RECYCLING AND REUSE OF PRODUCED WATER:

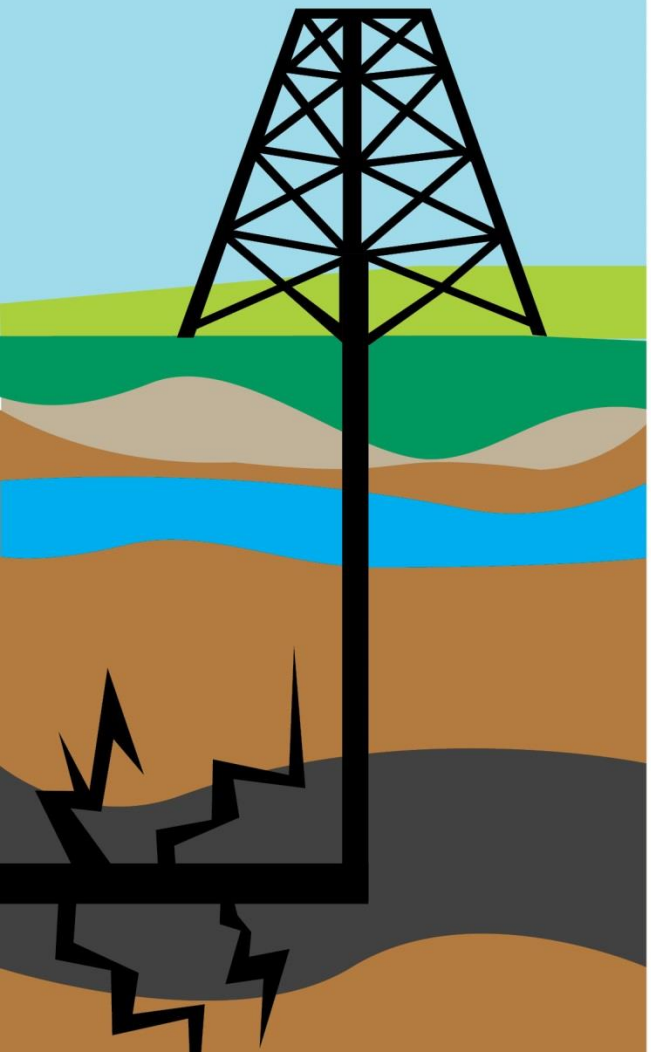
Risks and Regulatory Responses

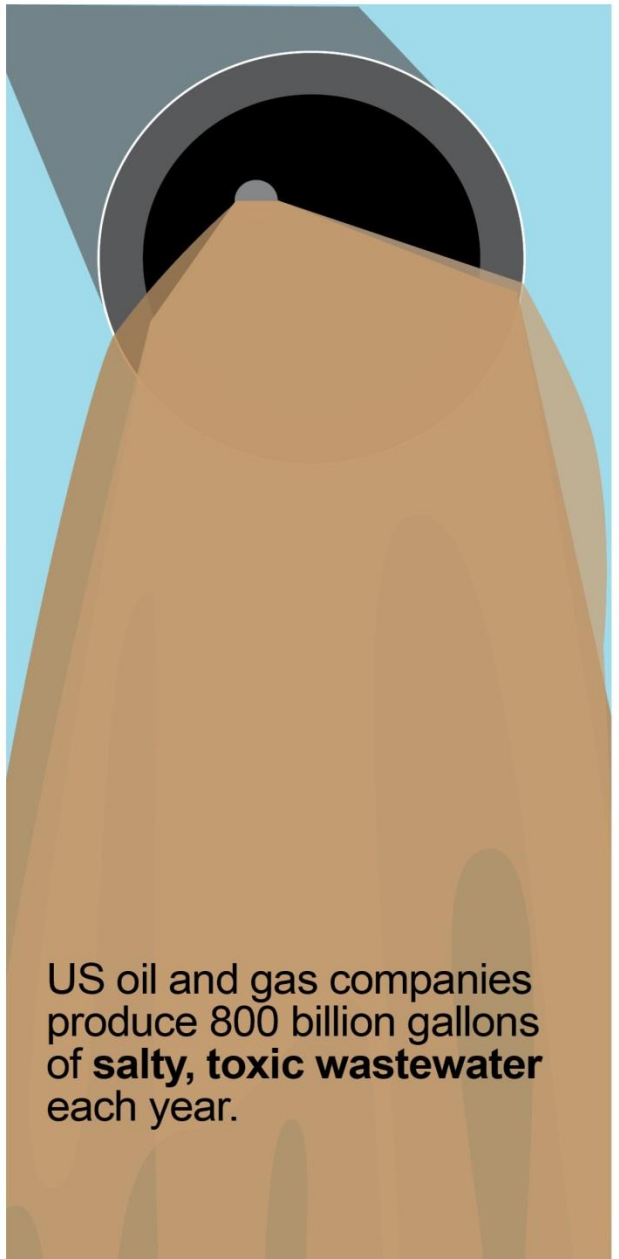
December 2015

EDF
ENVIRONMENTAL DEFENSE FUND®
Finding the ways that work

RISKS OF POORLY MANAGED OIL & GAS WASTEWATER

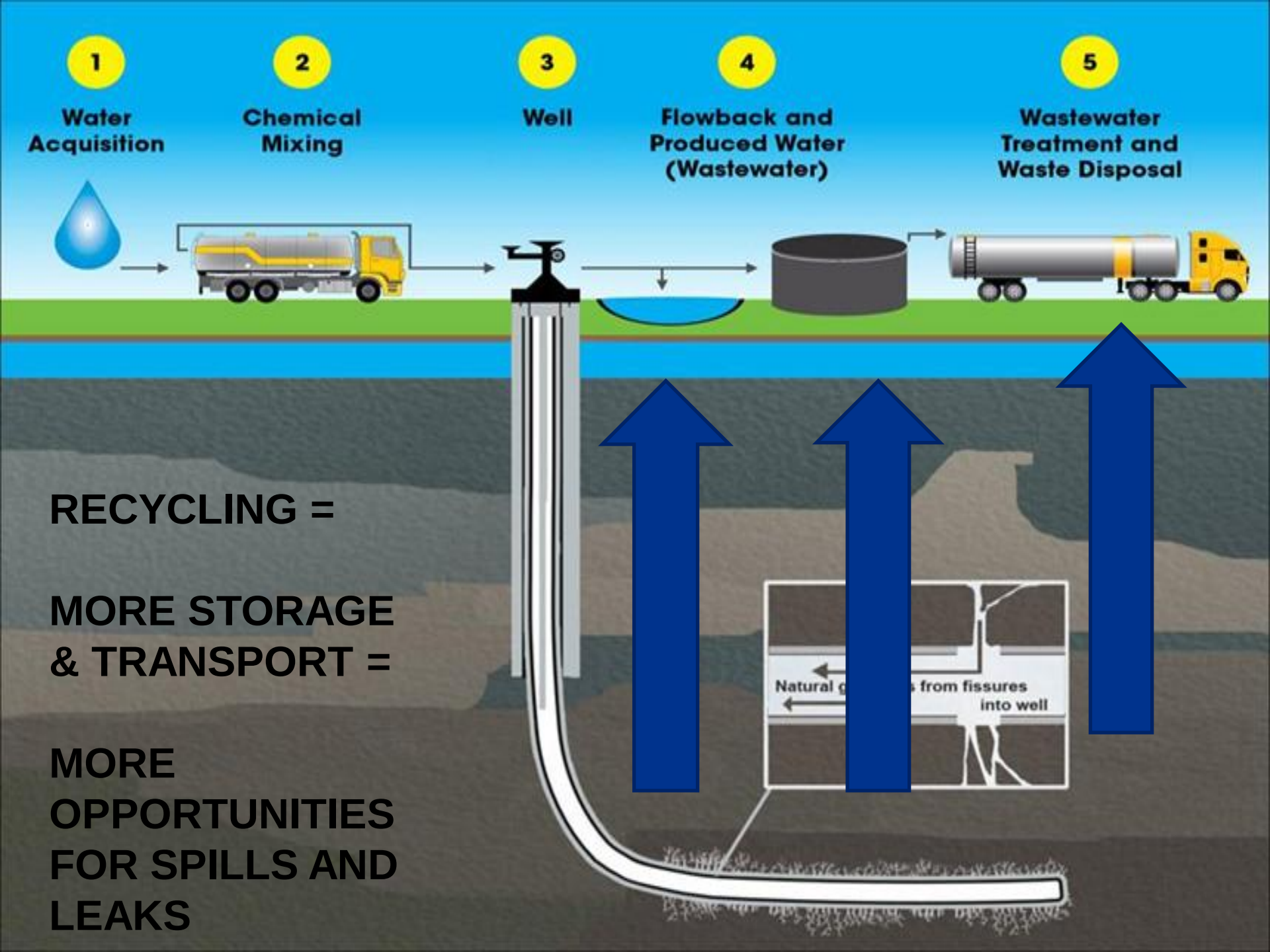
Water mixed with chemicals and sand is pumped under ground.





US oil and gas companies produce 800 billion gallons of **salty, toxic wastewater** each year.

If not properly managed, this waste can end up polluting...



RECYCLING =

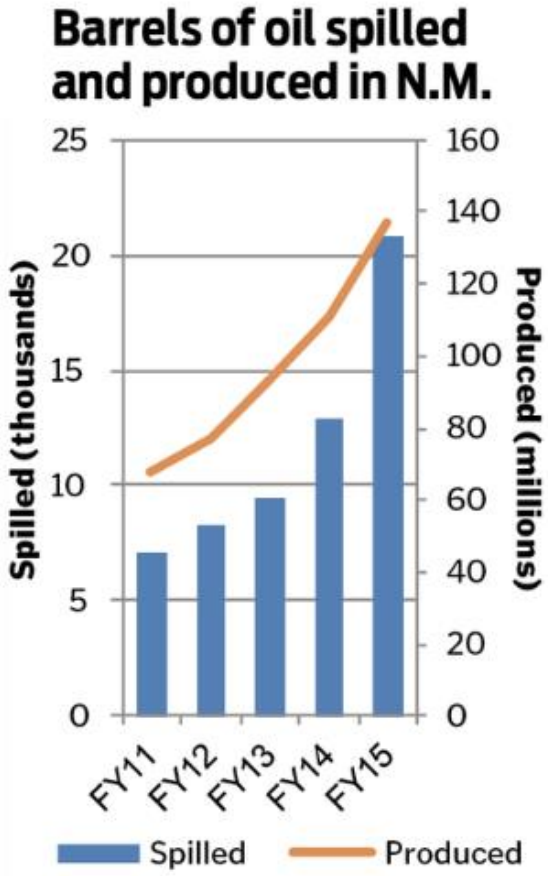
MORE STORAGE & TRANSPORT =

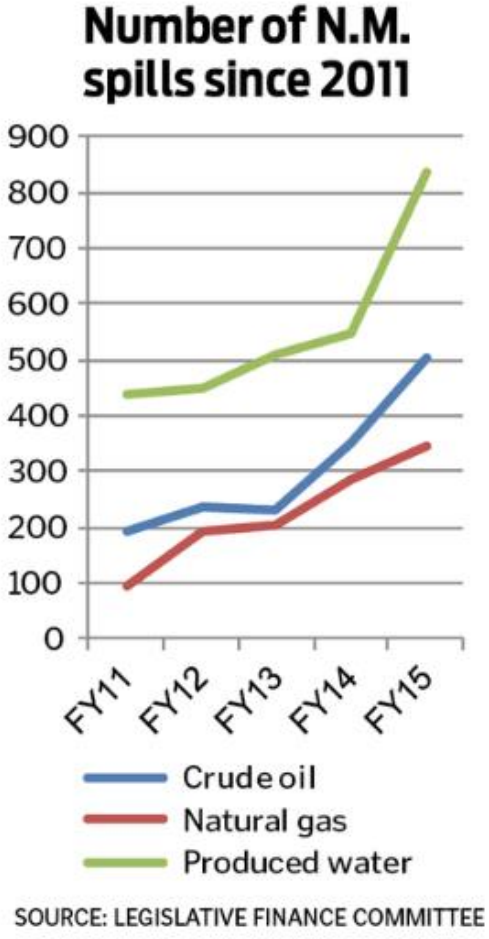
MORE OPPORTUNITIES FOR SPILLS AND LEAKS

U.S. Spill Rate INCREASING as Production DECLINES

National spill rate up 17% in 2014 –

EnergyWire, July 8, 2013





NM SPILLS UP 61% ; PRODUCTION UP 23%

Regulations – streamline permitting for storage

- **TEXAS (16 TAC 3.8)**
- Non-commercial pits approved by rule:
  - Lined, 2’ freeboard
  - Emptied annually, or equipped with leak detection
  - Promptly fix leaks

New rules for wastewater pipelines

BENEFICIAL USES OUTSIDE THE OIL FIELD =

NEW PATHWAYS FOR EXPOSURE

Of the **134 chemicals** identified by EPA Drinking Water Assessment (2015) as present in wastewater:

60 on EPA's priority pollutant list (constituting almost half of the priority pollutant list). (40 CFR pt 423 appx A).

< 30 pollutants specifically limited or monitored **in NPDES permits**

< 20 pollutants contained in Clean Water Act effluent limitation guidelines **centralized waste treatment (40 CFR pt 437).**

Irrigation Water Quality Standards

TABLE 3.4
QUALITY CLASSIFICATION OF WATER FOR IRRIGATION
(after Wilcox, 1955)

Water Class	Percent Sodium	Specific Conductance, µS/cm	Boron, mg/l: Sensitive Crops	Boron, mg/l: Semitolerant Crops	Boron, mg/l: Tolerant Crops
Excellent	<20	<250	<0.33	<0.67	<1.00
Good	20-40	250-750	0.33-0.67	0.67-1.33	1.00-2.00
Permissible	40-60	750-2000	0.67-1.00	1.33-2.00	2.00-3.00
Doubtful	60-80	2000-3000	1.00-1.25	2.00-2.50	3.00-3.75
Unsuitable	>80	>3000	>1.25	>2.50	>3.75

Table 9. Constituent limits for irrigation water (adapted from Rowe and Abdel-Magid, 1995)

Constituent	Long-term Use (mg/L)	Short-term Use (mg/L)
Aluminum (Al)	5	20
Arsenic (As)	0.1	2
Beryllium (Be)	0.1	0.5
Boron (B)	0.75	2
Cadmium (Cd)	0.01	0.05
Chromium (Cr)	0.1	1
Cobalt (Co)	0.05	5
Copper (Cu)	0.2	5
Fluoride (F)	1	15
Iron (Fe)	5	20
Lead (Pb)	5	10
Lithium (Li)	2.5	2.5
Manganese (Mn)	0.2	10
Molybdenum (Mo)	0.01	0.05
Nickel (Ni)	0.2	2
Selenium (Se)	0.02	0.02
Vanadium (V)	0.1	1
Zinc (Zn)	2	10

Colorado State University Extension

Irrigation Water Quality Criteria

Fact Sheet No. 0.506 Crop Series | Irrigation

by T.A. Bauder, R.M. Waskom, P.L. Sutherland and J. G. Davis*

Salt-affected soils develop from a wide range of factors including: soil type, field slope and drainage, irrigation system type and management, fertilizer and

Irrigation Water Quality Criteria

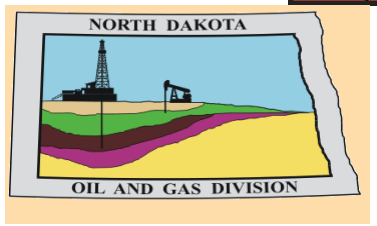
Soil scientists use the following categories

Quick Facts

- Knowledge of irrigation water quality is critical to

State Beneficial Use Regulators?

Oil and Gas Conservation Agencies



Environmental Regulators

State Engineers

Texas A&M / EWS Pilot Project: Pecos Cotton Irrigation

ANALYSIS	UNITS	PRODUCED WATER	RECYCLED WATER
Specific Gravity		1.03	1.0
pH		7.86	7.8
Conductivity		48,000	4,000
Total Hardness	mg/L as CaCO3	2,700	NA
Calcium	mg/L as CaCO3	1,900	NA
Magnesium	mg/L as CaCO3	800	NA
SAR		116	2.5
Iron	mg/L	0.2	NA
Sulfate	mg/L	43	NA
Boron	mg/L	53	1.0
Alkalinity	mg/L as CaCO3	1,200	NA
Chlorides	mg/L	21,500	1,500

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RAILROAD COMMISSION OF TEXAS
OIL AND GAS DIVISION

May 1, 2015

ENERGY WATER SOLUTIONS, LLC
9595 SIX PINES DR STE 8210
THE WOODLANDS TX 77380-1642

Re: **Letter of Authority to Treat and Re-Use Treated Produced Water**
(Recyclable Product) for Irrigation of Crops
Texas A&M AgriLife Research
Texas Agricultural Experiment Station Property
Approx. Three Acres of the D.W. Washburn Survey, A-7
Latitude, Longitude: 31.376140°, -103.637108°
Reeves County, Texas
Permit No.: LOA-A15-0006

Pursuant to Statewide Rule 8, Energy Water Solutions, LLC (EWS) is hereby authorized to receive, store, treat, and re-use approximately 12,000 barrels of produced water (recyclable product) for irrigation of cotton crops. The authority provided by this permit is based upon information provided in the application received March 27, 2015, and subsequent information.0.n received to date, and is subject to the following conditions:

1. The effective date of this permit is May 1, 2013, and expires on October 1, 2015.

2. Only 30,000 barrels total of non-hazardous RCRA-exempt produced water from the APC SWD Facility operated by Anadarko E&P Onshore LLC (Anadarko), the APC SWD No. 1

NEW MEXICO 19.18.34 NMAC

-Reuse downhole does not require a permit

-downhole = drilling, completion, production, secondary recovery, pressure maintenance or well plugging

-Any other use requires a permit

-Research with produced water (pilot projects) are favored in the rule, require prior authorization

http://www.24-7pressrelease.com/press-release/eddy-county-nm-leads-permian-oil-and-gas-production-for-the-third-consecutive-year-410264.php#

Wyoming Dept. of Environmental Quality

WYPDES – Short Form C-1 for Oil and Gas Production Facilities

Surface Discharge

TABLE 2

PARAMETER	REQUIRED DETECTION LIMIT and Required Units	STANDARD OR LIMIT*	SAMPLE RESULTS (Also submit lab results with application)
Aluminum, Dissolved	50 ug/L	750 ug/L	
Arsenic, Total Recoverable	1 ug/L	150 ug/L	
Barium, Total Recoverable (*New Facilities*	100 µg/L	2000 ug/L	
Boron, Dissolved (*New Facilities Only*)	100 ug/L	5000 ug/L	
Cadmium, Dissolved	5 ug/L	0.25 ug/L (hardness dep)	
Calcium, Dissolved	50 ug/L, report as mg/L		
Chloride – Technology Based	5 mg/L	2000 mg/L	
Chloride, For Class 2A and 2B Waters	5 mg/L	230 mg/L	
Chromium, Total	1ug/L	74.1 ug/L (hardness dependent)	
Copper, Dissolved	10 ug/L	9 ug/L (hardness	
Fluoride, Dissolved (*New Facilities Only*)	100 ug/L	4,000 ug/L	
Hardness (CaCO3) mg/L	10 mg/L as $CaCO_3$	(for metals analyses)	
Iron, Dissolved	50 ug/L	1000 ug/L	
Iron, Dissolved, for Class 2A and 2AB waters	50 ug/L	300 ug/L	
Lead, Dissolved	2 ug/L	2.5 ug/L (hardness dep)	
Magnesium, Dissolved	100 ug/L, report as mg/L		
Manganese, Dissolved	50 ug/L	1462 ug/L (hardness dep)	
Manganese, Dissolved, for Class 2A and 2AB	50 ug/L	50 ug/L	
Mercury, Dissolved	1 ug/L	0.77 ug/L	
Molybdenum, Dissolved (*New Facilities Only*)	100 ug/L	300 ug/L	
Nickel, Dissolved	10 ug/L	52 ug/L (hardness dep)	
Oil and Grease	5 mg/L	10 mg/L	
pH	0.1 pH unit	6.5-9.0 s.u.	


SLOW
PROCEED WITH
CAUTION

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