Lessons from Salt Creek

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Background

- In 2003 and 2004 prepared UAA for Salt Creek and sections of Powder River
- In support of a site specific water quality criterion for chloride
- In cooperation with PRCD Section 319 watershed grant
- UAA evaluated water quality, livestock use, wildlife, fisheries, and aquatic life

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Salt Creek

- Originally intermittent creek
- Has received produced water from Salt Creek, Teapot Dome and smaller fields for 75 years
- Since 1990 year round flows of 13-15 cfs
- Almost all base flow in creek is produced water
- During late summer Salt Creek contributes up to 90% of flow in Powder River

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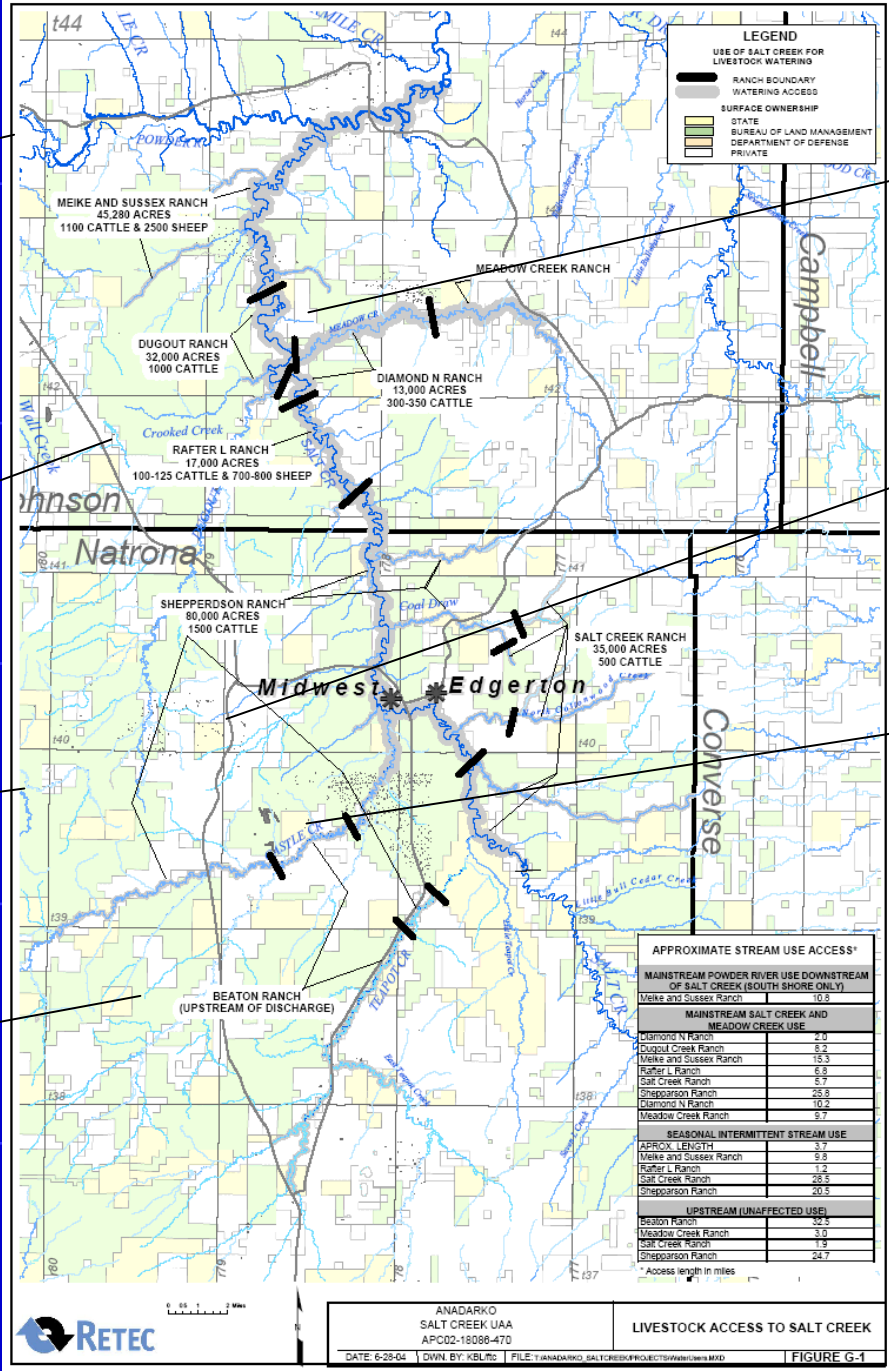
Powder River

Salt Creek

I-25

Salt Creek upstream of discharges



Meadow Creek field

Salt Creek field

Teapot Dome field

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Lesson 1: Livestock Use

- Interviewed and got written statements from ranchers with Salt Creek frontage
- All stated that they use and are dependent on Salt Creek for watering their stock
- Few alternative water sources available
- Ranchers indicate water is excellent for their cattle and sheep (also open in winter, lower salts in summer)
- Loss of Salt Creek water would force a reduction in herd size for all ranchers → economic loss

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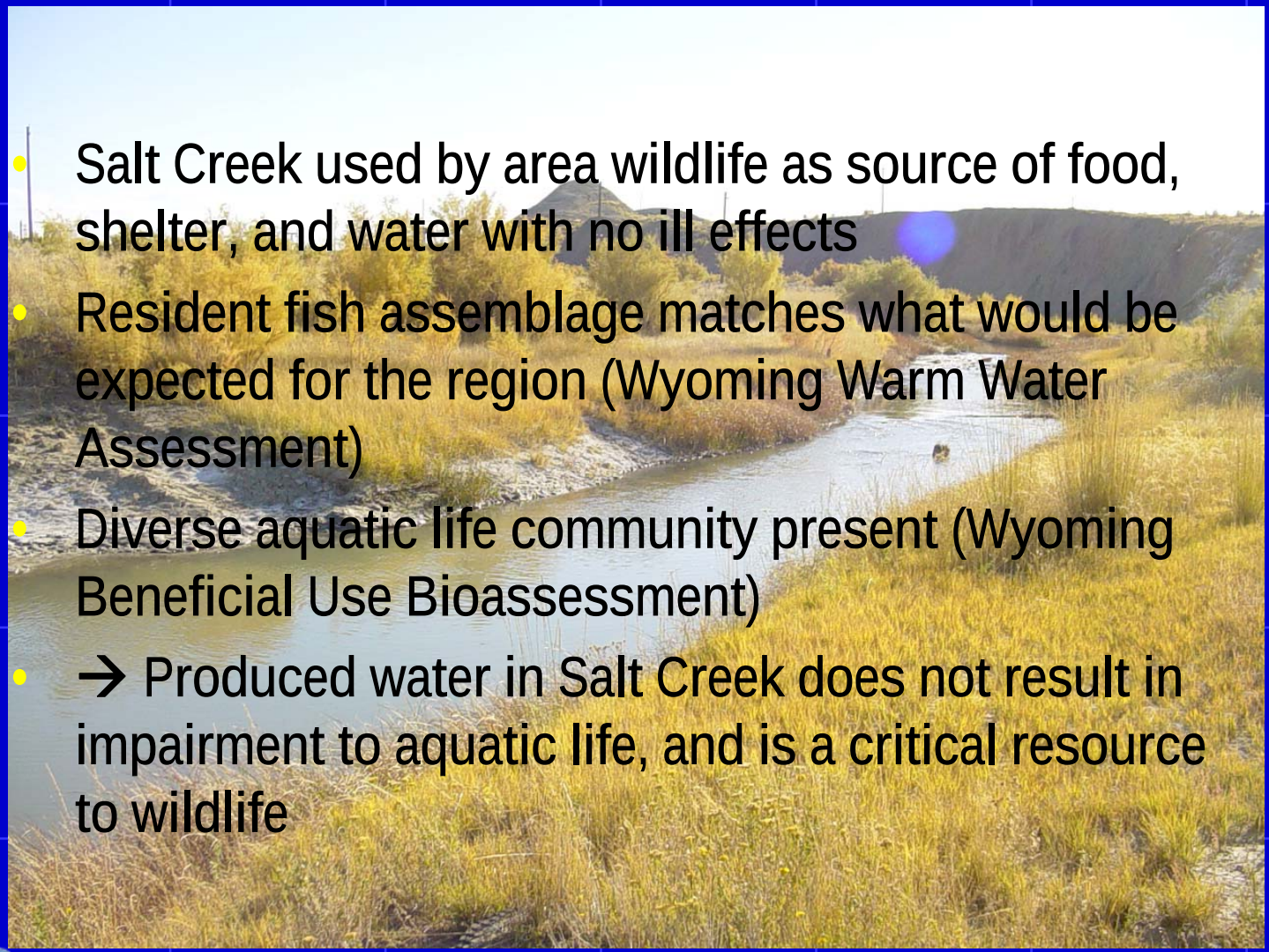
Lesson 2: Wildlife



- Salt Creek used by area wildlife as source of food, shelter, and water with no ill effects
- Resident fish assemblage matches what would be expected for the region (Wyoming Warm Water Assessment)
- Diverse aquatic life community present (Wyoming Beneficial Use Bioassessment)
- → Produced water in Salt Creek does not result in impairment to aquatic life, and is a critical resource to wildlife

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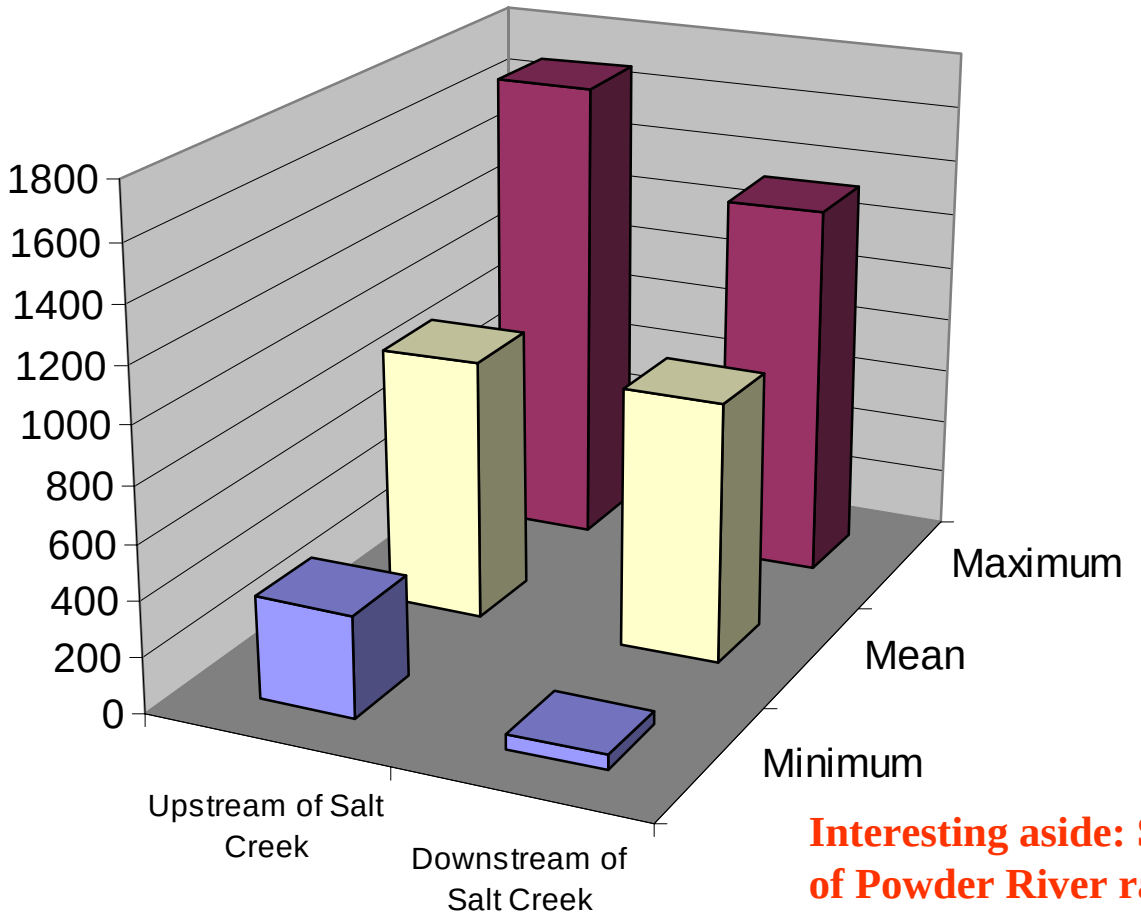
Sulfates in Powder River



Interesting aside: South Fork of Powder River ranges from 1300 to 2100 mg/L

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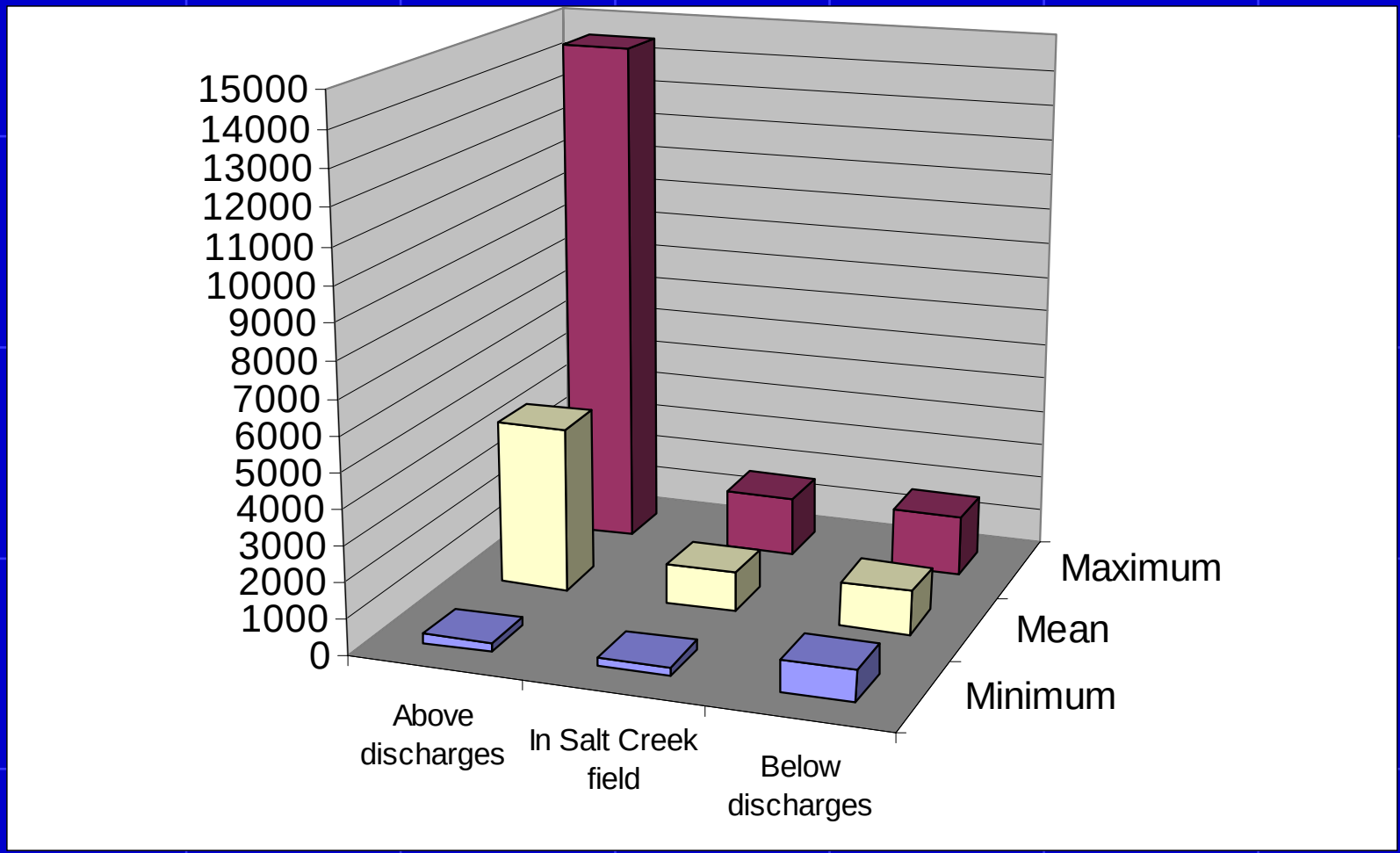
Sulfates in Salt Creek



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Sulfates

- Natural waters not affected by produced water routinely exceed 500 mg/L and may exceed 2000 mg/L sulfates
- Smaller intermittent streams may reach much higher (up to 14,000 mg/L recorded)

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Sulfate and TDS Toxicity

- Concentrations observed in Salt Creek which do not result in any negative effects on livestock or aquatic life:
  - Salt Creek ABOVE discharges
    - Sulfates 250-14500 mg/L (average 4700) → bad water
    - TDS 590-25100 mg/L (average 8040) → bad water
  - Salt Creek BELOW discharges
    - Sulfates 870-1700 mg/L (average 1220) → good water
    - TDS 3240-5040 mg/L (average 4030) → good water

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Barium

- Reviewed scientific literature on barium toxicity to livestock and wildlife
- Barium not generally considered a significant toxicant

- Canada recommended livestock levels:
  - 100 mg/L for livestock (*Agriculture and Agrifood Canada 2000*)
  - But Ontario 300 mg/L, British Columbia 5 mg/L

- U.S. lacks nationally recommended levels:
  - e.g. NAS 1974 or CAST 1974
  - State Ag Extension Services 10 mg/L
  - Recent summary (Beede 2005) notes 10 mg/L as "possible (health) problems based on scientific literature and field experience" [for dairy cattle]

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Summary

- Natural sulfate concentrations are high and often higher than the discharges
- No evidence of negative effect on livestock, wildlife, fisheries, or aquatic life from discharged PW to Salt Creek and in Powder River
- Use of creek with PW highly beneficial to ranchers as resource for livestock

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Aquatic Life

	MEADOW CREEK	SALT CREEK (UP-STREAM)	SALT CREEK (DISCHARGE AREA)		SALT CREEK (LOWER)			POWDER UPSTREAM OF SALT CREEK	POWDER DOWN-STREAM OF SALT CREEK
% comparison to reference	104%	REF-ERENCE	90%	115%	115%		117%	REF-ERENCE	84%
Conclusion	EQUIV	REF-ERENCE	EQUIV	EQUIV	EQUIV		EQUIV	REF-ERENCE	*EQUIV*
Primary Criteria Assessment									
Impairment Analysis	*100%*	*BASELINE*	*47%*	*53%*	*93%*	*93%*	*93%*	*REF-ERENCE*	*94%*
Conclusion	*EQUIV*	*BASELINE*	*MODERATE REDUC-TION*	*MODERATE REDUC-TION*	*EQUIV*	*EQUIV*	*EQUIV*	*REF-ERENCE*	*UNIMPAIRED*

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Fisheries

Salt Creek Fish Survey 2003-2004 (conducted by WGFD and private consultants)

Warm Water Fish Assessment	*Species*	*Comment*
Expected and Observed	Flathead Chub, Plains Minnow, Sand Shiner, Fathead Minnow, Plains killifish, Black Bullhead	Populations appear to be thriving in all areas of Salt creek
Expected yet not Observed	Common Carp	Missed by few
Not Expected yet Observed	Green Sunfish, Longnose Dace, Creek Chub	Sunfish is a release, others more typical of mountain streams
Not Expected and Not Observed	Many large river and/or rocky/clear stream fish	Sturgeon Chub is an interesting case

In spite of salty (TDS=3200-5000 ppm) water…

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