesticides (Wu et al., 2004). In contrast, little horizontal redistribution of As has been observed in the untilled As-contaminated soils underlying cattle tick dip sites (Kimber et al., 2002)...

Finally, while this work only considers the effect of tilling on the mobilization of residual arsenical pesticides, our work shows that the Pb and As are bound to small and presumably highly mobile particles. It is therefore likely that other types of land disturbances will also mobilize significant amounts of Pb and As in lands where arsenical pesticides were used, particularly over longer timescales. In southern New Hampshire, for example, former orchard land is currently being rapidly developed and urbanized. Our results suggest that as this land is developed, attention should be given to the possibility of mobilizing previously immobile reservoirs of Pb and As.

Total Arsenic in Drinking Water Supplies in Oregon (ug/l)

	All "Surface Water"	Selected Surface Water*	Groundwater under direct influence of SW	Groundwater (see table below)
Minimum	0.5	0.5	0.58	0.1
Maximum	9.0	5.7	14	411
Average	3.0	1.6	4.87	8.8
# samples	45	24	11	1642

* Sources that use only surface water and do not include well water as part of their supply.
Note 1: This data is for finish water, which means these are the levels after the raw water has been treated.
Note 2: This data includes only sources with detectable levels of arsenic (0.5 ug/l or more). There are additional sources where arsenic was not detected. Therefore, the data above do not represent the average of arsenic levels in surface water supplies throughout Oregon, but simply represent commonly occurring levels.
From: Drinking Water data base, Oregon, May 2009 query



From: Drinking Water data base, Oregon, May 2009 query.
Number of GW samples with arsenic values above previous value and up to value shown (i.e. 0.01–0.5; 0.51-1; 1.01-2, etc.).

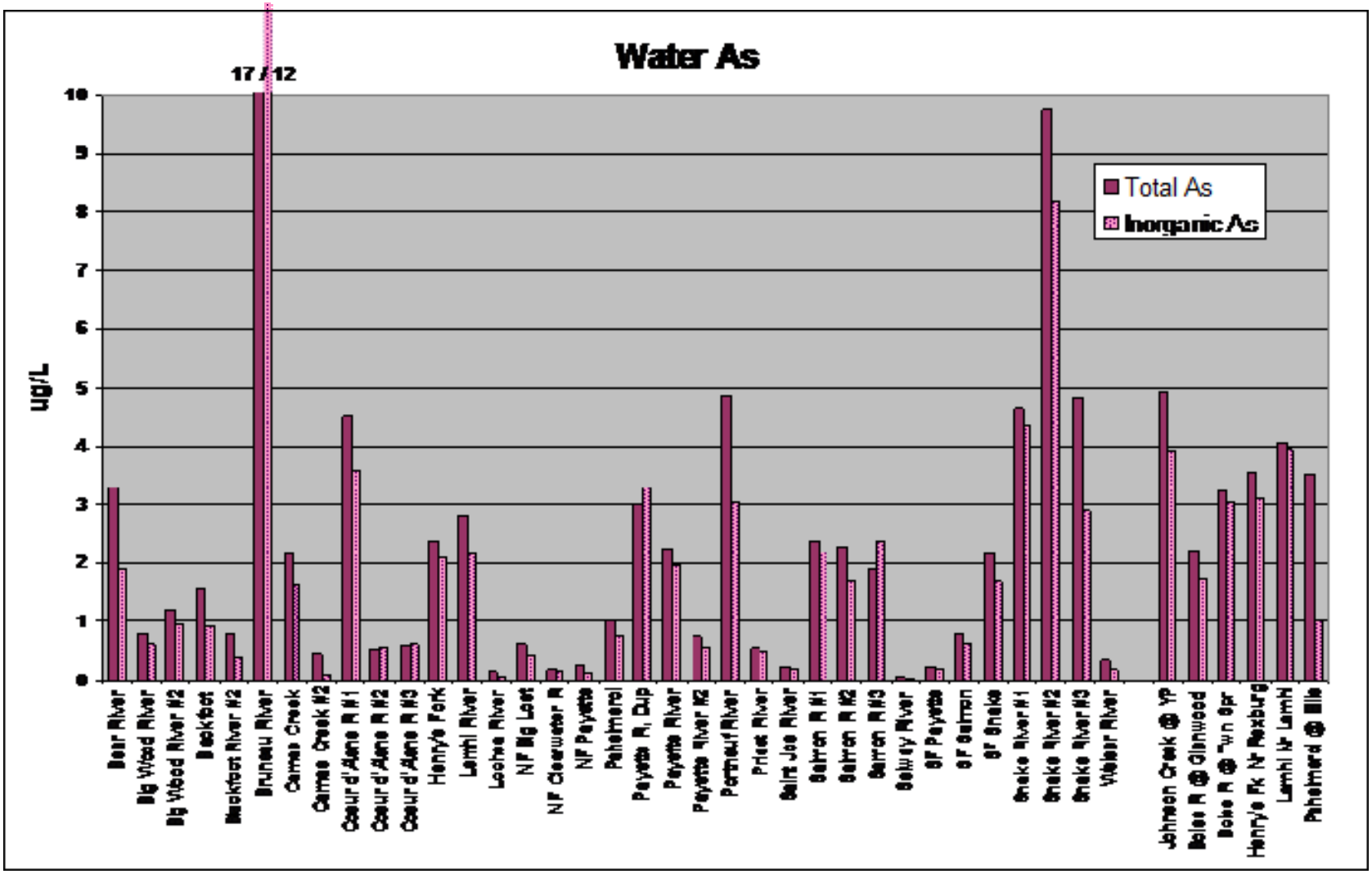


Figure 1. Data on total and inorganic arsenic from Idaho.
2008/09 total arsenic and inorganic arsenic data from 40 sites on major rivers across Idaho ranged from 25% to 100% inorganic arsenic; the mean was 75% inorganic. Idaho DEQ.

DEPARTMENT OF ENVIRONMENTAL QUALITY
Chapter 340
Proposed Rulemaking
STATEMENT OF NEED AND FISCAL AND ECONOMIC IMPACT

Amendments to Oregon Water Quality Standards for Arsenic, Iron and Manganese

Title of Proposed Rulemaking	Amending Oregon's Water Quality Standards: Revising Human Health Criteria for Arsenic, Iron and Manganese (OAR 340-041-0033, Table 20).
Statutory Authority or other Legal Authority	ORS 468B.010 and 468B.035, 468.020
Statutes Implemented	ORS 468B.048
Need for the Rule(s)	Oregon's current human health criteria for arsenic, iron and manganese are not attainable in many Oregon waters due to natural geologic sources. Clean Water Act requirements for implementing these water quality standards have resulted and will continue to result in DEQ and other entities expending resources to address pollutants that are predominantly natural. In addition, Oregon's current arsenic criteria are not consistent with EPA's recommendation to express the criteria as inorganic arsenic, which is the toxic form of the metal. The proposed arsenic criteria will also address, in part, EPA's June 1, 2010 disapproval of Oregon's human health criteria due to concerns about the fish consumption rate value used to derive the criteria. The proposed criteria revisions address these issues for arsenic, iron and manganese by putting in place only those criteria needed to protect human health and by setting those criteria at levels that continue to protect human health while recognizing the natural occurrence of these metals in Oregon waters. The proposed rule amendment withdraws several of the human health criteria for iron and manganese. The proposed amendment also establishes numeric inorganic arsenic criteria based on a fish consumption rate of 175 grams per day. The revised arsenic criteria are less stringent than the existing criteria. Upon scientific review, DEQ finds that proposed criteria are sufficient to protect human health. Because natural concentrations of arsenic present a risk to human health that is higher than the risk level that the Environmental Quality Commission (EQC) ordinarily uses to establish human health criteria, DEQ also proposes that the EQC adopt an arsenic reduction policy and rule. The purpose of this policy is to ensure that any arsenic added to Oregon waters from known and significant anthropogenic sources is reduced to the maximum extent possible in order to keep human health risks associated with arsenic in drinking water source waters as low as possible. The proposed revisions will result in: 1) more appropriate identification of water quality impairments by DEQ, and 2) more environmentally meaningful use of resources by DEQ and other entities.
Documents Relied Upon for Rulemaking	The following documents are available at the websites listed or by contacting Debra Sturdevant at sturdevant.debra@de.state.or.us or at 503-229-6691. *Water Quality Standards Review and Recommendations: Arsenic, Iron and Manganese.* Oregon DEQ, Water Quality Standards and Assessment Section, 2010. (http://www.deq.state.or.us/wq/standards/review.htm) *Quality Criteria for Water*. EPA, 1986. (http://www.epa.gov/waterscience/criteria/library/goldbook.pdf) *Water Quality Criteria*. EPA, 1976. (http://www.epa.gov/waterscience/criteria/library/redbook.pdf)
Requests for Other Options	Pursuant to ORS 183.335(2) (b) (G), DEQ requests public comment on whether other options should be considered for achieving the rule's substantive goals while reducing negative economic impact of the rule on business.

Fiscal and Economic Impact, Statement of Cost Compliance

Overview

The proposed arsenic, iron and manganese criteria revisions are shown in the table below. Because the proposed criteria are less stringent, the proposed rule amendments will provide an overall fiscal and economic benefit to both regulated parties and DEQ relative to meeting current criteria. Some permitted facilities will incur costs associated with developing and implementing an arsenic reduction plan. A significant amount of DEQ and permittee resources have been spent attempting to address high natural levels of arsenic throughout the state and without the proposed revisions, DEQ expects this will continue. As a result, DEQ expects that implementing the requirements contained in the arsenic reduction policy will be less costly than or perhaps, in a few cases, the same as implementing requirements associated with attaining the current criteria. In particular, the arsenic reduction policy requirements target significant measurable sources of arsenic and feasible reduction opportunities, resulting in a focused expenditure of resources in circumstances where anthropogenic contributions of arsenic are most likely to impact sources of drinking water.

In addition to decreasing costs to DEQ and permittees, the withdrawal of the "water + organism" criteria for iron and manganese is not expected to cause increase costs for water suppliers. Iron and manganese are naturally occurring earth metals generally present at levels below maximum contaminant levels (MCLs) for drinking water and have not historically presented problems for water suppliers. Should a situation arise in the future where a permitted discharge of iron or manganese causes a water supplier to incur treatment costs, DEQ has the authority through other existing water quality standards provisions to regulate that discharge. This would be a more efficient manner to address this rare circumstance than the current statewide numeric criteria.

Finally, DEQ does not expect the criteria changes to result in increased health risks or costs to the public from eating fish or drinking water for the reasons described in more detail in the following section.

Proposed Human Health Criteria for Arsenic, Iron and Manganese (µg/l)

Pollutant	Water + Fish Ingestion		Fish Consumption Only	
	Current Criteria	Proposed Criteria	Current Criteria	Proposed Criteria
Arsenic	0.0022	2.3 inorganic arsenic	0.0175	2.7 inorganic arsenic
Iron	300	None	None	None
Manganese	50	None	100	100 marine waters

Note: Current criteria are currently effective criteria from OAR 340-041-0033, Table 20.

Impacts on the General Public

DEQ does not expect that the general public will incur direct fiscal or economic impacts as a result of the revised criteria because the general public is not directly regulated under the Clean Water Act. In addition, the revisions are not expected to significantly affect the human health risks or costs associated with eating fish or drinking water in Oregon. Impacts to municipal sewage treatment and drinking water treatment works are discussed in the section on local governments.

DEQ's proposal to withdraw criteria for iron and manganese does not present a human health concern given the levels of these metals found in Oregon waters. EPA recommended these criteria to protect against potential taste and laundry staining impacts. There are other alternatives for controlling these

	affects should they be a problem for water suppliers in Oregon that are more targeted and efficient than retaining these statewide numeric criteria. DEQ does not expect the public to incur costs associated with health impacts from the revised criteria for arsenic because natural sources of arsenic are the primary source of arsenic in most waterbodies used as drinking water. Arsenic levels in Oregon waters commonly range from 1to 3µg/l. The risk associated with natural arsenic levels is not new; risk attributable to natural levels of arsenic has been present as long as people have been drinking Oregon water. To minimize any risks that could be associated with anthropogenic sources of arsenic, DEQ proposes an arsenic reduction policy rule. The purpose of this rule is to ensure that arsenic added to Oregon waters from known and significant anthropogenic sources is reduced to the maximum extent possible in order to keep any human health risk associated with arsenic in drinking water source waters as low as possible.	
Impacts to Small Business (50 or fewer employees – ORS183.310(10))	DEQ does not expect small businesses to be negatively impacted by this rule. Most small businesses in Oregon discharge to a publicly owned treatment works (POTW). Because they do not typically discharge directly to a water body, most small businesses are not required to get an NPDES permit. A POTW with arsenic, iron or manganese limits in their NPDES permit may in turn place requirements on small businesses in order to limit the amount of arsenic, iron or manganese a business discharges to the public sewer system. However, because the proposed rule changes will make the water quality criteria for these metals less stringent, the rule change will not lead to additional requirements or limits to businesses that discharge to POTWs beyond what would be required under the existing criteria.	
Cost of Compliance on Small Business (50 or fewer employees – ORS183.310(10))	a) Estimated number of small businesses subject to the proposed rule	Very few small businesses are directly subject to these water quality criteria because most small businesses do not have direct discharges to waters of the state and do not receive individual NPDES permits from DEQ. Most small businesses discharge to a POTW. Approximately 2700 permittees, many of whom would be small businesses, receive general NPDES permits from DEQ. The pollution control actions required under these permits will most likely not change as a result of the proposed revisions to the arsenic, iron and manganese criteria. In most cases, the actions address multiple pollutants, not just one of these three. If a permit does contain requirements specific to iron or manganese, those requirements may be able to be removed. Some businesses are subject to requirements from a POTW under their pretreatment program, including approximately 130 small businesses. DEQ does not have data indicating how many of these businesses receive limits for arsenic, iron or manganese. However, because the proposal will withdraw criteria for iron and manganese and make the arsenic criteria less stringent than current criteria, the number of small businesses subject to pretreatment requirements for these pollutants would either remain unchanged or be reduced.
	b) Types of businesses and industries with small businesses subject to the proposed rule	Wood treating facilities are known to have arsenic in their stormwater run-off. There are approximately 8 wood treating facilities that are required to meet specific permit limits or benchmarks in their NPDES permits for arsenic. The criteria value changes will not likely alter the actions these facilities take to control or treat arsenic in their discharge because those same actions will likely be needed to meet limits based on the revised criteria.
	c) Projected reporting, recordkeeping and other administrative activities required by small businesses for compliance with the proposed rule, including costs of professional services	The proposed criteria value changes are not likely to affect the reporting, recordkeeping or other administrative activities required of small businesses for compliance. If there is any impact, it would be that fewer businesses will be subject to requirements related to meeting water quality standards.

	d) The equipment, supplies, labor, and increased administration required by small businesses for compliance with the proposed rule	The proposed criteria value changes are not likely to affect equipment, labor, supplies or other expenses for small businesses related to compliance. If there is any impact, it would be that fewer businesses will be subject to requirements related to meeting water quality standards.
	e) A description of the manner in which DEQ involved small businesses in the development of this rulemaking	DEQ has met with and received input from a stakeholder workgroup that included business representatives, but not specifically small businesses. A representative from Associated Oregon Industries has participated on this workgroup. In addition, DEQ informed a larger Toxics Stakeholder Group of our intention related to these revisions. That group includes the Oregon Forest Industries Council, the Oregon Farm Bureau, a representative of small woodlot owners, Tribal representatives, commercial fishermen and Oregonians for Food and Shelter.
Impacts on Large Business (all businesses that are not "small businesses" under ORS183.310(10))	Large businesses that discharge directly to Oregon's surface waters are directly regulated through DEQ's water quality permitting program. These businesses must test their wastewater to determine what pollutant concentrations it contains. Businesses that have the potential to cause the water body to exceed water quality standards are subject to regulatory effluent limits that specify the maximum concentration of a pollutant that may be in their discharge. DEQ's current criteria for arsenic are for total arsenic and the new criteria will be for inorganic arsenic. Inorganic arsenic testing is more expensive than total arsenic, so monitoring costs may increase for some businesses. However, only those businesses with the potential to cause an exceedance of the criterion are required to regularly monitor throughout their permit term. Under the proposed rule, fewer businesses will be in this category. At this time, no major industrial dischargers and 13 minor industrial dischargers in Oregon have effluent limits in their NPDES permits for arsenic, iron or manganese. Many permittees, however, are being required to collect data. As permits are renewed, DEQ expects that additional permittees would have difficulty meeting the current criteria, particularly those located on water bodies that are listed as water quality impaired for these pollutants, such as the Willamette and Columbia Rivers. The proposed criteria changes will reduce unnecessary restrictions on permittees that would not be able to meet iron or manganese criteria. The proposed arsenic criteria are less stringent than the current criteria and therefore, should be less costly to attain. The proposed arsenic reduction policy is a new requirement that will apply to some dischargers. Facilities that discharge to waters that have arsenic levels below the proposed criteria and are delineated by DEQ as a drinking water source protection area must evaluate their potential to affect arsenic concentrations in the source water. Dischargers that have the potential to increase the concentration of arsenic in their receiving water body will be required to develop a plan and implement measures to reduce the amount of arsenic added from their process as much as feasible. The purpose of this requirement is to minimize any potential additional risk from the discharge to a public drinking water supply and to minimize any potential human health risk from arsenic exposure through drinking water. There are 19 major industrial NPDES permittees in Oregon. Only a subset of these will be subject to the arsenic reduction policy, as described above. Although there will be costs associated with developing and implementing an arsenic reduction plan, these costs should be lower than the costs that would be incurred by the facility to comply with the current arsenic criteria. In addition, these costs will be targeted to reducing arsenic associated with the facilities' processes (as opposed to reducing naturally-occurring arsenic) and achieving those reductions where the discharge may affect a public water supply.	
Impacts on Local Government	DEQ expects that compliance with the proposed criteria will be less costly for municipal dischargers than the current criteria for these three metals than under the current criteria. Some municipalities in areas of the state with high natural levels of arsenic may still find compliance with the revised criteria to be a challenge, particularly if there are groundwater inputs to their effluent. The revised criteria reduce that challenge, but do not eliminate it. DEQ is aware of the difficulties and intends to work with cities	

	on compliance strategies where it will be infeasible for the facility to meet the arsenic criteria due to inflow and infiltration issues or the presence of arsenic in source water. Cities that exceed the MCL of 10 µg/l in their effluent will be required to develop arsenic reduction plans under DEQ's program to address priority persistent pollutants (also known as Senate Bill 737). Because the proposed numeric criteria remain well below the arsenic MCL of 10µg/l, the proposed criteria will not cause drinking water suppliers to incur additional treatment costs in order to comply with the Safe Drinking Water Act.
Impacts on State Agencies other than DEQ	DEQ does not expect that the criteria revisions will have a fiscal or economic impact on other state agencies.
Impacts on DEQ	The proposed criteria revisions will reduce the resources that would be required for DEQ to permit facilities that cannot feasibly meet the current water quality criteria for arsenic, iron or manganese. DEQ anticipates that some of those resources may be spent evaluating and incorporating arsenic reduction measures into permits; however due to the focused eligibility criteria, DEQ does not expect a large number of facilities to be subject to this requirement. The proposed criteria revisions together with the arsenic redu ction plans will focus agency resources on ensuring actions are taken to reduce anthropogenic additions of arsenic and reduce the need for administrative remedies that may not yield any greater environmental results. The demand on DEQ resources to address toxics is growing and these revisions will help DEQ focus its efforts on other pollutants that need to be addressed. The proposed criteria revisions will also reduce the DEQ resource demands that would otherwise be required to address the 107 water body segments currently listed as impaired for arsenic, iron or manganese and in need of a TMDL. DEQ expects that very few of these listings will remain after they are re-evaluated and the impaired waters list is updated. Again, this will allow agency resources to address more important water quality problems and pollutants that have more potential for reduction. Due to the Agency's limited resources, it is important for DEQ to be able to align its resources to address those pollutants that are of concern and target areas where real environmental reductions can be achieved.
Assumptions	DEQ relied on the best available information to propose these amendments and is confident, based on the sources of information, that the data and information are reasonably true and accurate. DEQ concluded that is it in the interest of the public to expend public and private resources on actions that will result in measurable environmental benefits.
Housing Costs	DEQ has determined that this proposed rulemaking will have no effect on the cost of development of a 6,000 square foot parcel and the construction of a 1,200 square foot detached single family dwelling on that parcel.
Administrative Rule Advisory Committee	DEQ assembled a Toxics Water Quality Standards Rulemaking Workgroup to assist us with the development and evaluation of the proposed rule. This group has been meeting since January, 2009 and will continue to work with DEQ on additional rule provisions until fall of this year.

_____	_____	_____
Prepared by	Printed name	Date
_____	_____	_____
Approved by DEQ Budget Office	Printed name	Date

DEPARTMENT OF ENVIRONMENTAL QUALITY
Chapter 340
Proposed Rulemaking

ADDENDUM TO
STATEMENT OF NEED AND FISCAL AND ECONOMIC IMPACT

Amendments to Oregon Water Quality Standards for Arsenic, Iron and Manganese

Title of Proposed Rulemaking	Amending Oregon's Water Quality Standards: Revising Human Health Criteria for Arsenic (OAR 340-041-0033, Table 20).
Statutory Authority or other Legal Authority	ORS 468B.010 and 468B.035, 468.020
Statutes Implemented	ORS 468B.048
Explanation of Addendum	DEQ has made revisions to its proposed criteria for arsenic based on public comment and is reopening public comment to invite additional comment on the revised proposed arsenic criteria. The need for the rule and the fiscal and economic impacts of the proposed rule, which are described in the August 2010 "Statement of Need and Fiscal and Economic Impact: for the Amendments to Oregon Water Quality Standards for Arsenic, Iron and Manganese," have not changed. The primary difference between the arsenic criteria proposed for comment in August 2010 and the revised criteria proposed at this time is how the values were calculated. The numbers are similar as compared to the current criteria (see the Table below). In addition, this revised proposal includes separate "fish consumption only" criteria for freshwater and saltwater due to the very different bioconcentration rates for marine shellfish. See the Arsenic Issue Paper on DEQ's website for additional information: http://www.deq.state.or.us/wq/standards/metals.htm **Proposed Human Health Criteria for Arsenic (µg/l)** | | **Water + Fish Ingestion** | **Fish Consumption Only - Freshwater** | **Fish Consumption Only - Saltwater** | | Current criteria (total arsenic) | 0.0022 | 0.0175 | 0.0175 | | Criteria proposed Aug 2010 (inorganic arsenic) | 2.3 | 2.7 | 2.7 | | Revised proposed criteria (inorganic arsenic) | 2.1 | 2.1 | 1.0 | Note: Current criteria are currently effective criteria from OAR 340-041-0033, Table 20. DEQ has not changed the proposed arsenic reduction policy rule. DEQ will respond to public comment on the reduction policy and the arsenic criteria following the close of the comment period. In December 2010, the EQC adopted the iron and manganese criteria revisions that were also proposed in August 2010.
Need for the Rule(s)	The need for the rule is not changed.

Documents Relied Upon for Rulemaking	The following documents are available at the websites listed or by contacting Debra Sturdevant at sturdevant.debra@de.state.or.us or at 503-229-6691. *Water Quality Standards Review and Recommendations: Arsenic.* Oregon DEQ, Water Quality Standards and Assessment Section, February 1, 2010. (http://www.deq.state.or.us/wq/standards/review.htm)
Requests for Other Options	Pursuant to ORS 183.335(2) (b) (G), DEQ requests public comment on whether other options should be considered for achieving the rule's substantive goals while reducing negative economic impact of the rule on business.
Fiscal and Economic Impact, Statement of Cost Compliance	The revisions to the proposed criteria do not change the expected fiscal and economic impacts as described in the August 2010 "Statement of Need and Fiscal and Economic Impact."
Administrative Rule Advisory Committee	DEQ assembled a Toxics Water Quality Standards Rulemaking Workgroup to assist us with the development and evaluation of the toxics criteria review and rulemaking, including the revision to arsenic. This group met from January, 2009 through October 2010.

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Approved by DEQ Budget Office	Printed name	Date