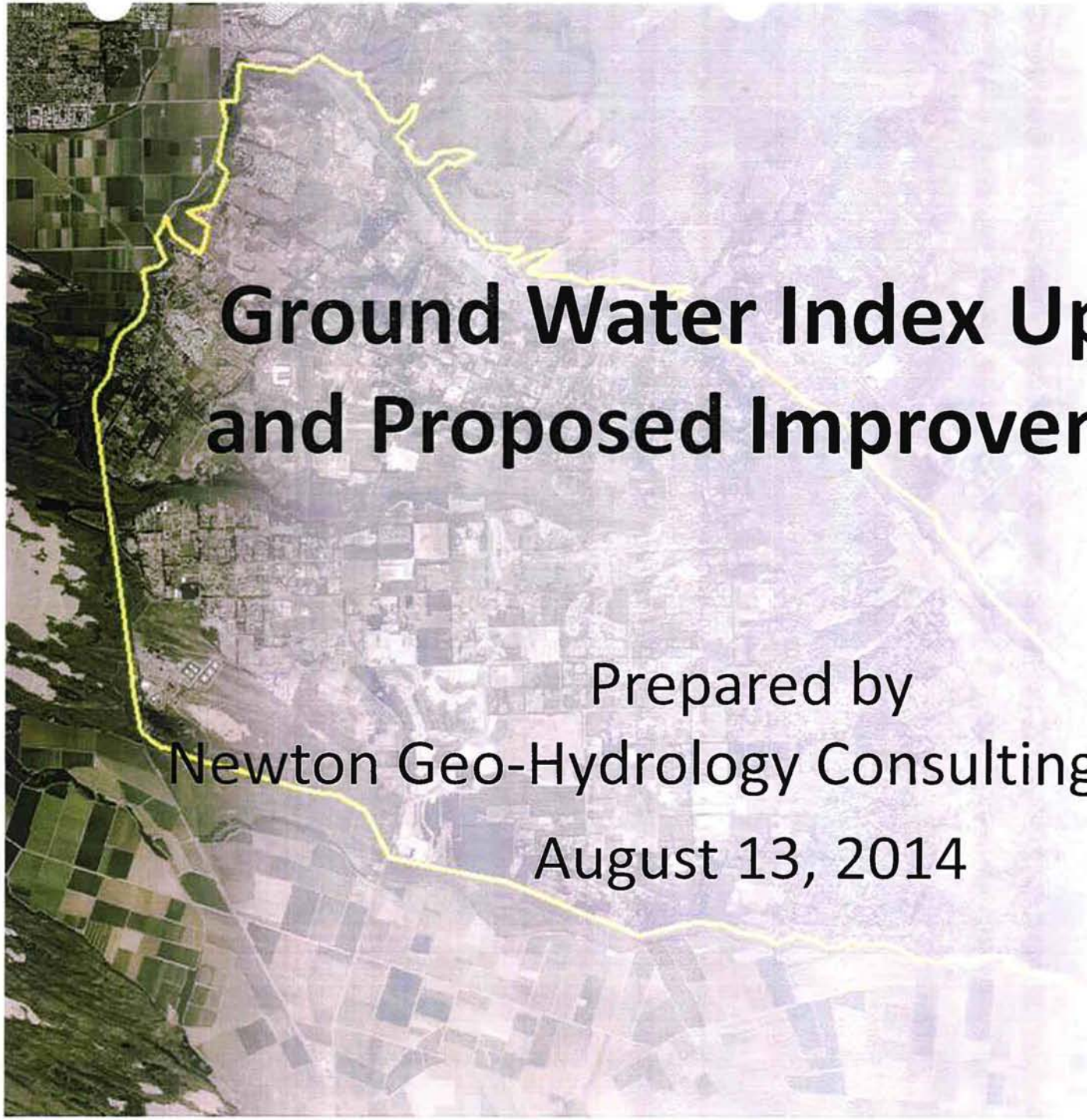
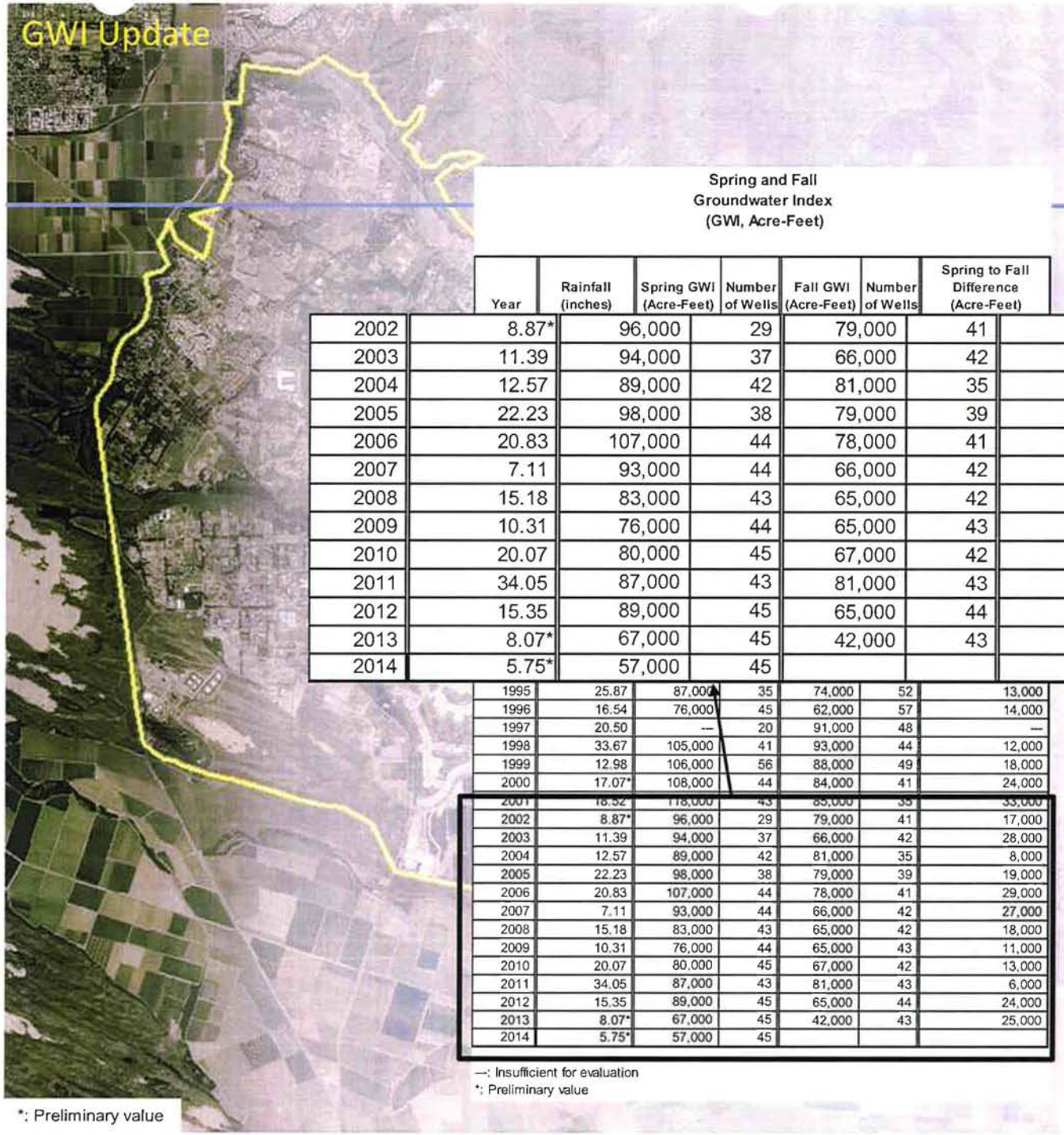


Ground Water Index Update and Proposed Improvements

Prepared by

Newton Geo-Hydrology Consulting Services

August 13, 2014



GWI

Spring and Fall Groundwater Index (GWI, Acre-Feet)

Year	Rainfall (inches)	Spring GWI (Acre-Feet)	Number of Wells	Fall GWI (Acre-Feet)	Number of Wells	Spring to Fall Difference (Acre-Feet)
2002	8.87*	96,000	29	79,000	41	17,000
2003	11.39	94,000	37	66,000	42	28,000
2004	12.57	89,000	42	81,000	35	8,000
2005	22.23	98,000	38	79,000	39	19,000
2006	20.83	107,000	44	78,000	41	29,000
2007	7.11	93,000	44	66,000	42	27,000
2008	15.18	83,000	43	65,000	42	18,000
2009	10.31	76,000	44	65,000	43	11,000
2010	20.07	80,000	45	67,000	42	13,000
2011	34.05	87,000	43	81,000	43	6,000
2012	15.35	89,000	45	65,000	44	24,000
2013	8.07*	67,000	45	42,000	43	25,000
2014	5.75*	57,000	45			

1995	25.87	87,000	35	74,000	52	13,000
1996	16.54	76,000	45	62,000	57	14,000
1997	20.50	--	20	91,000	48	--
1998	33.67	105,000	41	93,000	44	12,000
1999	12.98	106,000	56	88,000	49	18,000
2000	17.07*	108,000	44	84,000	41	24,000
2001	18.52	118,000	43	85,000	35	33,000
2002	8.87*	96,000	29	79,000	41	17,000
2003	11.39	94,000	37	66,000	42	28,000
2004	12.57	89,000	42	81,000	35	8,000
2005	22.23	98,000	38	79,000	39	19,000
2006	20.83	107,000	44	78,000	41	29,000
2007	7.11	93,000	44	66,000	42	27,000
2008	15.18	83,000	43	65,000	42	18,000
2009	10.31	76,000	44	65,000	43	11,000
2010	20.07	80,000	45	67,000	42	13,000
2011	34.05	87,000	43	81,000	43	6,000
2012	15.35	89,000	45	65,000	44	24,000
2013	8.07*	67,000	45	42,000	43	25,000
2014	5.75*	57,000	45			

--: Insufficient for evaluation
*: Preliminary value

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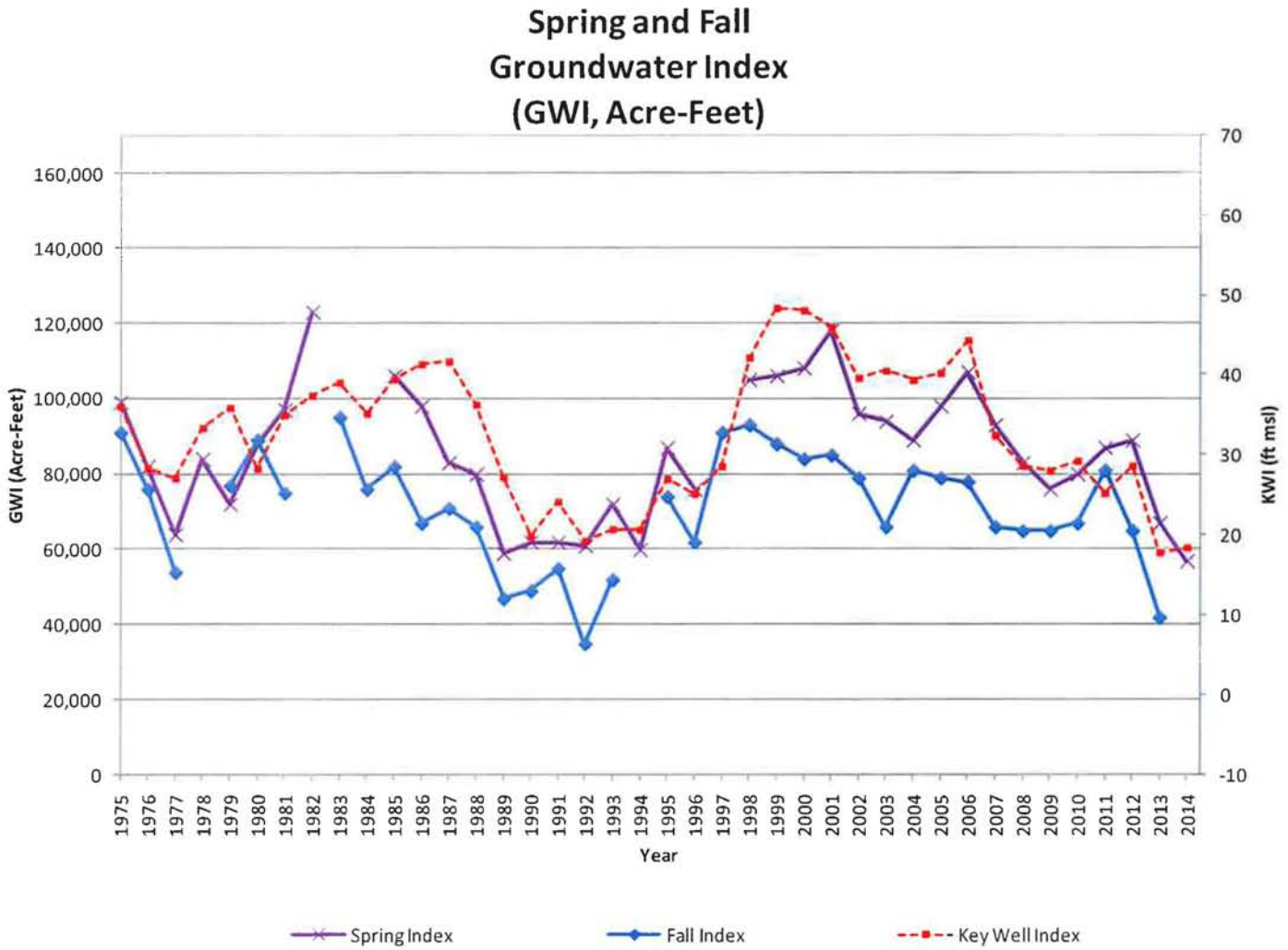
GWI



Proposed Scope of Work

Purpose of the proposed scope of work is to evaluate the efficacy of estimating how much water is available in storage as a function of a combination of consumptive use, production, and climatic conditions.

A Technical Memorandum will be prepared formalizing all findings, methods, assumptions, and recommendations.

Proposed Formalizations

$$R = Ru + I$$

Where:

R	= Rainfall
Ru	= Runoff
I	= Infiltration
CU	= Consumptive Use
ΔSs	= Change in Soil Storage
Re	= Recharge
ΔSgw	= Change in Ground Water
Fin	= Ground Water Flow In
Fout	= Ground Water Flow Out
P	= Pumping

Proposed Formalizations

$R = Ru + I$

$I = CU + \Delta Ss + Re$

Where:

R = Rainfall
Ru = Runoff
I = Infiltration
CU = Consumptive Use
ΔSs = Change in Soil Storage
Re = Recharge

ΔSgw = Change in Ground Water
Fin = Ground Water Flow In
Fout = Ground Water Flow Out
P = Pumping

Proposed Formalizations

$R = Ru + I$

$I = CU + \Delta Ss + Re$

$Re = R - Ru - CU - \Delta Ss$

Where:

R	= Rainfall
Ru	= Runoff
I	= Infiltration
CU	= Consumptive Use
ΔSs	= Change in Soil Storage
Re	= Recharge
ΔSgw	= Change in Ground Water
Fin	= Ground Water Flow In
Fout	= Ground Water Flow Out
P	= Pumping

Proposed Formalizations

$R = Ru + I$

$I = CU + \Delta Ss + Re$

$Re = R - Ru - CU - \Delta Ss$

$\Delta Sgw = Re + Fin - Fout - P$

Where:

R	= Rainfall
Ru	= Runoff
I	= Infiltration
CU	= Consumptive Use
ΔSs	= Change in Soil Storage
Re	= Recharge
ΔSgw	= Change in Ground Water
Fin	= Ground Water Flow In
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P	= Pumping

Proposed Formalizations

$$R = Ru + I$$

$$I = CU + \Delta Ss + Re$$

$$Re = R - Ru - CU - \Delta Ss$$

$$\Delta Sgw = Re + Fin - Fout - P$$

$$\Delta Sgw = R - Ru - CU - \Delta Ss + Fin - Fout - P$$

Where:

R	= Rainfall
Ru	= Runoff
I	= Infiltration
CU	= Consumptive Use
ΔSs	= Change in Soil Storage
Re	= Recharge
ΔSgw	= Change in Ground Water
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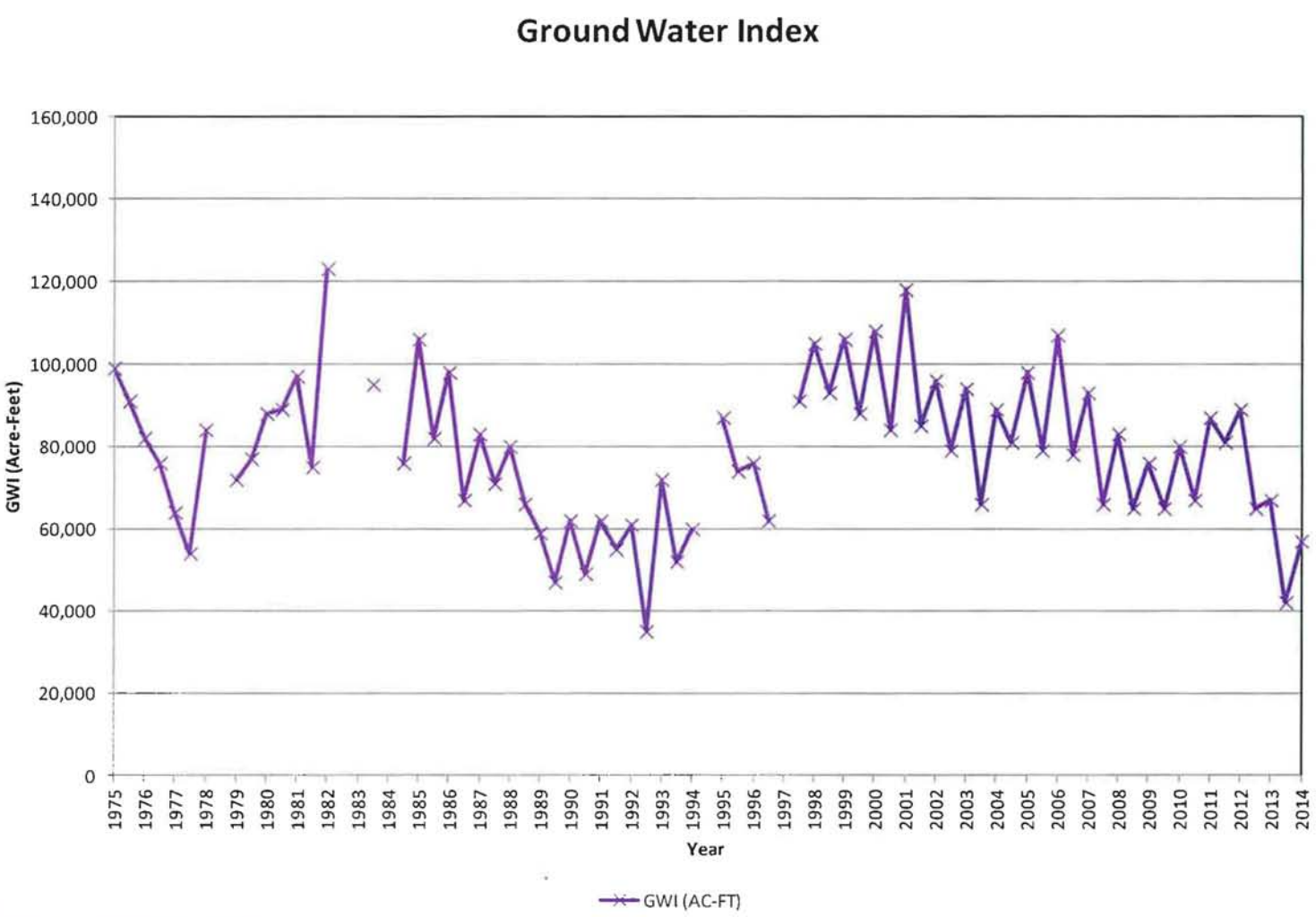
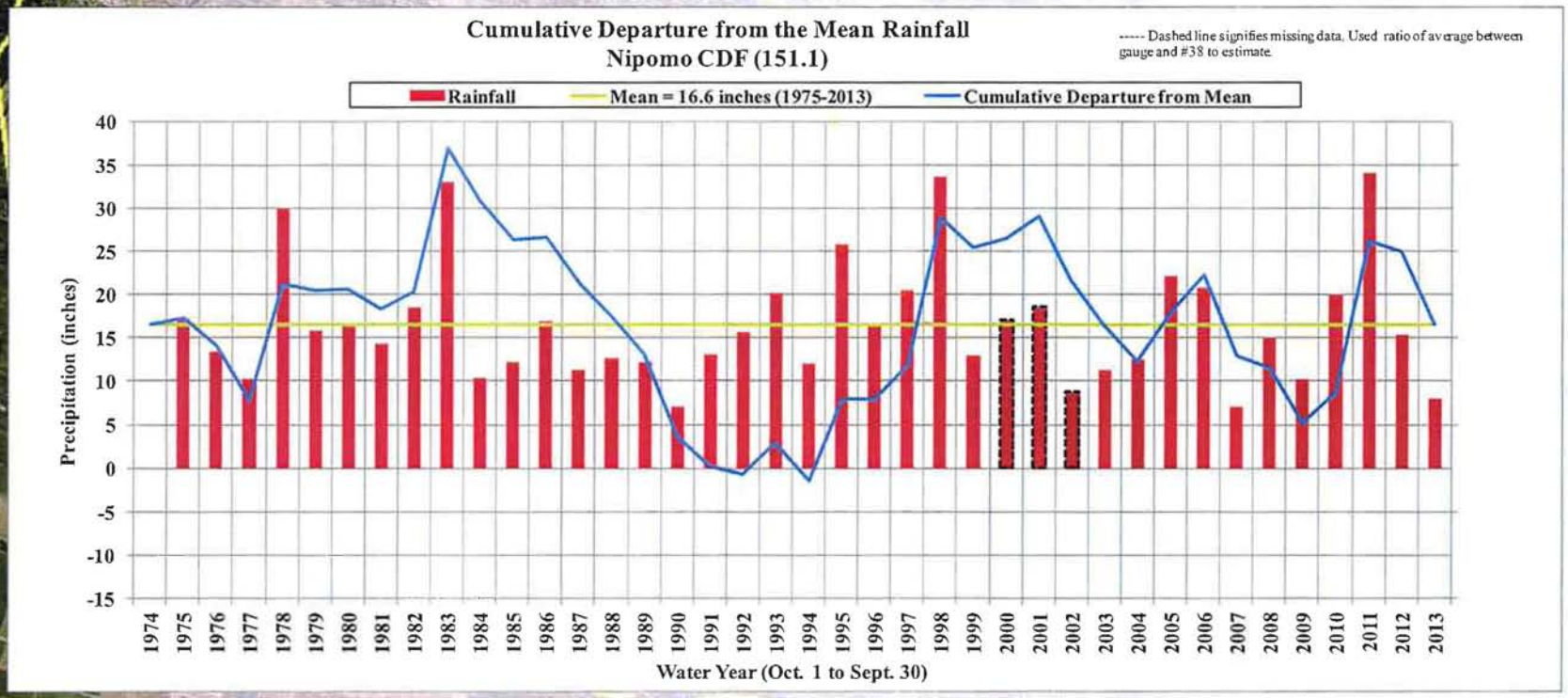
P	= Pumping

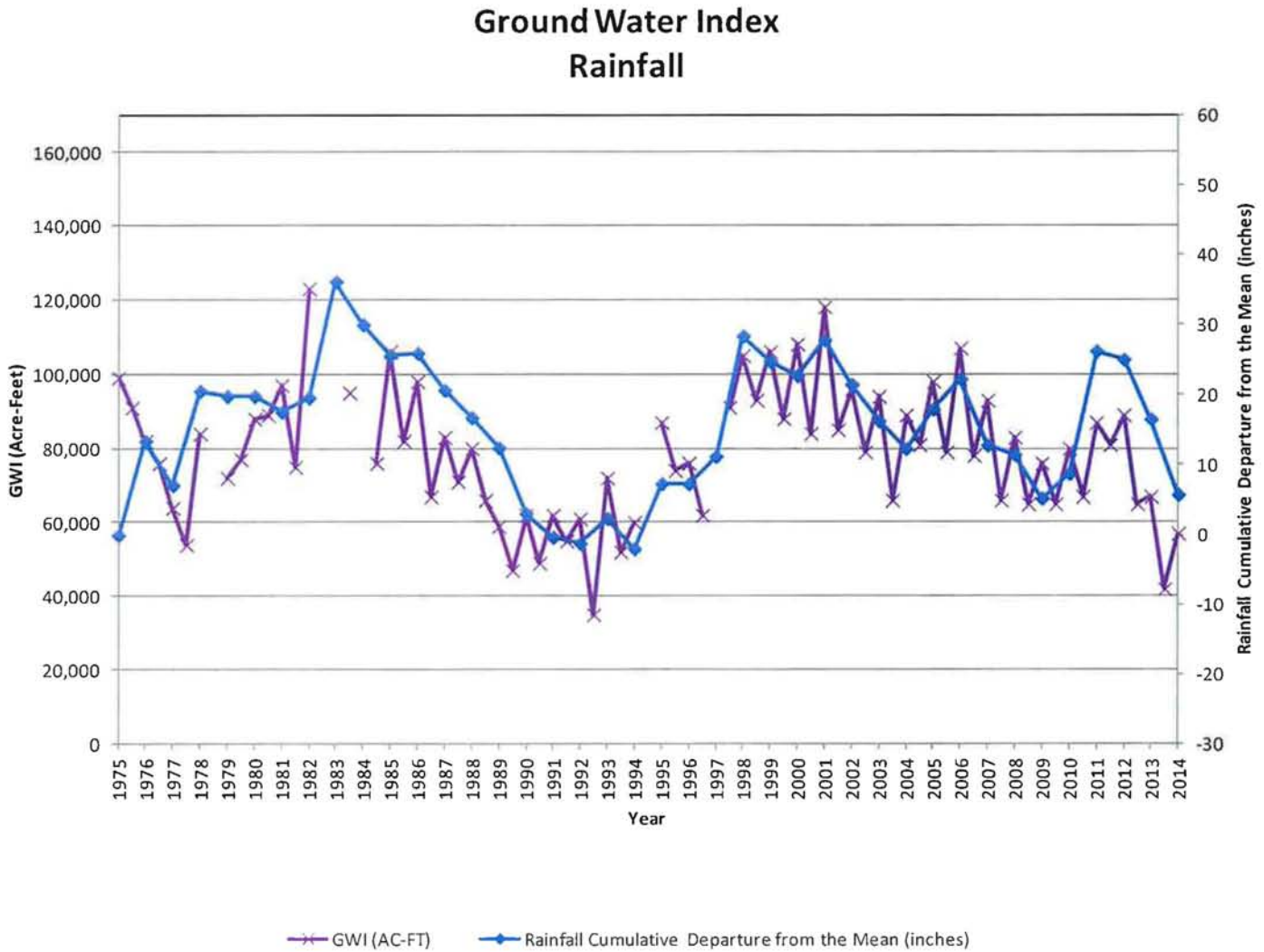
GWI ≅ ΔSgw



Annual Data



Correlation Between GWI and Rainfall



GWI ≅ ΔSgw

$GWI \cong \Delta Sgw = R - Ru - CU - \Delta Ss + Fin - Fout - P$

Data:

R = Measured

Ru = Assumed to be zero on the Mesa

CU = Calculated from land use and climate

ΔSs = Calculated from R, CU, soil properties

Fin = Calculated from ground water elevations

Fout = Calculated from ground water elevations

P = Measured

Proposed Scope of Work

- Compare trial combinations of precipitation (AFY) cumulative sum of departure from the mean and weighted averages, consumptive use (AFY), and production (AFY) to GWI (AFY) for data from 1975 to present,
- Temporally lag the above relationships with a range of time steps,
- Compute correlation coefficients for all trial fits to determine best fit,
- Determine the average (1975 to present) best fit, ie highest correlation,
- Evaluate if there is a difference in correlation between high ground water conditions versus low ground water conditions,
- If so, evaluate stratigraphy to determine if differences in high-low ground water conditions are related to production zones,
- Compute the scalar between best fit trial (AFY) and ground water index (AFY).

The scalar is related to system losses and estimation errors, water yield from the aquifers, and variations between production zones.