Appendix A: Extended Time Series Additional Documentation

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Transmittal Memo

To: Matt Lindburg, Brown & Caldwell
From: Kara Sobieski
Date: 12/16/2014, revised 2/13/2015
Re: SPDSS Model Interactions – Pilot Point Diversion Records

This transmittal reflects a revised time series of monthly historical diversions to support the development of the Pilot Point analysis. This deliverable meets the requirements outlined in Item 2 of the Model Interactions memo (GW_Inflow_Outflow_02-13-2015.docx, updated and included in this transmittal). The revisions reflect a simplified naming convention which eliminated the inclusion of many of the "non-typical structures" listed previously in Table 2.

The monthly historical diversion file (SP2015_GW_draft.ddh) contains monthly historical diversion data in acre-feet for the structures that are either located within or carry water through the active GW model area. Note that some structures with diversions in the SP2015_GW_draft.ddh file do not represent river headgate diversions and should not be treated as such. These "special" structures, shown in the **Table 1**, represent irrigation to land either downstream of off-channel reservoirs, lands irrigated from canals that deliver to more than one use, or reflect ground water only aggregate structures. These structures may have canal losses, non-consumed irrigation water, and pumping estimates in the final water budget output (*.dwb) from StateCU, and should be treated like any other structure when extracting information from the water budget output in StatePP. However, their headgate diversions represented in (SP2015_GW_draft.ddh) should be excluded in your efforts to estimate river gains and losses.

With the exception of the structures listed in Table 1, the remaining structures should be included in the Pilot Point method as they reflect actual river diversions. Note that the total diversions for some structures have been divided with portions assigned to a separate structure identifier; therefore it is the sum of these structures that reflect the total diversions. This applies to the following structures:

- Burlington Canal (0200802) = 0200805 + 023837_C
- Farmers Highline Canal (0700569) = 0700569 + 0700569_C
- Fisher Ditch (0700570) = 0700570 + 0700507_C

Additional notes:

- As denoted in the file name, the diversion data is draft and may change as SPDSS surface and consumptive use modeling efforts continue.
- WWG understands this initial Pilot Point effort does not require all the additional irrigation demand and ground water only structures, we have provided all of the structures in an effort to introduce the nomenclature and modeling identifiers for future deliverables.

Table 1
Structures to be Excluded for River Gains/Losses in SP2015_GW_draft.ddh file

StateCU Structure ID	Description
*WD*_AWP###	Aggregate Well Structure, designated by Water District and aggregate number
0100503_I	Riverside Canal Irrigation Demand
0100507_I	Bijou Canal Irrigation Demand
0100687_I	North Sterling Irrigation Demand
0103817_I	Jackson Lake Irrigation Demand
0200805_I	Denver-Hudson Canal Irrigation Demand
0200817_I	Evans No 2 Ditch Demand
0200828_I	Union Ditch Irrigation Demand
0200834_I	Lower Latham Ditch Irrigation Demand
0203837_I	FRICO-Barr Reservoir Irrigation Demand
0203876_I	Milton Reservoir Irrigation Demand
0300911_I	Larimer County Ditch Irrigation Demand
0300915_I	Cache La Poudre Ditch Irrigation Demand
0300919_I	Larimer Weld Canal Irrigation Demand
0300929_I	New Cache La Poudre Ditch Irrigation Demand
0300994_I	North Poudre Canal Irrigation Demand
0400521_I	Handy Ditch Irrigation Demand
0400524_I	Home Supply Ditch Irrigation Demand
0400530_I	Louden Ditch Irrigation Demand
0400532_I	Loveland Greeley Canal Irrigation Demand
0400588_I	Boulder Larimer County Irrigation Demand
0600537_C	Leggett Carrier to Panama Reservoir
0600537_I	Leggett Ditch Irrigation Demand
0600565_C	Leyner Cottonwood Carrier
0600565_I	Leyner Cottonwood Irrigation Demand
6400511_I	Harmony Ditch 1 Irrigation Demand

Memo

To: Brown & Caldwell
From: Kara Sobieski and Logan Callihan
Date: 3/17/2015
Re: Streamflow, Import and Export Data

The following summarizes the approach taken to determine the surface water flows within the ground water model boundary, the surface water inflows into the ground water model boundary, and the import and export components to/from the ground water model. The original data for this effort was developed in SPDSS Task 2, which identified key streamflow gages for both the SPDSS surface and ground water models. Streamflow data and import and export data has been reviewed, modified if necessary, and extended through 2013. Four separate StateMod formatted files are included with the deliverable as described below.

Surface Water Streamflow within the Ground Water Model

The file SP2015_SFwithinGW_032015.stm provides the time-series of historical streamflows at gages within the active ground water model boundary. Surface water flows within the ground water model are gaged streamflows located *within* the boundary of the ground water model. These gages were initially identified as key streamflow gages for the ground water model in SPDSS Task 2 based on the following criteria: key streamflow gages must have good or excellent records based on USGS ratings; have at least 70% of the records complete throughout the SPDSS study period (1950-2002 at the time); or have the best available data at an important location.

As part of the model extension, key streamflow gages within the ground water boundary were extended and filled through 2013. In general, the dataset was created by pulling monthly surface water flow records from HydroBase using TSTool and filling missing data based on the techniques outlined in the SPDSS Task 2 memoranda on stream gages and stream flow records. **Table 1** lists the surface water streamflow gages modeled *within* the SPDSS ground water model boundary.

Table 1. Surface Water Streamflows within the SPDSS Ground Water Model Boundary.

Water District	Structure ID[1]	Streamflow Gage
1	06754000	South Platte River near Kersey
1	06758500	South Platte River near Weldona
1	06759910 & 06760000	South Platte River at Cooper Bridge near Balzac & South Platte River at Balzac
2	06720500	South Platte River at Henderson
2	06721000	South Platte River at Fort Lupton
3	06752500	Cache La Poudre near Greeley
4	06744000	Big Thompson River at mouth near La Salle

Water District	Structure ID[1]	Streamflow Gage
5	06731000	St. Vrain Creek at mouth near Platteville
7	06720000	Clear Creek at Derby
8	06708000	South Platte River at Waterton
8	06709530 & 06709500	Plum Creek at Titan Road near Louviers & Plum Creek near Louviers
8	06710247, 06710245 & 06710000[2]	South Platte River below Union Ave at Englewood, South Platte River at Union Ave at Englewood & South Platte River at Littleton
8	06713500	Cherry Creek at Denver
8	06714000	South Platte River at Denver
9	06711500	Bear Creek at Sheridan
64	06764000	South Platte River at Julesburg

Source: HydroBase & SPDSS Task 2

Notes: [1] Multiple IDs indicate two gages were combined

[2] South Platte River at Littleton (06710000) is combined with South Platte River at Union (06710245). The Englewood Intake (0801013) is subtracted from the combined record, which is filled and then combined with South Platte River below Union (06710247).

Note, SPDSS Task 2 Figure 3 indicates the Cherry Creek at Denver gage (06713500) is also located within the groundwater model boundary. This gage, however, was identified only as a calibration gage and not filled.

Surface Water Inflows

The file SP2015_SWInflowToGW_032015.stm provides the time-series of historical river inflows to the active ground water model boundary. Surface water inflows, as recorded at streamflow gages, occur at the top of the main stem South Platte River and tributary basins upstream of the ground water model area. Missing data was filled based on techniques outlined in Task 2.

The ground water model boundary was spatially reviewed to identify streamflow gages that most represent the streamflow conditions at the ground water model boundary. In some instances, the streamflow gages have been adjusted to match the location of the boundary. For example, if the streamflow gage is located downstream of the ground water boundary, diversions located in between the actual location of the gage and groundwater boundary have been added to the gaged streamflow such that the gage reflects the inflow at the boundary. If the streamflow gage is located upstream of the groundwater boundary, diversions located between the actual location of the gage and the ground water boundary have been subtracted from the recorded streamflow resulting in the inflow at the boundary. **Table 2** lists the surface water inflows modeled in the SPDSS ground water model area by Water District and any diversions used to adjust the streamflow to the boundary.

Table 2. SPDSS Ground Water Model Area Surface Water Inflows.

Water District	Structure ID[1]	Streamflow Gage	Adjusted Streamflow by Adding (+) or Subtracting (-) Diversions
1	06753500	Lonetree Creek near Nunn	-
2	06720820	Big Dry Creek at Westminster	-
3	06752260	Cache La Poudre at Fort Collins	0300918, 0300919, 0300921, 0300922, 0300923 (+)
4	06741510	Big Thompson at Loveland	0400519, 0400503 0400541, 0400534, 0400532 (+)
4	06743500	Little Thompson River at Milliken	0400601, 0400599, 0400587 (+)
5	06725450	St. Vrain Creek below Longmont	-
6	06730200	Boulder Creek at North 75th	-
6	06730300	Coal Creek near Plainview	0600608, 0600605, 0600606, 0600609, 0600621, 0600615 (-)
7	06719505 & 06719500[2]	Clear Creek at Golden & Clear Creek near Golden	0700725, 0700502, 0700569, 0700698, 0700601 (-)
8	06712000	Cherry Creek near Franktown	0801362 (-)
8	06709530 & 06709500	Plum Creek at Titan Rd. near Louviers & Plum Creek near Louviers	-
8	PLACHACO[3]	South Platte River below Chatfield	0801007, 0801008, 0801009 (+)
9	06711500	Bear Creek at Sheridan	0900816 (+)

Source: HydroBase & SPDSS Task 2

Notes:
[1] Multiple IDs indicate two gages were combined
[2] Church Ditch (0700540) diverts between the locations of these two gages therefore the diversions were subtracted before the gages were combined
[3] The PLACHACO gage is filled with South Platte River at Littleton (06710000). See comment below Table 1 for how the South Platte River at Littleton gage is combined/filled, as the same methodology is applied for combining the Littleton gage with the PLACHACO gage.

Imports

The file SP2015_GW_IMP_032015.stm provides the time-series of imports into the active ground water model boundary. Imports into the ground water model represent any inflows that are diverted outside of the ground water model boundary but consumed within the active ground water model area. The imports can be characterized into two types, either imports used to meet municipal demands in the active ground water boundary or imports used to meet irrigation demands in the active ground water boundary. Below is a list of imports into the ground water model by type.

Municipal Imports. The following municipal imports divert water from outside the active ground water model boundary; however the consumptive use, the outdoor use return flows, and the waste water treatment return flows occur within the ground water model boundary.

- The following ditches divert above the active ground water model boundary for municipal use located within the active ground water model boundary:
    - Greeley Filters Pipeline (0300908)
    - Fort Collins Pipeline (0300906)

    - Loveland Pipeline (0400511)
- Denver Conduit No. 2 (0801002) – The Denver Conduit No. 2 is an underground pipeline that takes water from the Denver Intake (above the active ground water model boundary) to both the Platte Canyon and Marston Reservoirs for eventual treatment at the Marston Wastewater Treatment Plant and use within the Denver Water service area.
- Denver Foothills Pipeline No. 26 (0801017) – Denver Foothills Pipeline No. 6 delivers water from Strontia Spring Reservoir (above the active ground water model boundary) to the Foothills Water Treatment Plant and use within the Denver Water service area.
- Aurora Intake (0801001) – The Aurora Intake carries water from Strontia Springs Reservoir to regulate diversions to meet municipal demands.
- South Boulder Diversion Canal (0600590) – Denver Water's Northern System diverts transbasin and native water supplies from outside the ground water boundary to serve approximately 15 percent of Denver Water's demands in the ground water model. South Boulder Diversion Canal diverts from South Boulder Creek and conveys water to Ralston Reservoir and Moffat Treatment Plant.
- Diversions for the Cities of Thornton, Westminster and Northglenn – A majority of the Standley Lake Cities' supply is piped from Standley Lake (outside the active ground water model boundary) directly to the water treatment plant to serve these cities. The releases to the cities are available on a limited basis, generally from 1995 through 2006, in HydroBase under Standley Lake PL structures (IDs 0200991, 992, 993, 994). There is insufficient data in the records to utilize accurate filling techniques through TSTool to complete the records through the 1950 to 2012 study period. Therefore, the municipal demands for the Cities of Thornton, Westminster and Northglenn developed in SPDSS Task 66 are provided as an import to the ground water model.

Irrigation Imports. The following irrigation imports divert water from outside the active ground water model boundary; however the consumptive use and irrigation return flows occur within the ground water model boundary.

- North Poudre Canal (ID 0300994) - The North Poudre Canal diverts above the Cache La Poudre at Canyon near Ft. Collins streamflow gage to serve irrigated acreage under the North Poudre Irrigation Company (NPIC) within the ground water model. Additionally, NPIC acreage receives direct irrigation deliveries from Munroe Canal (0300905), also located outside the ground water model boundary. The diversions were combined and provided under ID 0300994.
- "South Side" Ditches (0300910, 0300913, 0300914) – The South Side ditch system is comprised of Pleasant Valley Canal (0300910), New Mercer Ditch (0300913), Larimer County No. 2 Ditch (0300914), and Arthur Ditch (0300918). Owned by the City of Fort Collins, the South Side ditch system is used primarily to irrigate parks and open space. All of these ditches, except for Arthur Ditch (0300918), divert outside of the groundwater boundary; however the consumptive use occurs within the boundary. Arthur Ditch (0300918) is not considered an import because it diverts within the ground water model boundary.
- The following ditches are part of off-channel reservoir systems that deliver water for irrigation within the ground water model boundary from both direct diversions outside the model boundary and off-channel storage within the model boundary. The irrigation

supply for each ditch is provided and does not only reflect total diversions at the ditch headgate.
    - Larimer County Ditch (0300911)
    - Cache La Poudre Ditch (0300915)
    - Handy Ditch (0400521)
    - Home Supply Ditch (0400524)
    - South Side Ditch (0400543)
    - Boulder Larimer Ditch (0400588)
    - Boulder White Rock Ditch (0600516)
    - Leyner Cottonwood Ditch (0600565)

- The following ditches divert outside the ground water model boundary to irrigated lands located within or on the edge of the ground water model boundary:
    - Dry Creek Ditch (0300912)
    - Taylor Gill Ditch (0301029)
    - Barnes Ditch (0400501)
    - George Rist Ditch (0400520)
    - Jim Eglin Ditch (0400596)
    - Osborne Caywood Ditch (0400600)
    - Green Ditch (0600528)
    - Church Ditch (0700540)
    - Farmers Highline Canal (0700569)
    - Wannamaker Ditch (0700698)
    - Lee Stewart Eskins Ditch (0700601)

Exports

The file SP2015_GW_EXP_032015.stm provides the time-series of exports from the active ground water model boundary. Exports from the ground water model boundary represent diversions that are used to meet demands and resulting consumptive use outside of the active ground water model area. Typically, the diversions are made below a surface water inflow stream gage but the consumptive use and returns occur outside outside of the ground water model area. The exports from the ground water model are summarized below.

Municipal Exports:

- Croke Canal (ID 0700553) – Croke Canal diverts below the Clear Creek near Golden streamflow gage and is the primary source of water stored in Standley Lake. Therefore the diversions take place within the ground water model area, but the storage and evaporative consumptive use takes place outside of the ground water model area. Standley Lake water is then released to serve the demands of the Standley Lake Cities (see the Municipal Imports section).

Transmittal Memo

To: Matt Lindburg, Brown & Caldwell
From: Kara Sobieski
Date: 7/16/2015
Re: SPDSS Model Interactions – Augmentation Plan Pumping and Recharge

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This transmittal reflects the following deliverables:

- **Canal Alias List (SP2015_GW_CanalAliasList.csv)**: This file contains a list of structures that are represented in the consumptive use and surface water model by an identifier other than their WDID (e.g. off-channel irrigation demands, diversion systems). This file was updated to reflect the new identifiers used by individual sub-basin surface water modelers. This file can be used to "translate" the canal assignments in the spatial coverage to match the structure identifiers used in the modeling effort. The file can be read directly into the StateDGI database and the "translations" are made before creating the final canal recharge file (*.can) read by StatePP.

- **Augmentation Well and Recharge Well Pumping (SP2015_GW_AugRch.gwp)**. This file contains a time series of historical pumping for the 1950 – 2013 period for each augmentation well and recharge well in the model. The list of augmentation and recharge wells used in the surface water modeling effort (shown below) was developed through discussions with Louis Flink at DWR in order to reflect only those wells that have been used recently for augmentation or recharge purposes. Note that these wells may also pump for irrigation or other uses, however this time series only reflects the augmentation or recharge pumping.

Modeled Augmentation Wells				Modeled Recharge Wells			
6405042	6405864	6406245	6406628	0109884	6405887	6406656	6406752
6405043	6405868	6406276	6406639	0109886	6406316	6406657	
6405071	6405901	6406279	6406664	0109887	6406330	6406658	
6405552	6406008	6406305	6406704	0110291	6406332	6406659	
6405556	6406073	6406337	6406705	6405031	6406475	6406666	
6405557	6406140	6406385	6406706	6405064	6406627	6406667	
6405604	6406164	6406527	6406707	6405084	6406649	6406685	
6405626	6406166	6406553		6405309	6406650	6406703	
6405857	6406180	6406554		6405310	6406654	6406709	
6405862	6406242	6406556		6405629	6406655	6406727	

- **Recharge Estimates by Recharge Area (SP2015_GW_RechargeArea.stm)**: This file contains a time series of historical recharge for the 1950 – 2012 period for each

recharge area that has recharge records in HydroBase (at the time of the query). The list of recharge areas included in this deliverable was originally developed during the House Bill 1278 modeling effort, and reflects 616 recharge areas. Of this total, 176 recharge areas are not currently reflected in the GW model and would need to be added. These recharge areas likely reflect those constructed after the development of the original GW modeling effort. Additionally, of the 671 recharge areas currently modeled in the GW model, 231 of those recharge areas do not have records in this deliverable. Reconciliation of this difference in records and recharge areas will need to be completed prior to incorporating this updated information.

Transmittal Memo

To: Matt Lindburg, Zach Wengrovius, Brown & Caldwell
From: Kara Sobieski
Date: November 17, 2015
Re: SPDSS Model Information – Basin-wide Scenario, Burlington System Overview, Summary of Model Changes

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This transmittal reflects the following deliverables:

- **South Platte River Basin-wide Consumptive Use Analysis**: This dataset includes consumptive use, irrigation return flows, and canal recharge information for irrigation and carrier structures in the entire South Platte Basin. This deliverable provides information on structures that are outside of the active ground water model boundary, but within the inactive boundary where they may have an impact on boundary conditions or lateral inflows. The dataset deliverable includes the basin-wide model input and output files; however, similar to the previously delivered ground water area subset scenario (sp2015GW_WCarriers), the detailed water budget output file (*.dwb) contains the bulk of information used for the ground water model. Note that other files previously developed based on information from the ground water area subset scenario (e.g. alias lists) and delivered have not been reproduced using the full scenario.

- **Burlington Ditch, FRICO-Barr, Henrylyn System Overview:** The Burlington, FRICO-Barr and Henrylyn Systems are represented in StateCU with several carriers and irrigation demands. A detailed overview of the system is provided *Task 5 - Key Structure Operating Memorandum – Burlington, FRICO–Barr, and Henrylyn Systems*; this summary provides specific information as to which structures reflect canal recharge and/or irrigation return flows and spatially where these return flows should be represented in the ground water model. Due to the complexity of these operations, the irrigation return flows are summarized in the first table, **Operations and Irrigation Recharge Approach,** and the canal recharge is summarized in the second table, **Canal Recharge Approach**. Refer to the figure at the end of this memo to assist with identification of canals and structures.

  As many of the demands (irrigation and reservoirs) included in these systems have a different conveyance loss, the total diversions through the Burlington Canal/O'Brian Canal Headgate (0200802) have been disaggregated and represented under three different model IDs: Denver-Hudson Canal (0200805), Little Burlington Canal (0200918), and Barr Lake Carrier (0203837_C). Therefore, no diversions, conveyance loss, or irrigation return flows associated to the primary Burlington Canal headgate (0200802) in the StateCU model. It is recommended the canal recharge assigned to this structure be

calculated by summing portions of the canal recharge estimated under these three different model IDs; see the **Canal Recharge Approach** table and the simplified figure below for the recommended calculations.

Operations and Irrigation Recharge Approach

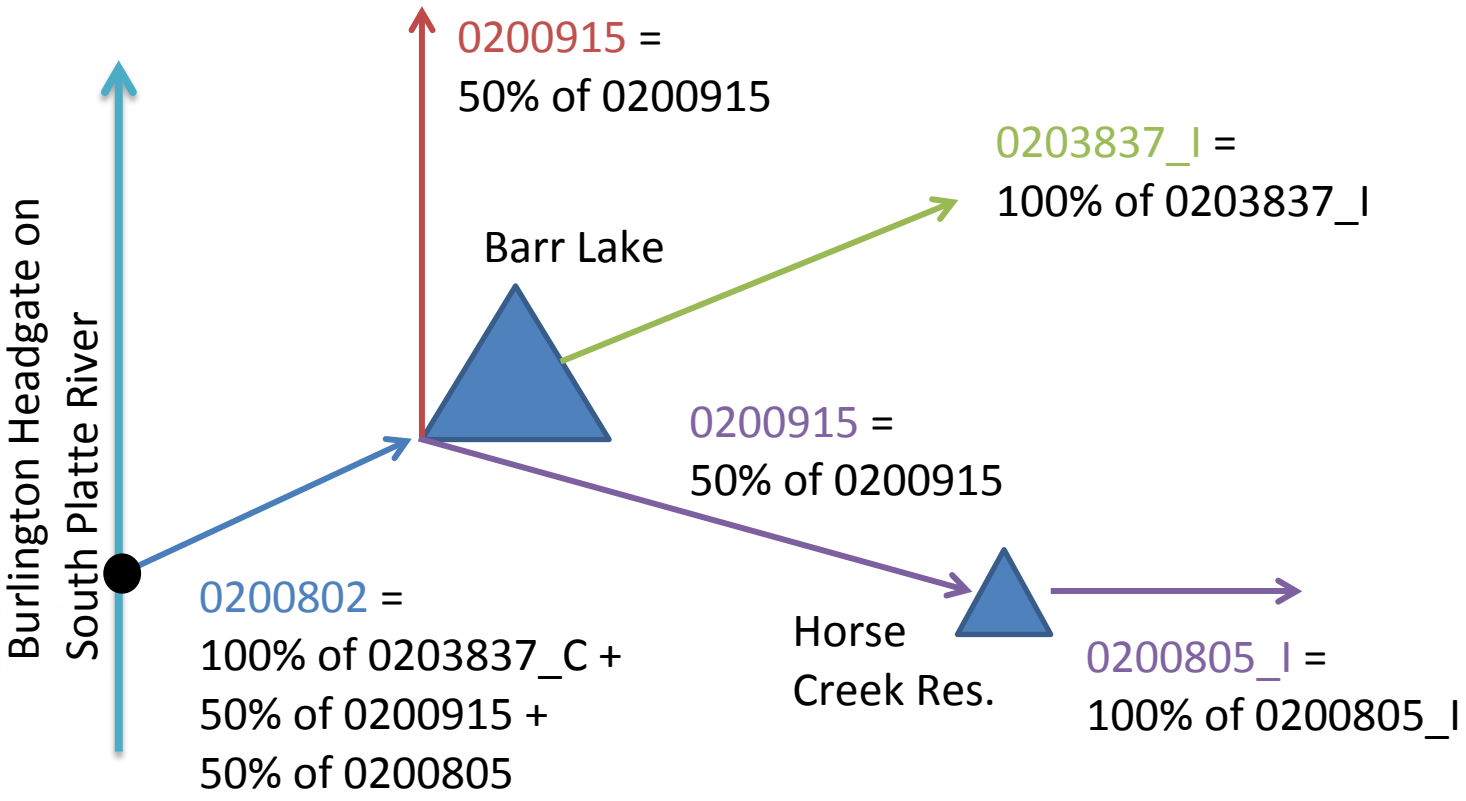
Model ID	Name	Operations	Irrigation Recharge
0200802	Burlington Canal	Carries direct diversions to Denver-Hudson Canal, Barr Lake, and Little Burlington system demands	N/A
0200805	Denver-Hudson Canal	Reflects total river diversions to Henrylyn Irrigation District (0200805_I) and Reservoirs (Horse Creek and Prospect Reservoirs)	N/A
0200805_I	Denver-Hudson Canal (Henrylyn) Irrigation Demand	Reflects portion of direct diversions to irrigation (after losses) and releases from reservoir to irrigation demand	Total return flows (recharge & overland) from irrigated lands assigned to 0200805 & 0200902
0200915	Little Burlington Canal	Reflects total river diversions to Little Burlington Canal irrigated lands	Total return flows from irrigated lands assigned to 0200915
0203837_C	Barr Lake Carrier	Reflects total diversion to storage in Barr Lake	N/A
0203837_I	Barr Lake Irrigation Demand	Reflects releases from Barr Lake to irrigation demand	Total return flows from irrigated lands assigned to 0203837

Canal Recharge Approach

Model ID	Name	Canal Length Reach in GIS	Canal Recharge Calculation
0200802	Burlington Canal	Burlington Canal headgate to Barr Lake	100% of conveyance loss in StateCU under 0203837_C + 50% of conveyance loss in StateCU under 0200805 + 50% of conveyance loss in StateCU under 0200915
0200805	Denver-Hudson Canal	Denver-Hudson Canal from Barr Lake to Horse Creek Reservoir	50% of conveyance loss in StateCU under 0200805 model ID
0200805_I	Denver-Hudson Canal (Henrylyn) Irrigation Demand	Denver-Hudson Canal from Horse Creek Reservoir to end of canal, including Box Elder Lateral	100% of conveyance loss in StateCU under 0200805_I model ID
0200915	Little Burlington Canal	Little Burlington Canal from Bar Lake to end of canal, including Brighton Lateral	50% of conveyance loss in StateCU under 0200915 model ID
0203837_C	Barr Lake Carrier	N/A – all conveyance loss included under 0200802 ID	N/A – all conveyance loss included under 0200802 ID
0203837_I	Barr Lake Irrigation Demand	Conveyance loss from Barr Lake to end of following outlet canals: Neres Canal East Neres Canal Beebe Canal E. Burlington Ext. Ditch Speer Canal	100% of conveyance loss in StateCU under 0203837_I model ID

W. Burlington Ext. Ditch

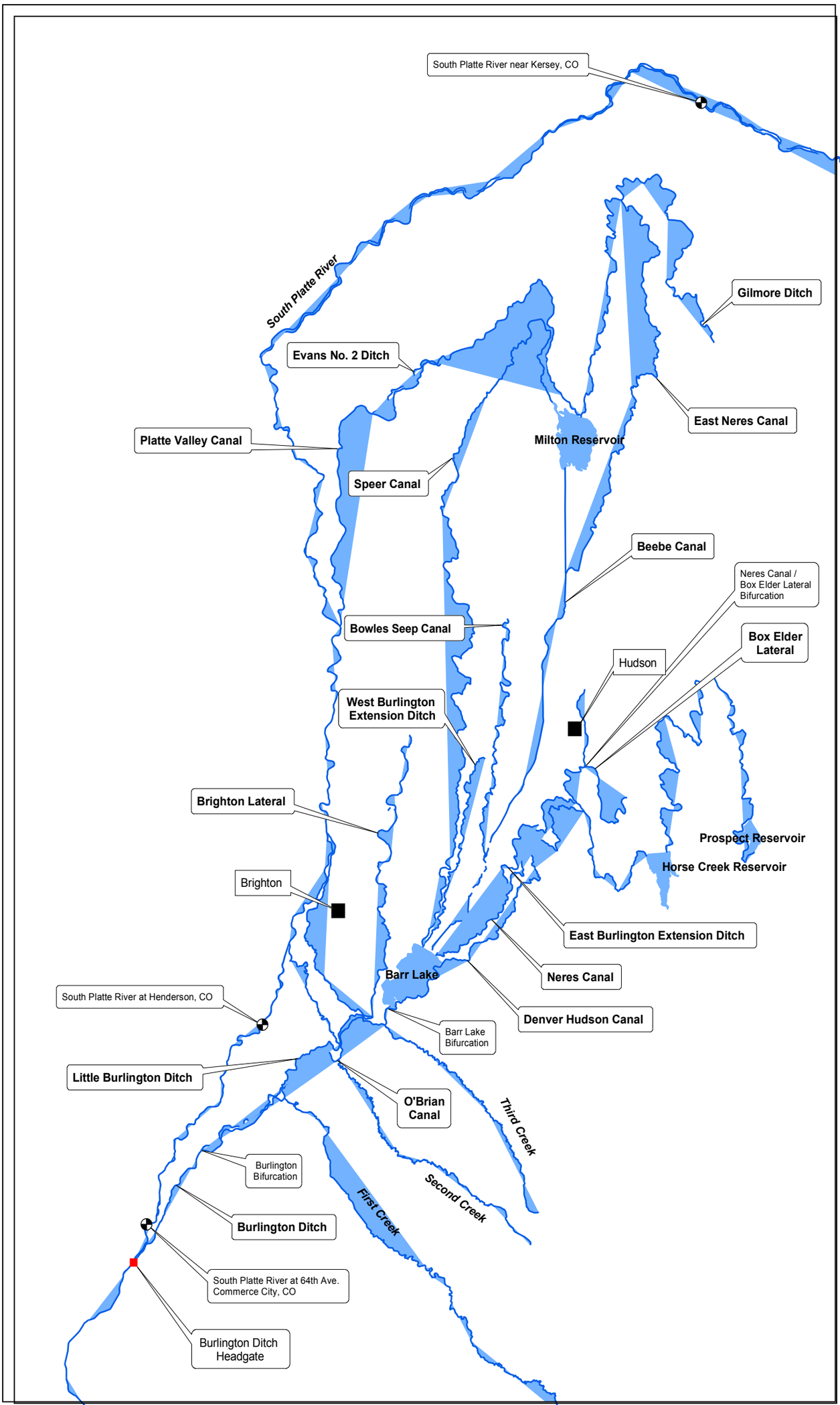
* The primary canals that carry water to irrigation demands have been included; other canals that carry multi-source water or may not be primary carriers have been excluded.



- **2008 to 2015 Model Changes**: The following table provides a summary of the model IDs that have changed or have been added/removed from the 2008 South Platte modeling effort to the 2015 modeling effort. There have been other changes (e.g. revised efficiencies, capacities, diversion amounts) implemented by the sub-basin modelers that are reflected in the 2015 model results but not explicitly listed below.

Model ID	Revision
01_ADP037	Disaggregated in 2015 Model, 0100643, 0100644, 0100835, and 0104486 modeled explicitly now
0200991 - 0200994	Added to the 2015 Model to reflect Standley deliveries to "Standley Lake Cities"; no irrigation or conveyance loss
0400502_D	Diversion system disaggregated in 2015 Model, 0400502 and 0400587 modeled explicitly
0500603_D & 0500603_I	Diversion system disaggregated in 2015 Model, 0500603, 0500564, 0500565, 0500568, 0500569, 0500570, 0500571, 0500572,

	0500573, 0500574, 0500575, 0500648 modeled explicitly
0600557	Added to the 2015 Model
05_ADP001	Divided up into two aggregate systems in 2015 Model, 05_ADP001 and 05_ADP002
0600597	Municipal structure, removed from 2015 Model
0600598	Municipal structure, removed from 2015 Model
0600599	Municipal structure, removed from 2015 Model
0600767	Municipal structure, removed from 2015 Model
0600800	Municipal structure, removed from 2015 Model
0600878	Municipal structure, removed from 2015 Model
0600889	Municipal structure, removed from 2015 Model
0600902	Municipal structure, removed from 2015 Model
0600943	Municipal structure, removed from 2015 Model
0700678	Added to the 2015 Model
0801*	Several municipal structures added/removed by sub-basin modeler, no irrigation or conveyance loss
2302*	Administrative gages in South Park revised model IDs from gage ID name (e.g. SFKANTCO) to HydroBase IDs (2302900)
AWP	Groundwater aggregates added/removed based on revised assignment of wells by DWR
0400521_I	Added as off-channel demand in 2015 Model
0400530_I	Added as off-channel demand in 2015 Model
0400532_I	Added as off-channel demand in 2015 Model
0400543_I	Added as off-channel demand in 2015 Model
0500563_I	Added as off-channel demand in 2015 Model
0500564_I	Added as off-channel demand in 2015 Model
0600501_C & 0600501_I	Added as off-channel demand in 2015 Model
0600516_I	Added as off-channel demand in 2015 Model
0600537_C & 0600537_I	Added as off-channel demand in 2015 Model
0600565_C & 0600565_I	Added as off-channel demand in 2015 Model
0700569_C	Added as off-channel demand in 2015 Model
0700570_C	Added as off-channel demand in 2015 Model
0801004_D	Removed diversion system designation (_D) in 2015 Model


South Platte River near Kersey, CO
South Platte River
Gilmore Ditch
Evans No. 2 Ditch
East Neres Canal
Platte Valley Canal
Milton Reservoir
Speer Canal
Beebe Canal
Neres Canal / Box Elder Lateral Bifurcation
Bowles Seep Canal
Box Elder Lateral
Hudson
West Burlington Extension Ditch
Brighton Lateral
Prospect Reservoir
Horse Creek Reservoir
Brighton
East Burlington Extension Ditch
Barr Lake
Neres Canal
South Platte River at Henderson, CO
Denver Hudson Canal
Barr Lake Bifurcation
Little Burlington Ditch
O'Brian Canal
Third Creek
Burlington Bifurcation
Second Creek
First Creek
Burlington Ditch
South Platte River at 64th Ave. Commerce City, CO
Burlington Ditch Headgate

Transmittal Memo

To: Matt Lindburg
From: Erin Wilson
Date: 12/12/2015
Re: SPDSS Model Interactions – Precipitation Recharge Files

This transmittal includes files required to develop the precipitation recharge input into the SPDSS ground water model. This deliverable meets the requirements outlined in item 1 of the Model Interactions memo (GW_Inflow_Outflow_12-12-2014.docx, updated and included in this transmittal).

1) Spreadsheet matching previous climate station IDs with new climate station IDs adopted by NOAA (HydroBaseClimateStation_newIDs). Note that the new climate station IDs are now stored in HydroBase and have been adopted for SPDSS consumptive use and surface water efforts.
2) Precipitation Recharge Grids for ArcMap (CDSSToolBox_climate_grids.zip). Note that these grids have not been revised to reflect the new climate station IDs adopted by NOAA.
3) Time series file with monthly total precipitation for each climate station, in standard StateMod format (SP2015.prc).
4) File previously submitted to CDM with GridID (row_column), climate station ID, and climate station weight (Grid_Precip_Wts.csv). This file was originally developed using StateDGI. We have replaced the previous NOAA climate station IDs with the new climate station IDs – this may allow you not to have to recreate the file or worry about the updating the gridded climate dataset at this time.

The climate station weight file (Grid_Precip_Wts.csv) is used in conjunction with the monthly precipitation by climate station file (SP2015.prc) and land use by category file (not included in this submittal) to estimate precipitation recharge in each ground water model cell. **Table 1** defines the initial recommended precipitation recharge by land use category, as a percent of total weighted precipitation, for the ground water model area as recommended in Task 64.

Table 1
Precipitation Recharge as Percentage of Total Precipitation

Land Use Category	Irrigation Season % April through October	Non-Irrigation Season November through March
ALFALFA_SOILA	23%	1%
ALFALFA_SOILB	14%	1%
ALFALFA_SOILC	4%	1%
ALFALFA_SOILD	2%	1%
CORN_SOILA	23%	1%
CORN_SOILB	14%	1%

CORN_SOILC	4%	1%
CORN_SOILD	2%	1%
DRY_BEANS_SOILA	23%	1%
DRY_BEANS_SOILB	14%	1%
DRY_BEANS_SOILC	4%	1%
DRY_BEANS_SOILD	2%	1%
FOREST_SOILA	1%	1%
FOREST_SOILB	1%	1%
FOREST_SOILC	1%	1%
FOREST_SOILD	1%	1%
GRASS_PASTURE_SOILA	23%	1%
GRASS_PASTURE_SOILB	14%	1%
GRASS_PASTURE_SOILC	4%	1%
GRASS_PASTURE_SOILD	2%	1%
NATIVE_VEGETATION_SOILA	1%	1%
NATIVE_VEGETATION_SOILB	1%	1%
NATIVE_VEGETATION_SOILC	1%	1%
NATIVE_VEGETATION_SOILD	1%	1%
ORCHARD_WO_COVER_SOILB	14%	1%
ORCHARD_WO_COVER_SOILC	4%	1%
ORCHARD_WO_COVER_SOILD	2%	1%
PHREATOPHYTE_SOILA	1%	1%
PHREATOPHYTE_SOILB	1%	1%
PHREATOPHYTE_SOILC	1%	1%
PHREATOPHYTE_SOILD	1%	1%
SMALL_GRAINS_SOILA	23%	1%
SMALL_GRAINS_SOILB	14%	1%
SMALL_GRAINS_SOILC	4%	1%
SMALL_GRAINS_SOILD	2%	1%
SOD_FARM_SOILA	23%	1%
SOD_FARM_SOILB	14%	1%
SOD_FARM_SOILC	4%	1%
SUGAR_BEETS_SOILA	23%	1%
SUGAR_BEETS_SOILB	14%	1%
SUGAR_BEETS_SOILC	4%	1%
URBAN_SOILA	1%	1%
URBAN_SOILB	1%	1%
URBAN_SOILC	1%	1%
URBAN_SOILD	1%	1%
VEGETABLES_SOILA	23%	1%
VEGETABLES_SOILB	14%	1%
VEGETABLES_SOILC	4%	1%
WATER_SOILA	0%	0%
WATER_SOILB	0%	0%
WATER_SOILC	0%	0%

WATER_SOILD	0%	0%
WATER_*ResWDID*_SOILA	0%	0%
WATER_*ResWDID*_SOILB	0%	0%
WATER_*ResWDID*_SOILC	0%	0%
WATER_*ResWDID*_SOILD	0%	0%

Brown AND Caldwell

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Memorandum

Subject: Procedures Used to Estimate M&I Pumping Data

Date: May 5, 2016

To: Andy Moore, Mary Halstead, and Emily LoDolce, CWCB and DWR

From: Matt Lindburg and Zach Wengrovius, Brown and Caldwell

Project: South Platte Decision Support System – Alluvial Groundwater Model Update
146767

Summary

Data were collected from various sources to extend the time series to December, 2012. The Groundwater Model Access database contains the previously determined pumping values[4] for January, 1950 to December, 2006. Data were also collected from some of the owners/operators of the wells and HydroBase records, when available.

First, HydroBase data were inserted where applicable to fill in the data for all years available. Then, M&I records obtained from the entities were filled in. For dates that have both sets of data, HydroBase data were applied. Next, the Access databases values were inserted to fill the time series to 12/2006 or when the earliest HydroBase record was available.

Lastly, data were filled in using the procedures described in the *Phase 3 Task 41.3 Estimation of Municipal and Industrial Pumping in the South Platte Alluvium Region Final** when applicable. For wells with no data available, the maximum estimated pumping will be set equal to the decreed pumping rate for each entity.

In the complete set of pumping data, from January, 1950 to December, 2003, the monthly pumping amounts are labeled according to their source. The pumping labels (sources) include:

- "Access" - Data previously used through 2006 in the Access database
- "Measured" - Data measured by owners/operators of well
- "HydroBase" - Data taken from HydroBase

See the following section for more detail on how the data were filled in for each well.

Detailed Descriptions of Procedures

The wells with pumping data in the Access database* (MI_Pumping) had their pumping time series extended until December, 2013. The procedures described below show in the detail how all dates were filled. The wells are organized according to their Well ID.

Aurora

- For all wells
  - 1/1950 to 10/2006 - Based on data in Access database
- For Aurora_Well_1, Aurora_Well_2, Aurora_Well_4, Aurora_Well_5 & Aurora_Well_6
  - 11/2006 to 10/2010 – Based on data provided by Aurora
  - 11/2010 to 12/2013 – Based on HydroBase data

        - Missing months filled in with zeros (no pumping) or measured pumping value.
        - Verified by looking at Aurora's measured data
- For Aurora_Well_3 &Aurora_Well_7
    - 11/2006 to 10/2013 – Based on data provided by Aurora

Aurora wells 1-4 were drilled July/August 1956, 5 & 6 were drilled in December 1955, and 7 was drilled in August 1963. Changed wells to not begin pumping until month after they were drilled. Also, after review of reported pumping rates 1990-2012, halved the estimated 1950-1989 pumping rates for these wells.

Brighton

- For all wells
    - 1/1950 to 12/2006 - Based on data in Access database
- For Brighton_Well_11, Brighton_Well_3, Brighton_Well_4, Brighton_Well_7, Brighton_Well_8 & Brighton_Well_9
    - 1/2007 to 10/2011 – Based on average of 2006 and 2013Assumed pumping in the last two years of record is the most representative of pumping records.
    - 11/2011 to 10/2013 – Based on HydroBase data
    - 11/2013 to 12/2013 –Based on average of 2006 and 2013
        - Assumed pumping in the last two years of record is the most representative of pumping records
- For rest of wells,
    - 1/2007 to 12/2013 – Based on 2006 data. Assumed pumping records most representative of current use.

Brush

- For all wells,
    - 1/1950 to 12/1965 - Based on data in Access database
    - 1/1966 to 10/2007 - Based on data provided by Brush
    - 11/2007 to 12/2013 - Based on HydroBase data
        - Missing months filled in with zeros or measured pumping value.
        - Verified by looking at Brush's data.

Carey Wells

- For all wells
    - 1/1950 to 12/2006- Based on Access database
    - 1/2007 to 12/2013
        - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

Cherry Creek (CCC) Wells

- For CCC_Well_1
    - 1/1950 to 12/2006 - Based on Access database
    - 12/2006 to 10/2007 - Based on average of 2004 & 2005 pumping
        - 2004 & 2005 years with measured data (Access database)
    - 11/2007 to 6/2011 - Based on HydroBase data
        - Blank values filled in with zeros, assumed zero pumping to reflect measured pumping trends
    - 7/2011to 12/2013 - Based on average of HydroBase data
- For CCC_Well_4 and CCC_Well_5,
    - 1/1950 to 12/2006 - Based on Access database
    - 12/2006 to 10/2007 - Based on average of 2004 & 2005 pumping
        - 2004 & 2005 years with measured data (Access database)
    - 11/2007 to 12/2013 - Based on HydroBase data

        - Blank values filled in with zeros, assumed zero pumping to reflect measured pumping trends

City Ice Wells

- For all wells,
    - 1/1950 to 12/2006 – Based on Access database
    - 12/2006 to 12/2013
        - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

CO State Wells

COLO STATE W 4 (COLO STATE W 3-8975-F) is screened from depth of 482' to 737' so clearly not alluvial and was removed

Denver Fire Department now occupies the property where COLO_STATE_W2, _3, and _5 are located; original wells were for leather tanning and other processing by Colorado By-Products which was sold to Beatrice Foods in 1965. Unclear how property was disposed of Beatrice or possibly Con-Agra after 1990 acquisition of Beatrice – i.e., when did industrial pumping stop? Private party sold property to CDOT in 1998 who then sold to City of Denver in 2004. NWT reduces pumping severely (<1% of pumping is achieved) which could be result of initial head issues in Denver area. Rates unchanged for now.

- For all wells
    - 1/1950 to 12/2006 - Based on Access database
    - 1/2007 to0 12/2013
        - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

Continental (Suncor) Wells

- For all wells
    - 1/1950 to 12/2006 - Based on Access database
    - 1/2007 to 12/2013
        - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

CWSD Wells (Centennial)

- For all wells
    - 1/1950 to 12/2006 - Based on Access database
    - 1/2007 to 12/2013 - Based on data provided by Centennial Surf Club/Highlands Ranch

Dekalb Wells (Grand Mesa Eggs)

- For all wells
    - 1/1950 to 12/2006 - Based on Access database
    - 1/2007 to 12/2013
        - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

ECCV Wells (East Cherry Creek Water and Sanitation District)

- For all wells,
    - 1/1950 to 12/2006 - Based on Access database

- 1/2007 to 3/2008 - Based on average years 2004-2006 (complete years of measured data)
- 4/2008 to 10/2013 Based on HydroBase Data
  - Blank values filled in with zeros, assumed zero pumping to reflect measured pumping trends

Englewood Wells

- For Englewood_Well_1
  - 1/1950 to 03/2005 - Based on Access database
  - 04/2005 to 02/2009 - Based on data provided by Englewood
    - Missing values filled in with zeros. Pumping is for irrigation thus has no pumping during winter months.
  - 03/2009 to 10/2013 - Based on HydroBase records
    - Missing values filled in with zeros. Pumping is for irrigation thus has no pumping during winter months.
  - 11/2013 to 12/2014 - Based on data provided by Englewood
    - Missing values filled in with zeros. Pumping is for irrigation thus has no pumping during winter months.
- For Englewood_Well_2
  - 1/1950 to 06/2004 - Based on Access database
  - 7/2004 to 02/2009 Based on data provided by Englewood
    - Missing values filled in with zeros. Pumping is for irrigation thus has no pumping during winter months.
  - 3/2009 to 10/2013 Based on HydroBase records
    - Missing values filled in with zeros. Pumping is for irrigation thus has no pumping during winter months.
  - 11/2013 to 12/2014 - Based on data provided by Englewood
    - Missing values filled in with zeros. Pumping is for irrigation thus has no pumping during winter months.
- For Englewood_Well_3
  - 1/1950 to 2/2004 - Based on Access database
  - 3/2004 to 2/2009- Based on data provided by Englewood
    - Missing values filled in with zeros. Pumping is for irrigation thus has no pumping during winter months.
  - 3/2009 to 10/2013 - Based on HydroBase records
    - Missing values filled in with zeros. Pumping is for irrigation thus has no pumping during winter months.
  - 11/2013 to 12/2014 - Based on data provided by Englewood
    - Missing values filled in with zeros. Pumping is for irrigation thus has no pumping during winter months.

- For Englewood_Well_6
    - 1/1950 to 3/2001 - Based on Access database
    - 4/2001 to 3/2009 - Based on data provided by Englewood
        - Missing values filled in with zeros. Pumping is for irrigation thus has no pumping during winter months.
    - 4/2009 to 9/2013 - Based on HydroBase records
        - Missing values filled in with zeros. Pumping is for irrigation thus has no pumping during winter months.
    - 10/2013 to 12/2014 - Based on data provided by Englewood
        - Missing values filled in with zeros. Pumping is for irrigation thus has no pumping during winter months.
- For Englewood_Well_7
    - 1/1950 to 12/2006 - Based on Access database
    - 12/2006 to 12/2014 filled in with zeros – no more pumping with this well since 1999 per Englewood's information

Fort Lupton

- For all Fort_Luption_Well_1, Fort_Lupton_Well_2, Fort_Lupton_Well_3 and Fort_Lupton_Well_4
    - 1/1950 to 12/2006 - Based on Access database
    - 12/2006 to 10/2011
        - Fill in data with calculated average from 1980-2005 since those are measured pumping records
    - 11/2011 to 10/2013 - Based on HydroBase records
        - Fill in missing with calculated average from 1980-2005
- For Fort_Lupton_Well_5 and Fort_Lupton_Well_6
    - 1/1950 to 12/2006 - Based on Access database
    - 12/2006 to 12/2013
        - Fill in data with calculated average from 1980-2005

Fort Morgan

- For Fort_Morgan_Well_1, Fort_Morgan_Well_15, Fort_Morgan_Well_16, Fort _Morgan_Well_3, Fort_Morgan_Well_4 and Fort_Morgan_Well_5
    - 1/1950 to 12/2006 - Based on Access database
    - 12/2006 to 12/213- Based on HydroBase records when available
        - Missing values filled in with data provided by Fort Morgan
- For rest of wells,
    - 1/1950 to 12/2006 - Based on Access database
    - 1/2007 to 12/2013 - Based on data provided by Fort Morgan

Great Western Wells

- For all wells,
    - 1/1950 to 12/2006 - Based on Access database
    - 1/2007 to 12/2013
        - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

Greeley Wells

- For Greeley_Well_1, Greeley_Well_3, Greeley_Well_4 and Greeley_Well_5
    - 1/1950 to 12/2006 - Based on Access database
    - 1/2006 to 12/2013 - Based on data provided by Greeley
        - Missing values for Jan and Feb 2007, assumed zero pumping to reflect measured pumping trends
- For remaining wells,
    - 1/1950 to 12/2006 - Based on Access database
    - 1/2007 to 12/2013
        - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

Hibbs Well

- 1/1950 to 12/2006 - Based on Access database
- 1/2007 to 12/2013
    - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

Hillrose Well

- 1/1950 to 12/2006 - Based on Access database
- 1/2007 to 12/2013
    - Based on average of 2002-2005 measured monthly pumping records

Julesburg Wells

- For Julesburg_Well_3
    - 1/1950 to 10/1995 - Based on Access database
    - 10-1995 to 12/2006 - Based on hydro base
        - Missing values filled in with Access database values
    - 1/2007 to 10/2007
        - Filled in with a percentage of pumping according to the yearly totals provided by Julesburg

January	3.5%
February	3.6%
March	4.3%
April	6.9%
May	11.1%
June	13.6%
July	16.7%
August	14.1%
September	11.2%
October	6.9%
November	4.3%
December	3.8%

        - Have monthly records from 1998 to 2005, so calculated pumping % of yearly total average across years
    - 11/2007 to 12/2013 - Based on HydroBase records
        - Missing values filled in with a percentage of pumping according to the yearly totals provided by Julesburg
- For rest of wells,
    - 1/1950 to 12/2006- Based on Access database
    - 1/2007 to 12/2013
        - Based on HydroBase data
            - Filled in with a percentage of pumping according to the yearly totals provided by Julesburg
            - Average monthly percentages from 1998 -2005 data

Jan	3.5%
Feb	3.6%
March	4.3%
April	6.9%
May	11.1%
June	13.6%
July	16.7%
August	14.1%
September	11.2%
October	6.9%
November	4.3%
December	3.8%

KB Packing Wells

- For all wells
    - 1/1950 to 12/2006 Based on Access database

- 1/2007 to 12/2013
  - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

Kersey Wells

- For all wells
  - 1/1950 to 12/2006 - Based on Access database
  - 1/2007 to 12/2013
    - Access data shows trend of yearly pumping increases by 4.727 AF. (% increase = 2.56%). Continue this projection forward.

Klausner Wells

The original SPDSS Database had total monthly pumping (ac-ft/mo) of:

Klausner_Well_1	40.35
Klausner_Well_2	33.63
Klausner_Well_3	30.26
Klausner_Well_4	5.04

for a total monthly rate of approx. 109 ac-ft/mo or 1,311 ac-ft/yr. These pumping rates are unsustainable with MODFLOW-NWT turning the rates down as the alluvium desaturates. A review of well permits indicates that the 4 wells now have a total 145.3 ac-ft/year allocation for Nile oil field flooding since 1986. The 145.3 ac-ft/yr is based on average estimated consumptive use for previous irrigation. These wells and the parcels that were apparently irrigated are NOT in the irrigation snapshots. New approach is to assume that the average of 145.3 for consumptive use is a more reasonable rate for both the irrigation as well as the oil field flooding. Scale the original database pumping rates at each individual well to get to 145.3 ac-ft/yr + also account for numbers of days in each month; annual rates (ac-ft/yr) are:

Klausner_Well_1	53.7
Klausner_Well_2	44.7
Klausner_Well_3	40.2
Klausner_Well_4	6.7

Links to Klausner well permits:

http://www.dwr.state.co.us/WellPermitSearch/View.aspx?receipt=9000936

http://www.dwr.state.co.us/WellPermitSearch/View.aspx?receipt=9000937

http://www.dwr.state.co.us/WellPermitSearch/View.aspx?receipt=9000938

http://www.dwr.state.co.us/WellPermitSearch/View.aspx?receipt=9000939

Krueger Well

- For well
  - 1/1950 to 12/2006 - Based on Access database
  - 1/2007 to 12/2013 – Based on HydroBase records

- Missing data filled in with maximum estimated pumping equal to decreed rate (as previously done for the Access database)
- HydroBase records are sporadic and do not have complete years, so cannot use its average

La Salle Wells

- For all Lasalle_Well_1 and LaSalle_Well_2
  - 1/1950 to 12/2006 - Based on Access database
  - 1/2007 to 12/2013
    - Access estimated data shows trend of total yearly AF increases by 0.3051 AF. (% increase = 0.3507%). Continue this projection forward.
- For all Lasalle_Well_3, LaSalle_Well_4 and LaSalle_Well_5
  - 1/1950 to 12/2006 Based on Access database
  - 1/2007 to 12/2013- Based on HydroBase records
    - Missing data filled in
      - Access estimated data shows trend of total yearly AF increases by 0.3051 AF. (% increase = 0.3507%). Continue this projection forward.

Lauck Wells

- For all wells
  - 1/1950 to 12/2006 - Based on Access database
  - 1/2007 to 12/2013
    - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

Log Lane Well

- For all wells
  - 1/1950 to 12/2006 - Based on Access database
  - 1/2007 to 12/2013
    - Based on 2004, year of measured data
    - 5/2010 well abandoned so zero pumping afterwards

Lousberg

- For all wells
  - 1/1950 to 12/2006 - Based on Access database
  - 1/2007 to 12/2013
    - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

Mathews Wells

- For all Mathews_Well_2
  - 1/1950 to 12/2006 - Based on Access database

    - 1/2007 to 12/2013
        - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)
- For Mathews_Well_1
    - 1/1950 to 12/2006 - Based on Access database
    - 1/2007 to 10/2011
        - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)
    - 11/2011 to 12/2013 -Based on HydroBase data
        - Missing data filled in with maximum estimated pumping equal to decreed rate

McAtee Wells

- For McAtee_Well_3, McAtee_Well_4, McAtee_Well_8
    - 1/1950 to 10/2006 - Based on Access database
    - 11/2006 to 12/2013 -Based on HydroBase data
        - Missing data filled in with maximum estimated pumping equal to decreed rate
- For rest of wells,
    - 1/1950 to 12/2006 - Based on Access database
    - 1/2007 to 12/2013
        - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

MCQWC Wells

- MCQWC_Well_2, MCQWC_Well_3, MCQWC_Well4 and MCQWC_Well_5
    - 1/1950 to 10/2006 - Based on Access database
    - 11/2006 to 12/2013- Based on HydroBase records
        - Filled in with pumping average 2005-2006 because based on actual monthly data for individual wells
- MCQWC_Well_1
    - 1/1950 to 12/2006 - Based on Access database
    - 1/2007 to 12/2013
        - Filled in with pumping average 2005-2006 because based on actual monthly data for individual wells

Merino Well

    - 1/1950 – 12/2006- Based on Access database
    - 1/2007 – 12/2013 - Based on HydroBase records
        - Missing data November and December, 2013 filled in with HydroBase values for pumping in 2012

Milliken Well

- 1/1950 to 12/2006 - Based on Access database
- 1/2007 to 12/2013
  - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

Montfort Wells

- For Monfort_Well_6
  - 1/1950 to 12/2006 - Based on Access database
  - 1/2007 to 12/2013
    - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)
- For rest of wells
  - 1/1950 to 12/2006 - Based on Access database
  - 1/2007 to 12/2013
    - Based on HydroBase records
    - Filled in missing data with maximum estimated pumping equal to decreed rate

Ovid Well

- 1/1950 to 12/2006 Based on Access database
- 1/2007 to 12/2013
  - Used years 2004-2005 to determine monthly percentage of pumping because these years are actual monthly measurements, then applied that to the yearly totals provided by Ovid

Jan	6.4%
Feb	5.5%
March	7.3%
April	8.5%
May	11.5%
June	12.7%
July	14.8%
August	12.4%
Sept	12.1%
Oct	7.6%
Nov	2.3%
Dec	2.3%

Pack Corp Wells

- For all wells
  - 1/1950 to 12/2006 - Based on Access database
  - 1/2007 to 12/2013
    - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

Platteville Wells

- For all wells
    - 1/1950 to 12/2006 - Based on Access database
    - 1/2007 to 12/2013
        - Access estimated data shows trend of total yearly AF increases by 6.59 AF. (% increase = 3.056%). Continue this projection forward.

PWSD Well

- 1/1950 to 12/2006 Based on Access database
- 1/2007 to 12/2013
    - Based on pumping trend 1983-2005; same pumping each month. Continue forward.

SACWSD (South Adams County Water and Sanitation District) Wells

- For SACWSD_Well_1
    - 1/1950 to 10/1995 - Based on Access database
    - 11/1995 to 12/2013 - Based on HydroBase data
        - Missing data filled in with average 1996-2000, 2003-2006, 2008 (full years of HydroBase data)
- SACSWD_Well_10
    - 1/1950 to 10/2001 - Based on Access database
    - 11/2001 to 12/2013 - Based on HydroBase data
        - Missing data filled in with pumping from 2003 (only full year of measured data)
- SACWSD_Well_2
    - 1/1950 to 10/1995 - Based on Access database
    - 11/1995 to 12/2013 - Based on HydroBase data
        - Missing data filled in with average 1998-2001, 2005 (full years of HydroBase data)
- SACWSD_Well_3
    - 1/1950 to 12/2006 - Based on Access database
    - 1/2007 to 12/2013
        - Filled in with zeros because database shows no pumping from 1988-2006. Assume continues with no pumping.
- SACWSD_Well_4
    - 1/1950 to 10/1995 - Based on Access database
    - 11/1995 to 12/2013 - Based on HydroBase data
        - Missing values filled in with average 1996-2000, 2003, 2005 – 2006, 2012 (full years of HydroBase data)
- SACWSD_Well_5
    - 1/1950 to 12/2006 - Based on Access database

    - 1/2007 to 12/2013
        - Filled in with average of years 2000-2005 (measured data)
- SACWSD_Well_6
    - 1/1950 to 1/1996 - Based on Access database
    - 2/1996 to 12/2013 - Based on hydro base data
        - Missing data filled in with average of 1998-2000, 2003, 2012 (full years of Hydro-Base data)
- SACWSD_Well_7
    - 1/1950 to 1/1996 - Based on Access database
    - 2/1996 to 12/2013 - Based on hydro base data
        - Missing data filled in with average of 1998-2005, 2008(full years of HydroBase data)
- SACWSD_Well_8
    - 1/1950 to 1/1996 - Based on Access database
    - 2/1996 to 12/2013 - Based on hydro base data
        - Missing data filled in with average of 1998-2001, 2003-2006 (full years of Hydro-Base data)
- SACWSD_Well_9
    - 1/1950 to 1/1996 - Based on Access database
    - 2/1996 to 12/2013 - Based on hydro base data
        - Missing data filled in with average of 1996-2008 (full years of HydroBase data)

Sedgwick

- For Sedgwick_Well_2,
    - 1/1950 to 12/2006 - Based on Access database
    - 1/2007 to 11/2007
        - Filled in with Monthly Average 2010-2012 (complete years with measured data)
    - 1/2007 to 12/2013- Based on HydroBase data
        - Missing data filled in with monthly Average 2010-2012 (complete years with measured data)
- For rest of wells,
    - 1/1950 to 12/2006 - Based on Access database
    - 1/2007 to 12/2013
        - Access estimated data shows trend of total yearly AF increases by 0.046 AF. (% increase = 0.41025%). Continue this projection forward.

Sterling Beef Wells

- For all wells,
    - 1/1950 to 12/2006 - Based on Access database

- 1/2007 to 12/2013
  - Based on HydroBase records
  - Missing data filled in average from years 2007-2011 (full years of HydroBase records)

Sterling EW Wells

- 1/1950 to 12/2006 - Based on Access database
- 1/2007 to 12/2013
  - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

Sterling Wells

- For Sterling_Well_1, Sterling_Well_2, Sterling Well_3
  - 1/1950 to 10/1999 - Based on Access database
  - 10/1999 to 10/2006 - Based on HydroBase data
    - Missing data filled in with access data base (based on actual pumping records)
  - 11/2009 to 12/2013 - Based on HydroBase data
    - Missing data filled in with average of years (full years of measured data)
      - Well 1 average 2000-2003, 2007-2009, 2012
      - Well 2 average 2001-2002, 2005, 2007
      - Well 3 average 2000-2002, 2007-2009, 2012
- Sterling_Well_10, Sterling_Well_4
  - 1/1950 to 12/2006 - Based on access data base
  - 1/2007 to 12/2013- Based on HydroBase data
    - Filled in with average from years (full years measured data)
      - Well 10 average 2001-2003, 2005, 2007
      - Well 4 average 2001-2005
- Sterling_Well_5
  - 1/1950 to 5/2000 Based on Access database
  - 6/2000 to 12/2006 Based on HydroBase data
    - Missing data filled in with Access database values because Based on measured pumping for those years
  - 1/2007 to 12/2013
    - Based on HydroBase
    - Missing values filled in with 2005 pumping (full year measured data)
- Sterling_Well_6
  - 1/1950 to 10/1995 - Based on Access database
  - 11/1995 to 12/2006 - Based on HydroBase records

        - Missing records filled in with Access database
    - 1/2007 to 12/2013 - Based on HydroBase records
        - Missing values filled in with pumping from 2005 (year full data).
        - No pumping November - April, fill in with zeros to reflect pumping trends
        -
- Sterling_Well_7
    - 1/1950 to 12/1995 - Based on access
    - 1/1996 to 12/2006 - Based on HydroBase
        - Missing data filled in with Access database
    - 1/2007 to 12/2013 - Based on HydroBase
        - Missing values filled in with average 2001-2002, 2005
- Sterling_Well_8, Sterling_Well_9
    - 1/1950 to 12/2006 - Based on access data base
    - 1/2007 to 12/2013
        - Filled in with HydroBase data
        - Missing data filled in with average from years 2001-2005 (full years measured data)
        - No pumping November - April, fill in with zeros to reflect pumping trends

Swift Wells

- For all wells,
    - 1/1950 to 12/2006 - Based on hydro base
    - 1/2007 to 12/2013
        - Fill in with average from 2004, 2005 because actual pumping records

Thornton Wells

- For all wells,
    - 1/1950 to 12/2006 - Based on hydro base
    - 1/2007 to 12/2013
        - Fill in with average from 2002-2005 because actual measured pumping records

Valencia Wells

- For all wells
    - 1/1950 to 12/2006 - Based on Access database
    - 1/2007 to 12/2013
        - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

Walker Wells

- For all wells

- 1/1950 to 12/2006 - Based on Access database
- 1/2007 to 12/2013
  - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

Walker_Well_3 (permit 2498-F) is an irrigation well and is included in the irrigation snapshots, so removed from the M&I pumping

Wiggins

- For all wells
  - 1/1950 to 12/2006 - Based on Access database
  - 1/2007 to 12/2013
    - Maximum estimated pumping equal to decreed rate (as previously done for the Access database)

Wiggins_Well_1 was an irrigation well until 1994; after 1994 the annual appropriation for municipal use was 170.3 ac-ft/yr and that 170.3 ac-ft/yr rate spread evenly per month

XCEL Public Service Wells

- Xcel_well_1
  - 1/1950 to 10/2001 - Based on Access database
  - 11/2001 to 12/2006 - Based on HydroBase
    - Missing data filled in with access database
  - 1/2007 to 12/2013- Based on HydroBase
    - Missing data filled in with measured data given to us by XCEL
- Xcel_Well_3
  - 1/1950 to 10/2005 Based on access
  - 11/2005 to 12/2013 - Based on HydroBase records
    - Missing data filled in with measured data by XCEL
- Xcel_Well_2, Xcel_Well_4 and Xcel_Well_5
  - 1/1950 to 10/2005- Based on access
  - 11/2005 to 12/2013 - Based on measured data by XCEL

Additional Observations

There were some discrepancies in the Access database. Various wells included in the MI_Pumping_Wells_wGridLocation sheet but not included in MI_Pumping sheet. Those wells are shown in the table below.

Only wells with pumping records in the access data base (MI_Pumping) had their time series extended.

Well ID	CCCC_Well_2	CCCC_Well_3	Lasalle_Well_6	NCWA_Well_1	NCWA_Well_2	NCWA_Well_3	Walker_Well_3
Permit Number	15447	15450	3673	4862	13429	60767	2498
Well name	HOLLAND MARCUS W 2-15447	HOLLAND MARCUS W 3-15450	LASALLE TOWN OF 3673-F	N COLO W ASSN W 1-04862F	N COLO W ASSN W 2-13429F	60767-F	WALKER WELL 4-2498-F
X coordinate	510013.3	510013.3	525243	503077.6	503077.8	504056.3	582009
Y coordinate	4391564	4391564	4467052	4529678	4529476	4528865	4460598

Also, various wells were missing permit numbers. Those wells include:

- Brighton_Well_10
- Brighton_Well_12
- Brighton_Well_13
- Brighton_Well_14
- Brighton_Well_15
- Brighton_Well_16
- Brighton_Well_17
- Brighton_Well_18
- Brighton_Well_19
- CO_State_Well_2
- CO_State_Well_3
- Continental_Well_10
- Continental_Well_9
- Mathews_Well_2
- McAtee_Well_1
- McAtee_Well_2
- SACWSD_Well_1
- SACWSD_Well_3
- SACWSD_Well_5
- Thornton_Well_1
- Thornton_Well_5
- Walker_Well_2