INSIGHT WATER SUPPLY AND WATER DEMAND - DRAFT

KEY ASSUMPTIONS AND METHODS FOR THE UPPER PLATTE RIVER BASIN ABOVE ODESSA

WATER SUPPLIES

For purposes of the evaluation methodology, the water supplies consist of the summation of streamflows, surface water consumptive uses, and groundwater depletions. Water supplies were tabulated for the period of 1988 – 2012 to represent naturally occurring wet and dry cycles. Required inflows are also included in the water supplies when evaluating individual sub-basins, but not when evaluating the entire overappropriated basin. Further description of each element of the water supply is provided below.

STREAMFLOWS– streamflows are the measured streamflow of the basin with the exception that mean daily flows in excess of the five-percent exceedance probability are capped at the five-percent exceedance value (see Figure 1)[1]. The streamflows for a sub-basin are calculated by subtracting the upstream gage from the downstream gage to establish the gain/loss in streamflow for each sub-basin. The exceptions are as follows:

- Lewellen Streamflow = Uncapped Lewellen gage
- South Platte Streamflow = Capped South Platte River at North Platte gage + Historic Korty Diversion
- North Platte Streamflow Gain = Capped North Platte gage + 40 cfs – Capped Keystone gage. (This was done to prevent Lake MAC operations from influencing the analysis.)
- Odessa Streamflow Gain = Capped Odessa gage – Capped "Streamflow at Confluence" of North Platte & South Platte Rivers + Kearney Diversion where the "Streamflow at Confluence" = North Platte River at North Platte + South Platte River at North Platte + Sutherland Return

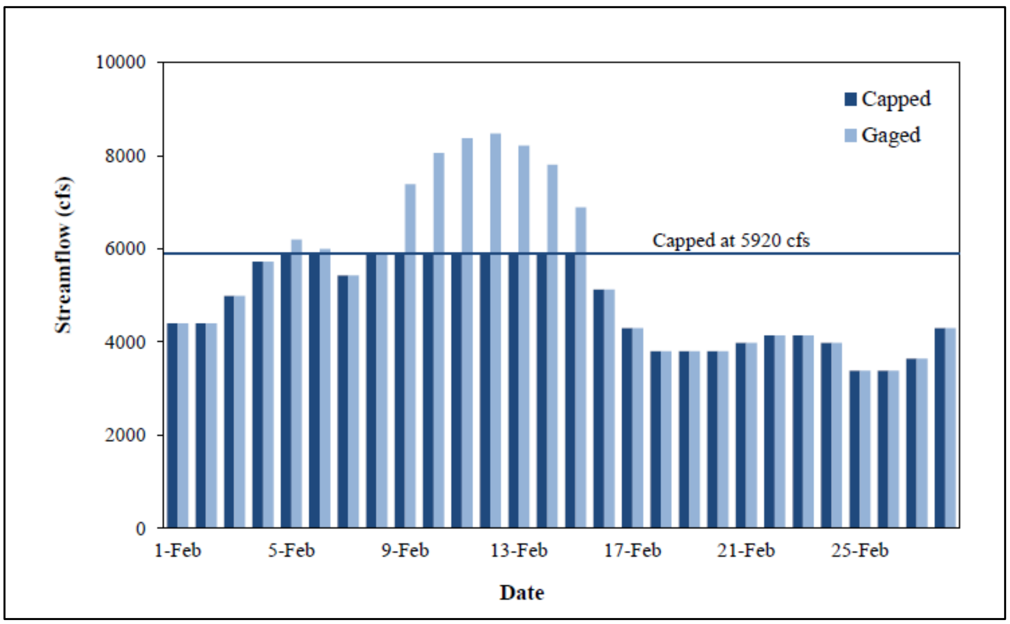

FIGURE 1: EXAMPLE OF AN EXCEEDANCE PLOT AND THE RESULT FROM CAPPING STREAMFLOWS AT THE FIVE-PERCENT EXCEEDANCE FLOW PROBABILITY (SOURCE: "INSIGHT METHODS" 2015)

[1] **Note: This is not done at Lewellen because Lake MAC does have the capacity to capture extreme events.**

GROUNDWATER DEPLETIONS – Groundwater depletions within the overappropriated portion of the Platte River Basin were calculated using the COHYST and WWUM to estimate the total impact groundwater pumping has had on streamflows through the period of record evaluated in the analysis (1988-2012).

Historical groundwater pumping and surface water deliveries within the COHYST model area which determined based on crop demands. Groundwater was used to meet the portion of crop demand that could not be met by surface water deliveries.

SURFACE WATER CONSUMPTIVE USE[2] – The surface water consumptive use aims to identify the level of consumption that occurred as a result of surface water diversions for irrigation and evaporation from major reservoirs (Lake McConaughy, Lake Maloney, Elwood Reservoir, Jeffery Reservoir, and Johnson Reservoir). The surface water consumption that was calculated for each canal included in the analysis was generally estimated from crop irrigation demands and the acreage that is served by surface water within each irrigation district. Surface water consumption was calculated for all major canals in the overappropriated portion of the Platte River Basin with the exception of Pathfinder Irrigation District, Gering-Fort Laramie, Mitchell-Gering, and Tri-State canals that divert from the North Platte River in the proximity of the Nebraska-Wyoming state line. The surface water consumptive use from these canals was not included in the water supply calculations and was also excluded from the consumptive surface water demand calculations. The models used to estimate surface water consumptive use represent historic irrigation practices.

REQUIRED INFLOWS – Required inflows are included as part of the water supply for each sub-basin with the exception of the two sub-basins (North Platte River Stateline to Lewellen and South Platte River Stateline to North Platte) that initiate from the state line. Required inflows represent the portion of water supply that flows from upstream locations to assist in meeting a portion of demands in downstream locations. The process for determining the portion of demands that is met by required inflows is based on determining each upstream subbasins proportional contribution to the overall water supply available in the downstream subbasin.

WATER DEMANDS

For purposes of the evaluation methodology, the water demands consist of the summation of consumptive use demands for irrigation, municipal, and industrial uses that are served by groundwater or surface water, net surface water loss, hydropower, instream flows, and downstream demands. Further description of each element of the water demands is provided below.

CONSUMPTIVE SURFACE WATER DEMANDS[3] – The demands for surface water include those for irrigation and evaporation as no significant municipal or industrial uses occur in the area. The models used to estimate surface water demands assume commingled lands are irrigated with groundwater. The demands are calculated by multiplying the surface water irrigated acres by the consumptive use estimates (irrigation requirements). Additionally, the temporal distribution of surface water demands differs from surface water consumptive use in that surface water demands that have access to water stored in reservoirs are redistributed from the peak season (June – August) to the non-peak season (September – May). SWD has been defined as the greater of either SWCU or the

[2] . Note: There are still three years (1993, 1995 and 1999) that the SW CU exceeds the demand in the WWUM. ARI would need more time to refine the splits for GW Pumping to CU on comingled acres versus the SW diversions to CU on comingled acres.

[3] In the COHYST area, SW demands for canals that may span more than one subbasin can be assigned to the point of diversion.

product of surface water irrigated acreage and the NIR for corn. The COHYST utilized the BL001 run data which assumed that comingled acres were fully met by groundwater. Also, BL001 repeats year 2005 land use post 2005.

CONSUMPTIVE DEMANDS FOR HYDROLOGICALLY CONNECTED GROUNDWATER (LONG-TERM GROUNDWATER DEMANDS) [4] – The demands for hydrologically connected groundwater are based on consumptive use estimates (irrigation requirements) multiplied by groundwater irrigated acres and commingled acres within the hydrologically connected area (10/50 area). The COHYST utilized the BL001 run data which assumed that comingled acres were fully met by groundwater. BL001 varies land use, acreage, and climate from year-to-year through 2005. Post 2005, BL001 repeats year 2005 land use and acreage but varies climate. For the WWUM area groundwater demands were set equal to groundwater depletions since groundwater depletions were often in excess of the groundwater demands[5]. The seasonal distribution of groundwater demands assigns 70% of the demands to the non-peak season (September – May) and 30% to the peak season (June – August). The split is current condition, and may shift in the future to more peak season depletions (60/40, 50/50, etc.) in coming years as aquifers are depleted.

LAKE MCCONAUGHY CHANGE-IN-STORAGE- Non-peak season change-in-storage is used to reduce peak season uses that hold storage water rights in Lake MAC. These demands are not reassigned to the non-peak season (break from INSIGHT methodology)

DEMANDS FOR NET SURFACE WATER LOSS – The demands for net surface water loss represent the seepage loss to the aquifer during transport of surface water through canal systems and losses at the field for surface water irrigated lands. This loss was estimated based on the difference between modeled head-gate diversions and surface water demands (the consumptive portion of diversions)[6].

DEMANDS FOR HYDROPOWER – Hydropower demands are represented for the Sutherland hydropower facility, CNPPID hydropower facilities (Jeffery, J-1, and J-2, with the Kingsley Hydropower excluded)[7], and Kearney hydropower facility. The demands for hydropower are represented by summing the streamflow and groundwater depletions (undepleted streamflow) available at the point of diversion and comparing that value to the lesser of the canal capacity or water right. Once the lesser of the undepleted stream, canal capacity, or water right has been established, the final step in calculating the hydropower demand is to integrate the surface water irrigation demands with the hydropower demands to ensure that the combination of demands does not exceed the canal capacity. If the combined demands exceed the canal capacity then the hydropower demands are further reduced to the canal capacity.

Two Sutherland demands scenarios were considered in order to "bookend" the demands that could be placed on either the North Platte or South Platte subbasin. The Keystone demand scenario is shown below. The Korty Demand Scenario reverses this process.

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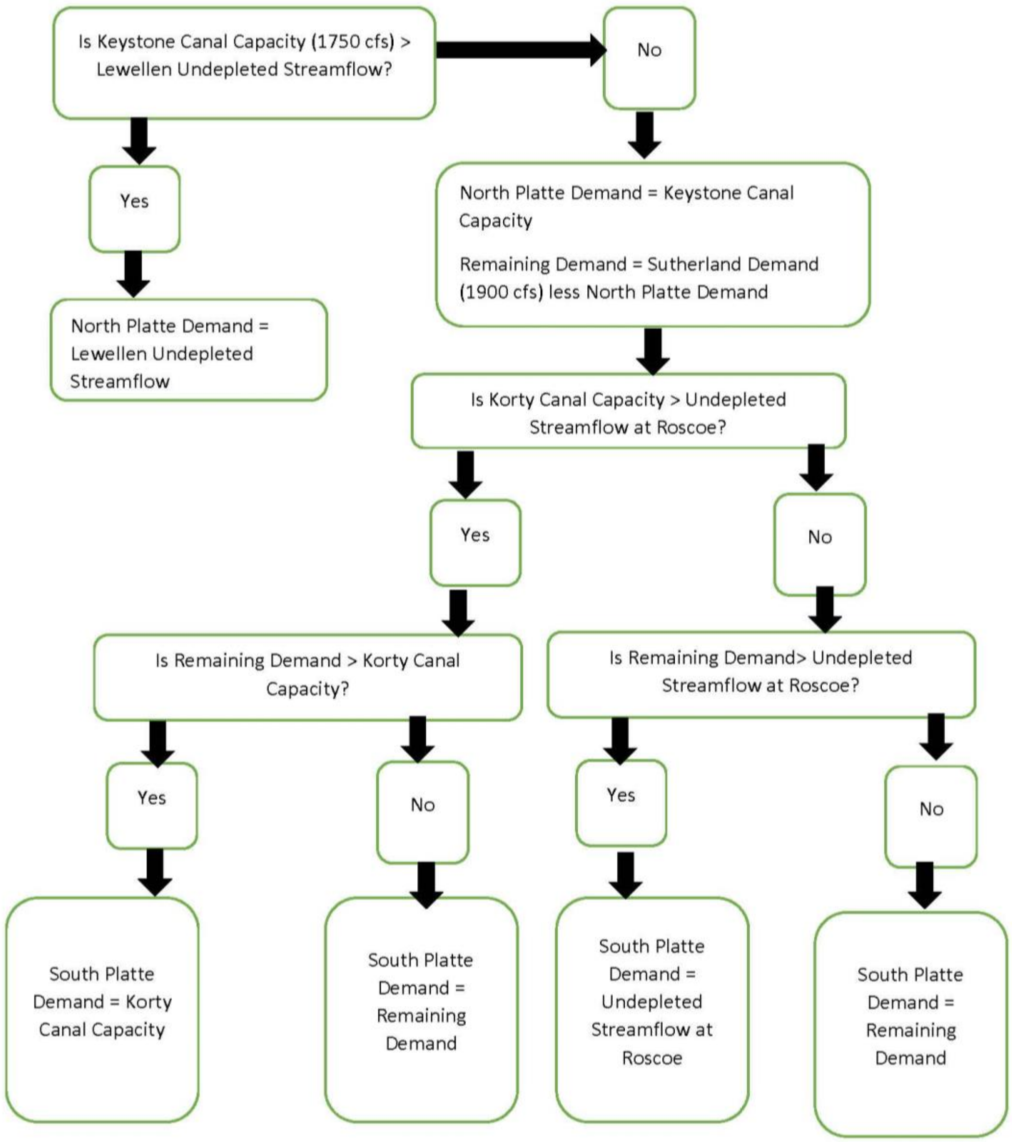
[4] ARI has indicated that M&I pumping has been included in the provided data. TFG has provided M&I as a separate dataset. The TFG M&I data only goes through 2005; therefore, 2005 was repeated through 2012.

[5] This was done because in some cases the GWDP > GWCU which was counterintuitive. This occurs more frequently in the WWUM area than the COHYST area. This issue could be investigated further in future analysis.

[6] Reservoir seepage was not considered as it is assumed this seepage is not a "demand" that must be satisfied in order to convey water in this System. Additionally, this seepage water returns to the System as baseflow/groundwater.

[7] Lake McConaughy is assumed to operate to satisfy the CNPPID demand; therefore, the CNPPID downstream demand was applied to the North Platte Subbasin instead of applying the full Lake McConaughy hydropower demand.

MAX KEYSTONE SUTHERLAND DEMAND SCENARIO



Undepleted streamflow at Lewellen = Uncapped streamflow at Lewellen gage + GWDP above Lewellen gage.

Undepleted streamflow at Roscoe = [South Platte River at Paxton] + [Reach Gain Loss from Roscoe to North Platte] + [South Platte River GWDP].

DEMANDS FOR INSTREAM FLOWS – Instream flow demands are represented in a similar manner to that of hydropower demands. Similar to hydropower demands the daily undepleted streamflow is calculated at the instream flow location and capped at the daily instream flow appropriation value. If the daily undepleted streamflow does not meet the instream flow appropriation, then the daily instream flow demand is capped to the undepleted streamflow. The final adjustment is to subtract the volume of consumption associated with upstream groundwater development in place at the time the appropriation was granted (i.e., 1993) to create a final volume of instream flow demand.

DEMANDS FOR DOWNSTREAM USES – Downstream demands for the overappropriated basin consist of a portion (based on the proportion of overappropriated basin water supplies relative to the water supplies at downstream locations) of downstream mainstem surface water and net surface water loss demands within the central and lower Platte River Basin plus a portion of the greater of instream flow or induced recharge appropriations located in the central and lower Platte River Basin. Downstream demands within the overappropriated basin vary based on location and the demands located downstream of that subbasin.

TRI-COUNTY NON-CONSUMPTIVE & SURFACE WATER DEMAND SPLIT: The Tri-County Canal serves both surface water and non-consumptive use demands. In some cases, the surface water demands are located upstream the non-consumptive use demands; therefore, it was necessary to consider the surface water and non-consumptive use demands separately for this canal. These demands were broken out as follow:

- **Full Tri-County Demand** = Minimum of [Canal losses above Brady + Max (surface water demands or CNPPID hydropower demand) OR Undepleted streamflow at Confluence of North Platte & South Platte Rivers]
- **Tri-County Non-consumptive Use Demand** = Full Tri-County Demand – Tri-County SW Demand – Tri-County Canal seepage

THE BALANCE OF WATER SUPPLIES AND WATER DEMANDS

The evaluation methodology seeks to compare the water supplies and water demands for two periods throughout the year. The peak season (June – August) and non-peak season (September – May) are used to assess the balance in water supplies and water uses. These comparisons evaluate the average balance in water supplies and water demands over the most recent twenty-five year period of data (1988-2012) to assess how wet and dry cycles impact the balance in water supplies and water demands.