# GROUND-WATER CONDITIONS
# IN THE AREA
# NORTHEAST OF KUNA
# WEST-CENTRAL ADA COUNTY, IDAHO

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INTRODUCTION

Statement of Problem

Many ground-water areas in southern Idaho have been severely impacted by the worst period of drought on record. Due to shortages in surface water supplies, some farmers have had to rely on ground water for a supplemental source of irrigation water. In these areas, declines in water levels due to the drought have been further impacted by these additional withdrawals. Since July 1987, approximately 1000 irrigation wells have been drilled in southern Idaho. Over one third of these were drilled in the Boise Valley.

The area northeast of Kuna (see Figure 1) is one of the areas in the Boise Valley where ground water has been severely impacted by the drought and additional use. Many domestic well owners in this area have been forced to deepen their wells or drill new ones because of declining water levels. Beginning in March 1993, a study was conducted to assess the magnitude of these declines and the relative causes of them (drought versus additional use). The results from this study are presented in the following report.

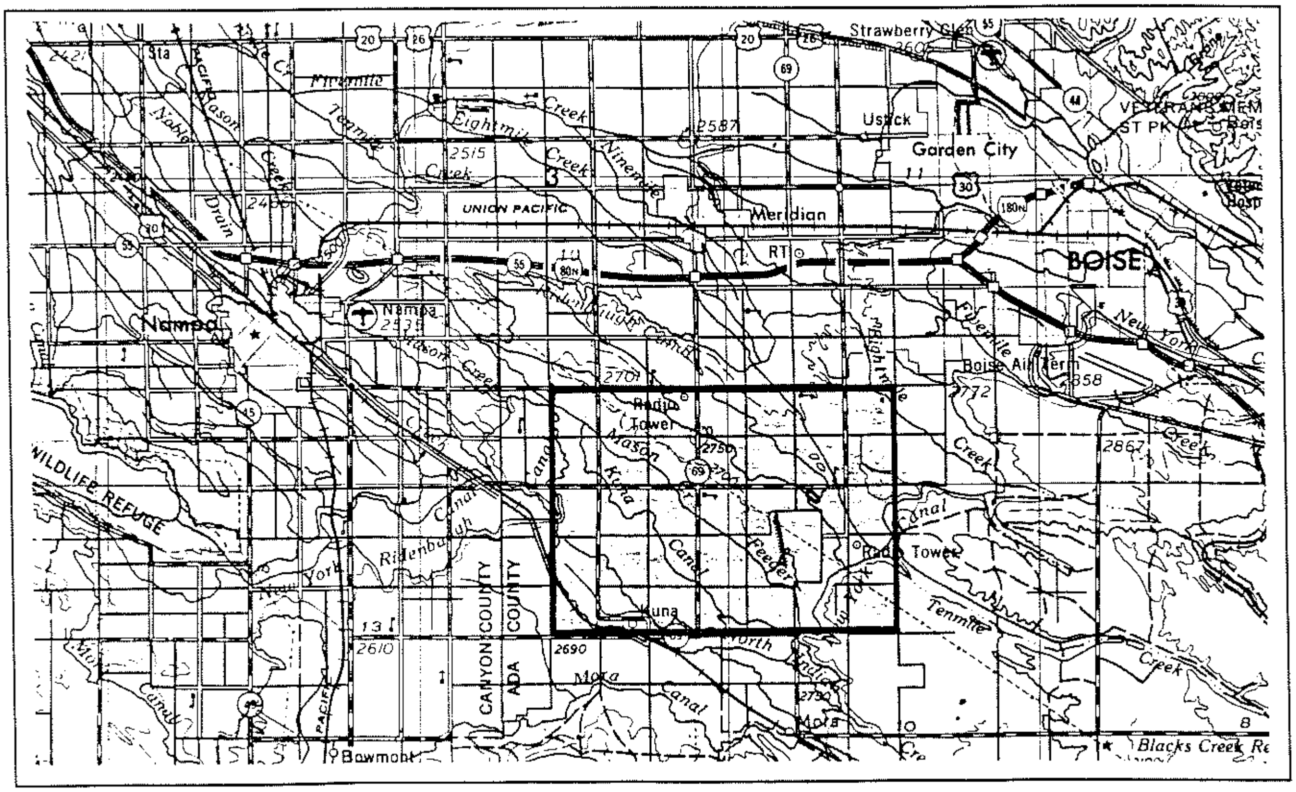



Figure 1. Location of Study Area

Well-Numbering System

The well-numbering system used in this report is identical to the system that is used by the U.S. Geological Survey (USGS) in Idaho. The system indicates the location of wells within the official rectangular subdivision of the public lands, with reference to the Boise base line and meridian. The first two segments of the number designate the township and range. The third segment gives the section number, followed by three letters and a number, which indicate the ¼ section (160-acre tract), ¼-¼ section (40-acre tract), ¼-¼-¼ section (10 acre tract), and serial number of the well within the tract. Quarter sections are lettered A, B, C, and D in counterclockwise order from the northeast of each section. Within quarter sections, 40-acre and 10-acre tracts are lettered in the same manner. For instance, well 12S-22E-16CCC1 corresponds to the legal location SW¼, SW¼, SW¼, Section 16, Township 12 South, Range 22 East, and was the first well inventoried in that tract (see Figure 2).

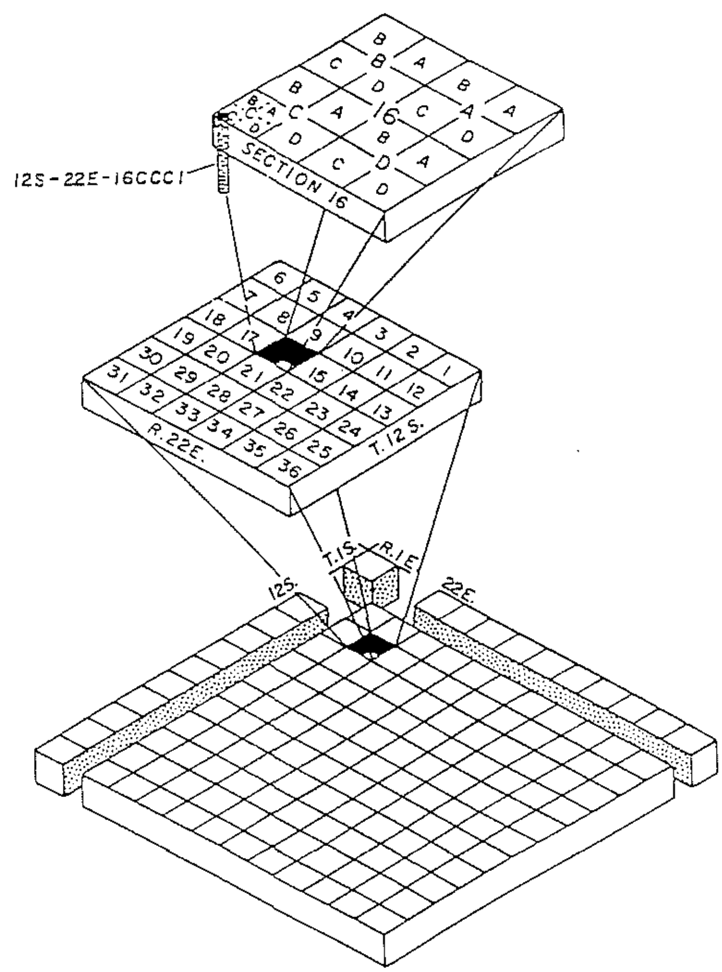



Figure 2. Well-Numbering System

## HYDROGEOLOGIC REGIME

### Occurrence and Movement of Ground Water

There are three rock units that occur in the study area. The deepest and oldest of these units is composed of interbedded layers of sand, silt, and clay. They accumulated over several millions of years in a lake (known as Lake Idaho) that occupied the western Snake River Plain. These sediments are collectively known as the Glenns Ferry Formation. The next unit is composed of sand and gravel layers. They were deposited by the ancestral Boise River, after the lake was drained about two million years ago. The shallowest unit is composed of lava flows (basalt). This unit is discontinuous in areal extent and only filled old drainages and local depressions. Figure 3 contains a geologic cross section through the study area that depicts each of these units.

The principal aquifer material in the study area is composed of the fine-grained lake sediments of the Glenns Ferry Formation. The shallower coarse river sediments and lava flows mainly occur above the water table and are largely unsaturated. Inflow or recharge to the aquifer occurs primarily through infiltration from irrigation water. Natural outflow or discharge from the aquifer occurs as underflow leaving the area to the west. Artificial discharge occurs through pumpage from wells.

Based on water-level measurements taken in March 1993, a map of the elevation of the water table was constructed for the study area and is shown on Figure 4. Pertinent information about the wells that were used to create this map are included in Table 1. The direction of ground-water movement is from east-southeast to west-northwest. The slope of the water table in the study area ranges from about 10 to 30 ft per mile. The gentle gradient over most of the area probably reflects the regional effects of recharge from irrigation water.

Table 1. Records of Selected Wells

Elevation of LSD: or land surface datum estimated from USGS topographic maps and field surveys.

Use of water: H - Domestic; I - Irrigation; S - Stock.

Depth to water: measured in feet below land surface.

| Well number | Elevation of LSD (ft) | Use of water | Well depth (ft) | Depth to first well opening (ft) | Depth to water (ft) | Date measured |
|---|---|---|---|---|---|---|
| 02N01E-07AAB1 | 2729 | H/S | 215 | 214 | 97.1<br>112.8 | 03/11/1970<br>03/29/1993 |
| 08ACC1 | 2728 | H | 260 | 254 | 94.4<br>110.0 | 3/11/1970<br>3/29/1993 |
| 09CAD1 | 2756 | H | 296 | 291 | 115.1<br>121.4 | 3/11/1970<br>3/29/1993 |

Table 1. Records of Selected Wells (continued)

| Well number | Elevation of LSD (ft) | Use of water | Well depth (ft) | Depth to first well opening (ft) | Depth to water (ft) | Date measured |
|---|---|---|---|---|---|---|
| 02N01E-10CCD1 | 2757 | H | 172 | 167 | 116.5<br>129.9 | 3/11/1970<br>3/29/1993 |
| 15ABA1 | 2766 | H | 243 | 240 | 128.0 | 4/29/1976 |
| 15CBC1 | 2775 | H | 188 | - | 137.0<br>149.3 | 3/30/1970<br>3/30/1993 |
| 16DDD1 | 2823 | H | 230 | - | 195.4<br>202.6 | 3/11/1970<br>3/29/1993 |
| 19DAD1 | 2721 | H/S | 102 | - | 70.2<br>72.2 | 3/11/1970<br>3/30/1993 |
| 02N01W-01ABD1 | 2727 | H | 200 | - | 108.2 | 3/11/1970 |
| 03DCC1 | 2636 | H | 84 | 82 | 56.0<br>67.0 | 3/12/1970<br>3/30/1993 |
| 11ABD1 | 2692 | I | 150 | 85 | 87.7<br>100.7 | 3/11/1970<br>3/30/1993 |
| 11ADA1 | 2685 | I | 130 | 64 | 79.0<br>94.6 | 3/11/1970<br>3/30/1993 |
| 15ADC1 | 2675 | H | 96 | 95 | 59.2<br>61.2 | 3/12/1970<br>3/30/1993 |
| 03N01E-31CDD1 | 2733 | H | 196 | 186 | 97.9<br>112.7 | 3/10/1970<br>3/30/1993 |
| 32DDA1 | 2696 | H | 127 | - | 45.2<br>58.8 | 3/10/1970<br>3/30/1993 |
| 34AAD1 | 2730 | H | 95 | - | 42.2<br>56.4 | 3/11/1970<br>3/29/1993 |
| 34CCC1 | 2721 | H/S | 95 | - | 65.9<br>77.9 | 4/17/1970<br>3/29/1993 |
| 03N01W-34ACB1 | 2643 | H/I | 178 | - | 58.6<br>70.4 | 3/11/1970<br>3/30/1993 |
| 35CCB1 | 2649 | H | 185 | - | 63.4<br>76.3 | 3/11/1970<br>3/30/1993 |
| 36DBA1 | 2736 | H/S | 270 | 250 | 111.7<br>125.0 | 3/11/1970<br>3/30/1993 |

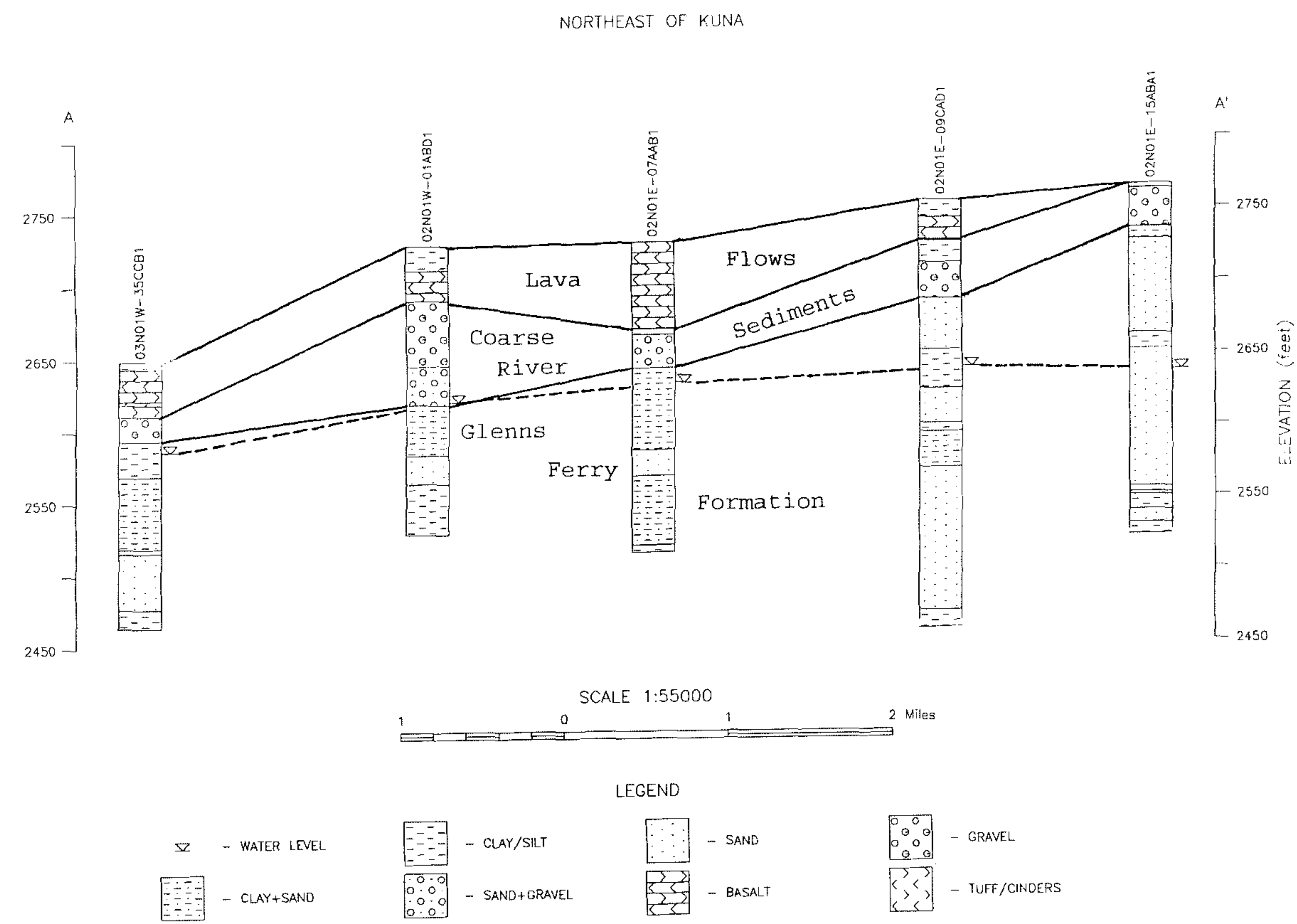



Figure 3. GEOLOGIC CROSS SECTION: A - A'

NORTHEAST OF KUNA

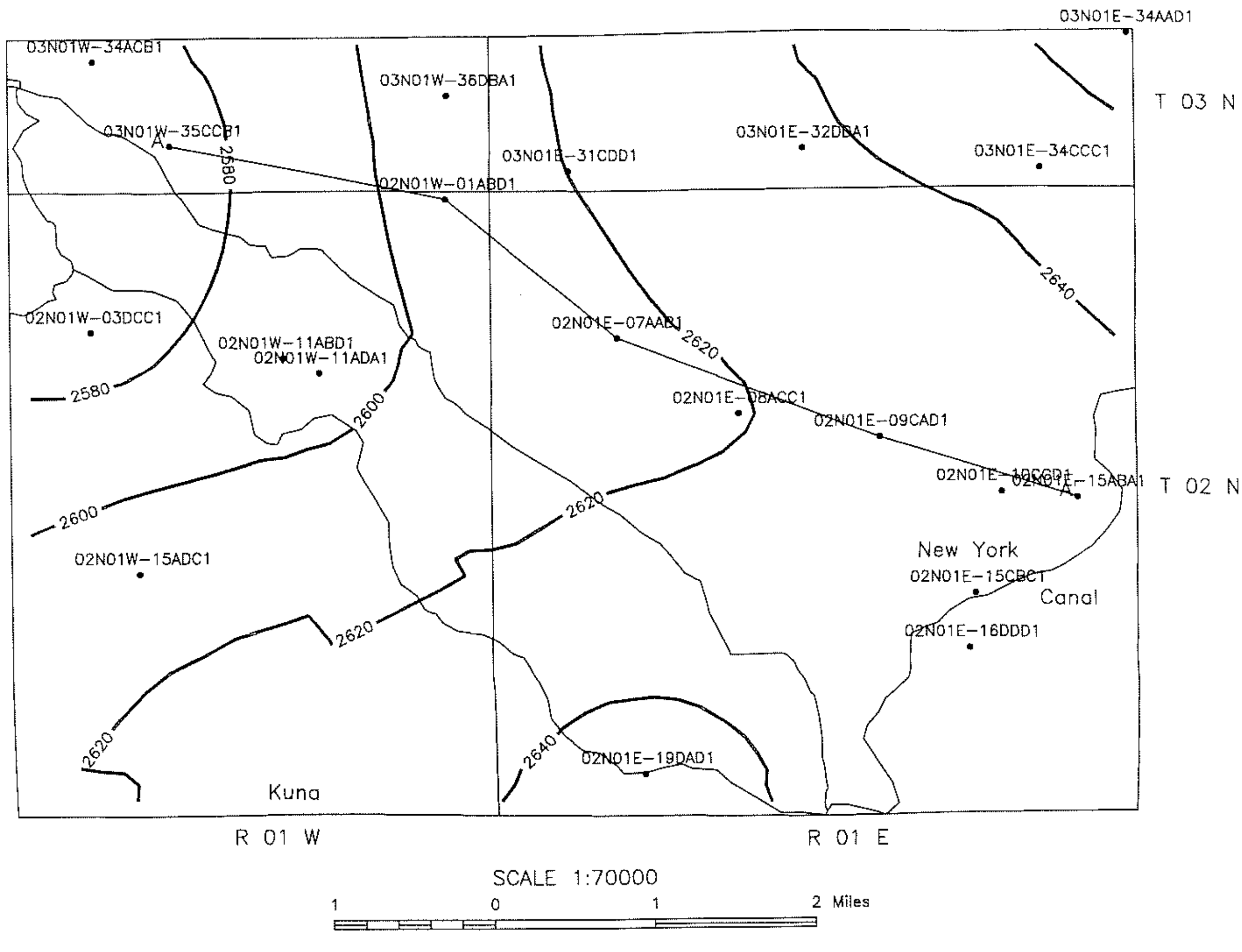



Figure 4. ELEVATION OF WATER TABLE, SPRING 1993

Relationship Between Recharge and Discharge

Changes in the amount of ground water held in storage are the result of the dynamic relationship between recharge and discharge in the study area. These changes are reflected in the annual and long-term fluctuations in the water table and are illustrated by the hydrograph of well 02N01W-11ADA1 included on Figure 5. In order to show the effects of recharge from irrigation water on the observed water-level trends, a hydrograph of the annual diversion and loss from the New York Canal between its head and Lake Lowell (gage 10) was also included on Figure 5. Since a strong correlation exists between water levels for a given year and diversion data for the previous year, the annual diversion data that is shown on the hydrograph has been shifted for this one-year time lag.

Seasonal fluctuations in water levels for this well are strongly dominated by the effects of recharge from irrigation water. Water levels are at their highest in late summer and lowest in early spring. Magnitudes of seasonal fluctuations range from about 3 to 16 ft.

Long-term water-level data for this well are limited. The well was removed from the statewide observation well network in 1983 and was only recently added back in. Since this period of missing data from 1984 to 1992 reflects a crucial time when the drought and additional development were taking place, an attempt was made to develop a statistical relationship between water levels and canal diversions, so projections in water-level trends could be made. Using data from selected years between 1968 to 1983 plus data for 1993 (a total of 15 years), a linear regression was performed on spring (March) water-level measurements and the previous annual diversions and loss in the New York Canal above Lake Lowell. The coefficient of determination ($R^2$) that was derived equaled about 0.8.

Using the regression parameters that were derived from these data, spring-time water levels were computed for well 02N01W-11ADA1 from the diversion data. A hydrograph was created that compares measured versus computed spring water levels for this well and is shown on Figure 6. As can be seen, both measured and computed values compare well with each other. The projected water levels that were computed after 1983 show a downward trend beginning in the late 1980's, which corresponds to reduced recharge that occurred during the drought. According to this analysis, if the water supply for the Boise Valley returns to normal, then water levels in this well would be at about 80 feet below land surface. However, any future changes in land use that reduce the amount of surface water irrigation in the area (such as increased urbanization) will undoubtedly cause water levels in the area to be lower.

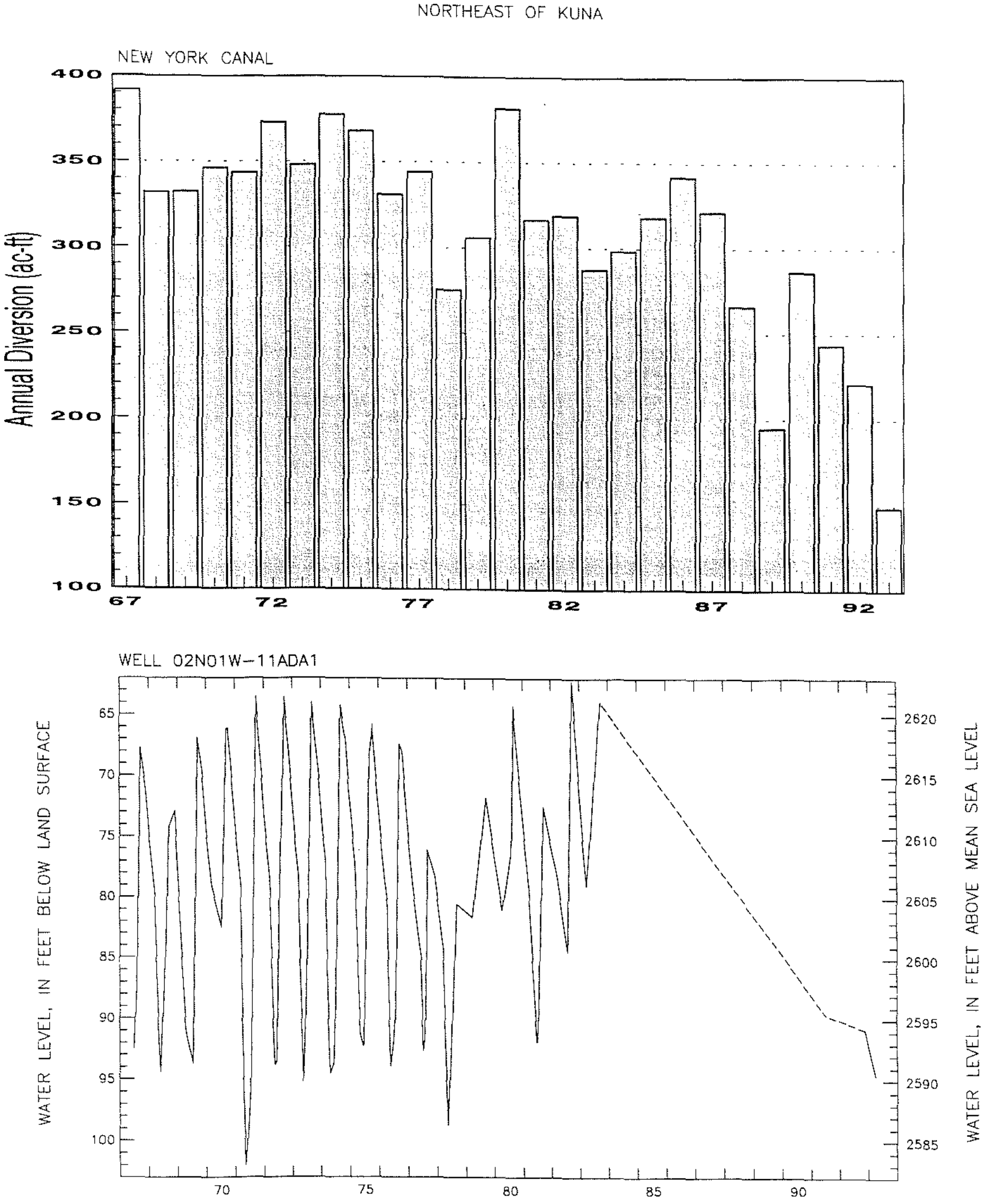
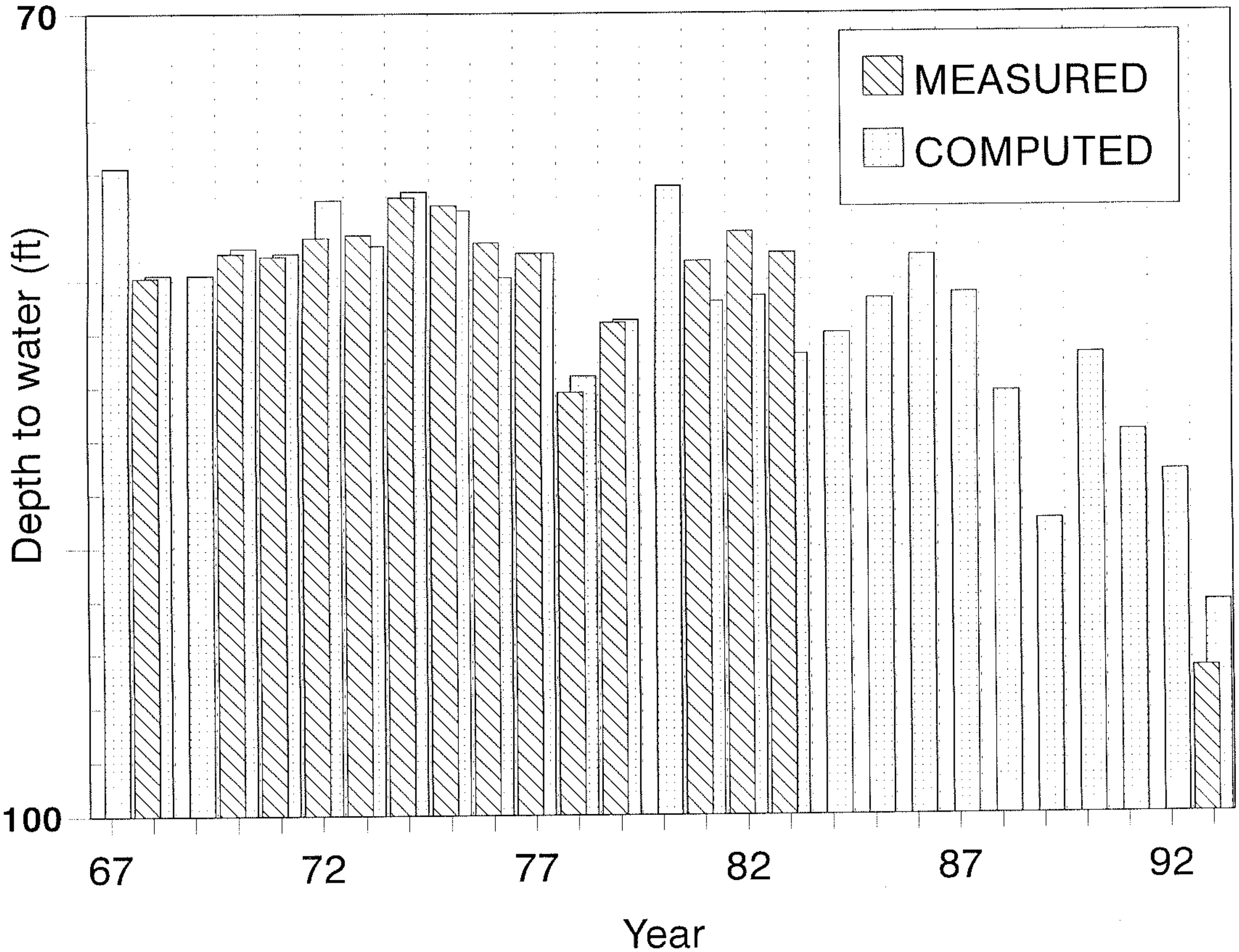



Figure 5. HYDROGRAPHS OF WELL 02N01W-11ADA1 AND NEW YORK CANAL

Figure 6. Measured vs Computed Spring Levels in Well 02N01W-11ADA1



In addition to evaluating the local changes in the water table at well 02N01W-11ADA1, a mass measurement of water levels in the study area was performed. Eighteen wells that were originally measured in March 1970 during a previous study of the area (Dion, 1973), were re-measured on March 29-30 (see Table 1). From these data, a map was constructed that shows what regional changes have occurred in the water table over the past 23 year period (see Figure 7). Declines in the water table range from less than 2 ft in the southern part of the study area to greater than 14 ft to the north. As was implied by the above statistical analysis, the cause for most of these declines in the water table is probably related to six years of reduced recharge that occurred during the drought. However, additional pumpage from new development and supplemental irrigation use has undoubtedly contributed to some of the local declines.

## Short-Term Well Interference

In order to assess the local effects of pumping large yielding wells, a hypothetical analysis of well interference was performed. A similar approach that was used near Wilder (Baker, 1992) was taken. Both of these areas lie within the western Snake River Plain and have similar hydrogeology. The results of an aquifer test that was conducted in Wilder area were used for this study.

The mean value for transmissivity (T) that was acquired from the Wilder study was used in the analysis and is equal to 6200 $ft^2$/day. This value for T compares well with test data from Well Drillers' Reports in the Kuna area.

The values for storage coefficient (S) that were acquired from the Wilder study were in the range of $10^{-4}$ and correspond to an aquifer that is confined. In retrospect, these values for S were too low, since the aquifer receives local recharge from surface water irrigation and responds like it is unconfined. The effects of delayed drainage during the pumping test were in part the cause for the low values of S that were computed. After pumping sufficient period of time, the effects of delayed drainage would diminish and the value for S would be in the range of an unconfined aquifer, or about $10^{-1}$. A value for S of 0.1 was used in the analysis.

The rate and length of pumping that was used in the analysis is based on a protested application (WR# 63-11732) for an irrigation well in the study area. The proposed use for this application is for supplemental irrigation with a maximum diversion (pumping) rate of 3.45 cfs or about 1550 gpm. The same cyclic pumping schedule that was used in the Wilder study to represent supplemental irrigation use was applied in this analysis. The pumping schedule consisted of five 30-day periods, each of which represents the main months of the irrigation season: May, June, July, August, and September. Each 30-day period is composed of 10 days of non-pumping followed by 20 days of pumping.

NORTHEAST OF KUNA

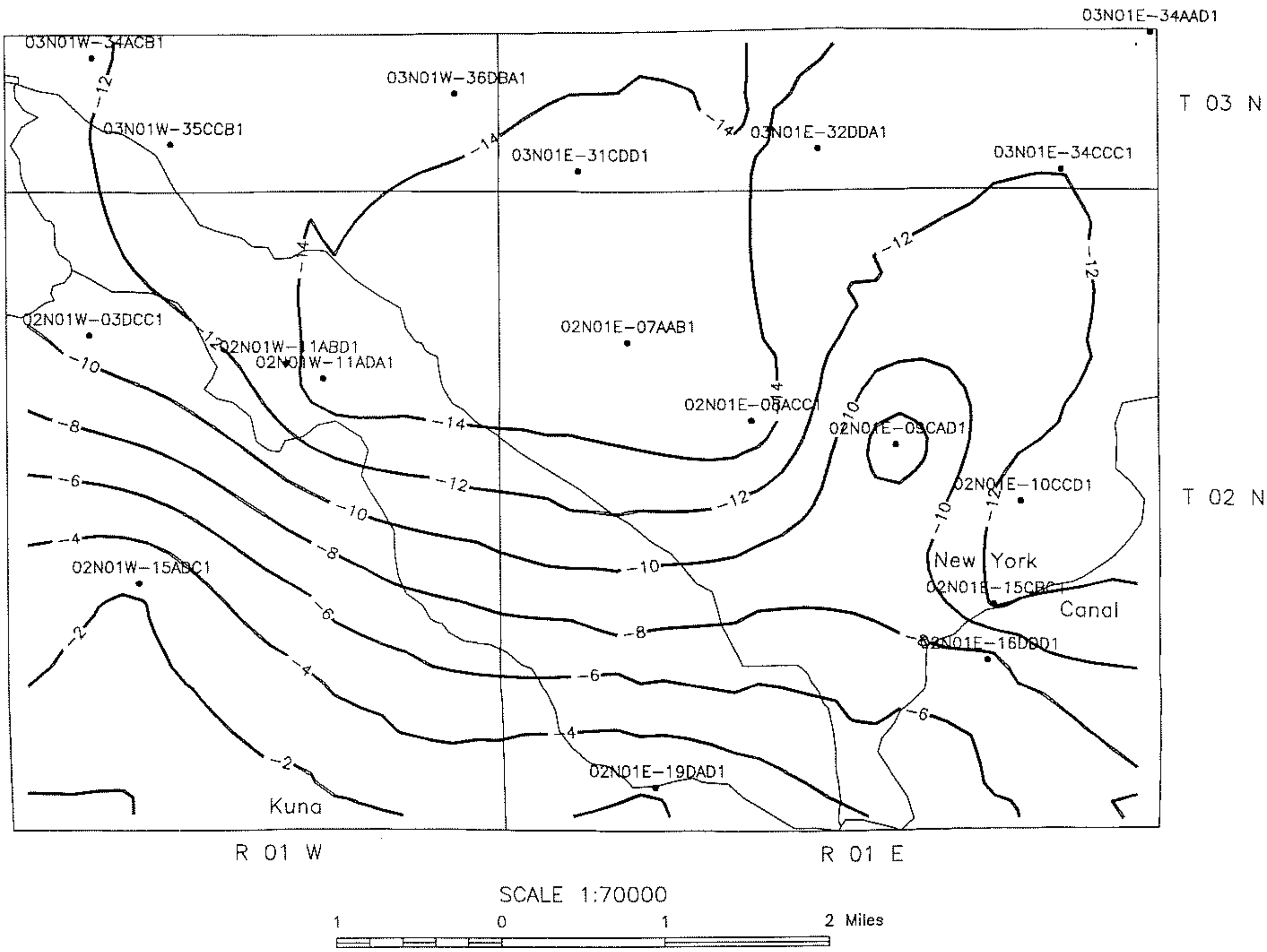



Figure 7. GENERALIZED WATER-LEVEL CHANGE MAP, SPRING 1970-1993

Since the maximum drawdown from pumping this well would occur at the end of the fifth period, it is the only period that is included in this report (see Figure 8.) As can be seen, at 1320 ft (¼ mile) from the well about 7 ft of drawdown is computed, at 2650 ft (½ mile) slightly greater than 2 ft of drawdown is computed, and at 3690 (¾ mile) less than 1 ft of drawdown is computed. This analysis suggests that only closely spaced wells (within a ¼ mile of each other) would significantly impact each other.

### Well Construction Practices

According to a review of Well Drillers' Reports, the majority of the wells that were drilled in the study area are for domestic purposes. A bar graph of well development in the study area that is shown on Figure 9 illustrates this point. Since 1967, over 600 domestic wells have been drilled, whereas, less than 40 non-domestic wells (mostly for irrigation) were drilled. Many of the domestic wells are too shallow (generally less than 20 ft below the water table.) These wells are the ones that have been severely impacted by declining water levels over the past six years.

## CONCLUSIONS

Water level declines in the study area over the past 23 years exceed 14 ft. According to a statistical analysis, most of the observed declines appear to be the result of reduced recharge from surface water during the recent drought. Local interference between wells may be significant for wells that are spaced closer than ¼ mile apart from each other. Most of the wells that have been deepened or re-drilled were originally drilled too shallow to provide adequate protection from the worst period of drought on record.

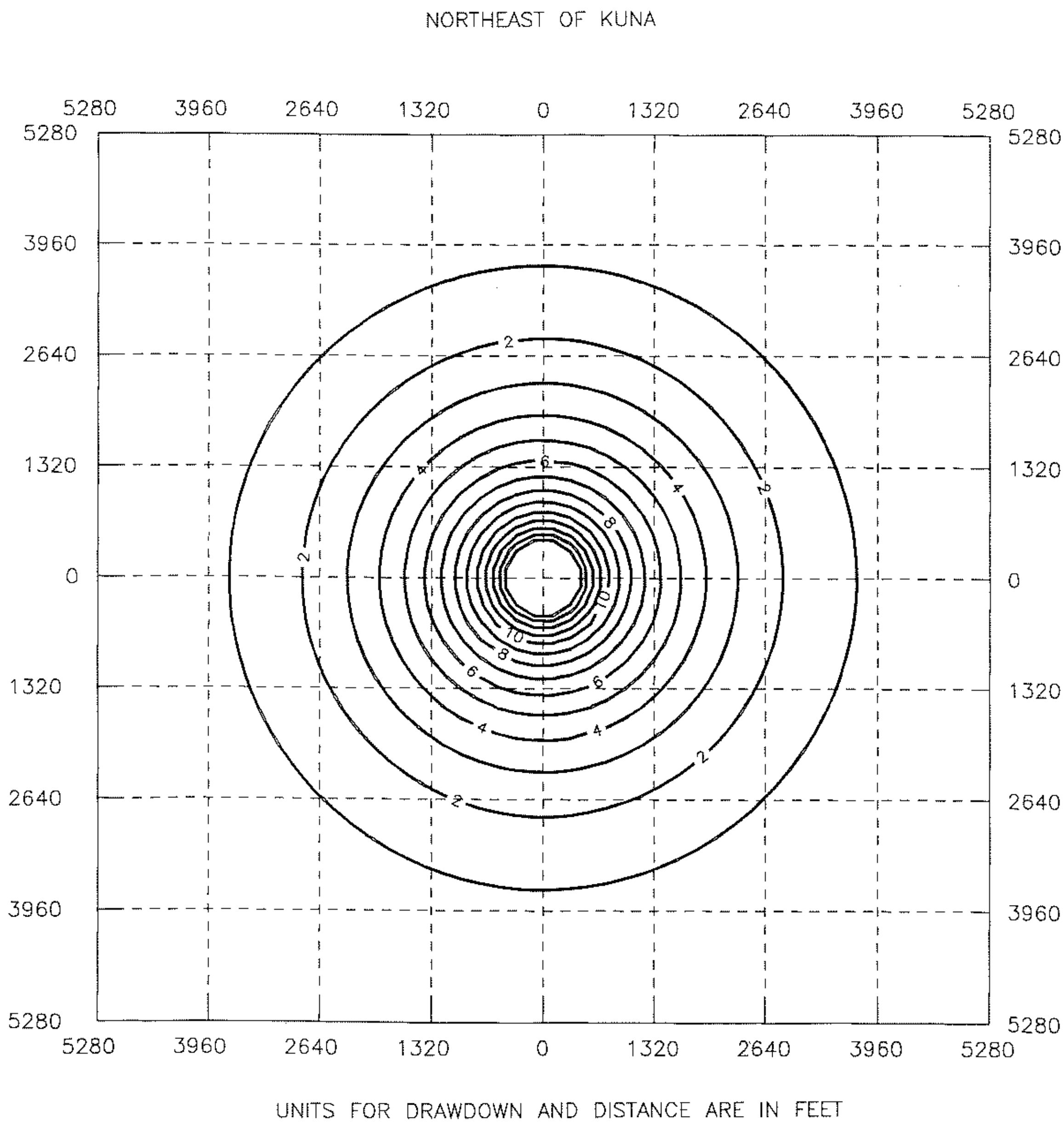
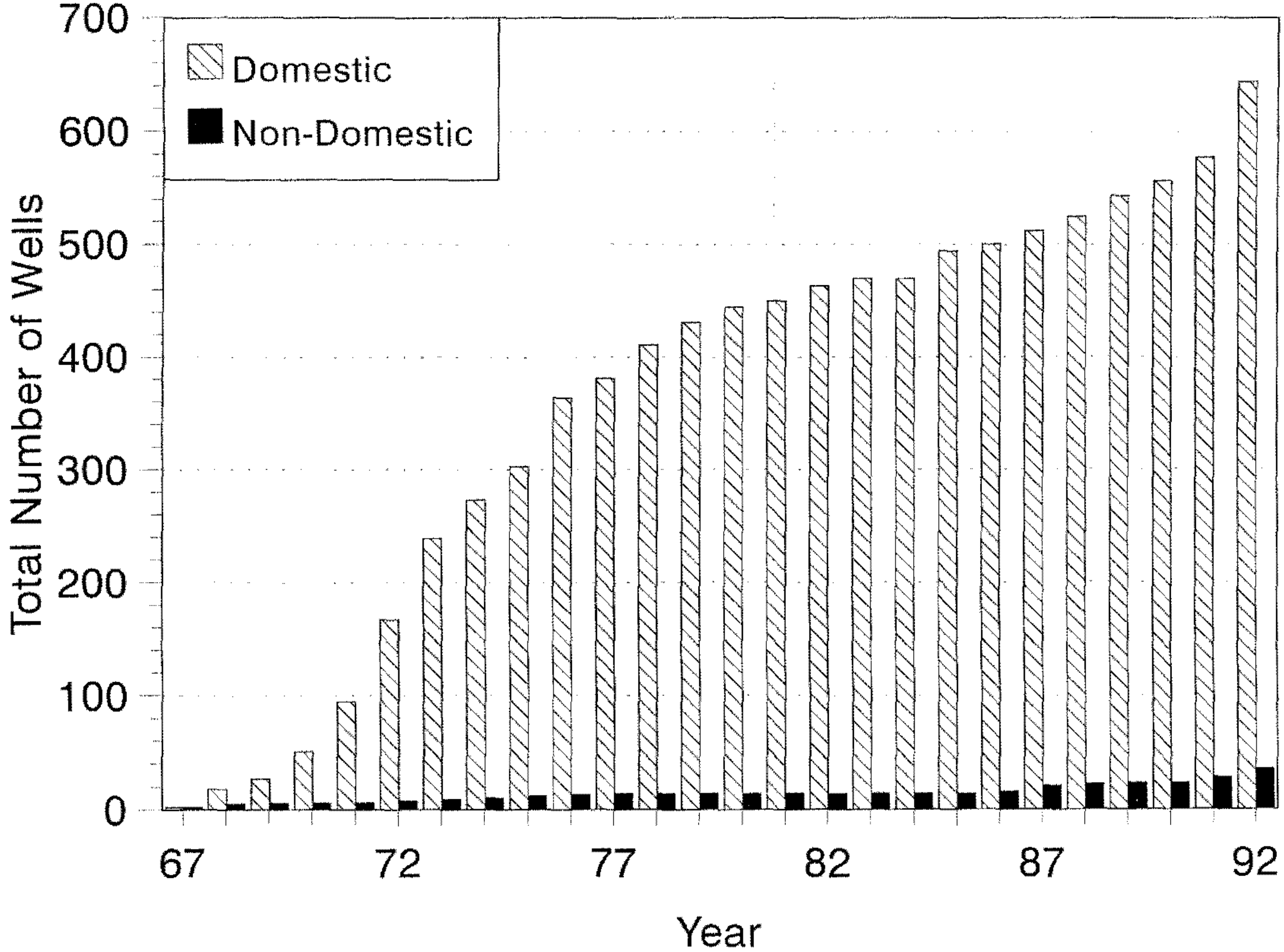



Figure 8. ESTIMATED DRAWDOWN AT THE END OF AN IRRIGATION SEASON FROM PUMPING A HYPOTHETICAL IRRIGATION WELL

Figure 9. Well Development Northeast of Kuna.
(Note: Only Wells Drilled Since 1967 Are Included)



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