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Wet Meadow Hydrologic Study

Introduction and Background

Since mid-2013, PRRIP has conducted hydrological and climatological monitoring at the Fox and Shoemaker wet meadow sites in support of broader objectives to improve the understanding and management of wet meadows within the Central Platte River Basin (CPRV) ([PRRIP 2021](#)). Both sites are on vegetated islands within the riparian zone of the Platte River. The Shoemaker Island site, considered a native wet meadow, is located approximately 13 miles southwest of Grand Island, NE. The Fox site, a restored wet meadow that was formerly converted to cropland, is approximately 4 miles southeast of Kearney, NE. Monitoring networks at each site include river stage gages, groundwater wells, weather stations, and various other logging devices. Amassed data sets include time series that span the 8-year monitoring period at either hourly, daily, or monthly measurement frequencies (**Table 1**).

Table 1 – Summary of wet meadow data for Shoemaker and Fox sites.

Parameter monitored	Quantity per Site	Record Span		Frequency	Instrumentation
		Shoemaker	Fox		
River Stage	2	Mar. 13 - Dec. 19	Mar. 13 - Jun. 20	Hourly	IS Level Troll 500, 5 psig
Groundwater elev.	16	Mar. 13 - Apr. 21	Mar. 13 - Mar. 21	Hourly	IS Level Troll 500, 5 psig
Runoff	3 / 5	Mar. 13 - Apr. 16	Mar. 13 - Apr. 16	Sporadic	USGS crest stage gage
Precipitation	1	May 13 - Aug. 21	May 13 - Apr. 20	Daily	CS tipping bucket (TE525-L)
Precipitation	1	May 13 - Dec. 13	May 13 - Dec. 13	Monthly	HPRCC winter precipitation gage
Wind speed	1	May 13 - Aug. 21	May 13 - Apr. 20	Hourly	CS met-one wind set, 034B-L
Wind direction	1	May 13 - Aug. 21	May 13 - Apr. 20	Hourly	CS met-one wind set, 034B-L
Solar Radiation	1	May 13 - Aug. 21	May 13 - Apr. 20	Hourly	CS silicon pyranometer, LI200X-L
Air Temperature	1	May 13 - Aug. 21	May 13 - Apr. 20	Hourly	CS temp. & humidity probe, HMP155A-L
Relative humidity	1	May 13 - Aug. 21	May 13 - Apr. 20	Hourly	CS temp. & humidity probe, HMP155A-L
Plant canopy temp.	1	May 13 - Aug. 21	May 13 - Apr. 20	Hourly	CS infrared radiometer, SI-111
Soil temperature	1	May 13 - Aug. 21	May 13 - Apr. 20	Hourly	CS temperature probe, 107L
Soil moisture	4	May 13 - Aug. 16	May 13 - Sep. 16	Hourly	Theta Probe soil moisture probe, MLX2
Reference ET	1	May 13 - Aug. 21	May 13 - Apr. 20	Hourly	ETgage modified atmometer, Model E
Snow depth	1	Dec. 13 - Apr. 16	Dec. 13 - Feb. 16	Hourly	Reconyx Hyperfire PC800 camera & *gage
Wetland/slough water elev.	1	May 14 - Sep. 14	Feb. 14 - Apr. 16	2/day	Reconyx Hyperfire PC800 camera & *gage

Summer 2021 Activities - Data QC

During the summer of 2021, wet meadow data were subject to rigorous quality control (QC) procedures to ensure that data meet quality standards prior to analysis. QC procedures involved reviewing scientific and environmental contexts under which data were collected, identifying and flagging and subsequently correcting or removing problematic data, and thoroughly documenting all QC decisions. QC criteria were defined as data that are accurate in time and magnitude and containing minimal gaps. Manual measurements collected throughout the study period were used to verify data accuracy and correct for instrument drift. The most persistent quality issues encountered during data QC included temporal gaps, offsets, and outliers. Primary correction measures included filling short-term data gaps through interpolation, shifting offset data, and removing bad data. River stage data were especially prone to quality issues due to the dynamic nature of field conditions. Relationships between wet meadow river stage and nearby USGS NWIS river stage gages were established to aid in QC and to fill long-term data gaps which spanned up to 50% of the monitoring period at some sites (e.g. **Figure 1**). QC procedures are summarized in a September 2021 internal PRRIP Executive Director's Office Wet Meadow Data QC Memo.



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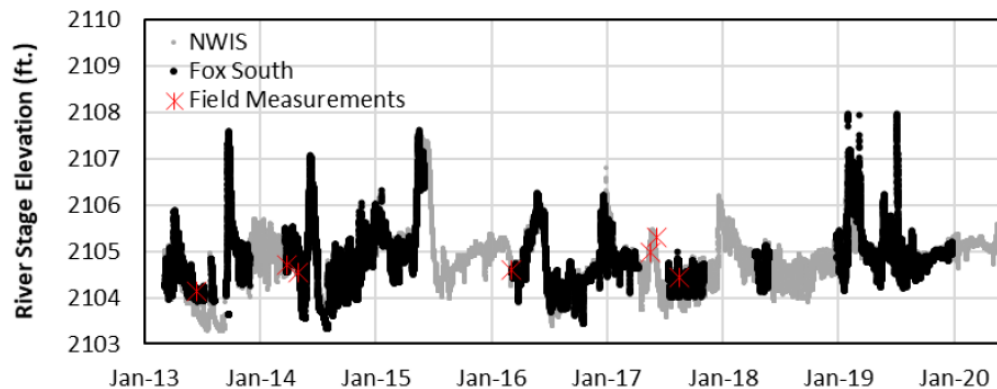


Figure 1 – Example of Platte River stage data supplemented with USGS-NWIS stage data at the Fox Site.

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Following Data QC, next steps include designing a hydrologic study that informs management decisions at wet meadow sites. Wet meadow hydrology was previously identified as a potential limiting factor for successful wet meadow restoration in the CPRV ([Davis et al. 2006](#), [Meyer et al. 2008](#)). While it is well established that shallow groundwater levels are critical to wet meadow health, current hydrological targets are loosely defined and managers lack critical decision-making tools that can be used to compare costs and optimize water use. Studies which quantify relationships between hydrological variables and wet meadows would significantly improve the ability to predict water needs for management. Further, clearly defined hydrological targets based on healthy wet meadow sites would improve efficiency and provide metrics to test management options.

Therefore, proposed objectives for this wet meadow hydrological study are to:

1. Quantify relationships between hydrological and meteorological variables at wet meadow sites to develop tools (e.g. models) with which to test different management scenarios.
2. Develop hydrological targets for managing wet meadow sites that can be assessed by seasonal hydroperiods and water level hydrographs.
3. Apply hydrological targets and compare water requirements for management options at one of PRRIP's managed wet meadow sites.

Preliminary work has focused on developing a potential workflow to address these objectives. A proposed workflow includes quantifying relationships between groundwater levels, stage increases, and precipitation at wet meadow sites through analytical groundwater models. Once calibrated, these models can serve as predictive tools for testing different management strategies. Next, hydrological targets will be defined based on published studies of water requirements for wet meadow vegetation and statistical metrics garnered from the native Shoemaker wet meadow site. Once hydrological targets are developed, the 8-year data set from the Fox site will be evaluated with respect to hydrological targets. For years where the site did not meet targets, calibrated models will be used to predict water-requirements to meet targets using different strategies and their associated costs. Results will include improved understanding of wet meadow hydrological relationships, development of hydrological targets for CPRV wet meadow maintenance, and a set of tools for testing management strategies related to wet meadow hydrology. This suggested workflow is summarized in **Figure 2**.



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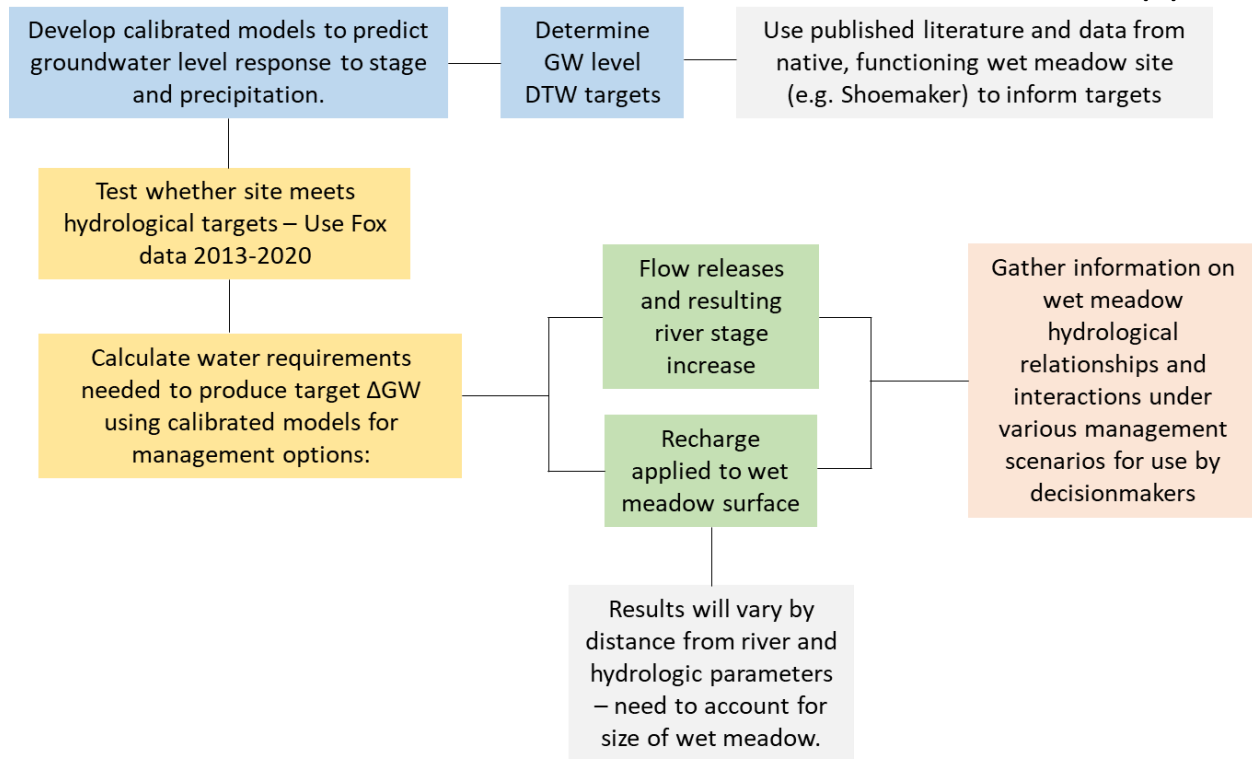


Figure 2 – Proposed workflow for the wet meadow hydrological study. Groundwater (GW). Distance to water (DTW).

References Cited

Davis, Craig A.; Austin, Jane E.; and Buhl, Deborah A., "Factors Influencing Soil Invertebrate Communities in Riparian Grasslands of the Central Platte River Floodplain" (2006). USGS Northern Prairie Wildlife Research Center. 2.

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Platte River Recovery Implementation Program (PRRIP). 2021. PRRIP Full Program Document Updated September 14, 2021, Adaptive Management Plan, Table 1, Ref. no. 28, pp. 125.

https://platteriverprogram.org/sites/default/files/2021-09/PRRIP%20Full%20Program%20Document%20Updated%209_14_2021.pdf