TRR Well Field Capacity

And

Water Adequacy

Prepared for

ICR WATER USERS ASSOCIATION

By

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Purpose

The purpose of this report as commissioned by the Board of Directors of the ICR Water Users Association is to provide information, or where to find information on, its contractual relationship with the developer of the TRR subdivision and golf course; its role relative to Arizona State requirements in Water Adequacy Reports and Notice of Intents to Serve; and the capacity of the well field relative to present and projected demand as well as a summary of previous capacity testing.

Executive Summary

The Talking Rock Ranch (TRR) subdivision was originally planned for 1,755 single family units to be built out in 9 Phases, including common areas, a clubhouse, restaurant, health and fitness center, and a golf course. The projected residential demand for the subdivision was 199 gallons per day per residence (gpd/r) or 391.1 acre feet per year (af/y) including outside use. Outside use includes landscape and commercial use. The projected use of the golf course was 400 af/y. The TRR well field was projected as the sole source of water for the subdivision and golf course although the original concept was that effluent derived from the ICR Wastewater Treatment plant would totally replace the golf course demand for ground water once all three subdivisions (Inscription Canyon Ranch (ICR), Whispering Canyon, and TRR) were built-out.

The subdivision is presently planned for 1,550 single-family units to be built out in 29 Phases of which 28 Phases consisting of 1,512 units will receive water from the TRR well field. Phase 26, the remaining Phase and better known as Preserve at the Ranch constitutes 38 units that receive their water from the ICR well field.

The subdivision is marketed under the concept that there is a 100-year water supply available. This requires a **Water Adequacy Report (WAR)** issued by the Arizona Department of Water Supply (ADWR) for each Phase. Issuance of a WAR requires a hydrologic evaluation by the developer approved by ADWR indicating, among other things, the physical and legal availability of ground water sufficient to meet the projected demand of that Phase. ICR Water Users Association (ICRWUA) must sign a Notice of Intent to Serve (NOIS) for each Phase before ADWR will issue the WAR. As presently platted with Water Adequacy Reports the TRR subdivision consists of 966 single-family residential lots contained within 15 Phases. ICRWUA is presently (October 2016) serving 217 residences within the platted area.

ICRWUA has contractually agreed to sign NOIS for the remaining Phases under conditions specified in the **Amended and Restated Water Service Agreement** and the **Settlement Agreement**. According to information provided to the Board by ADWR, once ICRWUA signs the NOIS it is solely responsible for supplying the required amount of water for that Phase. Prior to this the developer is responsible.

Present plans call for an additional 584 single-family residential lots contained within 14 Phases. This number includes the reduction of single-family units called for in Phases 17, 18, and 19. Each new Phase will require a WAR and a NOIS from ICRWUA before the WAR can be issued.

The original estimate of an average residential water use of 199 gpd/r including outside use has not held up over time. The water demand for all residences served has averaged 142 gpd/r. Each month however, an average of about 15 percent of residences use no water. Removing these residences from the calculation results in an average residential use of about 161 gpd/r. If landscape and commercial demands are included into the latter demand, existing annual residential demand for active accounts including outside use is about 224 gpd/r, table 3, and approaches 230 gpd/r. This usage would bring total residential demand at or just below the 391.1 af/y presently allotted by ADWR at full build of the subdivision.

An increase in water demand (residential, commercial, and landscape) for the remaining unplatted Phases taking the total demand beyond the 391.1 af/y allotted by ADWR for the subdivision as a whole (excluding the golf course) will require submittal of a hydrologic report to ADWR supporting the availability of the additional amount of ground water required. Given this, it is important that ICRWUA continue to track the monthly and annual water use of all categories in order to determine total annual and monthly water demand for existing Phases, thereby allowing the potential water demand of new unplatted phases to be estimated prior to ICRWUA agreeing to sign a NOIS.

Given the above considerations, there are essentially five ways to evaluate the projected demand on the well field water at build-out of the TRR subdivision:

a. ADWR set aside for 1,755 residences at 199 gpd/r demand including outside demand, golf course demand not included. Demand cannot exceed this without an additional hydrologic report submitted by the developer to ADWR that is subsequently approved and an additional water source provided by the developer.
b. Projection of existing residential demand of 230 gpd/r for 1,512 residential units that includes commercial and landscape use, projected golf course demand not included. This provides a comparison to the ADWR set aside based on the existing use.
c. Projection of existing residential demand of 230 gpd/r for 1,512 residential units that includes commercial and landscape use, projected golf course demand included. This provides an evaluation of the ultimate demand on the well field at full build-out of all three subdivisions.
d. ICRWUA's report **Comparison of the Capacity of the TRR well field to Demand** with golf course demand included no growth in landscape or commercial demand: This provides an evaluation of projected demand on the well field that was used in the **Settlement Agreement.**
e. Residential demand at existing use of 161 gpd/r, excluding landscape, commercial, and golf course demand. This provides the projected demand in the event of a declaration of water scarcity.

A comparisons of the five projected demands is shown in the table below for a) ADWR set aside for 1,755 residences at 199 gpd/r demand, golf course demand not included, b) residential demand at 230 gpd/r including outside use for 1,512 residential units, golf course demand not included, c) residential demand at 230 gpd/r including outside use for 1,512 residential units, golf course

demand included, d) ICRWUA's report **Comparison of the Capacity of the TRR well field to Demand** with golf course demand included, no growth in landscape or commercial demand and, e) residential demand at 161 gpd/r, commercial, landscape, and golf course demand not included.

af/y	mg/y[1]	gpd[2]	gpm[3]	projected/existing[4]
a. 391.1	127.4	349,128	**242**	**1.19**
b. 389.57	126.9	347,760	**242**	**1.19**
c. 516.95	168.4	461,461	**320**	**1.57**
d. 483.94	157.7	432,004	**300**	**1.47**
e. 272.70	88.9	243,432	**169**	**0.83**

[1]mg/y = million gallons per year; [2]gpd = gallons per day; [3]gpm = average pumping rate at the well field in gallons per minute; [4]projected/existing = projected water demand (gallons per year) divided by 2008-2015 average water demand of 107,432,450 gallons per year.

The potential impact of these demands can be seen in that the combined average daily use of the three wells in the TRR well field over the last few years has been approximately 18 hours per day. At the maximum projected demand (category "c" above), the average daily combined use would increase to about 28 hours.

Experience has shown that the yield from each well was significantly overstated while each well was fitted with an oversized pump. As a result, pumping lowered the water level in wells 2 and 3 to the point that both immediately experienced problems with air entrainment in the water and pump cavitation due to low water levels.

The pump on well 3 quickly failed from the combination of both problems. It was downsized in 2003 with a pump capacity of about 260 gpm after which the well has been highly reliable and has experienced minimal air entrainment. Continued problems with low water levels and entrained air at well 2 required the pump at this well to be downsized in 2009 to a pump capacity of about 285 gpm. Due to an electrical problem the pump failed in June 2013 and was replaced in July of that year. The capacity of the new pump is about 250 to 280 gpm. Since then, this well has been highly reliable and has experienced minimal air entrainment. Well 1 has also experienced problems with air entrainment and a study of this well was completed in 2011 that called for the pump to be downsized here as well. This was accomplished in February 2012.

Since the last pump replacements the average yield of wells 1, 2, and 3 has been steady at **about 330 gpm, 265 gpm, and 224 gpm** respectively thereby allowing the well field to meet the above average demands with two wells while keeping the third as a back-up.

Demand varies seasonally from average annual demand, however, with greater demand during the warmer drier months. Maximum projected average monthly summer demands, assuming a residential demand of 230 gpd/r and projected golf course demand, have a significant impact on pumping times at the well field with projected pumping rates in June and/or July requiring two wells to pump at or just below 24 hours per day.

Because daily demands can exceed average monthly demand it may be necessary to coordinate landscape and the golf course demand during this period of time and/or to consider reducing present and projected landscape demand.

Contractual Agreements between the Developer of the TRR Subdivision and ICRWUA

Two contractual agreements, the **Amended and Restated Water Service Agreement** (ARWSA) entered into on December 3, 2008, and the **Settlement Agreement** (SA) entered into on July 30, 2013 define the legal relationship between the developer of the TRR subdivision, Harvard Simon I, LLC , and Talking Rock Land, L.L.C (Harvard Investments) and ICRWUA. The former agreement replaces all previous agreements between the two parties, i.e., the Well Agreement and Amendment 1 of the Well Agreement.

Several major stipulations in the ARWSA are that:

- Water from the Talking Rock Wells will only be used to serve ICRWUA customers on the Talking Rock water system (the TRR subdivision and golf course), and that such restriction arises from recorded deed restrictions put in place by the seller of the Well Field Property whereon the TRR well field is located.
- ICRWUA agrees to deliver water to the Talking Rock Parties to be used at the Golf Course for Landscape Irrigation, Lake Fill and other non-potable purposes **up to a maximum of 400 acre-feet per annum**; and for construction purposes in an amount reasonably requested by the Talking Rock Parties for the development of Talking Rock subject to the terms set forth in the ARWSA.
- Residential demand in the TRR subdivision has priority over other demands in the subdivision including the golf course.
- In the event that water scarcity requires only residential delivery, ICRWUA will resume normal service to all parties as soon as practicable.
- The Talking Rock Parties agree to use reasonable efforts to 1) promote conservation, 2) minimize the use of groundwater for Landscape Irrigation, Lake Fill, and other non-potable purposes, and 3) use reasonable efforts to maximize the use of effluent.
- Term for ARWSA is 35 years from effective date of Agreement.

The **SA** addresses, among other issues, the requirement and conditions under which ICRWUA will sign State and County NOIS for a new Phase. The Agreement is based, in part, on conclusions of an ICRWUA report dated August 18, 2011 titled **Comparison of the Capacity of the TRR Well Field to Demand**. The latter report concludes that projected demand at the TRR subdivision that includes residential, commercial, landscape, and the golf course falls within the existing (2011) capacity of the TRR field assuming 1) a residential build-out to 1,636 homes and a demand of 199 gpd/r, 2) no change in commercial and landscape (4.4 million gallons per year) demand beyond that of 2010, and 3) all effluent from the ICR Sanitary District would be used on the TRR golf course.

A major stipulation in the SA is that in the event the capacity of the TRR well field is unable to meet the demands of a newly platted Phase in the TRR subdivision, and by no fault of ICRWUA, it is the responsibility of Harvard Investments to provide the additional water facilities, including water source, necessary to meet the incremental demand for the new Phase at their sole expense in accordance with and subject to provisions of the ARWSA prior to ICRWUA signing a NOIS for that Phase.

Water Adequacy Reports Issued For the TRR Subdivision

The total acreage of the TRR development was purchased from the developer of the Inscription Canyon Ranch (ICR) subdivision. It was agreed between both developers that ICRWUA, the water company created to serve the latter subdivision, would also serve the TRR subdivision. ICRWUA is regulated by the Arizona Corporation Commission (ACC) and since only about 400 acres of the land purchased by Harvard Investments were within ICRWUA's existing Certificate of Convenience and Necessity (service area) at the time of the purchase it was necessary for ICRWUA to apply to the ACC for an extension of its service area. ACC Decision 64360 dated January 15, 2002 accomplished this.

The initial hydrologic report submitted by Harvard Investments concerning water adequacy for the TRR subdivision was prepared by Southwest Ground-water Consultants (SWGC) on September 30, 1999 and submitted to ADWR in support of a Physical Availability Demonstration for the development. A Physical Availability Demonstration was initially used by developers and ADWR as a means to speed the process for a Water Adequacy Report once the proposed development was approved by the appropriate county.

Although ADWR concurred in a letter to Harvard Investments dated November 22, 1999 that a sufficient quantity of ground water is physically available to meet the development's projected demand, they also concluded that "*it has not been demonstrated that sufficient supplies are available for the entire projected demand to be supplied from the existing well located on the leased lands west of the property*". ADWR continued stating that "*At the time the developer applies for Water Adequacy Reports from this Department for each Phase of development, sufficient supplies of water for each Phase must be demonstrated*". This requirement means that ICRWUA must sign a Notice of Intent to Serve for each Phase before ADWR will issue a Water Adequacy Report for the Phase and before the Phase can be platted. Although not known or identified to ADWR at the time, the existing well in question was ICR 1 and not available to TRR owing to a restriction placed by the owners of the well (Pierce Properties) on ICRWUA. In fact, no well existed at this time that would have served the TRR subdivision.

The first request to ADWR for a Water Adequacy Report was filed by SWGC on behalf of Harvard Investments on April 25, 2001 for Phase 1 of the TRR subdivision consisting of 198 single-family residential lots. The estimated water demand for Phase 1 was based on an assumed residential use of 199 gpd/r including outside use of water. Total water demand therefore was stated to be 44.1 acre-feet per year (af/y). This request was made prior to inclusion of the main part of the development into ICRWUA's service area and was based on a report prepared by SWGC dated April 24, 2001 titled "*Hydrologic Study, In Support of a Water Adequacy Report, Talking Rock Ranch, Phase 1, Williamson Valley, Arizona*" that, in addition to the water demand of Phase 1, included a water demand for the golf

course of 400 af/y. Including both demands, the total demand was 444.1 af/y. In addition to stating the water demand for Phase 1 and the golf course the SWGC report states that a well, "*Harvard-1 was drilled and tested* (for 24 hours at 500 gpm (gallons per minute)) *in order to provide additional water capacity for the projected demand of Talking Rock Ranch Phase 1*". The well discussed in SWGC's report is TRR well 1.

The report identifies the long-term ground water resource as 5,709 af/y. As stated by SWGC, subtraction of the demand of Phase 1 and the golf course from this amount still leaves approximately 4,866 af/y available for other uses. The request also included a NOIS the entire subdivision from ICRWUA dated 4/21/2001 contingent upon ICRWUA's receipt of necessary approvals from the ACC. As noted above, neither Phase 1 nor the golf course was in ICRWUA's service area on April 25, 2001 when the SWGC report was submitted.

In an attempt to address this situation, ICRWUA filed an application with the ACC on June 1, 2001 for an extension of its service area to include the TRR subdivision. The request was scheduled for a hearing on September 6, 2001. In a separate but related matter, ADWR on July 25, 2001 notified Harvard Investments that their application for the Water Adequacy Report for Phase 1 was incomplete and needed a staff report from the ACC recommending approval of the extension within 60 days or ADWR would issue a report indicating that the water supply for the proposed subdivision was inadequate. ACC staff filed a favorable report on August 8, 2001 following which ADWR issued a Water Adequacy Report for Phase 1 on August 17, 2001. As noted above, ACC Decision 64360 extended ICRWUA's service area to include the entire TRR subdivision January 15, 2002.

Following their initial plan to build the subdivision out in eight Phases and given their previous application for a Water Adequacy Report for Phase 1, Harvard Investments on July 16, 2001 (still prior to the subdivision being included in ICRWUA's service area) applied to ADWR for an Analysis of Water Adequacy for Phases 2-8 consisting of 1,557 single-family lots. An Analysis of Water Adequacy reserves water for ten years with the possibility of five year extensions subject to ADWR approval. Harvard's estimated water demand for Phase 2-8 was still based on an assumed residential use of 199 gpd/r including outside use. The total demand for Phases 2-8 therefore was 347af/y. Harvard Investments application was granted. This amount includes the water demand for Phase 26 better known as "The Preserve at the Ranch" that, as previously discussed, receives its water from the ICR well field rather than the TRR well field. Even so its demand is included in water allocated by ADWR for TRR Phases 2-8 discussed below.

Including Phase 1 this request brought the total number of planned single-family residential lots in the subdivision to 1,755 and a total residential water demand of 391.1 af/y. In a letter dated December 20, 2001 ADWR concluded that based on the hydrologic report submitted with the application for an Analysis of Water Adequacy for Phases 2-8 there is sufficient ground water continuously available to meet the projected demand including that of Phase 1 and the golf course.

The letter further stated that the term of the analysis was for ten years from the date of the application (July 16, 2001) and may be renewed upon request subject to approval by ADWR. The letter went on to

state that "*prior to obtaining plat approval by the local platting authority and approval of the public report by the Department of Real Estate, a Water Adequacy Report must be obtained for each subdivision plat"*, meaning among other things, that a Notice of Intent to Serve from ICRWUA is required for each future application for a Water Adequacy Report. The letter continued stating that the findings of this Analysis of Adequate Water Supply may be used to demonstrate that certain conditions for a Water Adequacy Report have been met (i.e., physical availability). ADWR concluded stating that their determination may be invalidated if the development plan or other conditions change prior to filing for a Water Adequacy Report.

The July 16, 2001 Analysis of Adequate Water Supply was extended by ADWR on November 16, 2010 for a five year period expiring on July 16, 2016. The July 16, 2016 renewal was extended to July 16, 2021 by ADWR on August 23, 2016. Harvard Investments must demonstrate to ADWR's satisfaction additional progress or capital investment during the current extension period, July 16, 2016 – July 16, 2021, in order to apply for a third extension.

ADWR's December 20, 2001 issuance of the Analysis of Adequate Water Supply for Phases 2-8 in the amount of 347 af/y forms the basis for approval of the availability of ground water for all Phases beyond Phase 1. As each new Phase is granted a Water Adequacy Report the water demand of that Phase is subtracted from the 347 af/y initially available, table 1.

As noted, the TRR subdivision as presently platted with Water Adequacy Reports consists of 966 single-family residential lots contained within 15 Phases (table 1). As shown in table 1, the total water demand allocated by ADWR for these Phases is 225.84 af/y.

Column 1 in table 1 gives the name of the Phase for which a Water Adequacy Report has been issued. Column 2 provides the total acreage of the Phase. Column 3 is the number of single-family residential units or lots within the Phase; column 4 is the date the Water Adequacy Report was issued; column 5 is the date the Notice of Intent to Serve was issued Column 6 is the water demand of the Phase in af/y while column 7 is the average daily demand at the TRR well field stated in gpm. Column 8 shows the amount of water remaining after a given Phase's demand is cumulatively subtracted from the 347 af/y approved in ADWR's issuance of the December 20, 2001 Analysis of Adequate Water Supply for Phases 2-8.

Table 1 Platted Phases with Water Adequacy Reports, TRR Ranch Subdivision.

(1) Phase Recorded Platted	(2) Total Acres	(3) Residential Lots	(4) Water Adequacy Report Issued	(5) NITS Issued	(6) Water demand, (af/y)	(7) Water Demand, (gpm)	(8) Remaining (af/y)
1	328.37	198	8/17/2001	4/21/01	44.1[1]	27.3	347.00[2]
2 & 3	113.98	127	3/7/2002	4/21/01	28.31	17.5	318.69
4a	5.36	10	7/30/2002	4/21/01	2.23	1.4	316.46
5a, 5b, 6	41.33	73	10/8/2002	4/21/01	16.27	10.9	300.19
8	151.42	80	2/18/2004	4/21/01	17.83	11.1	282.36
9	189.31	107	9/8/2004	7/6/04	27.58	17.1	254.78
10, 12, 13	329.05	235	12/1/2005	7/6/04	54.8	34.0	199.98
26	264.99	38	9/8/2004	4/21/01	12.88	8.0	187.10
27	17.94	38	2/18/2004	4/21/01	8.47	5.3	178.63
11	66.12	60	12/10/2014	12/10/14	13.37	8.29	165.26
Total	**1,507.87**	**966**			**225.84**	**132.89**	

[1]Water allocated by August 17, 2001 Water Adequacy Report for Phase 1.

[2]Water allocated by December 20, 2001 Analysis of Adequate Water Supply issued by ADWR for Phases 2-8.

As noted above, an additional 14 Phases containing 584 single-family residential units are presently planned, table 2, for which, as shown in table 1, the amount of water still available is 165.26 af/y.

Although the subdivision's water demand was originally based on 199 gpd/r including outside use, there is no requirement that Harvard Investments adhere to this amount for future Phases. Any increase in water demand (residential, commercial, and landscape) for the remaining Phases taking the total demand beyond the 391.1 af/y allotted by ADWR for the subdivision as a whole (excluding the golf course) however, would require submittal of a hydrologic report to ADWR supporting the availability of the additional amount of ground water required.

Given the above, it is important that ICRWUA continue to track the monthly and annual water use of all categories in order to determine total annual and monthly water demand for existing phases, thereby allowing the potential water demand of new phases to be estimated prior to ICRWUA signing a NOIS.

As noted, the Settlement Agreement stipulates that In the event the capacity of the TRR well field is unable to meet the demands of a newly platted Phase in the TRR subdivision, by no fault of ICRWUA, it is the responsibility of the Harvard Investments to provide the additional water facilities, including water source, necessary to meet the incremental demand for the newly platted Phase at their sole expense in accordance with and subject to provisions of the ARWSA prior to ICRWUA signing a NOIS .

Table 2 TRR Projected Phases, Acreage, and Residential Lots

(1) Preliminary Design Phase	(2) Total Acres	(3) Residential Lots
7	12.22	35
14a	52.91	54
14b	36.71	12
15	259.32	84
16	134.73	38
17, 18, 19	365.17	50
20	195.9	96
21	133.07	86
22	139.63	45
23	111.34	26
24	78.80	18
25	172.92	40
Total	**1692.72**	**584**

Projection of Residential Demand at Full Build-Out Based On Existing Demand

ICRWUA categorizes monthly customer demand in terms of residential, commercial, landscape, construction, and golf course uses. It further identifies residential customers with zero water use. Existing annual demand for TRR residential customers excluding Phase 26 averages 142 gpd/r and 161 gpd/r when inactive accounts (customers with zero use) are not included, table 3. If landscape and commercial demands are included into the latter demand, existing annual residential demand for active accounts including outside use is about 224 gpd/r, table 3, and approaches 230 gpd/r, table 4. **Use of the latter value for all 1,512 residential single-family units results in an annual water demand of 389.57 af/y, only 1.53 af/y less than the total amount allocated for the subdivision by ADWR.**

Projecting annual residential demand based on 161gpd/r, and assuming 1,512 residential units, the projected residential demand is about 272.7af/y. This value is important only if ICRWUA has to prioritize water use due to a water shortage.

Table 3 Average 2013-2015 Monthly and Annual Average TRR Active Residential Water Demand With and Without Landscape and Commercial Use Included, in gallons per day per residence

1 Month	2 2013 Commercial and Landscape not included	3 2014 Commercial and Landscape not included	4 2015 Commercial and Landscape not included	5 2013-2015 average	6 average with landscape and commercial included
January	123	74	80	93	100
February	107	123	81	104	113
March	88	114	96	99	121
April	168	143	162	158	239
May	177	171	200	183	257
June	194	204	201	199	291
July	271	245	303	273	402
August	236	159	195	197	297
September	233	194	196	208	293
October	160	149	183	164	247
November	180	164	135	159	211
December	123	86	94	101	116
Annual Average	172	152	161	161	224

Table 4 Residential Demand including Outside Use (Landscape and Commercial)

	all			**zero use**	**active**	**active**			**total**	**total**
year	residences	demand	gpd/r	residences	residences	gpd/r	landscape	commercial	demand	gpd/r
2103	177	9,147,632	142	28	149	168	2,356,100	893,073	12,396,805	228
2014	200	9,860,705	135	21	179	151	2,964,600	887,143	13,712,448	210
2015	207	10,509,420	139	22	185	156	2,390,000	1,601,871	14,501,291	215
2016										

A comparison of the three projected demands for: a) ADWR set aside for 1,755 residences at 199 gpd/r demand, golf course demand not included, b) residential demand at 230 gpd/r for 1,512 residential units including outside use, golf course demand not included, and c) residential demand at 161 gpd/r for 1,512 residential units, commercial, landscape, and golf course demand not included is shown below. Column 5 shows the relationship between the projected demand and that of the 2010-2015 average demand at the well field.

	af/y	**mg/y**	**gpd**	**gpm**	**projected/existing**
a.	391.1	127.4	349,128	**242**	**1.19**
b.	389.57	126.9	347,760	**242**	**1.19**
c.	272.70	88.9	243,432	**169**	**0.83**

Projected Golf Course Demand

In addition to the projected residential demand discussed above, ADWR allocated and set aside 400 af/y in the aquifer for the TRR golf course when they issued the Water Adequacy Report for Phase 1. Given State regulation of its water resources, a permit for irrigation of the golf course is not required. Yavapai County also agreed to a continual yearly use of 400 af/y on the golf course when approving the development.

Harvard Investments however committed to the use of treated effluent from the ICR Wastewater Treatment Plant as part of its Development Plan with Yavapai County. As stated in the plan "*The existing and future effluent reuse system will be for the primary purpose of golf course irrigation. Any remaining effluent, after irrigation of and irrigation storage for the golf course, may be used for irrigation of landscaping in rights-of-way, common open space and recreational areas*". That said the Plan goes on to state that "*The turf required for the 18 hole golf course shall be limited to 90 acres. The golf course shall be designed in accordance with ADWR standards for an AMA and shall not use more than 400 acre feet of groundwater per year to irrigate the golf course. The developers shall not over-irrigate the golf course for the purpose of disposing of effluent, shall obtain an effluent reuse permit issued by ADEQ and comply with the various state laws and regulations for the use of effluent for irrigation purposes*".

Thus although 400 af/y (approximately 130.33 million gallons per year) of groundwater from the aquifer was committed by ADWR for use by the golf course and agreed to by the county, Harvard Investments is required to use treated effluent as a means to reduce this demand. Harvard Investments in fact stated that the use of effluent would entirely replace the need for groundwater. As discussed below this is not the case based on present conditions and projections.

As shown in Figure 1 the amount of treated effluent sent to the golf course has steadily increased since 2008 going from about 9.4 million gallons in 2008 when reliable records became available to about 15.2 million gallons in 2015.

Figure 1

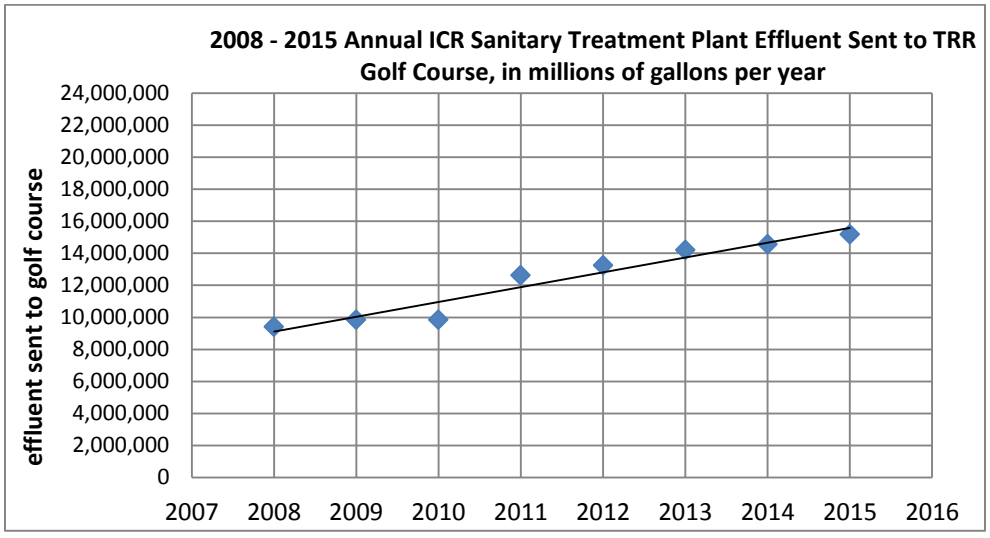

Table 5 shows the average number of residential units served by ICRWUA per year and therefore the average residential units served by the ICR Wastewater Treatment Plant for the same year. The treated effluent sent to the TRR golf course and the average daily effluent per residential unit per year is also shown.

It is clear from the table that although the amount of effluent sent to the golf course has increased since 2008 in response to an increase in residential units served by ICRWUA, the average daily effluent generation per residential unit has essentially stabilized between 2010 and 2015 at just over 80 gpd per residential unit. Using this value, the projected amount of effluent generated at full build-out of all four subdivisions (2306 residential units) is about 67,335,200 gallons per year.

This amount will not meet the expectation that treated wastewater effluent will meet the total water demand of the golf course at full built-out. **Table 6** shows the 2008-2015 golf course well field demand, the 2008-2015 treated effluent sent to the course, and the total 2008-2015 golf course demand for each year. The average 2008-2015 golf course demand including effluent is 108,835,730 gallons per year. **Subtracting the effluent generated at full build-out discussed immediately above from 108,835,730 leaves an approximate continuing demand on the TRR well field of about 41,500,530 gallons per year (127.37 af/y) or approximately 79 gpm at the well field.**

Table 5 2008-2015 Residential Units Served by the ICR Sanitary District, Effluent Sent to the TRR Golf Course, and Average Effluent Generation per Residential Unit.

Year	Residential Units	ICR Treatment Plant Effluent Sent to TRR Golf Course (gallons)	Average Effluent Generation per Residential Unit (gpd)
2008	428	9,395,462	60
2009	422	9,830,949	64
2010	431	12,966,964	82
2011	440	12,781,041	80
2012	442	13,229,639	82
2013	468	14,198,519	83
2014	496	14,549,262	80
2015	510	15,185,698	82

Table 6

YEAR	Golf Course Well Field Demand (gallons)	Effluent Sent to Golf Course (gallons)	Total Golf Course Demand(gallons)
2008	102,184,000	9,395,462	111,579,462
2009	93,892,000	9,830,949	103,722,949
2010	107,248,810	12,966,964	120,215,774
2011	102,180,500	12,781,041	114,961,541
2012	94,675,000	13,229,639	107,904,639
2013	96,138,000	14,198,519	110,336,519
2014	90,289,000	14,549,262	104,838,262
2015	81,941,000	15,185,698	97,126,698
2008-2015 Average	**96,068,539**	**12,767,192**	**108,835,730**

Commercial and Landscape Demand

Commercial demand consisting mainly of that required by the clubhouse, restaurant, and the health and fitness center varied from 822,534 to 945,663 gallons per year from 2009 through 2014 after which it substantially increased in to 1,601,871 gallons 2015, table 7. This increase, although somewhat smaller, appears to be continuing into 2016 based on data through October.

Table 7 2009-2015 Monthly and Annual Commercial Water Demand, in gallons

Month	2009	2010	2011	2012	2013	2014	2015	2016
January	52,211	35,855	31,188	58467	50,475	45,876	60,957	78,358
February	39,863	49,949	42,324	58467	43,522	48,619	100,898	64,901
March	42,919	37,396	43,626	58467	36,771	83,977	74,797	43,216
April	51,745	51,817	62,499	66,256	63,706	84,760	58,532	172,629
May	109,938	151,291	77,085	85,056	101,522	55,445	89,261	60,453
June	63,761	73,105	85,818	111,185	93,364	78,871	105,817	120,274
July	85,358	93,537	98,417	130,092	104,125	91,172	714,229	136,546
August	87,881	95,400	102,972	101,466	101,010	113,855	97,327	126,889
September	78,579	75,399	86,859	108,560	93,081	60,260	68,359	113,977
October	70,888	48,335	77,366	85,098	84,588	61,571	91,043	109,339
November	80,573	60,002	63,417	82,549	69,831	101,780	81,537	
December	113,838	50,448	58467		51,078	60,957	59,114	
Total	877,554	822,534	830,038	945,663	893,073	887,143	1,601,871	1,026,582[1]

[1]Total through October

Landscape demand from 2009 through October 2016 is shown in table 8. As shown it has varied from a low of 1,574,800 in 2012 to a high of 4,718,380 gallons in 2009. Demand from 2010 through 2015 remained below 3,000,000 gallons per year. 2016 appears to be running significantly above this general trend however.

The current (2016) combined commercial and landscape annual demand is above 5,000,000 gallons per year (15.35 af/y) and although this demand is relatively small compared to residential and golf course demands it is still significant when combined with residential use as discussed above. It is also significant in that irrigation is not an everyday phenomena but occurs on given days during which time it adds to the Maximum Daily Demand at the well field.

Table 8 Monthly and Annual Landscape Demand, in gallons

Month	2009	2010	2011	2012	2013	2014	2015	2016
January	8,610	770	0	25,300	0	0	0	20
February	11,130	3,720	29,600	25,400	0	0	0	20
March	64,900	510	0	25,300	0	17,600	0	8,040
April	553,370	192,660	87,100	84,300	118,400	534,100	288,600	399,310
May	795,890	371,020	195,300	113,300	297,800	331,600	341,400	401,580
June	446,140	449,540	263,300	200,800	336,800	401,800	344,000	416,530
July	661,930	553,040	264,000	279,000	402,500	367,800	468,800	632,500
August	712,500	293,460	295,800	236,400	382,500	141,700	259,800	866,080
September	633,200	268,010	189,90	205,100	245,900	480,200	295,700	647,240
October	454,560	245,200	195,300	185,800	346,600	387,500	320,800	659,050
November	305,150	185,000	65,500	194,100	225,600	245,900	70,900	
December	71,000	11,250	0	0	0	56,400	0	
Total	4,718,380	2,574,180	1,607,691	1,574,800	2,356,100	2,964,600	2,390,000	4,030,370[1]

[1]Total data for the year not available

Projected Total Residential, Golf Course, Commercial, and Landscape Demand at Full Build-Out

As part of the Settlement Agreement ICRWUA provided Harvard Investments with a report "*Comparison of the Capacity of the TRR Well Field to Demand*", dated August 18, 2011 verifying that as presently configured the TRR well field is capable of meeting the demand of the TRR subdivision and golf course at full build-out assuming the subdivision contained 1,636 single-family residences with a residential water demand of 199 gpd/r and that the golf course receives all of the effluent generated by the TRR subdivision at full build-out and the existing (2011) effluent from the ICR, Preserve at the Ranch, and Whispering Canyon subdivisions. The report assumed that the effluent would not meet the demand of the golf course.

Including the above report, there are essentially five ways to evaluate the projected demand on the well field water at build-out of the TRR subdivision:

a. ADWR set aside for 1,755 residences at 199 gpd/r including outside demand; golf course demand not included. The subdivision's demand, excluding the golf course, cannot exceed this amount without an additional hydrologic report submitted by the developer to ADWR that is subsequently approved and an additional water source provided by the developer.
b. Projection of existing residential demand of 230 gpd/r that includes commercial and landscape use for 1,512 residential units, projected golf course demand not included. This provides a comparison to the ADWR set aside based on the existing use.
c. Projection of existing residential demand of 230 gpd/r for 1,512 residential units that includes commercial and landscape use, projected golf course demand included. This provides an evaluation of the ultimate demand on the well field at full build-out of all three subdivisions.
d. ICRWUA's report **Comparison of the Capacity of the TRR well field to Demand** with golf course demand included; no growth in landscape or commercial demand: This provides an evaluation of projected demand on the well field that was used in the **Settlement Agreement.**
e. Residential demand at existing use of 161 gpd/r for 1,512 residential units, excluding landscape, commercial, and golf course demand. As noted above, this value is important only if ICRWUA has to prioritize water use due to a water shortage.

Table 9 gives comparisons of the five projected demands in terms of af/y, million gallons per year, gallons per day, gallons per minute at the well field, and the ratio of the projection to average well field pumpage from 2008-2015. Table 10 shows below for a) ADWR set aside for 1,755 residences at 199 gpd/r demand, golf course demand not included, b) residential demand for 1,512 residential units at 230 gpd/r including outside use, golf course demand not included, c) residential demand for 1,512 residential units at 230 gpd/r including outside use, golf course demand included, d) ICRWUA's report **Comparison of the Capacity of the TRR well field to Demand** with golf course demand included, no

growth in landscape or commercial demand e) residential demand at 161 gpd/r for 1,152 residential units, commercial, landscape, and golf course demand not included.

Table 9 Projections of TRR Subdivisions on the TRR Well Field

af/y	mg/y[1]	gpd[2]	gpm[3]	projected/existing[4]
a. 391.1	127.4	349,128	**242**	**1.19**
b. 389.57	126.9	347,760	**242**	**1.19**
c. 516.95	168.4	461,461	**320**	**1.57**
d. 483.94	157.7	432,004	**300**	**1.47**
e. 272.70	88.9	243,432	**169**	**0.83**

[1]mg/y = million gallons per year; [2]gpd = gallons per day; [3]gpm = average pumping rate at the well field in gallons per minute; [4]projected/existing = projected water demand (gallons per year) divided by 2008-2015 average water demand of 107,432,450 gallons per year.

The potential impact of these demands can be seen in that the combined average daily use of the three wells in the TRR well field over the last few years has been approximately 18 hours per day. At the maximum projected demand (category "c" above), the average daily combined use would increase to about 28 hours.

Table 10 2008-2015 Annual Demand at the TRR Well Field, in Gallons

2008	2009	2010	2011	2,012	2013	2014	2,015	Average
115,051,300	108,222,500	116,091,800	106,658,000	104,613,000	107,520,000	107,033,000	94,270,000	107,432,450

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Well Field Capacity and Demand at Full Build-Out

As discussed above ADWR has certified to the availability of and set aside 391.1 acre-feet of water for the TRR subdivision from the aquifer tapped by the TRR well field assuming 1,755 single family residences at full build-out and an assumed residential water demand of 199 gallons per day per residence (gpd/r) including outside use. ADWR has also set aside 400 af/y from the aquifer for the golf course.

ICRWUA, on the other hand, must evaluate the long-term ability of the TRR well field to meet the projected demands discussed in table 9. This requires comparing the projected water level decline occurring in the wells as a result of continuously withdrawing the required demands for 100 years to the available drawdown in the well. A failure to conduct appropriate testing of the wells prior to bringing them online makes such an analysis difficult, but an examination of pumping history and water levels to the present time in large part compensates for this. Beyond the collection of day to day pumpage and water levels, the most significant testing of the well field was conducted October 24 – 27, 2007 and is discussed in Appendix A.

The first well constructed at the TRR well field was TRR well 1. It was completed on February 5, 2001 to a total depth of 300 feet. TRR wells 2 and 3 followed with the second well completed to a total depth of 262 feet on April 20, 2002 and TRR well 3 completed to a total depth of 240 feet on May 5, 2002. Measured depth to water at completion of drilling for each well was 20 ft., 57 ft., and 23 ft. below land surface at wells 1, 2, and 3 respectively. Pumpage at the well field began in 2002 and has been continuous since. Water levels were not monitored until 2004 however, after which they were measured on an infrequent basis until October 2007 when airlines were installed in all three wells in addition to installation of a separate tube to allow direct measurement of water levels.

The pumping capacity at all three wells has been downsized from that originally installed due to initial overly optimistic estimates of the long-term yield of each well that resulted in unacceptable declines in water levels and air entrainment at all three wells. The pump at well 3 was downsized from 430 gpm to a range of about 220-260 gpm in 2003 after which the well has been highly reliable. The pump at well 2 was downsized from about 530 gpm to a pump capacity of about 285 gpm in 2009. Due to an electrical problem the pump at well 2 failed in June 2013 and was replaced in July of that year. The capacity of the new pump ranges from about 250 to 280 gpm. The pump at well 1 was downsized from 500 gpm in February 2012 with a pump capacity of about 330 gpm.

Representative pumping depths to water from 2009 to 2016 are shown in figures 2, 3, and 4 respectively. As can be seen pumping depths in wells 1 and 3 have significantly slowed if not essentially stabilized since 2012 at approximately 103 feet at well 1 and 166 feet at well 3. These depths leave nearly 200 feet of aquifer at well 1 and about 74 feet at well 3, both of which are more than acceptable for long term reliability. The decrease in pumping depth at well 1 that occurred in 2012 followed installation of the new pump with a lower capacity during that year. Concurrent with the stabilization of water levels the average yield of wells 1 and 3 has been steady at about 330 gpm and 224 gpm respectively.

The pumping depth to water at well 2 has decreased over the same time period from 143 feet to 130 feet following pump replacement in 2013 leaving 132 feet of aquifer at well 2 which is also more than acceptable for the long-term reliability of the well. Average yield from the well during the last several years has been steady at approximately 265 gpm.

The above yields allow the well field to meet the existing and projected average demands with two wells while keeping the third as a back-up.

Increased withdrawal from the well field to meet projected demand will result in increased pumping depths at the wells from those existing at the present time, but based on current history of pumping and water levels, these additional declines are not expected to impact the capacity of the well field to meet projected average demands.

Figure 2

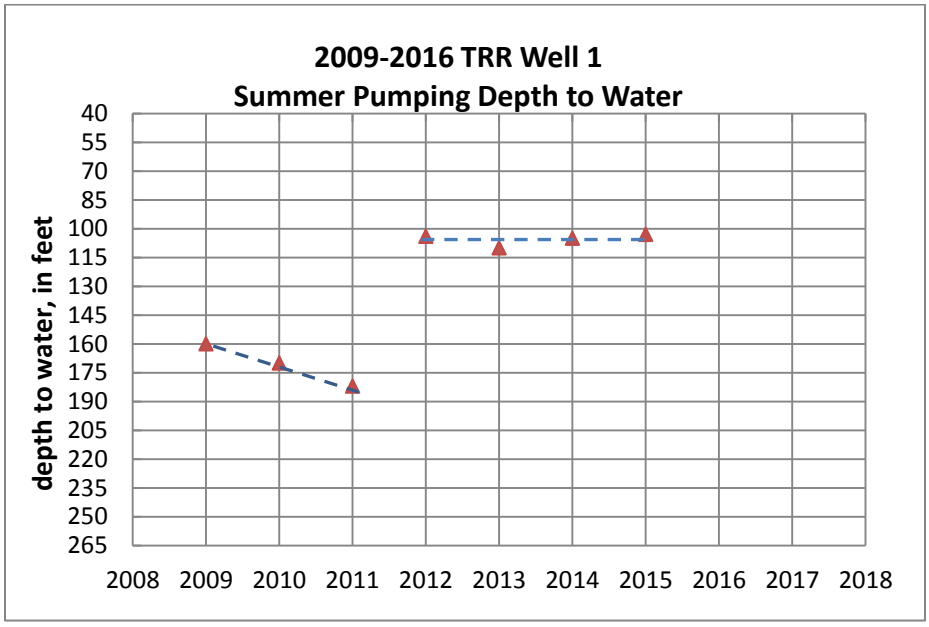


Figure 3

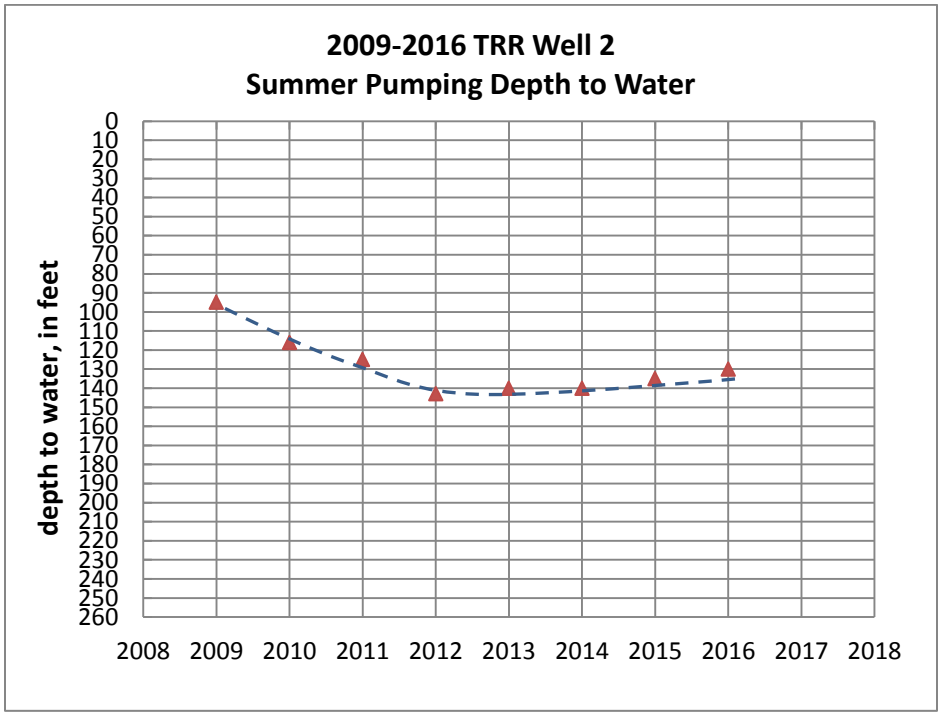
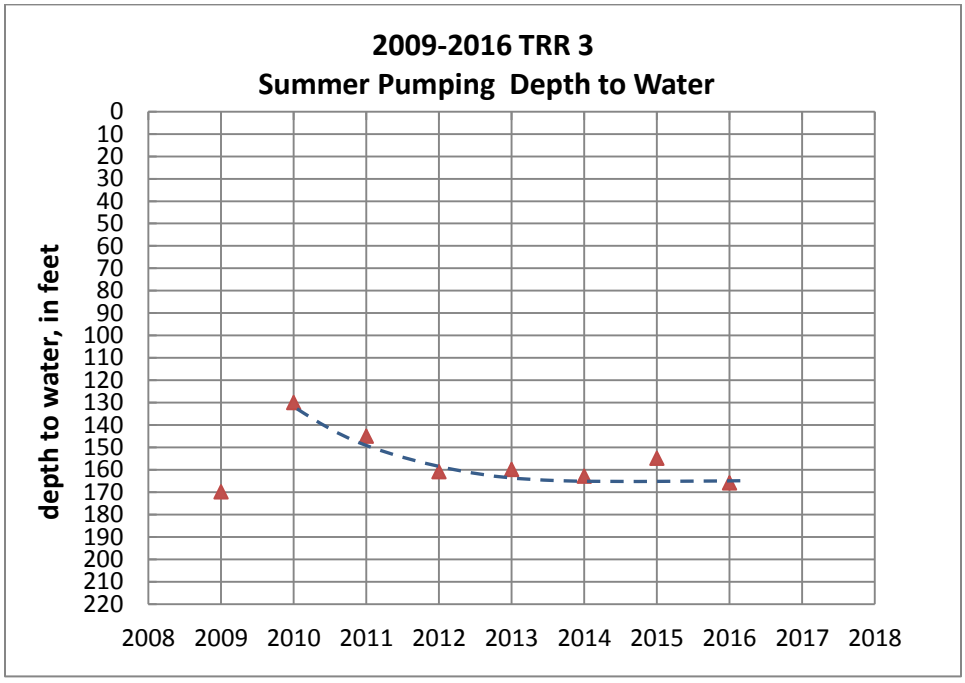


Figure 4



While the use of average values for water demand is important from the standpoint of overall water availability; the actual demand on the well field varies seasonally with maximum residential, commercial, and landscape demand (table 3), and golf course demand (table 10) being highest during the warmer drier part of the year and lowest during the colder parts.

Table 10 2008–2015 Golf Course Demand at the TRR Well Field

Month	2008	2009	2010	2011	2012	2013	2014	2015
Jan	0	0	0	4,312,700	-	4,929,000	2,688,000	3,723,000
Feb	0	0	5,616,200	482,200	-	3,556,000	4,699,000	1,898,000
March	3,879,000	3,528,000	4,837,400	1,486,700	8,189,200	2,003,000	5,357,000	1,105,000
April	13,233,000	9,577,000	10,869,400	7,055,200	8,257,100	9,493,000	9,807,000	9,365,000
May	12,702,000	15,675,000	15,396,500	10,554,300	9,960,800	12,514,000	11,308,000	10,529,000
June	16,814,000	9,792,000	10,334,000	12,351,600	12,326,900	11,811,000	14,345,000	10,455,000
July	12,746,000	12,864,000	10,606,200	13,912,700	15,509,500	15,103,000	12,191,000	10,151,000
Aug	13,189,000	13,084,000	12,770,700	13,736,300	14,468,400	8,278,000	8,589,000	8,758,000
Sept	13,219,000	10,981,000	9,405,600	14,799,800	7,081,600	7,893,000	4,436,000	8,191,000
Oct	9,355,000	12,040,000	12,503,400	8,676,700	5,770,200	7,585,000	5,084,000	8,338,000
Nov	6,432,000	4,836,000	9,478,800	6,623,100	7,105,500	8,211,000	6,816,000	7,090,000
Dec	615,000	1,515,000	5,428,600	8,189,200	6,005,800	4,762,000	4,969,000	2,338,000
Total	102,184,000	93,892,000	107,248,810	102,180,500	94,675,000	96,138,000	90,289,000	81,941,000

Table 11 shows the combined average daily demand on the TRR well field per month at full build-out of all subdivisions utilizing 1) the average daily demand per month of residential water use including landscape and commercial demand in column 6, table 3, and 2) golf course demand based on multiplying the percentage of each months water demand for 2015 (table 10) times the remaining future estimated demand of 41,500,530 per year. Column 3, table 11, shows the average daily residential demand per month based on 1,512 single-family residences; column 4 shows the average daily golf course demand per month; column 5 shows the combined average daily residential and golf course demand per month; column 6 shows the required pumping hours per day per month assuming wells 1 and 3 are pumping; column 7 shows the required pumping hours per day per month assuming wells 2 and 3 are pumping. A combination of wells 1 and 2 (not shown) would fall between the requirements shown in columns 6 and 7.

As shown, maximum projected summer demands have a significant impact on pumping times at the well field with projected pumping rates in July requiring two wells to pump at or just below 24 hours per day. Because daily demands can exceed average monthly demand it may be necessary to coordinate landscape and the golf course demand during this period of time and/or to consider reducing present and projected landscape demand.

Table 11

1 Month	2 2013-2016	3 1512	4 golf course	5 total	6 wells 1-3	7 wells 2-3
January	100	151,473	60,825	212,298	6.4	5.9
February	113	170,267	34,331	204,599	6.2	5.7
March	121	182,578	18,053	200,631	6.0	5.6
April	239	360,721	158,103	518,823	15.6	14.5
May	257	388,185	172,020	560,204	16.9	15.7
June	291	439,751	176,504	616,256	18.5	17.3
July	402	607,263	165,844	773,107	23.3	21.7
August	297	448,787	143,086	591,873	17.8	16.6
September	293	442,975	138,283	581,258	17.5	16.3
October	247	373,001	136,224	509,225	15.3	14.3
November	211	318,844	119,695	438,539	13.2	12.3
December	116	174,671	38,198	212,868	6.4	6.0

APPENDIX A

The October 24 – 27, 2007 Three-Day Well Field test

The TRR well field consists of three wells referred to as TRR wells 1, 2, and 3 (State registration numbers 584177, 589659, and 589660 respectively). Construction of TRR well 1 began on January 3, 2001 and was completed on February 5, 2001; construction of TRR well 2 began on March 27, 2001 and was completed April 20, 2002; construction of TRR well 3 began May 13, 2002 and was completed May 15, 2002. Southwest Groundwater Consultants (SWGC) under contract to Harvard Investments oversaw the location, construction, and testing of the well field.

The aquifer tapped by the TRR well field consist of medium to coarse sand with small amounts of intermixed gravel and layers of gravel and sand mixed with minor amounts of silt and clay. Interbedded within this material is a layer of basalt that is encountered at depths ranging from 70 ft., 108 ft., and 118 ft. below land surface at wells 1, 2, and 3 respectively. Thickness of the basalt ranges from 41 ft. to 50 ft. Geologic logs of nearby wells indicate that the areal extent of the basalt is limited and does not extend far beyond the well field. The base of the aquifer at the well field is formed by granitic and metamorphic rocks occurring at depths ranging from about 300 ft. below land surface at well 1, 262 ft. at well 2, and 240 ft. below land surface at well 3.

The regional water table lies in the unconsolidated sands and gravel above the basalt. In the absence of pumping, the altitude of the water table varies naturally in accordance with the seasonal pattern of precipitation. Measured depth to water at completion of drilling for each well was 20 ft., 57 ft., and 23 ft. below land surface at wells 1, 2, and 3 respectively. Wells 1 and 3 are at about the same elevation above sea level whereas well 2 is about 10 ft. higher. Subsequent non-pumping measurements at the well field have shown that the depth to water below land surface at well 2 is about 8-10 ft. deeper than that at wells 1 and 3 (which is consistent with the difference in elevation of the wells), rather than the 34-37 ft. difference indicated by the initial water level measurement at well 2. This suggests that the initial water level measurement at well 2 was affected by pumping conditions at TRR well 1.

The July 16, 2001 Analysis of Adequate Water Supply for Phases 2-8 approved by ADWR was not based on the long term capacity of TRR wells 1, 2, and 3 and the ability of these wells to meet the long-term demand of the TRR subdivision and golf course; rather it was based on the an estimate of average annual recharge to the aquifer and ground water flux through the aquifer being tapped by the wells. On the other hand, the ability of ICRWUA to meet the ultimate demand of each Phase and the golf course depends on the long-term yield of the TRR Well Field as a whole. **This analysis was never conducted prior to ADWR's acceptance of the July 16, 2001 Analysis of Adequate Water Supply for Phases 2-8**. For all practical purposes the only test conducted at the TRR well field was conducted from October 24 through October 27, 2007 the results of which are discussed in Appendix A.

Following completion of well construction SWGC tested each well. Based on tests results SWGC estimated the pumping capacity of each well assuming a twelve hour pumping period and further assuming that the yield of each well is independent of pumpage from the other wells. **Given these restrictions SWGC estimated the combined 12 hour yield of the well field at 1,485 gpm, with**

individual well yields for wells 1, 2, and 3 rated at 525 gpm, 530 gpm, and 430 gpm respectively. Given that the 12-hour yield of a well is not a realistically related to a well's long-term capacity and that the three wells are closely spaced with the result that pumpage from any given well can significantly lower the water level in the other two thereby lowering the yield of each well, SWGC's conclusions are essentially meaningless in terms of estimating the long-term yield of the well field. Even so, with the approval of Harvard Investments, each well was fitted with a pump that was capable of producing the stated 12 hour yield of the well.

The pumps originally installed on each well had to be considerably downsized in order for the well to become fully reliable under actual pumping conditions. Use of the well field beginning in 2002 quickly indicated that the actual yield from each well was considerably less than stated. Pumping lowered the water level in wells 2 and 3 to the point that both immediately experienced problems with air entrainment in the water and pump cavitation due to low water levels. The pump on well 3 quickly failed from the combination of both problems. The pump was downsized from 430 gpm to about 200 to 260 gpm in 2003 after which the well has been highly reliable and has experienced minimal air entrainment.

Problems with low water levels and entrained air at well 2 continued but were not as severe following the reduction in pump size at well 3. Ultimately, however, based on the results of the October 24-27, 2007 well field test discussed below and subsequent test for air entrainment the pump at this well was downsized in 2009 from 530 gpm to a pump capacity of about 285 gpm. Due to an electrical problem the pump failed in June 2013 and was replaced in July of that year. The capacity of the new pump is about 250 to 280 gpm. Since then, this well has been highly reliable and has experienced minimal air entrapment.

Well 1 also experienced problems with air entrainment and based on the results of the October 24-27, 2007 well field test and an additional study of air entrainment completed in 2011 its pumping capacity was downsized in February 2012 from about 500 gpm to about 330 gpm. Following this the well has been highly reliable.

Prior to the downsizing of the pump at well 2 in 2009 ICRWUA continually received complaints from homeowners within the TRR subdivision concerning an unacceptable concentration of air in residential water. In addition the well field was being heavily pumped during the pre-monsoon period for irrigation of the golf course. During the time period of June 1-July 11, 2007 well 1 averaged 16 hours per day while well 2 averaged 14.8 and well 3 averaged 23.4 hours per day. Maximum combined daily use of the three wells was 66.4 hours on July 2 and 3, with wells 1 and 3 pumped for 24 hours and well 2 for 15.8 hours.

Combined well field yield fell from 1,069 gpm on June 2 to 893 gpm on July 10, a decline of about 26 percent. Future projected growth at the TRR subdivision at the time would add approximately 1,610 additional residences and it was obvious that without a significant change in golf course demand the overall demand on the well field would only increase as more homes were added. Given the fact that pumpage from each well reduces the capacity of the other two wells and that the well field demand required simultaneous pumpage from all three wells that was approaching each well pumping 24 hours

per day, ICRWUA concluded that there was a need to identify the maximum capacity of the well field with all wells pumping simultaneously.

In response to this, a three day test of the TRR well field was conducted from 8:00 am Wednesday October 24, 2007 through 8:00 am Saturday October 27, 2007 with all three wells in the field pumping. Pumping rates and water levels in each well were monitored throughout the test. Water levels were also monitored at TRR well 4, a well installed by Harvard Investments about 450 feet from the well field in 2006. The test was conducted as a joint effort between ICRWUA and Harvard Investments.

A semi-quantitative method for monitoring air production from each well was also employed in order to help evaluate the possible source of reported problems with aerated water at TRR households.

Test Results – Well Yields

The test had two main purposes. One purpose was to establish the three day yield of the well field with simultaneous pumping from all three wells with the understanding that the short duration of the test combined with other hydrologic issues would not allow the ultimate long-term capacity of the well field to be established.

As shown in figure 1, the combined yield from the three wells declined over the three day test period, falling from about 1,200 gpm at the beginning to 828 gpm at the end. The decline in production was continuing at the termination of the test. Because production from the well field had not stabilized, the ultimate value for the combined yield of the three wells over a longer period of pumping could not be determined, but it was less than 828 gpm with the current configuration of pump size on the wells.

The initial yield from well 1 was 500 gpm. At the end of the test its yield had declined to 379 gpm and was continuing to decline, figure 2. The rates that are significantly above or below the trend line in figure 1 are early time data when the highest potential for error in the actual time of reading the flow meter exists. Overall, the decline in production from the well was about 24 percent.

Initial and final yields from well 2 were 485 gpm and 317 gpm respectively; figure 3, an overall decline in production of about 35 percent.

Initial yield from well 3 was 236 gpm while the yield over the final four hours of the test was only 132 gpm, figure 4. The latter value is considerably below the general decline in the well's yield during the test. The well's flow meter was independently read by two separate individuals at the end of the test however so that the value is not suspect. The overall decline in production was about 44 percent.

Water level declines in the three wells are shown in figures 5, 6, and 7 for wells 1, 2, and 3 respectively.

In general the pumping rate at well 1 was essentially stabilizing during the latter part of the test while the pumping rate at well 2 was in a small decline. The pumping rate for well 3 increased during the latter

part of the test, but then experienced a sharp decline over the last four hours. The reason for this decline is not evident in the drawdown measured at the well however.

By the end of the test, drawdown in TRR well 4 caused by the three day test was 64 feet indicating that the cone of depression resulting from the test extended a considerable distance. Had the cone of depression reached an aquifer boundary, thereby reducing well yield, the drawdown at well 3 would have sharply fell also but as can be seen in figure 8 this is not the case.

Despite the small decline in pumping rate at well 2 and the sharp drop in pumping rate at well 3, the hydrographs of drawdown for all three wells indicates that water levels were beginning to stabilize that, in turn, would indicate that the well yields were also nearing stabilization at the end of the test.

Figure 1

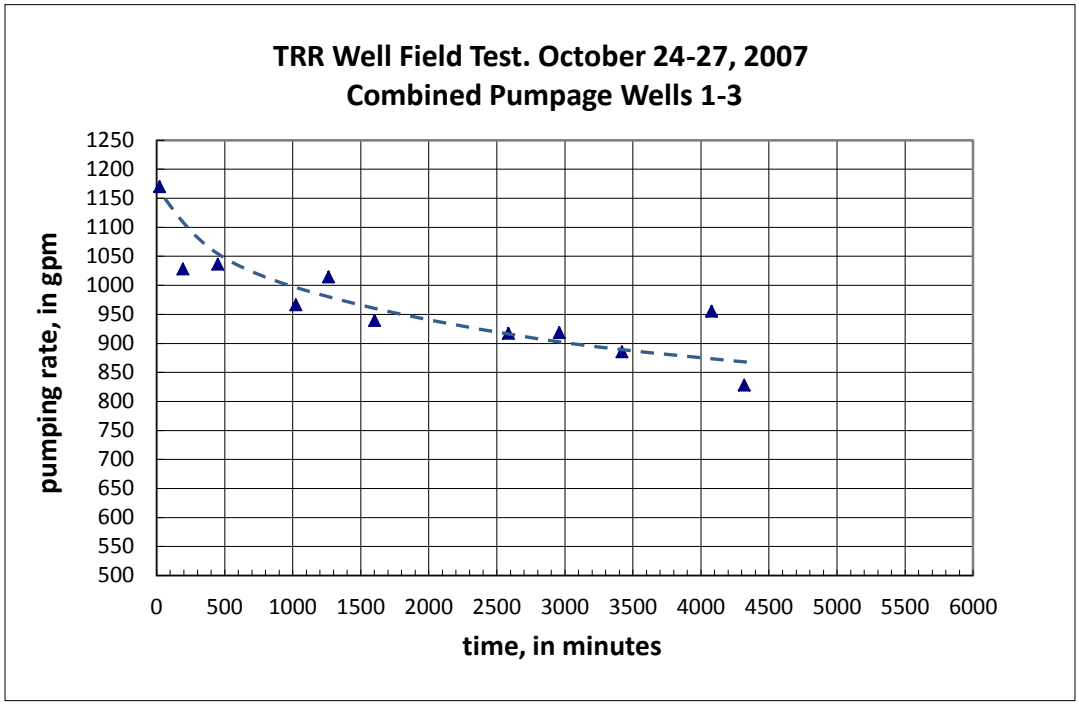


Figure 2

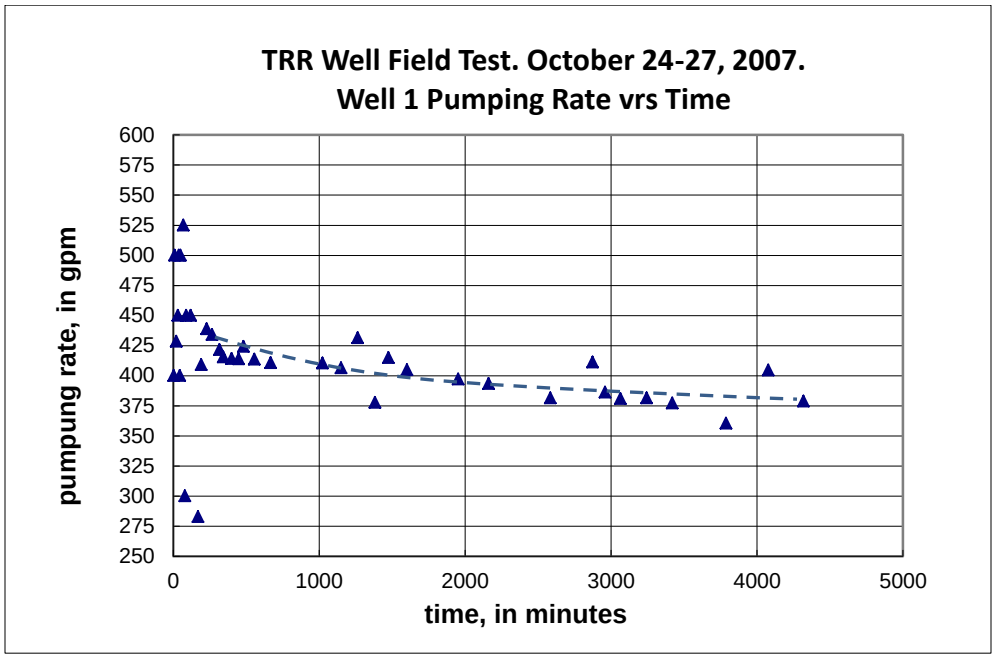


Figure 3

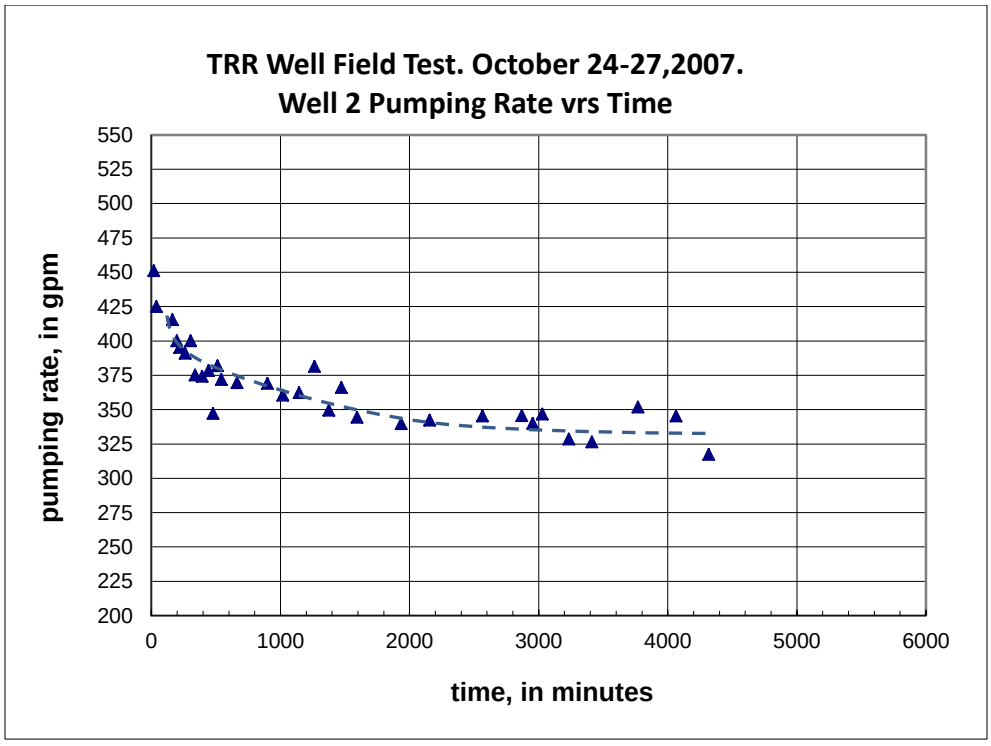


Figure 4

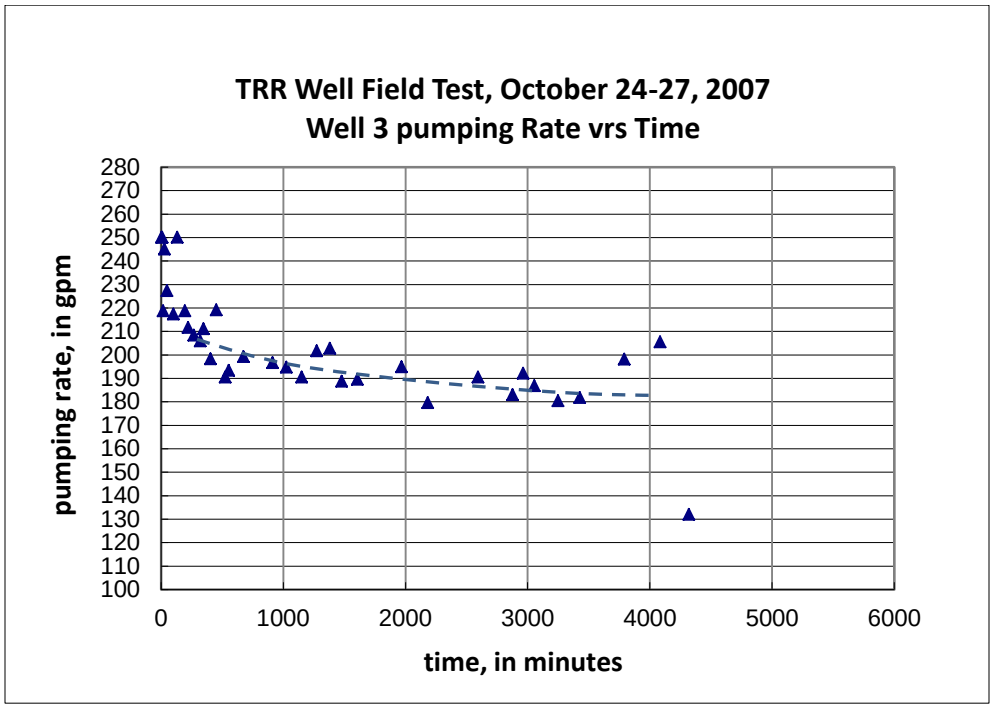


Figure 5

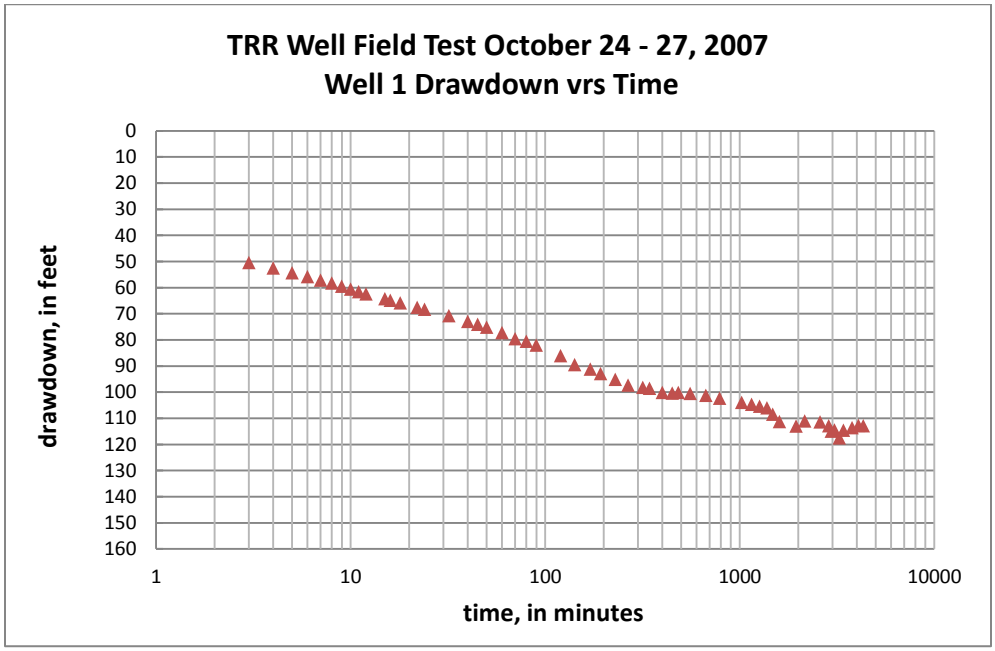


FIGURE 6

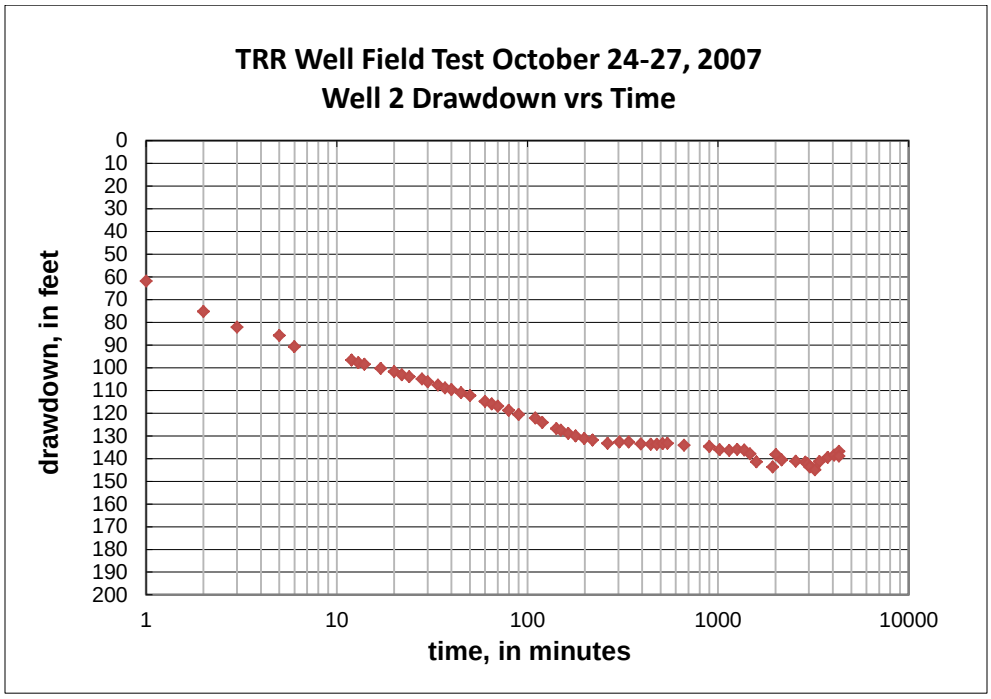
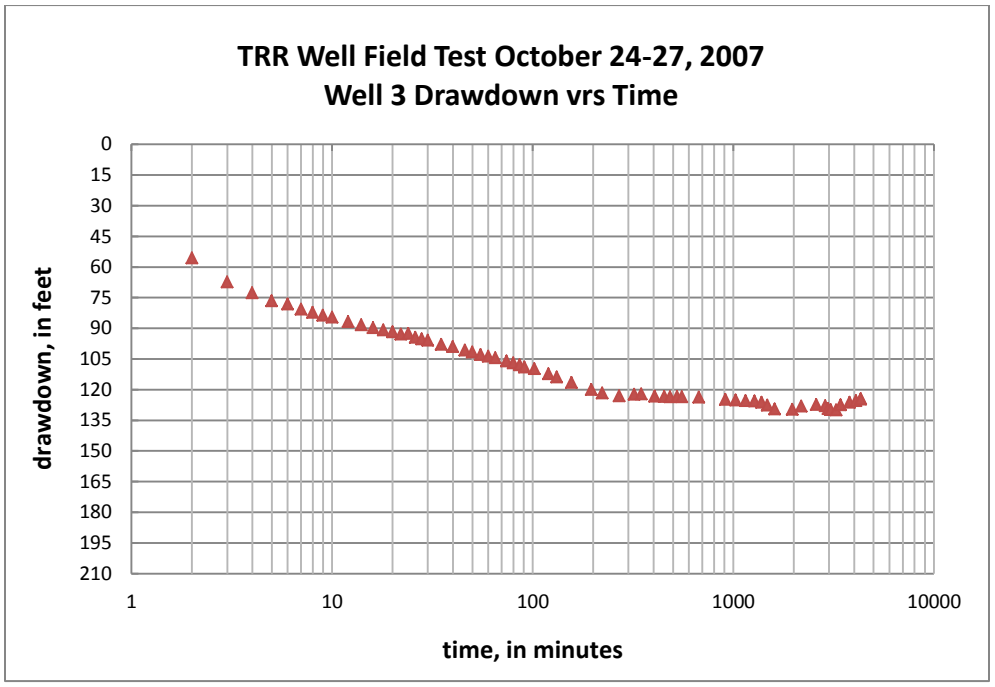


Figure 7



The most significant conclusion from the October 24-27, 2007 test at the TRR Well Field was that the 2007 pre-monsoon demand was essentially equal to or exceeded the well field's maximum yield. The maximum demand at the well field over the 2007 pre-monsoon season was 1,227,500 gallons on July 5. This demand required an average combined well field yield of 852 gpm, about 24 gpm more than the combined yield of the three wells at the end of the three-day test.

Given the projected increase in residential demand, it was apparent that the golf course demand on the well field during the pre-monsoon period had to be reduced. This led directly to the construction of the golf course lake with a capacity of 20,000,000 gallons. Filling the lake during periods of the year with low demand has significantly reduced pre-monsoon demand while stabilizing well yield at the same time.

The decline in well yields as the test progressed is not a normal characteristic of a well unless it is being over-pumped in terms of the aquifer and/or pump efficiency. Although counter intuitive, the long-term yield of a well field can be increased by lowering the pumping capacity at the well while increasing pump efficiency.

As noted above, the pumping capacity of all three wells has been reduced from their initial value with well 3 being downsized in 2003 and wells 1 and 2 being downsized after the October 2007 test. **The result, as discussed previously, has been a stabilization of water levels along with a commensurate stabilization of pumping rates.**

Test Results - Air Production

The second purpose of the October 24-27, 2007 well field test was to determine if one or more of the wells represented the source of aerated water at the TRR subdivision. Visual estimates made during the pre-monsoon season had shown that wells 1 and 2 produced significant amounts of air with that from well 1 exceeding that from well 2.

During the test then, air production from each well was measured from each well in order to determine if one or more of the wells represented the source of aerated water. Air production is in terms of air released per unit volume of pumped water at atmospheric pressure. The standard that was set by the ICRWUA was that air production from any of the three wells should not exceed 3.5 percent. The second purpose therefore was to measure air production.

Air production in wells 1 and 3 during the October 2007 test averaged 1.22 and 2.20 percent per unit volume. Average air production from well 2 was 11.27 percent. The combined average air production from the well field during the test was about 5.3 percent per unit volume. In addition, the measurements at 2 indicated that air entrainment increased as drawdown increased. This observation led to further testing of the wells that allowed a relationship between air production and drawdown to be established in both wells 1 and 2 that, in turn, further indicated the need to reduce the pump size at the wells. Following re-fitting of pump size of well 2 in 2009 and well 1in 2012 air entrainment has fallen to acceptable levels.