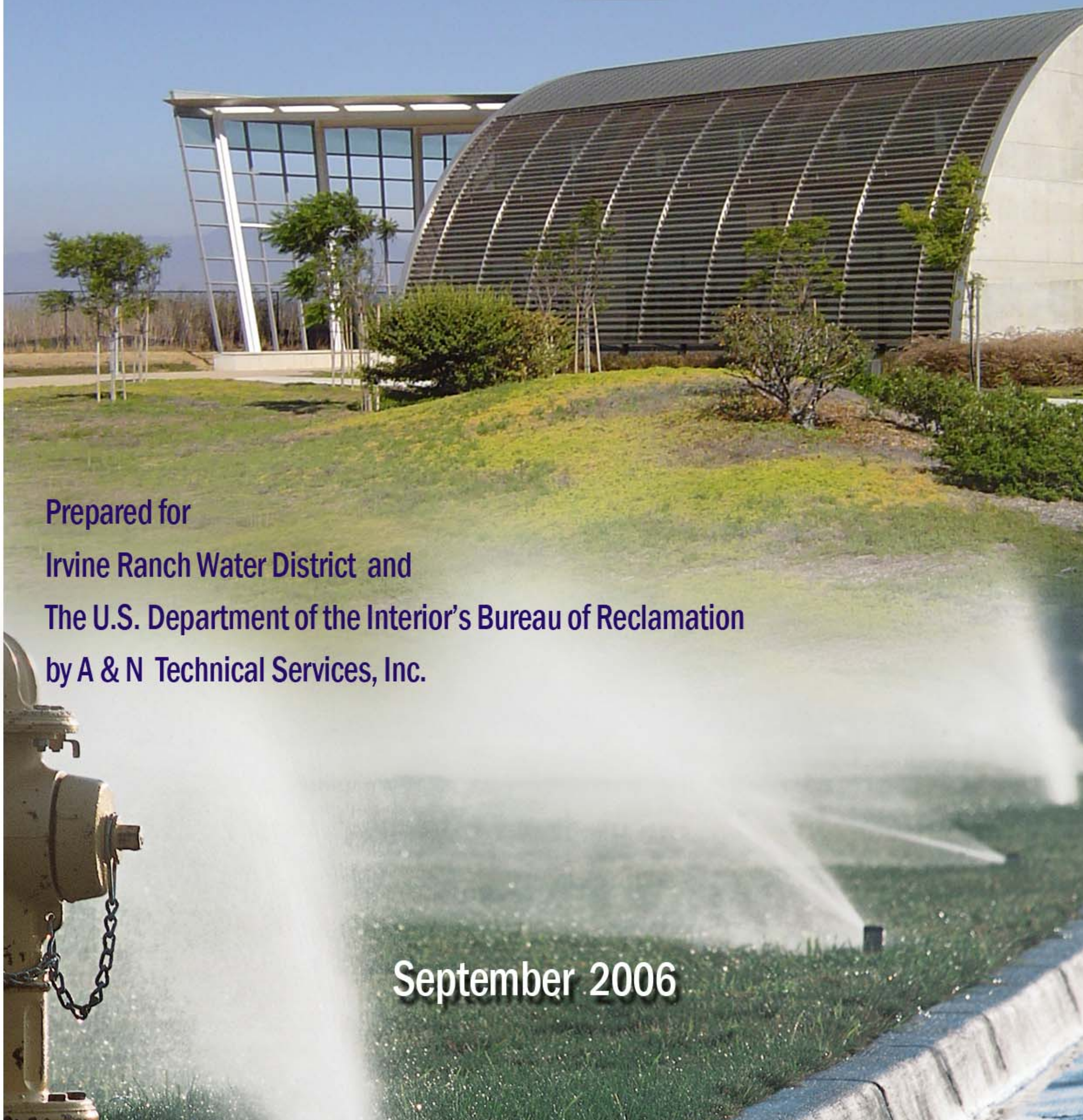
Commercial ET-Based Irrigation Controller Water Savings Study



Prepared for

Irvine Ranch Water District and

The U.S. Department of the Interior's Bureau of Reclamation

by A & N Technical Services, Inc.

September 2006

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FINAL REPORT

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Acknowledgements

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Summary

Water Savings: The statistical model of this report estimates that commercial customers who installed ET irrigation controllers saved 601 gallons per day on average over the five year post-installation period (the 95 percent confidence interval lies between 372 gpd and 830 gpd). Critically, no diminution of water savings could be detected—that is, the water savings observed in the first year tended to persist with no observable decrease in the magnitude of water savings. This finding is critical for determination of the value of investment in this form of water use efficiency improvement.

Customer Awareness and Satisfaction: The responding sample of participating commercial customers is very small (13 respondents of 16 contacted) so no definitive conclusions should be made. The suggestive findings from this small sample suggest a very uneven awareness of the functioning of the ET controller (several respondents were even unaware of who was paying for the signal fee). Many noted the decrease in water consumption and the resulting decrease in their water bill. There were no respondents who could not recommend the ET controllers to others, only 2 respondents who had no opinion, and the remainder of respondents stated that they would recommend the ET controllers to others. Follow-up visits to participating sites by IRWD staff were able to document several problems with ET controller setup and signal receptions. Appendix B contains the results of the Customer Survey and Site Visit follow-ups. The extremely uneven customer awareness of ET controllers underlines the importance of the initial setup and the need for periodic follow-up.

Introduction

The purpose of this work is a statistical analysis of water savings among commercial customers who installed evapotranspiration (ET) controllers in the Irvine Ranch Water District. This report documents a careful statistical analysis of historical water consumption data to derive estimates of the net water savings from these interventions. In addition, a survey of participating customers was conducted to assess their knowledge and satisfaction with the ET controllers. This study was made possible through the funding of the Irvine Ranch Water District and The U.S. Department of the Interior's Bureau of Reclamation.

Approach

Historical water consumption records (December 1999 to November 2005) for a sample of participants and for a sample of nonparticipating customers were examined statistically. The hypothesis was that installation of new irrigation technology or better management of existing equipment would reduce the observed water consumption of customers participating in this program. This study empirically estimates the water savings that resulted from commercial customers receiving ET controllers and initial installation assistance.

Since installation of ET controllers required the voluntary agreement of the customer to participate, this sample of customers can be termed “self-selected.” Customers were randomly chosen to receive the education-only treatment. While this analysis does quantitatively estimate the reduction of participant’s water consumption, one may not directly extrapolate this finding to nonparticipants. This is because self-selected participant can differ from customers that decided not to participate.

The explanatory variables in these models include

- Deterministic functions of calendar time, including

- The seasonal shape of demand
- Weather conditions
  - measures of air temperature
  - measures of precipitation, contemporaneous and lagged
- Customer-specific mean water consumption
- "Intervention" measures of the date of participation and the type of intervention

Data and Methods

Consumption records were compiled from the IRWD customer billing system for customers in the study areas. Billing histories were obtained from meter reads between December 1999 and November 2005. It is important to note that a meter read on August 1 will largely represent water consumption in July. Since the ET controllers were installed in May and June of 2001, the derived sample now contains more than four years of data for each participant. Table 1 presents descriptive statistics on the sample of landscape-only customers (17 accounts). A matched control group was selected by IRWD staff by visual inspection, finding 3-5 similar control sites for each participating site. Similarity was judged by irrigated area and type of use (Home Owner Association, Office, or Streetscape).

The descriptive statistics of the raw consumption data in Table 1 suggest a few things. The participant group had slightly higher mean pre-intervention use as compared to the matched control group (4.67 inches per acre versus 4.09 inches per acre). Since participants had been identified by higher than average consumption, this is not a surprising finding. The ET controllers were installed in May and June of 2001. The reader should be careful in interpreting mean use in 2001—or any other single year, for that matter—as realized weather can greatly affect any individual year[4].

[4] In 2001, evapotranspiration was less than average. It is possible that control customers completely switched off controllers during some cloudy periods. Applying water exactly according to ET-requirements might require higher levels of use.

Table 1: Descriptive Statistics

	Participant	Control
Number of Usable Accounts	17	97
Acres per Account	0.80	0.79
2000		
Mean Use (gpd)	2608.62	2835.41
Mean Use per Acre (inches/month)	4.67	4.09
No. of observations	1,114	1,015
2001		
Mean Use (gpd)	2232.79	2086.10
Mean Use per Acre (inches/month)	4.00	2.98
No. of observations	1,165	1,035
2002		
Mean Use (gpd)	2318.19	2248.83
Mean Use per Acre (inches/month)	4.01	3.13
No. of observations	1,213	1,044
2003		
Mean Use (gpd)	2021.10	2217.79
Mean Use per Acre (inches/month)	3.50	2.99
No. of observations	1,241	1,003
2004		
Mean Use (gpd)	2101.87	2271.05
Mean Use per Acre (inches/month)	3.57	3.06
No. of observations	1,221	1,006
2005		
Mean Use (gpd)	2070.47	2071.24
Mean Use per Acre (inches/month)	3.50	2.87
No. of observations	1,139	948

The post-intervention use of the participant group was brought down over time. Importantly, the amount of applied water among participants has not climbed back up over time. The statistical model will control for differences in pre-intervention use, weather fluctuations, and arrive a formal estimate of the delta change in water use.

Daily weather measurements—daily precipitation, maximum air temperature, and evapotranspiration—were collected from the CIMIS weather station located in Irvine. The daily weather histories were collected as far back as were available (January 1, 1948) to provide the best possible estimates for "normal" weather through the year. Thus we have at least 57 observations (one for each year) upon which to judge what "normal" rainfall and temperature for January 1rst of any given year.

Robust regression techniques were used to detect which observations are potentially data quality errors. This methodology determines the relative level of inconsistency of each observation with a given model form. A measure is constructed to depict the level of inconsistency between zero and one; this measure is then used as a weight in subsequent regressions. Less consistent observations are down-weighted. Other model-based outlier diagnostics were also employed to screen the data for any egregious data quality issues.

Specification

A Model of Water Demand

The model for customer water demand seeks to separate several important driving forces. In the short run, changes in weather can make demand increase or decrease in a given year. These models are estimated on a meter-specific level and, as such, should be interpreted as a condensation of many types of relationships—meteorological, physical, behavioral, managerial, legal, and chronological. Nonetheless, these models depict key short-run and long-run relationships and should serve as a solid point of departure for improved quantification of these linkages.

Systematic Effects

This section specifies a water demand function that has several unique features. First, it models seasonal and climatic effects as continuous (as opposed to discrete monthly, semi-annual, or annual) function of time. Thus, the seasonal component in the water demand model can be specified on a continuous basis, then aggregated to a level comparable to measured water use (e.g. monthly). Second, the climatic component is specified in different form as a similar continuous function of time. The weather measures are thereby made independent of the seasonal component. Third, the model permits interactions of the seasonal component and the climatic component. Thus, the season-specific response of water demand can be specific to the season of the year.

The general form of the model is:

Equation 1

$$Use = \mu_i + S_t + W_t + E_{i,t}$$

where ***Use*** is the quantity of water demand within time *t*, the parameter $\boldsymbol{\mu_i}$ represents mean water consumption per meter *i*, $\boldsymbol{S_t}$ is a seasonal component, $\boldsymbol{W_t}$ is the weather component, $\boldsymbol{E_{i,t}}$ is the effect the landscape interventions for meter *i* at time period *t*. Each of these components is described below.

Seasonal Component : A monthly seasonal component can be formed using monthly dummy variables to represent a seasonal step function. Equivalently, one may form a combination of sine and cosine terms in a Fourier series to define the seasonal component as a continuous function of time.[1] The following harmonics are defined for a given day *T*, ignoring the slight complication of leap years:

Equation 2

$$S_t \equiv \sum_{1}^{6}\left[\beta_{i,j}\cdot\sin\left(\frac{2\pi\cdot jT}{365}\right)+\beta_{i,j}\cdot\cos\left(\frac{2\pi\cdot jT}{365}\right)\right] = Z\cdot\beta_S$$

[1] The use of a harmonic representation for a seasonal component in a regression context dates back to *Hannan* [1960]. *Jorgenson* [1964] extended these results to include least squares estimation of both trend and seasonal components.

where T = (1,...365) and j represents the frequency of each harmonic.[2] Because the lower frequencies tend to explain most of the seasonal fluctuation, the higher frequencies can often be omitted with little predictive loss.

To compute the seasonal component one simply sums the multiplication of the seasonal coefficient with its respective value. This number will explain how demand changes due to seasonal fluctuation.

Weather Component: The model incorporates two types of weather measures into the weather component–maximum daily air temperature and rainfall.[3] The measures of temperature and rainfall are then logarithmically transformed to yield:

Equation 3

$$R_t \equiv \ln\left[1+\sum_{t=T}^{T_d} Rain_t\right], A_t \equiv \ln\left[\sum_{t=T}^{T_d}\frac{AirTemp_t}{d}\right]$$

where d is the number of days in the time period. For monthly aggregations, d takes on the values 31, 30, or 28, ignoring leap years; for daily models, d takes on the value of one. Because weather exhibits strong seasonal patterns, climatic measures are strongly correlated with the seasonal measures. In addition, the occurrence of rainfall can reduce expected air temperatures. To obtain valid estimates of a constant seasonal effect, the seasonal component is removed from the weather measures by construction.

Specifically, the weather measures are constructed as a departure from their "normal" or expected value at a given time of the year. The expected value for rainfall during the year, for example, is derived from regression against the seasonal harmonics. The expected value of the weather measures ($\hat{\boldsymbol{A}}=\boldsymbol{Z}\hat{\boldsymbol{\alpha}}$) is subtracted from the original weather measures:

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[2] If measures of water demand are available on a daily basis, the harmonics defined by Equation 2 can be directly applied. When measures of water demand are only observed on a monthly basis, two steps must be taken to ensure comparability. First, water demand should be divided by the number of days in the month to give a measure of average daily use. Otherwise, the estimated seasonal component will be distorted by the differing number of days in a month. The comparable measures of the seasonal component are given by averaging each harmonic measure for the number of days in a given time period.

[3] Specifically it uses the maximum daily air temperature and the total daily precipitation at the Irvine weather station. This station was selected due to its proximity to the study area.

Equation 4

$$W_t \equiv (R_t - \widehat{R}_t) \cdot \beta_R + (A_t - \widehat{A}_t) \cdot \beta_A$$

The weather measures in this deviation-from-mean form are thereby separated from the constant seasonal effect. Thus, the seasonal component of the model captures all constant seasonal effects, as it should, even if these constant effects are due to normal weather conditions. The remaining weather measures capture the effect of weather departing from its normal pattern.

The model can also specify a richer texture in the temporal effect of weather than the usual fixed contemporaneous effect. Seasonally-varying weather effects can be created by interacting the weather measures with the harmonic terms. In addition, the measures can be constructed to detect lagged effects of weather, such as the effect of rainfall one month ago on this month's water demand.

Effect of Landscape Interventions: Information was compiled on the timing and location of each ET controller installation and education-only customer participation. The account numbers from these data were matched to meter consumption histories going back to 1999. All raw meter reads were converted to average daily consumption by dividing by the number of days in the read cycle. Using these data, relatively simple "intervention analysis" models[5] were statistically estimated where, in this case, the intervention is ET controller installation. The form of the intervention is:

Equation 5

$$E_{i,t} \equiv I_{ET} \cdot \beta_{ET}$$

The indicator variable I_{ET} takes on the value one to indicate the presence of a working ET controller and is zero otherwise. The parameter $\hat{\beta}_{ET}$ represents the mean effect of installing an ET controller and is expected to be negative (installing an ET controller reduces water consumption.)

[4]See Box and Tiao, "Intervention Analysis with Applications to Economic and Environmental Problems" *Journal of the American Statistical Association*, Vol 70, No. 349, March 1975, pp. 70-70.

This formulation also permits formal testing of the hypothesis that landscape interventions can affect the seasonal shape of water consumption within the year. Since numerous studies have identified a tendency of customers to irrigate more than ET requirements in the fall and somewhat less in the spring, it will be informative to examine the effect of ET controllers designed to irrigate in accord with ET requirements. The formal test is enacted by interacting the participation indicators with the sine and cosine harmonics.

Stochastic Effects

To complete the model, we must account for the fact that not every data point will lie on the plane defined by **Equation 1**. This fundamental characteristic of all systematic models can impose large inferential costs if ignored. Misspecification of this "error component" can lead to inefficient estimation of the coefficients defining the systematic forces, incorrect estimates of coefficient standard errors, and an invalid basis for inference about forecast uncertainty. The specification of the error component involves defining what departures from pure randomness are allowed. What is the functional form of model error? Just as the model of systematic forces can be thought of as an estimate of a function for the "mean" or expected value, so too can a model be developed to explain departures from the mean—i.e., a "variance function" If the vertical distance from any observation to the plane defined by **Equation 1** is the quantity **ε**, then the error component is added to **Equation 1**:

Equation 6

$$Use = \mathbf{f}\left(\mathbf{S}_t, \mathbf{C}_t, \mathbf{T}_t\right) + \varepsilon$$

The error structure is assumed to be of the form:

Equation 7

$$\varepsilon_{it} = \mu_i + \xi_{it}$$
$$where$$
$$\mu_i \sim N(0, \sigma_\mu^2)$$
$$\xi_{it} \sim N(0, \sigma_\xi^2)$$

The X and ξ are assumed to be independent of each other and of μ. The individual component μ represents the effects of unmeasured site characteristics on site water use. An example of such an unmeasured characteristic might be the water use behavior of the commercial customer. This effect is assumed to persist over the estimation period. The second component ξ represents random error. Because μ and ξ are independent, the error variance can be decomposed into two components:

Equation 8

$$\sigma_\varepsilon^2 = T \cdot \sigma_\mu^2 + \sigma_\xi^2$$

This model specification is accordingly called an error components or variance components model. The model was estimated using maximum likelihood methods.

Estimated Landscape Customer Water Demand Model

Table 2 presents the estimation results for the model of landscape (irrigation-only) customer water demand. This sample represents water consumption among 114 accounts between December 1999 and November 2005. This sample contains 15 ET controller accounts, 76 matched control accounts.

The constant term (1) describes the intercept for this equation. The independent variables 2 to 9—made up of the sines and cosines of the Fourier series described in Equation 2—are used to depict the seasonal shape of water demand. The estimated weather effect is specified in “departure-from-normal” form. Variable 10 is the departure of monthly temperature from the average temperature for that month in the season. (Average seasonal temperature is derived from a regression of daily temperature on the seasonal harmonics.) Rainfall is treated similarly (Variable 11). One month lagged rainfall deviation is also included in the model (Variables 12). The next variable accounts for the amount of irrigated acreage on the site. (Note that while measured acreage is available for all irrigation-only accounts, this is not true for single family accounts.)

The effect of the landscape conservation program interventions is captured in the following rows. The parameter on the indicator for ET controllers (15) suggests that the mean change in water consumption is 601 gallons per day, approximately 22 percent of the pre-intervention water use. The variables testing for differences in pre-intervention use distinguish slightly higher preintervention use among commercial participants.

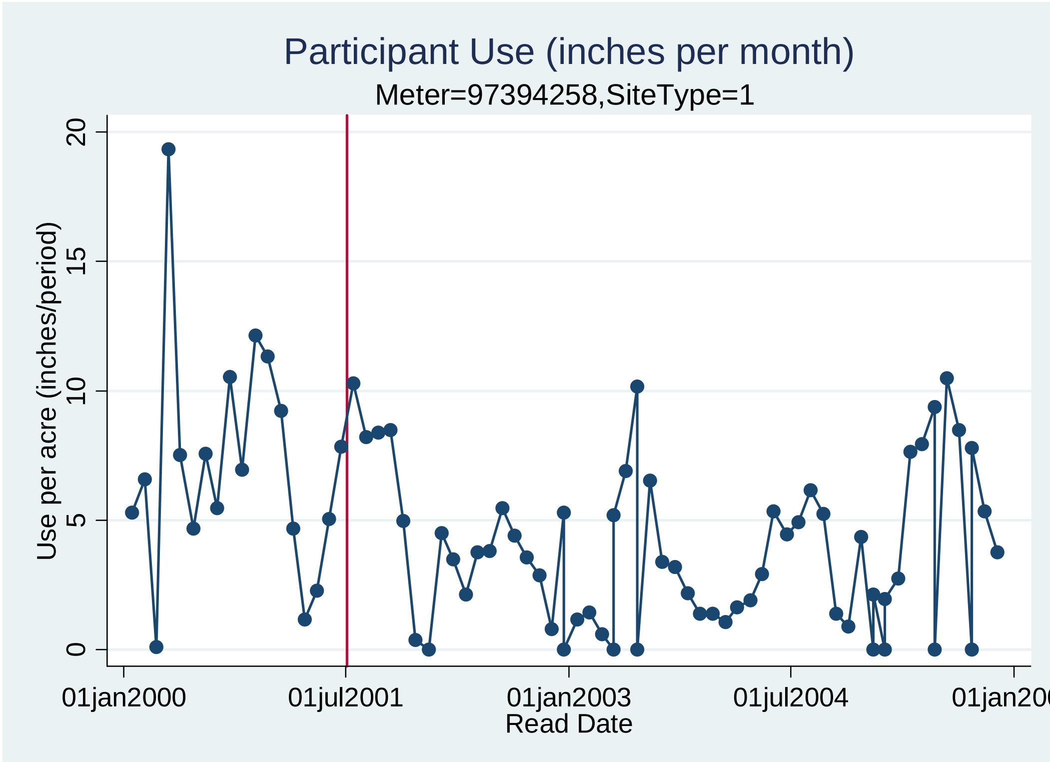
Table 2:
Landscape Customer Water Demand Model
Dependent Variable: Average Daily Metered Water Consumption (in gallons per day)

Independent Variable	Coefficient	Std. Error
1. Constant (Mean intercept)	531.4165	161.9351
2. First Sine harmonic, 12 month (annual) frequency	-1374.4600	26.8217
3. First Cosine harmonic, 12 month (annual) frequency	429.8214	26.6200
4. Second Sine harmonic, 6 month (semi-annual) frequency	-96.8666	28.0013
5. Second Cosine harmonic, 6 month (semi-annual) frequency	13.4249	27.7848
6. Third Sine harmonic, 4 month frequency	-153.0850	29.6651
7. Third Cosine harmonic, 4 month frequency	-38.6209	30.1548
8. Fourth Sine harmonic, 3 month (quarterly) frequency	67.9449	32.9077
9. Fourth Cosine harmonic, 3 month (quarterly) frequency	13.1107	32.2209
10. Deviation from logarithm of 31 or 61 day moving average of maximum daily air temperature	1829.307	610.5852
11. Deviation from logarithm of 31 or 61 day moving sum of rainfall	-378.721	47.59295
12. Monthly lag from rain deviation	-194.697	45.54725
13. Irrigated Acreage (in acres)	2118.9290	145.8384
14. ET controller sites, test for difference in pre-intervention use	527.3253	316.3494
15. Average Effect of ET controller (21 accounts)	-600.9360	116.6949
Number of observations		8243
Number of customer accounts		114
Standard Error of Individual Constant Terms		1100.0
Standard Error of White Noise Error		1682.3
Time period of Consumption	Dec. 1999 - Nov. 2005	

Appendix A – Graphs of Water Consumption

Graphs of ET Controller Participant Use

Account Number	Meter Number	Site Acres	Site Type	Non-Res-Name
60-______-03-0	____4258	0.52	1	PANEL SYSTEMS
62-______-01-3	____9944	0.78	2	NGK SPARK PLUGS
62-______-01-0	____5339	0.34	3	PACIFIC CHURCH OF IRVINE
60-______-03-8	____8565	0.23	4	SAP
60-______-06-2	____0479	0.24	5	ARBOR SURGICAL TECHNOLOGIES
60-______-01-4	____3289	0.17	5	WESTERN GRAPHTEC
60-______-01-3	____5279	0.07	6	JOES GARAGE
60-______-02-5	____2783	0.17	7	GRAPHTEC
62-______-01-4	____2256	1.02	8	NORTHWOOD SQUARE TOWN HOMES
62-______-01-3	____5351	1.33	8	SHEFFIELD MANOR HOA
62-______-01-5	____8567	0.68	8	NORTHWOOD PARK HOA
62-______-01-0	____2228	0.51	8	PROFESSIONAL REAL ESTATE
62-______-01-9	____5522	1.27	9	WOODBRIDGE VILLAGE ASSN
62-______-01-3	____5529	0.82	9	WOODBRIDGE VILLAGE ASSN
62-______-01-7	____0276	0.67	9	NORTHWOOD PARK HOA
62-______-02-1	____4813	0.57	9	NORTHWOOD PARK HOA
62-______-01-6	____7864	0.92	100	CITY OF IRVINE
62-______-02-5	____9683	0.66	100	CITY OF IRVINE
62-______-02-2	____0274	0.36	100	CITY OF IRVINE
62-______-01-1	____1240	1.65	100	CITY OF IRVINE
62-______-01-9	____1270	0.74	100	CITY OF IRVINE
62-______-01-8	____6305	0.23	100	CITY OF IRVINE
62-______-02-4	____5338	0.38	100	CITY OF IRVINE
62-______-01-7	____5358	0.19	100	CITY OF IRVINE
62-______-02-2	____0212	1.91	100	CITY OF IRVINE
62-______-01-9	____3341	1.13	100	CITY OF IRVINE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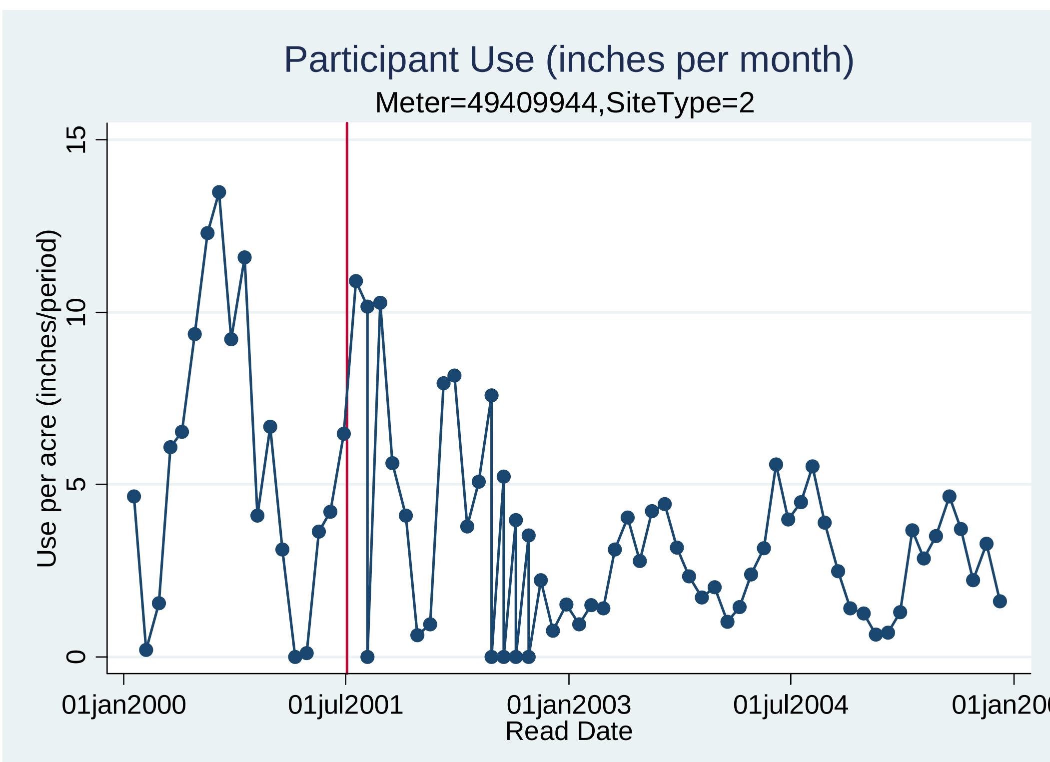
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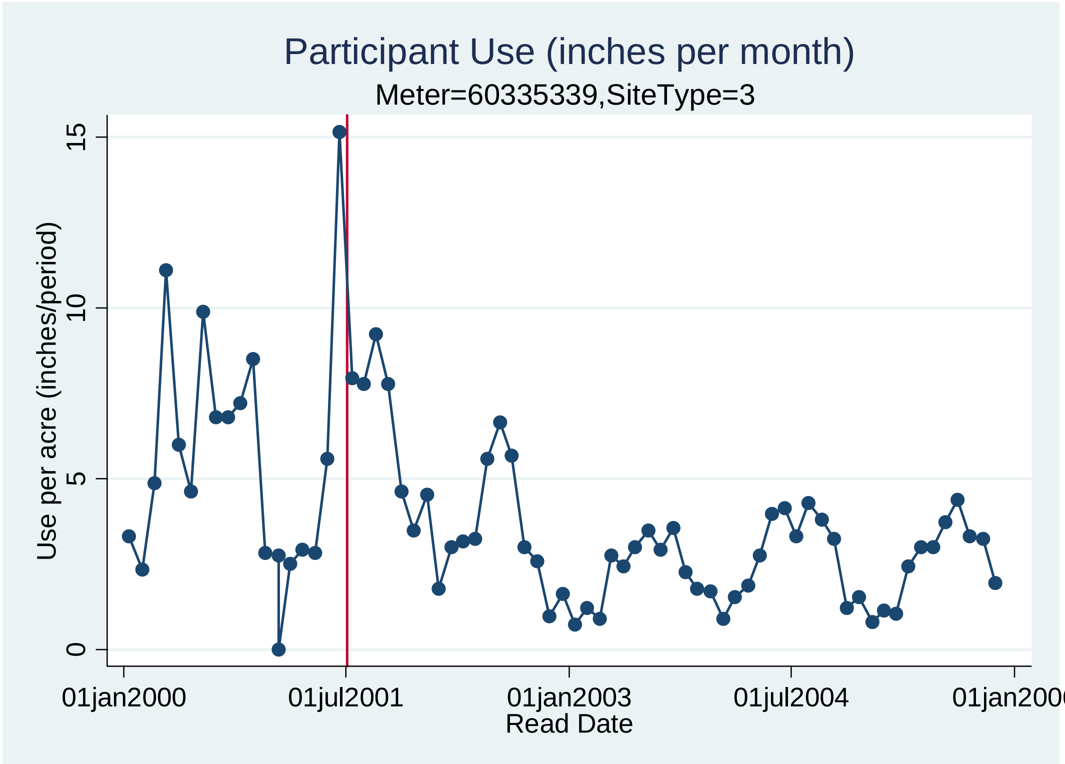
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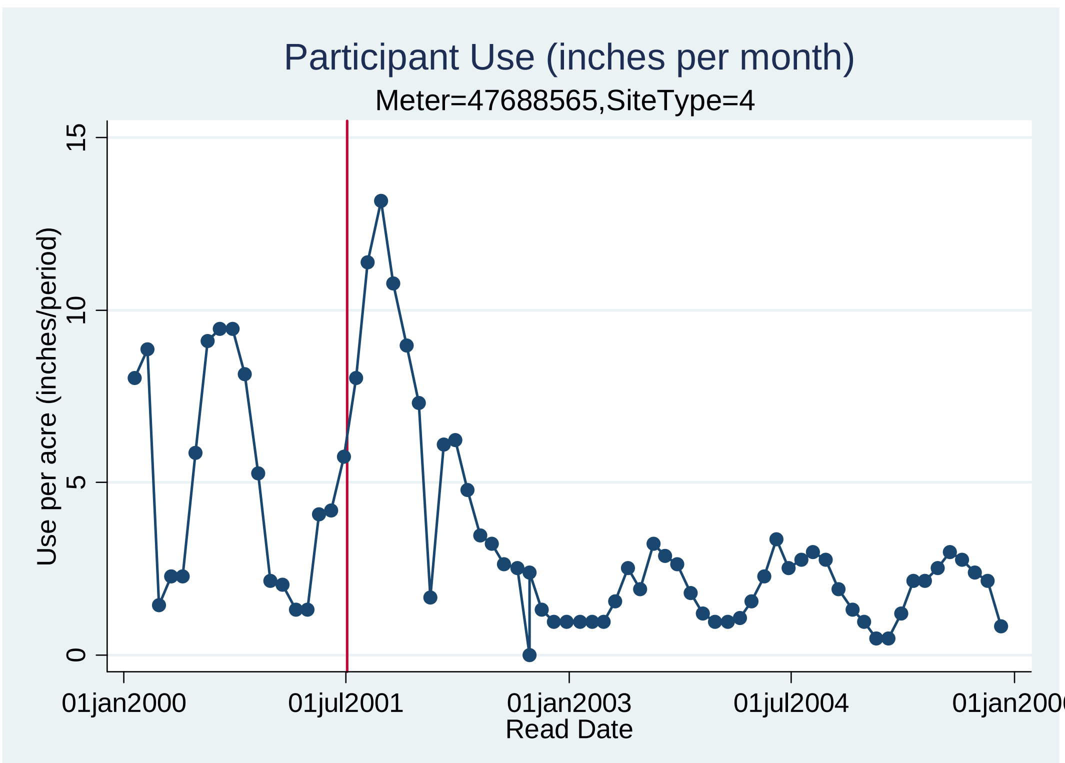
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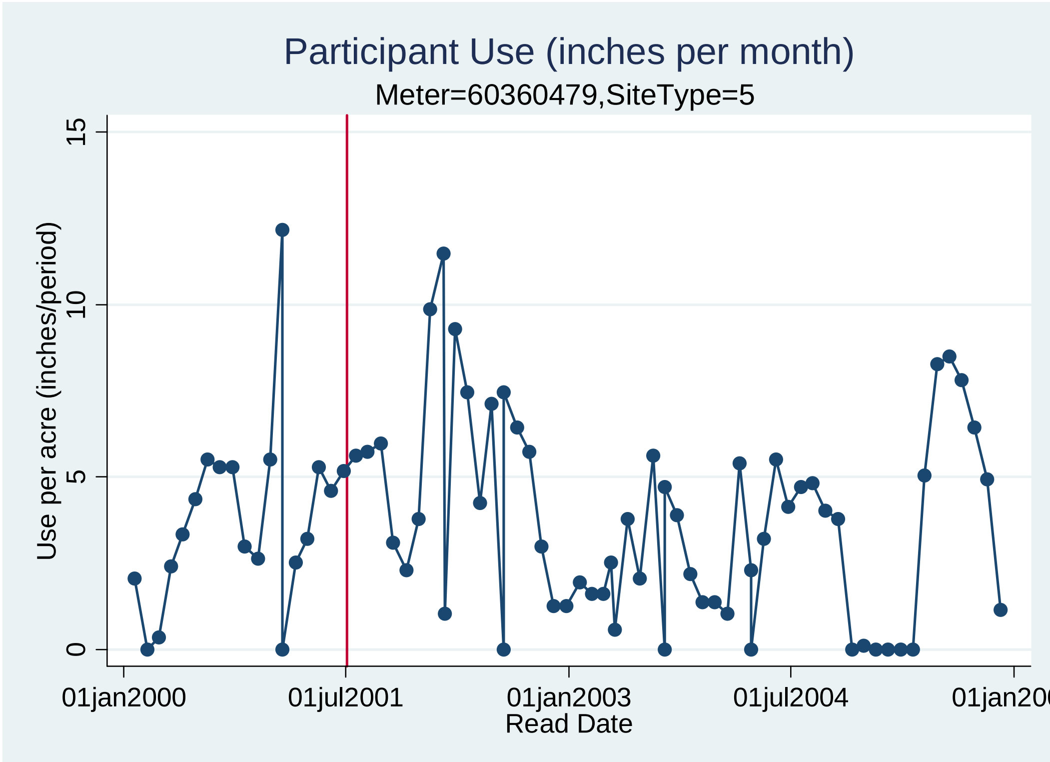
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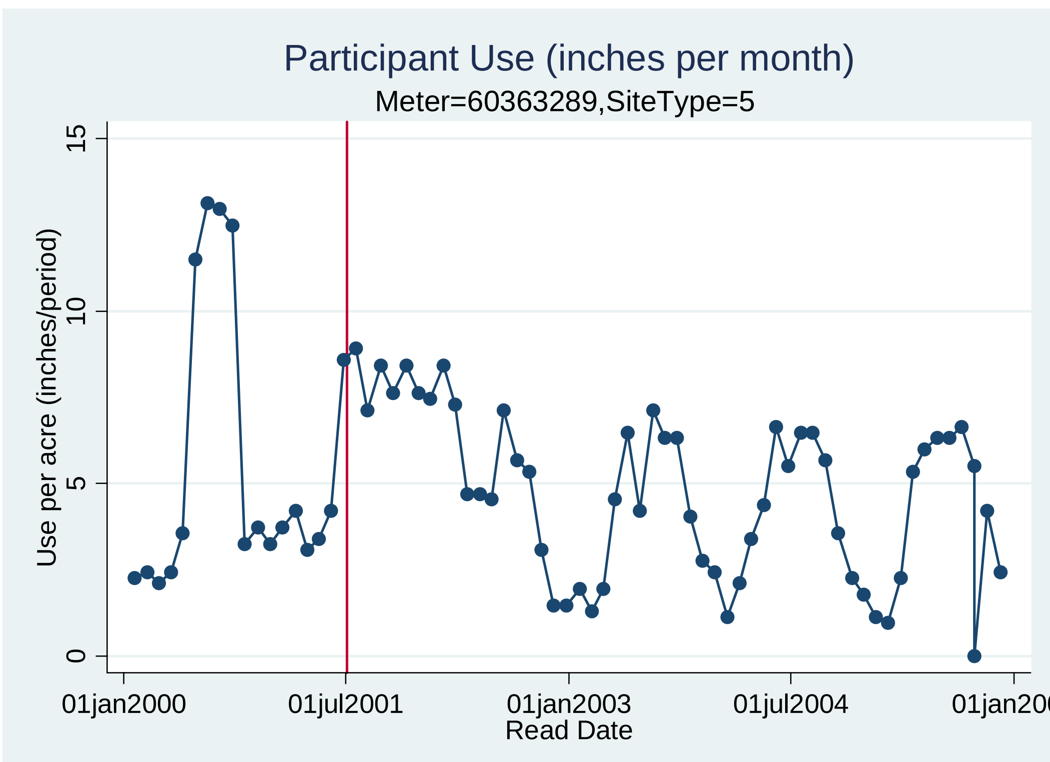
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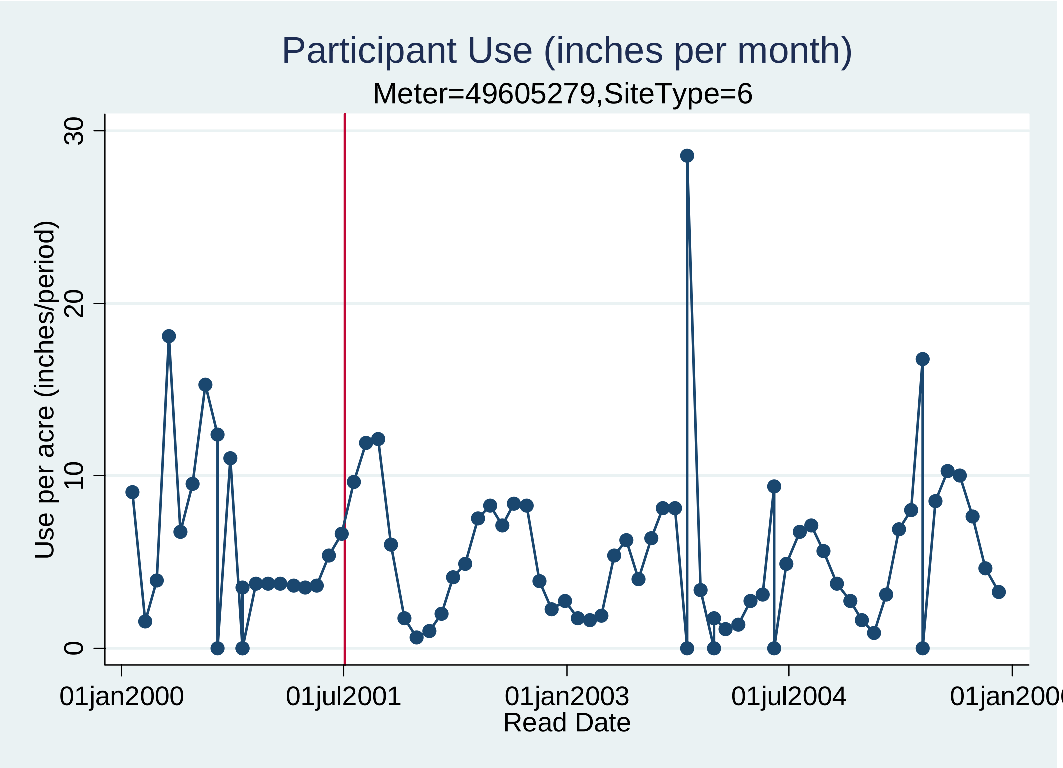
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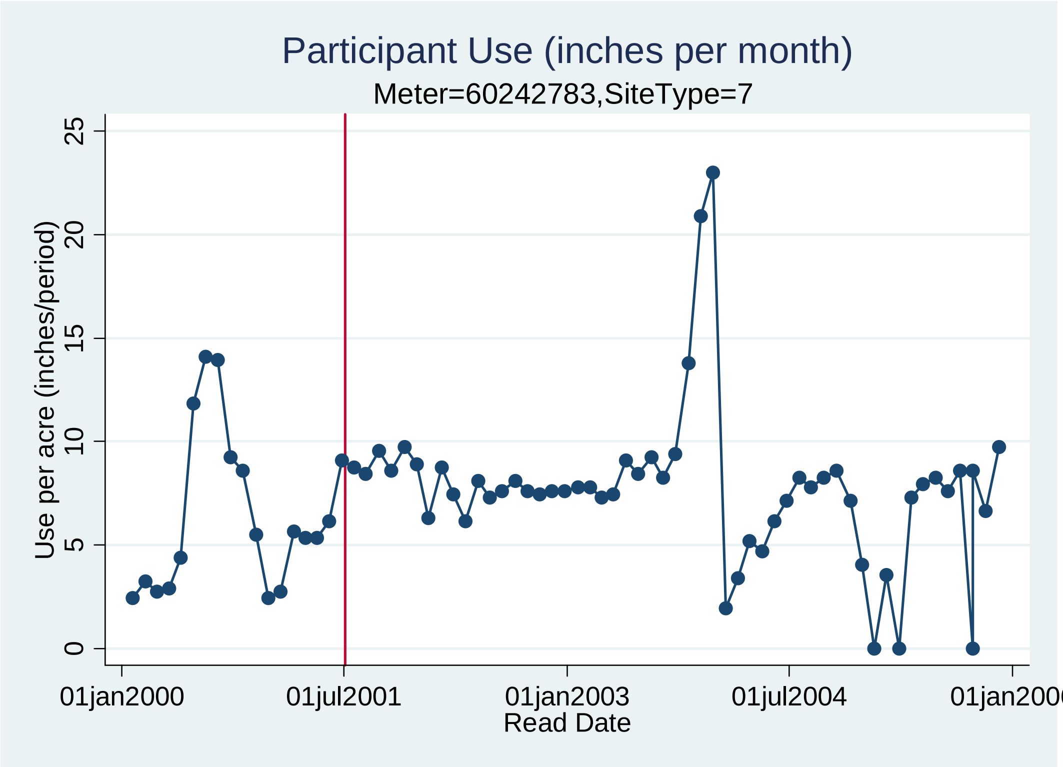
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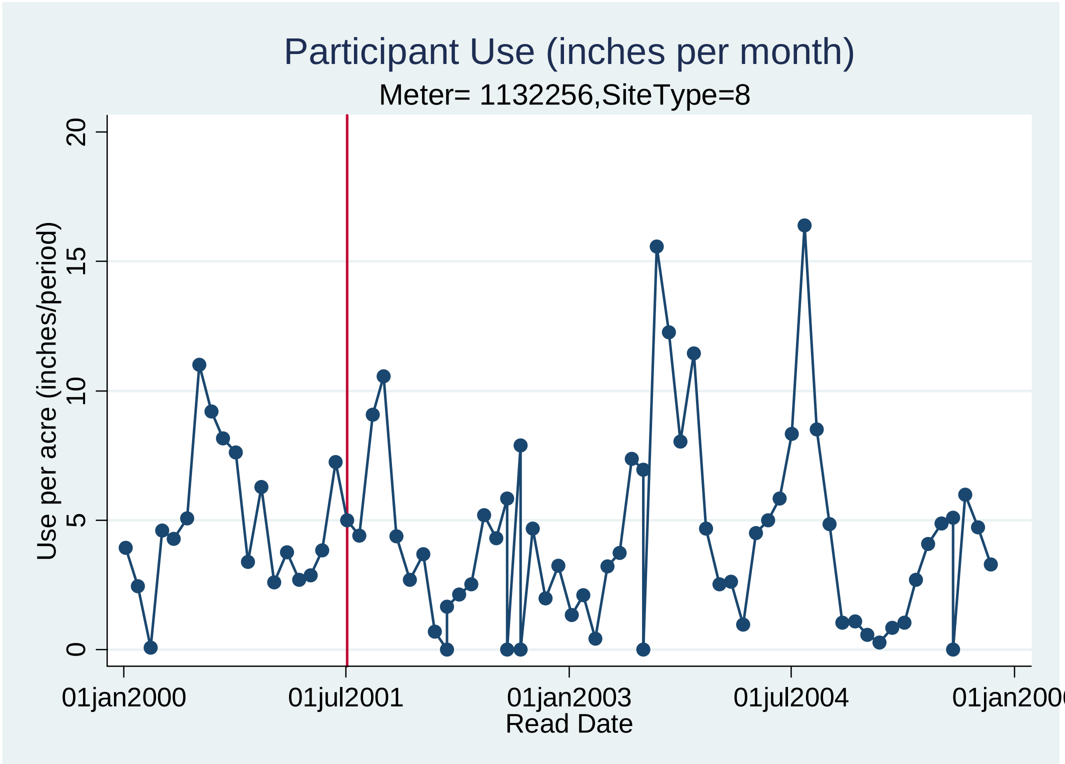
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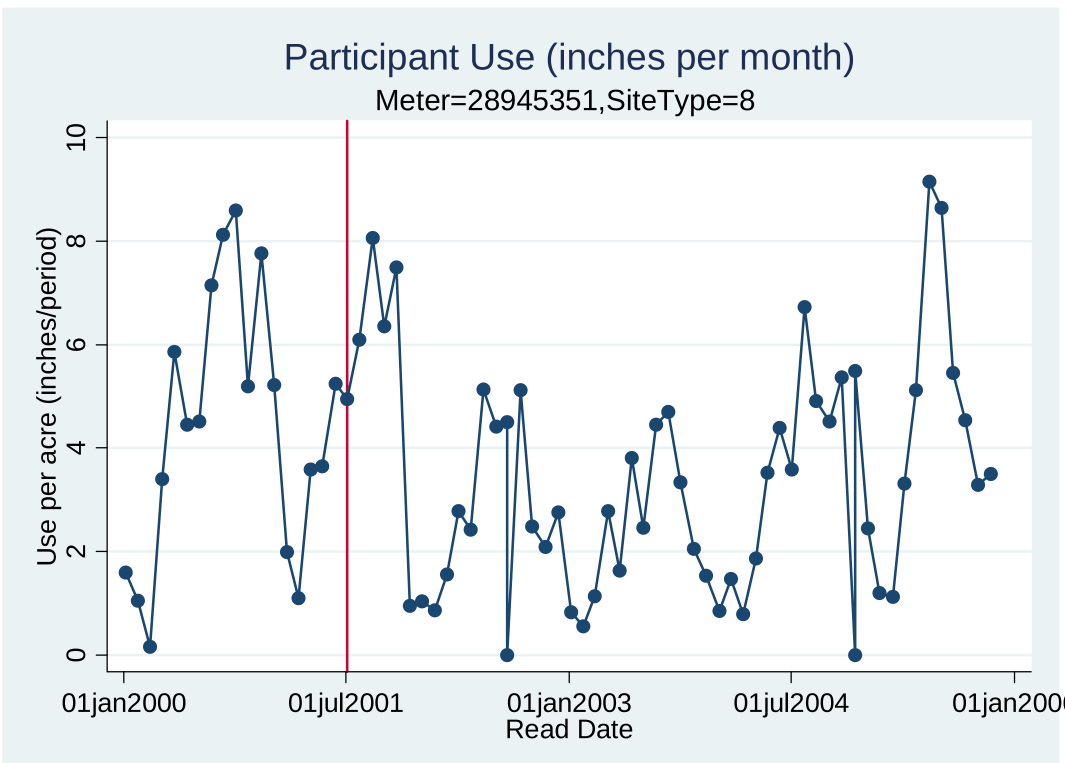
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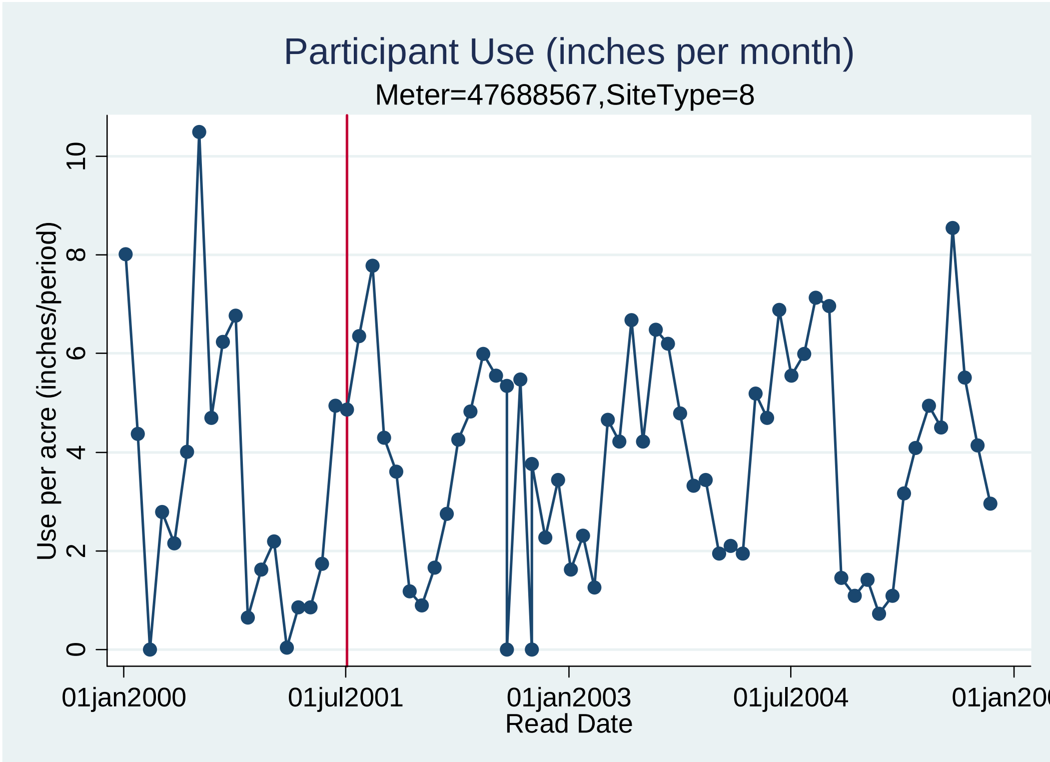
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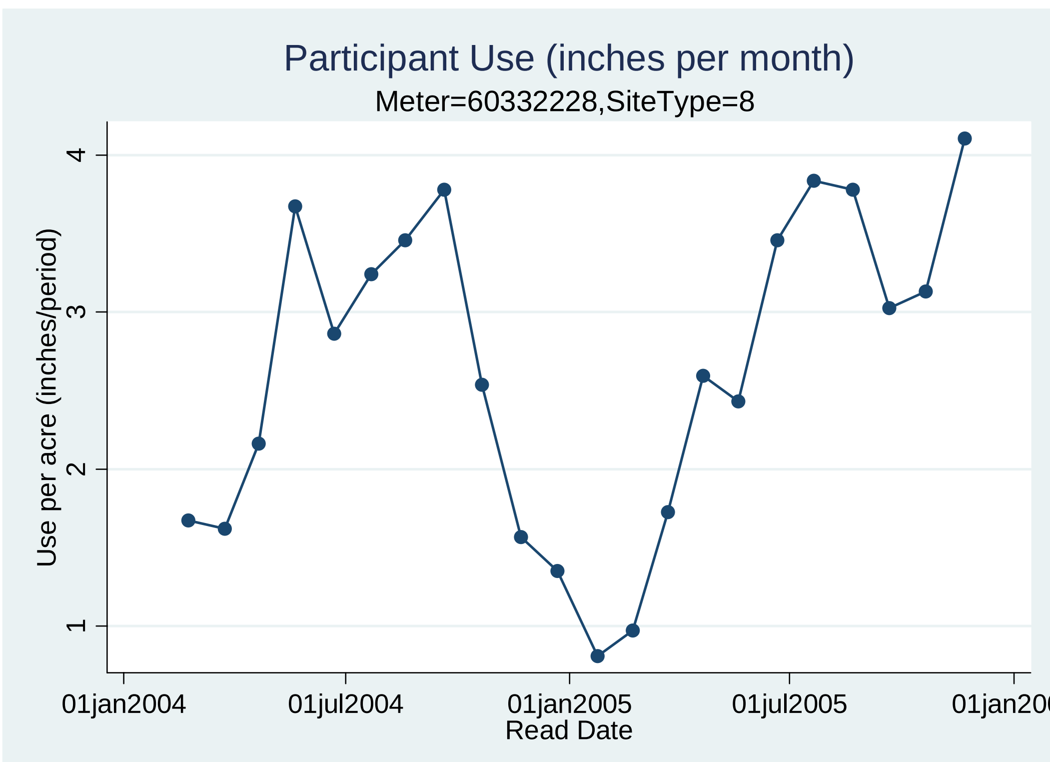
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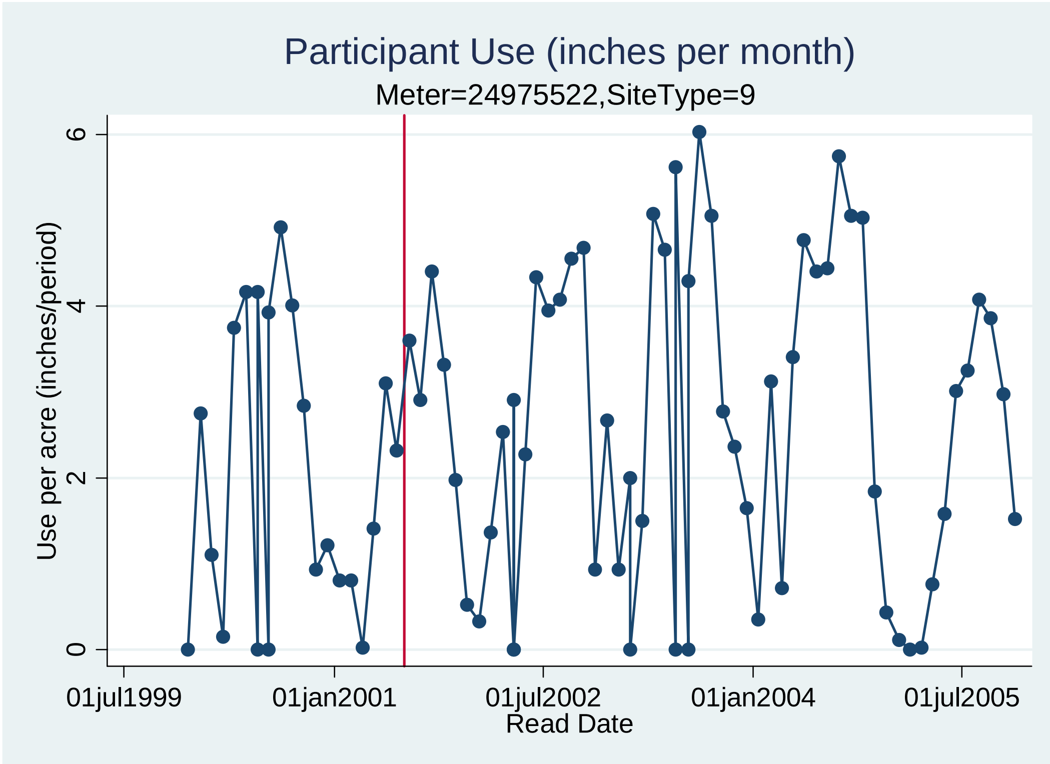
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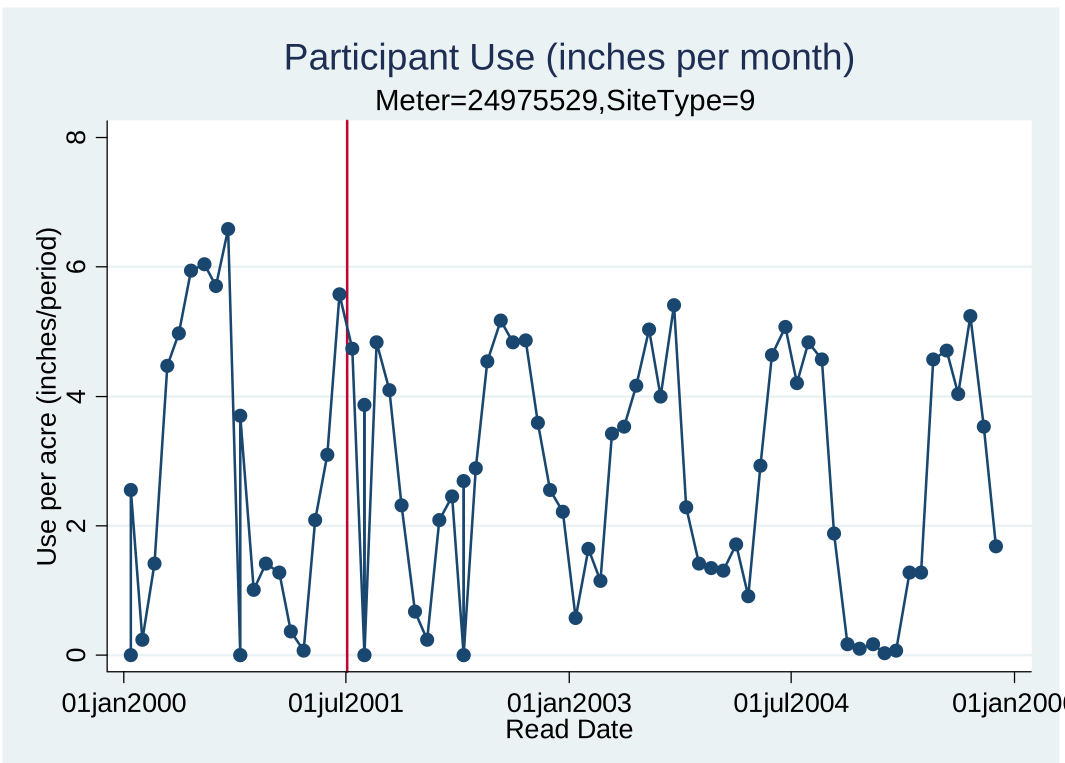
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8
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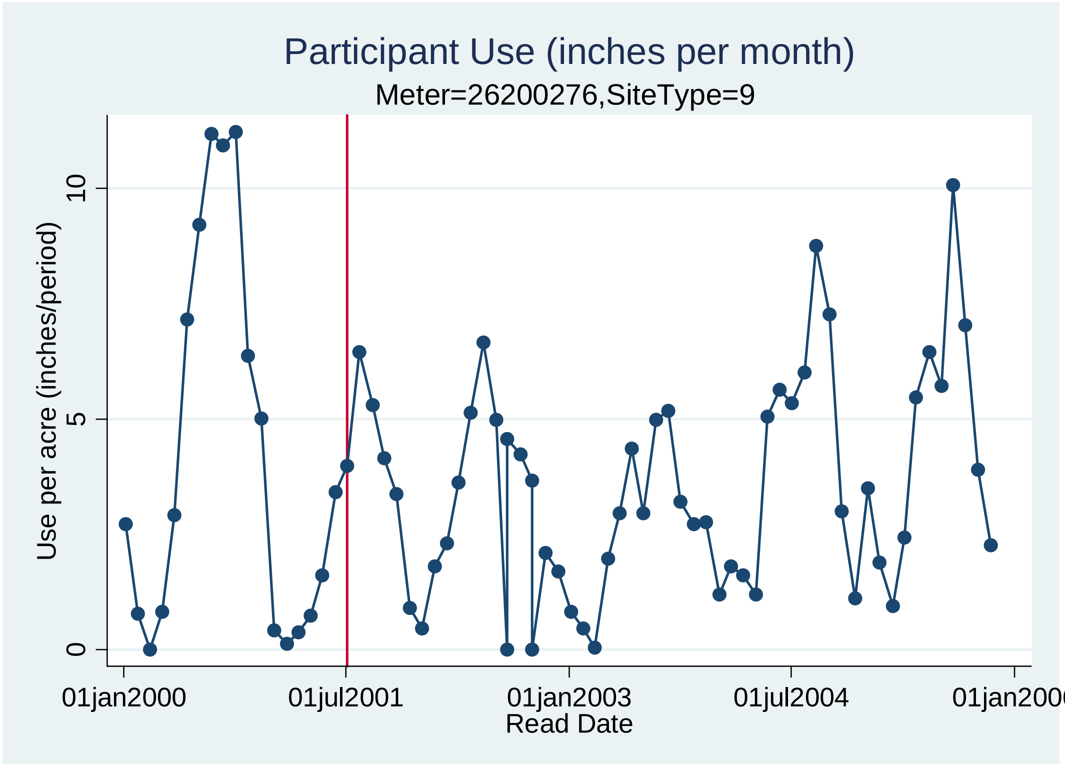

Participant Use (inches per month)
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Use per acre (inches/period)
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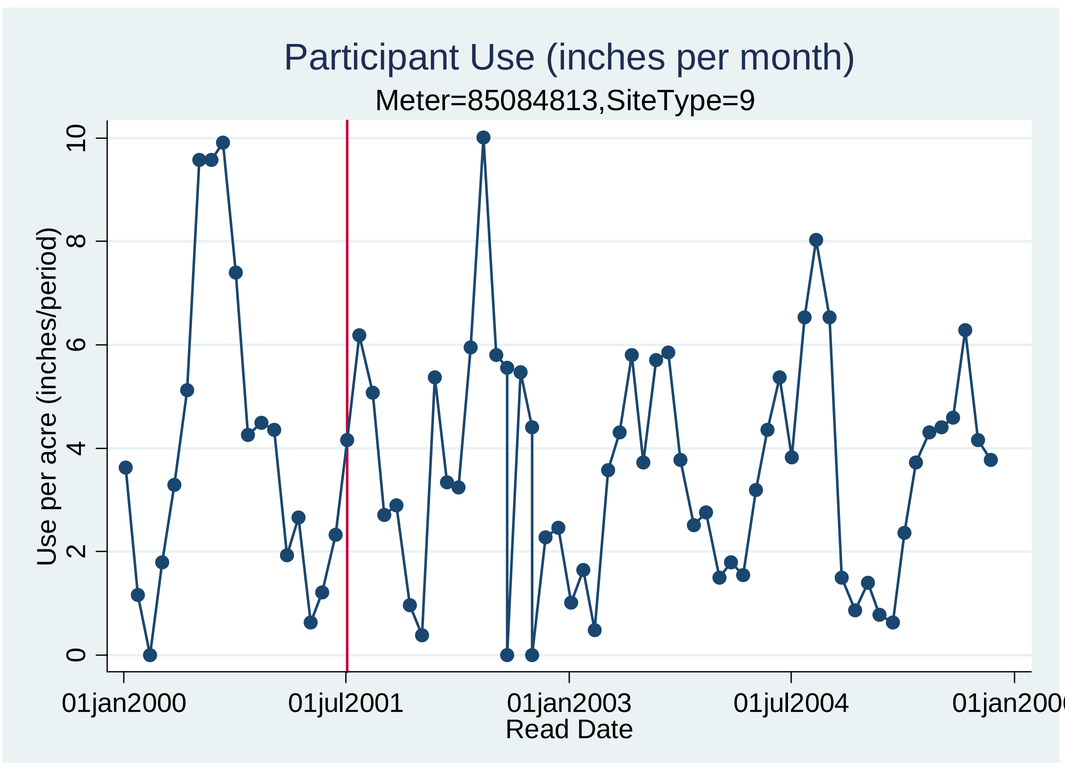
Read Date



Participant Use (inches per month)
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Use per acre (inches/period)
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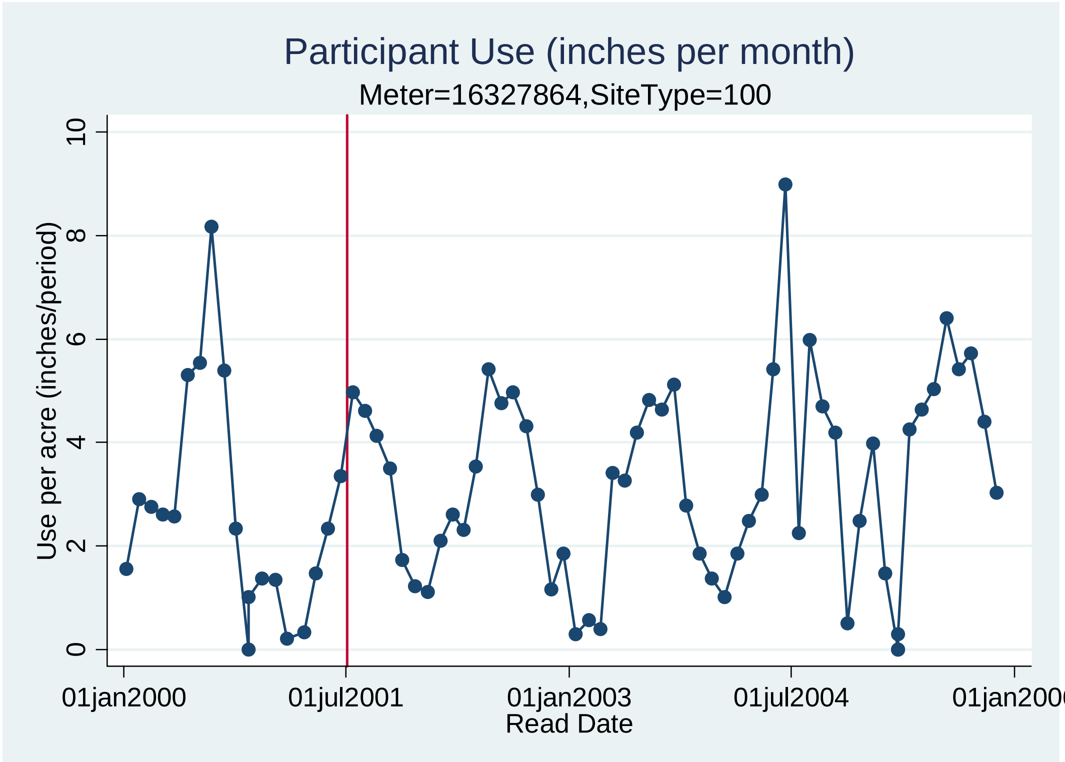
Participant Use (inches per month)
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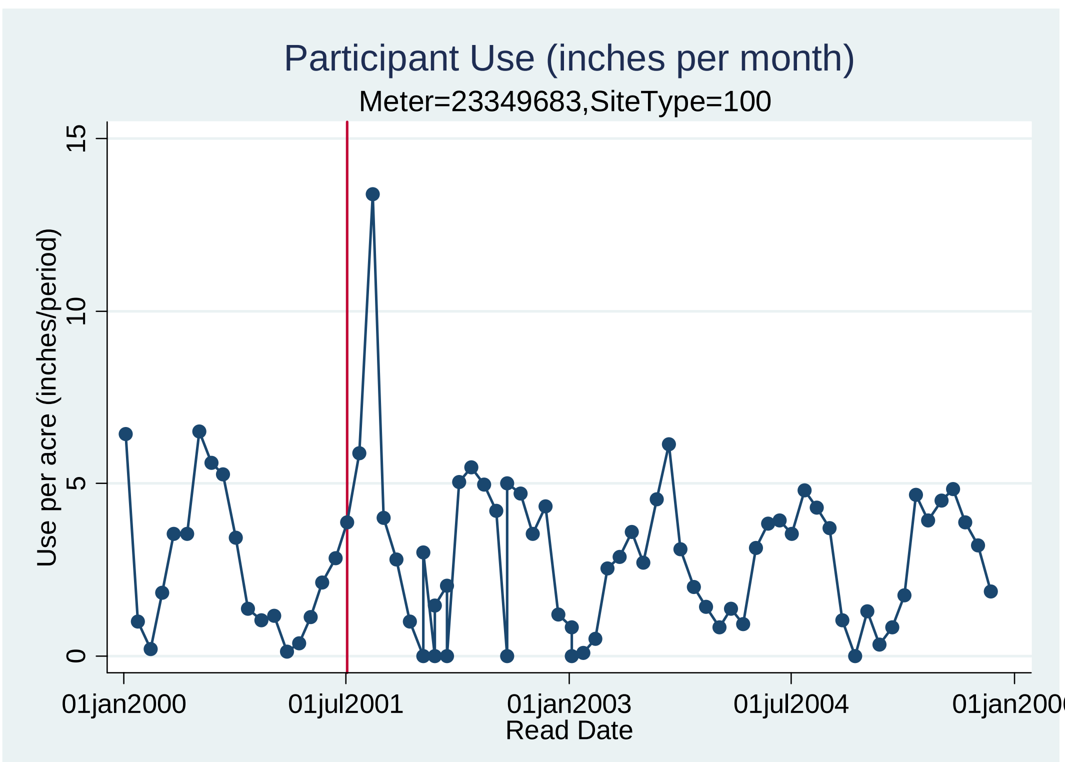
Participant Use (inches per month)
Meter=23349683,SiteType=100
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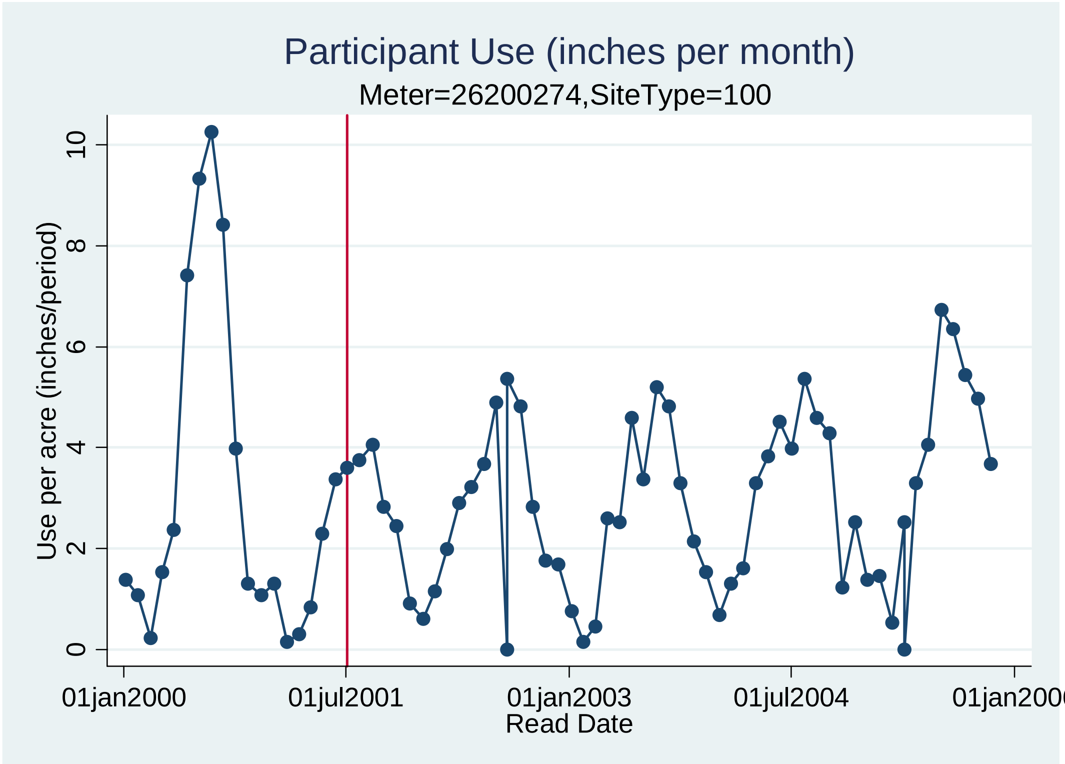
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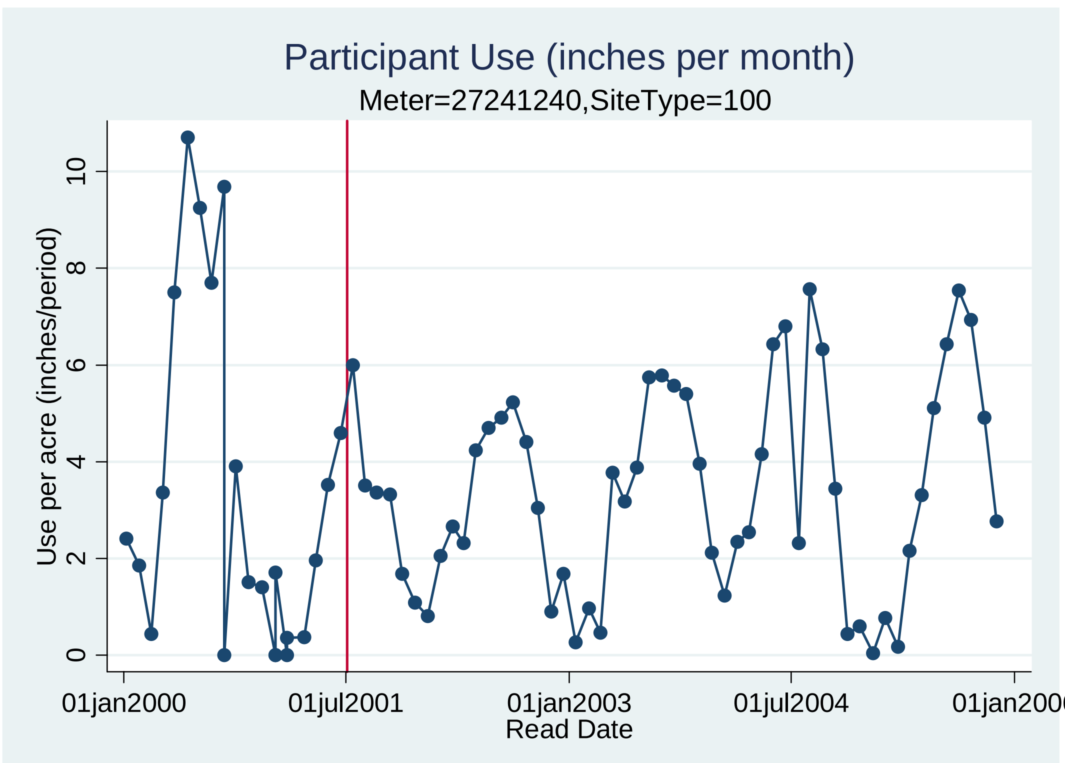
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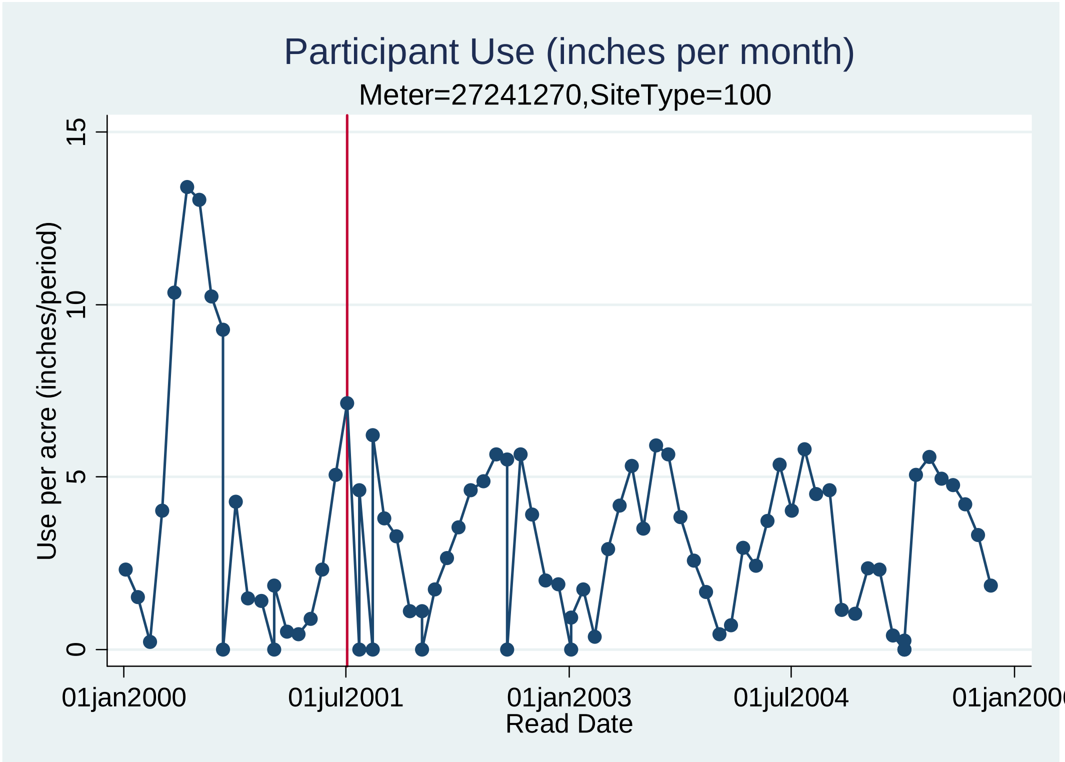
Read Date


Participant Use (inches per month)
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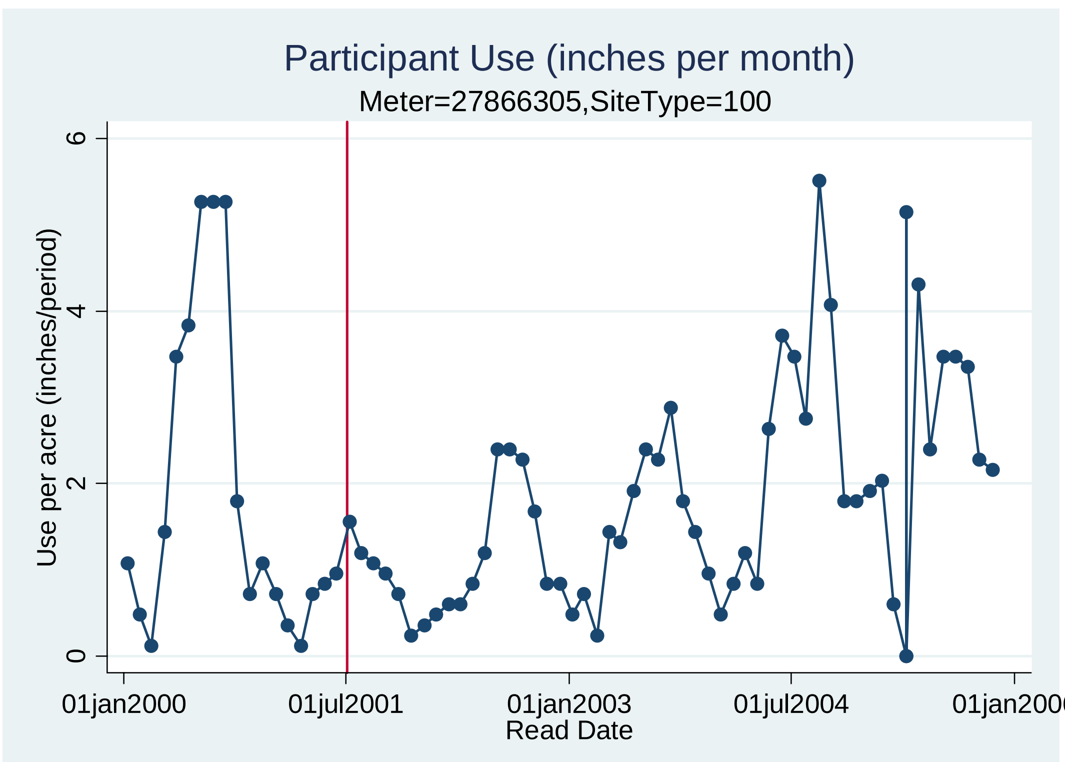
Read Date


Participant Use (inches per month)
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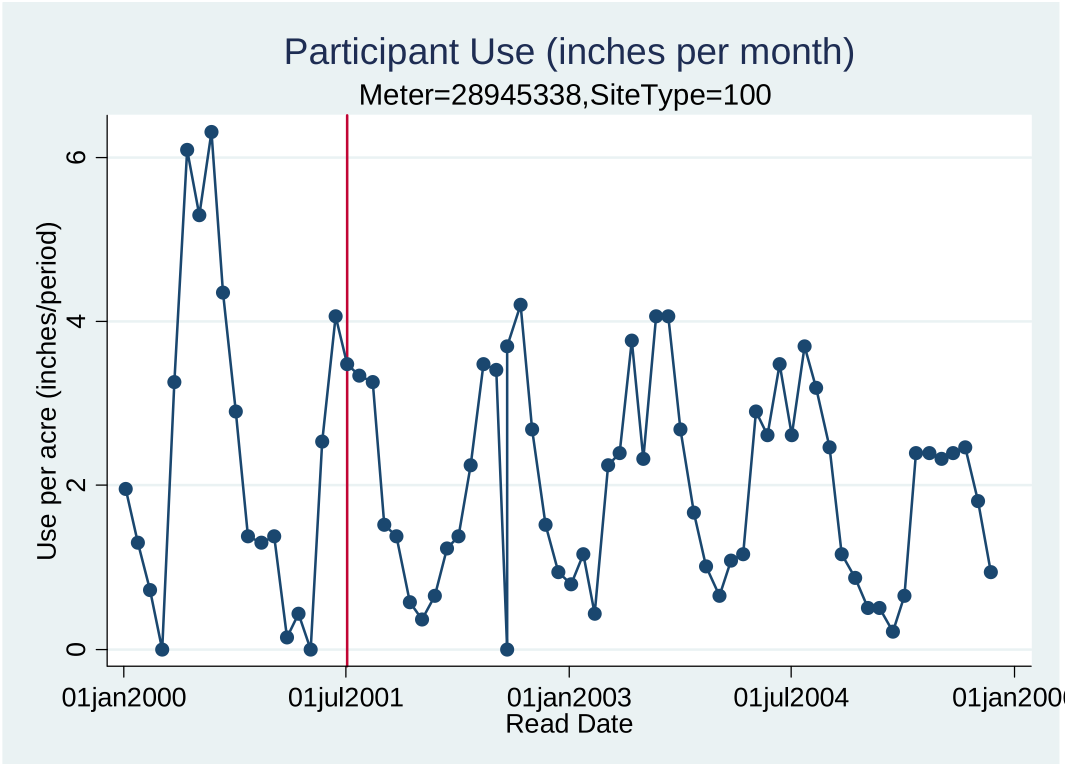
Read Date


Participant Use (inches per month)
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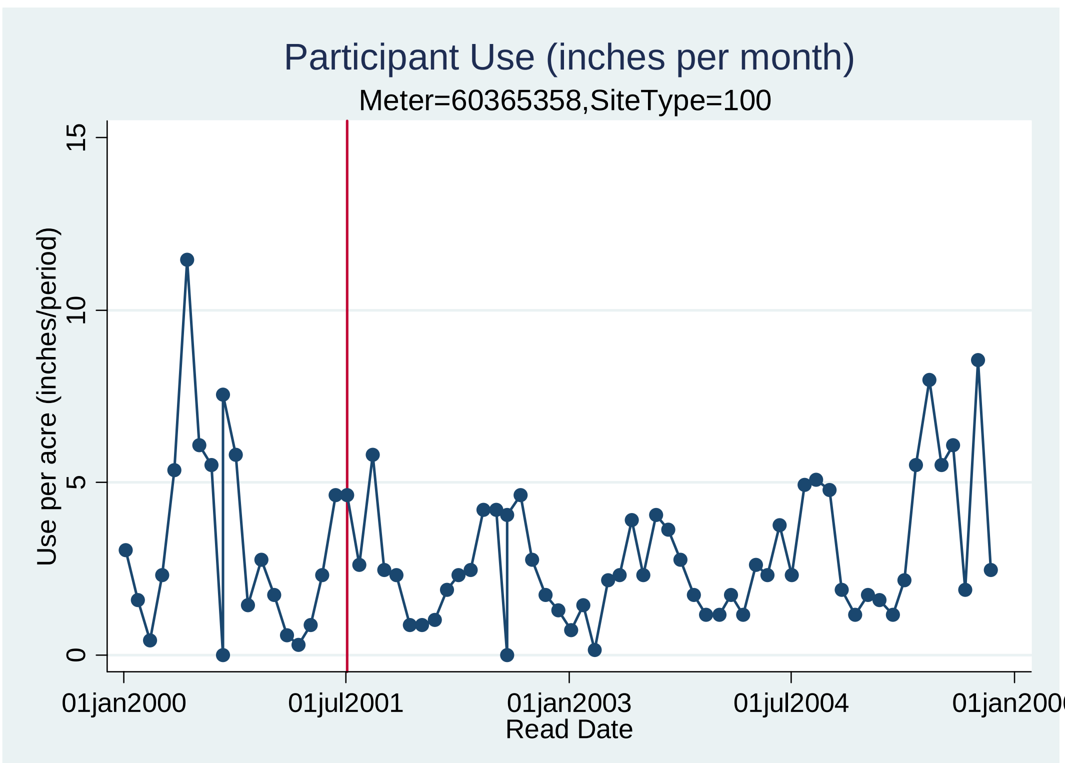
Read Date


Participant Use (inches per month)
Meter=60365358,SiteType=100
Use per acre (inches/period)
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01jul2001
01jan2003
01jul2004
01jan2006
Read Date

Appendix B – Customer Survey Results

IRWD Customer Survey – Commercial ET Controllers (Results)

1. Rank the overall appearance of your landscaping, since the ET Controller was installed, from 1 to 5.
   (1) Excellent - 1
   (2) Good - 2
   (3) Average - 3
   (4) Poor - 1
   (5) Very Poor – 0
   No response circled – 3

COMMENTS QUESTION 1:

Definite improvement, spent amount 10-12K in upgrades to property, switched/changed landscapes.
Changed property managers last month, not much information.
Not Turf friendly.
Depends on time of year, looks under-watered, has dated irrigation system.
Wasn't working properly, Programming based on previous week, couldn't adjust for mid-week changes. Very labor intensive.

2. Have you noticed any change in your water bill in the past 2 years? (if no, who pays the bill? Do you see the bills?)
   (1) Increased - 0
   (2) Decreased - 5
   (3) About the Same - 2
   (4) Don't know - 0
   No response circled – 3

COMMENTS QUESTION 2:

Made multiple visits to sites to adjust the programming, Client did not seem to understand how controller operated.
Water bill has gone down, a few spikes due to a broken line
Client does not know, would have to look at account history
Works awesome for water bill, would still put it in.
Valves have been stuck.

3. Has the scheduling of the controller changed in the past 2 years?
   (1) Yes - 1
   (2) No - 5
   (3) Don't Know - 1
   No response circled – 3

COMMENTS QUESTION 3:

Yes, with some landscaper, most likely changed but unknown.
Only thing is in the summer, they add 5% on hilly areas for 2 months
Messed with it to keep on top of it.

Controller locked by city, no access.

4. Who is responsible for changes to the controller schedule?
   (1) Landscape Contractor - 3
   (2) Property Management - 0
   (3) Property Owner – 0
   (4) Other – 5 – IRWD, Checked by Nick, A Macoule, City, landscape coordinator
   (5) Don't Know – 0
   No response circled – 2

5. Is the signal fee for the ET irrigation controller currently being paid? ($48 yr)
   (1) Yes - 3
   (2) No - 1
   (3) Don't Know - 4
   Why is responsible for payment? COMMENTS: - Thought IRWD responsible
   No response circled – 2

6. Overall, were you satisfied with how the ET irrigation controller managed landscape water?
   (1) Yes - 7
   (2) No - 0
   No response circled – 3
   Why?____

COMMENTS QUESTION 6:

Some points of confusion for Board of Directors.
No as good as was told.
Good system ,but thinks allocation is too low, wants more water.
Likes, installed on other properties.

7. At the end of this study will you:
   (1) Keep the ET Controller and pay the signal fee (approx $50/year) - 4
   (2) Keep the ET Controller, cancel the signal fee, and program it manually - 2
   (3) Have the old/original controller reinstalled - 1
   No response circled – 3

8. If you answered 2 or 3 to question #7, Why?
   ____
   ____
   ______

COMMENTS QUESTION 8:

Wanted to know who to call if the grass starts to die, if controller breaks.
New landscape has knowledge of ET Controller, so doesn't need to pay fee
Doesn't know what they plan to do.
Pricing Weathertrak versus other companies – computer monitors are beneficial.

9. Would you recommend the ET irrigation controller to others?
   (1) Yes - 7
   (2) No – 0

(3) No Opinion – 1
No response circled – 2
Why?____

ET Controller Survey
Notes from Site Visits
Jan-May

Customer Name	**Notes from January**	**Notes in May**
Northwood Square	By Pool, front cont. aut. Disconnected, default ET 1.00 turned off. Re-connected ant. Current date/time OK -- Back cont. no ant., default ET 0.39, turned off, current date/time --other cont: front cont. turned off, default ET 1.00, current date/time OK -back cont. turned off default ET 1.58 current date/time OK	By Pool, front cont. current date/time, no signal, default ET, all stations fully automated --Rear cont, default ET, current date/time, user programmed no ET --2nd cont site, front cont, default ET, all stations user programmed, no ET, back cont. default ET, all stations user programmed, no ET. Both show correct date/time
Sheffield Manor	By Pool, locked, no key front cont. #1-12 "communication lost" Default ET-1.00 rebooted current date/time OK. #13-15 received current signal current date/time OK	Front controller, cont #1unplugged, on default, station 1-12 fully automated, station 1-4.2 min, 3x4 days/week, station 2-12 l0 min lx5days/wk cont #2 comm lost default ET, all programs fully automated Pool Area Controller- both comm. .ost had HydroPoint send signal, will check later to verify, cont. #1 unplugged, got permission from Dave Ramos to plug it in
Northwood Park HOA	By tennis courts, turned off, received current signal, current date/time OK	
Northwood Park HOA	By Pool, locked, no key	
Northwood Park HOA		
Monterrey at Tustin Ranch	Communication lost, didn't touch it, not ours, called Kevin	A64B67C69D16 (locked on C), serial #1055, communication lost, 5/16/06
Joe's Garage	Beeping, weird display, rebooted, program seems to have held default ET, current date/time after re-boot	A60B68C68D16 (locked on C), serial #2124, communication lost, 5/16/06
Professional Real Estate	OK	OK
Creekside Park	Communication lost, default ET, display date 12/29/05, reset to current date/time	No display
Cobblestone Park	OK current signal received 1/03/06	communication lost, default ET
Panel Systems	OK	OK
Pacific Church	OK	OK
SAP	OK	OK
Arbor Surgical	OK	OK
Graphtec	OK	OK
NGK	Customer replaced ET controller and didn't notify IRWD	OK