

Review of Water Quality in the Rio Grande for Potable Use

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RMS AWWA/WEF Lunch Seminar
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Why were these reviews done?

- This section of the Rio Grande has not been used as a drinking water source before.
- Buckman Direct Diversion (BDD) City/County WTP recently started construction.
- ABCWUA San Juan-Chama WTP recently started operation.
- Both utilities requested independent analysis of water quality and treatment issues because of concerns within the community.



Presentation outline

- Watershed and impacts on water quality
- Treatment train (pilot and full-scale)
- Regulated contaminants
 - Microorganisms / IOCs / SOCs
- Unregulated contaminants
 - Perchlorate
 - Pharmaceuticals / personal care products (PPCPs)
- Radionuclides
- Disinfection by-products
- Summary / More info

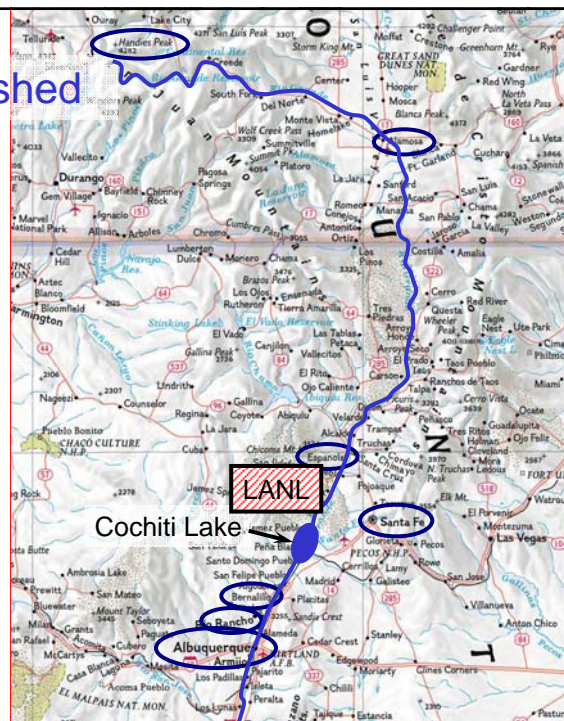
3 of 45



Rio Grande watershed

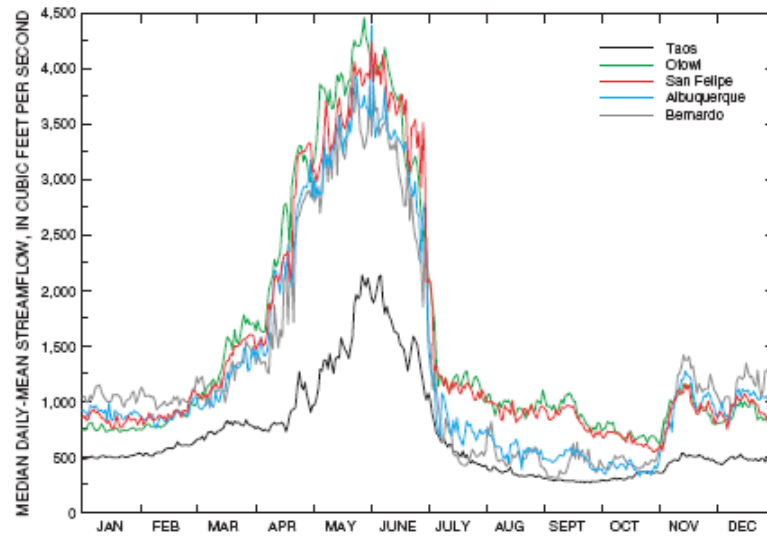
Factors affecting water quality:

- Climate/terrain
- Upstream discharges:
 - Heavy industry
 - Agriculture
 - Population
- Cochiti Lake
- Los Alamos N. L.



4 of 45

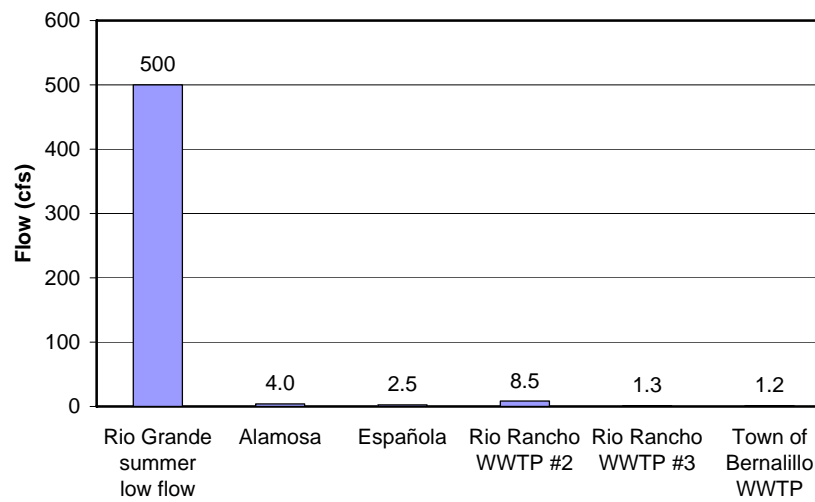
Streamflow in the Rio Grande



5 of 45

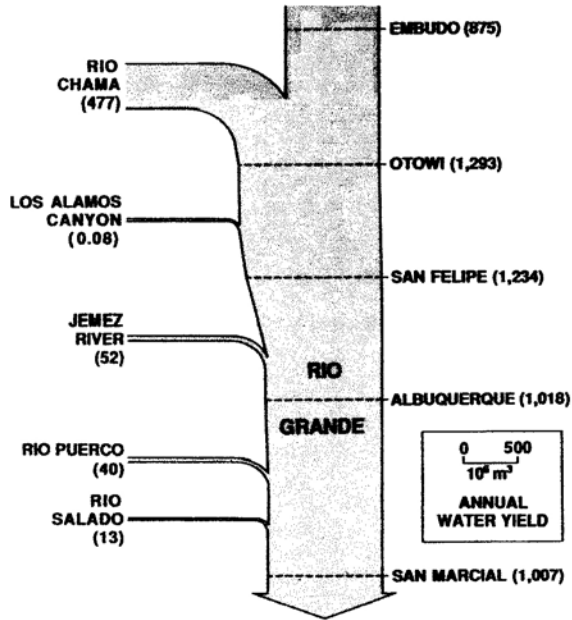
Source: Langman and Anderholm, USGS, SIR 2004-5188

Impact of wastewater discharges



6 of 45

Impact of Los Alamos canyon (water)

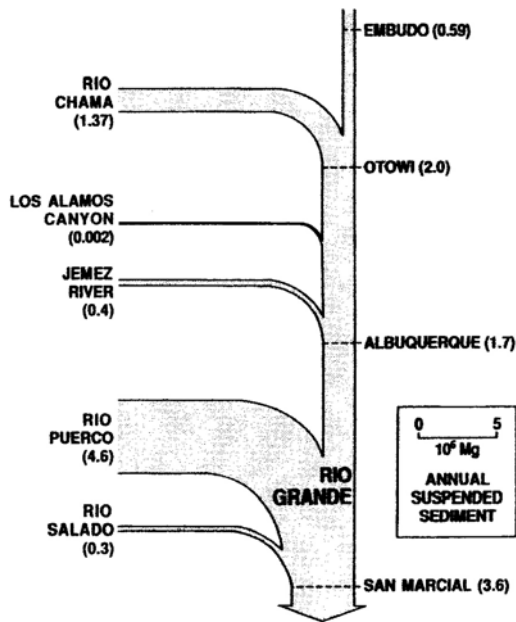


Annual water contribution of Los Alamos canyon to the Rio Grande: 0.008 %

Ref: Graf (1994)

7 of 45

Impact of Los Alamos canyon (sediment)

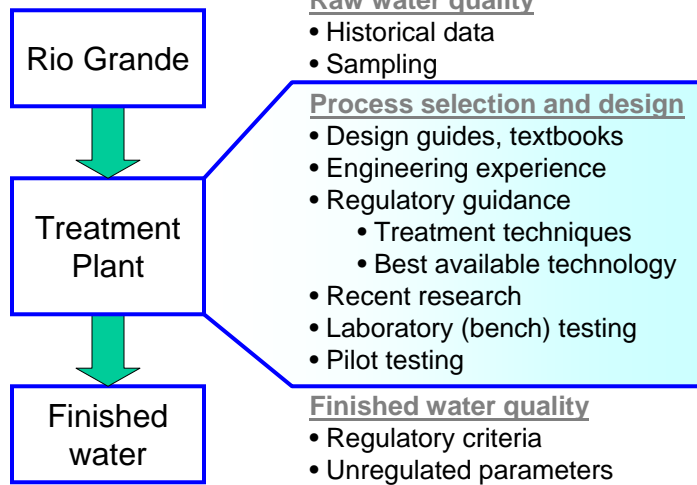


Annual sediment contribution of Los Alamos canyon to the Rio Grande: 0.1 %

Ref: Graf (1994)

8 of 45

Water treatment design process



9 of 45

Data sources on river water quality

- NMED
- USGS
- LANL
- BDD pilot plant
- ABCWUA pilot plant

10 of 45

Pilot testing

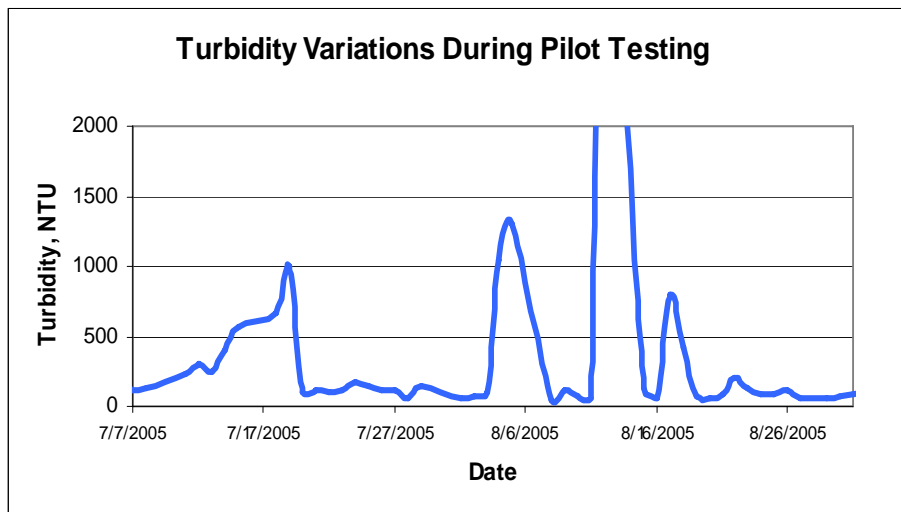
BDD

ABCWUA



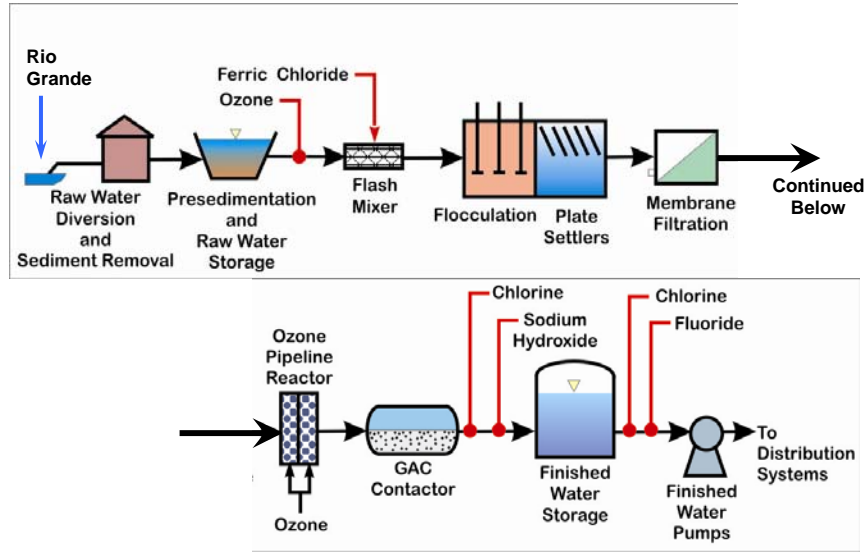
11 of 45

Sediment in the river (BDD)



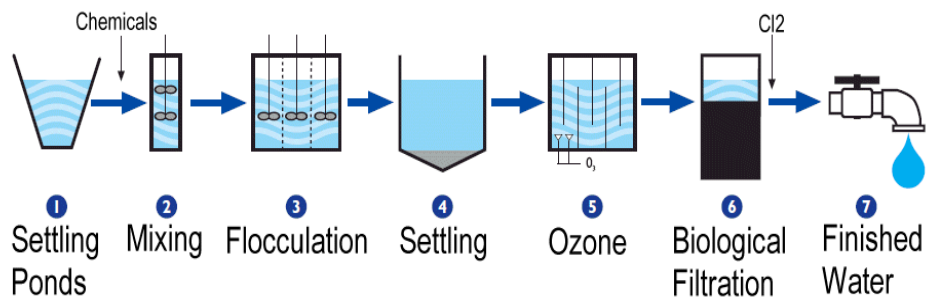
12 of 45

BDD City/County WTP process train



13 of 45

San Juan Chama WTP process train



14 of 45

Regulated: Microorganisms

- Both plants have multiple barriers: filtration, ozonation, chlorine

San Juan Chama WTP Log removal credit:

Organism	Achieved with filters	Achieved with ozone	Achieved with chlorine	Total removal achieved	Removal required
Viruses	2	2.3	> 4	> 8	4
<i>Giardia</i>	2.5	0.7	2.5	5.7	3
<i>Cryptosporidium</i>	4	—	—	4	3

15 of 45

Regulated: Inorganics (ABCWUA pilot)

- 29-32 samples, raw water (MCL is for treated water)
- Non-detectable: Sb, Cd, Cu, CN, Hg, NO₂, Se, Tl

	Detects	Median (mg/L)	Max. (mg/L)	MCL (mg/L)	OK?
As	29	0.003	0.005	0.010	Yes
Ba	15	0.1	0.3	2	Yes
Be	1	0.001	0.001	0.004	Yes
Cr	29	0.004	0.015	0.1	Yes
F	32	0.4	0.47	4	Yes
Ni	3	0.01	0.02	0.1	Yes
NO ₃	2	0.064	0.11	10	Yes

16 of 45

Regulated: Organics (ABCWUA pilot)

- Pretty much the same story.
- Sampling during ABCWUA pilot plant:
 - Raw and treated water
 - ~ 100 organic contaminants
 - ~ 30 sampling episodes
- Thousands of samples; almost no detections of anything.

17 of 45



Unregulated: Perchlorate

- Why an issue?
 - Explosive manufacturing/detonation is one source for perchlorate
 - Can interfere with thyroid function
- Conclusions
 - Perchlorate not regulated, current health advisory level = 15 $\mu\text{g/L}$
 - Measured values in river:
 - Mostly below detection limit
 - Average measured conc. = 0.064 $\mu\text{g/L}$
 - Maximum measured conc. = 0.071 $\mu\text{g/L}$

18 of 45



Unregulated: Pharmaceuticals (PPCPs)

- NMED (28 PPCPs, 23 surface water samples)
 - Only detect: 30 ng/L amitriptylene at Buckman Crossing
- USGS (Cochiti to Albuquerque)
 - Hundreds of samples (52 – 196 organics, 3 locations, multiple times)
 - Only detect: 0.2 ng/L tris(2-butoxyethyl)phosphate
- Brown (39 PPCPs, 1 sample near intake)
 - No detects
- Martinet (19 PPCPs)
 - 7 detects in shallow groundwater adjacent to Rio Grande (above SWRP but below intake)

19 of 45



Perspective on PPCPs

- amitriptylene consumed at 30 ng/L in 2 L/day for 70 years provides lifetime exposure of 1.5 mg.
- amitriptylene taken for depression: typical daily dose is 40 – 150 mg.
 - If no removal at treatment plants, lifetime exposure would be 100 times less than single day's dose when taken for medical purposes.

20 of 45



Treatment for PPCPs

- Ozone has been found to be one of the most effective treatment processes for PPCPs.
- Both plants use ozone.

Summary

- Risk of PPCP presence in Rio Grande is extremely low.
- Plants have the best technology for removing PPCPs.

21 of 45



Radionuclides – Why an issue?

- Plant intakes are downstream of Los Alamos National Lab
 - Canyons are contaminated
- Radionuclides may have health impacts after long-term exposure

22 of 45



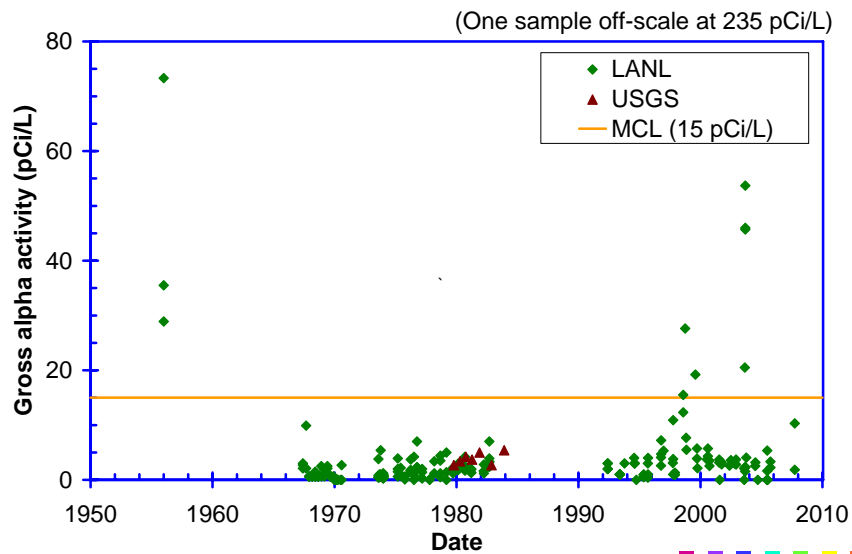
Radionuclide regulations

Parameter	MCL
■ Uranium	30 µg/L
■ Radium 226/228	5 pCi/L
■ Gross alpha activity <ul style="list-style-type: none"> ■ Excludes uranium and radon ■ Includes plutonium, americium, others 	15 pCi/L
■ Gross beta and photon emitters <ul style="list-style-type: none"> ■ Includes 126 different isotopes 	4 mrem/yr

23 of 45



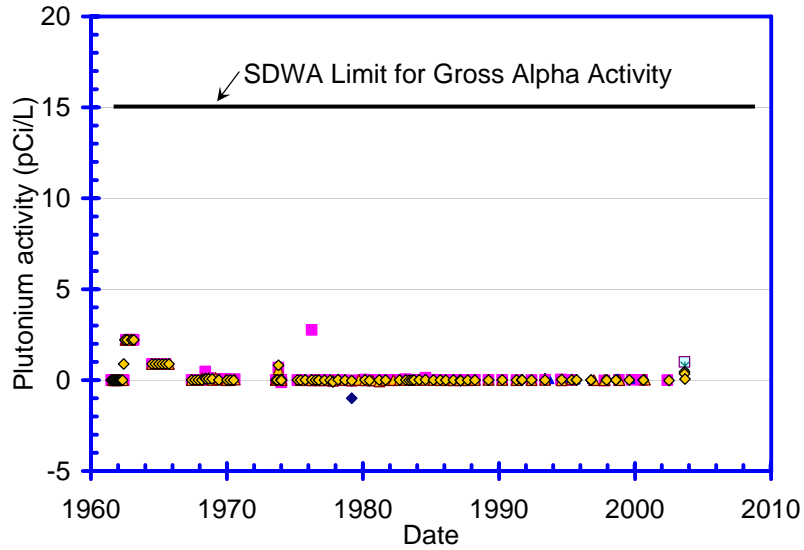
Gross alpha, Rio Grande above Cochiti



24 of 45

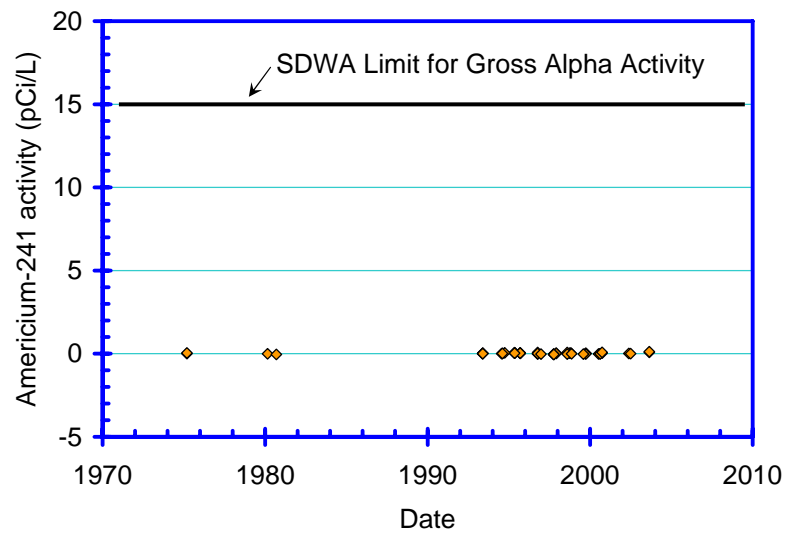


Plutonium, Rio Grande above Cochiti



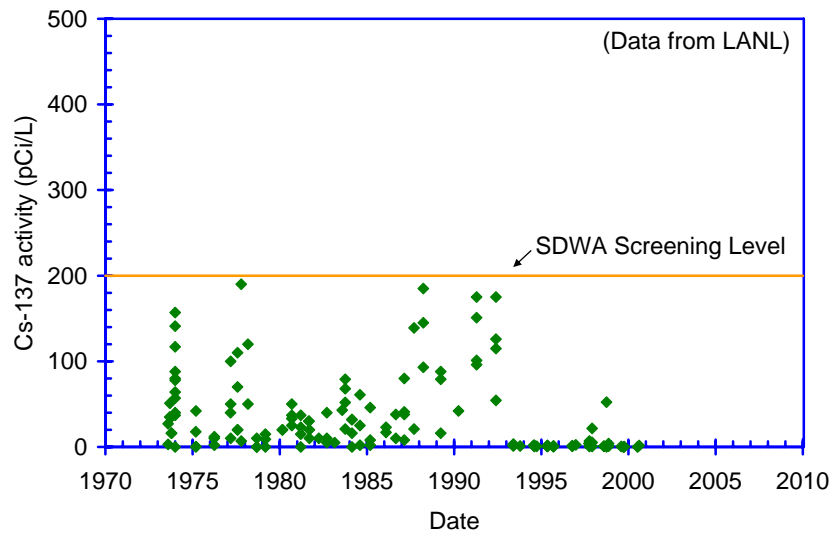
25 of 45

Americium, Rio Grande above Cochiti



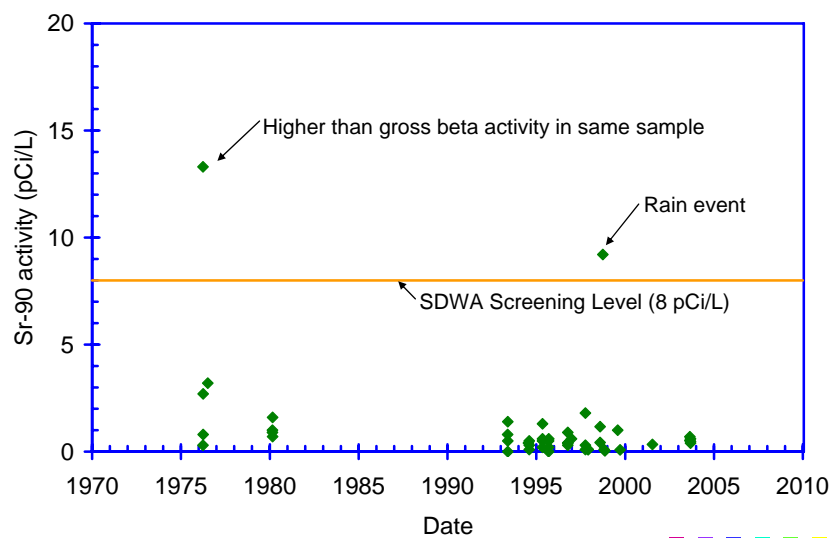
26 of 45

Cesium-137, Rio Grande above Cochiti



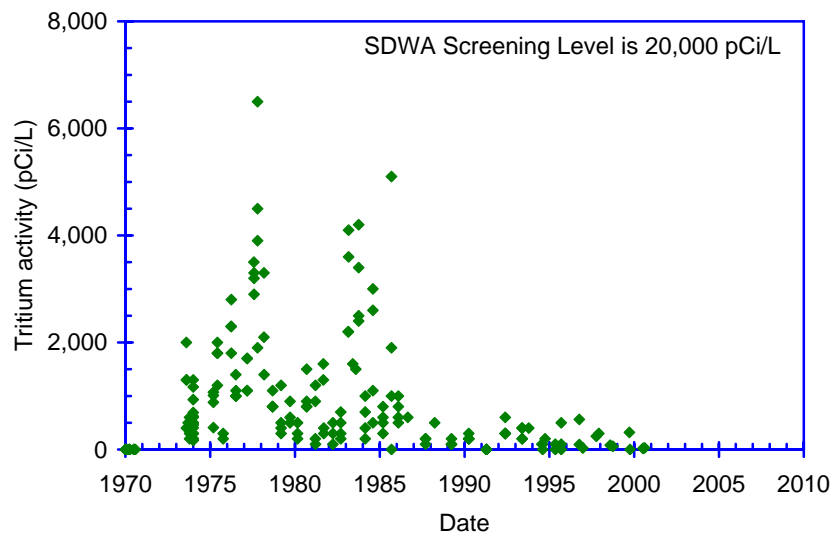
27 of 45

Strontium-90, Rio Grande above Cochiti



28 of 45

Tritium, Rio Grande above Cochiti

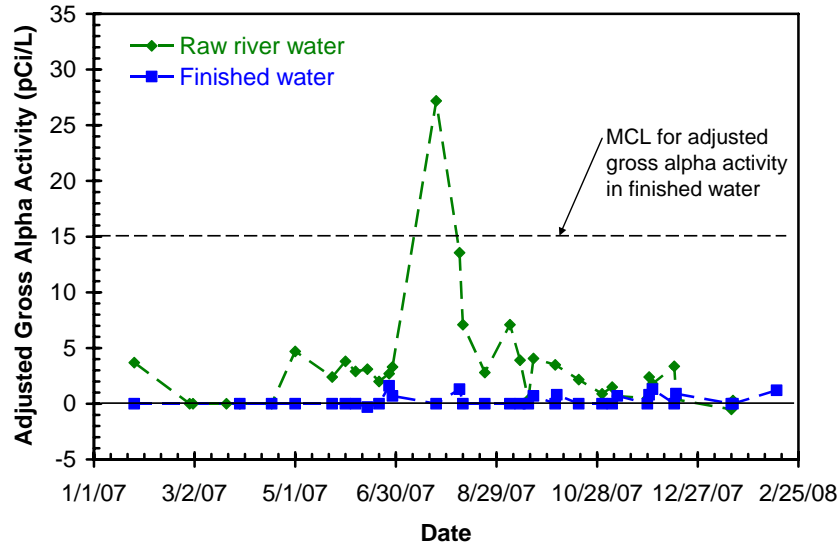


Radionuclides below Cochiti

- USGS (Falk and Anderholm) did a summary of all radionuclide activity between Cochiti and Albuquerque for water years 1985-2005 from all agencies.
- All raw water samples were below corresponding treated water regulatory limits.
- In general, radioactivity below Cochiti is less than above Cochiti.

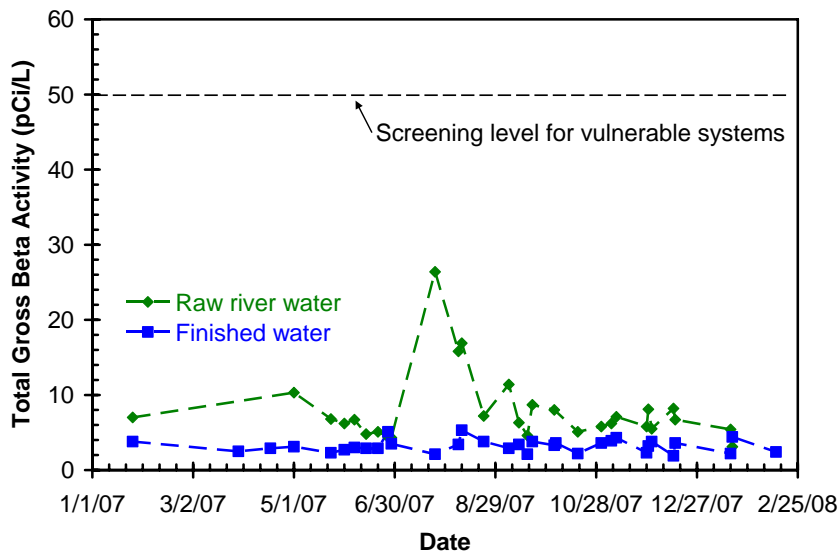
30 of 45

Gross alpha activity removal in ABCWUA pilot



31 of 45

Gross beta activity removal in ABCWUA pilot



32 of 45

Radionuclide summary for ABCWUA

- Historical data from USGS, NMED, and LANL:
 - Radioactivity in river water downstream of Cochiti Lake always below regulated limits for treated drinking water
- Intensive additional testing during pilot plant:
 - River water (before treatment) almost always below regulated limits for treated drinking water
- Pilot plant results:
 - Treatment process is very effective at removing radionuclides

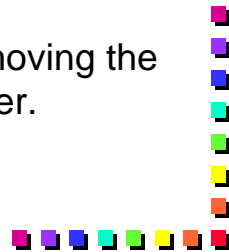
33 of 45



Radionuclide summary for BDD

- Concentrations in the river are almost always below regulated levels.
 - Exceptions can be traced to storm events with high turbidity in the river.
 - Specific radionuclides like plutonium and americium are very low compared to regulations.
- Inflow to treatment facility can be stopped during storm events.
- Treatment process is capable of removing the contaminants if they were in the water.

34 of 45



Radiation exposure comparison



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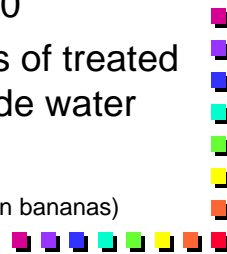
banana

400

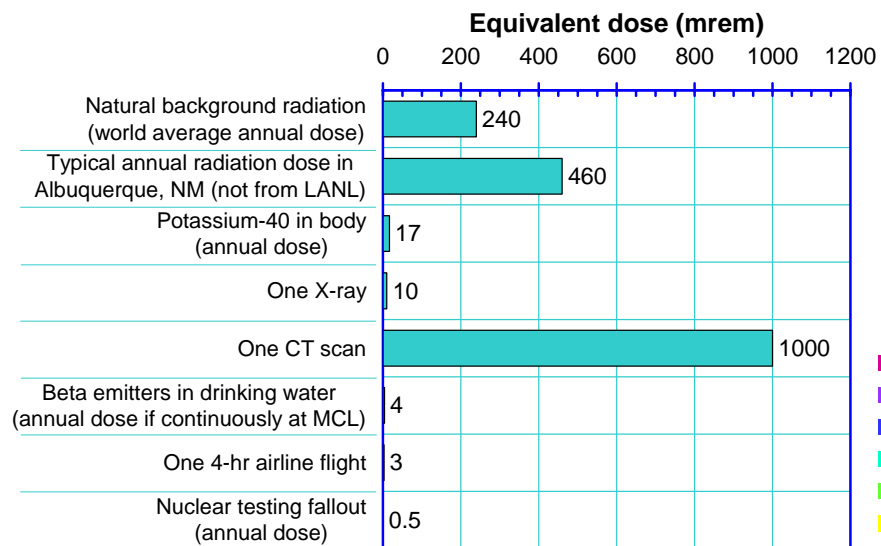
8-oz glasses of treated
Rio Grande water

(Gross beta activity comparison based on potassium-40 in bananas)

35 of 45



Radiation is everywhere



36 of 45



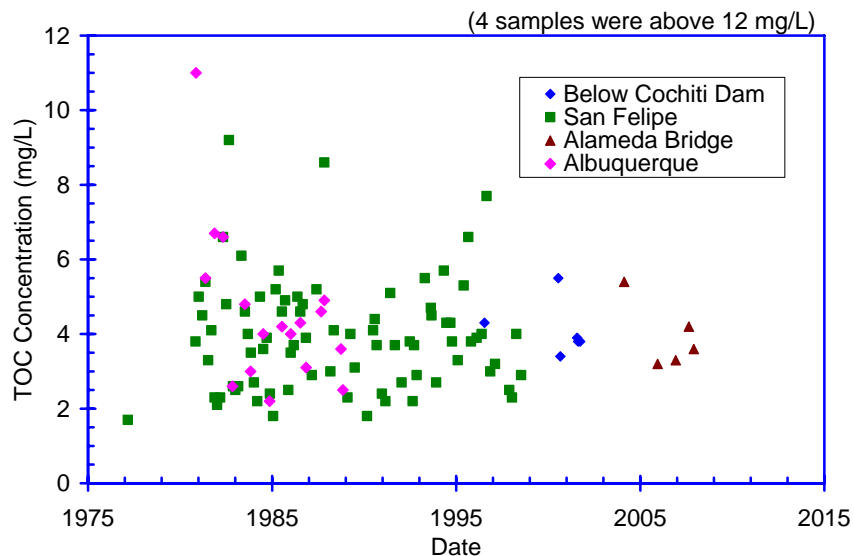
Disinfection by-products: Why an issue?

- Reactions between disinfectants and pathogens is key to delivering safe water
- Reactions between disinfectants and natural organic matter (NOM) create contaminants
 - May have health impacts after long-term exposure
- Rio Grande has higher NOM than groundwater

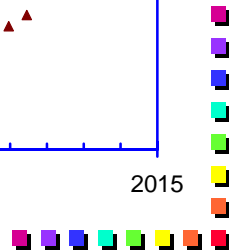
37 of 45



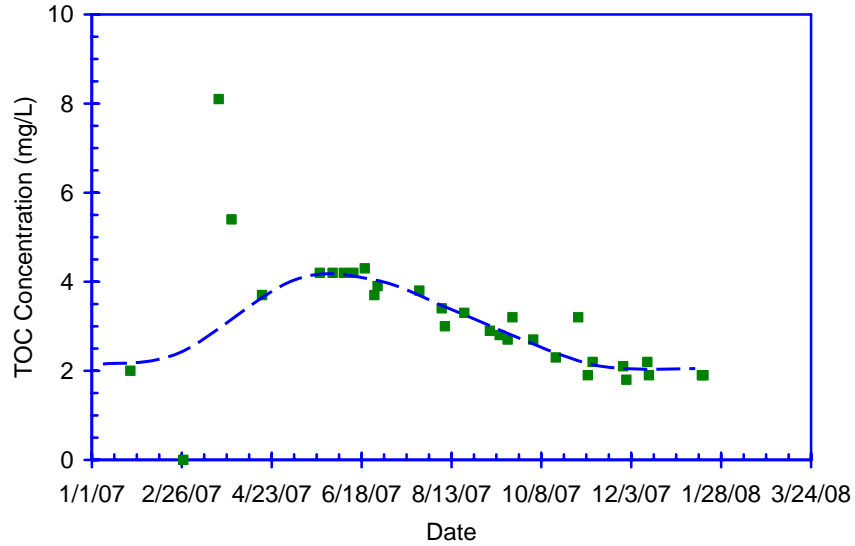
TOC in the Rio Grande (1975 – 2007)



38 of 45



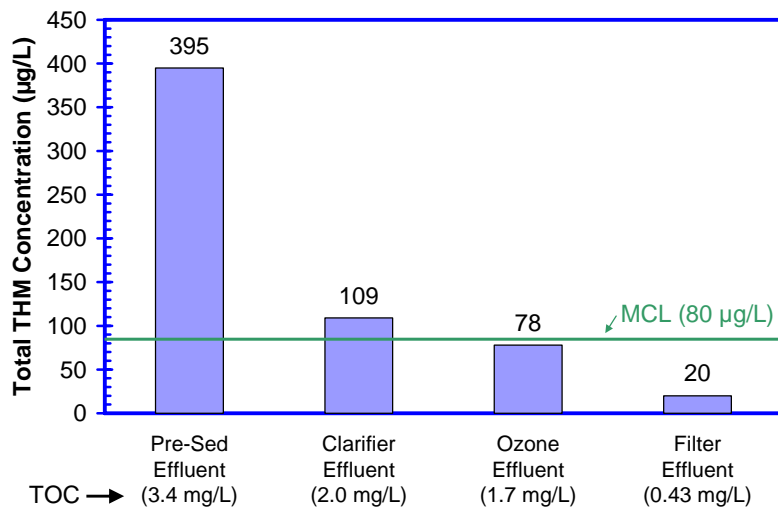
TOC in the Rio Grande (2007)



39 of 45

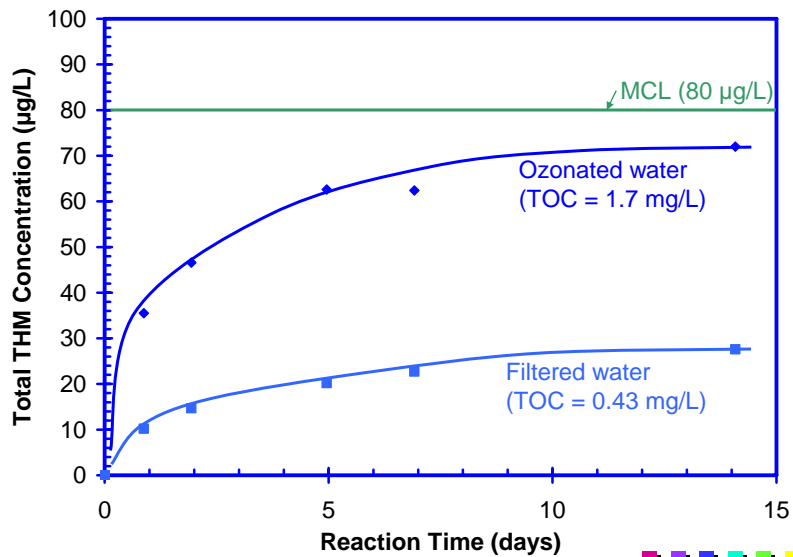
Source: ABCWUA pilot plant

THM Formation Potential (7-day)



40 of 45

Simulated Distribution System Tests



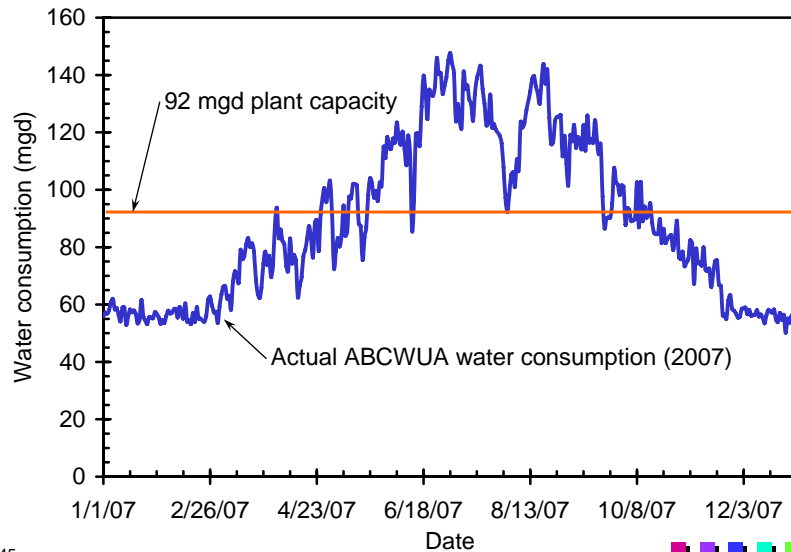
41 of 45

Disinfection by-products: Conclusions

- Robust design:
 - Enhanced coagulation and ozone/biofiltration to remove natural organic matter
 - Primary disinfectant: ozone
- Pilot plant and additional testing results:
 - Plant effective at removing natural organic matter
 - DBP formation meets regulations
- Additional factors of safety:
 - Low DBP formation in the winter, compliance based on annual averages
 - Blending with groundwater

42 of 45

Production and capacity of San Juan Chama WTP



43 of 45

Summary

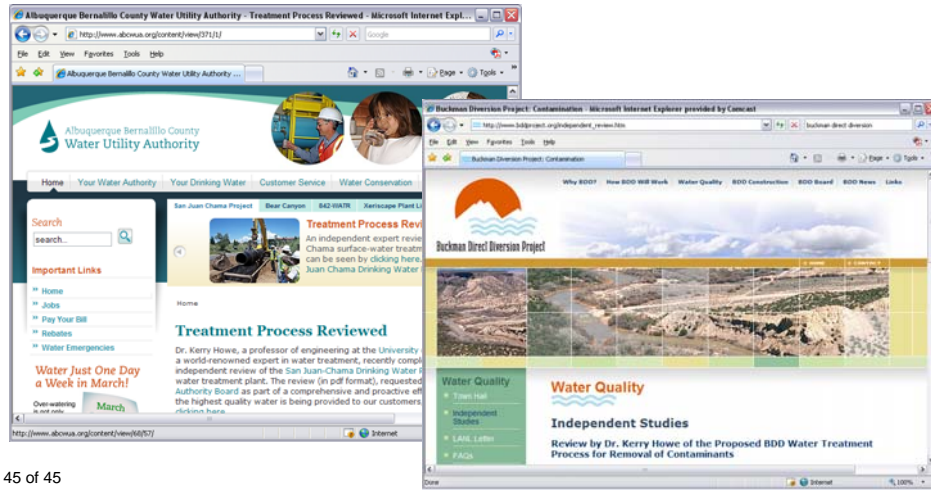
- Not much impact on Rio Grande from man-made contaminants.
- Treatment challenges are mostly related to sediment removal.
- Treatment trains are very robust for removing a wide range of regulated and unregulated constituents.

44 of 45

For more information:

<http://www.abcwua.org/content/view/371/1/>

http://www.bddproject.org/independent_review.htm



45 of 45