DNR Form 638-2

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STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES

APPLICATION FOR A MUNICIPAL AND RURAL DOMESTIC GROUND WATER TRANSFERS PERMIT

INSTRUCTIONS

For Department Use Only

Application Number: MT-40
Date Filed: May 13, 2011
Receipt Number: G-164
Amount: 50.00

Complete items 1 through 10 by printing in ink or typing the appropriate information and by placing an (X) in the appropriate boxes.

The following information shall be provided on 8½x 11 inch paper (or folded to such size). An answer is required for each item of A-H. Each answer must be clearly identified in the application. When using a ground water model, justify the applicability to the given geologic setting.

A. Discussion of impacts on surrounding ground water and surface water supplies. Include expected radius of cone of depression and how it was determined and location of any existing wells or water rights that may be impacted.
B. Statement of impacts on any existing threatened or endangered species in project area.
C. Pump test information, if available, including length of test, data from pump test, and location of observation wells.
D. Information on geology and hydrology of area such as thickness of aquifer, depth to water, aerial extent, transmissivity and how it was determined, and whether aquifer is confined or unconfined.
E. Description of type of well, including drawings.
F. Planned operation schedule. (Describe hours per day the wells will likely be pumped, whether there will be seasonal changes to schedule, whether there will be a rotation of wells pumped, and whether certain wells are only for backup purposes.)
G. Explanation of the basis for the amount of water requested. This should include current population and projected growth, daily per capita water use data, current industrial or other large uses and projected growth. The explanation should also include answers to the requirements for approval of the application stated in § 46-642, R.R.S., 1943, as amended, namely: whether request is reasonable, not contrary to the conservation and beneficial use of ground water, and not detrimental to the public welfare.
H. Map showing location of proposed wells, pipelines (exclusive of distribution lines) and the area of proposed use. The map shall be legible and at a scale of not less than one inch to the mile.

A non-refundable filing fee (payable to the Department of Natural Resources) can be computed from the table below and must accompany this application.

QUANTITY OF WATER REQUESTED (daily average)	COST
First 5,000,000 gallons per day	$50.00
Each additional increment (or portion) of 5,000,000 gallons per day	$20.00

1. Name, address and telephone number of Applicant:

Western Nebraska Joint Water Board, P.O. Box 305, Morrill, NE 69358
Attn: Brad Cole
Phone: 308-247-2312 / Fax: 308-247-2061

Name, address and telephone number of person to contact concerning application:

Frank A. Strong IV, P.E., M.C. Schaff & Associates, 2116 Pioneer Avenue, Cheyenne WY 82001
Phone: 307-635-2828 / Fax: 307-635-9902 / email: FStrong@mcschaff.com

2. Identify the city, village, rural area or other entity to be supplied water:

Combined well-field to serve the communities of Henry, Lyman & Morrill

3. Maximum rate of withdrawal for which a permit is requested (complete both) 750 gallons per minute
810,000 gallons per day

Indicate whether the amount is for each well or a total rate for all wells.
750 gpm maximum per each well and 810,000 gpd total rate for all wells (3 total)

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4. The daily AVERAGE amount of w[illegible] quested: 500,000 Gallons p

5. Total quantity of water to be withdrawn annually (gallons). 182,500,000

6. Number of wells proposed: 3 Number of existing wells: 7

7. Location of the proposed ground water wells and existing wells:
(Indicate 40-acre government subdivision, Section, Township, Range and County, and registration number(s) if applicable):

See Attached Exhibit 1: Henry - [redacted] Lyman - [redacted]

Morrill: [redacted]

8. Construction will start on or before November 1, 20 11.

9. Construction will be completed on or before April 30, 20 13.

10. If the permit is granted, does the applicant request imposition of statutory spacing protection for one year for test holes or wells to be constructed? ☐ Yes ☒ No

If yes, indicate below the name and address of the owners and occupiers of land affected by the granting of such spacing protection, and a description of the land they own or occupy.

I certify that I am familiar with the information contained in this application, and that to the best of my knowledge and belief, such information is true.

Applicant (Signature and Title) Date 5-10-11

Forward application and fee to:

State of Nebraksa
Department of Natural Resources
301 Centennial Mall South
P.O. Box 94676
Lincoln, Nebraska 68509-4676
(402)471-2363

The Lyman, Henry and Morrill Well Field Notes-R58W, T23N Section 10

A. Discussion of impacts on surrounding ground water and surface water supplies. Include expected radius of cone of depression and how it was determined and location of any existing wells or water rights that may be impacted.

1. For convenience sake the proposed well field for the towns of Lyman, Henry and Morrill will be referred to as the LHM well field. Three wells are planned for this field. The most easterly of the wells, Well 3, lies approximately 900 feet west of the nearest meander of the North Platte River. Groundwater flow, based on a solution to the three point problem, is towards the North Platte, that is, in an east-northeasterly direction. Aquifer parameters were determined on the basis of an aquifer test conducted on January 4-6, 2010 (see Section C). Aquifer thickness was found to be 170 feet (see Appendix D Boring Log).

2. The Nebraska Department of Natural Resources lists six wells in the immediate vicinity of the well field. These are A-007086, A-007086B, A-007085A, G-023669, G-062324, and G-094679 (see figure @). None are within 1,000 feet of the LHM wells. There are two that are downgradient of Well 1, A-007086, and A-007086B. Both of these are beyond the calculated stagnation point, that point where the pull of the well pump is balanced by natural ground water flow away from the well. The stagnation point occurs within the cone of depression and represents the downgradient limit of the capture zone. Calculations indicate that using a pumping rate at 750 gallons per minute the stagnation point is approximately 61 feet downgradient (see appendix A). Note that the planned pumping schedule for each of the wells is one eight hour shift per day and followed by an idle period of sixteen hours. Pumping is to be rotated among the wells every eight hours.

3. Well A-007086B lies approximately 1,200 feet northwest of Well 3. The planned withdrawal for this well is 1000 gpm. At 1,200 feet this would cause an approximate 0.1 foot drop in the water table at Well 3 (0.06% the depth of the 170 foot water table aquifer), assuming a horizontal ground water flow with uniform aquifer characteristics. Although horizontal ground water flow may not exist at the site the angle of incidence is very low.

4. During the January 2010 aquifer test complete recovery occurred in the observation well approximately six hours after pumping stopped. The observation well was 40 feet from the production well. Total drawdown was approximately 1.47 feet with increases and decreases of approximately 0.03 foot occurring during the last hours of the test. The pumping rate varied between 1420 and 1435 gallons per minute for a 48 hour period. It should be noted that this is almost twice the planned pumping rate and six times longer than the planned production shift. On the basis of the test results the water table level following an eight hour pumping period at 750 gallons per minute and succeeded by a sixteen hour idle period could be expected to completely recover.

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Table I. Computed drawdown at different distances assuming withdrawal of 750 gallons per minute for an eight hour period

Distance in feet	Drawdown in feet	As percentage of aquifer thickness
1	1.15	0.67
10	0.74	0.44
100	0.34	0.20
1000	0.02	0.01
1337	0	0

Assuming a transmissivity of 130,800 ft^2/day a specific yield of 0.197 and horizontal ground water flow

5. By contrast if for some reason only one well was used at a constant pumping rate for 24 hour period the calculated cone of depression could extend over 2,000 feet although most of the decline would be less than 0.1 foot difference from the original water level. At 1,000 feet the calculated drawdown would be 0.065 feet. Calculations for a drawdown at distances of 10, 100 and 1,000 feet for a one well scenario using different time periods with the above mentioned aquifer and production parameters are provided in Table II below (also see Appendix B). It should be noted that after 50 years of constant production from one well the drawdown from the production well is 1.01% of the depth of the aquifer at a distance of 10 feet and 0.53% the depth of the aquifer at 1,000 feet. Additional computations that include an angle of incidence indicate a maximum capture zone width of less than a thousand feet (see Appendix A). The crux of these calculations is that the well field wells are unlikely to significantly impact or be impacted by any of the surrounding wells.

6. Analytical equations were used to make the above computations. Analytical equations are useful in situations where the subsurface is characterized by near uniform aquifer values and only simple answers are required. In those situations with non-uniform aquifer characteristics or a more detailed understanding of the nature groundwater movement is desired a numerical model may be preferable. In this situation analytical methods were considered preferable due to the uniformity of the subsurface.

Table II. Computed drawdown for a single hypothetical well at a production of 750 gallons per minute (144,375 ft^3/day)

Time in days	Drawdown in feet at 10 feet distance	As percentage of aquifer thickness	Drawdown in feet at 100 feet distance	As percentage of aquifer thickness	Drawdown in feet at 1,000 feet distance	As percentage of aquifer thickness
.33	0.75	0.40	0.34	0.20	0.02	0.01
1	0.84	0.50	0.44	0.30	0.06	0.04
365	1.37	0.80	0.96	0.60	0.60	0. 40
3650	1.57	0.90	1.16	0.70	0.76	0.45
18250 (50 years)	1.72	1.01	1.30	0.80	0.90	0.53

Assuming a transmissivity Of 130,800 ft^2/day, a specific yield of 0.197 and a horizontal ground water flow.

B. Statement of impacts on any existing or endangered species in the project area.

The Environmental Report prepared for USDA-Rural Development by M.C. Schaff & Associates, dated 3-March-2008, the surface water in the project area is habitat for four (4) endangered species that are dependent on sufficient surface flow volumes, namely, the Least Tern, Piping Plover, Whooping Crane and Pallid Sturgeon. From this same report, the project is not expected to have an adverse effect on the biological resources in the area.

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C. Pump test information, if available, including length of test, location of observation wells.

1. There has been one aquifer test at the site that has been used to determine aquifer parameters such as transmissivity. The test was conducted in January 4-6th of 2010. The position of the production well, registered as G-153251 is provided on figure &,

2. Sargent Drilling Co. of Broken Bow, NE was contracted to perform the pump test. Two wells were installed and developed for the test, a two foot diameter 180 foot production well screened in the lower 40 foot and a nine inch diameter 180 foot observation well screened in the lower 100 feet. The wells were installed 40 feet apart. The planned withdraw rate for the production well was 1,420 gpm however during a site visit on the 6th it was found to be pumping at 1435 gpm. Readings for water depth in the observation well were taken every 900 seconds for the 48 hour duration of the test. Drawdown and time data were collected on the InSitu data system. (see Appendix C)

3. After the test was completed data was transmitted to PG&E and processed into an EXCEL format. It was then copied and pasted into the Pump Test Wizard of the Aqtesolve program.

D. Information on the geology and hydrology of area such as thickness of aquifer, depth to water, aerial extent, transmissivity and how it was determine, and whether the aquifer is confined or unconfined.

1. The planned well field is to be installed in an unconsolidated deposit of sands and gravels that form an unconfined water table aquifer. This aquifer, referred to as the Alluvial Aquifer, is a result of a channel cut by the North Platte over geologic time and subsequently filled by water borne sediments. Bore logging at the site by PG&E revealed that the sediments consist of 180 feet of gravel and coarse sand of which approximately 170 feet are saturated. The aquifer is underlain by the Cretaceous Period Pierre Shale, although remnants of the Oligocene Chadron Formation of less than a foot thickness have been encountered. The depth to water at the time of well installations in the area varied from six to ten feet. The water table elevation can be expected to change abruptly and radically when influenced by precipitation or flooding. The field itself is located near a bend in the river at a point where the Alluvial Aquifer, as determined by the surficial features, extends two miles in width.

2. The Neuman method was selected for evaluation of transmissivity and specific yield because it was developed for use with unconfined aquifers and partial penetration by the wells in the aquifer. Although curve fitting and parameter options allowed more than one possible solution a reasonable fit for transmissivity was 130,800 ft^2 /day with a specific yield at 0.1973. Assuming a 170 foot aquifer the hydraulic conductivity is 770 ft/day (see Appendix C). Aquifer tests from Goshen County, Wyoming indicate that the hydrologic characteristics identified at the site extend well beyond Torrington. Hydraulic conductivity computed from six aquifer tests conducted in flood-plain deposits ranged from 200 to 1,200 feet/day. Additional literature describing the hydraulic conductivities at different points along the Platte in Scottsbluff County described values ranging from 11 to 840 feet per day. The highest value

in Scottsbluff County was south of the Platte and close to the river in conditions similar to the test well at the site.

E. Description of the type of well including drawings.

Three wells are to be included in the well field. Their proposed positions are provided below:

Proposed well No. 1 [redacted]
Proposed well No. 2 [redacted]
Proposed well No. 3 [redacted]

A schematic of the proposed wells is provided in the attached detail drawings (excerpted from the construction plan set).

Table III. Planned Well Characteristics

	Depth	Screen interval	Slot size	Inside diameter	Outside diameter	Grout interval	Filter pack interval
Well 1	178'	126'-168'	0.100"	16"	24"	7' to 88'	105'-178'
Well 2	158'	108-148'	0.100"	16"	24"	7' to 83'	88' - 158'
Well 3	100'	51' - 91'	0.100"	16"	24"	7' - 40'	45'-100'

F. Planned operation schedule. (describe hours per day the wells will likely be pumped, whether there will be seasonal changes to schedule, whether there will be a rotation of wells pumped, and whether certain wells are only for backup purposes.)

The planned system consists of three wells that will withdraw a maximum of 750 gpm each. Typically, one pump will be run at a time, with the control system set to cycle through each of the three pumps in succession. Each pump expected to run 4-hrs per day during "average use" periods.

G. Explanation for the basis of the amount of water requested. *This should include the population and projected growth, daily per capita water use data, current industrial or other large uses and projected growth. The explanation should also include answers to the requirements for approval of the application stated in §46-642 R.R.S., 1943, as amended, namely: whether it is reasonable, not contrary to the conservation and beneficial use of ground water, and not detrimental to the public welfare.*

1. The 2009 population estimates by the Nebraska Department of Economic Development (NDED) for Henry, Lyman and Morrill were 161, 405 and 941 respectively for a total of 1,507. This indicates a drop from the 2000 census figure of 1,540. The NDED also estimates that Scottsbluff County will continue to lose population at least until 2050

2. The anticipated drop in water usage from 1055.4 acre-feet to 641.4 acre-feet is attributable to the installation of water meters on individual homes and businesses. Previously only the municipal wells had flow meters. The result was an excessive use of water and no fiscal encouragement for conservation. Prior to the installation of household water meters usage in excess of 700 gallons per day were not unusual although 300 gallons per

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day was considered normal. The current predictions for water use are based on the usage patterns per household when water metering & conservation measures are implemented.

3. Each village plans to utilize their existing wells to irrigate their own parks. Lyman will convert one of their existing wells to supply non-potable water to an existing industry in town after the new well field is constructed and online.

4. M.C. Schaff evaluated current and projected groundwater use for the three villages. The results are summarized below;

Table III. Past water usage

Town	Water use millions of gallons	Water use Acre-feet	Water use Cubic feet
Lyman	7.58	232.6	10,132,056
Morrill	214.0	656.7	28,605,852
Henry	54.1	166.0	7,230,960
totals	343.9	1055.4	45,973,224

Table IV. Estimated future water usage, both non-industrial and non-irrigation

Town	Water use millions of gallons	Water use Acre-feet	Water use Cubic feet
Lyman	48.2	147.9	6,429,456
Morrill	109.5	336	14,636,160
Henry	18.6	51.1	1,225,916
totals	176.3	541.0	23,515,960

Table V. Estimated future water usage for Lyman both industrial and irrigation

Use	Water use millions of gallons	Water use Acre-feet	Water use Cubic feet
Industrial non-potable	12.8	39.3	1.711,908
Park irrigation	4.6	14.1	614,196
totals	17.4	53.4	2,326,104

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Table VI. Morrill and Henry Park Irrigation and Total Estimated Water Use

Use	Water use millions of gallons	Water use Acre-feet	Water use Cubic feet
Morrill	14.6	44.8	1,951,488
Henry	0.7	2.1	91,476
Total estimated water use for all sources	209.0	641.4	27,939,384

H. Map showing location of proposed wells, pipelines (exclusive of distribution lines) and the area of proposed use. The map shall be legible and at a scale of not less than one inch to the mile.

See attached map

I. Additional Ground Water Issues

§46-613.01 requires that the director of the Department of Natural Resources consider the following issues prior to issuing a Ground Water transfer Permit:

(1) The nature of the proposed use and whether it is a beneficial use of ground water;

The changeover from the current system of wells to the new well field will provide a more efficient distribution and use of potable ground water for the residents of Lyman, Morrill and Henry. It is a beneficial use in that it replaces current water supplies that fail to meet current drinking water quality standards with a new source that meets the current standards.

(2) The availability to the applicant of alternative sources of surface or ground water;

Alternative water sources available to the three villages include the Brule Formation and the North Platte River. The Brule consist of consolidated beds of siltstone with occasional layers of sandstone. Groundwater movement in this type of subsurface is principally through fractures. In the Brule these fractures are neither sufficiently extensive nor sufficiently uniform to provide a dependable long term water supply.

The final potential alternative source, the North Platte River, already has all of its water appropriated.

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Appendix A

Stagnation and Capture Zone Calculations

The equations used to calculate the stagnation point and the maximum width of the capture zone where taken from Applied Ground-Water Hydrology and Hydraulics, 2nd edition, Michael Kasenow, 2001

The equation for the stagnation point in an unconfined aquifer is: Stg pt.$=QL/(2\pi K(h^2_2-h^2_1)$)and the maximum width of the capture zone is: $W=2 * QL/(2K(h^2_2-h^2_1)$ where:

Q=pumping rate, in the case of the wellfield 144,396 ft^3/day

K=hydraulic conductivity, as determined by the Neuman method, 770 feet/day

The first hydraulic head used here was Well 1-174 feet, the second was Well 3-166 feet, Squared and the difference taken equals 2912. The distance between the two is 2790 feet.

The stagnation point is therefore at 61 feet downgradient and the maximum capture zone width is 385 feet.

All these numbers should be considered approximations.

Appendix B

Computation of Drawdowns

The equations used here were taken from Applied groundwater Hydrology and Well Hydraulics, 2[nd] ed., Michael Kaesnow, 2001

$\mu=r^2S/4Tt$ & $s=QW(\mu)/4\pi T$,

where r=distance from the well to a point

S=storativity, in the case of these calculations, specific yield was substituted,

T=transmissivity in feet^2/day

t=time in days

Q=pumping rate

W(μ)=(-0.5772-ln μ + μ -(μ ^2/(2*2!))+(μ ^3/(3*3!))-(μ ^4/(4*4!))

s=drawdown in feet

Drawdown calculations for time at 1,000 foot distance

Storativity	0.1973	0.1973	0.1973	0.1973
Transmissivity	130800	130800	130800	130800
Times	0.33	1	365	18250
Rates of Withdraw	144375	144375	144375	144375
Distance	1000	1000	1000	1000
u=(r²S)/(4Tt)	1.14273	0.37710	0.00103	2.07E-05
w(u)=(-0.5772-ln u+u-(u^2/(2*2!))+(u^3/(3*3	0.17078	0.74235	6.29896	10.2099
calculated for drawdown	24661.2	107193.	909545.	1474280
calculated for drawdown	1642848	1642848	1642848	1642848
Drawdown Confined	0.01501	0.06524	0.55364	0.89739
Unconfined Correction	0.01501	0.06526	0.55454	0.89977

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Drawdown calculations for distance for eight hours

Storativity	0.1973	0.1973	0.1973	0.1973	0.1973
Transmissivity	130800	130800	130800	130800	130800
Times	0.33	0.33	0.33	0.33	0.33
Rates of Withdraw	144396	144396	144396	144396	144396
Distances	1	10	100	1000	1337.44
Thickness	170	170	170	170	170
$u=(r^2S)/(4Tt)$	1.14E-06	0.000114	0.011427	1.142735	2.044062
w(u)=(-0.5772-ln u+u-(u^2/(2*2!))+(u^3/(3*3!))-(u^4/(4*4!))	13.10489	8.49983	3.905941	0.170789	1.46E-07
calculated for drawdown	1892293	1227342	564002.2	24661.22	0.021016
calculated for drawdown	1642848	1642848	1642848	1642848	1642848
Drawdown is =	1.151	0.747	0.343	0.015	0

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Appendix C

Aquifer Test Results

AQTESOLV for Windows

Data Set: \\schaffsbs\users\brothman\My Documents\Henry Well Field Model\Aquifer Test Results and Data\Neu
Date: 05/04/11
Time: 11:54:48

PROJECT INFORMATION

Company: PGE
Client: Towns of Henry, Lyman, Morrill
Location: [redacted]
Test Date: 1/4-6/2010
Test Well: Production Well

AQUIFER DATA

Saturated Thickness: 170. ft
Anisotropy Ratio (Kz/Kr): 0.1806

PUMPING WELL DATA

No. of pumping wells: 1

Pumping Well No. 1: Prod Well

X Location: 0. ft
Y Location: 0. ft

Casing Radius: 0.833 ft
Well Radius: 1. ft

Partially Penetrating Well
Depth to Top of Screen: 130. ft
Depth to Bottom of Screen: 170. ft

No. of pumping periods: 367

Pumping Period Data

Time (sec)	Rate (gal/min)	Time (sec)	Rate (gal/min)
0.	1420.	6.0E+4	1420.
0.251	1420.	6.36E+4	1420.
0.501	1420.	6.72E+4	1420.
0.751	1420.	7.08E+4	1420.
1.001	1420.	7.44E+4	1420.
1.251	1420.	7.8E+4	1420.
1.501	1420.	8.16E+4	1420.
1.939	1420.	8.52E+4	1420.
2.159	1420.	8.88E+4	1420.
2.382	1420.	9.24E+4	1420.
2.602	1420.	9.6E+4	1420.
3.079	1420.	9.96E+4	1420.
3.299	1420.	1.032E+5	1420.
3.52	1420.	1.068E+5	1420.
4.009	1420.	1.104E+5	1420.
4.228	1420.	1.14E+5	1420.
4.448	1420.	1.176E+5	1420.
4.67	1420.	1.212E+5	1420.
4.889	1420.	1.248E+5	1420.
5.152	1420.	1.284E+5	1420.
5.371	1420.	1.32E+5	1420.
5.589	1420.	1.356E+5	1420.
5.808	1420.	1.392E+5	1420.
6.027	1420.	1.428E+5	1420.
6.246	1420.	1.464E+5	1420.
6.466	1420.	1.5E+5	1420.

Time (sec)	Rate (gal/min)	Time (sec)	Rate (gal/min)
6.721	1420.	1.536E+5	1420.
7.14	1420.	1.572E+5	1420.
7.56	1420.	1.608E+5	1420.
7.98	1420.	1.644E+5	1420.
8.461	1420.	1.68E+5	1420.
9.	1420.	1.716E+5	1420.
9.48	1420.	1.716E+5	1435.
10.08	1420.	1.74E+5	1435.
10.68	1420.	1.74E+5	1435.
11.28	1420.	1.74E+5	1420.
11.94	1420.	1.74E+5	1420.
12.66	1420.	1.74E+5	1420.
13.44	1420.	1.74E+5	1420.
14.22	1420.	1.74E+5	1435.
15.06	1420.	1.74E+5	1435.
15.96	1420.	1.74E+5	1435.
16.92	1420.	1.74E+5	1435.
17.88	1420.	1.74E+5	1420.
18.96	1420.	1.74E+5	1420.
20.1	1420.	1.74E+5	1420.
21.3	1420.	1.74E+5	1420.
22.56	1420.	1.74E+5	1435.
23.88	1420.	1.74E+5	1435.
25.32	1420.	1.74E+5	1435.
26.82	1420.	1.74E+5	1435.
28.38	1420.	1.74E+5	1420.
30.06	1420.	1.74E+5	1420.
31.86	1420.	1.74E+5	1420.
33.72	1420.	1.74E+5	1420.
35.76	1420.	1.74E+5	1435.
37.86	1420.	1.74E+5	1435.
40.08	1420.	1.74E+5	1435.
42.48	1420.	1.74E+5	1435.
45.	1420.	1.74E+5	1420.
47.64	1420.	1.74E+5	1420.
50.46	1420.	1.74E+5	1420.
53.46	1420.	1.74E+5	1420.
56.64	1420.	1.74E+5	1435.
60.	1420.	1.74E+5	1435.
63.6	1420.	1.74E+5	1435.
67.2	1420.	1.74E+5	1435.
71.4	1420.	1.74E+5	1420.
75.6	1420.	1.74E+5	1420.
79.8	1420.	1.74E+5	1420.
84.6	1420.	1.74E+5	1420.
90.	1420.	1.74E+5	1435.
94.8	1420.	1.74E+5	1435.
100.8	1420.	1.74E+5	1435.
106.8	1420.	1.74E+5	1435.
112.8	1420.	1.74E+5	1420.
119.4	1420.	1.74E+5	1420.
126.6	1420.	1.74E+5	1420.
134.4	1420.	1.74E+5	1420.
142.2	1420.	1.74E+5	1435.
150.6	1420.	1.74E+5	1435.
159.6	1420.	1.74E+5	1435.
169.2	1420.	1.74E+5	1435.
178.8	1420.	1.74E+5	1420.
189.6	1420.	1.74E+5	1420.
201.	1420.	1.74E+5	1420.
213.	1420.	1.74E+5	1435.
225.6	1420.	1.74E+5	1435.

Time (sec)	Rate (gal/min)	Time (sec)	Rate (gal/min)
238.8	1420.	1.74E+5	1420.
253.2	1420.	1.74E+5	1420.
268.2	1420.	1.74E+5	1435.
283.8	1420.	1.74E+5	1435.
300.6	1420.	1.74E+5	1435.
318.6	1420.	1.74E+5	1420.
337.2	1420.	1.74E+5	1420.
357.6	1420.	1.74E+5	1435.
378.6	1420.	1.74E+5	1420.
400.8	1420.	1.74E+5	1420.
424.8	1420.	1.74E+5	1435.
450.	1420.	1.74E+5	1435.
476.4	1420.	1.74E+5	1435.
504.6	1420.	1.74E+5	1420.
534.6	1420.	1.74E+5	1420.
566.4	1420.	1.74E+5	1420.
600.	1420.	1.74E+5	1435.
636.	1420.	1.74E+5	1435.
672.	1420.	1.74E+5	1435.
714.	1420.	1.74E+5	1420.
756.	1420.	1.74E+5	1420.
798.	1420.	1.74E+5	1420.
846.	1420.	1.74E+5	1420.
900.	1420.	1.74E+5	1435.
948.	1420.	1.74E+5	1435.
1008.	1420.	1.74E+5	1435.
1068.	1420.	1.74E+5	1435.
1128.	1420.	1.74E+5	1420.
1194.	1420.	1.74E+5	1420.
1266.	1420.	1.74E+5	1420.
1344.	1420.	1.74E+5	1420.
1422.	1420.	1.74E+5	1435.
1506.	1420.	1.74E+5	1435.
1596.	1420.	1.74E+5	1435.
1692.	1420.	1.74E+5	1420.
1788.	1420.	1.74E+5	1420.
1896.	1420.	1.74E+5	1420.
2010.	1420.	1.74E+5	1435.
2130.	1420.	1.74E+5	1435.
2256.	1420.	1.74E+5	1435.
2388.	1420.	1.74E+5	1435.
2532.	1420.	1.74E+5	1435.
2682.	1420.	1.74E+5	1420.
2838.	1420.	1.74E+5	1420.
3006.	1420.	1.74E+5	1420.
3186.	1420.	1.74E+5	1420.
3372.	1420.	1.74E+5	1420.
3576.	1420.	1.74E+5	1435.
3786.	1420.	1.74E+5	1435.
4008.	1420.	1.74E+5	1435.
4248.	1420.	1.74E+5	1435.
4500.	1420.	1.74E+5	1420.
4764.	1420.	1.74E+5	1420.
5046.	1420.	1.74E+5	1420.
5346.	1420.	1.74E+5	1420.
5664.	1420.	1.74E+5	1420.
6000.	1420.	1.74E+5	1435.
6360.	1420.	1.74E+5	1435.
6720.	1420.	1.74E+5	1435.
7140.	1420.	1.74E+5	1435.
7560.	1420.	1.74E+5	1435.
7980.	1420.	1.74E+5	1420.

Time (sec)	Rate (gal/min)	Time (sec)	Rate (gal/min)
8460.	1420.	1.74E+5	1420.
9000.	1420.	1.74E+5	1420.
9480.	1420.	1.74E+5	1435.
1.008E+4	1420.	1.74E+5	1435.
1.068E+4	1420.	1.74E+5	1420.
1.128E+4	1420.	1.74E+5	1420.
1.194E+4	1420.	1.74E+5	1435.
1.266E+4	1420.	1.74E+5	1435.
1.344E+4	1420.	1.74E+5	1420.
1.422E+4	1420.	1.74E+5	1420.
1.506E+4	1420.	1.74E+5	1435.
1.596E+4	1420.	1.74E+5	1435.
1.692E+4	1420.	1.74E+5	1420.
1.788E+4	1420.	1.74E+5	1420.
1.896E+4	1420.	1.74E+5	1435.
2.01E+4	1420.	1.74E+5	1435.
2.13E+4	1420.	1.74E+5	1420.
2.256E+4	1420.	1.74E+5	1420.
2.388E+4	1420.	1.74E+6	1435.
2.532E+4	1420.	1.74E+5	1435.
2.682E+4	1420.	1.74E+5	1420.
2.838E+4	1420.	1.74E+5	1435.
3.006E+4	1420.	1.74E+5	1420.
3.186E+4	1420.	1.74E+5	1420.
3.372E+4	1420.	1.74E+5	1435.
3.576E+4	1420.	1.74E+5	1420.
3.786E+4	1420.	1.74E+5	1435.
4.008E+4	1420.	1.74E+5	1435.
4.248E+4	1420.	1.74E+5	1420.
4.5E+4	1420.	1.74E+5	1435.
4.764E+4	1420.	1.74E+5	1420.
5.046E+4	1420.	1.74E+5	1435.
5.346E+4	1420.	1.74E+5	1420.
5.664E+4	1420.		

OBSERVATION WELL DATA

No. of observation wells: 1

Observation Well No. 1: OB1

X Location: 0. ft
Y Location: 40. ft

Radial distance from Prod Well: 40. ft

Partially Penetrating Well
Depth to Top of Screen: 70. ft
Depth to Bottom of Screen: 170. ft

No. of Observations: 185

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
900.	1.11	8.46E+4	1.46
1800.	1.14	8.55E+4	1.47
2700.	1.17	8.64E+4	1.47
3600.	1.16	8.73E+4	1.46
4500.	1.18	8.82E+4	1.45
5400.	1.19	8.91E+4	1.44
6300.	1.19	9.0E+4	1.47
7200.	1.21	9.09E+4	1.47

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Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
8100.	1.22	9.18E+4	1.46
9000.	1.23	9.27E+4	1.47
9900.	1.24	9.36E+4	1.47
1.08E+4	1.26	9.45E+4	1.46
1.17E+4	1.26	9.54E+4	1.47
1.26E+4	1.26	9.63E+4	1.46
1.35E+4	1.27	9.72E+4	1.48
1.44E+4	1.28	9.81E+4	1.47
1.53E+4	1.29	9.9E+4	1.47
1.62E+4	1.29	9.99E+4	1.47
1.71E+4	1.3	1.008E+5	1.47
1.8E+4	1.3	1.017E+5	1.47
1.89E+4	1.31	1.026E+5	1.47
1.98E+4	1.31	1.035E+5	1.45
2.07E+4	1.31	1.044E+5	1.48
2.16E+4	1.32	1.053E+5	1.46
2.25E+4	1.32	1.062E+5	1.48
2.34E+4	1.33	1.071E+5	1.48
2.43E+4	1.33	1.08E+5	1.46
2.52E+4	1.33	1.089E+5	1.46
2.61E+4	1.34	1.098E+5	1.49
2.7E+4	1.34	1.107E+5	1.46
2.79E+4	1.35	1.116E+5	1.48
2.88E+4	1.35	1.125E+5	1.48
2.97E+4	1.35	1.134E+5	1.48
3.06E+4	1.35	1.143E+5	1.48
3.15E+4	1.36	1.152E+5	1.47
3.24E+4	1.36	1.161E+5	1.47
3.33E+4	1.37	1.17E+5	1.47
3.42E+4	1.36	1.179E+5	1.47
3.51E+4	1.37	1.188E+5	1.48
3.6E+4	1.36	1.197E+5	1.48
3.69E+4	1.37	1.206E+5	1.49
3.78E+4	1.37	1.215E+5	1.49
3.87E+4	1.38	1.224E+5	1.48
3.96E+4	1.37	1.233E+5	1.49
4.05E+4	1.38	1.242E+5	1.46
4.14E+4	1.39	1.251E+5	1.47
4.23E+4	1.39	1.26E+5	1.46
4.32E+4	1.39	1.269E+5	1.49
4.41E+4	1.39	1.278E+5	1.48
4.5E+4	1.39	1.287E+5	1.47
4.59E+4	1.4	1.296E+5	1.49
4.68E+4	1.4	1.305E+5	1.49
4.77E+4	1.4	1.314E+5	1.5
4.86E+4	1.39	1.323E+5	1.48
4.95E+4	1.41	1.332E+5	1.46
5.04E+4	1.42	1.341E+5	1.47
5.13E+4	1.41	1.35E+5	1.47
5.22E+4	1.42	1.359E+5	1.47
5.31E+4	1.42	1.368E+5	1.48
5.4E+4	1.43	1.377E+5	1.48
5.49E+4	1.41	1.386E+5	1.47
5.58E+4	1.42	1.395E+5	1.48
5.67E+4	1.42	1.404E+5	1.47
5.76E+4	1.42	1.413E+5	1.48
5.85E+4	1.43	1.422E+5	1.47
5.94E+4	1.43	1.431E+5	1.47
6.03E+4	1.43	1.44E+5	1.49
6.12E+4	1.43	1.449E+5	1.47
6.21E+4	1.43	1.458E+5	1.47
6.3E+4	1.43	1.467E+5	1.48

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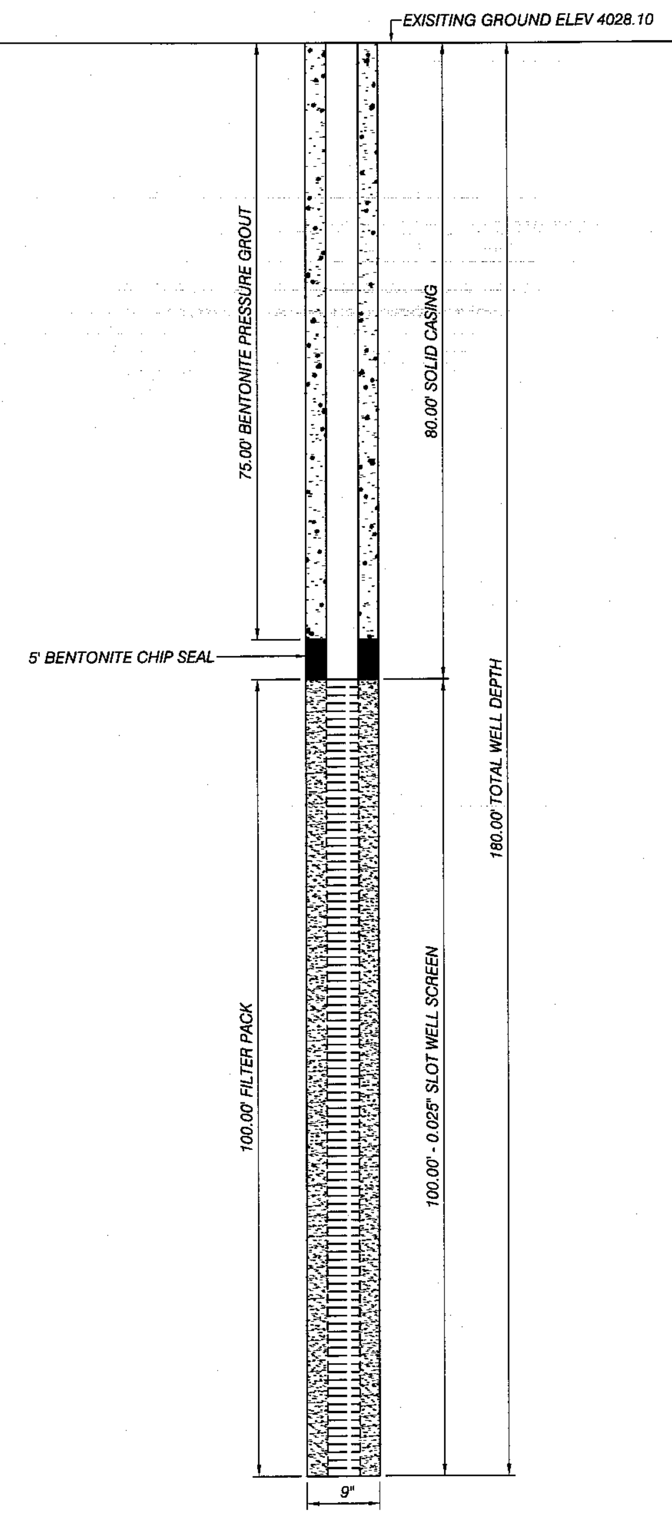
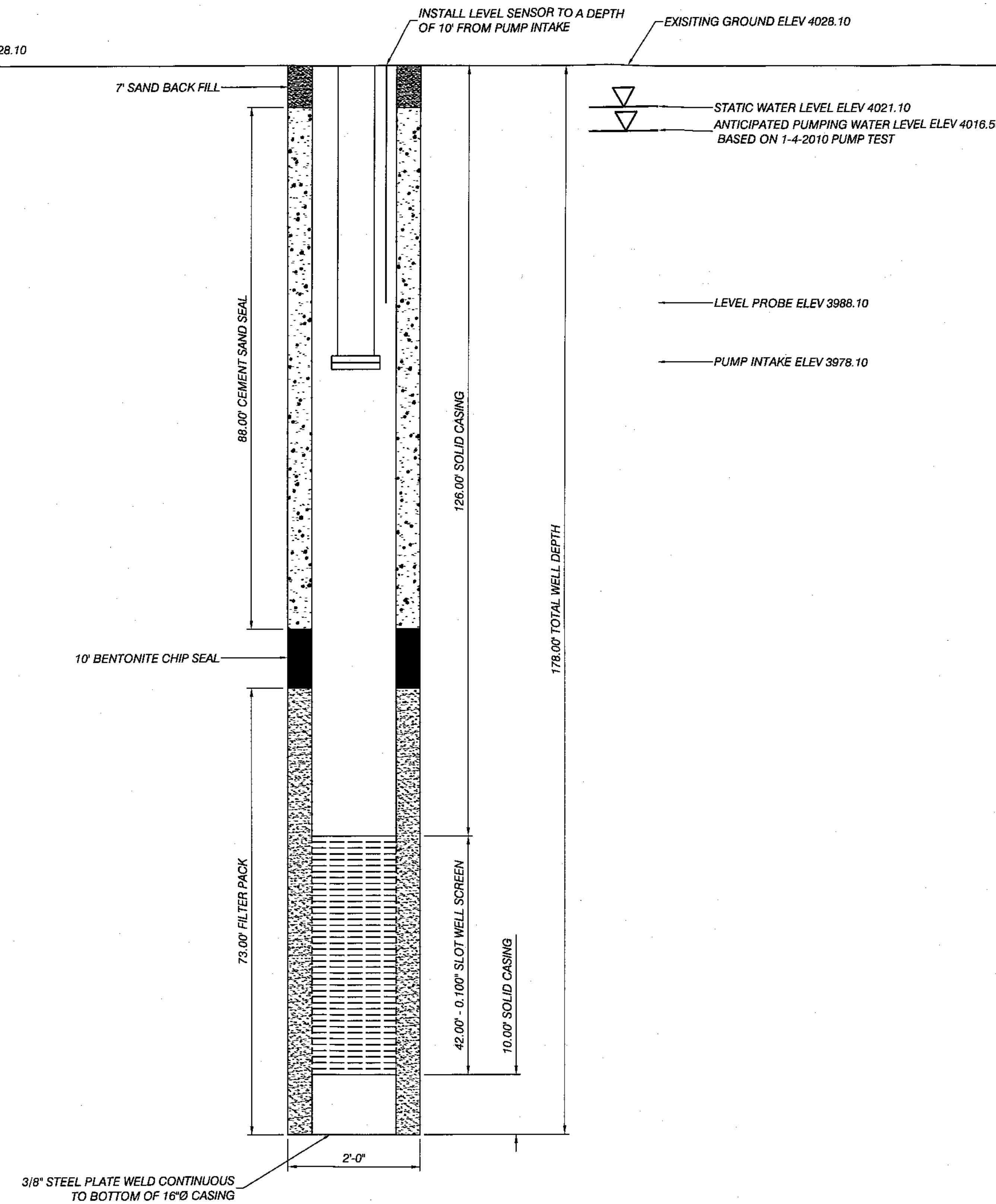


OBSERVATION WELL NO. 1 DETAIL - AS BUILT

NOT TO SCALE



PRODUCTION CASING NO. 1 DETAIL - AS BUILT

NOT TO SCALE

M. C. SCHAFF & ASSOCIATES, INC.
818 SOUTH BELTLINE HIGHWAY EAST
SCOTTSBLUFF, NEBRASKA 69361
ENGINEERS ♦ PLANNERS ♦ DESIGNERS ♦ LAND SURVEYORS
PH: 308-635-1926 FAX: 308-635-7807 INTERNET: WWW.MCSCHAFF.COM

PROJECT: WESTERN NEBRASKA REGIONAL WATER SYSTEM WELLFIELD IMPROVEMENTS WELL NO. 1 DETAILS

CLIENT: WNJWB

PROJECT NUMBER: 1SC072001
PROJECT DATE: 04/01/2011
PROJECT MGR: F.A.S.
PROJECT TEAM:

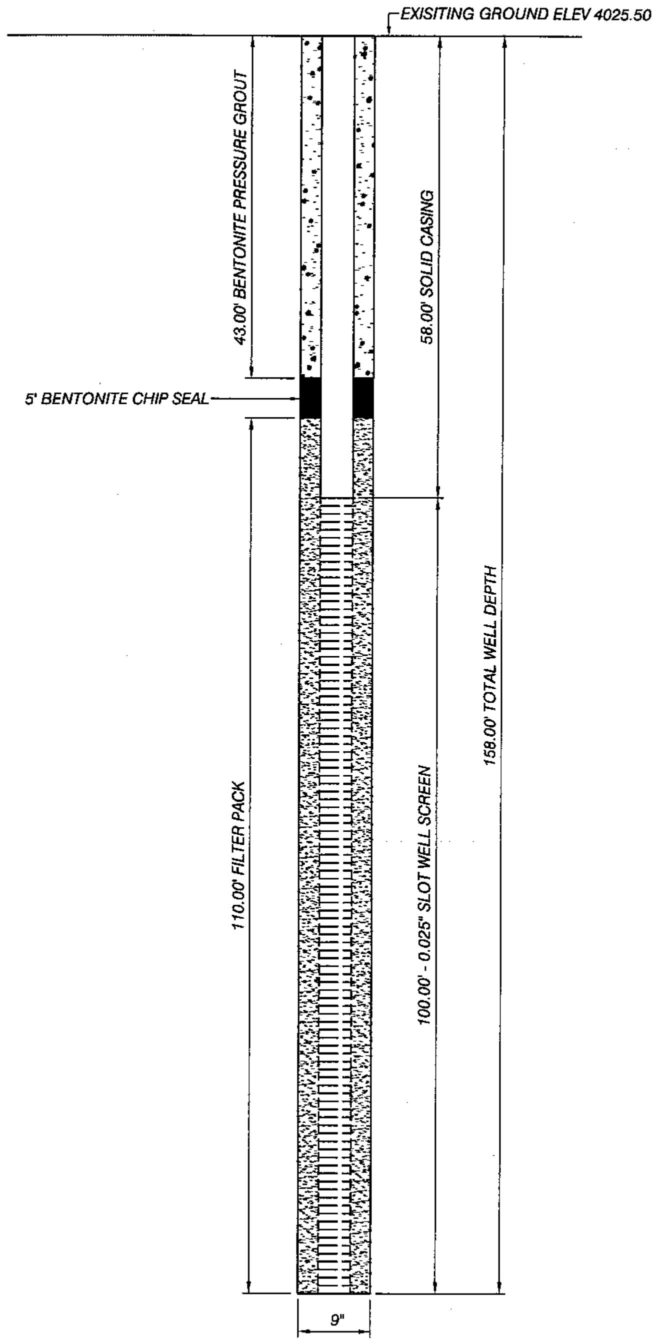
PROFESSIONAL ENGINEER
FRANK A. STRONG IV
E-11218
STATE OF NEBRASKA
SEAL

DATE	REVISION

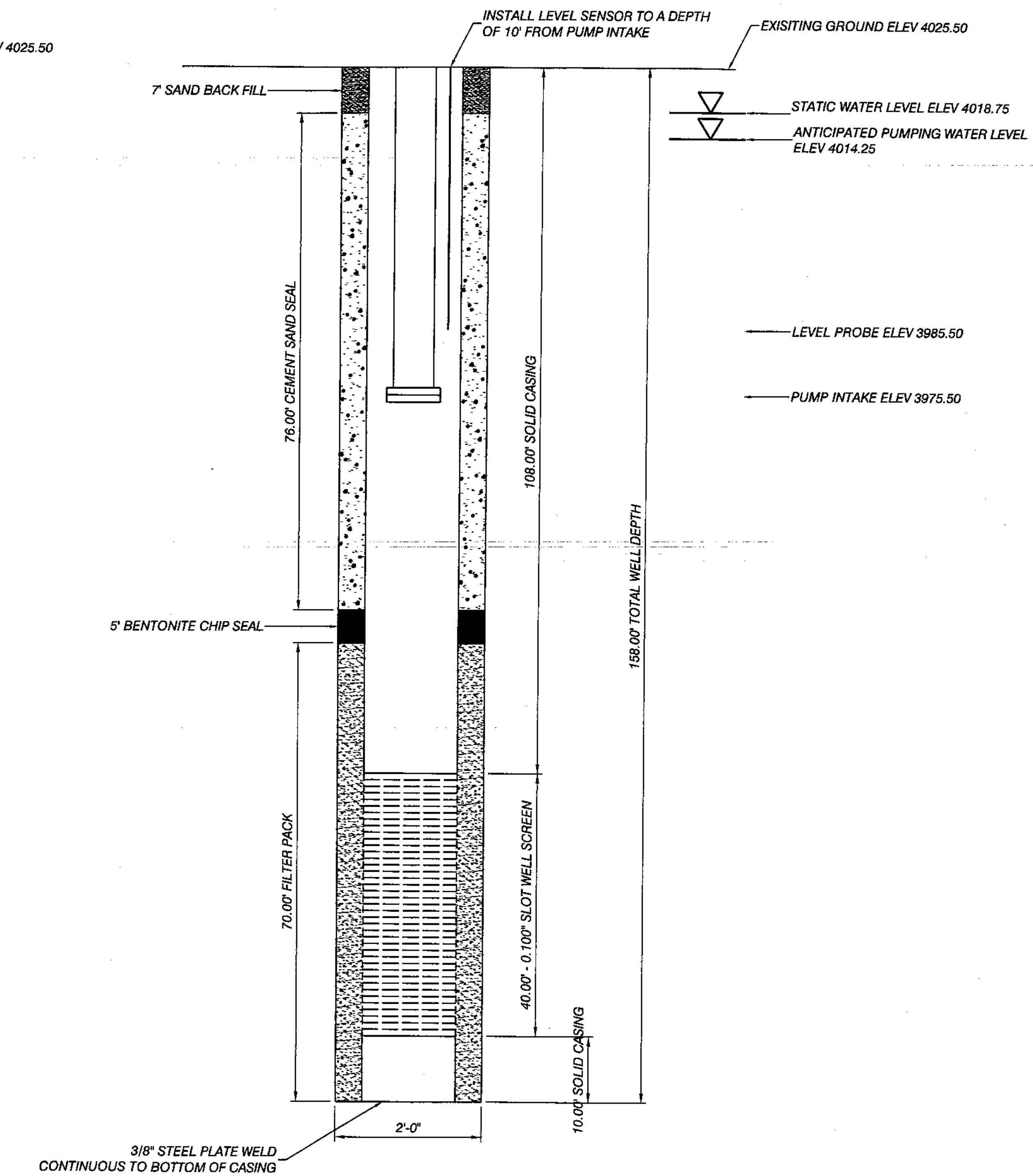
SHEET 10 OF 15

D-4

MAY 1 3 2011



OBSERVATION WELL NO. 2 DETAIL - AS BUILT
NOT TO SCALE



PRODUCTION CASING NO. 2 DETAIL
NOT TO SCALE

NOTES

THE CONTRACTOR SHALL PLACE CASING CENTRALIZES AT THE CASING JOINTS.

THE FILTER PACK SHALL BE 1/8 x 1/4 AND SHALL MEET THE FOLLOWING GRADATION WITHIN ±5%:

SIEVE	% RETAINED
3/8	0
4	65
8	97
16	99
30	99
50	99
100	99
200	99

THE CASING SHALL BE 16" DIAMETER X 0.375" STEEL WITH MINIMUM WEIGHT OF 54.57 LB/FT.

THE SCREEN SHALL BE 100 SLOT HIGH FLOW STAINLESS STEEL WIRE WRAP SCREEN WITH A MINIMUM OPEN AREA OF 266 SQUARE INCHES PER FOOT OF SCREEN.

BENTONITE CHIPS SHALL BE SCREENED WITH A 1/4" SIEVE TO REMOVE ALL FINES PRIOR TO PLACEMENT.

GROUND ELEVATION OF TEST HOLE AND PRODUCTION CASING IS 4026.0

TEST WELL WAS CONSTRUCTED ON NOVEMBER 12, 2009.

THE TEST WELL SIZE WAS A 9" DIAMETER PILOT HOLE WITH A TOTAL DEPTH OF 158'. A 0.025" SLOTTED 4" SDR-17 PVC SCREEN WAS INSTALLED AS SHOWN ON THE OBSERVATION WELL DIAGRAM.

THE ANTICIPATED WELL PRODUCTION IS 700 GPM AND THE PRODUCTION CASING SHALL BE TEST PUMPED AT 1400 GPM.

THE ANTICIPATED PUMP SIZE IS 10" AND THE ANTICIPATED COLUMN PIPE SIZE IS 6".

WELL LOG PREPARED BY SARGENT DRILLING CO.

Depth	Description
0-2	Topsoil
2-12	Coarse Sand
12-18	Medium Gravel
18-40	Medium Gravel, Coarse Gravel
40-60	Medium Gravel
60-120	Medium Gravel, Coarse Gravel
120-158	Coarse Gravel
158-160	Clay
160-180	Shale

M. C. SCHAFF & ASSOCIATES, INC.
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PH: 308-635-1926 FAX: 308-635-7807 INTERNET: WWW.MCSCHAFF.COM

PROJECT: WESTERN NEBRASKA REGIONAL WATER SYSTEM WELLFIELD IMPROVEMENTS WELL NO. 2 DETAILS

CLIENT: WNJWB

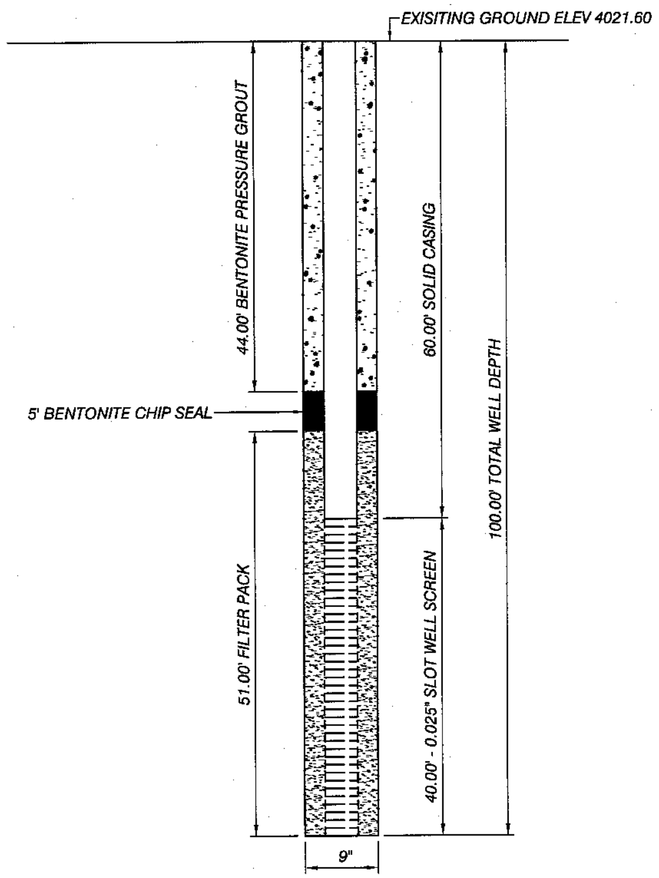
PROJECT NUMBER: 1SC072001
PROJECT DATE: 04/01/2011
PROJECT MGR: FAS
PROJECT TEAM:

PROFESSIONAL ENGINEER
FRANK A. STRONG IV
E-11218
STATE OF NEBRASKA

DATE	REVISION

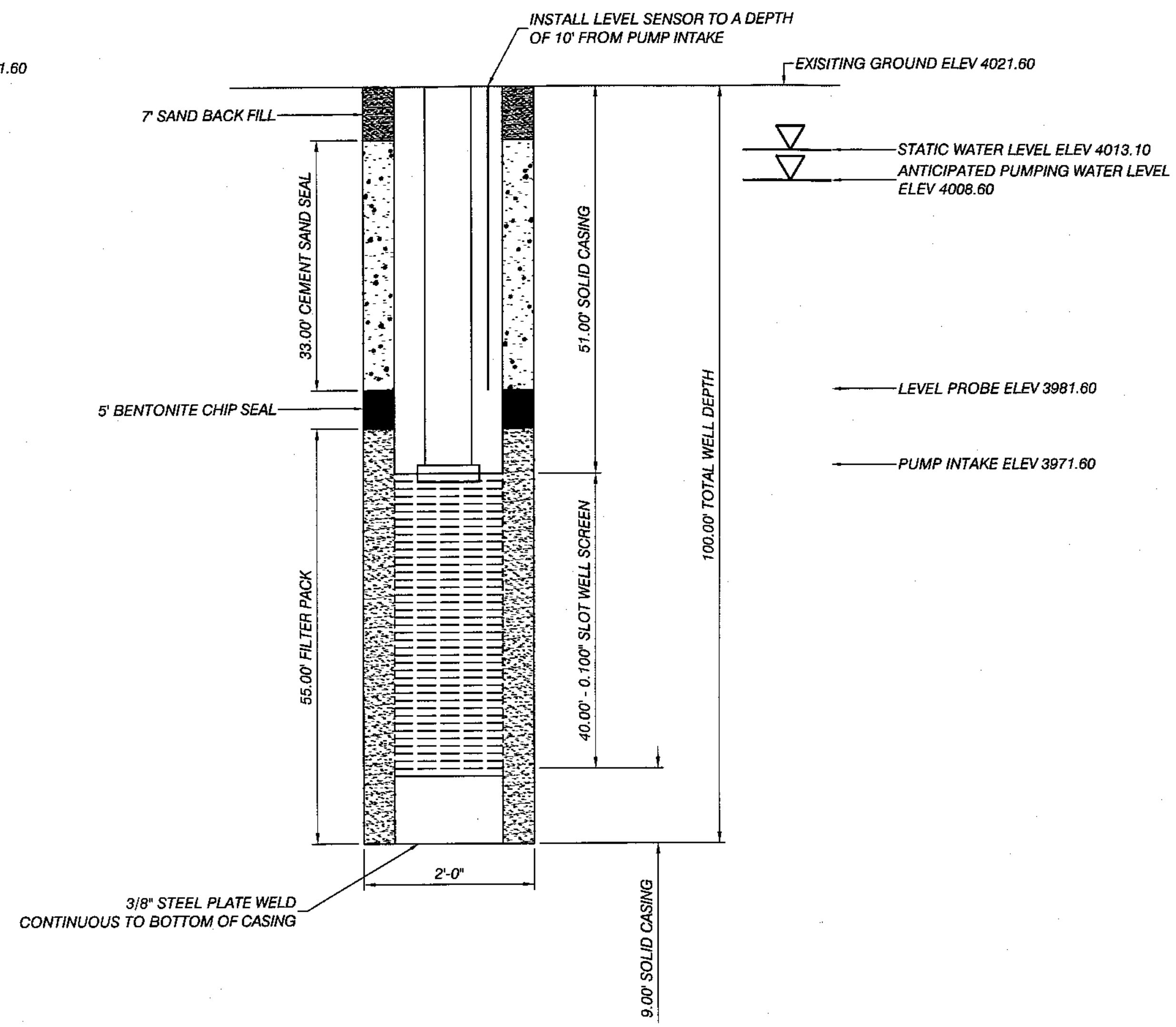
SHEET 11 OF 15
D-5

MAY 13 2011



OBSERVATION WELL NO. 3 DETAIL - AS BUILT

NOT TO SCALE



PRODUCTION CASING NO. 3 DETAIL

NOT TO SCALE

NOTES

THE CONTRACTOR SHALL PLACE CASING CENTRALIZES AT THE CASING JOINTS.

THE FILTER PACK SHALL BE 1/8 x 1/4 AND SHALL MEET THE FOLLOWING GRADATION WITHIN ±5%:

SIEVE	% RETAINED
3/8	0
4	65
8	97
16	99
30	99
50	99
100	99
200	99

THE CASING SHALL BE 16" DIAMETER X 0.375" STEEL WITH MINIMUM WEIGHT OF 54.57 LB/FT.

THE SCREEN SHALL BE 100 SLOT HIGH FLOW STAINLESS STEEL WIRE WRAP SCREEN WITH A MINIMUM OPEN AREA OF 266 SQUARE INCHES PER FOOT OF SCREEN.

BENTIONITE CHIPS SHALL BE SCREENED WITH A 1/4" SIEVE TO REMOVE ALL FINES PRIOR TO PLACEMENT.

GROUND ELEVATION OF TEST HOLE AND PRODUCTION CASING IS 4022.0

TEST WELL WAS CONSTRUCTED ON NOVEMBER 5, 2009.

THE TEST WELL SIZE WAS A 9" DIAMETER PILOT HOLE WITH A TOTAL DEPTH OF 100'. A 0.025" SLOTTED 4" SDR-17 PVC SCREEN WAS INSTALLED AS SHOWN ON THE OBSERVATION WELL DIAGRAM.

THE ANTICIPATED WELL PRODUCTION IS 700 GPM AND THE PRODUCTION CASING SHALL BE TEST PUMPED AT 1400 GPM.

THE ANTICIPATED PUMP SIZE IS 10" AND THE ANTICIPATED COLUMN PIPE SIZE IS 6".

WELL LOG PREPARED BY SARGENT DRILLING CO.

Depth	Description
0-2	Topsoil
2-8	Coarse Sand
8-40	Medium Gravel, Coarse Gravel
40-60	Coarse Gravel
60-100	Medium Gravel, Coarse Gravel

M. C. SCHAFF & ASSOCIATES, INC.
818 SOUTH BELTLINE HIGHWAY EAST
SCOTTSBLUFF, NEBRASKA 69361
ENGINEERS ◆ PLANNERS ◆ DESIGNERS ◆ LAND SURVEYORS
PH: 308-635-1926 FAX: 308-635-7807 INTERNET: WWW.MCSCHAFF.COM

PROJECT: WESTERN NEBRASKA REGIONAL WATER SYSTEM WELLFIELD IMPROVEMENTS WELL NO. 3 DETAILS

CLIENT: WNJWB

PROJECT NUMBER: 1SC072001
PROJECT DATE: 04/01/2011
PROJECT MGR: F.A.S.
PROJECT TEAM: B.M.S./D.H.

PROFESSIONAL ENGINEER
FRANK A. STRONG IV
E-11218
STATE OF NEBRASKA

DATE	REVISION

SHEET 12 OF 15

D-6

MAY 13 2011

NORTH PLATTE
Natural Resources District
P.O. Box 280 Scottsbluff, NE 69363-0280 Phone: 308-632-2749 Fax: 308-632-4346

MEMORANDUM

TO: FILE

FROM: Thad Kuntz

REVIEWED BY: Dick Luckey – High Plains Hydrology, LLC

CC:

FILE: LHM Project

DATE: December 6, 2009

RE: Analysis of Impacts to Existing Water Users by the Villages of Lyman, Henry, and Morrill Well Field Consolidation

INTRODUCTION

The Villages of Lyman, Henry, and Morrill have joined together to form the Western Nebraska Water Board and are planning to develop a new well field (three 750 gallon per minute wells) in one central location for their potable water supply. The Water Board has applied to drill one of the three new wells located north of Lyman just south of the North Platte River (Figure 1). Also the Water Board has purchased a 140 acre pivot and they intend to retire 47 certified acres for the new well field location (Attachment 1).

The existing Village wells will be converted to a non-potable use for irrigation of parks and will be pumped at a reduced rate after completion of the new well field.

This analysis was based on the report provided to NPNRD by M.C. Schaff & Associates on October 21, 2009 (Attachment 1).

ESTIMATED FUTURE WATER USE OF EXISTING AND PROPOSED WELLS

Table 1 shows the current and estimated future total water use of the existing wells in each Village and the estimated water use with the proposed well field.

Table 1
Current and Estimated Future Usage

Well Name	Current Usage (Acre-Feet/Year)	Estimated Future Usage (Acre-Feet/Year)	Estimated Change in Future Usage (Acre-Feet/Year)
Total Lyman Wells Water Use	232.6	53.4	-179.2
Total Morrill Wells Water Use	656.7	44.8	-611.9
Total Henry Wells Water Use	166.0	2.1	-163.9
Total Proposed Wells Water Use	0.0	541.0	541.0
Retirement of 45 Acres at 14.1 Inches per Acre	55.2	0.0	-55.2
Total Usage	1110.5	641.3	-469.2

Note: Negative change values represent reduction of water use. The reduction is partially due to each Village adding meters to existing customers.

STREAM FLOW DEPLETION/ACCRETION ANALYSIS TO THE NORTH PLATTE RIVER

The existing and proposed wells are within the North Platte River alluvium. As seen on Figure 1, the proposed well field will be located north of Lyman, NE and just south of the North Platte River and Farmers Irrigation Canal diversion.

A North Platte River impact analysis was completed using the existing COHYST Western Model Unit (WMU) ground water model and the external zone budget program. The zone budget analysis was completed to determine the impacts to the river between the diversion points along the North Platte River. Table 2 explains the zones and Figure 1 shows the areal extent of the zones.

Table 2
Zone Budget Explanation

Zone	Beginning Diversion Point	Ending Diversion Point
Zone 1	Western Model Boundary	Mitchell Gering Canal
Zone 2	Mitchell Gering Canal	Farmers Canal
Zone 3	Farmers Canal	Enterprise Canal
Zone 4	Enterprise Canal	Eastern Model Boundary

The model was run for 50 years using 100 stress periods. The stress periods include pumping season (May through September) and non-pumping seasons (October through April). Each pumping season has 5 time steps which represents 5 months of pumping. Each non-pumping season has 7 time steps which represents 7 months of non-pumping. Each year is 365.25 days to account for the extra day in a leap year.

Water use from the existing wells will be reduced significantly when the new well field is completed. The reduction in water use is simulated with injection wells and have a yearly rate equal to the difference between current and estimated future usage (Current – Future = Injection Rate). Due to the limited information of individual well pumping amounts for each year, the total amounts pumped by all Village wells were split among individual wells to estimate pumping amounts. The increase in water use from the proposed wells is simulated with pumping wells in the model and split among all three wells. Table 3 is a list of the model cell locations of each well and the model yearly pumping totals for each.

Table 3
Model Pumping Locations and Amounts

Well	Model Location (Row, Column)	Pumping Amounts (Acre-Feet/Year)
Lyman Well No. 1	85 , 18	-44.8
Lyman Well No. 2	84 , 17	-44.8
Lyman Well No. 3	84 , 18	-44.8
Lyman Well No. 4	83 , 18	-44.8
Morrill Grade School Well	78 , 30	-204.0
Morrill Steen Well	79 , 31	-204.0
Morrill Trailer Park Well	78 , 29	-204.0
Henry Fire Hall and Park Wells	73 , 18	-163.9
Proposed Well No. 1	76 , 18	161.9
Proposed Well No. 2	77 , 19	161.9
Proposed Well No. 3	76 , 19	161.9

Note: The pumping amounts for the proposed wells have been reduced by the amount of retired consumptive use. (Proposed Pumping – Retired Consumptive Use = Actual Proposed Pumping) The above sums may be different than in the model due to rounding.

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To allow for easier calculation of stream flow depletions and accretions using the additional pumping amounts shown in Table 3, the existing model pumping was simulated using the MODFLOW Recharge Package rather than the MODFLOW Well Package. The pumping and non-pumping conditions represent the 1998 pumping and non-pumping seasons respectively. All other model packages were not modified from the COHYST WMU. These two 1998 stress periods were repeated 50 times to obtain 50 years of modeling data or data from May 1, 2010 to April 20, 2060.

RESULTS

To calculate the stream flow depletions and accretions to the North Platte River, the three following models were run for 50 years:

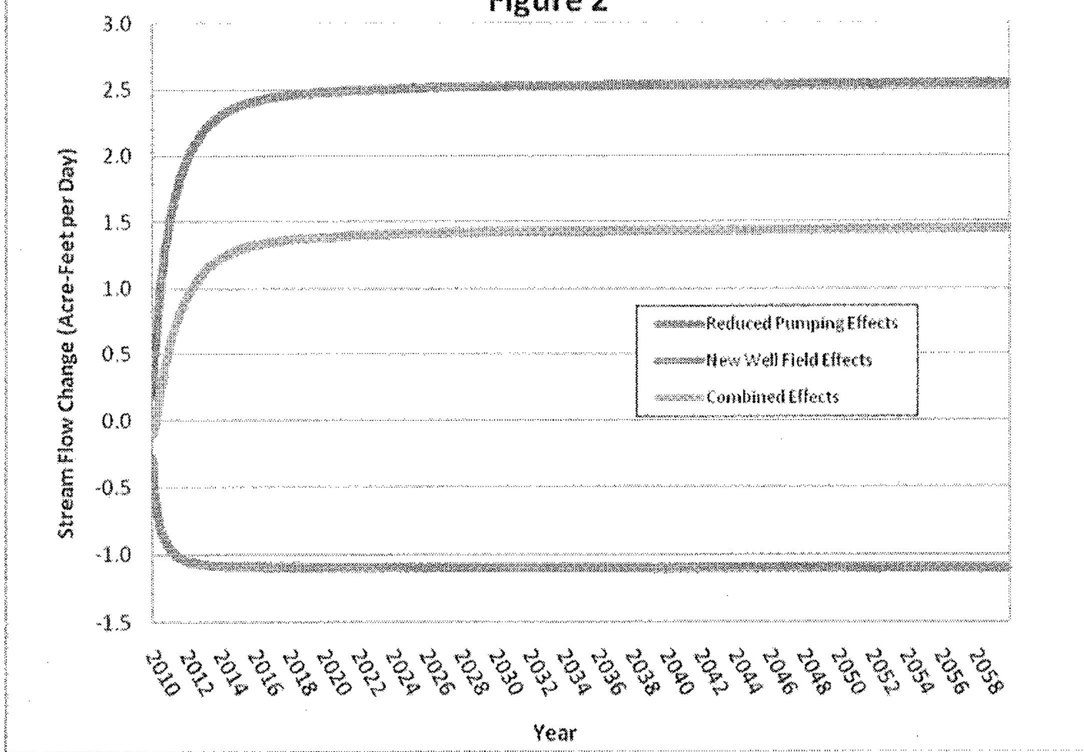
- A model without any changes in pumping (Baseline Run).
- A model with new injection wells which represents the reduction in pumping (Injection Run).
- A model with the new pumping which represents the proposed well field (Pumping Run).

The calculations were based on the cumulative model outputs per stress period for the following components: ground water storage, wells, rivers, streams, head dependent boundaries (HDB), drains, recharge, and evapotranspiration (ET). The rivers (mainstem of the North and South Platte Rivers), streams (tributaries to North and South Platter Rivers), HDB (Lake McConaughy), and drains were added together to calculate stream flow change. The cumulative impacts were divided by the total days in the each time step to obtain a rate. Then the following calculations were completed on the entire model and each zone in order to determine impacts to the surface water system, ET, and ground water storage:

- Injection Run – Baseline Run = Impacts from Reduced Pumping
- Pumping Run – Baseline Run = Impacts from Proposed Well Field
- Impacts from Reduced Pumping + Impacts from Proposed Well Field = Net Impact to the North Platte River, including tributaries

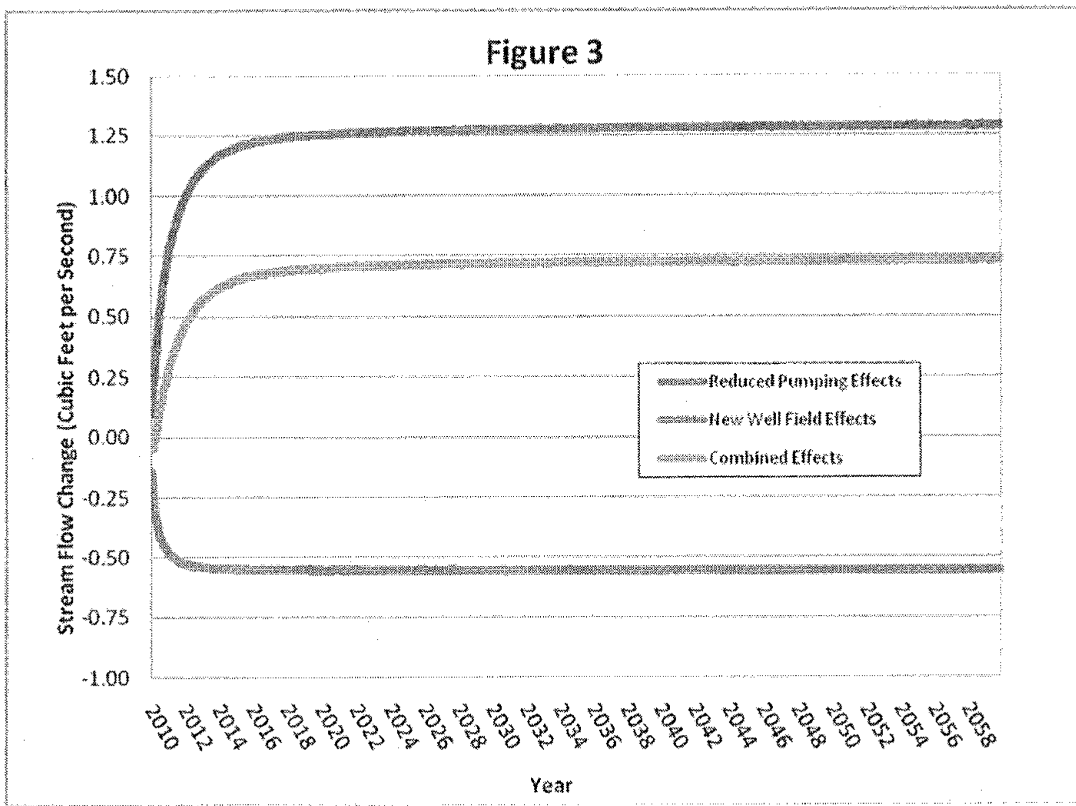
Figure 2 shows the cumulative impacts to the entire North Platte River in Acre-Feet per Day.

Figure 2



MAY 13 2011

Figure 3 shows the cumulative impacts to the entire North Platte River in Cubic Feet per Day.



For impacts to the river in each zone refer to Appendix A.

Figure 2 and Figure 3 show the maximum negative stream flow change to the North Platte River begin in 2012 and are around 1.1 Acre-Feet per Day (0.6 Cubic Feet per Second). The impacts from existing wells are spread over a larger areal extent and are farther from the river. This slows the positive stream flow change to the North Platte River which is represented by a longer response curve which reaches a maximum of 2.5 Acre-Feet per Day (1.3 Cubic Feet per Second) beginning around 2017. The combined stream flow change on the North Platte River from the injection and pumping is positive and reaches a maximum of about 1.4 Acre-Feet per Day (0.7 Cubic Feet per Second) beginning around 2017.

Table 4 summarizes the change in surface water components, ET, and ground water storage divided by the total water injected or pumped. Snapshots of the outputs from the model were taken in 2011, 2020, and 2060.

Table 4

Reduced Pumping Effects				
Year	Increase in Stream Flow	Increase in ET	Increase in Ground Water Storage	Total
2011	35%	1%	64%	100%
2020	82%	2%	16%	100%
2060	94%	2%	4%	100%
New Well Field Effects				
Year	Decrease in Stream Flow	Decrease in ET	Decrease in Ground Water Storage	Total
2011	-55%	-11%	-34%	-100%
2020	-78%	-16%	-5%	-100%
2060	-82%	-17%	-1%	-100%

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Table 4 shows that the changes to the stream flow increase as time increases and impacts to ground water storage decrease as time increases. The impacts in the model ET when water is injected to the aquifer show a maximum of a 2 percent increase due to the small increase in water level over the entire model which results in an increase in riparian ET. The change to simulated ET when water is pumped from the proposed well field shows a maximum of 17 percent ET salvage or reduction in water level near the proposed well field that negatively impact riparian ET.

MODEL ERRORS AND LIMITATIONS

The COHYST WMU ground water flow model used in this analysis is not a perfect representation of the natural system; however it is thought to be a reasonable representation of it. The model was constructed using the current understanding of the natural system at the time and it is calibrated using measured water levels and estimated long-term average groundwater flow to streams. The calibration indicated that the model is a reasonable representation of the natural system.

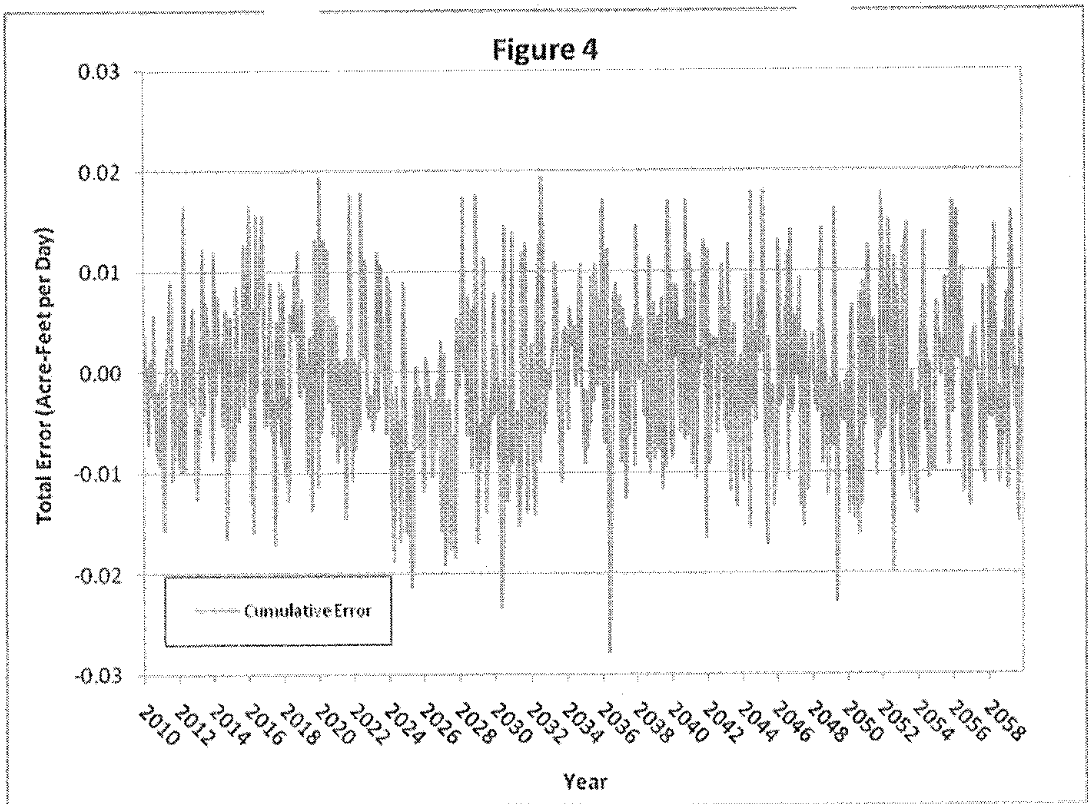
The model uses numerical techniques to simultaneously solve the groundwater flow equation at each of the approximately 45,000 active model cells. The solution is not perfect, so it is possible in the model to create or destroy water. To measure the closure of the solution, a water budget was computed at the end of each time step. If the water budget closed within reasonable tolerances, the solution is thought to be reasonable. The error in the water budget is a measure of how much water is created or destroyed in the model.

The error in the baseline water budget ranged from 1.384 acre-feet per day to 7.502 acre-feet per day and averaged 4.429 acre-feet per day. The error in the injection water budget ranged from 1.388 acre-feet per day to 7.505 acre-feet per day and averaged 4.431 acre-feet per day. The error in the pumping water budget ranged from 1.381 acre-feet per day to 7.502 acre-feet per day and averaged 4.427 acre-feet per day. All of these errors were a fraction of 1% of the inflows and outflows in the model.

The same mass balance errors probably occur in the baseline simulation, the injection simulation, and the pumping simulation over much of the model area and these errors are not related to the new injection or pumping wells. To estimate the model errors due to the new injection or pumping wells, the baseline water budget was subtracted from the injection water budget or the pumping water budget on a time-step by time-step basis. Table 5 shows the minimum, maximum, and average water budget range.

TABLE 5			
DIFFERENCE IN WATER BUDGETS (Acre-Feet per Day)			
Run	**Minimum**	**Maximum**	**Average**
Injection	-0.018	+0.020	0.002
Pumping	-0.015	+0.009	-0.002
Cumulative	-0.028	+0.019	-0.001

These errors are several orders of magnitude smaller than the new or reduced pumping at the well fields, indicating that they have a negligible effect on the results. The cumulative error was added together to show the total error of the injection and pumping (Figure 4). Appendix B shows the errors associated with the injection and pumping.



As the understanding of the ground water flow system improves in the future, the model may change and simulated results may change. Changes in simulated aquifer properties could change the timing of simulated depletions or accretions to the river. However, all the well fields are very close to the river which causes the simulated effects to stabilize in just a few years, and this is unlikely to change.

The Results section indicated some decrease in riparian ET due to pumping from the new well field (ET salvage). Simulation of riparian ET in this analysis was done using the standard method that has been used in the COHYST modeling.

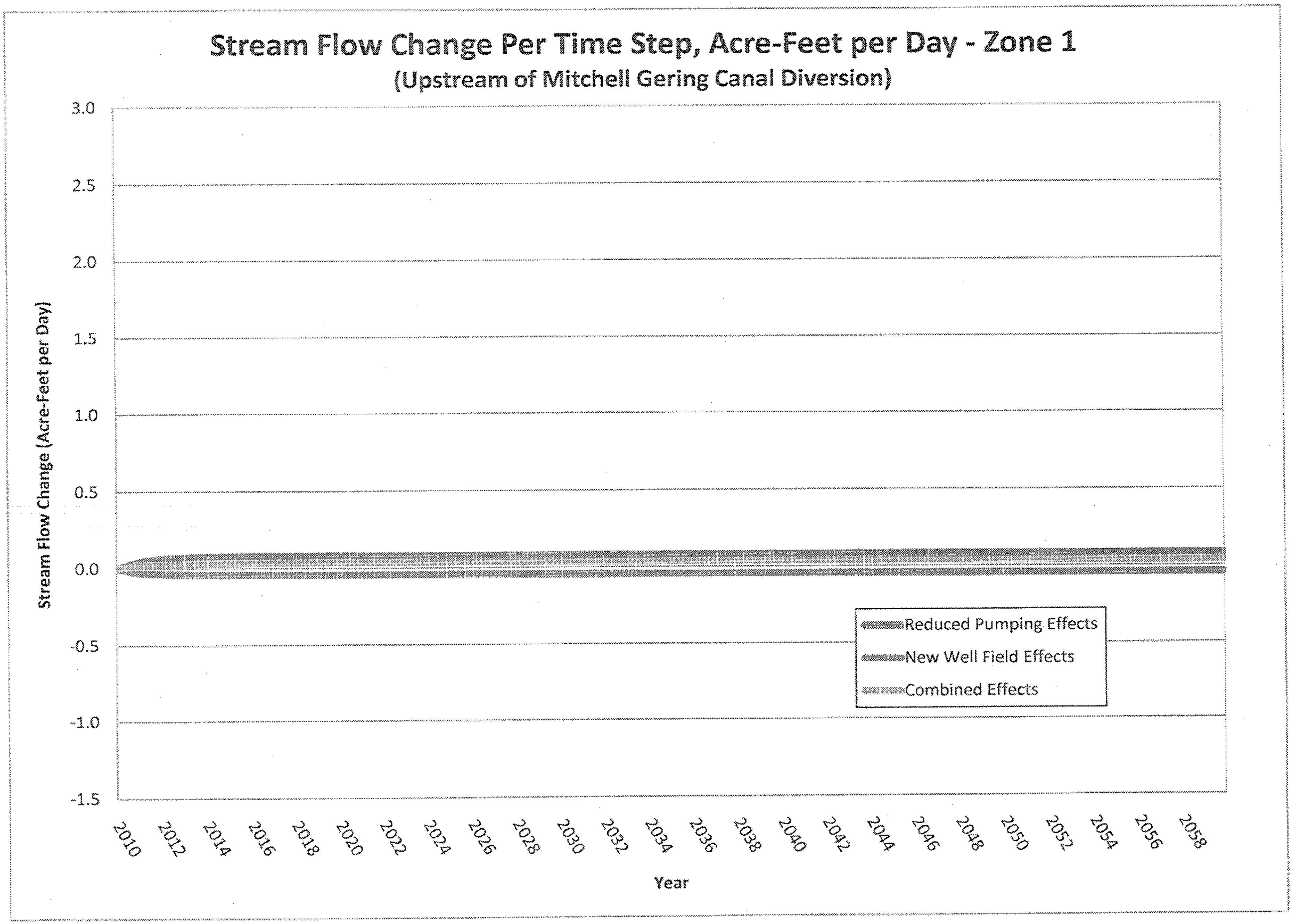
Other changes in the model in the future, such as changing simulated recharge or adding supplemental pumpage in surface-water irrigated areas, are not likely to have substantial effects in this analysis to the change in stream flow from the changes in the well fields.

CONCLUSIONS

Based on the model runs and calculated impacts to the river the total impact to the system is an accretion of 1.4 Acre-Feet per Day (0.7 Cubic Feet per Second). Also, there are accretions in all zones except for zone 2. In zone 2 (Mitchell Gering Canal Diversion to Farmers Canal Diversion) there is depletion to the river of 0.4 Acre-Feet per Day (0.22 Cubic Feet per Second). The errors in each model are smaller than the resulting impacts to the North Platte River which shows that almost all of the water is accounted for.

FIGURES

APPENDIX A



Stream Flow Change Per Time Step, Acre-Feet per Day - Zone 1
(Upstream of Mitchell Gering Canal Diversion)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
Stream Flow Change (Acre-Feet per Day)
Reduced Pumping Effects
New Well Field Effects
Combined Effects
2010
2012
2014
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
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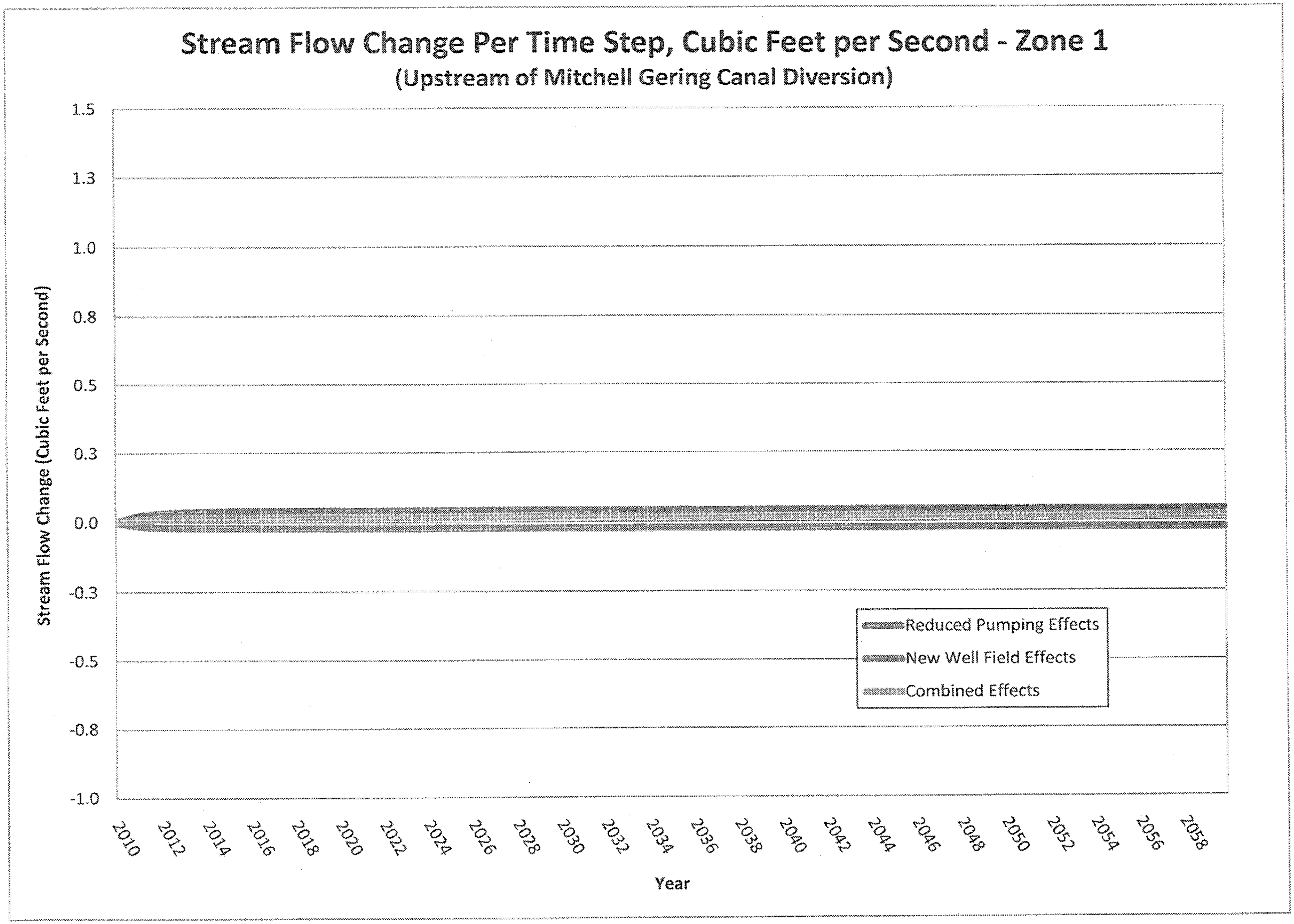
Year


Stream Flow Change Per Time Step, Cubic Feet per Second - Zone 1
(Upstream of Mitchell Gering Canal Diversion)
Stream Flow Change (Cubic Feet per Second)
1.5
1.3
1.0
0.8
0.5
0.3
0.0
-0.3
-0.5
-0.8
-1.0
Reduced Pumping Effects
New Well Field Effects
Combined Effects
2010
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Year

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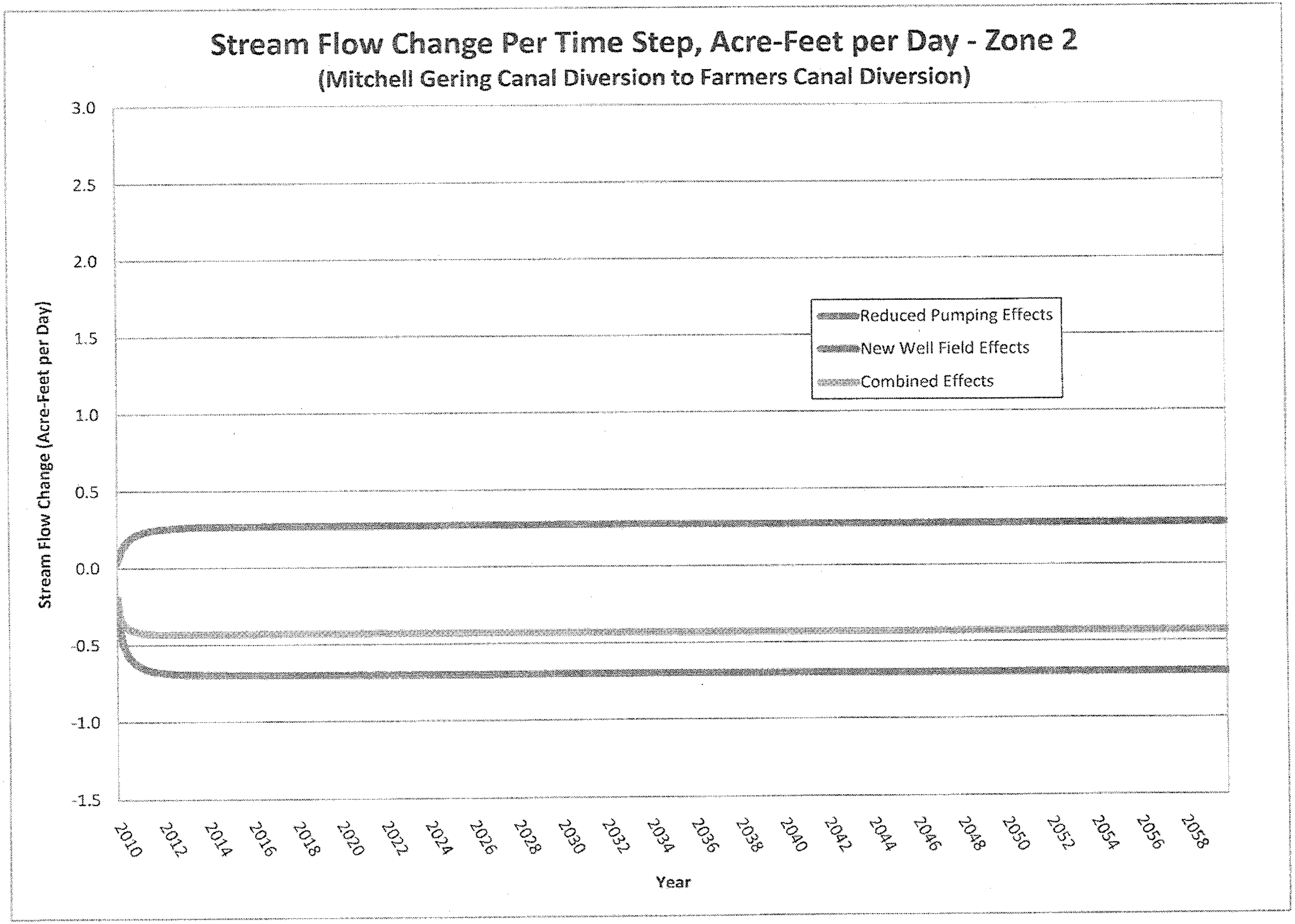

Stream Flow Change Per Time Step, Acre-Feet per Day - Zone 2
(Mitchell Gering Canal Diversion to Farmers Canal Diversion)
Stream Flow Change (Acre-Feet per Day)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
Reduced Pumping Effects
New Well Field Effects
Combined Effects
2010
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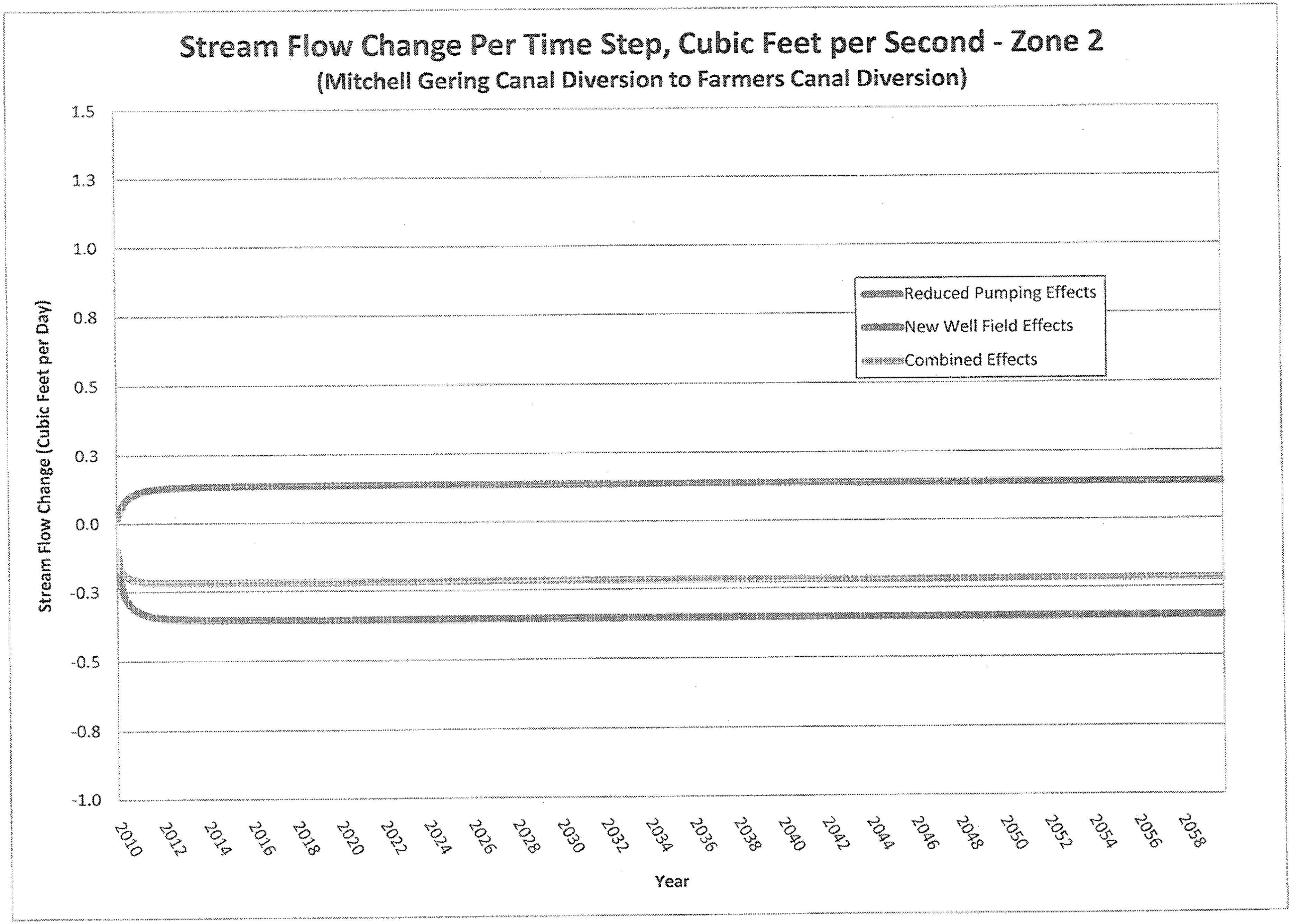
Stream Flow Change Per Time Step, Cubic Feet per Second - Zone 2
(Mitchell Gering Canal Diversion to Farmers Canal Diversion)
Stream Flow Change (Cubic Feet per Day)
1.5
1.3
1.0
0.8
0.5
0.3
0.0
-0.3
-0.5
-0.8
-1.0
Reduced Pumping Effects
New Well Field Effects
Combined Effects
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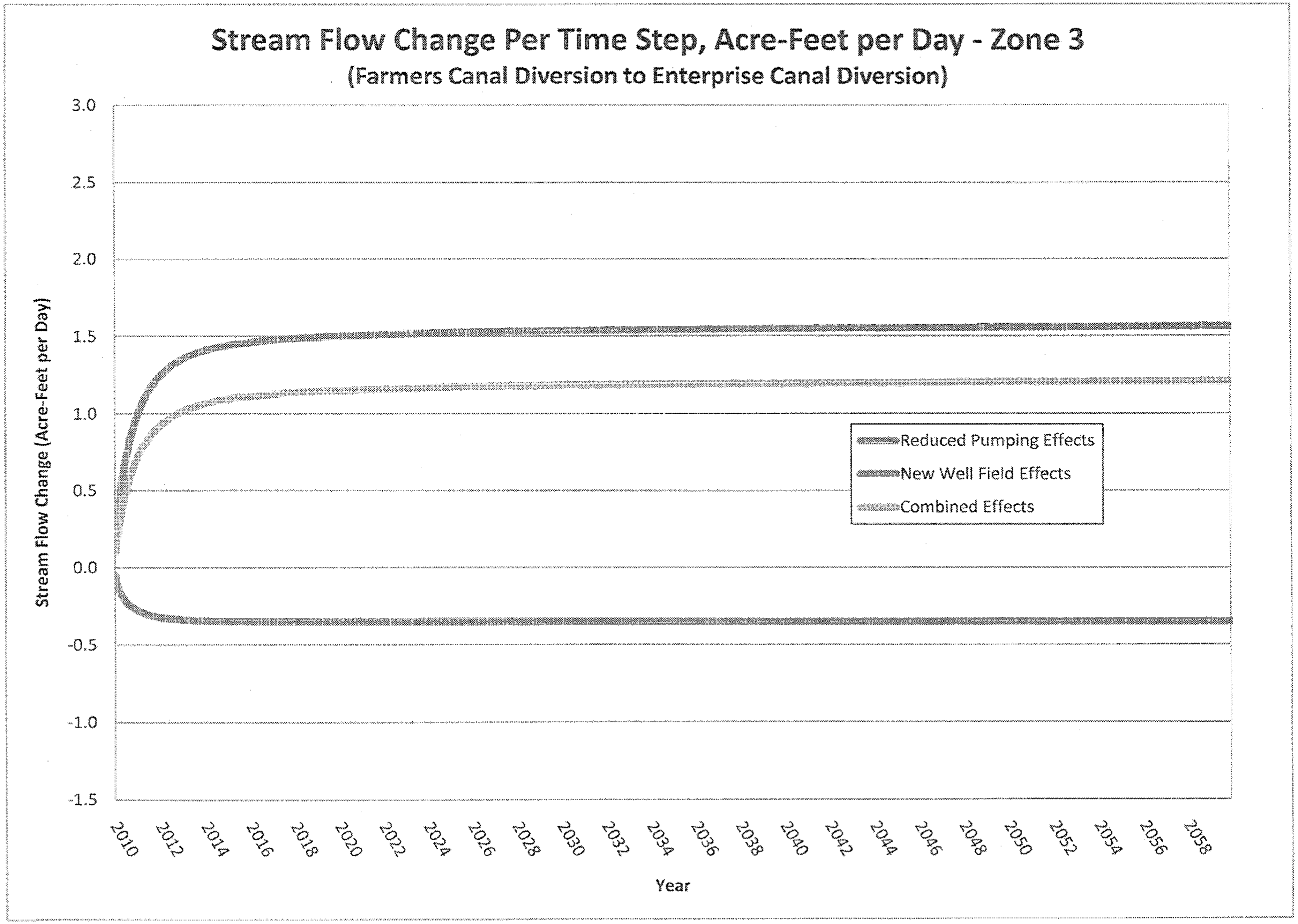

Stream Flow Change Per Time Step, Acre-Feet per Day - Zone 3
(Farmers Canal Diversion to Enterprise Canal Diversion)
Stream Flow Change (Acre-Feet per Day)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
2010
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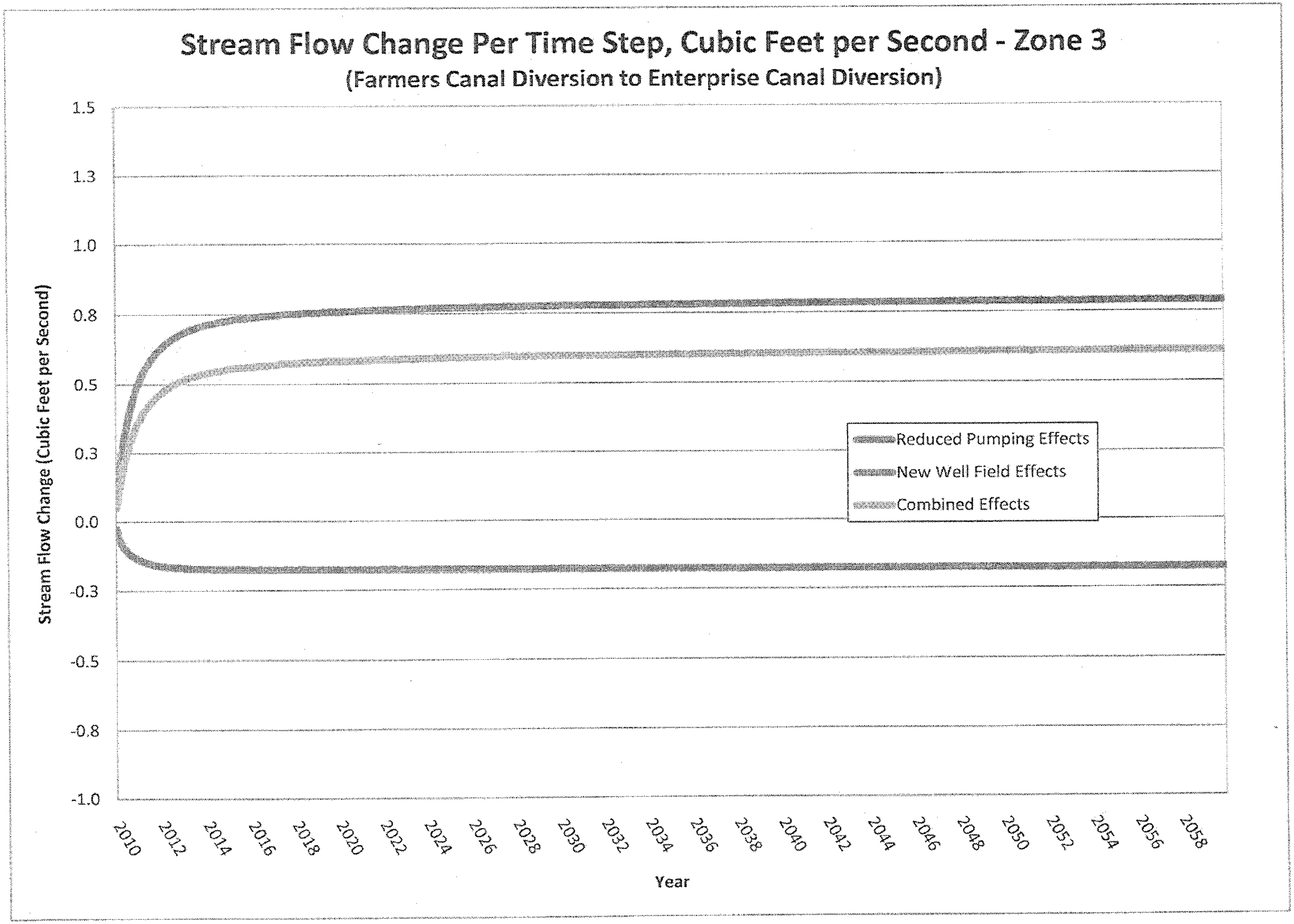
Year
Reduced Pumping Effects
New Well Field Effects
Combined Effects


Stream Flow Change Per Time Step, Cubic Feet per Second - Zone 3
(Farmers Canal Diversion to Enterprise Canal Diversion)
Stream Flow Change (Cubic Feet per Second)
1.5
1.3
1.0
0.8
0.5
0.3
0.0
-0.3
-0.5
-0.8
-1.0
Reduced Pumping Effects
New Well Field Effects
Combined Effects
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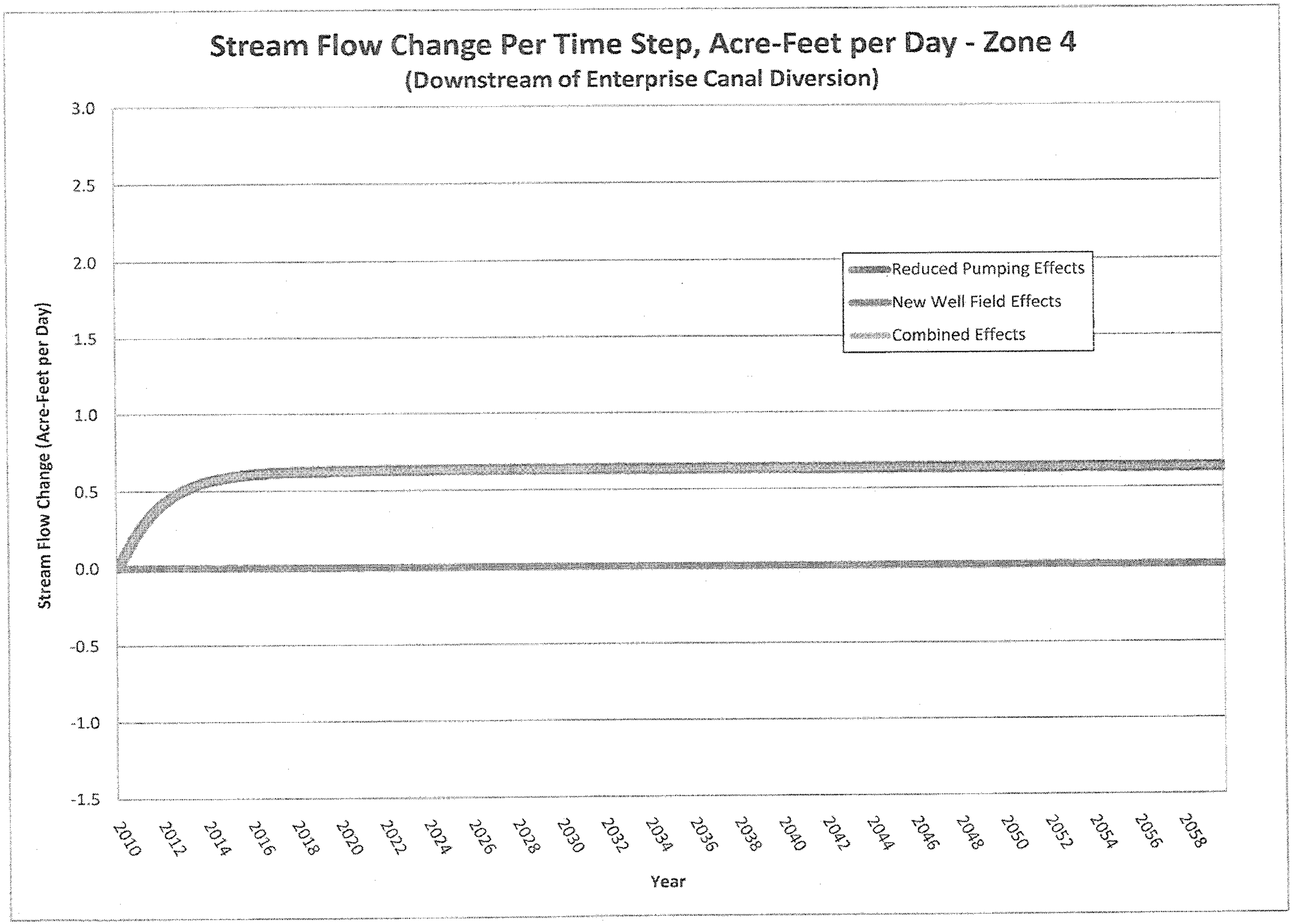

Stream Flow Change Per Time Step, Acre-Feet per Day - Zone 4
(Downstream of Enterprise Canal Diversion)
Stream Flow Change (Acre-Feet per Day)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
Reduced Pumping Effects
New Well Field Effects
Combined Effects
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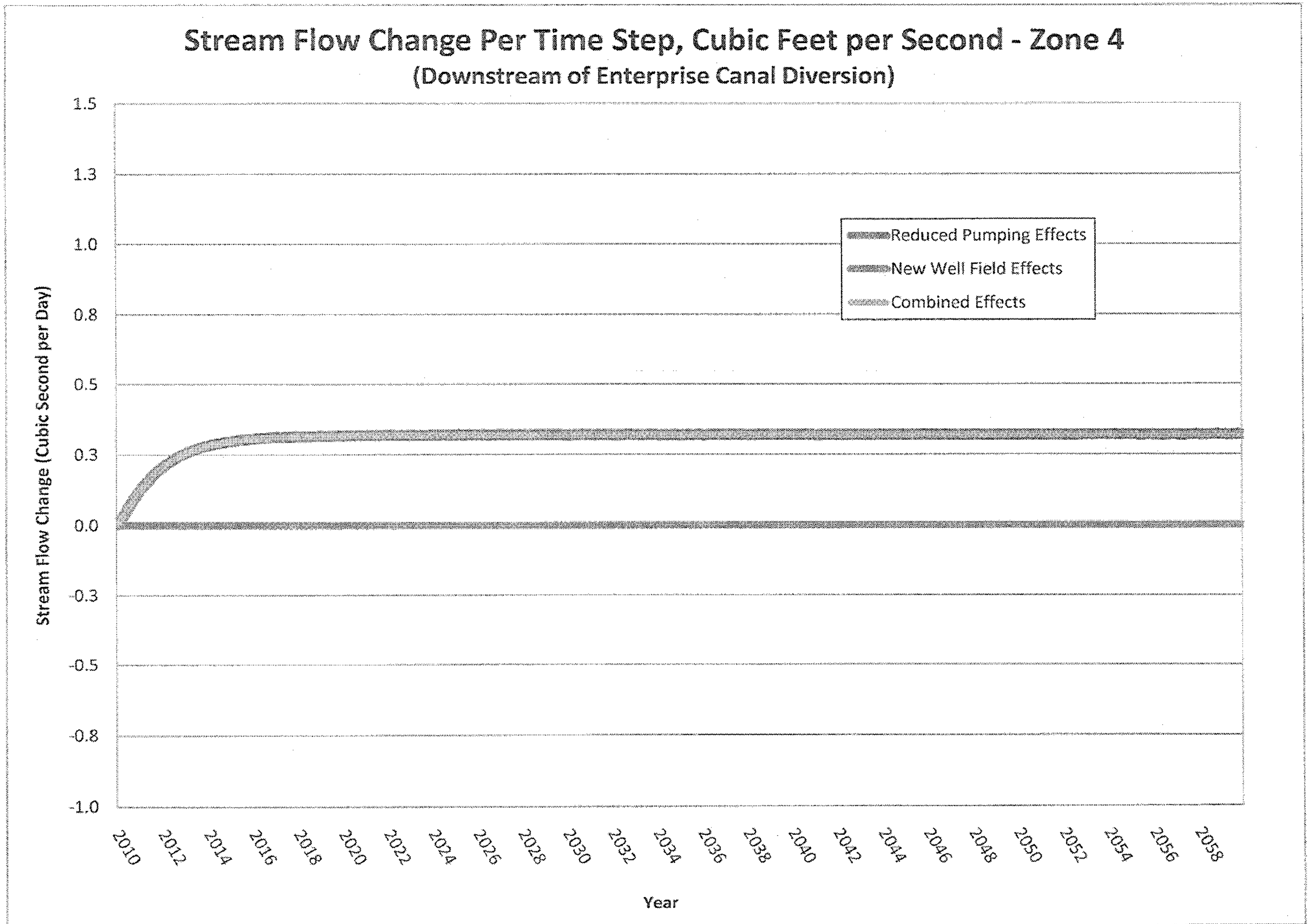

Stream Flow Change Per Time Step, Cubic Feet per Second - Zone 4
(Downstream of Enterprise Canal Diversion)
Stream Flow Change (Cubic Second per Day)
1.5
1.3
1.0
0.8
0.5
0.3
0.0
-0.3
-0.5
-0.8
-1.0
Reduced Pumping Effects
New Well Field Effects
Combined Effects
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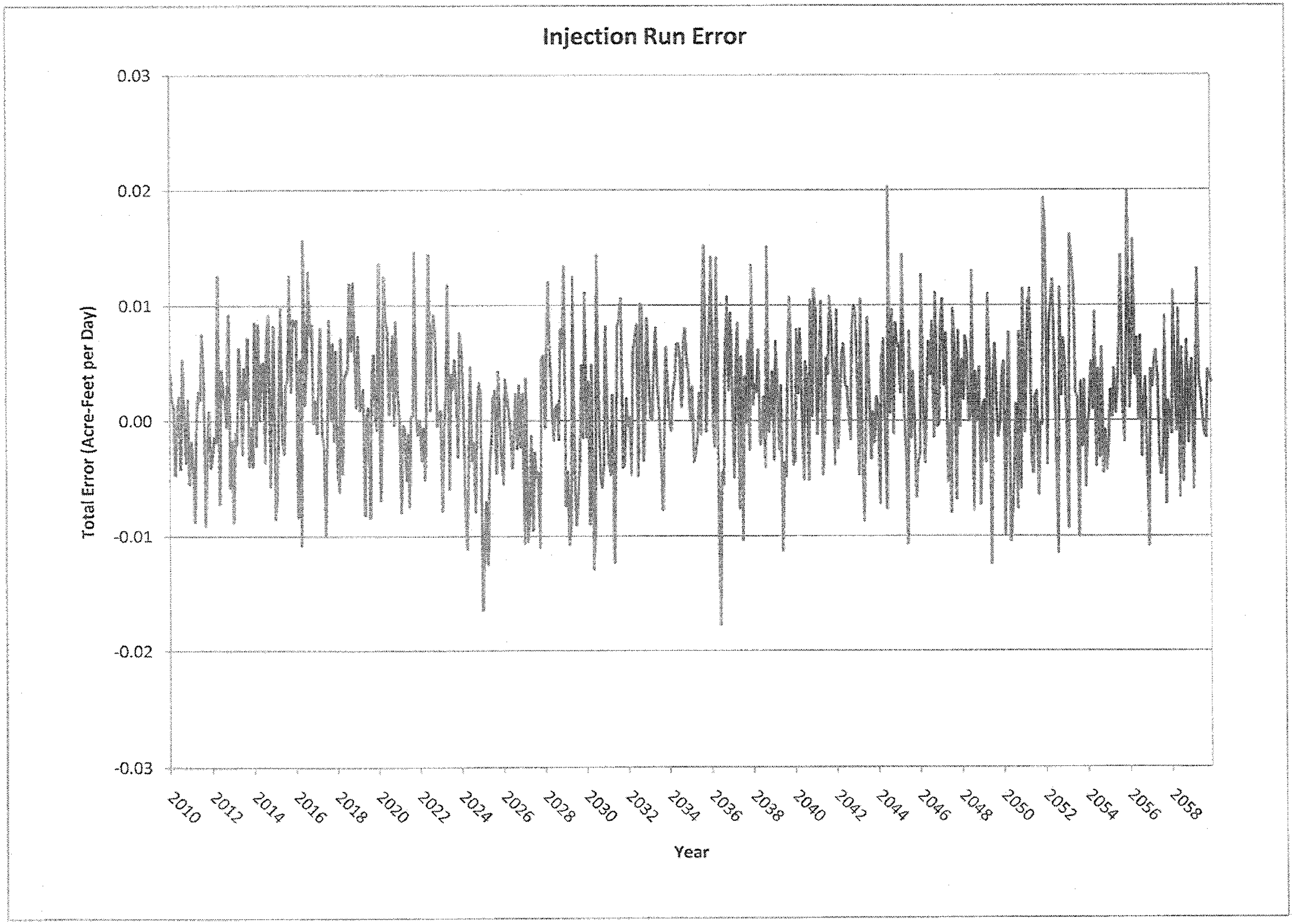
APPENDIX B

MAY 13 2011


Injection Run Error
Total Error (Acre-Feet per Day)
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
2010
2012
2014
2016
2018
2020
2022
2024
2026
2028
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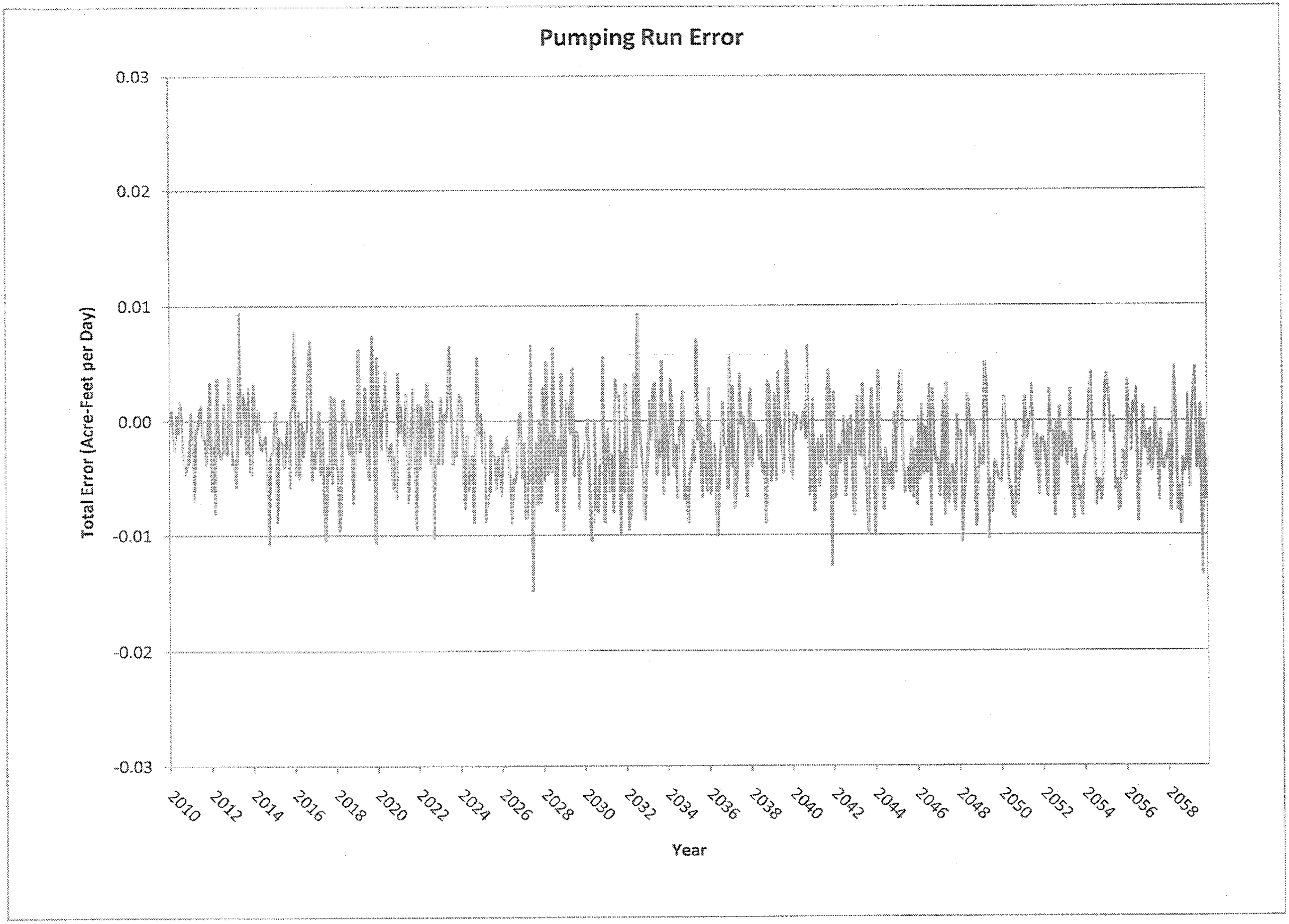
Year

MAY 13 2011


Pumping Run Error
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
Total Error (Acre-Feet per Day)
2010
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2014
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2058
Year

MAY 13 2011

ATTACHMENT 1

Principals
M. C. Schaff
D. A. Schaff
L. D. McCaslin
K. A. Beatty

M. C. SCHAFF & ASSOCIATES, INC.

ENGINEERS — PLANNERS — SURVEYORS

818 South Beltline Highway East
Scottsbluff, Nebraska 69361
308/635-1926 FAX: 308/635-7807

P.O. Box 1340
Douglas, Wyoming 82633
307/358-0128

October 21, 2009

Ron Cacek
North Platte NRD
P.O. Box 280
Scottsbluff, NE 69361

RE: Regional Wellfield Lyman, Morrill and Henry

Dear Mr. Cacek:

The Village of Lyman, Morrill and Henry have formed a regional water board and are planning for the construction of a regional wellfield to supply potable water to each village. The attached sheets show the past water usage and estimated future use. Also, attached is a map and table showing the location of the existing wells and the proposed location of the new regional wells.

The wellfield will consist of three 750 gpm wells. The wellfield is located in the [redacted] in Scotts Bluff County.

Water Meters have been installed in Lyman and Morrill and we have seen significant reductions in water use from past years. Henry plans to bid out their meter project after the first of the year.

Each Village plans to utilize their existing wells to irrigate their own parks. Lyman has already converted one of their wells. Morrill and Henry have not determined how and which wells will be converted to irrigate the parks.

Lyman will convert one of their existing wells to supply non-potable water to an existing industry in town after the new well field is constructed and online.

An application for a new well permit will be submitted after a contractor is selected. We are currently bidding a project for the construction of one of the three production well casings. Bids will be received on October 27. We hope to be ready to begin drilling the week of November 30th.

If you have any questions or require additional information, please contact me at 307.358.0128.

Respectfully

FOR THE FIRM OF
M.C. SCHAFF & ASSOCIATES

Frank A Strong IV, P.E.

CC: Tammy Cooley, Board Clerk

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WellName	Latitude	Longitude
Regional WellField		
Proposed Well No. 1	[redacted]	
Proposed Well No. 2	[redacted]	
Proposed Well No. 3	[redacted]	
Henry		
Fire Hall Well	[redacted]	
Grade School Well	[redacted]	
Park Well	[redacted]	
Morrill		
Grade School Well	[redacted]	
Steen Well	[redacted]	
Trailer Park Well	[redacted]	
Lyman		
Well No. 1	[redacted]	
Well No. 2	[redacted]	
Well No. 3	[redacted]	
Well No. 4	[redacted]	

Past Water Usage

Lyman, Nebraska

Existing wells
Well No. 1 - 431
Well No. 2 - 471
Well No. 3 - 611
Well No. 4 - 901

Average yearly water use is	75.8 MG	=	232.6 acre-ft

Morrill, Nebraska

Existing Wells
Grade School Well - 531
Trailer Park Well - 801
Steen Well - 931

Average yearly water use is	214.0 MG	=	656.7 acre-ft

Henry, Nebraska

Existing Wells
Fire Hall Well - 221
Park Well - 931

Average yearly water use is	54.1 MG	=	166.0 acre-ft
Total	343.9 MG	=	1055.4 acre-ft

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Estimated Future Water Usage

Regional Well Field

Well No. 1	to be constructed
Well No. 2	to be constructed
Well No. 3	to be constructed

Lyman estimate yearly use	48.2 MG	=	147.9 acre-ft
Morrill estimate yearly use	109.5 MG	=	336.0 acre-ft
Henry Estimated yearly use	18.6 MG	=	57.1 acre-ft
Total	176.3 MG	=	541.0 acre-ft

Lyman, Nebraska

Existing wells
Well No. 1 - 431
Well No. 2 - 471
Well No. 3 - 611
Well No. 4 - 901

Industrial Non-potable	12.8 MG	=	39.3 acre-ft
Park Irrigation	4.6 MG	=	14.1 acre-ft
Total	17.4 MG	=	53.4 acre-ft

Morrill, Nebraska

Existing Wells
Grade School Well - 531
Trailer Park Well - 801
Steen Well - 931

Park Irrigation	14.6 MG	=	44.8 acre-ft

Henry, Nebraska

Existing Wells
Fire Hall Well - 221
Park Well - 931

Park Irrigation	0.7 MG	=	2.1 acre-ft

Total Estimated Water Use	**209.0 MG**	**=**	**641.4 acre-ft**

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Irrigation Land at Wellfield

land to be dried up	47 acres		
Based on 14.1" of water	18.0 MG	=	55.2 acre-ft

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MITIGATION AND RELEASE AGREEMENT

This Mitigation and Release Agreement ("Agreement") is made and entered into this __ day of September, 2010, between Farmers Irrigation District, a political subdivision of the State of Nebraska ("Releasor"), and Western Nebraska Joint Water Board ("Releasee").

Recitals:

a. The Releasor acknowledges the Releasee is constructing a regional wellfield in or near the North Platte River in western Scotts Bluff County, Nebraska.

b. Pursuant to Permit No. NP-IN-09010 issued to Releasee by the North Platte Natural Resources District, there is a possibility of increased depletion and adverse impact on surface water diversion to the North Platte River resulting from the relocation, construction and use of the regional wellfield by Releasee.

Agreement:

1. In consideration of the Releasee drying up 19.2 acres in the southwest and northwest corners of the project property and abandoning one 1,000 gallon per minute well in the northwest corner of the project property and other good and valuable consideration receipt of which is acknowledged, the Releasor now grants a full and complete release of Releasee's obligation to mitigate any potential depletion and adverse impact on surface water diversion to the North Platte River resulting from the relocation, construction and use of the regional wellfield by Releasee. The parties understand and acknowledge it may be difficult, if not impossible, to determine any increase in depletion or adverse impact on surface water diversion to the North Platte River resulting from the relocation, construction and operation of the regional well field. In lieu of undertaking the necessary expense to conduct hydrological surveys and analysis to calculate any damages resulting from the increased depletion and adverse impact on surface water diversion to the North Platte River, the parties agree that the drying up of 19.2 acres and abandoning one 1,000 gallon per minute well, all of which are located on the project property shall be sufficient to mitigate any potential depletion or adverse impact on the surface water diversion to the North Platte River.

2. The parties acknowledge this Agreement is entered into for the purpose of Releasee mitigating any depletion or adverse impact on surface water diversion to Releasor pursuant to Permit No. NP-IN-09010 and the report by the Natural Resources District as a result of the relocation, construction and use of the regional wellfield by Releasee. The consideration by Releasee to Releasor is intended to fulfill any mitigation or depletion obligation and compensate Releasor for any other adverse impact or damages that may or could result due to the relocation, construction and use of the Releasee's regional well field.

3. Upon the execution of this Agreement and the drying up of land , as well as

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abandonment of the well, the Releasee agrees to dismiss its appeal of the findings in the Natural Resources District report and Permit No. NP-IN-09010.

4. This Agreement shall be binding upon and inure to the parties and their respective representatives, successors and assigns.

FARMERS IRRIGATION DISTRICT,
Releasor,

By ______________________

WESTERN NEBRASKA JOINT WATER BOARD,
Releasee,

By ______________________

ACKNOWLEDGMENT OF AGREEMENT

STATE OF NEBRASKA, NATURAL RESOURCES DISTRICT,

By ______________________

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