# A.1.8 Memorandum October 2018 Update: Post 97 Analysis WWUMM

Memorandum

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|---|---|
| To: | Kari Burgert, DNR |
| From: | The Flatwater Group, Inc. |
| Subject: | October 2018 Update: Post 97 Analysis – Western Water Use Model (WWUM) Area |
| Update: | 10/11/2018 |

# A. Introduction

The Flatwater Group, Inc. (TFG) was tasked by the Nebraska Department of Natural Resources (DNR) with developing recharge and pumping files (.RCH and .WEL files, respectively) for several Post 97 Analysis scenarios in the WWUM area. Section B of this memorandum describes the setup of the model TFG used to develop these files. TFG's task originally consisted of developing 7 simulation runs which were divided into two groups based upon assumed future (scenario years 2014-2063) climate conditions:

Group 1: 50-year projection by repeating a 25-year historical period (1989-2013) twice; and
Group 2: 50-year projection by repeating a five-year historical period (2009-2013) ten times.

Section C describes the inputs for the Group 1 model runs and is organized as follows:

C1. Baseline Scenario
C2. No Groundwater Only Pumping Scenario
C3. Post 97 Development Rollback Scenario

Section D describes the inputs for the Group 2 model runs and is organized as follows:

D1. Metered Baseline Scenario
D2. Metered Baseline Scenario: No Groundwater Only Pumping Scenario
D3. Metered Baseline Scenario: Simulated Groundwater Pumping Scenario
D4. Metered Baseline Scenario: Post 97 Development Rollback Scenario

TFG's task was updated in October 2018 to develop files (.RCH and .WEL files) for seven additional runs based on the Group 2 (Section D) model setup. For these runs, revised canal recharge and municipal and industrial (M&I) pumping information was used; and is described in section E.

Section F describes the inputs for each of the seven additional runs and is organized as follows:

F1_a. Metered Baseline Scenario with updated canal recharge and M&I pumping
F1_b. Metered Baseline Scenario without canal recharge or M&I pumping
F2_a. Metered Baseline Scenario: No Groundwater Pumping with updated canal recharge and no M&I Pumping
F2_b. Metered Baseline Scenario: No Groundwater Pumping without canal recharge or M&I pumping
F3_a. Metered Baseline Scenario: Post 97 Rollback Scenario with updated canal recharge and 1997 level of M&I pumping
F3_b. Metered Baseline Scenario: Post 97 Rollback Scenario with updated canal recharge and historic levels of M&I pumping

F3_c. Metered Baseline Scenario: Post 97 Rollback Scenario without canal recharge or M&I pumping

## B. Model Setup[1]

The watershed model utilized for DNR's Post 97 analysis was based upon the historically calibrated Western Water Use Model (WWUM). Inputs were incorporated from the results of the Historically Calibrated Model (Run028) and the Conservation Study's Baseline (Base001). Several modifications were necessary to implement the scenarios through the watershed model. All scenario changes were made to region 1 of the WWUM. Regions 2-6 remained consistent with the Historically Calibrated Model and did not vary from scenario to scenario.

### B1. Climate

The climate inputs for the watershed model remained consistent with the Historically Calibrated Model's inputs.

### B2. Land Use

The Post 97 analysis converted from a parcel and cell-based approach, to strictly a cell-based approach. This methodology was chosen to simplify the manipulation of the data sets used for the scenarios. This required three different land use data sets.

1) Baseline Data Set (LU004)
   The baseline data set was acquired directly from the Historically Calibrated Model. No modifications were made.

2) No Groundwater Only Pumping Data Set (LU004_ngwp)
   The No Groundwater Only Pumping data set was developed by making alterations to the Baseline Data Set. All groundwater only irrigated lands were converted to dryland cropping maintaining the crop mix.

3) Restrict Post 97 Groundwater Only Irrigated Land Development Data Set (LU004_p97)
   The Post 97 data set was developed by making alterations to the Baseline Data Set. For the years 1953 through 1997 the land use remained constant. Between 1998 and 2013 surface water only and comingled lands were developed as seen in the Baseline Data Set, while groundwater only irrigated lands were kept at 1997 levels. The balance of the acres within a cell were handled one of three ways:

   - If the number of irrigated acres[2] in the cell exceeded 40.0 acres, the excess acres remained in the model and the dryland acres were set to 0.0. The annual total of excess acres never exceeded 1,000 acres and was typically less than 125 per year.
   - If the irrigated acres were less than 40.0 acres, but the irrigated acres plus the dry acres were greater than 40.0 acres; acres were removed from the dryland crops until the total number of acres was equal to 40.0[3].

[1] All alterations to the land use occurred strictly in WWUM region 1.
[2] Irrigated acres are defined as the total of the land use file year's surface water only and comingled irrigated acres plus the 1997 groundwater only irrigated acres.
[3] The removal process proceeded in order from crop 1 to crop 12.

- If the irrigated acres plus the dryland acres was less than 40.0 acres, the balance was added as dryland corn.

**B3. Irrigation Estimates**

Typically, in the WWUM, the irrigation volumes applied within a cell are first determined on a parcel basis then divided among the cells which the parcel overlays. At the same time, an application efficiency for the cell is determined weighted, according to the volume applied by either sprinklers or flood irrigation. The migration from the parcel-based approach to the cell-based approach yields the need to develop a new way to initialize the volume of applied water. This method will be described for each scenario and replaces the 'Parcel_Pump_wSWdel' program in the RSWB.

The irrigation estimates were copied from either the Conservation Study baseline or the Calibrated Historical model. The conservation study represents a scenario where all irrigation volumes are simulated to meet a target NIR. Furthermore, methodology between determining the irrigation split on comingled lands consistently uses the 'mutual ditch' across all canals.

The irrigation volumes in the Calibrated Historical model include diversion records and metered pumping supplemented by simulated volumes based on a target NIR. Additionally, the surface water canals in the area use different methodology to determine the irrigation split on comingled lands; incorporating either a 'mutual ditch' or a 'maximum supply' approach.

Simulated irrigation volumes use one of two sets of NIR values. Set 1 is based on 95% of the CROPSIM predicted NIR. Set 2 is based on 95% of the CROPSIM predicted NIR for all crops except Alfalfa, Small Spring Grains, and Irrigated Pasture which are set at 80% of the CROPSIM predicted NIR.

**B4. Virtual Pumping in the '.WEL' file**

Another by-product of migrating from the parcel based approach was the removal of the link between the cell on which the pumping was applied and the certificate and well from which it was pumped. Rather, for all runs in this analysis a 'virtual pumping' technique was used in which pumping was extracted from the cell it was applied.

**B5. Call Year Routine**

A call year routine was initiated in each program of the RSWB to allow for the projection of the model results into a period of time where no input files exist. The call year file was able to control the land use, climate, application efficiency, canal recharge, miscellaneous pumping and recharge, and municipal and industrial pumping which was included in the simulation years results.

**B6. Canal Recharge, Miscellaneous Pumping and Recharge, Municipal and Industrial pumping**

Canal recharge was obtained from the conservation study's baseline inputs. Two canal recharge data sets were used; the baseline NPNRD data set and the Western Canal and Pumpkin Creek data set. For the model projected simulation years, the canal recharge annual file from the simulated climate year was used. For example, in 2063 climate from 2013 was used; therefore, canal recharge values from 2013 were also used.

Miscellaneous pumping and recharge was obtained from the datasets used to create the Calibrated Historical Model. These datasets included UNW_Run012, WCOHYST_Run025, Western_002, Colorado002, and Wyoming002 for regions 2-6. The miscellaneous pumping and recharge files matched the representative year for the simulated climate. For example, in 2063 the climate is represented by

2013; however, there is no 2013 data for the Region 4, rather it is copied from 2010. Therefore, 2010 data for region 4 will be included in the results for 2063.[4]

There is no municipal and industrial pumping included in any scenarios.

[4] The projected years used the same canal recharge and miscellaneous inputs as the as the climate year used to represent projected year. This information is defined in the WWUM watershed model documentation.

## C. Post 97 Scenarios with 25 Year Period Projected Twice

The following description defines the changes made to the model. Each scenario is implemented in Region 1 then combined with the pumping and recharge from UNW_Run012, WCOHYST_Run025, Colorado002, Western002, and Wyoming002; and the canal recharge from Base001 and WPC001 to create the '.WEL' and '.RCH' file for inclusion in the groundwater model.

### C1. Baseline Scenario (1953-2063) (Baseline001)

Deliverable: WWUM_p97_Baseline001.zip
Date: 10/24/2017

Simulated Period (1953-2013)

| | |
|---|---|
| Climate: | 1953-2013 |
| Land use: | Baseline Data Set |
| Surface Water Deliveries: | Copied from the conservation study's baseline scenario |
| Comingled Pumping: | Copied from the conservation study's baseline scenario |
| Groundwater Pumping: | Simulated to meet a target NIR |
| NIR Set: | 2 |
| Application Efficiency: | Copied from the conservation study's baseline scenario |
| Canal Recharge: | Yes |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulated Period (2014-2063)

| | |
|---|---|
| Climate: | 1989-2013 repeated twice |
| Land use: | Baseline Data Set: year 2013 |
| Surface Water Deliveries: | Simulated to meet a target NIR |
| NIR Set: | 1 |
| Comingled Pumping: | Simulated to meet a target NIR |
| NIR Set: | 1 |
| Comingled Split: | 85%[5] surface water 15% groundwater |
| Groundwater Pumping: | Simulated to meet a target NIR |
| NIR Set: | 2 |
| Application Efficiency: | Copied from the conservation study's baseline scenario's year 2013 |
| Canal Recharge: | Yes – match simulated climate year |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes – match simulated climate year |
| Miscellaneous Recharge: | Yes – match simulated climate year |

[5] The conservation study's baseline had an average split of 85%-15% on comingled irrigation 1989-2013.

**C2. No Groundwater Only Pumping Scenario (1953-2063) (NGWP_001)**

Deliverable: WWUM_p97_NGWP_001_20171026.zip
Date: 10/26/2017

Simulated Period (1953-2013)

| | |
|---|---|
| Climate: | 1953-2013 |
| Land use: | No Groundwater Only Pumping Data Set |
| Surface Water Deliveries: | Copied from the conservation study's baseline scenario |
| Comingled Pumping: | Copied from the conservation study's baseline scenario |
| Groundwater Pumping: | None |
| Application Efficiency: | Copied from the conservation study's baseline scenario |
| Canal Recharge: | Yes |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulated Period (2014-2063)

| | |
|---|---|
| Climate: | 1989-2013 repeated twice |
| Land use: | No Groundwater Only Pumping Data Set: year 2013 |
| Surface Water Deliveries: | Simulated to meet a target NIR |
| NIR Set: | 1 |
| Comingled Pumping: | Simulated to meet a target NIR |
| NIR Set: | 1 |
| Comingled Split: | 85% surface water 15% groundwater |
| Groundwater Pumping: | None |
| Application Efficiency: | Copied from the conservation study's baseline scenario's year 2013 |
| Canal Recharge: | Yes – match simulated climate year |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes – match simulated climate year |
| Miscellaneous Recharge: | Yes – match simulated climate year |

**C3. Post 97 Development Rollback Scenario (p97_001)**

Deliverable: WWUM_p97_p97_001_20171025.zip
Date: 10/25/2017

Simulated Period (1953-2013)

| | |
|---|---|
| Climate: | 1953-2013 |
| Land use: | Restrict Post 97 Groundwater Only Irrigated Land Development Data Set |
| Surface Water Deliveries: | Copied from the conservation study's baseline scenario |
| Comingled Pumping: | Copied from the conservation study's baseline scenario |
| Groundwater Pumping: | Simulated to meet a target NIR |
| NIR Set: | 2 |
| Application Efficiency: | Copied from the conservation study's baseline scenario |
| Canal Recharge: | Yes |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulated Period (2014-2063)

| | |
|---|---|
| Climate: | 1989-2013 repeated twice |
| Land use: | Restrict Post 97 Groundwater Only Irrigated Land Development Data Set: year 2013 |
| Surface Water Deliveries: | Simulated to meet a target NIR |
| NIR Set: | 1 |
| Comingled Pumping: | Simulated to meet a target NIR |
| NIR Set: | 1 |
| Comingled Split: | 85% surface water 15% groundwater |
| Groundwater Pumping: | Simulated to meet a target NIR |
| NIR Set: | 2 |
| Application Efficiency: | Copied from the conservation study's baseline scenario's year 2013 |
| Canal Recharge: | Yes – match simulated climate year |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes – match simulated climate year |
| Miscellaneous Recharge: | Yes – match simulated climate year |

## D. Post 97 Scenarios with 5 Year Period Projected 10 times

The following description defines the changes made to the model. Each scenario is implemented in Region 1 then combined with the pumping and recharge from UNW_Run012, WCOHYST_Run025, Colorado002, Western002, and Wyoming002; and the canal recharge from Base001 and WPC001 to create the '.WEL' and '.RCH' file for inclusion in the groundwater model.

**D1. Metered Baseline Scenario (1953-2063) (HistBase_001)**

Deliverable: WWUM_p97_HistBase_001_20171030.zip
Date: 10/30/2017

Simulated Period (1953-2013)

| | |
|---|---|
| Climate: | 1953-2013 |
| Land use: | Baseline Data Set |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model |
| Comingled Pumping: | Copied from the Calibrated Historical Model |
| Groundwater Pumping: | Copied from the Calibrated Historical Model |
| Application Efficiency: | Copied from the Calibrated Historical Model |
| Canal Recharge: | Yes |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulated Period (2014-2063)

| | |
|---|---|
| Climate: | 2009-2013 repeated ten times |
| Land use: | Baseline Data Set; matches simulated climate year |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model to match simulated climate year |
| Comingled Pumping: | Copied from the Calibrated Historical Model to match simulated climate year |
| Groundwater Pumping: | Copied from the Calibrated Historical Model to match simulated climate year |
| Application Efficiency: | Copied from the Calibrated Historical Model to match simulated climate year |
| Canal Recharge: | Yes – match simulated climate year |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes – match simulated climate year |
| Miscellaneous Recharge: | Yes – match simulated climate year |

**D2. Metered Baseline Scenario: No Groundwater Pumping (1953-2063) (Histngwp_001)**

Deliverable: WWUM_p97_Histngwp_001_20171030.zip
Date: 10/30/2017

Simulated Period (1953-2013)

| | |
|---|---|
| Climate: | 1953-2013 |
| Land use: | Baseline Data Set |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model |
| Comingled Pumping: | Copied from the Calibrated Historical Model |
| Groundwater Pumping: | None |
| Application Efficiency: | Copied from the Calibrated Historical Model |
| Canal Recharge: | Yes |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulated Period (2014-2063)

| | |
|---|---|
| Climate: | 2009-2013 repeated ten times |
| Land use: | Baseline Data Set; matches simulated climate year |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model to match simulated climate year |
| Comingled Pumping: | Copied from the Calibrated Historical Model to match simulated climate year |
| Groundwater Pumping: | None |
| Application Efficiency: | Copied from the Calibrated Historical Model to match simulated climate year |
| Canal Recharge: | Yes – match simulated climate year |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes – match simulated climate year |
| Miscellaneous Recharge: | Yes – match simulated climate year |

**D3. Metered Baseline Scenario: Simulated Groundwater Pumping (1953-2063) (HistNIR_002)**

Deliverable: WWUM_p97_HistNIR_002_20171208.zip
Date: 12/8/2017

Simulation Period (1953-2006)

| | |
|---|---|
| Climate: | 1953-2006 |
| Land use: | Baseline Data Set |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model |
| Comingled Pumping: | Copied from the Calibrated Historical Model |
| Groundwater Pumping: | Copied from the Calibrated Historical Model[6] |
| Application Efficiency: | Copied from the Calibrated Historical Model |
| Canal Recharge: | Yes |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulation Period (2007-2013)

| | |
|---|---|
| Climate: | 2007-2013 |
| Land use: | Baseline Data Set |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model |
| Comingled Pumping: | Copied from the Calibrated Historical Model |
| Groundwater Pumping: | Simulated to meet a target NIR |
| NIR Set: | 2 |
| Application Efficiency: | Copied from the Calibrated Historical Model |
| Canal Recharge: | Yes |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulation Period (2014-2063)

| | |
|---|---|
| Climate: | 2009-2013 repeated ten times |
| Land use: | Baseline Data Set; matches simulated climate year |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model to match simulated climate year |
| Comingled Pumping: | Copied from the Calibrated Historical Model to match simulated climate year |
| Groundwater Pumping: | Simulated to meet a target NIR |
| NIR Set: | 2 |
| Application Efficiency: | Copied from the Calibrated Historical Model to match simulated climate year |
| Canal Recharge: | Yes – match simulated climate year |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes – match simulated climate year |
| Miscellaneous Recharge: | Yes – match simulated climate year |

[6] During this period groundwater pumping in the Historically Calibrated Model is simulated

**D4. Metered Baseline Scenario: Post 97 Development Rollback Scenario (1953-2063) (Hist_p97_001)**

Deliverable: WWUM_p97_Hist_p97_001_20180302.zip
Date: 3/2/2018

Simulation Period (1953-1997)

| | |
|---|---|
| Climate: | 1953-1997 |
| Land Use: | Restrict Post 97 Groundwater Only Irrigated Land Development Data Set (Same as the baseline for this period of time) |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model |
| Comingled Pumping: | Copied from the Calibrated Historical Model |
| Groundwater Pumping: | Copied from the Calibrated Historical Model (During this period groundwater pumping in the Historically Calibrated Model is simulated) |
| Application Efficiency: | Copied from the Calibrated Historical Model |
| Canal Recharge: | Yes |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulation Period (1998-2013)

| | |
|---|---|
| Climate: | 1998-2013 |
| Land Use: | Restrict Post 97 Groundwater Only Irrigated Land Development Data Set |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model |
| Comingled Pumping: | Copied from the Calibrated Historical Model |
| Groundwater Pumping: | Simulated to meet a target NIR |
| NIR Set: | 2 |
| Application Efficiency: | Copied from the Calibrated Historical Model |
| Canal Recharge: | Yes |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulation Period (2014-2063)

| | |
|---|---|
| Climate: | 2009-2013 repeated ten times |
| Land Use: | Restrict Post 97 Groundwater Only Irrigated Land Development Data Set; matches simulated climate year |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model to match simulated climate year |
| Comingled Pumping: | Copied from the Calibrated Historical Model to match simulated climate year |
| Groundwater Pumping: | Simulated to meet a target NIR |
| NIR Set: | 2 |
| Application Efficiency: | Copied from the Calibrated Historical Model to match simulated climate year |
| Canal Recharge: | Yes – match simulated climate year |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes – match simulated climate year |
| Miscellaneous Recharge: | Yes – match simulated climate year |

## E. Update to the Post 97 Analysis Scenario Input files *Updated October 2018

The Metered Baseline Scenarios were updated to include new canal recharge and municipal and industrial (M&I) pumping data. The new groundwater model inputs were created by appending the new data sets to existing agricultural pumping and recharge datasets.

### E1. Updates to the Model Setup: Canal Recharge, M&I Pumping

This section replaces section B6 of the model setup for future runs.

Adaptive Resources, Inc. (ARI) develop an update version of the canal recharge inputs: *WWUM_ConveyanceLoss_28092018.csv*. Data was provided for the period 1953-2013. This information was provided to DNR. DNR then provided the information to TFG on October 1, 2018. This canal recharge data was compiled and formatted into the canal recharge data set *WWUMrr_001* which replaced the data sets *Base001* and *WPC001*. For the model projected simulation years, the canal recharge annual file from the simulated climate year was used. For example, in 2063 climate from 2013 was used; therefore, canal recharge values from 2013 were also used.

ARI also developed a set of Municipal and Industrial pumping data: *rr2018_muni_ind_inpu.csv*. Data was provided for the period May 1953 through 2063[7]; with instruction that the 2014-2063 was repeated from the years 2009-2013. The data was provided in $ft^3$/day. ARI provided this information to DNR. DNR then provided the information to TFG on October 1, 2018. The M&I data was converted in AF/mon[8] using the actual number of calendar days for each month. Then compiled and formatted into the M&I data set *MIrr_001*.

The following description defines the changes made to the model. Each scenario is implemented in Region 1 then combined with the pumping and recharge from UNW_Run012, WCOHYST_Run025,

[7] It should be noted that prior to 1997 there was no M&I pumping in the provided data
[8] Or AF/stress period

Colorado002, Western002, and Wyoming002 to create the '.WEL' and '.RCH' file for inclusion in the groundwater model.

# F. Post 97 Scenarios with 5 Year Period Projected 10 times *Updated October 2018

Section 0 describes the runs which incorporates the changes to the DNR Post 97 Analysis defined in Section E.

### F1. Metered Baseline Scenario (1953-2063) (HistBase_001) Updated

These runs use the same agricultural pumping and recharge as *Metered Baseline Scenario (HistBase_001)* from section D1.

### F1_a. Metered Baseline Scenario (1953-2063) (HistBase_001) with updated canal recharge and M&I pumping

Deliverable: WWUM_p97_HistBase_001_CnlSeep_MI_20181010.zip
Date: 10/10/2018

Simulated Period (1953-2013)

| | |
|---|---|
| Climate: | 1953-2013 |
| Land use: | Baseline Data Set |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model |
| Comingled Pumping: | Copied from the Calibrated Historical Model |
| Groundwater Pumping: | Copied from the Calibrated Historical Model |
| Application Efficiency: | Copied from the Calibrated Historical Model |
| Canal Recharge: | Yes |
| M&I Pumping: | Yes |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulated Period (2014-2063)

| | |
|---|---|
| Climate: | 2009-2013 repeated ten times |
| Land use: | Baseline Data Set; matches simulated climate year |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model to match simulated climate year |
| Comingled Pumping: | Copied from the Calibrated Historical Model to match simulated climate year |
| Groundwater Pumping: | Copied from the Calibrated Historical Model to match simulated climate year |
| Application Efficiency: | Copied from the Calibrated Historical Model to match simulated climate year |
| Canal Recharge: | Yes – match simulated climate year |
| M&I Pumping: | Yes – as specified by ARI dataset |
| Miscellaneous Pumping: | Yes – match simulated climate year |
| Miscellaneous Recharge: | Yes – match simulated climate year |

**F1_b. Metered Baseline Scenario (1953-2063) (HistBase_001) without canal recharge or M&I pumping**

Deliverable: WWUM_p97_HistBase_001_NoCnlSeep_NoMI_20181010.zip
Date: 10/10/2018

Simulated Period (1953-2013)

| | |
|---|---|
| Climate: | 1953-2013 |
| Land use: | Baseline Data Set |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model |
| Comingled Pumping: | Copied from the Calibrated Historical Model |
| Groundwater Pumping: | Copied from the Calibrated Historical Model |
| Application Efficiency: | Copied from the Calibrated Historical Model |
| Canal Recharge: | No |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulated Period (2014-2063)

| | |
|---|---|
| Climate: | 2009-2013 repeated ten times |
| Land use: | Baseline Data Set; matches simulated climate year |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model to match simulated climate year |
| Comingled Pumping: | Copied from the Calibrated Historical Model to match simulated climate year |
| Groundwater Pumping: | Copied from the Calibrated Historical Model to match simulated climate year |
| Application Efficiency: | Copied from the Calibrated Historical Model to match simulated climate year |
| Canal Recharge: | No |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes – match simulated climate year |
| Miscellaneous Recharge: | Yes – match simulated climate year |

**F2. Metered Baseline Scenario: No Groundwater Pumping (1953-2063) (Histngwp_001) *Updated**

These runs use the same agricultural pumping and recharge as *Metered Baseline: No Groundwater Pumping (Histngwp_001)* from section D2.

**F2_a. Metered Baseline Scenario: No Groundwater Pumping (1953-2063) (Histngwp_001) with updated canal recharge and without M&I pumping**

Deliverable: WWUM_p97_HistNgwp_001_CnlSeep_NoMI_20181010.zip
Date: 10/10/2018

Simulated Period (1953-2013)

| | |
|---|---|
| Climate: | 1953-2013 |
| Land use: | Baseline Data Set |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model |
| Comingled Pumping: | Copied from the Calibrated Historical Model |
| Groundwater Pumping: | None |
| Application Efficiency: | Copied from the Calibrated Historical Model |
| Canal Recharge: | Yes |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulated Period (2014-2063)

| | |
|---|---|
| Climate: | 2009-2013 repeated ten times |
| Land use: | Baseline Data Set; matches simulated climate year |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model to match simulated climate year |
| Comingled Pumping: | Copied from the Calibrated Historical Model to match simulated climate year |
| Groundwater Pumping: | None |
| Application Efficiency: | Copied from the Calibrated Historical Model to match simulated climate year |
| Canal Recharge: | Yes – match simulated climate year |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes – match simulated climate year |
| Miscellaneous Recharge: | Yes – match simulated climate year |

**F2_b. Metered Baseline Scenario: No Groundwater Pumping (1953-2063) (Histngwp_001) without canal recharge or M&I pumping**

Deliverable: WWUM_p97_HistNgwp_001_NoCnlSeep_NoMI_20181010.zip
Date: 10/10/2018

Simulated Period (1953-2013)

| | |
|---|---|
| Climate: | 1953-2013 |
| Land use: | Baseline Data Set |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model |
| Comingled Pumping: | Copied from the Calibrated Historical Model |
| Groundwater Pumping: | None |
| Application Efficiency: | Copied from the Calibrated Historical Model |
| Canal Recharge: | No |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulated Period (2014-2063)

| | |
|---|---|
| Climate: | 2009-2013 repeated ten times |
| Land use: | Baseline Data Set; matches simulated climate year |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model to match simulated climate year |
| Comingled Pumping: | Copied from the Calibrated Historical Model to match simulated climate year |
| Groundwater Pumping: | None |
| Application Efficiency: | Copied from the Calibrated Historical Model to match simulated climate year |
| Canal Recharge: | No |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes – match simulated climate year |
| Miscellaneous Recharge: | Yes – match simulated climate year |

**F3. Metered Baseline: Post 97 Development Rollback Scenario (Hist_p97_001) *Updated**

These runs use the same agricultural pumping and recharge as *Metered Baseline: Post 97 Development Rollback Scenario (Hist_p97_001)* from section D4.

**F3_a. Metered Baseline Scenario: Post 97 Development Rollback Scenario (1953-2063) (Hist_p97_001) with updated canal recharge and 1997 level of M&I pumping**

Deliverable: WWUM_p97_Hist_p97_001_CnlSeep_97MI_20181011.zip
Date: 10/11/2018

Simulation Period (1953-1997)

| | |
|---|---|
| Climate: | 1953-1997 |
| Land Use: | Restrict Post 97 Groundwater Only Irrigated Land Development Data Set (Same as the baseline for this period of time) |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model |
| Comingled Pumping: | Copied from the Calibrated Historical Model |
| Groundwater Pumping: | Copied from the Calibrated Historical Model (During this period groundwater pumping in the Historically Calibrated Model is simulated) |
| Application Efficiency: | Copied from the Calibrated Historical Model |
| Canal Recharge: | Yes |
| M&I Pumping: | Yes |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulation Period (1998-2013)

| | |
|---|---|
| Climate: | 1998-2013 |
| Land Use: | Restrict Post 97 Groundwater Only Irrigated Land Development Data Set |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model |
| Comingled Pumping: | Copied from the Calibrated Historical Model |
| Groundwater Pumping: | Simulated to meet a target NIR |
| NIR Set: | 2 |
| Application Efficiency: | Copied from the Calibrated Historical Model |
| Canal Recharge: | Yes |
| M&I Pumping: | Yes – At 1997 levels |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulation Period (2014-2063)

| | |
|---|---|
| Climate: | 2009-2013 repeated ten times |
| Land Use: | Restrict Post 97 Groundwater Only Irrigated Land Development Data Set; matches simulated climate year |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model to match simulated climate year |
| Comingled Pumping: | Copied from the Calibrated Historical Model to match simulated climate year |
| Groundwater Pumping: | Simulated to meet a target NIR |
| NIR Set: | 2 |
| Application Efficiency: | Copied from the Calibrated Historical Model to match simulated climate year |
| Canal Recharge: | Yes – match simulated climate year |
| M&I Pumping: | Yes – At 1997 levels |
| Miscellaneous Pumping: | Yes – match simulated climate year |
| Miscellaneous Recharge: | Yes – match simulated climate year |

**F3_b. Metered Baseline Scenario: Post 97 Development Rollback Scenario (1953-2063) (Hist_p97_001) with updated canal recharge and Historic levels of M&I pumping**

Deliverable: WWUM_p97_Hist_p97_001_CnlSeep_HistMI_20181011.zip
Date: 10/11/2018

Simulation Period (1953-1997)

| | |
|---|---|
| Climate: | 1953-1997 |
| Land Use: | Restrict Post 97 Groundwater Only Irrigated Land Development Data Set (Same as the baseline for this period of time) |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model |
| Comingled Pumping: | Copied from the Calibrated Historical Model |
| Groundwater Pumping: | Copied from the Calibrated Historical Model (During this period groundwater pumping in the Historically Calibrated Model is simulated) |
| Application Efficiency: | Copied from the Calibrated Historical Model |
| Canal Recharge: | Yes |
| M&I Pumping: | Yes |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulation Period (1998-2013)

| | |
|---|---|
| Climate: | 1998-2013 |
| Land Use: | Restrict Post 97 Groundwater Only Irrigated Land Development Data Set |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model |
| Comingled Pumping: | Copied from the Calibrated Historical Model |
| Groundwater Pumping: | Simulated to meet a target NIR |
| NIR Set: | 2 |
| Application Efficiency: | Copied from the Calibrated Historical Model |
| Canal Recharge: | Yes |
| M&I Pumping: | Yes |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulation Period (2014-2063)

| | |
|---|---|
| Climate: | 2009-2013 repeated ten times |
| Land Use: | Restrict Post 97 Groundwater Only Irrigated Land Development Data Set; matches simulated climate year |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model to match simulated climate year |
| Comingled Pumping: | Copied from the Calibrated Historical Model to match simulated climate year |
| Groundwater Pumping: | Simulated to meet a target NIR |
| NIR Set: | 2 |
| Application Efficiency: | Copied from the Calibrated Historical Model to match simulated climate year |
| Canal Recharge: | Yes – match simulated climate year |
| M&I Pumping: | Yes – as specified by ARI dataset |
| Miscellaneous Pumping: | Yes – match simulated climate year |
| Miscellaneous Recharge: | Yes – match simulated climate year |

**F3_c. Metered Baseline Scenario: Post 97 Development Rollback Scenario (1953-2063) (Hist_p97_001) without canal recharge or M&I pumping**

Deliverable: WWUM_p97_Hist_p97_001_NoCnlSeep_NoMI_20181011.zip
Date: 10/11/2018

Simulation Period (1953-1997)

| | |
|---|---|
| Climate: | 1953-1997 |
| Land Use: | Restrict Post 97 Groundwater Only Irrigated Land Development Data Set (Same as the baseline for this period of time) |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model |
| Comingled Pumping: | Copied from the Calibrated Historical Model |
| Groundwater Pumping: | Copied from the Calibrated Historical Model (During this period groundwater pumping in the Historically Calibrated Model is simulated) |
| Application Efficiency: | Copied from the Calibrated Historical Model |
| Canal Recharge: | No |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulation Period (1998-2013)

| | |
|---|---|
| Climate: | 1998-2013 |
| Land Use: | Restrict Post 97 Groundwater Only Irrigated Land Development Data Set |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model |
| Comingled Pumping: | Copied from the Calibrated Historical Model |
| Groundwater Pumping: | Simulated to meet a target NIR |
| NIR Set: | 2 |
| Application Efficiency: | Copied from the Calibrated Historical Model |
| Canal Recharge: | No |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes |
| Miscellaneous Recharge: | Yes |

Simulation Period (2014-2063)

| | |
|---|---|
| Climate: | 2009-2013 repeated ten times |
| Land Use: | Restrict Post 97 Groundwater Only Irrigated Land Development Data Set; matches simulated climate year |
| Surface Water Deliveries: | Copied from the Calibrated Historical Model to match simulated climate year |
| Comingled Pumping: | Copied from the Calibrated Historical Model to match simulated climate year |
| Groundwater Pumping: | Simulated to meet a target NIR |
| NIR Set: | 2 |
| Application Efficiency: | Copied from the Calibrated Historical Model to match simulated climate year |
| Canal Recharge: | No |
| M&I Pumping: | No |
| Miscellaneous Pumping: | Yes – match simulated climate year |
| Miscellaneous Recharge: | Yes – match simulated climate year |