A.1.3 Memorandum on COHYST2010 area Model Runs

Memorandum

To: Kari Burgert, DNR

From: The Flatwater Group, Inc.

Subject: Robust Review – COHYST area Model Runs

Date: 11/26/2018

INTRODUCTION

The Flatwater Group, Inc. (TFG) was contracted by the Platte Basin Water Project Coalition through the Nebraska Department of Natural Resources (NDNR) to provide technical assistance for the Robust Review project. The purpose of the Robust Review project is to assess streamflow impacts resulting from management actions taken as part of the Basin-Wide Plan and/or Natural Resource District (NRD) Integrated Management Plans (MPs). The focus of this memorandum is to identify the scenario simulations created for the Robust Review project and define their setup.

The remaining discussion within this document is organized into four sections:

Section 0 of this memorandum describes the setup of the model TFG used to develop these files.

Section 0 describes the first iteration of the of the Robust Review scenarios and the inputs used to create the simulations. TFG's task originally consisted of developing three simulation runs, with multiple Municipal and Industrial (M&I) pumping scenarios. However, the groundwater land use modifications to the baseline and the unretired scenario were limited to Tri-Basin NRD and Twin Platte NRD.

0. Baseline Scenario
0. Unretired Scenario
0. Post 1997 Development Rollback Scenario
    0. 1997 level of M&I development
    0. Historical level of M&I development

Section D describes requested updates to land use and M&I pumping information made by the three Natural Resource Districts (NRDs) in the COHYST model domain area during the course of the Robust Review project.

Section E describes the updated Robust Review scenario simulations created to implement the changes described in Section D. It contains a list of the Robust Review simulations with a description of how each scenario was represented. Section E is organized as follows:

0. Baseline Scenario
    0. No M&I pumping
0. Unretired Scenario

0. Post 1997 Development Rollback Scenarios
    0. 1997 level of M&I development
    0. Historical level of M&I development
    0. No M&I pumping
0. No Groundwater Only Pumping Scenario

Section 0 described the updates to the Unretired Scenario land use data set to fix the acres unretired to account for post 2010 temporary retirements being implemented at twice the area of these retirements. This accounted for 40.8 acres in TPNRD and 111.3 acres in TBNRD.

Section 0 describes the updated Robust Review Unretired Scenario simulation created to implement the changes described in Section 0. It contains a list of the simulation with a description of who the scenario was represented. Section 0 is organized as follows:

A1. Unretired Scenario

MODEL SETUP

The watershed model utilized for the Robust Review was based upon the calibrated Cooperative Hydrology Study (COHYST) 2010 watershed model. Additional inputs were incorporated from the Conservation Study's Baseline (Base001). Several modifications were necessary to implement the scenarios through the watershed model.

A1. MODEL STRUCTURE

The Robust Review model runs include a historical period (1950-2013) and a projected period (2014-2063). The Watershed model was modified to draw Water Balance Parameter (WBP) data from two sets. The first set uses the traditional time trended WBPs that represent the change in farming practices over time. This set is applied to the historical period. The second set switches to the WBP developed using the most current set of farming practices. This set is applied to the projected period.

CLIMATE

The WBP input data sets implemented in the COHYST 2010 model were updated for the Robust Review in the COHYST model area. Two changes were made to the CROPSIM model (v8.0). The first change updated the recharge routine from precipitation on irrigated simulations during the irrigation season. A second change made the transfer of soil water content between subsequent years consistent on the number of decimals passed between variables.

The same COHYST weather stations were simulated for the circa 1950s, 1970s, and 2000s farming practices and then time trended over the historical period. The time trended information was spatially gridded to create the COHYST WBP data set Run002\Grid_TT for application in Robust Review's historical period. The Circa 2000s information was spatially gridded to create the COHYST WBP data set Run002\Grid98 for application in the Robust Review's projected period.

LAND USE

Multiple land use data sets were implemented in the Robust Review within the COHYST area to hand the different modeled scenarios.

BASELINE LAND USE (RR001\LU004_RR2013EXT)

The first step was to establish a baseline land use. The Robust Review Land Use used land use data sets for the period 1950 to 2013. The 1985-2010 land use was consistent with the land use used in COHYST 2010. The 1950-1984 land use was obtained from the 2013 FAB analysis. This was also consistent with the way land use was represented in the Conservation Study. The period 2011-2013 was created by adding and removing the NRD and DNR specified retirements, transfers, and variances from the 2010 land use file. The land use modifications were applied to groundwater only irrigated lands. Surface water only and comingled lands were not altered. With the exception of the 6 Mile canal which was converted completely to comingled and the GWC was set to 1.0 effectively making these lands groundwater only irrigated. The 2014-2023 period was further modified to accommodate

temporary retirement contracts ending[1]. At the time of the first Robust Review Iteration the land use modifications were applied for Twin Platte NRD and Tri-Basin NRD.

Details about the modifications made to the Land use data sets can be found in the Land Use Memorandums[2]:

TBNRD_RR_Memo_20180713.docx
TPNRD_RobustReview_LU_20180713.docx

UNRETIRED SCENARIO LAND USE (RR001\LU004_RR2013MOD)

The second set was to develop to capture the influence of the retired groundwater only irrigated acres. The baseline land use was modified to add back in the temporary and permanently retired groundwater only irrigated acres. No modifications were made to surface water only or comingled lands. At the time of the first Robust Review Iteration the land use modifications were applied for Twin Platte NRD and Tri-Basin NRD.

Details about the modifications made to the Land use data sets can be found in the Land Use Memorandums[3]:

TBNRD_RR_Memo_20180713.docx
TPNRD_RobustReview_LU_20180713.docx

[1]A ten-year temporary retirement would only be retire for 10 years as opposed to persisting throughout the projected period.

[2] The land use memos were updated to account for changes requested by the NRDs and the implementation of the CPNRD modifications.

[3] The land use memos were updated to account for changes requested by the NRDs and the implementation of the CPNRD modifications.

POST 1997 GROUNDWATER DEVELOPMENT ROLLBACK LAND USE (LU004P97)[4]

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 the 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 in the cell exceeded 160.0 acres[5], the excess acres irrigated acres remained in the model and the dryland acres were set to 0.0. The annual total of the excess acres never exceeded 10,000 acres. Averaging 2,100 acres from 1998-2005 and 9,200 acres from 2006-2013. The overwhelming majority of this acre imbalance occurred in the Republican River, Big Blue River, and Little Blue River Basins.
- IF the irrigated acres were less than 40.0 acres, but the irrigated acres plus the dry acres were greater than 160.0 acres; acres were removed from the dryland crops until the total number of acres was equal to 160.0.
- If the irrigated acres plus the dryland acres was less than 40.0 acres, the balance was added as dryland corn.

IRRIGATION ESTIMATES

All groundwater only irrigation estimates were simulated to meet a target NIR.

The Robust Review used the Surface Water Irrigation District surface water deliveries from the Conservation Study[6]. This deliveries data set spanned from 1950 through 2013. For the projected period (2014-2063) the total canal deliveries were copied to match the climate year. This total was then divided among the acres to receive surface water as specified by the simulation year land use file[7]. For surface water only and comingled lands not in the surface water operations model, the irrigation volumes were simulated to meet a target NIR.

Comingled pumping was implemented in the same manner as the COHYST 2010 model. A portion of the target NIR designated by the Groundwater Concentration Factor (GWC) is meet by pumping. Additionally, if the surface water deliveries were insufficient to meet the demanded deliveries (1-GWC), pumping was applied to make up the deficit.

The same surface water deliveries and comingled pumping were applied to each scenario.

CANAL RECHARGE

---

[4]All of the NRD and DNR specified modifications to the groundwater irrigated acres happened in1999 or later. This means that the post 1997 groundwater development rollback land use data set was not altered by these changes.

[5]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.

[6]The Robust Review was not running the COHYST Surface Water Operations Model.

[7] Example: In 2014 Cozad Canal would receive the 1989 volume of deliveries which would be divided over the 2014 surface water only and comingled lands serviced by the Cozad Canal.

The Robust Review used the Republican River canal recharge from the COHYST 2010 model. The 1950-1984 canal recharge was copied from 1985. The 2011-2013 canal recharge was copied from 2010 which was in turn originally copied from 2005. (RRcnl001)

MUNICIPAL AND INDUSTRIAL (M&I) PUMPING

The Robust Review used the M&I pumping from the Statewide M&I data set in the COHYST model area (MI001).

ROBUST REVIEW SCENARIOS (ITERATION 1)

Using the setup and updates described in Section 0, the watershed model was used to simulate a variety of scenarios for the Robust Review and create the corresponding inputs for the groundwater model. Section 0 contains a list of these simulations with a description of how the scenario was represented.

A1. BASELINE SCENARIO (BASE001)

Deliverable: RobustReview_Base001_20180711.zip

Date: 7/11/2018

Simulated Period (1950-2013)

Climate:	1950 – 2013
Land Use:	Baseline Extension (RR001\LU004_rr2013ext)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes
M&I Pumping:	Yes

Simulated Period (2014-2063)

Climate:	1989 – 2013 repeated twice
Land Use:	Baseline Extension (RR001\LU004_rr2013ext)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year

Canal Recharge:	Yes – match simulated year
M&I Pumping:	Yes – Uses the 2013 estimate

UNRETIRED SCENARIO (MOD001)

Deliverable: RobustReview_MOD001_20180711.zip

Date: 7/11/2018

Simulated Period (1950-2013)

Climate:	1950 – 2013
Land Use:	Unretire Acres (RR001\LU004_rr2013mod)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes
M&I Pumping:	Yes

Simulated Period (2014-2063)

Climate:	1989 – 2013 repeated twice
Land Use:	Unretire Acres (RR001\LU004_rr2013mod)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes – match simulated year
M&I Pumping:	Yes – Uses the 2013 estimate

POST 1997 GROUNDWATER DEVELOPMENT ROLLBACK SCENARIO (DP97_001)

POST 197 GROUNDWATER DEVELOPMENT ROLLBACK SCENARIO 1997 LEVEL OF M&I

Deliverable: RobustReview_dP97_001_20180720.zip

Date: 7/20/2018

Simulated Period (1950-1997)

Climate:	1950 – 1997
Land Use:	Post 97 GW Scenario Land Use (LU004p97)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes
M&I Pumping:	Yes (MI001)

Simulated Period (1998-2013)

Climate:	1998 – 2013
Land Use:	Post 97 GW Scenario Land Use (LU004p97)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes
M&I Pumping:	Yes – At 1997 levels of pumping (MI001)

Simulated Period (2014-2063)

Climate:	1989 – 2013 repeated twice
Land Use:	Post 97 GW Scenario 2013 Land Use (LU004p97)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes – match simulated year
M&I Pumping:	Yes – At 1997 levels of pumping (MI001)

POST 197 GROUNDWATER DEVELOPMENT ROLLBACK SCENARIO WITH HISTORIC LEVELS OF M&I

Deliverable: RobustReview_dP97_001_20180716.zip

Date: 7/16/2018

Simulated Period (1950-1997)

Climate:	1950 – 1997
Land Use:	Post 97 GW Scenario Land Use (LU004p97)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes
M&I Pumping:	Yes (MI001)

Simulated Period (1998-2013)

Climate:	1998 – 2013
Land Use:	Post 97 GW Scenario Land Use (LU004p97)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes
M&I Pumping:	Yes (MI001)

Simulated Period (2014-2063)

Climate:	1989 – 2013 repeated twice
Land Use:	Post 97 GW Scenario 2013 Land Use (LU004p97)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes – match simulated year
M&I Pumping:	Yes – At 2014 estimate levels of pumping (MI001)

*The output of this run is no longer on the TFG server. Only the results provided to DNR remain. The output was replaced with 1997 level of M&I pumping before it was determined that both sets of information were desired. This run could be replicated, but the subsequent Post 1997 runs would replace this run in the Robust Review Analysis.

ROBUST REVIEW COHYST AREA UPDATES

A second iteration of the Robust Review was completed to accommodate the changes to groundwater only irrigated acres in the Central Platte NRD. Furthermore, the requested changes from TPNRD and TBNRD were also implemented. The following changes were made:

A1. LAND USE

The Baseline Land Use data set and the Unretired Scenario Land use data sets were updated as follows:

- The CPNRD retirements, transfers, and variances were implemented into both data sets
- The TBNRD temporary retirement '*Pheasants Forever*' contract term was changed from 4 years to 5 years

This information was combined with the previous modifications to create new data sets:

BASELINE LAND USE (RR002\LU004_RR2013EXT_002)
UNRETIRED SCENARIO LAND USE (RR002\LU004_RR2013MOD_002)

Details about the modifications made to the baseline and unretired scenario land use data sets can be found in the Land Use Memorandums[8]:

CPNRD_RR_LUmemo_LU20181017.pdf
TBNRD_RR_Memo_LU20181017.pdf
TPNRD_RobustReview_LU20181017.pdf

NO GROUNDWATER PUMPING SCENARIO LAND USE (RR002\LU004_RR2013EXT_002_NGWP)

The No Groundwater Pumping Scenario land use converted all groundwater only irrigated acres in the Baseline Land Use Data Set (RR002\LU_rr2013ext_002) to dryland acres of the same crop mix. Surface water only and comingled land use remained unchanged.

MUNICIPAL AND INDUSTRIAL (M&I) PUMPING

The industrial pumping from the Gerald Gentleman Power Station (GGS) in the TPNRD was modified to use estimates developed by Nebraska Public Power District (NPPD) in their annual reports. The COHYST M&I data set (MI001) was modified by moving the GGS pumping data to their own set of inputs:

Details about the modifications made to the M&I data sets can be found in the M&I Memorandum:

GGS_update_20181022.docx

[8] The land use memos were updated to account for changes requested by the NRDs and the implementation of the CPNRD modifications.

COHYST M&I FOR THE ROBUST REVIEW (MIRR001)

Contains the information from the COHYST M&I data set (MI001) sans the GGS pumping estimates.

GERALD GENTLEMAN STATION PUMPING (GGSRR_002)

Contains the new pumping estimates for GGS.

ROBUST REVIEW SCENARIOS (ITERATION 2)

The newly updated inputs developed in Section 0 were implemented into the watershed model to create a new set of Robust Review scenario simulations and the corresponding inputs for the groundwater model. Section 0 contains a list of these simulations with a description of how the scenario was represented.

A1. BASELINE SCENARIO (BASE002)

Deliverable: RobustReview_COHYST_Base002_20180831.zip
Date: 8/31/2018

Simulated Period (1950-2013)

Climate:	1950 – 2013
Land Use:	Baseline Extension (RR002\LU004_rr2013ext_002)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes
M&I Pumping:	Yes

Simulated Period (2014-2063)

Climate:	1989 – 2013 repeated twice
Land Use:	Baseline Extension (RR002\LU004_rr2013ext_002)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes – match simulated year

M&I Pumping:	Yes – Uses the 2014 estimate

BASELINE SCENARIO – NO MUNICIPAL AND INDUSTRIAL PUMPING (BASE002_SANSMI)

Deliverable: RobustReview_COHYST_Base002_sansMI_20180905.zip

Date: 9/5/2018

Simulated Period (1950-2013)

Climate:	1950 – 2013
Land Use:	Baseline Extension (RR002\LU004_rr2013ext_002)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes
M&I Pumping:	No

Simulated Period (2014-2063)

Climate:	1989 – 2013 repeated twice
Land Use:	Baseline Extension (RR002\LU004_rr2013ext_002)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes – match simulated year
M&I Pumping:	No

UNRETIRED SCENARIO (MOD002)

Deliverable: RobustReveiw_COHSYT_MOD002_20180831.zip

Date: 8/31/2018

Simulated Period (1950-2013)

Climate:	1950 – 2013
Land Use:	Unretired Acres (RR002\LU004_rr2013mod_002)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes
M&I Pumping:	Yes

Simulated Period (2014-2063)

Climate:	1989 – 2013 repeated twice
Land Use:	Unretired Acres (RR002\LU004_rr2013mod_002)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes – match simulated year
M&I Pumping:	Yes – Uses the 2014 estimate

POST 1997 GROUNDWATER DEVELOPMENT ROLLBACK SCENARIO (DP97_001)

These runs use the same agricultural pumping and recharge from the *Post 1997 Groundwater Development Rollback Scenario (dP97_001)* from Section 0. The difference between the runs is the municipal and industrial pumping data sets which were applied and the way they were applied.

POST 1997 GROUNDWATER DEVELOPMENT ROLLBACK SCENARIO WITH 1997 LEVEL OF M&I

*Updated with new M&I data sets

Deliverable: RobustReview_dP97_001_MIrr001_20180904.zip

Date: 9/4/2018

Simulated Period (1950-1997)

Climate:	1950 – 1997
Land Use:	Post 97 GW Scenario Land Use (LU004p97)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes
M&I Pumping:	Yes (MIrr_001, GGSrr_002)

Simulated Period (1998-2013)

Climate:	1998 – 2013
Land Use:	Post 97 GW Scenario Land Use (LU004p97)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes

M&I Pumping:	Yes – At 1997 levels of pumping (MIrr_001, GGSrr_002)

Simulated Period (2014-2063)

Climate:	1989 – 2013 repeated twice
Land Use:	Post 97 GW Scenario 2013 Land Use (LU004p97)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes – match simulated year
M&I Pumping:	Yes – At 1997 levels of pumping (MIrr_001, GGSrr_002)

POST 1997 GROUNDWATER DEVELOPMENT ROLLBACK SCENARIO WITH HISTORICAL LEVELS OF M&I

*Updated with new M&I data sets

Deliverable: RobustReview_dP97_001_MIrr001HistDev_20180905.zip

Date: 9/5/2018

Simulated Period (1950-1997)

Climate:	1950 – 1997
Land Use:	Post 97 GW Scenario Land Use (LU004p97)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes
M&I Pumping:	Yes (MIrr_001, GGSrr_002)

Simulated Period (1998-2013)

Climate:	1998 – 2013
Land Use:	Post 97 GW Scenario Land Use (LU004p97)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes
M&I Pumping:	Yes (MIrr_001, GGSrr_002)

Simulated Period (2014-2063)

Climate:	1989 – 2013 repeated twice
Land Use:	Post 97 GW Scenario 2013 Land Use (LU004p97)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes – match simulated year
M&I Pumping:	Yes – At 2014 estimate levels of pumping (MIrr_001, GGSrr_002)

POST 1997 GROUNDWATER DEVELOPMENT ROLLBACK SCENARIO WITH NO M&I

Deliverable: RobustReview_dP97_001_MIrr001_none_20180904.zip

Date: 9/4/2018

Simulated Period (1950-1997)

Climate:	1950 – 1997
Land Use:	Post 97 GW Scenario Land Use (LU004p97)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes
M&I Pumping:	No

Simulated Period (1998-2013)

Climate:	1998 – 2013
Land Use:	Post 97 GW Scenario Land Use (LU004p97)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes
M&I Pumping:	No

Simulated Period (2014-2063)

Climate:	1989 – 2013 repeated twice
Land Use:	Post 97 GW Scenario 2013 Land Use (LU004p97)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes – match simulated year
M&I Pumping:	No

NO GROUNDWATER ONLY PUMPING SCENARIO (NGWP_003)

Deliverable: RobustReview_nGWP_003_20180906.zip

Date: 9/6/2018

Simulated Period (1950-2013)

Climate:	1950 – 2013
Land Use:	Baseline Extension No Groundwater Only Lands (Lu004_rr2013ext_002_ngwp)
Groundwater Pumping:	None
Surface Water Deliveries:	Copied from the Conservation Study Baseline
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes
M&I Pumping:	No

Simulated Period (2014-2063)

Climate:	1989 – 2013 repeated twice
Land Use:	Baseline Extension No Groundwater Only Lands (RR002\LU004_rr2013ext_002_ngwp)
Groundwater Pumping:	None
Surface Water Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes – match simulated year
M&I Pumping:	No

ROBUST REVIEW COHYST AREA UPDATES (ITERATION 2.1)

The second iteration of the Robust Review was modified after identifying a data discrepancy between the unretired acres scenario and the cumulative retirements. It was determined that the temporary retirements after 2010 were being added back in at double the rate they should have been. This resulted in 40.8 additional GW only acres in TPNRD and 111.3 additional GW only acres in the TBNRD. The land use data set for the Unretired Scenario was rebuilt to remove the additional unretire acres. No other changes were made.

A1. THIS CREATED THE LAND USE DATA SET:

UNRETIRED SCENARIO LAND USE (RR002\LU004_RR2013MOD_002.1)

This land use dataset was created with the same method and inputs as 0; the only exception was that the post 2010 temporary retirements were not added back into the data set. This was not necessary as the modified data set was extended from the 2010 land use from COHYST 2010; as opposed to the modification being made to the extended baseline dataset. Details about the modified data sets can be found in the Land Use Memorandums[9]:

CPNRD_RR_LUmemo_LU20181121.pdf

TBNRD_RR_Memo_LU20181121.pdf

TPNRD_RobustReview_LU20181121.pdf

[9] The land use memos were updated to account for the removal of the double addition of unretired acres.

ROBUST REVIEW SCENARIO (ITERATION 2.1)

The newly updated inputs developed in Section 0 were implemented into the watershed model to create a new Unretired Scenario simulation and the corresponding inputs for the groundwater model. Section 0 summarizes the inputs used to represent the scenario within the model.

A1. UNRETIRED SCENARIO (MOD002)

Deliverable: RobustReveiw_COHSYT_MOD002.1_20181121.zip
Date: 11/26/2018

Simulated Period (1950-2013)

Climate:	1950 – 2013
Land Use:	Unretired Acres (RR002\LU004_rr2013mod_002.1)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Canal Recharge:	Yes
M&I Pumping:	Yes

Simulated Period (2014-2063)

Climate:	1989 – 2013 repeated twice
Land Use:	Unretired Acres (RR002\LU004_rr2013mod_002.1)
Groundwater Pumping:	Simulated to meet a target NIR
Surface Water Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year
Comingled Pumping:	Simulated to meet a target NIR and supplement deficient comingled deliveries
Comingled Deliveries:	Copied from the Conservation Study Baseline to match simulated climate year

Canal Recharge:	Yes – match simulated year
M&I Pumping:	Yes – Uses the 2014 estimate