



Summary of Incorporating 2020 Agricultural Practices

6/4/2024

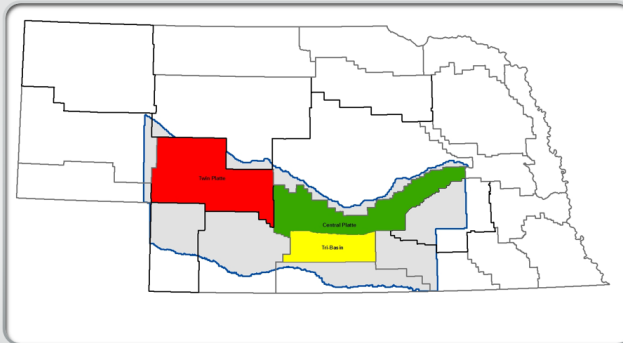
Previous Presentations

Conservation Study Irrigation Application Efficiency & Tillage Scenarios

21 MARCH 2018

March 2018 –Phase 1 of the Conservation Study

- Results indicated tillage practices would have a higher impact on the water budget than irrigation efficiency changes
- Builds on efforts begun nearly a decade ago



COHYST Model Area Conservation Study

Field Work Preparation – 4/9/2020



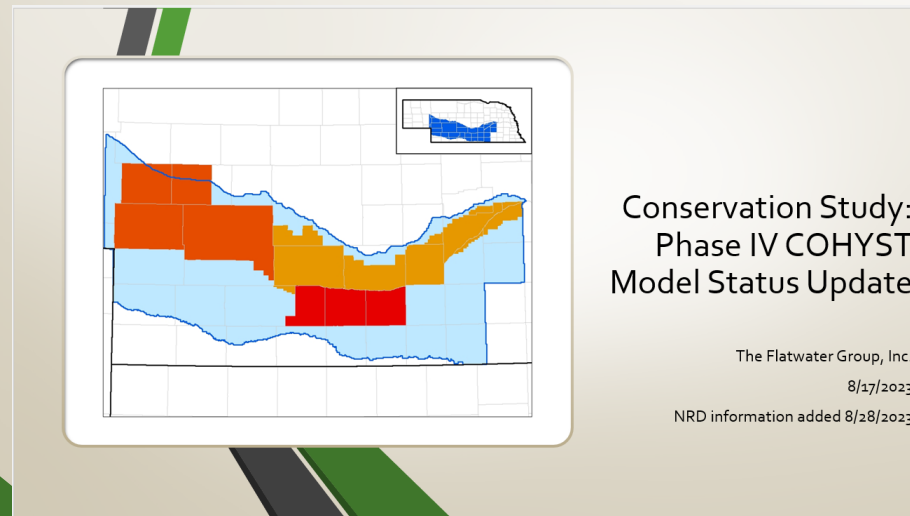
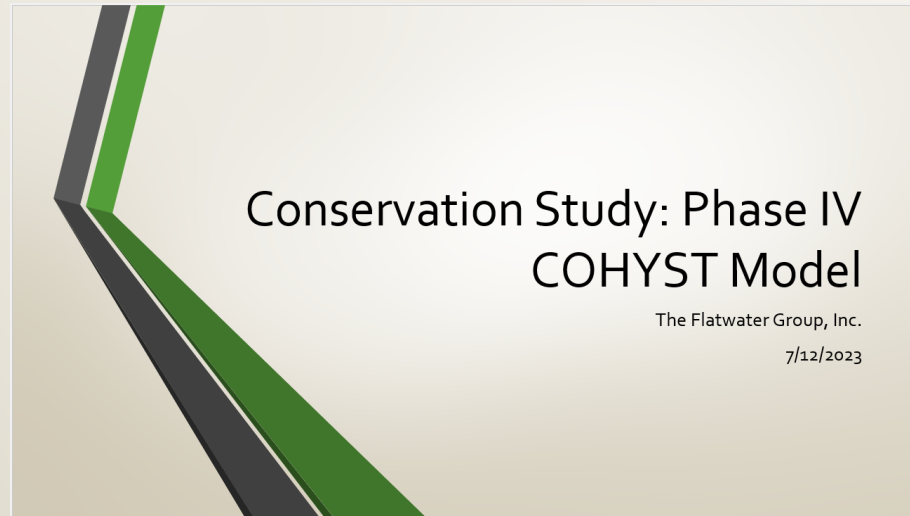
April 2020– Phases 2 & 3 of the Conservation Study

- Summarizes the design and results of field collection efforts conducted by the NRDs to obtain the tillage information incorporated into the 2020 Robust Review

Previous Presentations

July 2023 – Phase 4 of the Conservation Study

- Discusses model setup changes to implement the finding from Phase 3 into the watershed model
- Incorporates additional 2020 Production Practices
 - Crop Phenology (GDD, HI, Planting Dates)
- Creation of 2020 SIM Files
 - Build on existing 50s, 70s, 90s, datasets
 - Use of gridded climate inputs



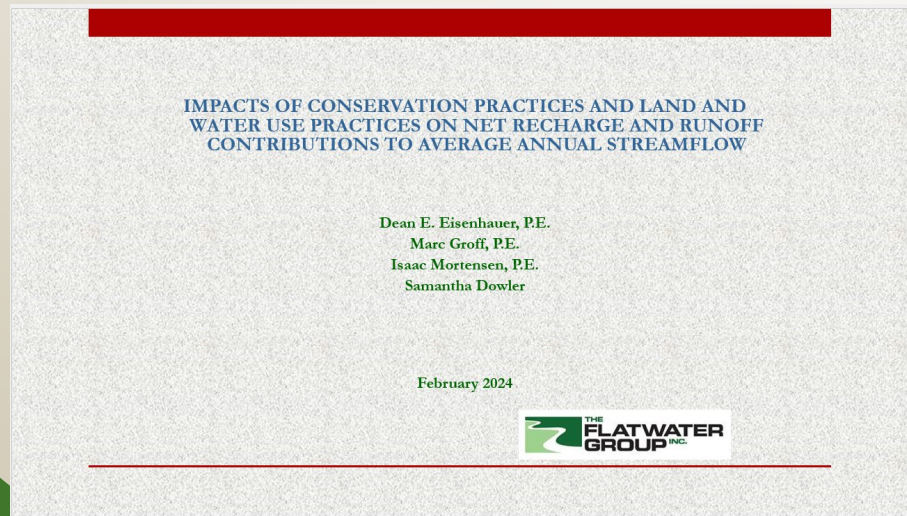
August 2023 – Preliminary 2023 Robust Review Methods Run

- Uses 2020 SIM files discussed in July
- Climate extended through 2020 and run with 2019 Robust Review land use inputs (i.e. 2011-2020 land use = 2010)
 - Shows distribution of anticipated Net Recharge change

Previous Presentations

November 2023 – 2023 Robust Review Run

- Presents 2023 Robust Review Modeling Results and Water Budget Information
 - Includes comparisons to TPNRD Meter Information



February 2024 – Impacts Summary

- Summarizes by NRD impacts to net recharge and runoff contributions to streamflow

Robust Review Model Runs

Historical - Baseflow

Historical - Total Flow



TFG Support Task

Task 100

Del Date

27-Nov

Ref Name

Baseline2020_001

Baseline1998_001

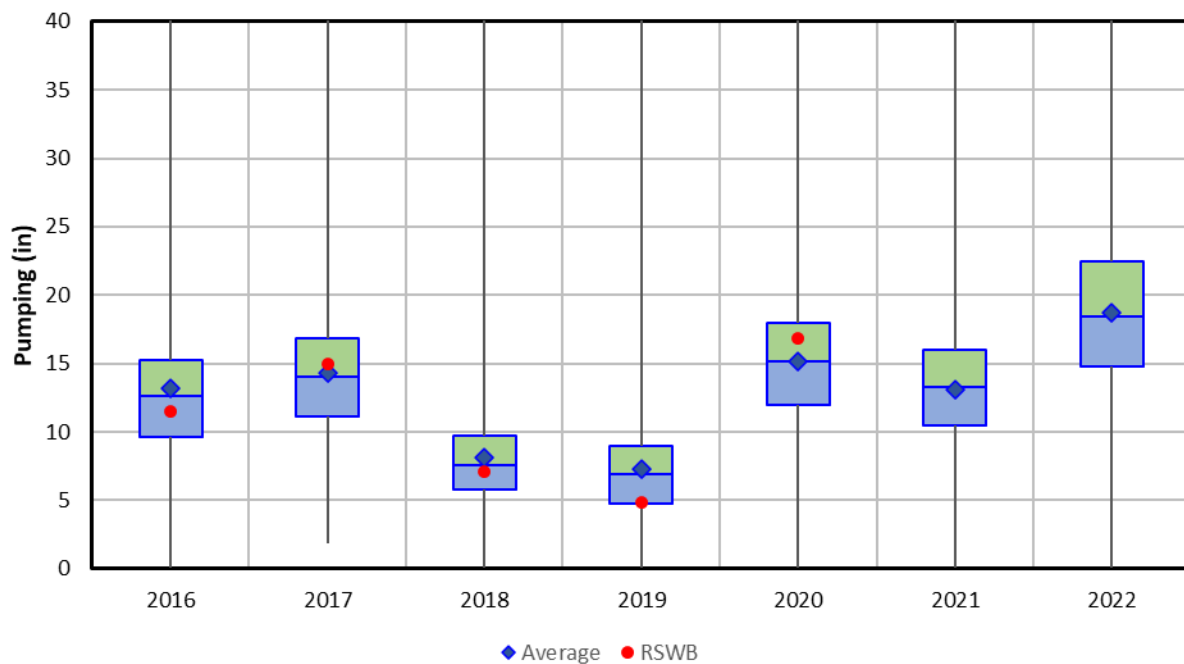
Tillage

2020 SIM Files

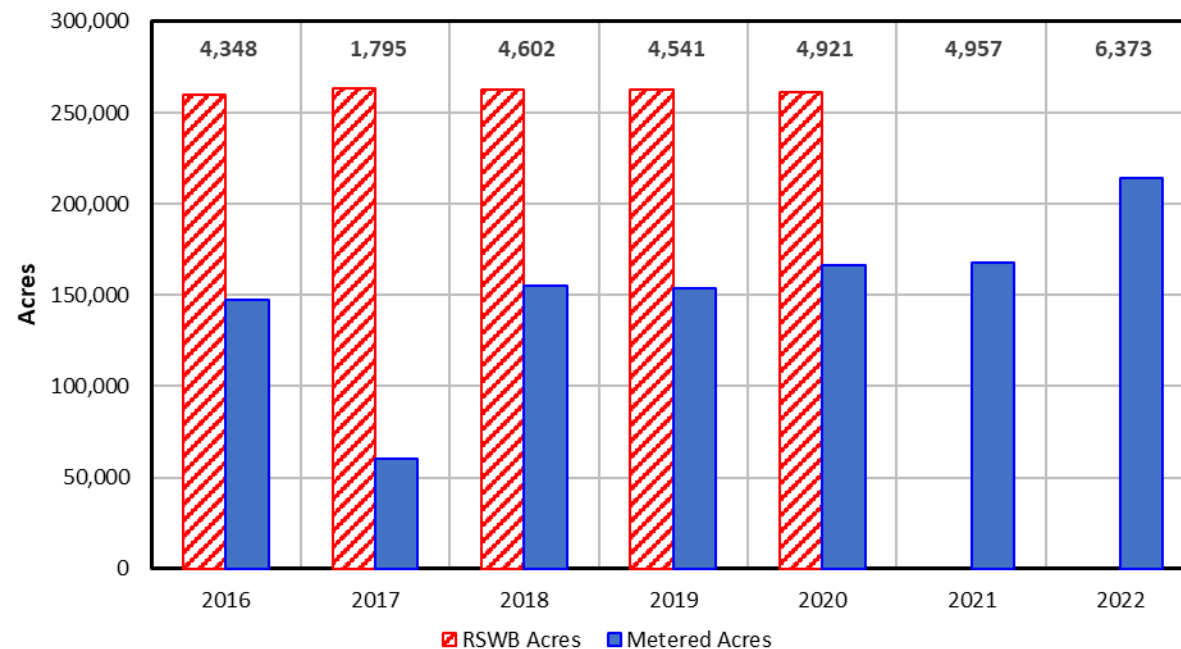
1998 SIM Files

TPNRD – Pumping Comparison

TPNRD - Metered Pumping



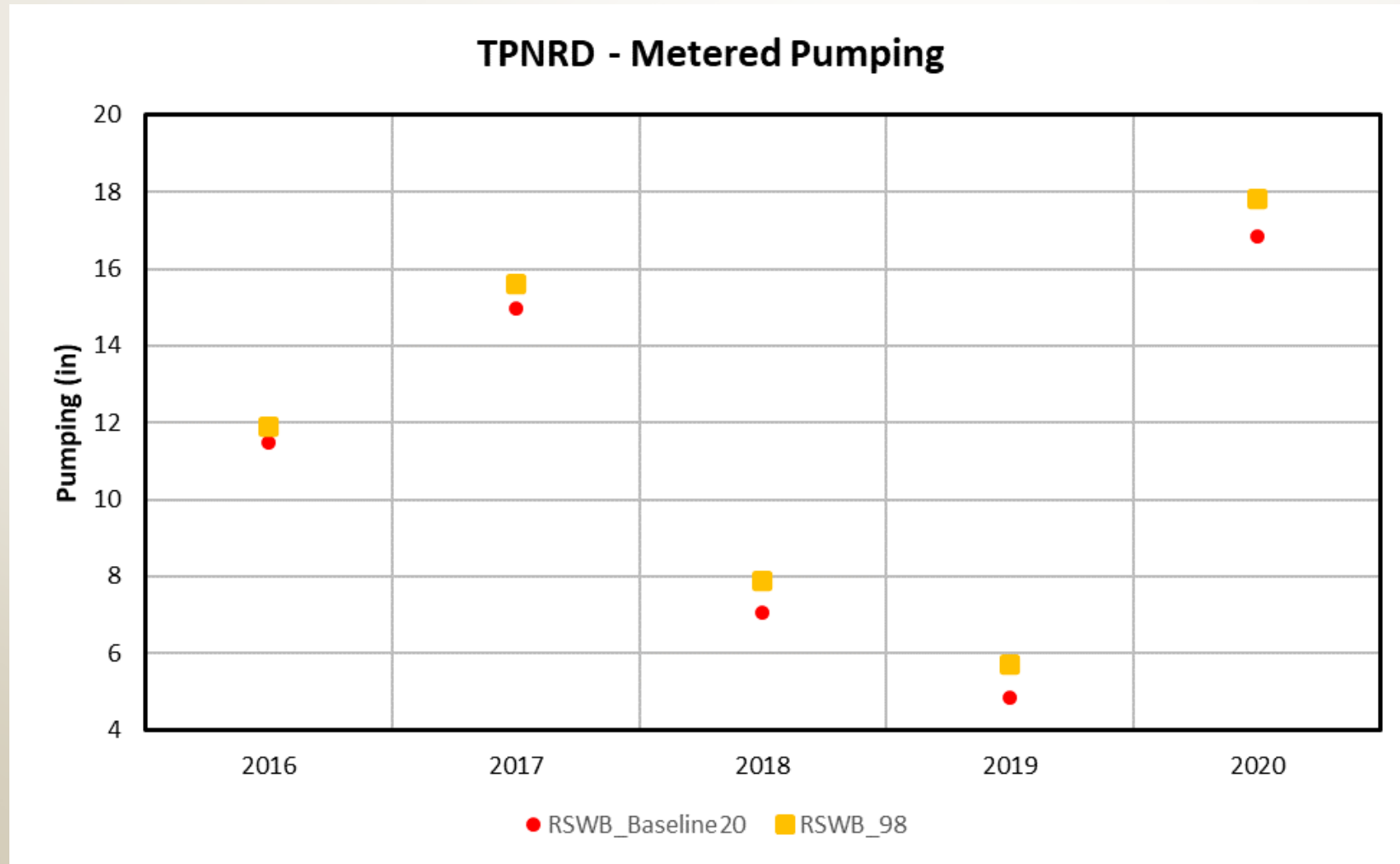
TPNRD - GW Irrigated Acres



Note: Number values above bars indicate number of metered pumping entries available.

Robust Review Model Runs	TFG Support Task	Del Date	Ref Name	Production Practices
Historical - Baseflow	>	Task 100	29-Nov	Baseline2020_001
Historical - Total Flow				Baseline1998_001

Production Practice Update Impacts on Pumping Estimates

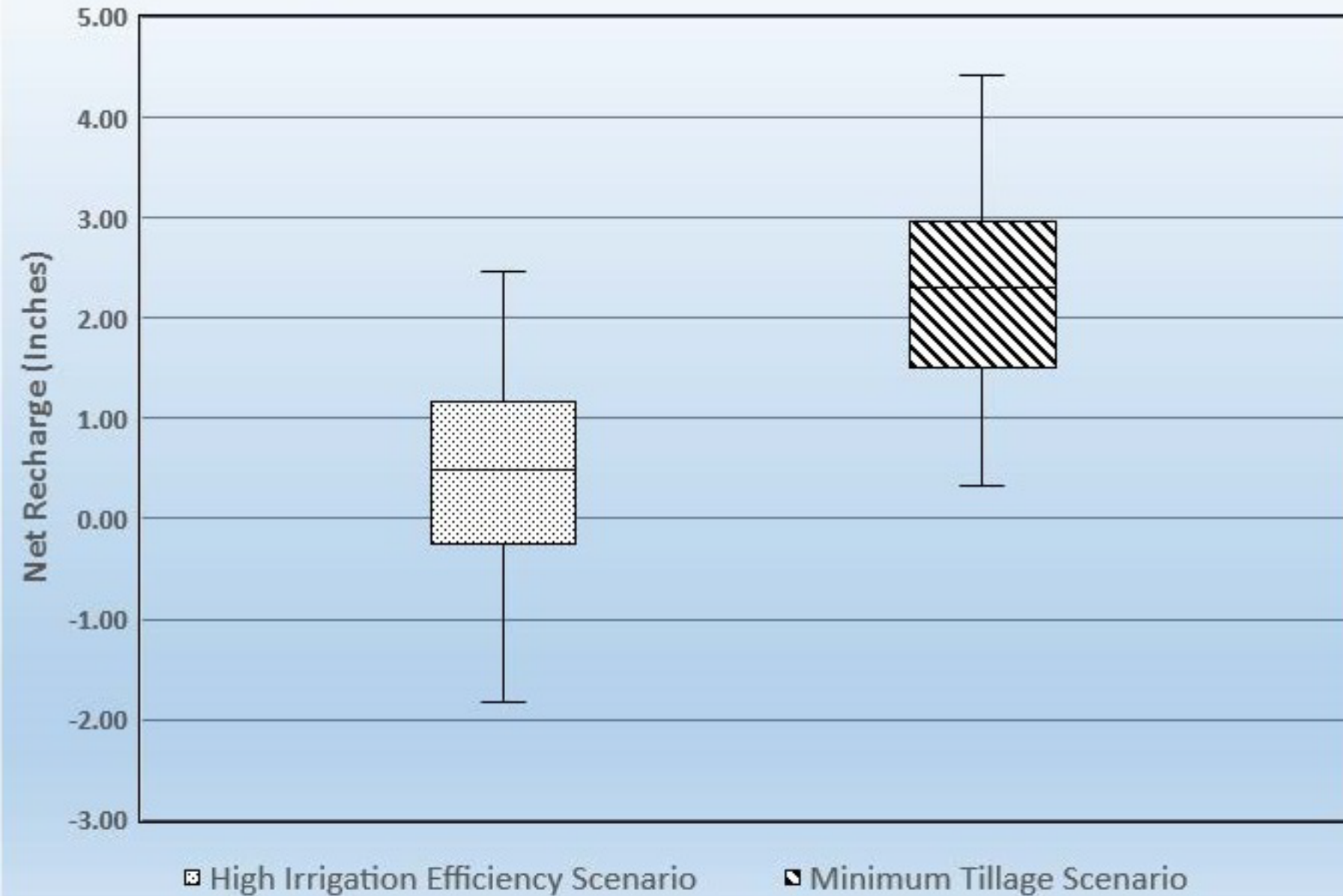




Conservation Study Irrigation Application Efficiency & Tillage Scenarios

21 MARCH 2018

Range of Net Recharge Values - "Envelope" Scenario



Net Recharge:

**Recharge Change
– Pumping Change**

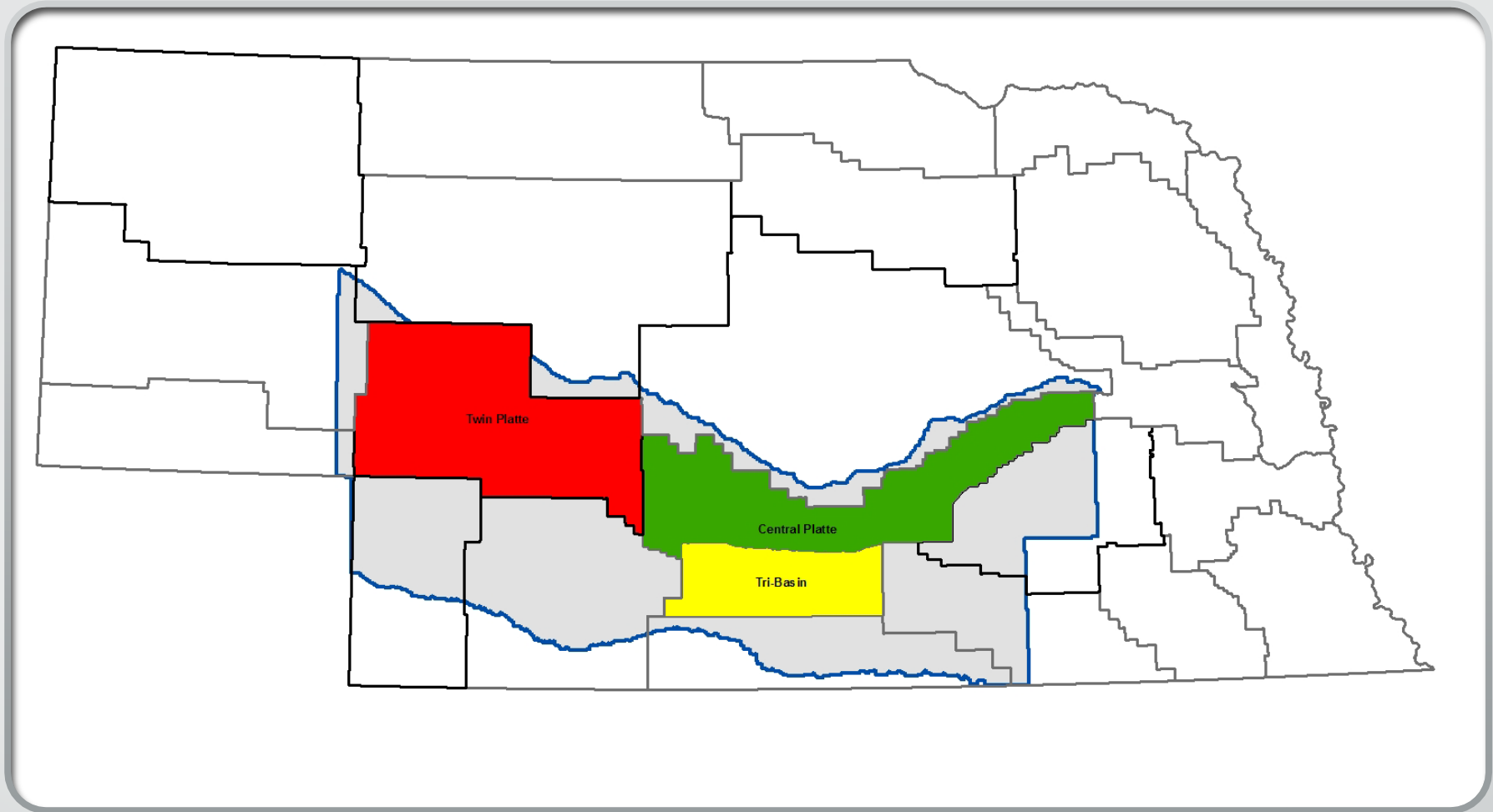
**Positive = Aquifer Gaining Water
Negative = Aquifer Losing Water**

Graph represents the distribution of average annual depths computed as the volumetric change divided by the acres impacted in the scenario.

Out of the 10,500,000 acres in the combined NRD areas, the scenarios impacted:

IAE Scenario: 2,350,000 acres

Till Scenario: 3,100,000 acres



COHYST Model Area Conservation Study

Field Work Preparation – 4/9/2020



Conventional Tillage leaves less than 15% residue on the soil surface.

Conservation Tillage leaves at least 30% residue on the soil surface.

No-Till leaves the soil covered 100% of the time.

Image Source:
<https://www.pennington.com/all-products/agriculture/resources/why-use-a-cover-crop>

Goal of this phase of the Conservation Study is to collect information on current Tillage Practices

Collect information that is:

1. Collected in a manner consistent with previous collection efforts
2. Results can be used in current and future water use models

Nebraska Roadside Transect Survey 2016

Procedures for Using a Roadside Transect Survey For Obtaining Tillage/Crop Residue Data and Resource Assessment

Adapted from procedures designed by:
Conservation Technology Information Center
www.ctic.purdue.edu

Introduction

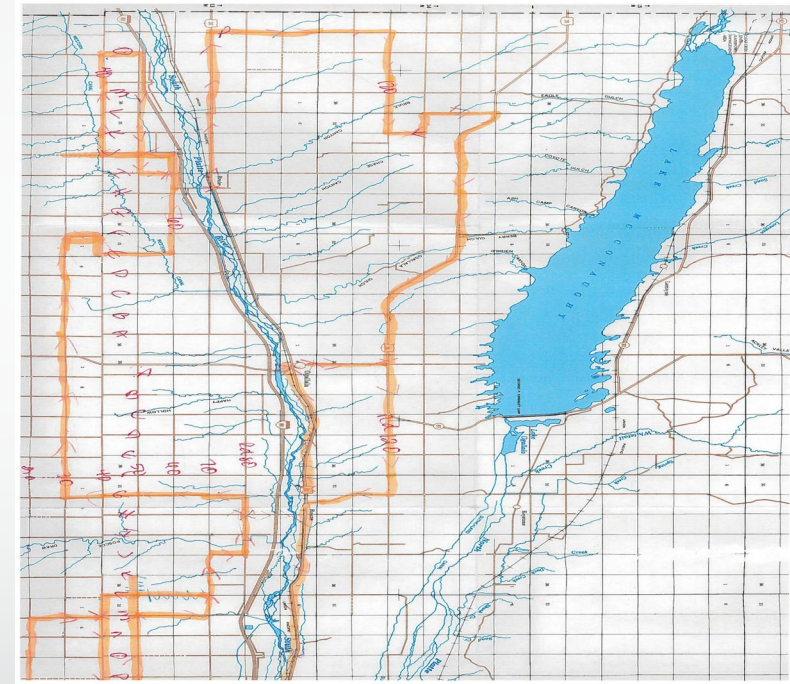
This 2016 Nebraska roadside transect survey is designed to gather information to be used as part of Nebraska's resource assessment. Items that information are being gathered on includes visible erosion, common structural practices, tillage and crop residue management systems, and Eastern Red Cedar (ERC) invasion. It is adapted from the 2008 procedures for the Cropland Roadside Transect Survey designed by the Conservation Technology Information Center (CTIC). In 2016, approximately 20 Counties will be surveyed

The purpose of the survey is threefold: (1) to provide information that can be used by Nebraska NRCS and the Natural Resource Districts in establishing priorities for conservation needs, and for educational or other programs, (2) to evaluate progress achieved in reaching county or statewide goals, and (3) to provide accurate data on the adoption of conservation tillage systems and the state of Nebraska's Resources. The roadside transect survey is an ideal tool for rapid assessment as well as measuring progress for locally led conservation. The state data used for Resource Assessment will have a higher confidence level with the inclusion of data from the Roadside survey.

Procedures Establishing and Marking the Route

Base our methods on CTIC procedures adopted by NRCS for use in previous tillage practice surveys.

- Roadside Survey Approach



- Data collection occurs at ½ mile intervals along route
 - Need minimum of 460 sites per county (reduced proportionately for partial counties)

To Recap our general process:

1. Establish the route to drive through the County. If previous years' paths are available, those would be excellent to use. Plan to sample sites every ½ mile – you can get two sites at each stop (e.g. field to the left of the road is Site 1 and field to the right is Site 2).
2. Establish a time to conduct the survey. Will need to be after planted crops have emerged, but before crop canopies completely shade rows or the first cultivation occurs.
3. At each site, complete the Tillage Survey Results form. If measured transects are conducted, keep transect record sheets with the Results forms.
4. Once a county is completed, the information on the various forms will be compiled and percentages of each crop/tillage combination will be determined

Questions / Discussion

2020

Phase III Conservation Measures Study: Tillage Survey Results

Conventional Tillage	Conservation Tillage	No-Till
		
Conventional Tillage leaves less than 15% residue on the soil surface.	Conservation Tillage leaves at least 30% residue on the soil surface.	No-Till leaves the soil covered 100% of the time.

Prepared For:



The Flatwater Group, Inc

12/2/2020

- Table 4A Revised 4/21/2022

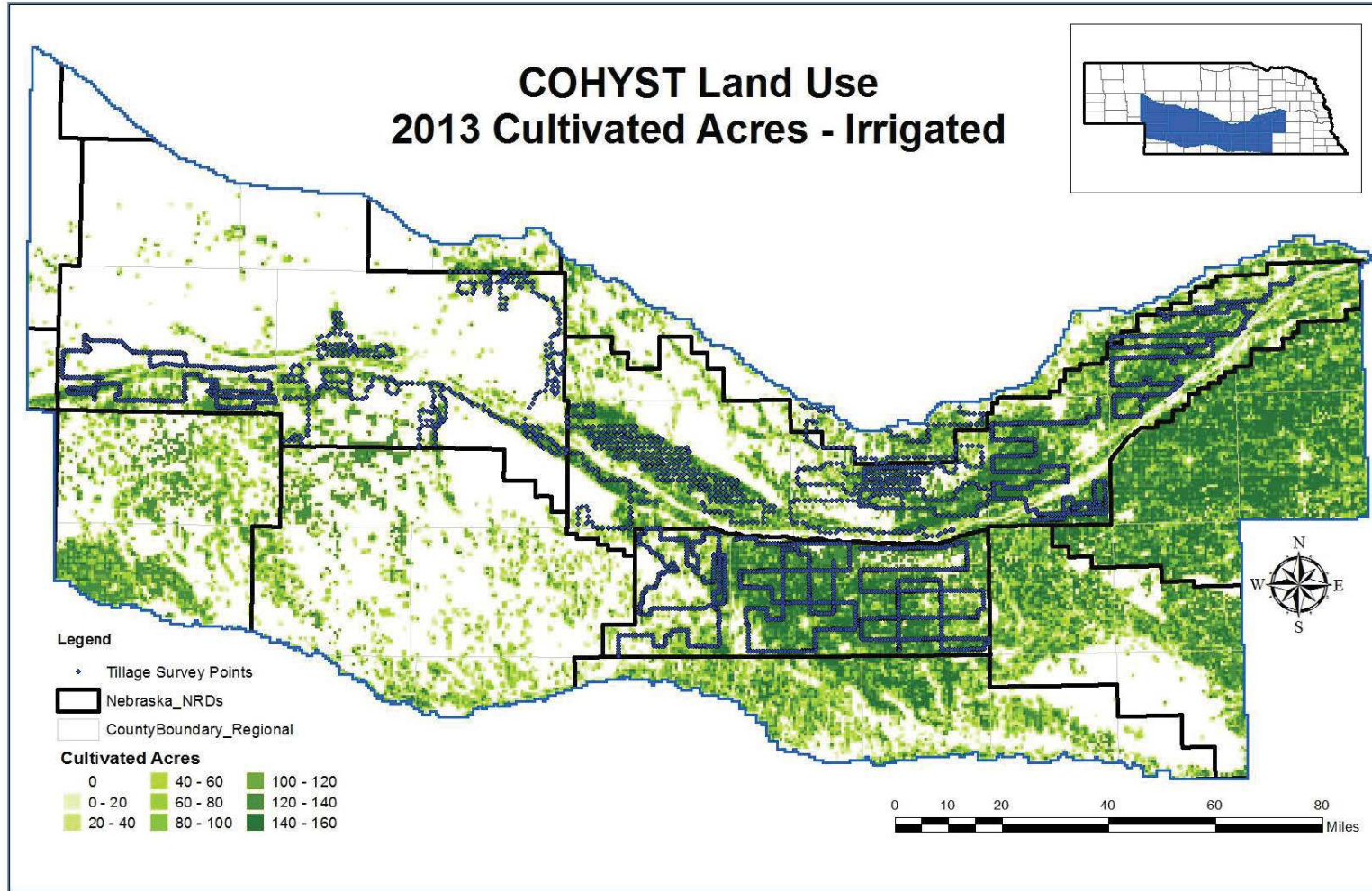


Figure 5: 2020 Tillage Survey Points with 2013 Irrigated Acreage

Table 1 - 2020 Conservation Study Field Work Summary

NRD	County	Total Number of Sites	Number of Cropland Sites	Number of Farmstead/Pasture/Range/Windbreak Sites	Number of Sites Removed Due to QC Issues
Twin Platte NRD					
	Keith	690	538	149	3
	Lincoln	752	460	285	7
Tri-Basin NRD					
	Gosper	608	379	227	2
	Phelps	646	525	121	0
	Kearney	688	555	133	0
Central Platte NRD					
	Buffalo	806	551	246	9
	Merrick	700	524	164	12
	Dawson	573	464	96	13
	Hall	596	525	62	9
<hr/>					
Totals		6,059	4,521	1,483	55

Table 2A - Cropland Site Count Matrix - Keith County

Crop	Conventional-Till	Mulch-Till	No-Till	Reduced-Till	Ridge-Till	Strip-Till	Unknown	Grand Total
	<15%	> 30%		15-30%	> 30%	> 30%	/NA	
Barley	0	0	1	0	0	0	0	1
Corn	9	98	181	11	2	33	0	334
Fallow	7	0	34	0	0	0	5	46
Oats	2	0	1	0	0	0	0	3
Other	0	0	3	1	0	0	11	15
Rye	2	0	0	0	0	0	0	2
Soybeans	1	24	50	3	0	7	0	85
Sugarbeets	0	3	2	0	0	0	0	5
Wheat-Winter	31	1	1	14	0	0	0	47
Grand Total	52	126	273	29	2	40	16	538

Table 2B - Cropland Site Percentage Matrix - Keith County

Crop	Conventional-Till	Mulch-Till	No-Till	Reduced-Till	Ridge-Till	Strip-Till	Unknown	Grand Total
	<15%	> 30%		15-30%	> 30%	> 30%	/NA	
Barley	0%	0%	100%	0%	0%	0%	0%	100%
Corn	3%	29%	54%	3%	1%	10%	0%	100%
Fallow	15%	0%	74%	0%	0%	0%	11%	100%
Oats	67%	0%	33%	0%	0%	0%	0%	100%
Other	0%	0%	20%	7%	0%	0%	73%	100%
Rye	100%	0%	0%	0%	0%	0%	0%	100%
Soybeans	1%	28%	59%	4%	0%	8%	0%	100%
Sugarbeets	0%	60%	40%	0%	0%	0%	0%	100%
Wheat-Winter	66%	2%	2%	30%	0%	0%	0%	100%
Grand Total	10%	23%	51%	5%	0%	7%	3%	100%



Conservation Study: Phase IV COHYST Model

The Flatwater Group, Inc.

7/12/2023

Project Background

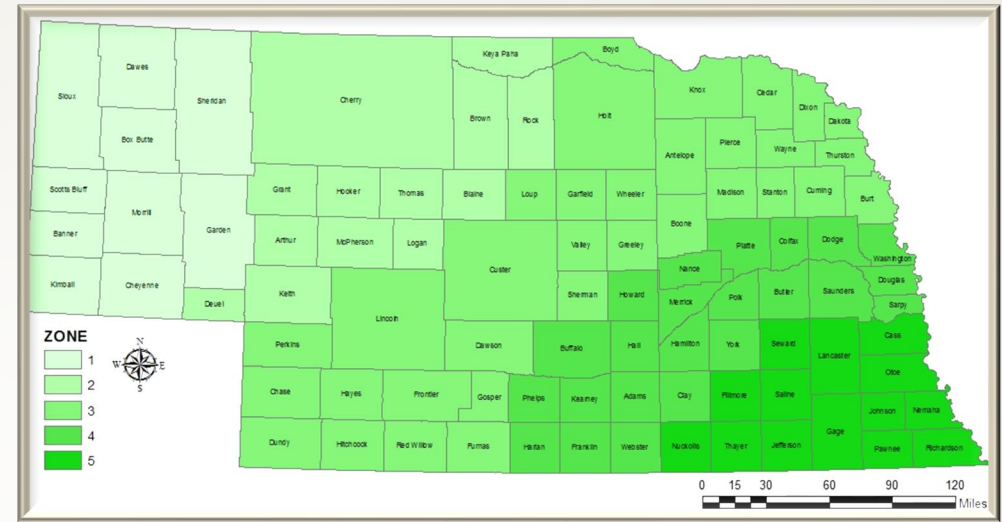
- Conservation Study – Phase 3 performed a survey of conservation practices to identify and quantify the prevalence of different tillage practices in the Twin Platte NRD, Central Platte NRD, and Tri-Basin NRD.
- The survey identified six predominant tillage practices based upon observations of residue coverage near the time of spring planting
- Each NRD then identified the relative occurrence of each tillage practice within the district
- Phase IV looks to implement the finding from Phase 3 into the watershed modeling process for the COHYST area



Project Background

- Conservation Study Phase IV also updated crop phenology and irrigation management
- The implementation of this information is in the format of a set of new CROPSIM 'Simfiles' input files collectively referred to as the 2020 set point
- The COHYST model was extended through 2020 in preparation for the 2023 Robust Review Modeling

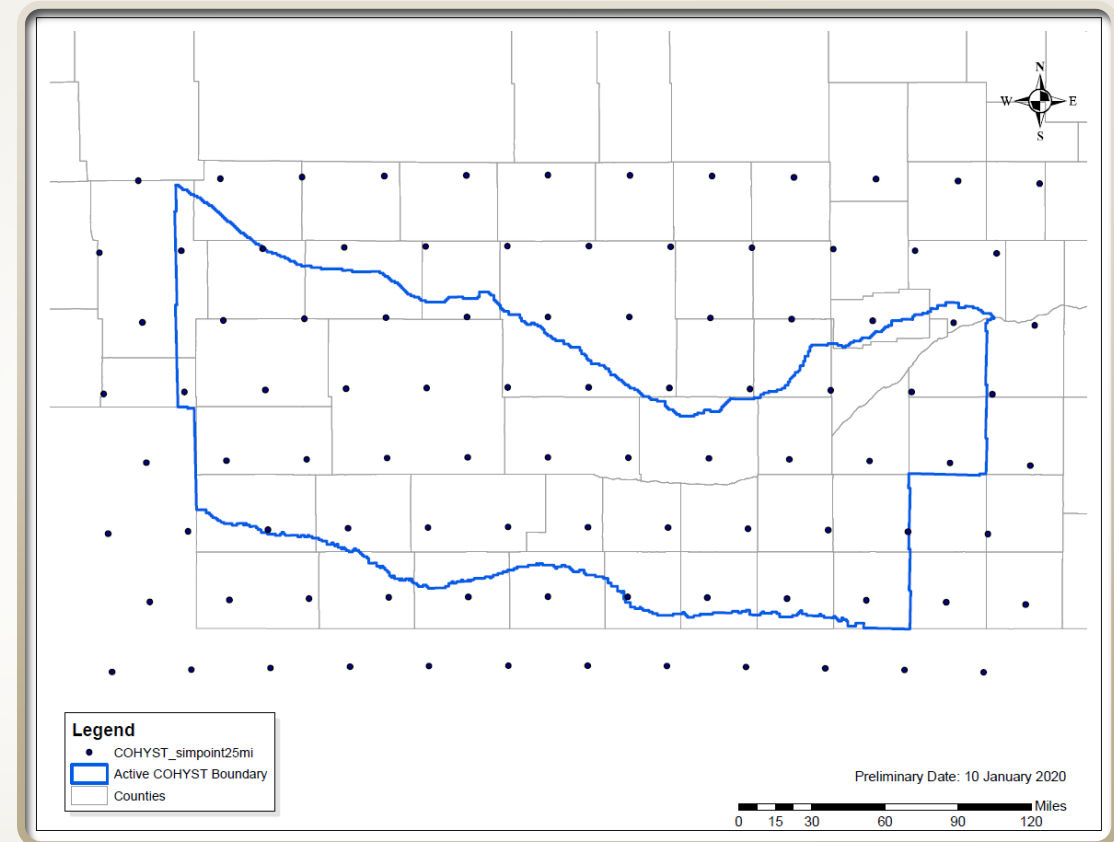
Simfile Development



- The 2020 set point consists of SIMFILES for 6 tillage categories and 5 CROPSIM Management Zones
 - 1 set of Simfiles for each of the tillage categories. Tillage operations vary from category to category, but within a single category they do not vary between management zones
 - 1 set of phenology for each management zone. Crop Phenology varies from management zone to zone, but within a single management zone the same crop phenology is applied to each tillage category

CROPSIM Simulations

- The new SIMFILES were used to create a system of soil water balance estimates. Estimates were created for each combination of:
 - Crop
 - Irrigation
 - Soil
 - Tillage category
- This was done at each simulation point in the COHYST 25 mile TIN for the period 1996-2020 using the weather data from ACIS grid 21 (PRISM) and ACIS grid 1.



NRD – County Tillage Mix

NRD	NRD_Name	County	County_Name	CropCode_RS WB	Crop_Name	Conventional	No Till	Reduced Till	Mulch Till	Ridge Till	Strip Till
17	TPNRD	439	Lincoln	1	Corn	0.03	0.42	0.07	0.23	0.03	0.21
17	TPNRD	439	Lincoln	9	Soybeans	0.01	0.54	0.09	0.22	0.05	0.10
17	TPNRD	439	Lincoln	5	WinterWheat	0.67	0.00	0.33	0.00	0.00	0.00
17	TPNRD	434	Keith	1	Corn	0.03	0.54	0.03	0.29	0.01	0.10
17	TPNRD	434	Keith	9	Soybeans	0.01	0.59	0.04	0.28	0.00	0.08
17	TPNRD	434	Keith	5	WinterWheat	0.66	0.02	0.30	0.02	0.00	0.00
24	TBNRD	420	Gosper	1	Corn	0.04	0.34	0.03	0.15	0.09	0.36
24	TBNRD	420	Gosper	9	Soybeans	0.02	0.55	0.01	0.07	0.03	0.32
24	TBNRD	420	Gosper	5	WinterWheat	0.00	1.00	0.00	0.00	0.00	0.00
24	TBNRD	452	Phelps	1	Corn	0.07	0.32	0.23	0.17	0.03	0.17
24	TBNRD	452	Phelps	9	Soybeans	0.02	0.48	0.23	0.10	0.03	0.14
24	TBNRD	452	Phelps	5	WinterWheat	0.00	0.50	0.17	0.00	0.00	0.00
24	TBNRD	433	Kearney	1	Corn	0.10	0.29	0.17	0.00	0.02	0.42
24	TBNRD	433	Kearney	9	Soybeans	0.05	0.64	0.11	0.02	0.02	0.17
24	TBNRD	433	Kearney	5	WinterWheat	0.00	1.00	0.00	0.00	0.00	0.00
18	CPNRD	393	Buffalo	1	Corn	0.19	0.14	0.13	0.08	0.08	0.36
18	CPNRD	393	Buffalo	9	Soybeans	0.09	0.42	0.11	0.06	0.06	0.26
18	CPNRD	393	Buffalo	7	Milo	0.33	0.00	0.33	0.33	0.00	0.00
18	CPNRD	393	Buffalo	5	WinterWheat	1.00	0.00	0.00	0.00	0.00	0.00
18	CPNRD	444	Merrick	1	Corn	0.18	0.14	0.04	0.05	0.16	0.44
18	CPNRD	444	Merrick	9	Soybeans	0.08	0.16	0.11	0.05	0.21	0.38
18	CPNRD	444	Merrick	7	Milo	1.00	0.00	0.00	0.00	0.00	0.00
18	CPNRD	444	Merrick	5	WinterWheat	0.00	0.50	0.00	0.00	0.00	0.00
18	CPNRD	407	Dawson	1	Corn	0.17	0.07	0.13	0.04	0.08	0.52
18	CPNRD	407	Dawson	9	Soybeans	0.10	0.14	0.09	0.04	0.16	0.48
18	CPNRD	407	Dawson	7	Milo	0.00	0.00	0.00	1.00	0.00	0.00
18	CPNRD	423	Hall	1	Corn	0.23	0.08	0.29	0.05	0.07	0.28
18	CPNRD	423	Hall	9	Soybeans	0.11	0.27	0.23	0.14	0.06	0.20

Tillage Mix - NRD

NRD	NRD_Name	CropCode_RS WB	Crop_Name	Conventional	No Till	Reduced Till	Mulch Till	Ridge Till	Strip Till
17	TPNRD	1	Corn	0.03	0.49	0.05	0.26	0.02	0.15
17	TPNRD	9	Soybeans	0.01	0.56	0.06	0.25	0.03	0.09
17	TPNRD	5	WinterWheat	0.66	0.02	0.3	0.02	0	0
24	TBNRD	1	Corn	0.09	0.29	0.2	0.1	0.04	0.28
24	TBNRD	9	Soybeans	0.06	0.51	0.16	0.07	0.04	0.16
24	TBNRD	5	WinterWheat	0.12	0.34	0.14	0.12	0.12	0.12
18	CPNRD	1	Corn	0.19	0.1	0.16	0.06	0.1	0.39
18	CPNRD	9	Soybeans	0.09	0.25	0.12	0.07	0.13	0.34
18	CPNRD	7	Milo	0.4	0	0.2	0.4	0	0
18	CPNRD	5	WinterWheat	0	0.5	0	0	0	0

Regionalized Soil Water Balance Model Setup

- Modeled Period 1998-2020
- Land Use and Groundwater Concentration Factor
 - 1998-2010 used 1998-2010
 - 2011-2020 used 2010
 - Used files from 2019 Robust Review
- Canal Recharge, M&I pumping, and Miscellaneous Pumping and Recharge were not included
- All model runs were demand or 'a' iteration runs. Canal Supply = Canal Demand
- One run was made for each of the WBP input data sets

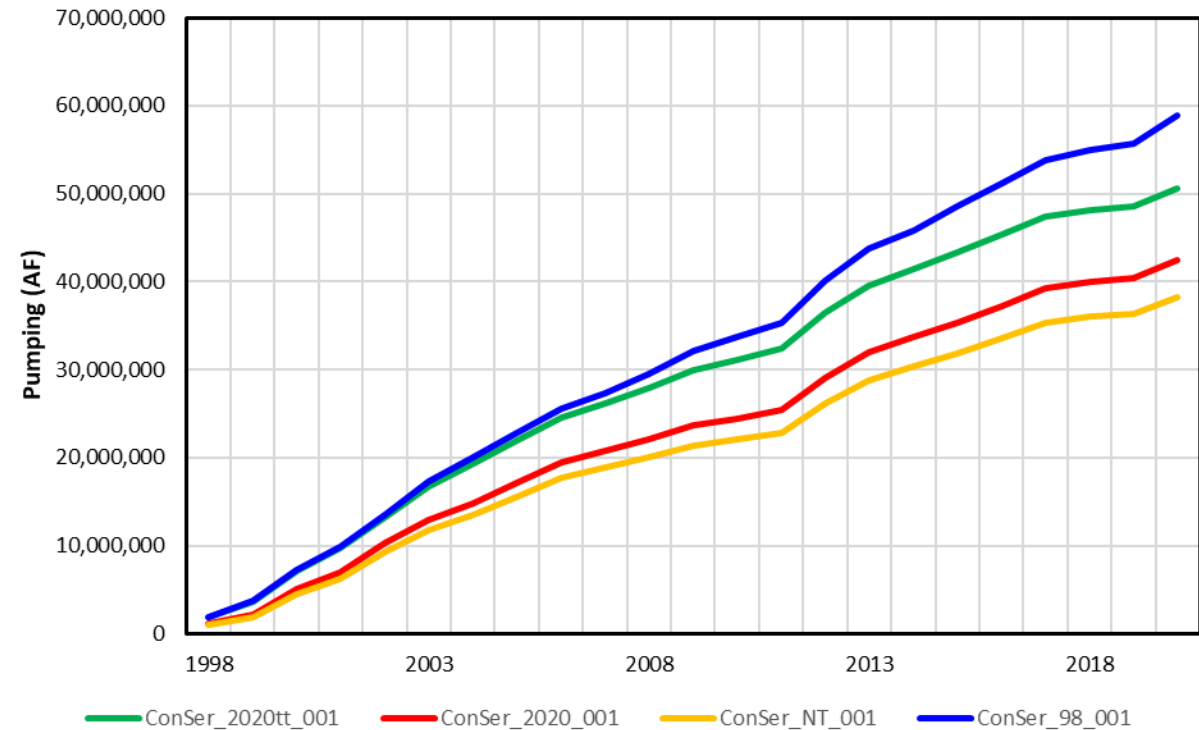
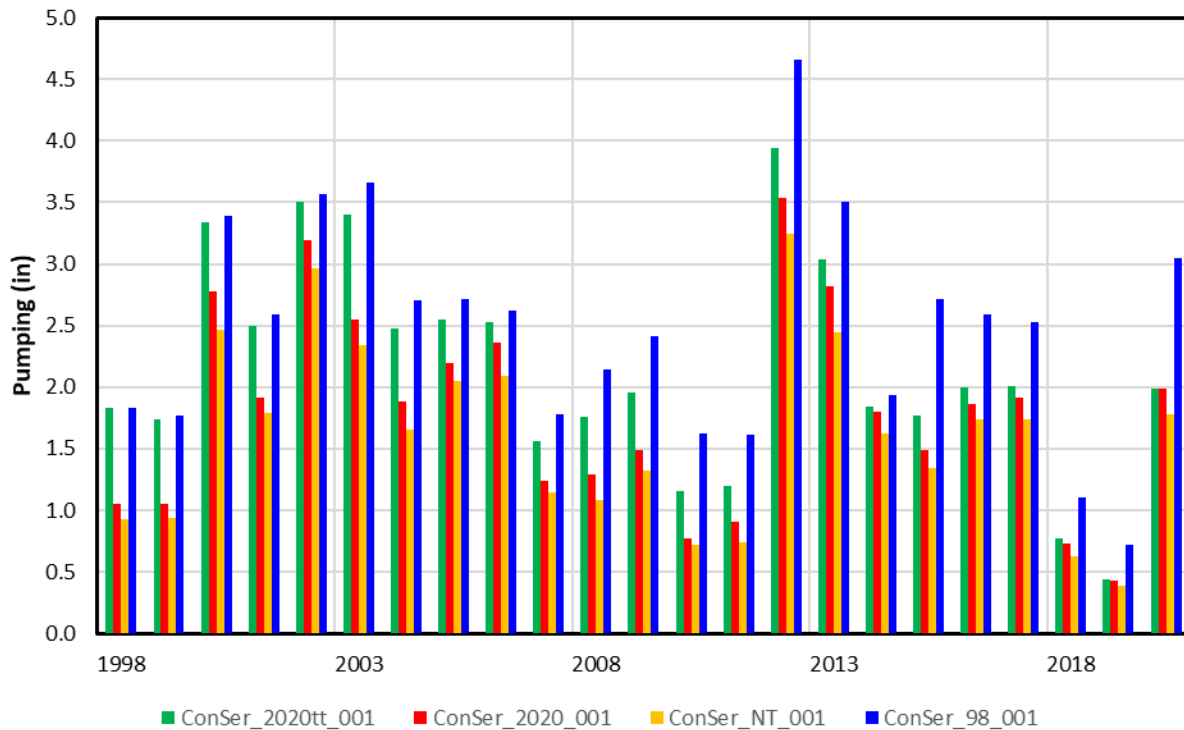
Ground Water Pumping Model Domain

ConSer_98_001: Grid21_98
Gridded weather data, 98 Farming Practices

ConSer_NT_001: Grid21_NT
Gridded weather data, No Till Farming Practices

ConSer_2020_001: Grid21_2020
Gridded weather data, 2020 Tillage Mix

ConSer_2020tt_001: Grid21_2020tt
Gridded weather data, Time Trend between 98 Farming Practices and 2020 Tillage Mix



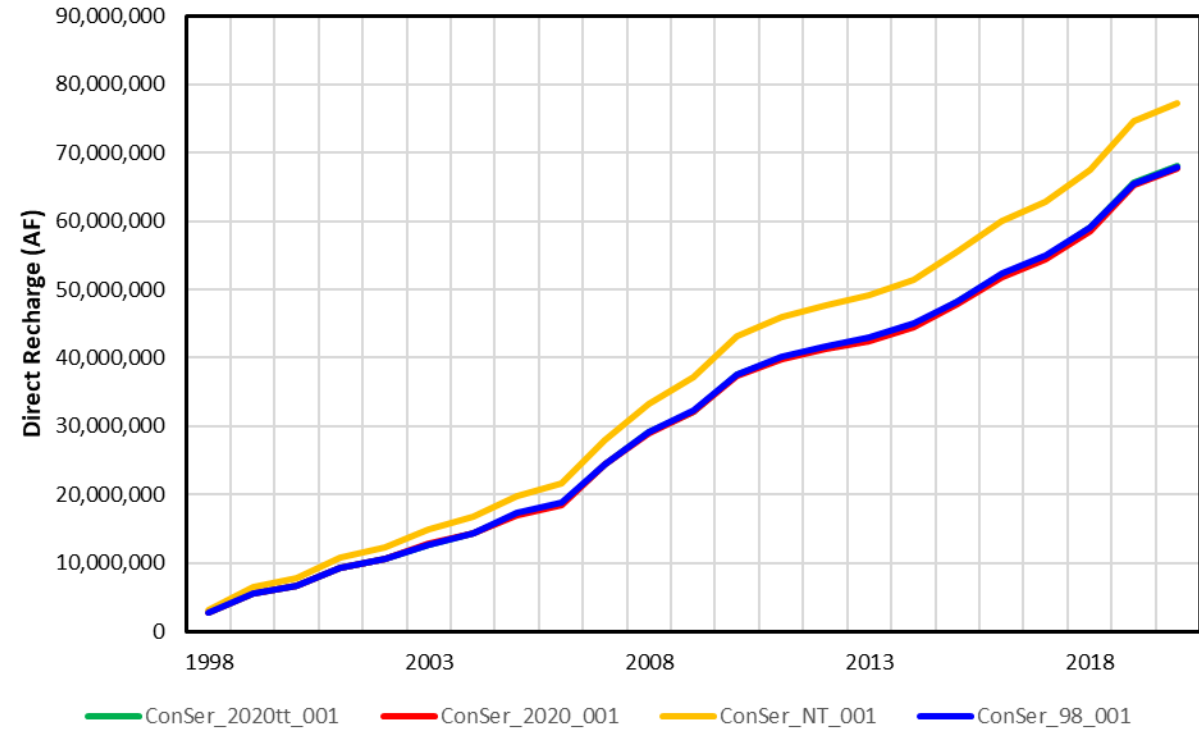
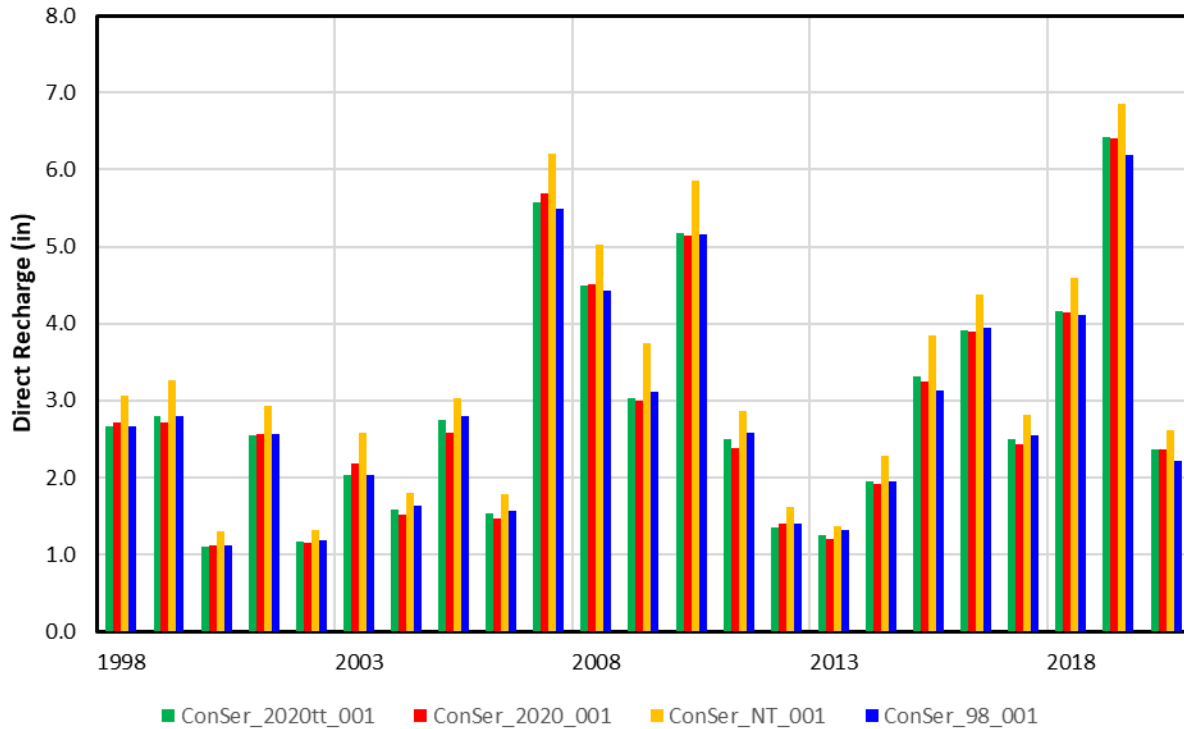
Direct Recharge Model Domain

ConSer_g8_001: Grid21_g8
Gridded weather data, 98 Farming Practices

ConSer_NT_001: Grid21_NT
Gridded weather data, No Till Farming Practices

ConSer_2020_001: Grid21_2020
Gridded weather data, 2020 Tillage Mix

ConSer_2020tt_001: Grid21_2020tt
Gridded weather data, Time Trend between 98 Farming Practices and 2020 Tillage Mix



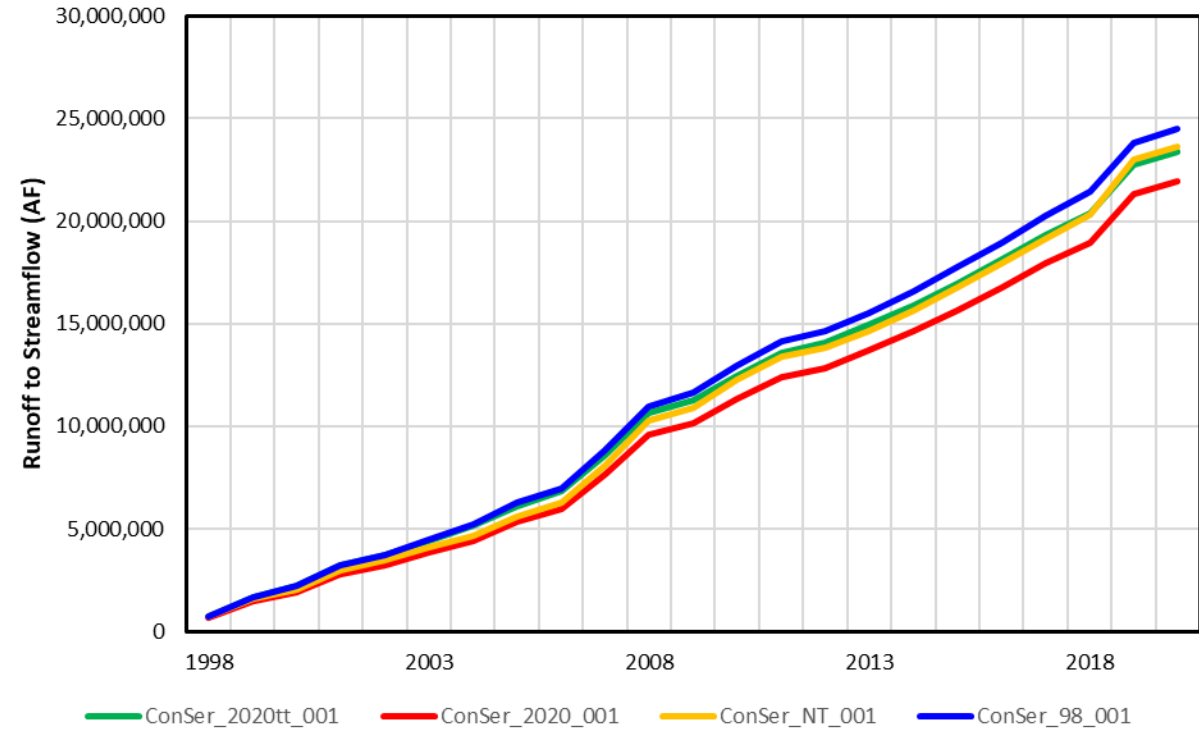
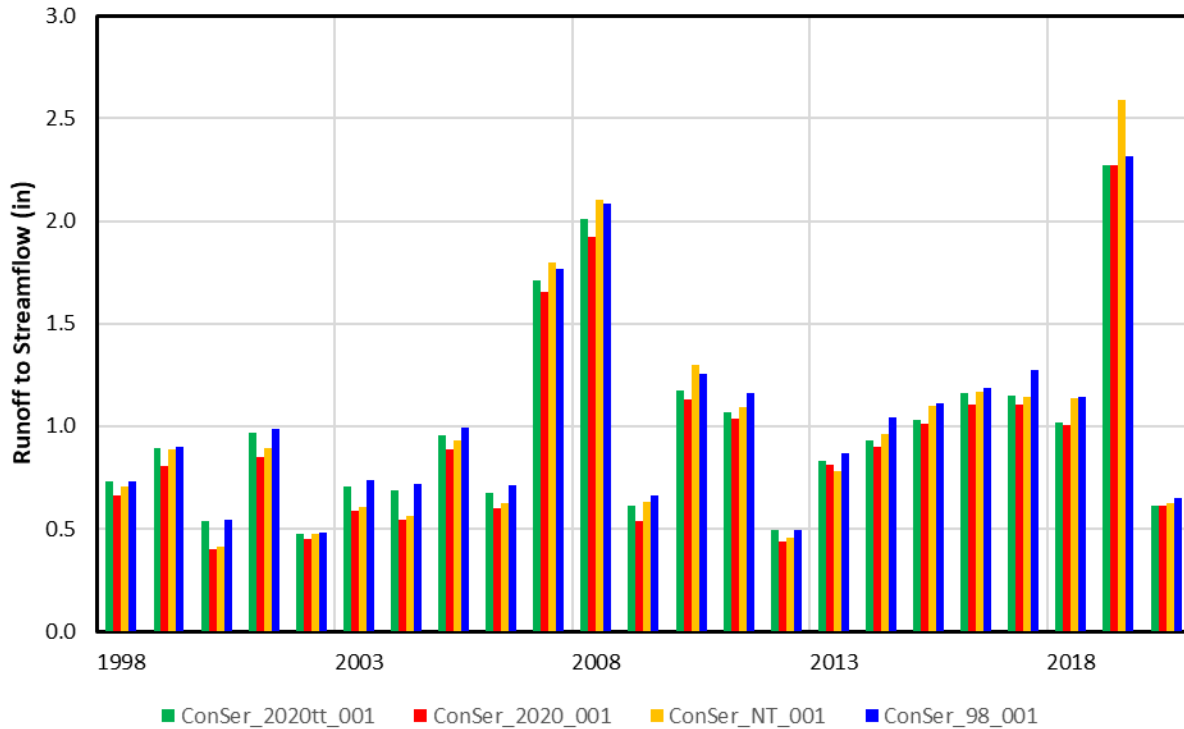
Runoff Contributions to Streamflow Model Domain

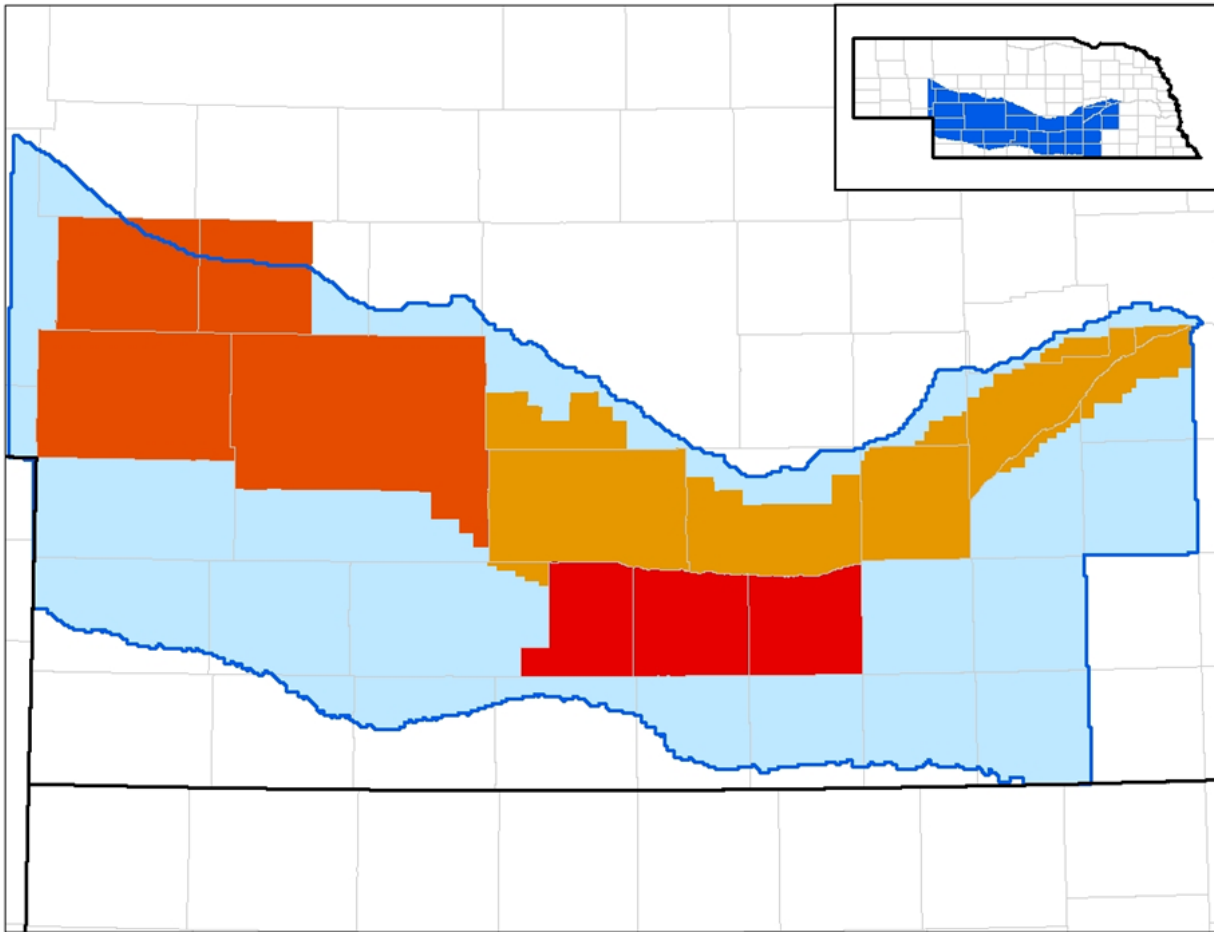
ConSer_98_001: Grid21_98
Gridded weather data, 98 Farming Practices

ConSer_NT_001: Grid21_NT
Gridded weather data, No Till Farming Practices

ConSer_2020_001: Grid21_2020
Gridded weather data, 2020 Tillage Mix

ConSer_2020tt_001: Grid21_2020tt
Gridded weather data, Time Trend between 98 Farming Practices and 2020 Tillage Mix





Conservation Study: Phase IV COHYST Model Status Update

The Flatwater Group, Inc.

8/17/2023

NRD information added 8/28/2023

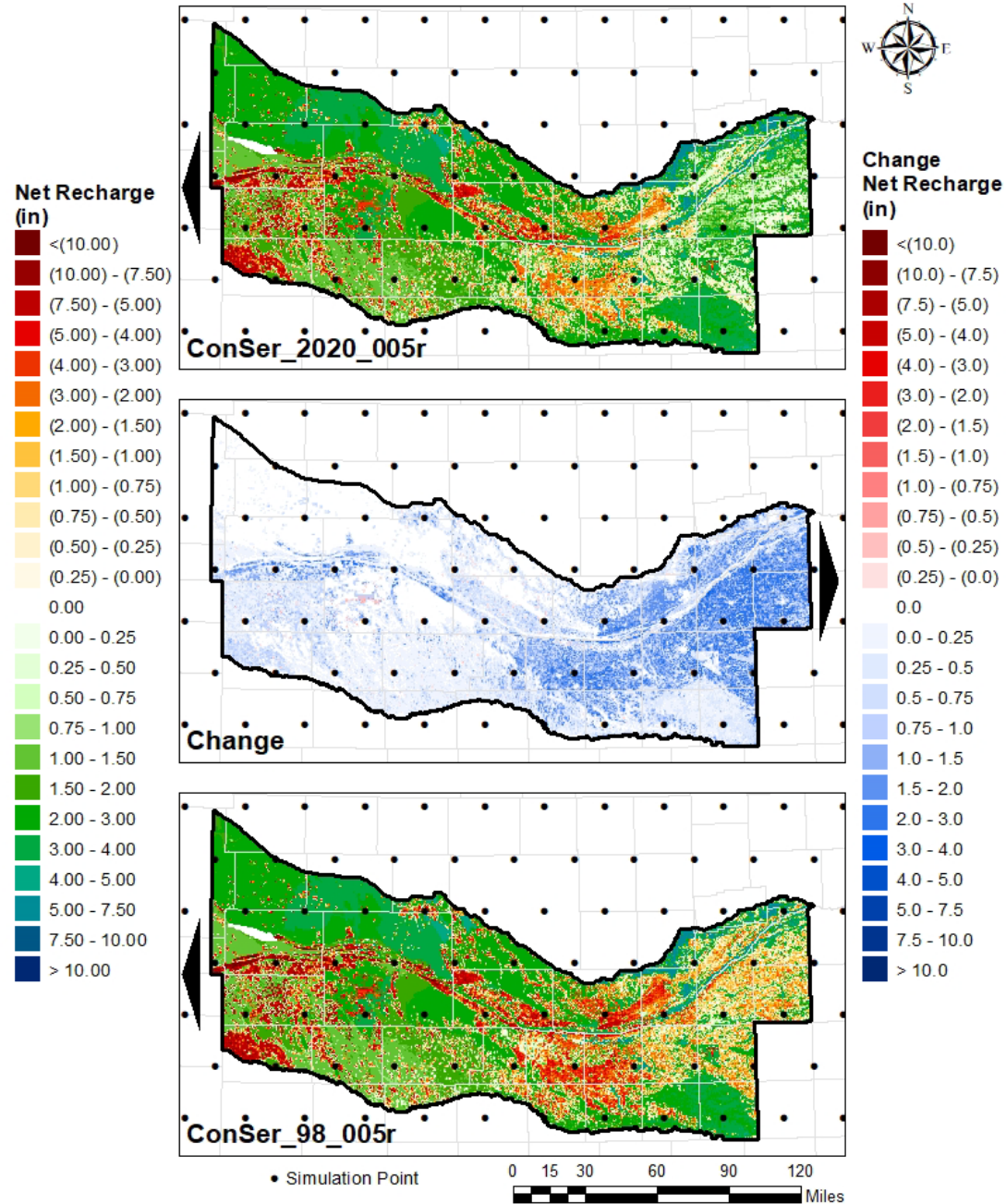
Regionalized Soil Water Balance Model Setup

- Three scenarios were developed
 - ConSer_98_005r
 - Farming practices circa 1998 were used for the modeling period 1998-2020
 - ConSer_2020_005r
 - Farming practices reflect circa 2020 practices
 - Includes tillage and crop phenology updates (planting dates, harvest index, GDD, etc.)
 - Reflects explicit modeling of corn/soybean rotation
 - ConSer_2020tt_005r
 - Results reflect a temporal trending of results between the above two scenarios from 1998 through 2020

Regionalized Soil Water Balance Model Setup

- Modeled Period 1998-2020
- Land Use Information taken from 2019 Robust Review
 - 1998-2010 time period used 1998-2010 land use estimates
 - 2011-2020 time period repeated 2010 land use estimate
- Results reflect “on field” actions
 - Canal Recharge, M&I pumping, and Miscellaneous Pumping and Recharge were not included
 - Surface water deliveries taken from STELLA Demand Run (the ‘a’ run)

Average Net Recharge COHYST Model Area: 1998-2020





Robust Review 2023 Progress Update

November 2023



NEBRASKA

Good Life. Great Water.

DEPT. OF NATURAL RESOURCES



Jim Pillen, Governor

DATE: August 22, 2023
TO: POAC Technical Committee
FROM: Jennifer Schellpeper, Water Planning Division Head
SUBJECT: COHYST Model Runs

MEMORANDUM

A list of previously shared 2023 Robust Review planned model runs are indicated in the table. Please provide any feedback to the NeDNR within a week, preferably not later than August 30, 2023.

Historical - Baseflow
Historical - Total Flow
1997 GWO Irrigation - Baseflow - TPNRD
1997 GWO Irrigation - Total Flow - TPNRD
1997 GWO Irrigation - Baseflow - CPNRD
1997 GWO Irrigation - Total Flow - CPNRD
1997 GWO Irrigation - Baseflow - TBNRD
1997 GWO Irrigation - Total Flow - TBNRD
1997 GWO Irrigation - Baseflow - Outside NRDs
1997 GWO Irrigation - Total Flow - Outside NRDs
1997 GWO Irrigation and M&I - Baseflow or Total Flow - TPNRD
1997 GWO Irrigation and M&I - Baseflow or Total Flow - CPNRD
1997 GWO Irrigation and M&I - Baseflow or Total Flow - TBNRD
1997 GWO Irrigation and M&I - Baseflow or Total Flow - Outside NRDs
No Retirements - Baseflow or Total Flow - CPNRD
No Retirements - Baseflow or Total Flow - TBNRD
No North Dry Creek Augmentation
No NCORPE Augmentation - TPNRD or North Pipeline
No NCORPE Augmentation - MRNRD or South Pipeline
1997 Combined - Baseflow or Total Flow - TPNRD
1997 Combined - Baseflow or Total Flow - CPNRD
1997 Combined - Baseflow or Total Flow - TBNRD
No GWO Pumping - Baseflow or Total Flow - TPNRD
No GWO Pumping - Baseflow or Total Flow - CPNRD
No GWO Pumping - Baseflow or Total Flow - TBNRD
No GWO Pumping - Baseflow or Total Flow - Outside NRDs

Thomas C. Riley, P.E., Director

Department of Natural Resources

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Lincoln, Nebraska 68521-6729 FAX 402-471-2900

dnr.nebraska.gov

Robust Review Model Runs		TFG Support Task	Del Date	Ref Name	Production Practices			
Historical - Baseflow	➤	Task 100	29-Nov	Baseline2020_001	2020 SIM Files			
Historical - Total Flow				Baseline1998_001	1998 SIM Files			
1997 GWO Irrigation - Baseflow - TPNRD	➤	Task 200	29-Nov	p1997_2020_001	2020 SIM Files			
1997 GWO Irrigation - Total Flow - TPNRD								
1997 GWO Irrigation - Baseflow - CPNRD								
1997 GWO Irrigation - Total Flow - CPNRD								
1997 GWO Irrigation - Baseflow - TBNRD								
1997 GWO Irrigation - Total Flow - TBNRD								
1997 GWO Irrigation - Baseflow - Outside NRDs								
1997 GWO Irrigation - Total Flow - Outside NRDs								
1997 GWO Irrigation and M&I - Baseflow or Total Flow - TPNRD				p1997_1998_001	1998 SIM Files			
1997 GWO Irrigation and M&I - Baseflow or Total Flow - CPNRD								
1997 GWO Irrigation and M&I - Baseflow or Total Flow - TBNRD								
1997 GWO Irrigation and M&I - Baseflow or Total Flow - Outside NRDs								
No Retirements - Baseflow or Total Flow - CPNRD				➤	Task 400	TBD		
No Retirements - Baseflow or Total Flow - TBNRD								
No North Dry Creek Augmentation	➤	No TFG Involvement						
No NCORPE Augmentation - TPNRD or North Pipeline								
No NCORPE Augmentation - MRNRD or South Pipeline								
1997 Combined - Baseflow or Total Flow - TPNRD								
1997 Combined - Baseflow or Total Flow - CPNRD								
1997 Combined - Baseflow or Total Flow - TBNRD								
No GWO Pumping - Baseflow or Total Flow - TPNRD	➤	Task 300	27-Nov	nGWLands_001	2020 SIM Files			
No GWO Pumping - Baseflow or Total Flow - CPNRD								
No GWO Pumping - Baseflow or Total Flow - TBNRD								
No GWO Pumping - Baseflow or Total Flow - Outside NRDs								

Robust Review Model Runs

Historical - Baseflow

Historical - Total Flow



TFG Support Task

Task 100

Del Date

27-Nov

Ref Name

Baseline2020_001

Baseline1998_001

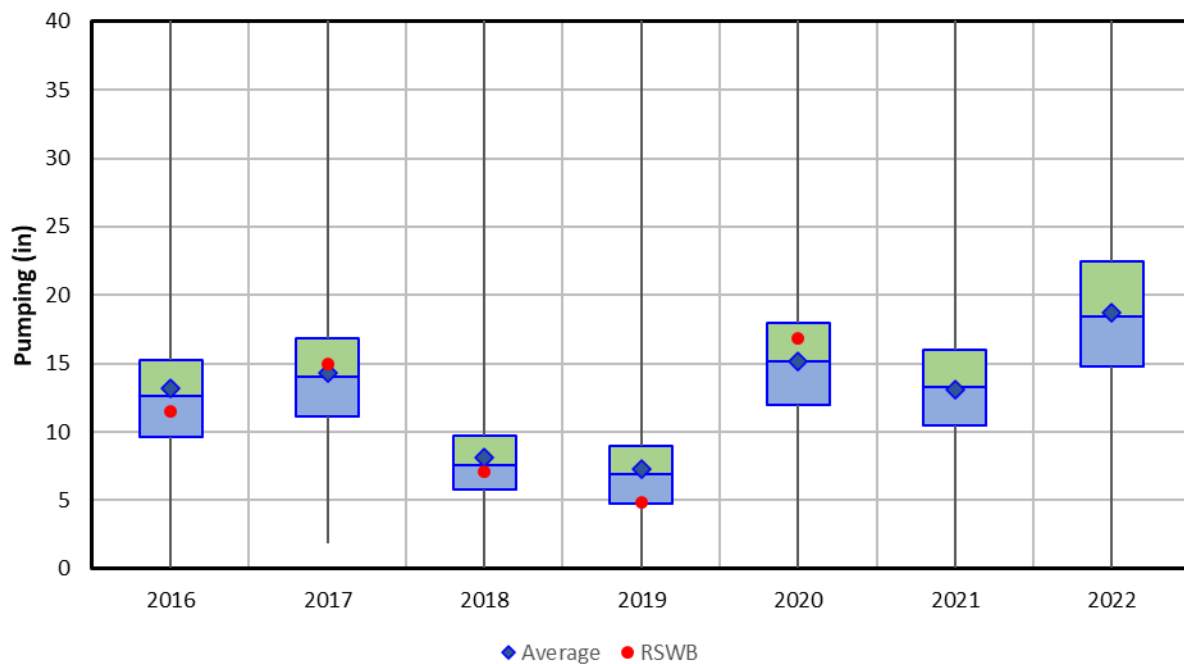
Tillage

2020 SIM Files

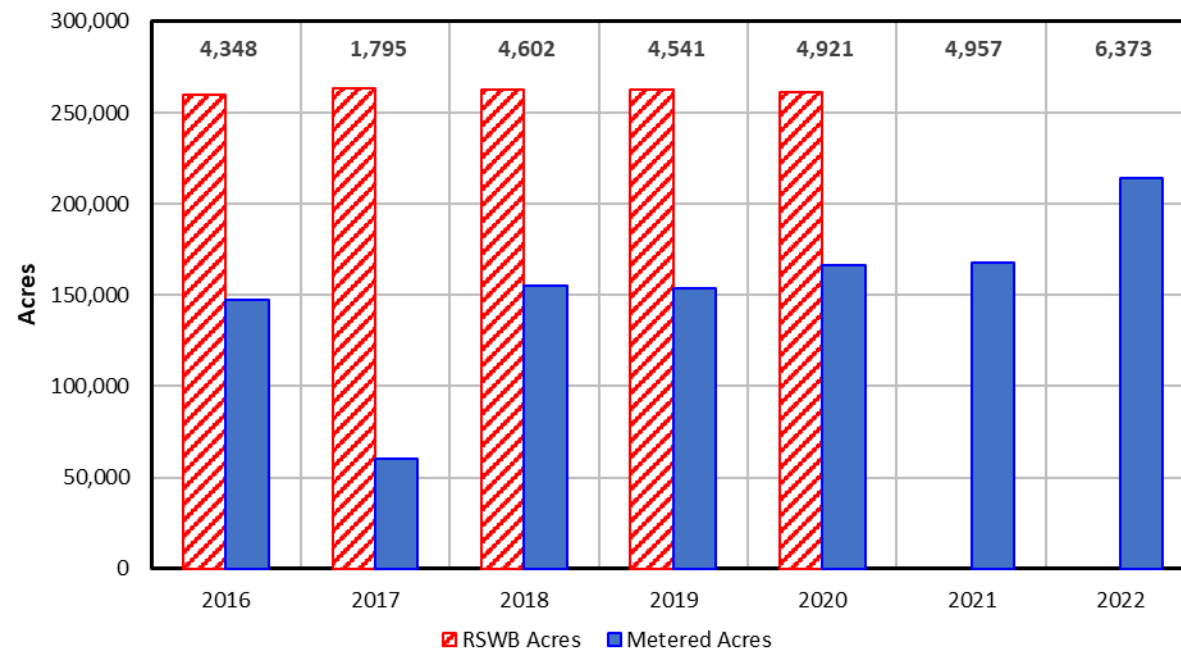
1998 SIM Files

TPNRD – Pumping Comparison

TPNRD - Metered Pumping



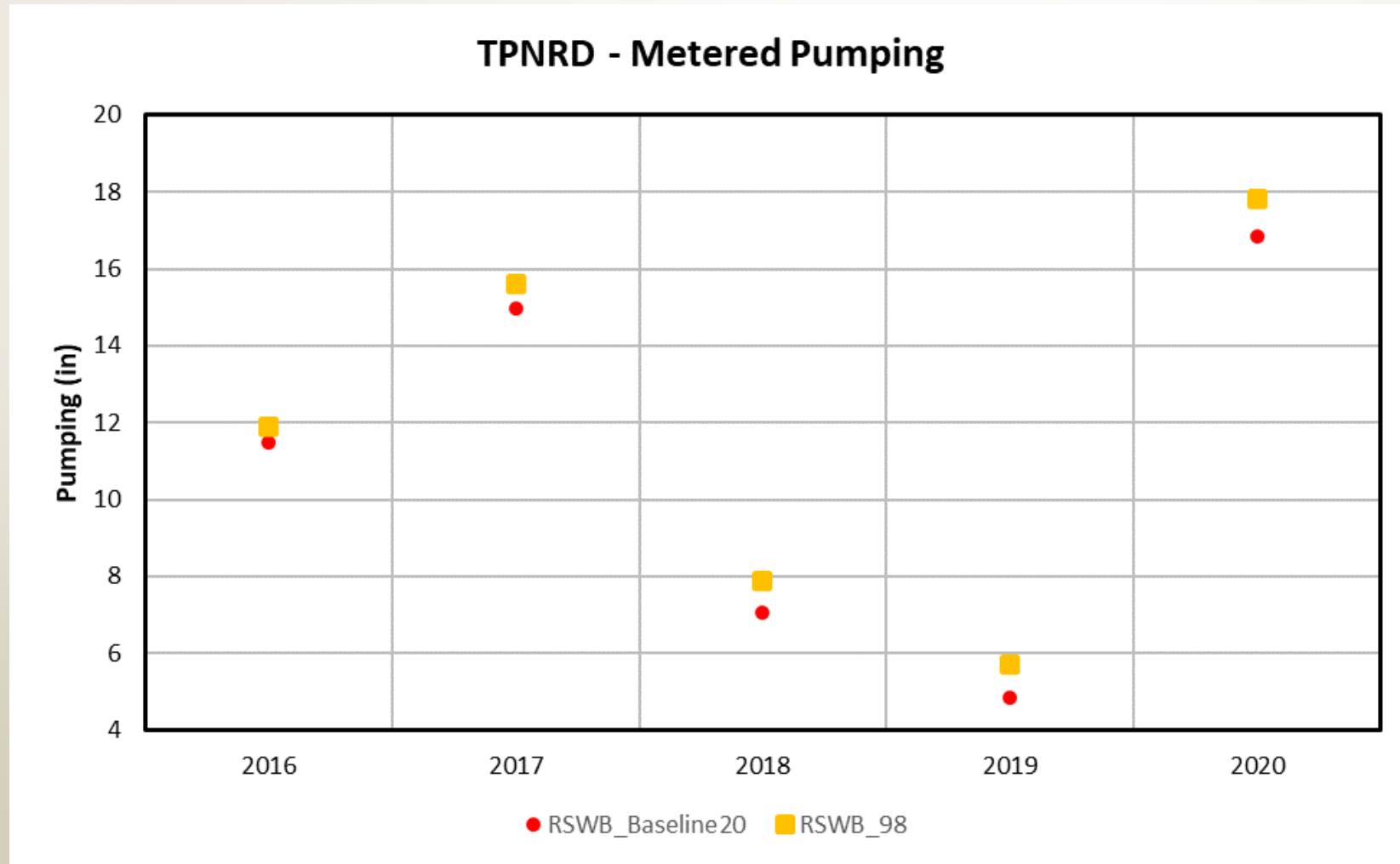
TPNRD - GW Irrigated Acres



Note: Number values above bars indicate number of metered pumping entries available.

Robust Review Model Runs	TFG Support Task	Del Date	Ref Name	Production Practices
Historical - Baseflow	>	Task 100	29-Nov	Baseline2020_001
Historical - Total Flow				Baseline1998_001

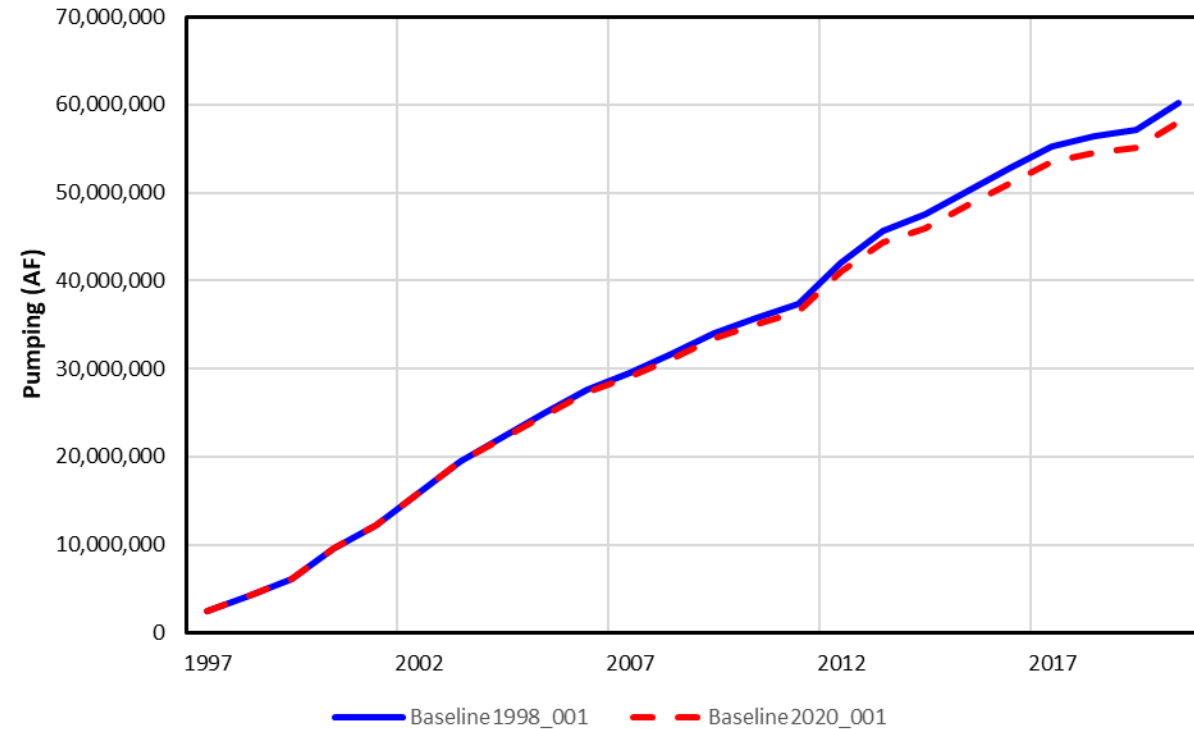
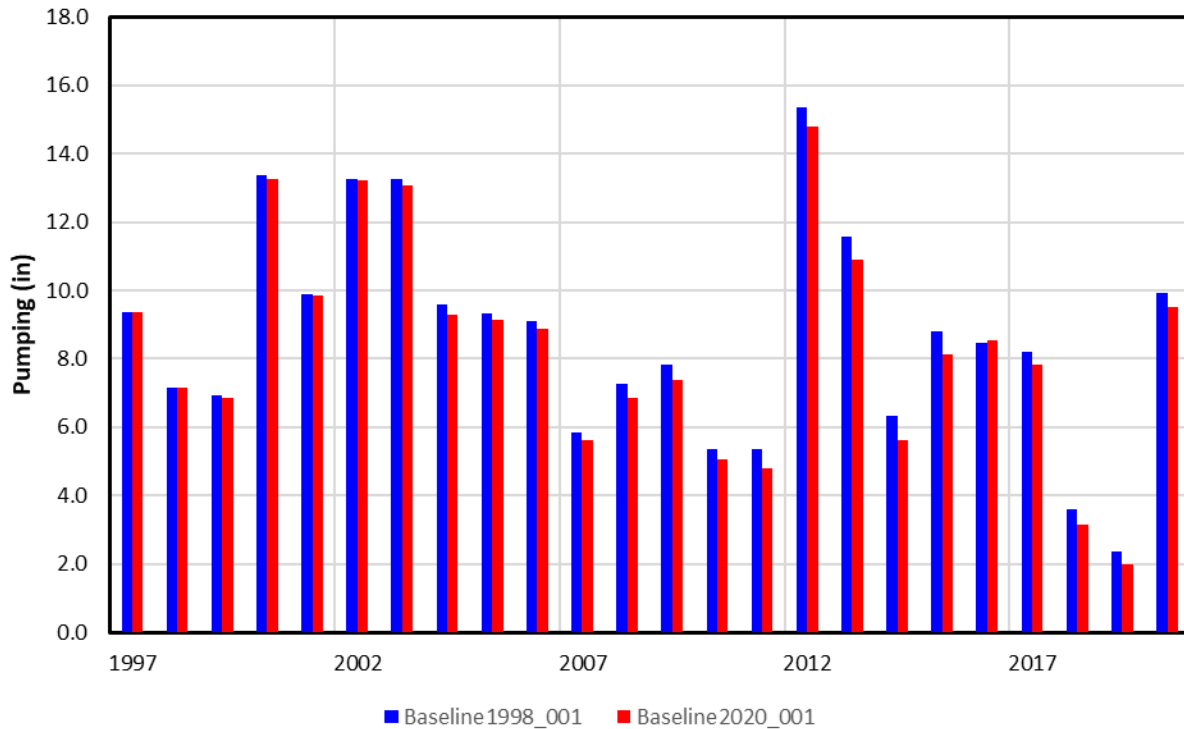
Production Practice Update Impacts on Pumping Estimates



Robust Review Model Runs	TFG Support Task	Del Date	Ref Name	Tillage
Historical - Baseflow	Task 100	27-Nov	Baseline2020_001	2020 SIM Files
Historical - Total Flow			Baseline1998_001	1998 SIM Files

Pumping Comparison – Production Practice Impacts

GW Only Irrigated Acres



Robust Review Model Runs	TFG Support Task	Del Date	Ref Name	Production Practices
Historical - Baseflow	Task 100	29-Nov	Baseline2020_001	2020 SIM Files
Historical - Total Flow			Baseline1998_001	1998 SIM Files
1997 GWO Irrigation - Baseflow - TPNRD	Task 200	29-Nov		
1997 GWO Irrigation - Total Flow - TPNRD				
1997 GWO Irrigation - Baseflow - CPNRD				
1997 GWO Irrigation - Total Flow - CPNRD			p1997_2020_001	2020 SIM Files
1997 GWO Irrigation - Baseflow - TBNRD				
1997 GWO Irrigation - Total Flow - TBNRD				
1997 GWO Irrigation - Baseflow - Outside NRDs				
1997 GWO Irrigation - Total Flow - Outside NRDs				
1997 GWO Irrigation and M&I - Baseflow or Total Flow - TPNRD				
1997 GWO Irrigation and M&I - Baseflow or Total Flow - CPNRD			p1997_1998_001	1998 SIM Files
1997 GWO Irrigation and M&I - Baseflow or Total Flow - TBNRD				
1997 GWO Irrigation and M&I - Baseflow or Total Flow - Outside NRDs				

Dry Historic LU, 2020 SIM
 + CO Historic LU, 2020 SIM
 + GW Historic LU, 2020 SIM
 + SW Historic LU, 2020 SIM

Dry p1997 LU, 2020 SIM
 + CO Historic LU, 2020 SIM
 + GW p1997 LU, 1998 SIM
 + SW Historic LU, 2020 SIM

=====

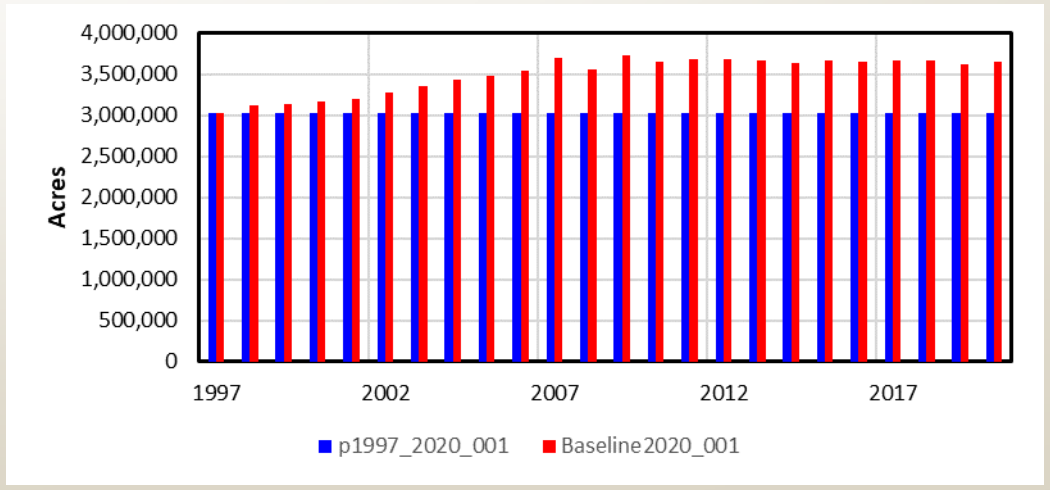
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α =Current Condition

β =1997 Condition

$Impact = \alpha - \beta$

GW Only Irrigated Acres



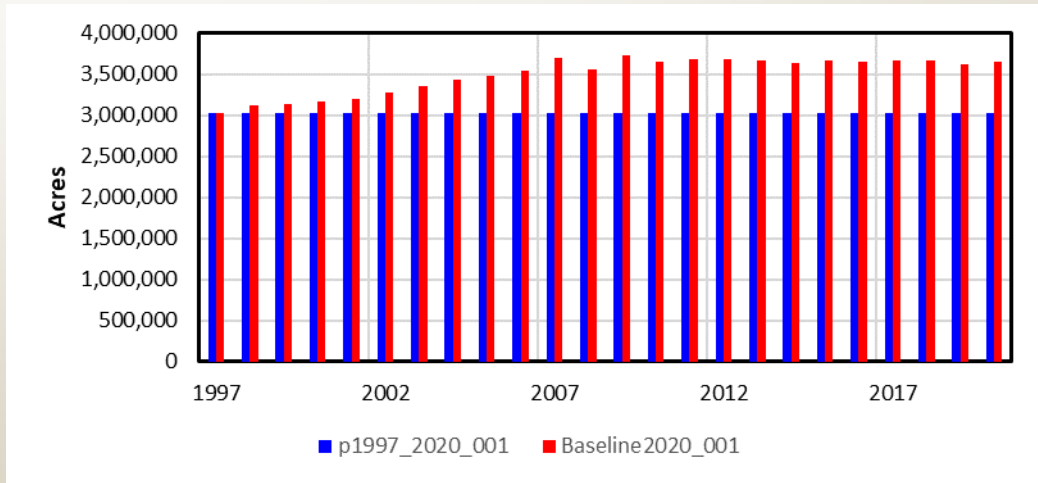
GW Only acreage in excess of 1997 levels re-classified as "dryland" equivalent of the previous irrigated crop mix for Task 200

Robust Review Model Runs	TFG Support Task	Del Date	Ref Name	Production Practices
Historical - Baseflow	Task 100	29-Nov	Baseline2020_001	2020 SIM Files
Historical - Total Flow			Baseline1998_001	1998 SIM Files
1997 GWO Irrigation - Baseflow - TPNRD	Task 200	29-Nov		
1997 GWO Irrigation - Total Flow - TPNRD				
1997 GWO Irrigation - Baseflow - CPNRD				
1997 GWO Irrigation - Total Flow - CPNRD			p1997_2020_001	2020 SIM Files
1997 GWO Irrigation - Baseflow - TBNRD				
1997 GWO Irrigation - Total Flow - TBNRD				
1997 GWO Irrigation - Baseflow - Outside NRDs				
1997 GWO Irrigation - Total Flow - Outside NRDs				
1997 GWO Irrigation and M&I - Baseflow or Total Flow - TPNRD				
1997 GWO Irrigation and M&I - Baseflow or Total Flow - CPNRD			p1997_1998_001	1998 SIM Files
1997 GWO Irrigation and M&I - Baseflow or Total Flow - TBNRD				
1997 GWO Irrigation and M&I - Baseflow or Total Flow - Outside NRDs				

<p>Dry Historic LU, 2020 SIM</p> <p>+ CO Historic LU, 2020 SIM</p> <p>+ GW Historic LU, 2020 SIM</p> <p>+ SW Historic LU, 2020 SIM</p> <p>=====</p> <p>α=Current Condition</p>	<p>Dry p1997 LU, 2020 SIM</p> <p>+ CO Historic LU, 2020 SIM</p> <p>+ GW p1997 LU, 1998 SIM</p> <p>+ SW Historic LU, 2020 SIM</p> <p>=====</p> <p>β=1997 Condition</p>
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Impact = α - β

GW Only Irrigated Acres



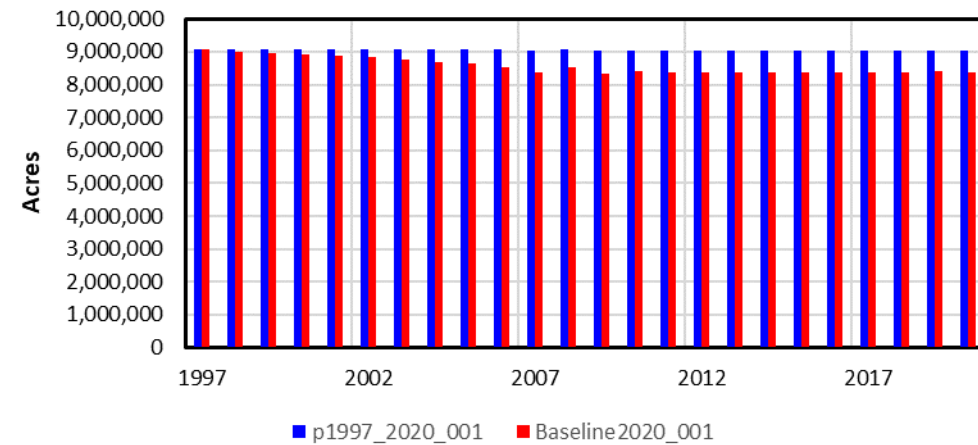
GW Only acreage in excess of 1997 levels re-classified as "dryland" equivalent of the previous irrigated crop mix for Task 200

Robust Review Model Runs	TFG Support Task	Del Date	Ref Name	Production Practices
Historical - Baseflow	Task 100	29-Nov	Baseline2020_001	2020 SIM Files
Historical - Total Flow			Baseline1998_001	1998 SIM Files
1997 GWO Irrigation - Baseflow - TPNRD	Task 200	29-Nov	p1997_2020_001	2020 SIM Files
1997 GWO Irrigation - Total Flow - TPNRD				
1997 GWO Irrigation - Baseflow - CPNRD				
1997 GWO Irrigation - Total Flow - CPNRD				
1997 GWO Irrigation - Baseflow - TBNRD				
1997 GWO Irrigation - Total Flow - TBNRD				
1997 GWO Irrigation - Baseflow - Outside NRDs				
1997 GWO Irrigation - Total Flow - Outside NRDs				
1997 GWO Irrigation and M&I - Baseflow or Total Flow - TPNRD				
1997 GWO Irrigation and M&I - Baseflow or Total Flow - CPNRD				
1997 GWO Irrigation and M&I - Baseflow or Total Flow - TBNRD	p1997_1998_001	1998 SIM Files		
1997 GWO Irrigation and M&I - Baseflow or Total Flow - Outside NRDs				

Dryland Acres: 1997-2020 Average

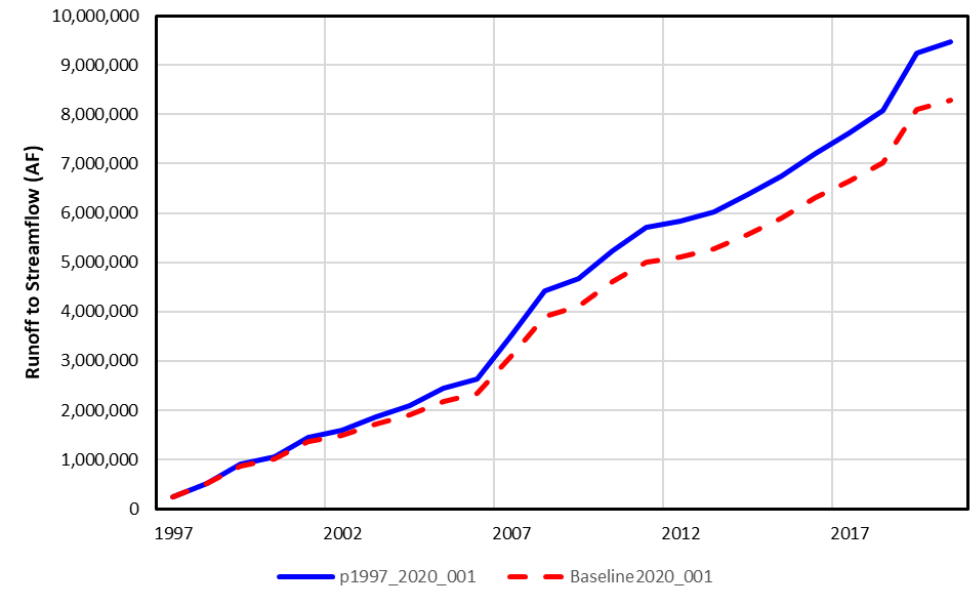
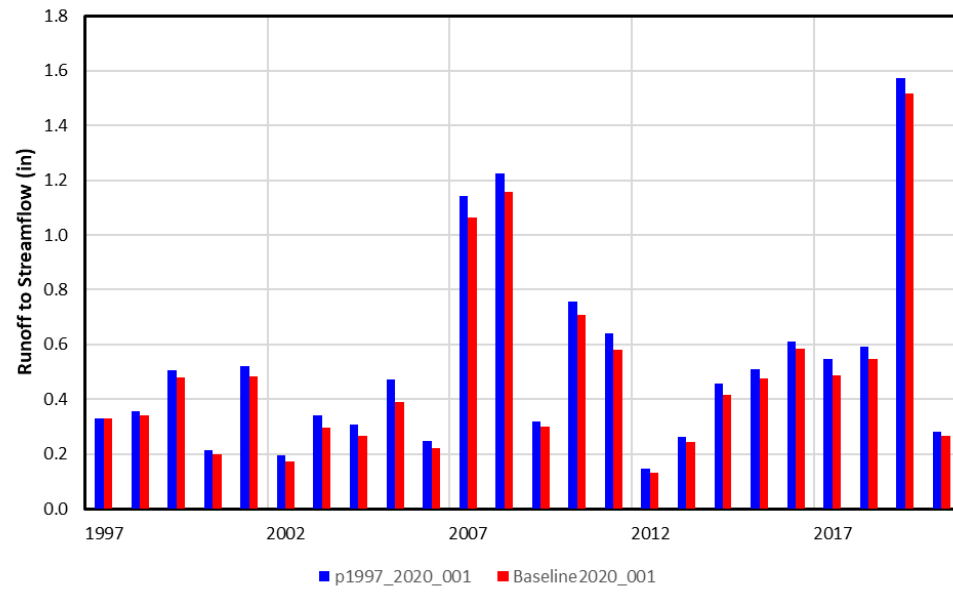
Parameter	p1997_2020_001			Baseline2020_001		
	AF	in	%	AF	in	%
Acres	9,050,428			8,572,150		
Precipitation	17,927,506	23.77	100.0%	16,875,997	23.62	100.0%
Groundwater Pumping	-	-	0.0%	-	-	0.0%
Surface Water Deliveries	-	-	0.0%	-	-	0.0%
Total Applied Water	17,927,506	23.77	100.0%	16,875,997	23.62	100.0%
Field Evapotranspiration	15,500,933	20.55	86.5%	14,657,169	20.52	86.9%
Field Deep Percolation	1,817,530	2.41	10.1%	1,701,764	2.38	10.1%
Field Runoff	722,674	0.96	4.0%	626,706	0.88	3.7%
Irrigation Surface Losses	-	-	0.0%	-	-	0.0%
Field Water Balance	(113,631)	(0.15)	-0.6%	(109,642)	(0.15)	-0.6%
Lateral Losses	-	-	0.0%	-	-	0.0%
Field Runoff	722,674	0.96	4.0%	626,706	0.88	3.7%
Runoff Contributions to Streamflow	394,401	0.52	2.2%	344,980	0.48	2.0%
Runoff Losses to Recharge	164,137	0.22	0.9%	140,863	0.20	0.8%
Runoff Losses to Evapotranspiration	164,137	0.22	0.9%	140,863	0.20	0.8%
Net Recharge	1,981,667	2.63		1,842,627	2.58	
Net Impact to Rivers	2,376,067	3.15		2,187,608	3.06	

Dryland Acres

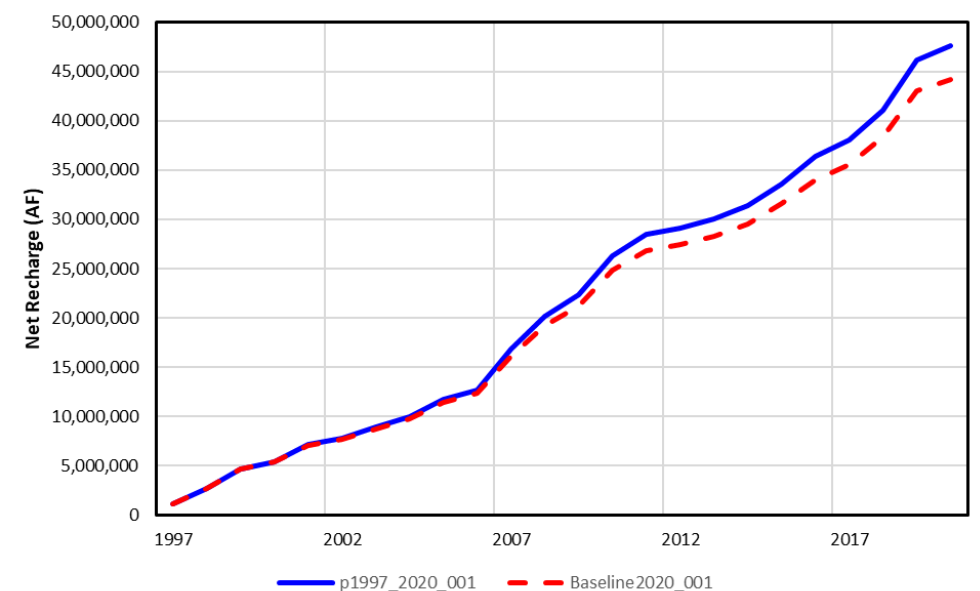
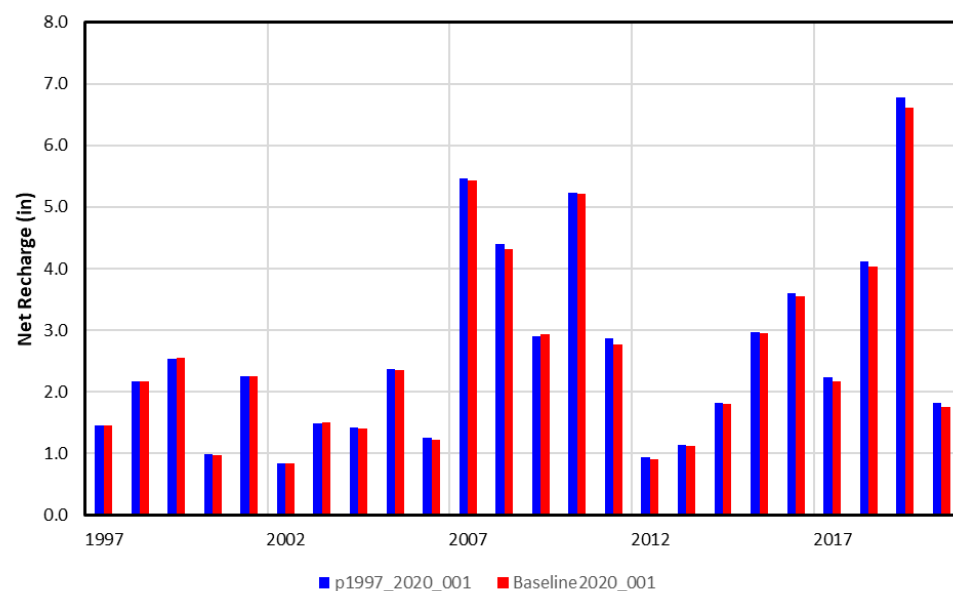


GW Only acreage in excess of 1997 levels re-classified as "dryland" equivalent of the previous irrigated crop mix for Task 200

SF: Dryland Acres: Baseline (2020 SIM) [α] vs Dryland Acres: Post 1997 (2020 SIM) [β]



NR: Dryland Acres: Baseline (2020 SIM) [α] vs Dryland Acres: Post 1997 (2020 SIM) [β]

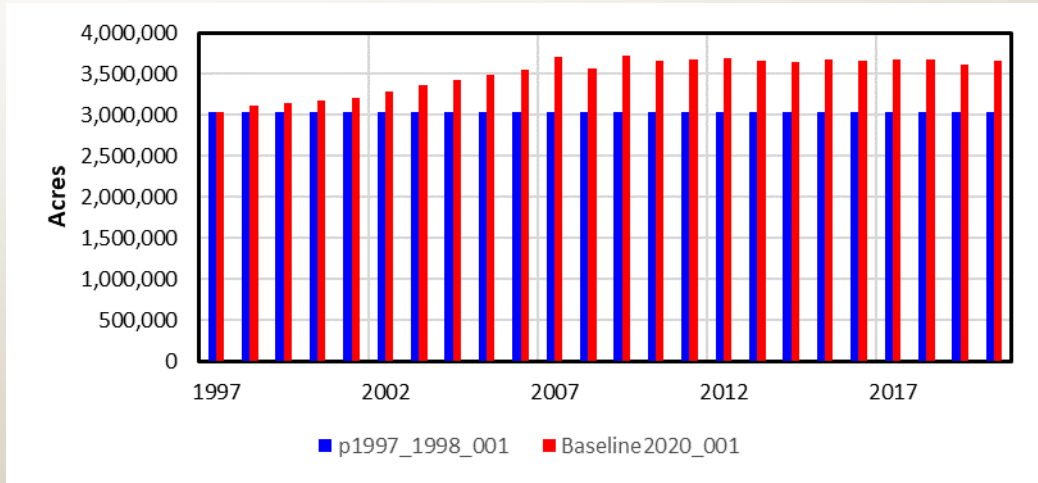


Robust Review Model Runs	TFG Support Task	Del Date	Ref Name	Production Practices		
Historical - Baseflow	Task 100	29-Nov	Baseline2020_001	2020 SIM Files		
Historical - Total Flow			Baseline1998_001	1998 SIM Files		
1997 GWO Irrigation - Baseflow - TPNRD	Task 200	29-Nov				
1997 GWO Irrigation - Total Flow - TPNRD						
1997 GWO Irrigation - Baseflow - CPNRD						
1997 GWO Irrigation - Total Flow - CPNRD				p1997_2020_001	2020 SIM Files	
1997 GWO Irrigation - Baseflow - TBNRD						
1997 GWO Irrigation - Total Flow - TBNRD						
1997 GWO Irrigation - Baseflow - Outside NRDs						
1997 GWO Irrigation - Total Flow - Outside NRDs						
1997 GWO Irrigation and M&I - Baseflow or Total Flow - TPNRD					p1997_1998_001	1998 SIM Files
1997 GWO Irrigation and M&I - Baseflow or Total Flow - CPNRD						
1997 GWO Irrigation and M&I - Baseflow or Total Flow - TBNRD						
1997 GWO Irrigation and M&I - Baseflow or Total Flow - Outside NRDs						

Dry Historic LU, 2020 SIM	Dry p1997 LU, 2020 SIM
+ CO Historic LU, 2020 SIM	+ CO Historic LU, 2020 SIM
+ GW Historic LU, 2020 SIM	+ GW p1997 LU, 1998 SIM
+ SW Historic LU, 2020 SIM	+ SW Historic LU, 2020 SIM
=====	=====
α = Current Condition	β = 1997 Condition

Impact = $\alpha - \beta$

GW Only Irrigated Acres



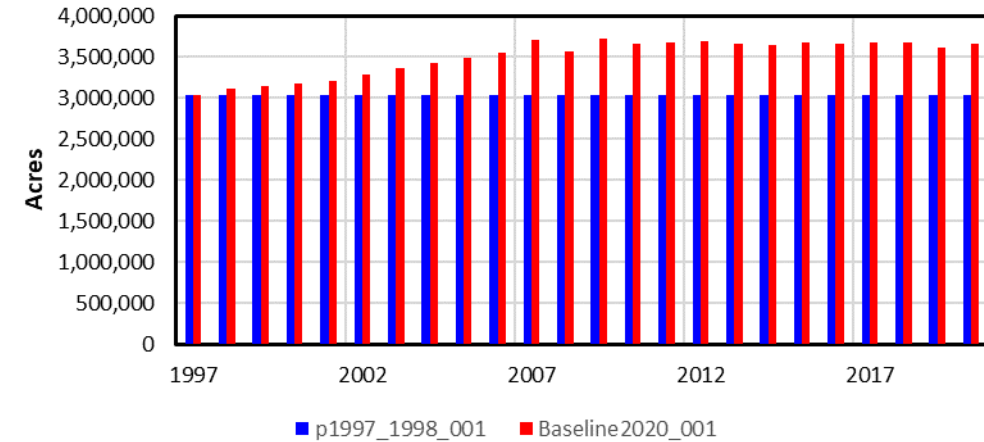
GW Only acreage in excess of 1997 levels re-classified as "dryland" equivalent of the previous irrigated crop mix for Task 200

Robust Review Model Runs	TFG Support Task	Del Date	Ref Name	Production Practices		
Historical - Baseflow	Task 100	29-Nov	Baseline2020_001	2020 SIM Files		
Historical - Total Flow			Baseline1998_001	1998 SIM Files		
1997 GWO Irrigation - Baseflow - TPNRD	Task 200	29-Nov				
1997 GWO Irrigation - Total Flow - TPNRD						
1997 GWO Irrigation - Baseflow - CPNRD						
1997 GWO Irrigation - Total Flow - CPNRD				p1997_2020_001	2020 SIM Files	
1997 GWO Irrigation - Baseflow - TBNRD						
1997 GWO Irrigation - Total Flow - TBNRD						
1997 GWO Irrigation - Baseflow - Outside NRDs						
1997 GWO Irrigation - Total Flow - Outside NRDs						
1997 GWO Irrigation and M&I - Baseflow or Total Flow - TPNRD					p1997_1998_001	1998 SIM Files
1997 GWO Irrigation and M&I - Baseflow or Total Flow - CPNRD						
1997 GWO Irrigation and M&I - Baseflow or Total Flow - TBNRD						
1997 GWO Irrigation and M&I - Baseflow or Total Flow - Outside NRDs						

GW Only Irrigated Acres: 1997-2020 Average

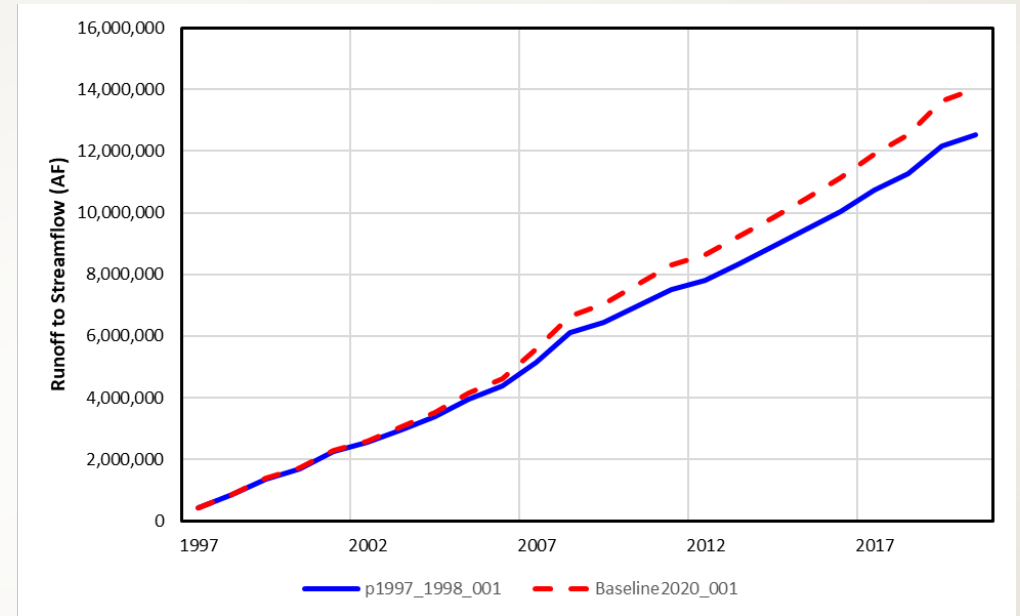
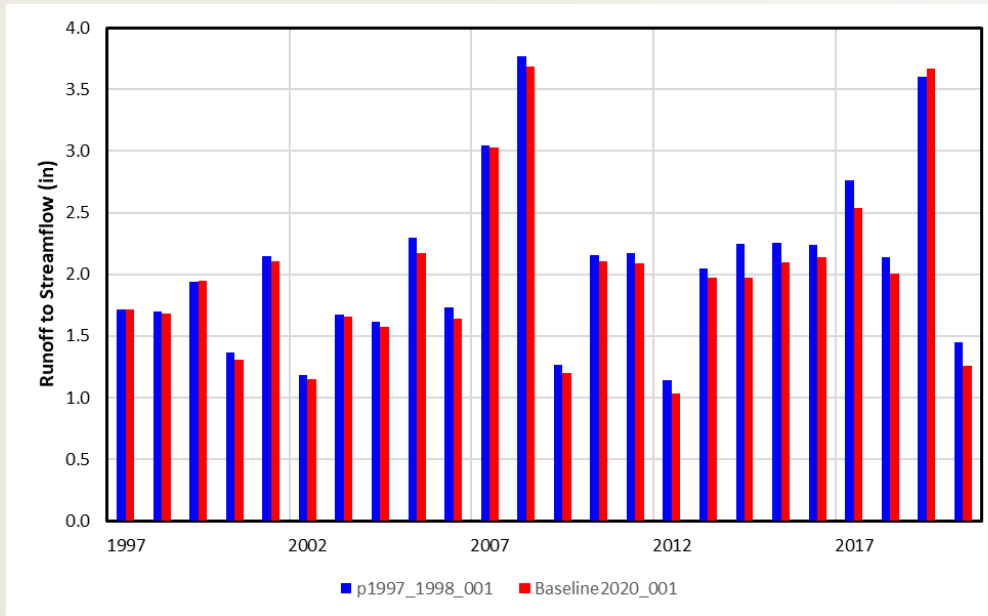
Parameter	p1997_1998_001			Baseline2020_001		
	AF	in	%	AF	in	%
Acres	3,030,435			3,500,915		
Precipitation	6,559,743	25.98	74.7%	7,593,238	26.03	75.9%
Groundwater Pumping	2,223,510	8.80	25.3%	2,415,095	8.28	24.1%
Surface Water Deliveries	-	-	0.0%	-	-	0.0%
Total Applied Water	8,783,253	34.78	100.0%	10,008,334	34.31	100.0%
Field Evapotranspiration	7,065,076	27.98	80.4%	7,866,776	26.96	78.6%
Field Deep Percolation	719,077	2.85	8.2%	1,026,688	3.52	10.3%
Field Runoff	925,936	3.67	10.5%	1,038,831	3.56	10.4%
Irrigation Surface Losses	111,176	0.44	1.3%	120,755	0.41	1.2%
Field Water Balance	(38,012)	(0.15)	-0.4%	(44,716)	(0.15)	-0.4%
Lateral Losses	-	-	0.0%	-	-	0.0%
Field Runoff	925,936	3.67	10.5%	1,038,831	3.56	10.4%
Runoff Contributions to Streamflow	522,654	2.07	6.0%	583,785	2.00	5.8%
Runoff Losses to Recharge	201,641	0.80	2.3%	227,523	0.78	2.3%
Runoff Losses to Evapotranspiration	201,641	0.80	2.3%	227,523	0.78	2.3%
Net Recharge	(1,302,792)	(5.16)		(1,160,885)	(3.98)	
Net Impact to Rivers	(780,138)	(3.09)		(577,100)	(1.98)	

GW Only Irrigated Acres

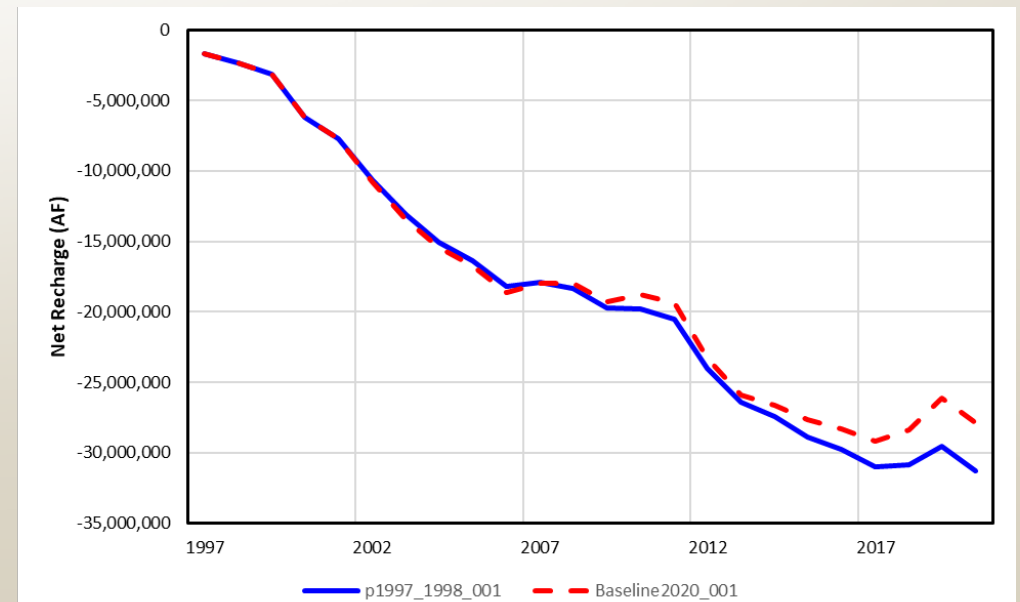
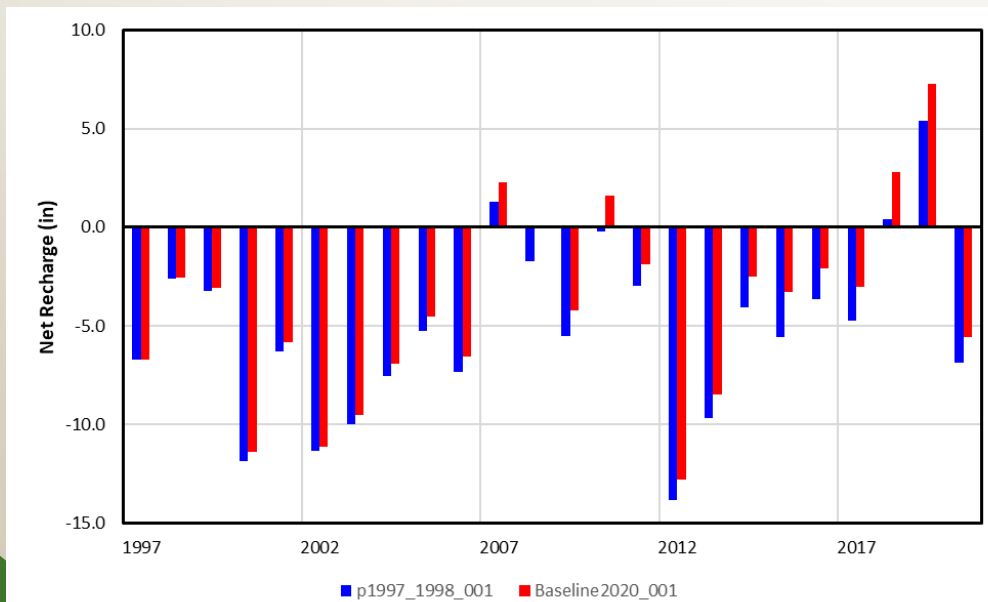


GW Only acreage in excess of 1997 levels re-classified as "dryland" equivalent of the previous irrigated crop mix for Task 200

SF: GW Only Irrigated Acres: Baseline (2020 SIM) [α] vs GW Only Irrigated Acres: Post 1997 (1998 SIM) [β]



NR: GW Only Irrigated Acres: Baseline (2020 SIM) [α] vs GW Only Irrigated Acres: Post 1997 (1998 SIM) [β]

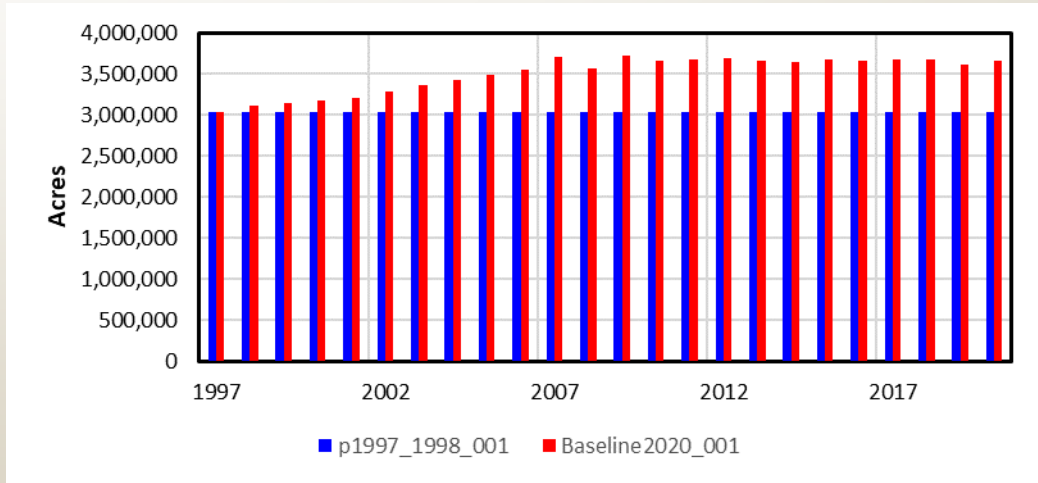


Robust Review Model Runs	TFG Support Task	Del Date	Ref Name	Production Practices		
Historical - Baseflow	Task 100	29-Nov	Baseline2020_001	2020 SIM Files		
Historical - Total Flow			Baseline1998_001	1998 SIM Files		
1997 GWO Irrigation - Baseflow - TPNRD	Task 200	29-Nov				
1997 GWO Irrigation - Total Flow - TPNRD						
1997 GWO Irrigation - Baseflow - CPNRD						
1997 GWO Irrigation - Total Flow - CPNRD				p1997_2020_001	2020 SIM Files	
1997 GWO Irrigation - Baseflow - TBNRD						
1997 GWO Irrigation - Total Flow - TBNRD						
1997 GWO Irrigation - Baseflow - Outside NRDs						
1997 GWO Irrigation - Total Flow - Outside NRDs						
1997 GWO Irrigation and M&I - Baseflow or Total Flow - TPNRD					p1997_1998_001	1998 SIM Files
1997 GWO Irrigation and M&I - Baseflow or Total Flow - CPNRD						
1997 GWO Irrigation and M&I - Baseflow or Total Flow - TBNRD						
1997 GWO Irrigation and M&I - Baseflow or Total Flow - Outside NRDs						

Dry	Historic LU, 2020 SIM	Dry	p1997 LU, 2020 SIM
+ CO	Historic LU, 2020 SIM	+ CO	Historic LU, 2020 SIM
+ GW	Historic LU, 2020 SIM	+ GW	p1997 LU, 1998 SIM
+ SW	Historic LU, 2020 SIM	+ SW	Historic LU, 2020 SIM
=====		=====	
α	Current Condition	β	1997 Condition

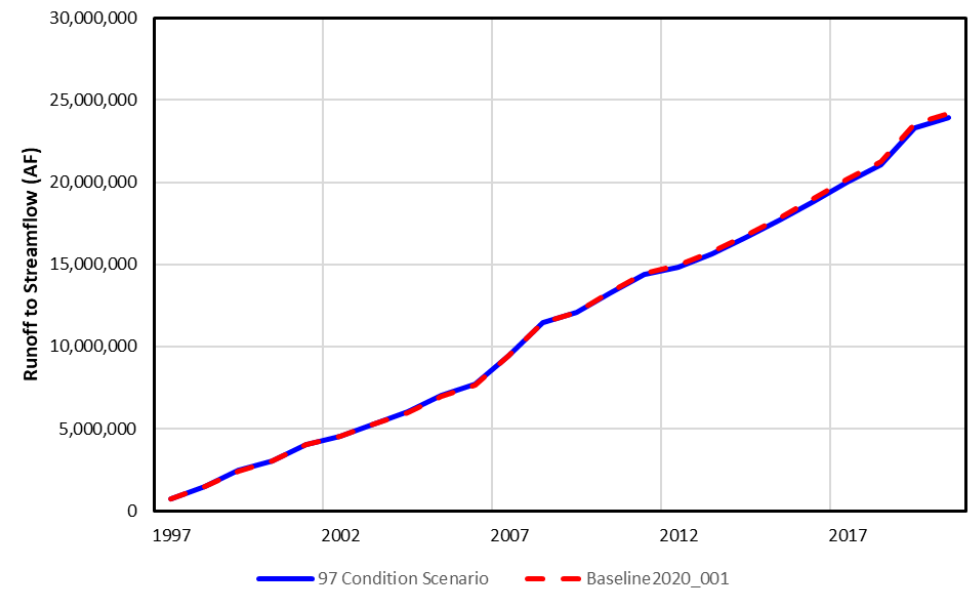
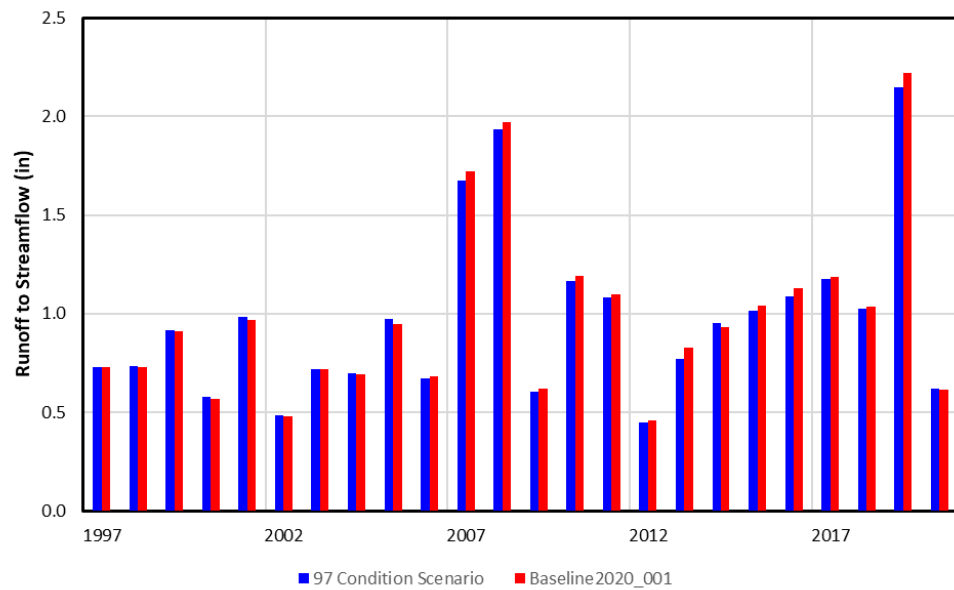
Impact = $\alpha - \beta$

GW Only Irrigated Acres

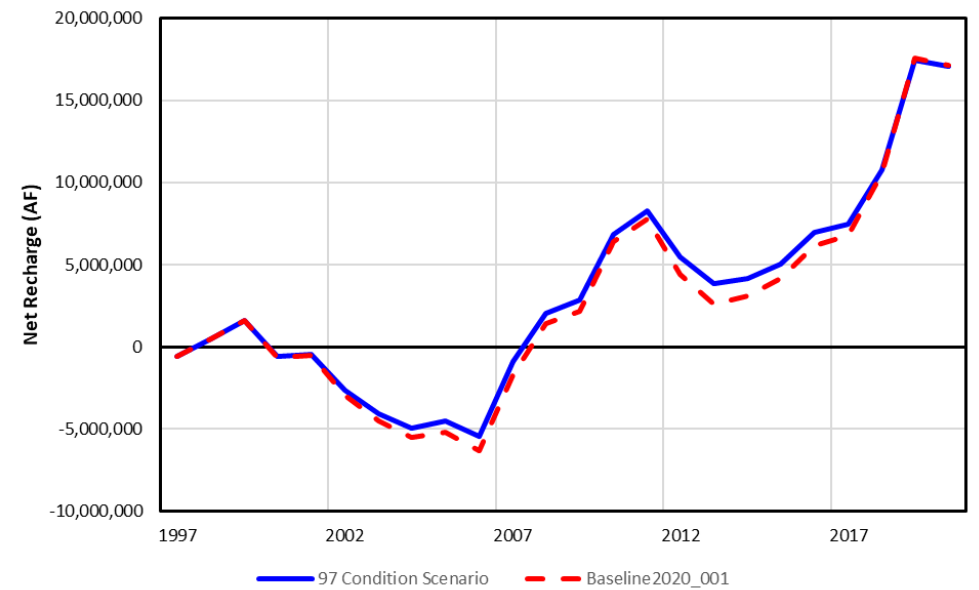
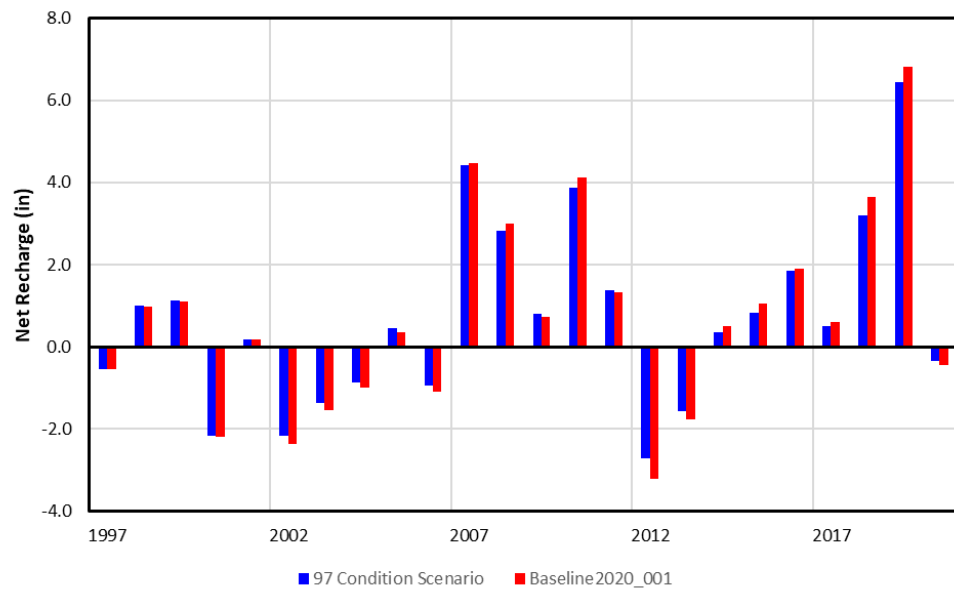


GW Only acreage in excess of 1997 levels re-classified as "dryland" equivalent of the previous irrigated crop mix for Task 200

Impact $\alpha - \beta$: Runoff To Streamflow



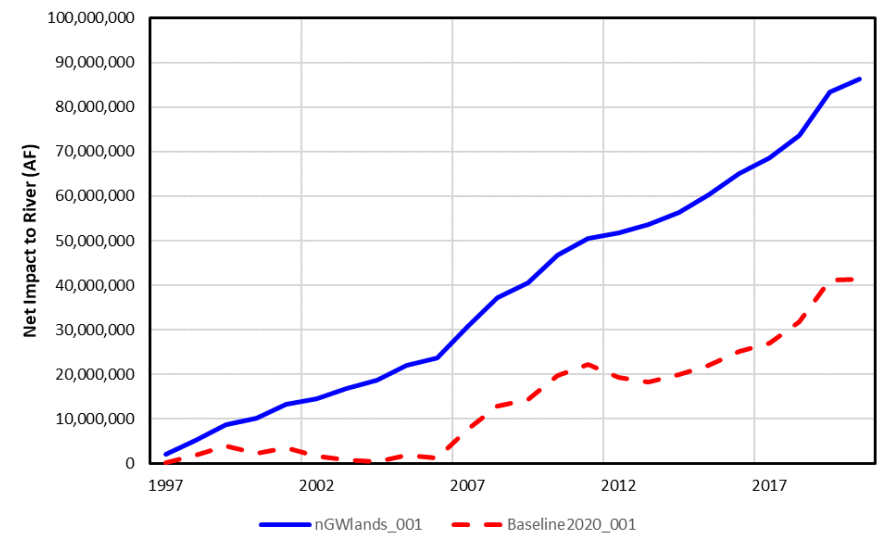
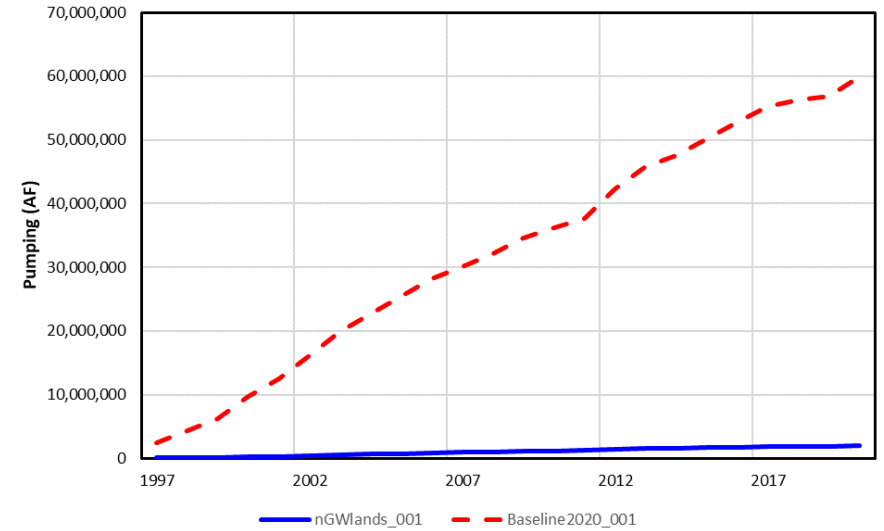
Impact $\alpha - \beta$: Net Recharge



Robust Review Model Runs	TFG Support Task	Del Date	Ref Name	Tillage
Historical - Baseflow	Task 100	27-Nov	Baseline2020_001	2020 SIM Files
Historical - Total Flow			Baseline1998_001	1998 SIM Files
No GWO Pumping - Baseflow or Total Flow - TPNRD	Task 300	27-Nov	nGWLands_001	2020 SIM Files
No GWO Pumping - Baseflow or Total Flow - CPNRD				
No GWO Pumping - Baseflow or Total Flow - TBNRD				
No GWO Pumping - Baseflow or Total Flow - Outside NRDs				

Average 1997 – 2020: All Acres

Parameter	nGWLands_001			Baseline2020_001		
	AF	in	%	AF	in	%
Acres	12,374,240			12,374,240		
Precipitation	25,086,584	24.33	98.9%	25,086,584	24.33	90.3%
Groundwater Pumping	81,713	0.08	0.3%	2,496,808	2.42	9.0%
Surface Water Deliveries	201,962	0.20	0.8%	201,962	0.20	0.7%
Total Applied Water	25,370,259	24.60	100.0%	27,785,355	26.95	100.0%
Field Evapotranspiration	21,514,691	20.86	84.8%	23,219,801	22.52	83.6%
Field Deep Percolation	2,497,401	2.42	9.8%	2,808,965	2.72	10.1%
Field Runoff	1,493,011	1.45	5.9%	1,786,785	1.73	6.4%
Irrigation Surface Losses	10,145	0.01	0.0%	130,899	0.13	0.5%
Field Water Balance	(144,988)	(0.14)	-0.6%	(161,096)	(0.16)	-0.6%
Lateral Losses	12,317	0.01	0.0%	12,317	0.01	0.0%
Field Runoff	1,493,011	1.45	5.9%	1,786,785	1.73	6.4%
Runoff Contributions to Streamflow	837,140	0.81	3.3%	1,008,361	0.98	3.6%
Runoff Losses to Recharge	327,935	0.32	1.3%	389,212	0.38	1.4%
Runoff Losses to Evapotranspiration	327,935	0.32	1.3%	389,212	0.38	1.4%
Net Recharge	2,755,940	2.67		713,686	0.69	
Net Impact to Rivers	3,593,081	3.48		1,722,047	1.67	



**IMPACTS OF CONSERVATION PRACTICES AND LAND AND
WATER USE PRACTICES ON NET RECHARGE AND RUNOFF
CONTRIBUTIONS TO AVERAGE ANNUAL STREAMFLOW**

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Marc Groff, P.E.


Isaac Mortensen, P.E.

Samantha Dowler

February 2024



The question: With the adoption of updated production practices from 1997 through 2020, water budget conditions in the eastern NRD's (TBNRD and CPNRD) seems to be enhanced (e.g. show less depletion) even considering new groundwater development, but in the more western NRD (TPNRD) water budget conditions are reduced (e.g. show more depletion) under the same scenario. Why?



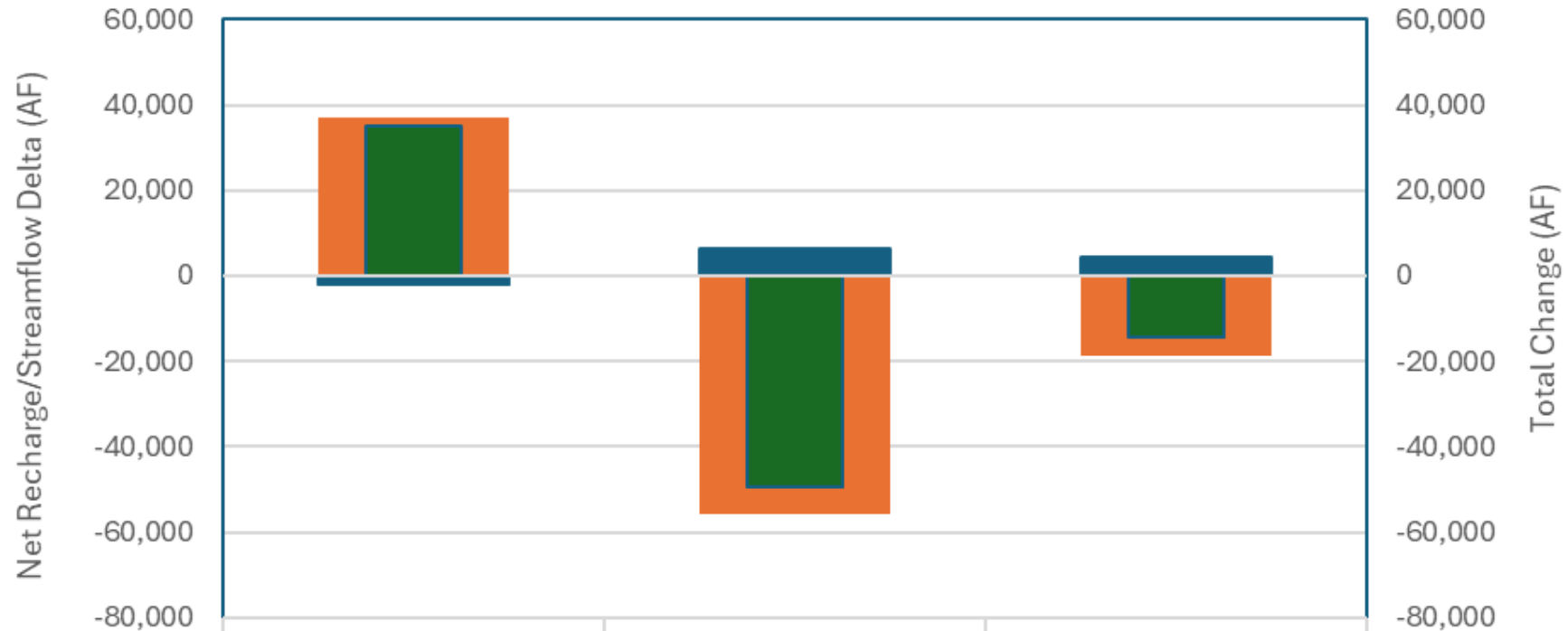
Three important factors are:

- The relative amount of groundwater irrigated area in 1997 and the impact the updated production practices had on these lands
 - The relative increases in groundwater irrigated area since 1997 and the impacts this additional irrigated area had on net recharge and runoff contributions to streamflow
 - The simultaneous reduction in dryland area and the impact this had on net recharge and runoff contributions to streamflow
-

Impact of Production Practice Changes and Water and Land Use Changes on Net Recharge and Runoff Contributions to Annual Streamflow (SF)

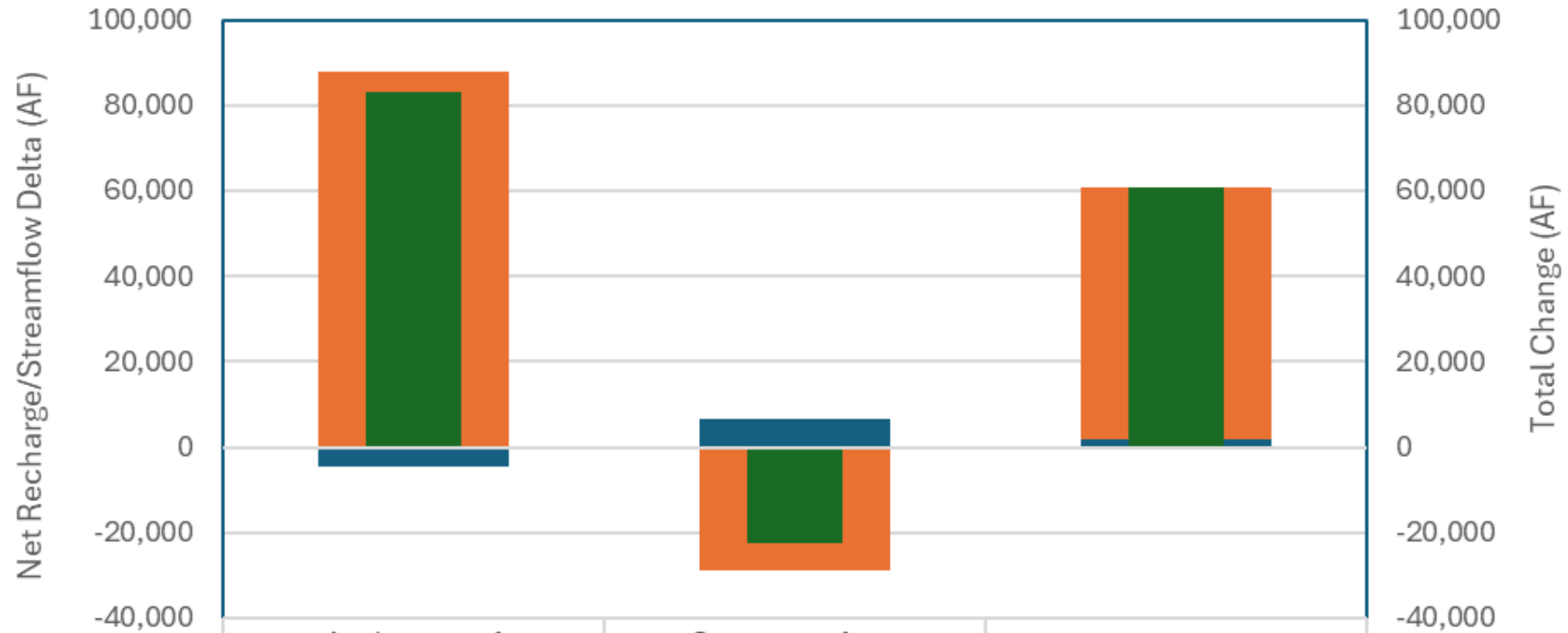
	1997 Groundwater Only Irrigated Area (Ac)	Change in Groundwater Only Irrigated Area 1997-2020 (Ac)	1997 Dryland Area (Ac)	Change in Dryland Area 1997-2020 (Ac)	Impact of 2020 Updated Production Practice (AF)		Impact of Land Use Irrigation Status Change (AF)		Net Effect (AF)
					Net Recharge	Runoff contribution to SF	Net Recharge	Runoff contribution to SF	
Twin Platte NRD	207,911	55,350	2,298,224	-59,731	36,950	-1,994	-55,614	6,205	-14,453
Tri Basin NRD	406,660	53,036	450,483	-54,477	87,775	-4,633	-28,924	6,416	60,634
Central Platte NRD	819,474	50,570	1,238,013	-52,638	119,286	-8,442	-34,619	15,660	91,885

Twin Platte NRD



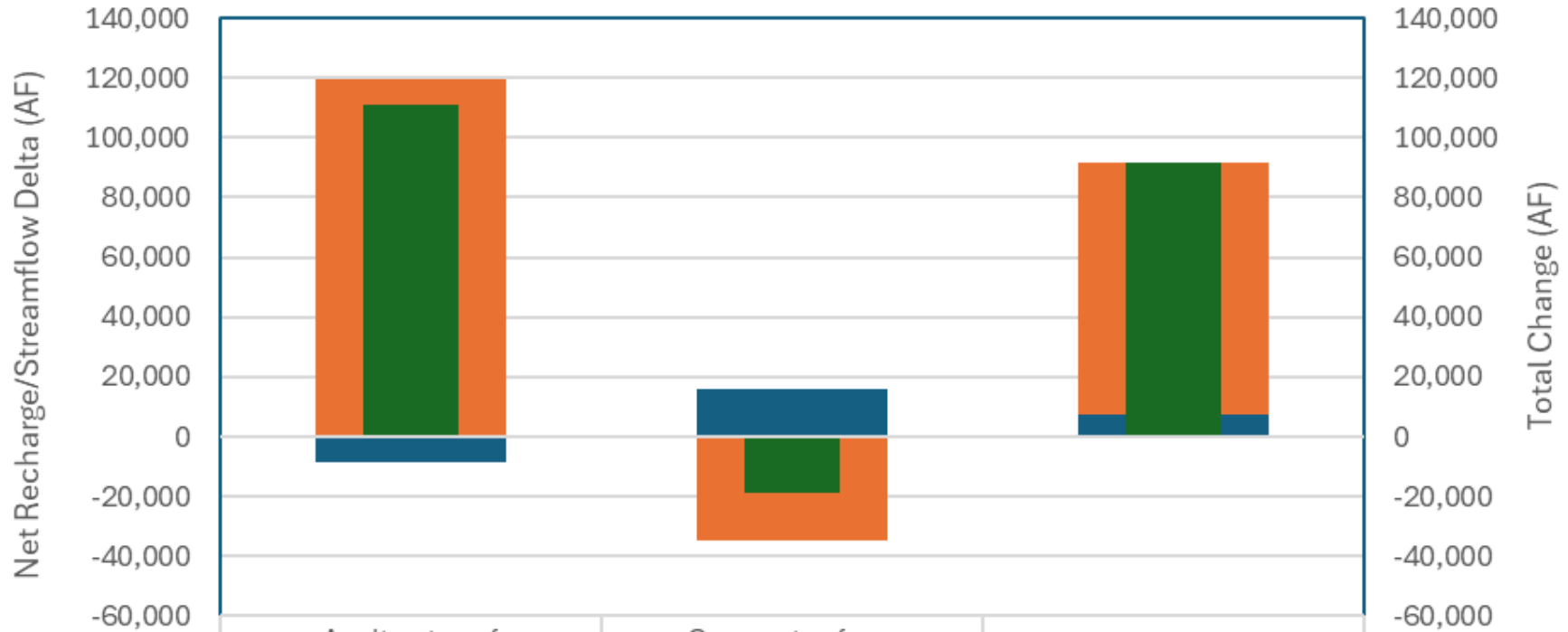
	Application of Updated Production Practices	Conversion from Dryland to Irrigated Land Use	Net Effect
Net Recharge Delta	36,950	-55,614	-18,664
Runoff to SF Delta	-1,994	6,205	4,211
Total Change	34,956	-49,409	-14,453

Tri-Basin NRD



	Application of Updated Production Practices	Conversion from Dryland to Irrigated Land Use	Net Effect
Net Recharge Delta	87,775	-28,924	58,851
Runoff to SF Delta	-4,633	6,416	1,783
Total Change	83,142	-22,508	60,634

Central Platte NRD



	Application of Updated Production Practices	Conversion from Dryland to Irrigated Land Use	Net Effect
Net Recharge Delta	119,286	-34,619	84,667
Runoff to SF Delta	-8,442	15,660	7,218
Total Change	110,844	-18,959	91,885

Summary

- In all NRDs, updated production practices had a positive impact to net recharge and a negative impact to runoff while the expansion of ground water irrigated acres/reduction of dryland acres served to reduce net recharge and increase runoff
 - The effect of updated production practices in the groundwater irrigated area was much less in TPNRD than in the eastern two NRD's because of the much smaller groundwater irrigated area in 1997
 - Even though each NRD added over 50,000 acres of groundwater irrigated area in the past 25 years, the negative impact of the additional acreage is much less in the east than in the west. This is because of the higher withdrawal per acre in the west and lower recharge, both due to lower precipitation in the west
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