Preliminary Assessment of Specific Conductance and Total Dissolved Solids Loading Rates in Agricultural Drainwater of the Carson Division of the Newlands Project, Churchill COunty, Nevada

A report of the study "stillwater Wildlife Management Area Contaminant Loading"
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FINAL REPORT

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Abstract

Section 206 of the Truckee-Carson-pyramid Lake Water Rights Settlement Act (P.L. 101-618, November 1990) (Act) authorized the purchase of water rights to support a long-term average of 25,000 acres of wetlands in Lahontan Valley, Nevada. The U.S. Fish and Wildlife Service, the lead Federal agency responsible for implementation of this section of the Act, is restricting purchases to agricultural water rights in the Carson Division of the Newlands Project. Acquisition of agricultural water rights could enhance wetland habitat conditions by securing a water supply and by reducing total dissolved solids and trace elements in agricultural drainwater entering the wetlands. Because the quality of agricultural drainwater in the Newlands Project is variable, the overall benefit of water rights acquisition to wetlands can be increased by selective purchase of water rights associated with drains contributing relatively large loads of agriculturally-induced contaminants.

This study was implemented to identify drains and drain segments in the Carson Division of the Newlands Project contributing relatively larger loads of agricultural contaminants. To accomplish this task, specific conductance of drainwater and drain discharges were measured to calculate total dissolved solids loading rates. Existing data on arsenic, boron, and selenium concentrations in detritus collected from drains in the Newlands Project were evaluated to identify drains containing relatively higher concentrations. The magnitude of this study prohibited attainment of all objectives. Limited numbers of data points (each site was surveyed once) also reduced the value of the study findings. Further research needs and changes in study design are identified.

Key Words: Agricultural Drainage; Total Dissolved Solids; Trace Elements; Contaminant Loading; Lahontan Valley, Nevada

Introduction

The quantity and quality of wetlands in Lahontan Valley, Nevada, which include wetlands in Stillwater National Wildlife Refuge (NWR), Stillwater Wildlife Management Area (WMA), Carson Lake, and numerous other wetlands (Fig. 1), have declined considerably since intensive agricultural practices began shortly after 1900. As a consequence, the abundance and diversity of fish and wildlife in this area has declined. Agricultural water consumption, increased loading of dissolved solids, and mobilization and transport of potentially toxic trace elements from agricultural lands have been identified as factors contributing to these declines (Hoffman et al. 1990). Public concern for the loss of wetland habitat, degradation of wetland quality, and declines in wildlife abundance and species diversity prompted efforts to improve wetland conditions. In November 1990, the Truckee-Carson-pyramid Lake Water Rights Settlement Act (Public Law 101-618) (Act) was enacted by Congress. This Act contained measures to enhance fish and wildlife habitat associated with the Truckee and Carson River basins. Section 206 of the Act, authorized the purchase of water rights to sustain a long-term average of 25,000 acres of wetland habitat in the Lahontan Valley. The U.S. Fish and Wildlife Service (Service), the lead Federal agency responsible for implementing this section, has identified the preferred alternative as acquisition of agricultural water rights from the Newlands Project area near Fallon, Nevada (otherwise known as the Carson Division of the Newlands Project).

The transfer of agriCUltural water rights from the Carson Division of the Newlands Project may serve to improve wetland habitat conditions by increasing the volume of water entering wetlands and by reducing the load of agriculturally-induced contaminants discharged to wetlands. In the latter, a reduction of contaminant loading may result from the discontinuation of irrigation and the subsequent decrease in the mobilization, transport, and redistribution of dissolved solids, including trace elements. However, because agriculturally-induced contaminants are not homogeneously distributed throughout the Newlands Project area (Hoffman et al. 1990), it is believed that an even greater contaminant load reduction may be realized through selective agricultural land retirement. This study was implemented to investigate this possibility.

To identify areas within the Carson Division of the Newlands Project contributing proportionally greater loads of agriculturally-induced contaminants, specific conductance and discharge of agricultural drains were determined. This information was used to estimate total dissolved solids (TDS) loading rates in specific agricultural drains and laterals. These data were supplemented with trace element analyses of detritus collected from drains in the Newlands Project as part of the Department of the Interior Detailed Study of Agricultural Drainage in and near Stillwater WMA (Rowe et al. 1991), hereafter referred to as the detailed study.

Several unforseen factors, including the extent and dynamics of the agriCUltural drainage system in the Newlands Project, staffing limitations, and shortages in agricultural water deliveries due to regional drought prevented the generation of information that is of immediate use to aid in water rights acquisition. Limited numbers of data points (each site was surveyed once) further reduce the value of study findings. study findings are used to recommend changes in study methods and to recommend drainage areas in which to concentrate further research activities.

Background

Prior to agricultural development, wetlanda covered approximately 172,000 acres in the Lahontan Valley (Hoffman et al. 1990). These wetlands, which included Carson Lake, Stillwater Marsh, and numerous smaller wetlands supported large and diverse assemblages of fish and wildlife. The Carson River, originating in the eastern slopes of the Sierra Nevada, was the primary source of water (Fig. 1). Because Carson River discharge varied annually and seasonally, wetland size also varied.

In 1902, the Reclamation Service (the predecessor agency of the U.S. Bureau of Reclamation) established the Truckee-Carson Project, an extensive irrigation water delivery system in the Lahontan Valley. This project, later renamed the Newlands Project, allowed for the development of agricultural land near Fallon, Churchill County, Nevada (Fig. 1). Irrigation water to support the project was stored in Lahontan Reservoir on the Carson River. In addition to the Carson River, water was imported from the Truckee River through the Truckee Canal beginning in 1905. This approximately 60 kilometer (km) canal extends from Derby Dam on the Truckee River to Lahontan Reservoir (Fig. 1). A system of canals was constructed to deliver water from Lahontan Reservoir to flood irrigate an anticipated maximum of 73,000 acres. An extensive network of agricultural drains (over 550 km) was constructed to prevent soil saturation (U.S. Bureau of Reclamation 1991b). These drains discharge into adjacent wetland areas, including Carson Lake and Stillwater Marsh.

As a result of agricultural water consumption, the quantity of water entering the wetlands was reduced. The decreased amount of relatively fresh water and the increased discharge of agricultural drainwater to wetlands led to increased TDS concentrations. Hoffman et al. (1990) found that TDS concentrations in water passing through the Newlands Project increased by a factor of 10 or more. TDS concentrations in water released from Lahontan Reservoir typically ranged from 200 to 400 mg/L while concentrations in water from agricultural drains ranged from 566 to over 41,000 mg/L. Hoffman et al. (1990) also found elevated concentrations of certain constituents, including potentially toxic trace elements. In many cases, concentrations exceeded baseline concentrations and/or Federal and State criteria for the protection of aquatic life and/or the propagation of wildlife. Of primary concern were arsenic, boron, mercury, and selenium, in water, sediment, and/or biota collected from wetlands in Lahontan Valley. Other constituents, including chromium, copper, zinc, un-ionized ammonia, TDS, and sodium, approached levels of concern. Agricultural practices were identified as primary contributors to the mobilization and redistribution of these constituents. Adverse biological effects attributed to wetland habitat degradation included significant losses of wetland vegetation, declines in species abundance, and shifts in species composition (Hoffman et al. 1990). Contaminant loading associated with agricultural drainage also has been correlated with incidences of reproductive failure, developmental abnormalities, increased incidence of infectious diseases, long-term degradation of body conditions, and mortality of migratory birds (Hoffman et al. 1990; Moore et al. 1990).

During recent years, western Nevada has experienced drought. The 1991 water year (October 1, 1990 to September 31, 1991) was the fifth consecutive year of below-normal precipitation and run-off from the Sierra Nevada. As a result, Newlands Project water users received below-normal water deliveries. In 1990, water deliveries were delayed for 2 weeks at the beginning of the irrigation season and terminated 2 weeks before the end of the scheduled season. Deliveries were restricted to 163,407 acre-feet, or 70 percent of entitlements to water users (U.S. Bureau of Reclamation 1991a). In 1991, deliveries were delayed 5 weeks at the beginning of the irrigation season and terminated 4 weeks early. Deliveries were also suspended during a 2-week period in late September 1991. In 1991, 106,325 acre-feet, about 50 percent of entitlements, were delivered (U.S. Bureau of Reclamation 1992). Water shortages also prompted large-scale reuse of drainwater for irrigation. As a result, wetland size and quality were further diminished.

Methods

Field data were collected from October through December 1990, and June through August 1991. The original intent was to visit each site during both periods. However, because of the extent of the drain network, staffing limitations, and time constraints, each drain site was visited only once.

During these periods, discharge and specific conductance in most major drains flowing toward stillwater WMA and Carson Lake area were measured. TJ Drain and Hunter Drain were excluded from this study because remedial measures for these drains were under consideration. In each drain, measurement sites in the main stem, laterals, and sublaterals were selected to determine discharge and specific conductance. Measurement sites were typically at points immediately upstream of the confluence of two or more drains, laterals, and sublaterals. In drain segments with large distances between lateral intersections (typically 1.5 km or more), measurement sites were established at intermediate locations. The actual number of acres served by major drains has not been determined and may be impossible to ascertain (Gene Harms, U.S. Bureau of Reclamation, pers. comrn., 1990; in Lico 1992). Therefore, no attempt was made to correlate discharge and loading rates of each drain to agricultural acreage served.

Drainwater discharge (liters per second; LIs) was measured using methods described by Hamilton and Bergersen (19B4). At each measurement site, a transect was placed perpendicular to the drainwater flow. The transect line was divided into increments based on width. Where drain flow width exceeded 4.6 meters (m), each increment represented 5 percent of the drain flow width. Where drain flow width was between 0.5 and 4.6 m, each increment represented 10 percent of stream width. A minimum increment width of 5 centimeters (em) was used to estimate flow volume in drains less than 0.5 m wide. Water column depth (em) at the center of each increment was assumed to represent the average increment depth. Water velocity (em per second; cmjs), also measured at the center point of each increment, was measured at 60 percent of the water column depth with a Marsh McBirney model 401 Water Current Meter. This velocity represented mean velocity of that increment. At measurement sites where bottom sediments in drains would not support the wading rod, a strip of 0.64 em (0.25 inch) plywood (approximately 15 em X 30 em) was used to support the rod. Flow velocities, increment width, and water column depth were used to calculate discharge for each increment. The sum of discharges for all transect increments represented instantaneous discharge at that transect. Reverse flows were found in three locations (2 sites in West Carson Lake Drain and one site in Carson Lake 1 Drain). To quantify dissolved solids movement at these sites the absolute value of these flows were used to determine loading rates.

Specific conductance (microsiemensjcm; µS/cm) was measured with a Yellow Springs Instruments Model 33 S-C-T Meter. Specific Conductance from this meter was periodically referenced with one of two Fisher Scientific Company Digital conductivity Meters to check accuracy. To calculate loading rates, specific conductance measurements were converted to TDS (milligrams per liter; mgjL) using the following relationships (Hoffman et al. 1990):

Specific conductance (SC) less than 5,000 µS/cm:

TDS (mgjL) = 0.5B4(SC) + 22.1

Specific conductance over 5,000 µS/cm:

TDS (mgjL) = 0.682(SC) - 269

Hoffman et. al. (1990) cautioned against using the latter formula for extrapolating TDS at levels greater than 9,000 µS/cm. However, for comparative purposes, this formula was used to calculate loading rates at five sites (three in Harmon Drain HDS1 lateral, one in Carson Lake 1 Drain CLN1 lateral, and one in Carson Lake Drain COW3 lateral) where specific conductance exceeded 9,000 µS/cm.

Instantaneous TOS loading rates (grams per second; gjs) were obtained by the following formula:

TOS loading rate (gjs) = (Ljs)(mgjL)j1000

Discharge, specific conductance, and corresponding loading rates represent conditions at the time of sampling. Conditions vary widely depending on season and agricultural practices at the time of sampling. Comparisons of load estimates among drains in the Newlands Project were not attempted because of temporal variability. The absence of flow at many sites did not permit loading rate calculations.

Results and Discussion

A total of 347 sites representing over 300 km of drains were surveyed during this study (Appendix A presents site data; Appendix B illustrates the locations of sites). These sites were located in 21 drains, 14 of which discharged toward Stillwater WMA and 7 of which discharged toward Carson Lake (Fig. 2; Table 1). These drains branched into 187 lateral and sublateral drains. Conditions in major laterals and sublaterals are summarized in Table 2.

Where possible, sites were established at locations where detritus samples were collected in 1988 as part of the detailed study. Results of trace element analyses for these samples are presented in Rowe et al. (1991). Concentrations of arsenic, boron, and selenium in S9 detritus samples collected from agricultural drains in the Carson Division of the Newlands Project are used to further characterize conditions in agricultural drains (Table 3).

Stillwater Wildlife Management Area *Drainage*

A total of 268 sites representing over 220 kilometers in 14 drains that discharge toward Stillwater WMA were surveyed (Table 1). Specific conductance of drain water ranged from 250 to >50,000 µS/cm. Specific conductance at 123 sites in 9 primary drain systems where flowing water was found ranged from 290 to 16,000 µS/cm. Discharge at these sites ranged from <1 to almost 1700 L/s. Loading rates ranged from <1 to over 630 g/s. Conditions in individual drains are discussed below.

Diagonal Drain

Diagonal Drain, extending almost 80 km, was the most extensive drain surveyed. This drain discharges to Stillwater Point Reservoir on Stillwater NWR (Appendix B). Specific conductance at 92 sites ranged from 350 to 3,020 µS/cm during the fall (Table 1). Sixty sites conveyed flowing water when surveyed. Specific conductance at these sites ranged from 350 to 2,400 µS/cm. The maximum discharge, approximately 1,700 L/s, and the maximum TDS loading rate, approximately 630 gis, were found in the main stem near the terminus of the drain (Appendix A). No lateral appeared outstanding in terms of TDS load contribution. At flowing water sites higher specific conductance levels were found in laterals DDN4 (Pasture Road Drain), DDN5 (unnamed), and DDN8 (Harrigan Road Drain) and sublaterals DDN6Wl and DDN6W2 in Testolin Road Drain (Table 2). However, discharge and corresponding loading rates were generally low. Higher loading rates were found in laterals DDN2 (L Line Canal), DDN3 (Lower Diagonal Drain), and DDN6 (Testolin Road Drain). However, high loading rates were attributable to higher discharge levels.

Thirteen detritus samples were collected from Diagonal Drain during the detailed study (Rowe et al. 1991). Relatively high concentrations of arsenic and selenium were found in samples collected at survey site DDIO on the main stem (44 and 1.9 µg/g, respectively) and site DDN6W3.3 in Testolin Road Drain (38 and 2.6 µg/g, respectively; Table 3). A relatively high boron concentration (47 µg/g) was found at sample site DDN3.2 in Lower Diagonal Number 1 Drain. Concentrations of arsenic, boron, and selenium in detritus at other collection points in this drain were below or slightly above mean levels in the project area.

New River Drain

New River Drain, surveyed during the fall, discharges to Harmon Reservoir, a Newlands Project reregulating reservoir. Water in the reservoir is used to irrigate agricultural fields near Stillwater NWR. Specific conductance at 26 sites in New River Drain, including 11 flowing water sites, ranged from 290 to 2250 µS/cm (Table 1). The maximum discharge, over 140 L/s, and the maximum loading rate, almost 60 gis, were found in the main stem above site NR6. Below this point, drain discharge was pumped into L Line Canal, a New1ands Project water delivery canal. Four of 8 laterals contained flowing water (Table 2). Higher specific conductance levels were found in laterals NRN1 and NRS3. However, discharge and corresponding loading rates were relatively low.

Two detritus samples were collected from New River Drain during the detailed study (Rowe et a1. 1991). One sample collected in the main stem near site NR5 contained a comparatively high concentration of arsenic (54 µg/g) and a moderate concentration of boron (44 µg/g; Table 3).

South Harmon Drain

South Harmon Drain enters Harmon Reservoir on the southern end. Two sites representing 3.3 km of drain were sampled during the fall. Specific conductance was 530 and 850 µS/cm (Table 1). Flowing water was found at site HS1 (Table 2). A loading rate of approximately 15 g/s was estimated from a flow of approximately 30 L/s.

One detritus sample collected near the mouth of South Harmon Reservoir Drain during the detailed study (Rowe et a1. 1991) contained comparatively low concentrations of arsenic, boron, and selenium (Table 3).

North Harmon Drain

North Harmon Drain enters Harmon Reservoir at the north-western end. Two sites representing 1.5 km were sampled during the fall. Specific conductance was 720 and 1,290 µS/cm (Table 1). Low discharge at each site corresponded to low loading rates (Table 2). Rowe et a1. (1991) did not collect detritus samples for trace element analysis from this drain.

Harmon Drain

Harmon Drain, surveyed during the fall, discharges to Stillwater Slough. stillwater Slough enters Stillwater NWR near Lead Lake. Thirty-eight sites, representing over 25 km, were surveyed in this drain. specific conductance ranged from 250 to 16,000 µS/cm (Table 1). Specific conductance at 24 flowing water sites ranged from 320 to 16,000 µS/cm. The maximum discharge rate, 85 L/s, and loading rate, over 75 gis, were found in the main stem of the drain. In laterals with flowing water, the highest specific conductance (16,000 µS/cm) was found in the 4.2 km-10ng HDS1 lateral (Table 2). This value exceeded the 9,000 µS/cm range for conversion of specific conductance to dissolved solids (mg/L) presented in Hoffman (1990), so accurate conversion was not possible. However, for comparative purposes, a loading rate of over 60 g/s for a discharge of 7 L/s is obtained if Hoffman's conversion formula is used. Relatively high specific conductance values were also found in lateral HDN1. However, a low discharge «1 L/S) corresponded to a relatively low loading rate (1.4 g/S) in this 1.4 km-10ng lateral. Above the confluence of these laterals, specific conductance drops considerably. The maximum specific conductance value observed in the remainder of the drain was 1,000 µS/cm.

Five detritus samples were collected from Harmon Drain during the detailed study (Rowe et al. 1991). Relatively high arsenic concentrations were found at sites HD6 and HDS5 (74 and 41 µg/g, respectively), a high boron concentration was found at site HDS1.2 (53 µg/g), and a high selenium concentration was found at site HDS5 (2.4 µg/g; Table 3).

Kent Drain East

Kent Drain East, surveyed during the summer, also discharges to Stillwater Slough. Specific conductance at one site on this short (1 km) drain was 1450 µS/cm (Table 1). Flowing water was not found in this drain, therefore a loading rate was not determined. Rowe et al. (1991) did not collect detritus samples for trace element analysis from this drain.

Kent Drain

Kent Drain, which discharges to Stillwater Slough, was surveyed during the summer. Specific conductance at 4 sites ranged from 3,500 µS/cm to greater than the capacity of our meter (>50,000 µS/cm). No flowing water was found in this drain. Evaporation, and subsequent concentration of dissolved solids at these stagnant sites, undoubtedly contributed to these extreme TDS concentrations. The lack of flowing water prohibited the determination of loading rates in this drain. However, high TDS concentrations suggest that load contributions from this drain may be significant under higher flow conditions. Rowe et al. (1991) did not collect detritus samples for trace element analysis from this drain.

Norton Drain

Six sites in Norton Drain, which also discharges to Stillwater Slough, were surveyed during the summer. Specific conductance ranged from 8,000 µS/cm to greater than the capacity of our equipment (>50,000 µS/cm). Again, concentration of dissolved solids through evaporation at these stagnant sites undoubtedly contributed to these extreme TDS concentrations. Again, loading rates in this drain were not determined, but high TDS concentrations suggest that load contributions from this drain may be significant under higher flow conditions. Rowe et al. (1991) did not collect detritus samples for trace element analysis from this drain.

Paiute Diversion Drain

Paiute Diversion Drain, surveyed during the summer, enters stillwater NWR near Lead Lake. specific conductance at 42 sites, representing over 40 km, ranged from 300 to 39,500 µS/cm (Table 1). Specific conductance at 11 flowing water sites ranged from 410 to 1,700 µS/cm. The maximum loading rate, almost 45 gis, was found in the main stem (Table 2). Flowing water was found in only 3 of 11 laterals. Specific conductance in these laterals was relatively low. Like Kent and Norton Drains, evaporation undoubtedly contributed to concentration of dissolved solids leading to high specific conductance values in laterals with stagnant water.

Concentrations of arsenic, boron, and selenium were comparatively low in six detritus samples collected from Paiute Diversion Drain during the detailed study (Rowe et al. 1991).

Paiute Drain

Paiute Drain, surveyed during the summer, enters Stillwater NWR near Lead Lake. Specific conductance at 32 sites, representing almost 25 km of drain, ranged from 400 to 8,900 µS/cm (Table 1). Specific conductance at 9 flowing water sites ranged from 400 to 1,830 µS/cm. Flowing water was found in 3 of 7 laterals. The maximum discharge, approximately 150 L/s, and the maximum loading rate, over 90 gis, was found near the terminus of lateral PDWI (Table 2). Specific conductance was relatively high in Bailey Drain (lateral PDSl), but the discharge and corresponding loading rate were relatively low.

Concentrations of arsenic, boron, and selenium were comparatively low in three detritus samples collected from Paiute Drain during the detailed study (Rowe et al. 1991).

Shaffner Drain

Shaffner Drain discharges to Vaughn Slough near the Indian Lakes area on Stillwater WMA. Seven sites, representing 2.7 km, were surveyed during the summer. Specific conductance ranged from 1,550 to 2,100 µS/cm (Table 1). Flowing water was only found at one site in the main stem. A flow of 12 L/S and a specific conductance level of 1650 µS/cm corresponded to a loading rate of approximately 11 g/s (Table 2).

Two detritus samples were collected from Shaffner Drain during the detailed study (Rowe et al. 1991). Selenium concentrations in these samples were among the highest observed during that study (3.2 and 6.5 µg/g; Table 3). One sample also contained a relatively high concentration of boron (74 µg/g).

ERB Drain

ERB Drain discharges to the Carson River near Sagouspi Dam. Nine sites representing 11 km of drain were surveyed during the summer. Specific conductance ranged from 480 to 2,000 µS/cm (Table 1). Specific conductance at 4 flowing water sites in the main stem ranged from 1,500 to 1,600 µS/cm. Modest flows at these sites corresponded to relatively large loading rates (Table 2). No flowing water was found in 3 laterals.

One detritus sample collected from ERB Drain during the detailed study (Rowe et al. 1991) contained a comparatively high concentration of arsenic (46 µg/g; Table 3).

Lower Soda Lake Drain

Lower Soda Lake Drain discharges to the Carson River upstream of sagouspi Dam. Five sites representing 3.3 km were surveyed during the summer (Table 1). Specific conductance ranged from 1,100 to 1,520 µS/cm. Flowing water was not found at any sites surveyed. Rowe et al. (1991) did not collect detritus samples for trace element analysis from this drain.

Upper Soda Lake Drain

Upper Soda Lake Drain discharges to the Carson River upstream of Sagouspi Dam. Two sites representing 3.8 km were surveyed during the Summer (Table 1). Specific conductance at these sites were 1,220 and 1,700 µS/cm. Flowing water was not found at either site.

One detritus sample collected from Upper Soda Lake Drain during the detailed study (Rowe et al. 1991) contained comparatively high arsenic and selenium concentrations (44 and 3.0 µg/g, respectively; Table 3).

Carson Lake Area Drainage

Over 90 km in seven drains were surveyed in the Carson Lake drainage area during the summer (Table 1). With the exception of Carson Lake Drain and Downs Drain, all drains discharge to Lee Drain, which serves as a water distribution canal for Carson Lake Pasture. Specific conductance at 79 sites, including 39 sites where flowing water was found, ranged from 350 to 13,500 µS/cm. Discharge at the sites ranged from <1 to almost 430 Lis. Loading rates ranged from approximately 2 to over 220 *g/s*. Conditions in individual drains are discussed below.

West Carson Lake Drain

Specific conductance at 3 sites in West Carson Lake Drain, including 2 where flowing water was found, ranged from 2,100 to 4,500 µS/cm (Table 1). Discharge and loading rates at each site were relatively low (Table 2). Rowe et al. (1991) did not collect detritus samples for trace element analysis from West Carson Lake Drain.

Carson Lake 1 Drain

Specific conductance at 25 sites in Carson Lake 1 Drain, including 13 sites where flowing water was found, ranged from 400 to 13,500 µS/cm (Table 1). The maximum discharge, almost 100 Lis, and maximum loading rate, over 60 gis, were found in the main stem of the drain (Table 2). Flowing water was found in 5 of 9 laterals. Higher specific conductances and higher loading rates were found in laterals CLNl and CLW1. Lateral CLNl was particularly notable. Unfortunately, specific conductance in this lateral, 13,500 µS/cm, exceeded the 9,000 µS/cm range for conversion of specific conductance to dissolved solids (mg/L) presented in Hoffman (1990), so accurate conversion to TDS was not possible. However, for comparative purposes, a loading rate of over 22.2 *gls* for a discharge of 2.5 Lis is obtained if Hoffman's conversion formula is used.

Six detritus samples were collected from Carson Lake 1 Drain during the detailed study (Rowe et al. 1991). With the exception of a moderate concentration of arsenic in a sample from lateral CLW5 (37 µg/g) and a moderate concentration of boron in a sample collected near site CL7 (41 µg/g), concentrations of arsenic, boron, and selenium were generally below or only slightly above mean concentrations of samples collected throughout the Newlands Project area (Table 3).

carson Lake Drain

Specific conductance at 23 sites in Carson Lake Drain, including 12 sites where flowing water was found, ranged from 700 to 11,200 µS/cm (Table 1). The maximum discharge, almost 90 Lis, and maximum loading rate, almost *110 gis*, were found in the main stem of the drain (Table 2). The higher loading rates were found near the drain terminus. Flowing water was found in 4 of 7 laterals. Specific conductances and loading rates were moderately high in laterals CDW1, CDW3, and CDW4. Specific conductance at two sites in lateral CDW3 exceeded the 9,000 µS/cm range for conversion of specific conductance to dissolved solids (mg/L) presented in Hoffman et al. (1990), so accurate conversion to TOS was not possible. However, for comparative purposes, a loading rate of over 3.1 *gls* for a discharge of 0.4 Lis is obtained if Hoffman's conversion formula is used.

Four detritus samples were collected from Carson Lake Drain during the detailed study (Rowe et al. 1991). The concentration of boron in a sample from lateral CDW3 was very high (100 µg/g; Table 3). With the exception of a moderately high arsenic concentration in a sample collected near site CD7 (44 µg/g), concentrations of arsenic, boron, and selenium were generally below or only slightly above mean concentrations of samples collected throughout the Newlands Project area (Table 3).

Downs Drain

Specific conductance at 5 sites in Downs Drain, representing 4.3 km, ranged from 1,450 to 8,000 µS/cm (Table 1). Flowing water was only found in the main stem near the terminus of this drain (Table 2). A flow of approximately 8 L/s and a specific conductance of 1,450 µS/cm corresponded to a loading rate of more than 7 g/s.

One detritus sample collected from Downs Drain during the detailed study (Rowe et al. 1991) contained a high boron concentration (54 µg/g) and a very high selenium concentration (3.5 µg/g; Table 3).

Gummow Drain

Specific conductance at 3 sites in Gummow Drain, representing 6.7 km, ranged from 350 to 1,340 µS/cm (Table 1). Specific conductances at 2 flowing water sites were 350 and 600 µS/cm. The maximum discharge, 56 L/s, and maximum loading rate, 20.8 gis, were found in the main stem of the drain.

concentrations of arsenic, boron, and selenium in one detritus sample collected from Gummow Drain during the detailed study (Rowe et al. 1991) were near mean levels found in the Project area (Table 3).

L Drain

Specific conductance at 11 sites in L Drain, representing almost 15 km, ranged from.800 to 1,500 µS/cm (Table 1). Flowing water was only found in the main stem of the drain. Specific conductance at these 6 sites ranged from 800 to 900 µS/cm (Table 2). The maximum flow, approximately 260 L/s, corresponded to the maximum loading rate, almost 130 g/s.

Two detritus samples collected from L Drain during the detailed study (Rowe et al. 1991) contained concentrations of arsenic, boron, and selenium that were below mean levels found in the Project area (Table 3).

Lee Drain

Lee Drain serves as a water distribution canal for Carson Lake Pasture and receives drainwater from all drains flowing into the Carson Lake area. Specific conductance at nine sites in this drain ranged from 750 to 8,200 µS/cm (Table 1). Specific conductance at 3 flowing water sites ranged from 790 to 850 µS/cm.

Concentrations of arsenic, boron, and selenium in one detritus sample collected from Lee Drain during the detailed study (Rowe et al. 1991) were below mean levels found in the Project area (Table 3).

COnclusion

Specific conductance, discharge, and corresponding TDS loading rates in agricultural drains in the Carson Division of the Newlands Project were highly variable. Of drains that discharged to Stillwater Wildlife Management Area, Diagonal Drain had the highest loading rate. However, this drain also served the largest area and had the greatest discharge. Loading rates in other drains serving this area were considerably lower. Excluding Lee Drain, the largest loading rates entering Carson Lake were found in Carson Lake Drain and L Drain. Variability within and among drains reflect the dynamic nature of the system. Conditions in drains are also highly variable. Lico (1992) found considerable changes in discharge and specific conductance in agricultural drains in relatively short periods of time. In extreme cases, specific conductance changed by more than 1,000 µS/cm in a 24 h period. Hoffman et al. (1990) found more gradual changes in specific conductance throughout the irrigation season; specific conductance was generally higher in the pre-irrigation season (late winter) and decreased in the late-irrigation season (fall). Long-term hydrologic conditions (drought) at the time of our study also affected observed conditions.

Recommendations

Several changes in study design are needed to more accurately assess agriculturally-induced contaminant contributions from specific areas in the Newlands Project. Most importantly, each sampling site should be monitored several times before, during, and following the irrigation season. More than one irrigation season may be needed to fully characterize discharge and accurately assess contaminant load contributions. Drain discharge should be correlated to irrigation water delivery to specific agricultural lands. Such a correlation should include amounts of water delivered and specific conductance of that water. Future studies should also integrate soils information such as overall soil types, alkalinity, and levels of salts and trace elements. Such information for Lahontan Valley is currently being developed by the Soil Conservation Service and the Bureau of Reclamation. To more fully characterize agricultural contaminants in specific drains, trace element analysis should accompany load allocations. This measure would allow assessment of relative contributions of specific trace elements.

Discharge measurements are also a source of error in determining contaminant loading rates. Where possible, existing water control structures should be used. However, few such structures occur in agricultural drains so fixed water control structures should be installed. Such structures may consist of V-notch weirs constructed of plywood.

Finally, because of the extent of the drainage system, future studies should focus on limited areas. Our data and those of Rowe et al. (1991) indicate several areas appear to contribute proportionally greater amounts of agricultural contaminants. Unfortunately, survey methodology and hydrologic conditions at the time of our sampling prevented meaningful load allocations to many of the drains and laterals. However, relatively high loading rates proportional to discharge were found in some drain laterals. These included:

- Harmon Drain laterals HDSl and HDN1;
- Paiute Drain lateral PDS1;
- Carson Lake 1 Drain laterals CLNl and CLW1,
- Carson Lake Drain laterals COWl, CDW3, and CDW4, and
- Downs Drain.

High specific conductance was found in other drains. However, no flowing water was found and loading rates could not be determined. Large loads of dissolved solids may be contributed under higher flow conditions. More data is needed to better assess loading rates from these drains.

Relatively high specific conductance was also found at two sample sites in Lee Drain. However, this drain served as a distribution canal for Carson Lake Pasture and probably received minimal subsurface drainage. High specific conductance probably reflects drainage from other agricultural drains (the Down's Drain discharge point is located near these sampling sites).

Analytical data for detrital matter collected from agricultural drains in the Carson Division of the Newlands Project from Rowe et al. (1991) also indicated that certain drains may contribute proportionally greater amounts of arsenic, boron, and selenium. Relatively high levels of these trace elements were found at one or more sites in the following drains and laterals:

Arsenic:

- Diagonal Drain main stem and lateral DDN6W3,
  New River Drain main stem,
  Harmon Drain main stem and lateral HOSS,
  ERB Drain main stem,
  Upper Soda Lake Drain main stem,
  Carson Lake 1 Drain lateral CLWS,
  Carson Lake Drain main stem,

Boron:

- Diagonal Drain lateral DDN3,
- New River Drain main stem,
- Harmon Drain lateral HDS1,
- Shaffner Drain lateral SHS1,
- Carson Lake 1 Drain main stem,
- Carson Lake Drain lateral CDW3,
- Downs Drain main stem,

Selenium:.

- Diagonal Drain main stem and lateral DDN6W3,
  Harmon Drain lateral HDSS,
  Shaffner Drain main stem and lateral SHS1,
  Upper Soda Lake Drain main stem,
  Downs Drain main stem.

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References

Hamilton, K., and E.P. Bergersen. 1984. Methods to Estimate Aquatic Habitat **Variables.** Colorado Cooperative Fishery Unit, Colorado state **University,** Fort Collins, Colorado.

Hoffman, R.J., R.J. Hallock, T.G. Rowe, M.S. Lico, H.L. Burge, and S.P. Thompson. 1990. Reconnaissance Investigation of water Quality, Bottom Sediment, and Biota Associated with Irrigation Drainage in and near Stillwater Wildlife Management Area, Churchill County, Nevada, 1986-87. U.S. Geological Survey Water-Resources Investigations Report 89-4105.

Lico, M.S. 1992. Detailed study of irrigation drainage in and near wildlife management areas, west-central Nevada, 1987-90; Part A. Water quality, sediment composition, and hydrogeochemical processes in Stillwater and Fernley Wildlife Management Areas. U.S. Geological Survey Water-Resources Investigations Report 92-4024A.

Moore, S.B., J Winckel, S.J. Detwiler, S.A. Klasing, P.A. Gaul, N.R. Kanim, B.E. Kesser, A.B. DeBevec, K. Beardsley, and L.K. Puckett. 1990. Fish and Wildlife Resources and Agricultural Drainage in the San Joaquin Valley, California. San Joaquin Valley Drainage Program, Sacramento, California.

Rowe, T.G., M.S. Lico, R.J. Hallock, A.S. Maest, and R.J. Hoffman. 1991. Physical, chemical, and biological data for detailed study of irrigation drainage in and near Stillwater, Fernley, and Humboldt Wildlife Management Areas and Carson Lake, west-central Nevada, 1987-89. U.S. Geological Survey Open-File Report 91-185.

U.S. Department of the Interior, Bureau of Reclamation. 1991a. Quarterly Report of Activities Fallon Field Office, Fourth Quarter, October 1990 December 1990. u.S. Bureau of Reclamation, Mid-Pacific Region, Carson City, Nevada.

U.S. Department of the Interior, Bureau of Reclamation. 1991b. Newlands Project Water Measurement Management and Conservation Program 1990 Annual Report. U.S. Bureau of Reclamation, Mid-Pacific Region, Carson City, Nevada.

U.S. Department of the Interior, Bureau of Reclamation. 1992. Quarterly Report of Activities Fallon Field Office, Fourth Quarter, October 1991 December 1991. U.S. Bureau of Reclamation, Mid-Pacific Region, Carson City, Nevada.

Table 1. Number of sample sites, drain lengths, and specific conductance (mean and range) of all sites, and number of sites, discharge range (liters per second), specific conductance (mean and range), and TOS loading rate (grams per second) for selected agricultural drains in the Carson Division of the Newlands Project that discharge toward Stillwater National Wildlife Refuge (NWR) and Carson Lake. Data were collected during the fall, 1990, and summer, 1991.

Drain Name	TOTAL SITES				SITES WITH FLOWING WATER				
	No. of Sites	Drain Length {kmJ	Specific Conductance (uS/em) Mean	Ranoe	Number of Sites	Discharge Range (L/s)	Specific Conduct. (uS/em) Mean	Range	Max. TDS Loading Rate (o/s)
STILLWATER NWR DRAINAGE									
Diagonal Drain	92	78.9	805	350-3020	60	<1-1697	778	350-2400	633.1
New River Drain	26	20.0	766	290-2250	11	<1-142	864	290-2250	59.4
South Harmon Drain	2	3.3	600	530-850	1	28	850	850	14.7
North Harmon Drain	2	1.5	1005	720-1290	2	<1	1005	720-1290	0.2
Harmon Drain	38	26.7	6374	250-16000	24	<1-85	2847	320-16000	76.9
Kent Drain East	1	1.0	1450	1450	0	-	-	-	-
Kent Drain	4	1.2	NA	3500->5000e	0	-	-	-	-
Norton Drain	6	2.4	NA	8000- >5000e	0	-	-	-	-
Paiute Diversion Dr.	42	41.9	3054	300-39500	11	2-152	1128	410-1700	44.7
Paiute Drain	32	23.9	1334	400-8900	9	<1-152	987	400-1830	92.3
Shaffner Drain	7	2.7	1767	1550-2100	1	12	1650	1650	11.4
ERB Drain	9	10.9	1322	480-2000	4	47-80	1575	1500-1600	76.5
Lower Soda Lake Dr.	5	3.3	1294	1100-1520	0	-	-	-	-
Upper Soda Lake Dr.	2	3.8	1460	1220-1700	0	-	-	-	-
CARSON LAKE DRAINAGE									
West Carson Lake Dr.	3	4.6	3000	2100-4500	2	<1-1	3300	2100-4500	1.7
Carson Lake 1 Drain	25	29.2	2683	400-13500	13	<1-100	2537	410-13500	63.9
Carson Lake Drain	23	22.5	3528	600-11200	12	<1-89	3523	700-11200	109.2
Downs Drain	5	4.3	4486	1450-8000	1	8	1450	1450	7.4
Gummow Drain	3	6.7	783	350-1340	2	2-58	475	350-600	20.8
LOrain	11	14.8	937	800-1500	6	86-261	875	800-900	127.8
Lee Drain	9	8.7	3414	750-8200	3	291-428	830	790-850	222.0

NA - Specific conductance exceeded the range of the meter. Calculations of means were not possIble.

Table 2. Number of sample sites, drain lengths, and specific conductance (mean and range) of all sites, and number of sites, discharge range {liters per second}, specific conductance (mean and range), and TDS loading rate (grams per second) for the main stem, laterals, and sublaterals of agricultural drains discharging toward Stillwater National Wildlife Refuge and Carson Lake. Data were collected in the fall, 1990, and summer, 1991.

		TOTAL SITES				SITES WITH FLOWING WATER				
Drain Name	**Lateral** ID	**No. of Sites**	**Drain** Length **(km)**	**Specific Conduct.** (uS/em) Mean	Range	**No. of Sites**	**Discharge Range (L/s)**	**Specific Conduct.** (uS/em) **Mean**	**Rance**	Max. TDS **Loading** Rate **(g/s)**
DIAGONAL DRAIN										
Main Stem	DD	13	27.0	620	490 600	10	26 1697	626	490 800	633.1
New River Slough 1	**DONO**	1	ND	Dry	-	0	-	-	-	-
New River Slough 2	**DDN1**	2	0.2	920	920	1	5	920	920	2.8
L Une Canal	DDN2	1	ND	500	500	1	73	500	500	22.9
Lower Diagonal No.1										
Main Stem	DDN3	8	7.6	897	700-1220	7	1-25	897	700-1220	11.0
Unnamed	DDN3NI	1	0.8	890	890	0	-	-	-	-
Unnamed	DDN3S1	2	0.3	1850	1850	0	-	-	-	-
Unnamed	DDN3N2	2	1.4	840	780-900	0	-	-	-	-
Unnamed	DDN3N3	3	0.8	720	720	1	1	720	720	0.3
Unnamed	DDN3N5	1	0.5	1500	1500	0	-	-	-	-
Unnamed	DDN3N6	1	ND	Dry	-	0	-	-	-	-
Pasture Road Dr.	DDN4	5	2.3	1530	790-2400	2	1	1900	1400-2400	2.0
Unnamed	DDN5	1	1.1	1750	1750	1	1	1750	1750	1.2
TestoHn Road Dr.	DDN6									
Main Stem	DDN6	7	6.0	636	590-720	6	2-175	643	600-720	70.4
Unnamed	DDN6WI	,	0.5	2000	2000	1	<1	2000	2000	0.2
Unnamed	DDN6W2	,	0.5	1400	1400	1	2	1400	1400	1.9
Unnamed	DDN6W3	10	6.1	943	560-3020	4	14-28	670	560-790	13.7
Unnamed	DDN6W4	20	16.7	515	350-690	16	1-88	513	350-690	32.4
Unnamed	DDN6W5	1	ND	Dry	-	0	-	-	-	-
Unnamed	DDN6W6	3	1.9	823	700-890	3	1-11	823	700-890	5.7
Unnamed	DDSI	1	0.6	1150	1150	1	<1	1150	1150	0.2
Unnamed	DDN7	1	1.4	600	600	0	-	-	-	-
Harrigan Road Dr.	DDN8	4	2.4	1048	760-1420	4	3-14	1048	760-1420	7.8
Unnamed	DDS3	2	0.8	500	500	1	14	500	500	4.5
NEW RIVER DRAIN										
Main Stem	NR	9	9.2	717	500 1420	6	4 142	780	600 1420	59.4
Unnamed	NRSI	2	0.8	855	510-1200	0	-	-	-	-
Unnamed	NRS2	,	0.3	380	380	0	-	-	-	-
Unnamed	NRNI	2	0.5	1500	1500	1	<1	1500	1500	0.3
Unnamed	NRN2	5	5.0	858	610-1120	0	-	-	-	-
Unnamed	NRS3	1	0.3	2250	2250	1	1	2250	2250	1.9
Unnamed	NRN3	1	1.2	430	430	1	6	430	430	1.6
Unnamed	NRS4	3	1.3	343	290-390	2	7	320	290-350	1.6
Unnamed	NRS5	2	1.4	605	600-610	0	-	-	-	-
SOUTH HARMON DRAIN										
Main Stem	HS	1	1.4	850	850	1	28	850	850	14.7
Unnamed	HSWI	1	1.9	530	530	0	-	-	-	-
NORTH HARMON DRAIN										
Main Stem	HN	1	0.4	120	120	1	<1	720	720	0.1
Unnamed	HNWI	1	1.1	1290	1290	1	<1	1290	1290	0.2

Table 2. (Continued)

Drain Name	Lateral ID	No. of Sites	OT, Drain Length (km)	Specific Conduct. (uS/em) Mean	Ranoe	No. of Sites	Discharge Range (L/s)	Specific Conduct. (uS/em) Mean	Ranoe	TDS Loading Rate (g/s)
HARMON DRAIN										
Main Stem	HD	10	11.6	847	550 1600	8	71 85	921	590 1600	76.9
Unnamed	HDSI	9	4.2	5570	320-16000	8	<1-7	6158	320-16000	**60.3***
Unnamed	HDNI	4	1.5	6238	1110-10100	1	<1	7500	7500	1.4
Unnamed	HDS2	1	0.7	1000	1000	1	3	1000	1000	1.7
Unnamed	HDS4	1	ND	Dry	-	0	-	-	-	-
Unnamed	HDS5	1	0.8	800	800	0	-	-	-	-
Unnamed	HDN3	12	7.9	513	250-710	6	71	533	400-620	27.2
KENT DRAIN EAST										
Main Stem	KDEI	1	1.0	1450	1450	0			-	
KENT DRAIN										
Main Stem	KD	2	0.6	3500	3500	0		-		
Unnamed	KOSI	1	ND	Dry	-	0	-	-	-	-
Unnamed	KDNI	1	0.6	>50000	>50000	0	-	-	-	-
NORTON DRAIN										
Main Stem	ND	2	1.3	NA	20000 >5OOOC	0				
Unnamed	NDEI	1	0.6	8000	8000	0	-	-	-	-
Unnamed	NDWI	1	ND	Dry	-	0	-	-	-	-
Unnamed	NDW2	2	0.5	NA	>50000	0	-	-	-	-
PAIUTE DIVERSION DRAIN										
Main Stem	UP	9	9.5	1410	940 1700	7	18 51	1434	940 1700	44.7
Unnamed	UPSI	1	0.5	410	410	1	152	410	410	39.8
Unnamed	UPWI	I	1.6	*lnO*	*lnO*	0	-	-	-	-
Unnamed	UPW2	5	4.7	2717	600-4650	1	12	600	600	4.5
Unnamed	UPW3	1	0.9	11100	11100	0	-	-	-	-
Unnamed	UPW4	1	0.4	24000	24000	0	-	-	-	-
Unnamed	UPS2	5	6.3	465	300-610	0	-	-	-	-
Unnamed	UPW5	2	1.0	610	610	0	-	-	-	-
Unnamed	UPW6	1	1.8	39500	39500	0	-	-	-	-
S5A Drain	UPW7	2	1.6	1990	480-3500	0	-	-	-	-
Branch 1 Drain	UPW8	13	11.6	904	410-2250	2	2-8	650	410-890	4.4
Unnamed	UPS3	1	2.0	650	650	0	-	-	-	-
PAIUTE DRAIN										
Main Stem	PD	7	6.6	1173	400 1630	4	6-148	1140	400 1630	38.1
Bailey Drain	PDSI	2	2.6	5300	1700-8900	1	2	1700	1700	2.3
Swope Drain										
Main Stem	PDWI	9	6.6	788	500-1600	3	1-152	700	500-1000	92.3
Unnamed	PDW1WI	1	0.4	2000	2000	0	-	-	-	-
Unnamed	PDW1W2	1	0.4	1700	1700	0	-	-	-	-
Unnamed	PDW1W3	1	ND	Dry	-	0	-	-	-	-
Unnamed	PDW1W4	1	1.9	490	490	0	-	-	-	-
Unnamed	PDW1W5	1	0.7	1900	1900	0	-	-	-	-
Unnamed	PDW1W6	1	1.6	500	500	0	-	-	-	-
Unnamed	PDW1W7	2	0.5	550	550	0	-	-	-	-
Unnamed	PDW1W8	1	ND	Dry	-	0	-	-	-	-
Unnamed	PDEI	1	1.3	600	600	0	-	-	-	-
Unnamed	PDW2	1	NO	Dry	-	0	-	-	-	-

Table 2. (Continued)

Drain Name	Lateral 10	No. of Sites	Drain Lenglh (km)	Specific Conduct. (uS/em) Mean	Range	No. of Sites	TES VVII WATER Discharge Range (L/s)	Specific Conduct. (uS/em) Mean	Ranne	Max. TDS Loading Rate (g/s)
PAIUTE DRAIN (eontinuedl										
Unnamed	PDW3	1	0.7	1680	1680	0				
Unnamed	PDW4	1	NO	Dry	-	0	-	-	-	-
Unnamed	PDW5	1	0.6	520	520	1	<1	520	520	0.1
DRAIN										
Main Stem	SH	3	2.4	1600	1550 1650	1	12	1650	1650	11.4
Branch 1	SHS1	3	0.3	2100	2100	0	-	-	-	-
Unnamed	SHN1	1	NO	DIY	-	0	-	-	-	-
ERB DRAIN										
Main Stem	ER	6	7.9	1268	700 1600	4	47 80	1575	1500 1600	76.5
Unnamed	ERNI	1	0.2	1700	1700	0	-	-	-	-
Unnamed	ERSI	1	1.6	2000	2000	0	-	-	-	-
Unnamed	ERS2	1	1.2	480	480	0	-	-	-	-
LOWER SODA LAKE DRAIN										
Main Stem	LS	3	2.3	1267	1100 1350	0			-	-
Unnamed	LSSI	1	0.5	1150	1150	0	-	-	-	-
Unnamed	LSS2	1	0.5	1520	1520	0	-	-	-	-
UPPER SODA LAKE DRAIN										
Main Stem	US	1	1.4	1220	1220	0				
Unnamed	USWI	1	2.4	1700	1700	0	-	-	-	-
WEST CARSON LAKE DRAIN										
Main Stem	WCW	2	4.0	2250	2100 2400	1	<1	2100	2100	0.6
Unnamed	WCSI	1	0.6	4500	4500	1	1	4500	4500	1.7
CARSON LAKE 1 DRAIN										
Main Stem	CL	9	9.3	979	580 1520	5	3 100	927	700 1060	63.9
Unnamed	CLNI	1	2.4	13500	13500	1	2	13500	13500	**22.2***
Unnamed	CLN2	1	1.6	410	410	1	11	410	410	3.0
Unnamed	CLWI	4	3.2	4188	1720-6000	4	<1-17	4188	1720-6000	17.9
Unnamed	CLW2	1	1.8	1180	1180	0	-	-	-	-
Unnamed	CLW3	3	1.4	883	400-1250	0	-	-	-	-
Unnamed	CLW4	1	0.7	680	680	0	-	-	-	-
Unnamed	CLW5	1	5.7	700	700	1	19	700	700	8.3
Unnamed	CLW6	3	1.8	1833	1250-2850	1	3	1250	1250	2.2
Unnamed	CLW7	1	1.3	600	600	0	-	-	-	-
CARSON LAKE DRAIN										
Main Stem	CD	8	8.2	2883	700 3700	7	18 89	2537	700 3350	109.2
Unnamed	COWI	1	3.4	2300	2300	1	3	2300	2300	4.6
Unnamed	CDW2	1	NO	Dry	-	0	-	-	-	-
Carson Lake 1	CDW3	5	5.8	2683	3900-11200	2	<1	9600	8000-11200	**3.1***
Unnamed	CDW4	1	0.6	2050	2050	1	8	2050	2050	9.7
Unnamed	COWS	5	3.1	1072	710-1500	1	9	970	970	5.6
Unnamed	CDW6	1	1.0	6000	6000	0	-	-	-	-
Unnamed	CDW7	1	0.4	700	700	0	-	-	-	-

Table 2. (Continued)

Drain Name	Lateral 10	No. of Sites	TOTAL Drain Length (km)	Specific Conduct (uS/em) Mean	Rance	WITH No. of Sites	Discharge Range (L/s)	Specific Conduct. (uS/em) Mean	Ranae	Max. TOS Loading Reteta/sl
DOWNS DRAIN										
Main Stem	DO	3	3.1	3910	1450 8000	1	8	1450	1450	7.4
Unnamed	DOW1	1	0.8	7900	7900	0	-	-	-	-
Unnamed	DOW2	1	0.4	2800	2800	0	-	-	-	-
GUMMOW DRAIN										
Main Stem	GO	1	5.7	800	600	1	56	600	600	20.8
East Drain	GDEI	1	0.5	350	350	1	2	350	350	0.5
West Drain	GDWI	1	0.5	1340	1340	0	-	-	-	-
LORAIN										
Main Stem	LD	6	9.7	875	800 900	6	86 261	875	800 900	127.8
Unnamed	LDW1	1	0.9	890	890	0	-	-	-	-
Unnamed	LDN1	1	0.8	1500	1500	0	-	-	-	-
Unnamed	LDN2	1	0.7	860	860	0	-	-	-	-
Unnamed	LDN3	1	1.2	900	900	0	-	-	-	-
Unnamed	LDN4	1	1.5	910	910	0	-	-	-	-
LEE DRAIN										
Main Stem	WL	5	4.7	3502	790 8000	2	291 428	820	790-850	222.0
Unnamed	WLW1	1	0.5	850	850	1	291	850	850	150.9
Unnamed	WLS1	1	NO	Dry	-	0	-	-	-	-
Unnamed	WLE1	1	NO	8200	8200	0	-	-	-	-
North Drain	WLN1	1	3.5	750	750	0	-	-	-	-

NO - not determined

*** Specific conductance exceeded the 9,000 uS/cm range for conversion of specific conductance to total dissolved solids (mg/l) given in Hoffman et al. (1990). Value given is, therefore, an approximation.**

Table 3. Concentrations (ug/g dry weight) of arsenic, boron, and selenium ln detritus samples collected from agricultural drains near Falion, Nevada during a Department of the Interior study of agricultural drainage in the Newlands Project. Data is from Rowe et al. (1991).

Lateral Name	Lateral 10	Site 10	USGS Site 10	Sample Collection Date	Concentration (dry weight) Arsenic (uq/q)	Boron (ua/a)	Selenium (ua/al
DIAGONAL DRAIN							
Main stem		007	63	8/25/88	20	27	0.9
Main stem		008	34	9/02/88	18	12	0.7
Main stem		0010	32	8/30/88	44	18	1.9
Main stem		0013	8	8/29/88	30	24	1.6
Main stem			9	8/29/88	23	15	1.3
Main stem			5	8/29/88	18	19	1.1
L. Diagonal NO.1	DDN3	DDN3.2	62	8/25/88	19	47	0.7
Teslolin Road Drain	DDN6	DDN6.1	33	9/02/88	27	16	1.2
Teslolin Road Drain	DDN6	DDN6W3.3	31	9/02/88	38	16	2.6
Testolin Road Drain	DDN6	DDN6W4.1	29	8/29/88	21	20	1.2
Teslolin Road Drain	DDN6	DDN6W4.6	4	8/29/88	23	20	1.4
Teslolin Road Drain	DDN6	DDN6.5	30	8/29/88	34	22	1.2
Testolin Road Drain	DDN6	DDN6W6	28	8/29/88	24	25	0.9
NEW RIVER DRAIN							
Main slem		NR2	26	9/12/88	12	22	0.4
Main slem		NR5	27	9/12/88	54	44	1.0
SOUTH HARMON DRAIN							
Main slem		HS1	61	9/02/88	6	7	0.2
HARMON DRAIN							
Main stem		HD4	58	9/07/88	21	30	1.6
Main stem		HD6	21	9/02/88	74	22	0.5
Unnamed	HDS1	HDS1.2	59	9/02/88	13	53	0.7
Unnamed	HDS3	NDS3.1	25	9/02/88	28	38	1.1
Unnamed	HDSS	HDS5	24	9/02/88	41	42	2.4
PAIUTE DIVERSION DRAIN							
Main slem			49	9/08/88	11	27	0.4
Main stem		UP2	50	9/12/88	15	28	0.8
Main slem		UP7	53	9/02/88	13	32	0.4
Main stem		UP10	55	9/02/88	18	20	1.0
Branch 1 Drain	UPW8	UPW8.1	54	9/02/88	24	20	0.2
Branch 1 Drain	UPW8	UPW8.3	20	9/02/88	30	34	1.6
PAIUTE DRAIN							
Main stem		PD1	64	9/02/88	14	9	0.3
Main stem		PD4	52	9/09/88	12	25	0.2
Swope Drain	PDW1	PDW1W7	56	9/08/88	13	14	0.3
SHAFFNER DRAIN							
Main stem		SH1	16	9/09/88	24	38	3.2
Branch 1	SHS1	SHS1	17	9/09/88	36	74	6.5
ERB DRAIN							
Main stem			18	9/07/88	46	28	0.2

Table 3. (continued)

Lateral Name	Lateral ID	Site ID	USGS Site ID	Sample Collection Date	Concentration (dry weight) Arsenic (ug/g)	Boron rug/g)	Selenium lug/g)
UPPER SODA LAKE DRAIN							
Main stem			3	9/02/88	44	30	3.0
CARSON LAKE 1 DRAIN							
Main stem		Cl2	47	9/09/88	14	26	0.4
Main stem		CL7	12	8/30/88	22	41	0.7
Main stem			11	8/30/88	21	25	0.8
Unnamed	CLN1	CLN1	46	9/09/88	13	31	0.3
Unnamed	CLW5	CLW5	13	8/30/88	26	35	0.9
Unnamed	CLW5		14	9/02/88	37	30	0.5
CARSON LAKE DRAIN							
Main stem		CD1	45	9/09/88	11	28	0.3
Main stem		CD7	37	9/02/88	44	20	0.8
Carson Lake 1	CDW3	CDW3.3	43	9/02/88	20	100	1.3
Unnamed	CDW5		42	8/30/88	33	28	0.7
DOWNS DRAIN							
Main stem		001	44	9/09/88	23	54	3.5
GUMMOW DRAIN							
Main stem		GD1	10	8/30/88	26	20	1.2
LORAIN							
Main stem		LD3	36	8/25/88	12	15	0.5
Unnamed	LDNl	LDN1	35	8/25/88	13	24	0.2
LEE DRAIN							
Main stem		WL1	41	9/08/88	10	19	0.3
DRAINS NOT SAMPLED							
Sheckler Deep Dr.			6	8/29/88	32	27	2.0
Upper West Side Dr.			7	8/29/88	23	16	1.5
Aline			38	8/25/88	23	37	0.3
Mussl Drain			15	9/09/88	13	31	0.2
Pierson Drain			39	8/25/88	23	42	0.6
J1 Deep Drain			40	9/09/88	14	14	0.2
TJ Drain			66	9/06/88	38	76	3.1
L. Soda Lake Ext. Dr.-			19	9/09/88	56	28	1.3
Stillwater Slough			51	9/09/88	17	34	0.4
Stillwater Slouch			57	9/12/88	20	31	0.8
PRI JEIT					25	30	.1

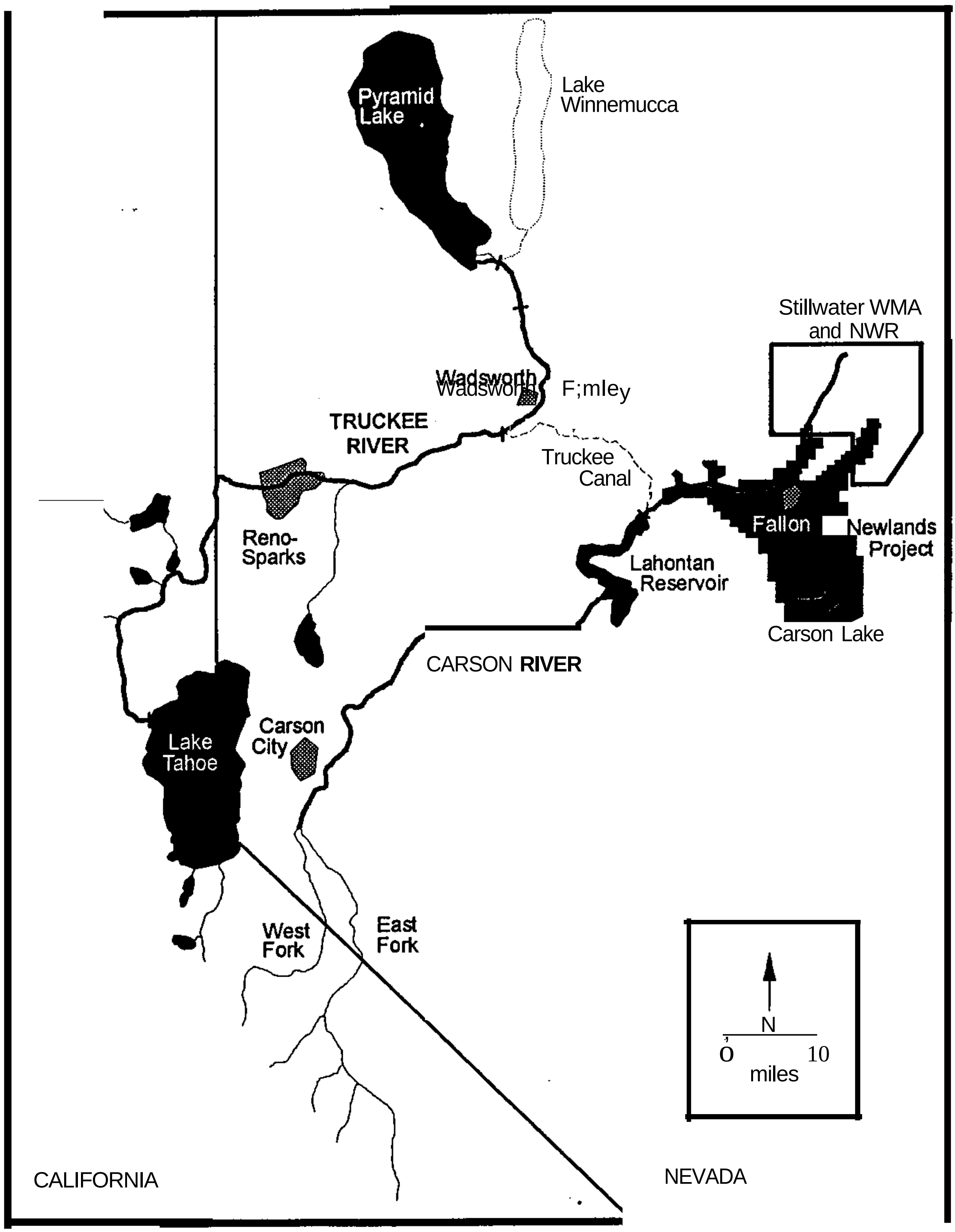

Figure 1. Map of Carson and Truckee River drainages showing the Newlands Project, Stillwater Wildlife Management Area aand National Wildlife Refuge, and Carson Lake.

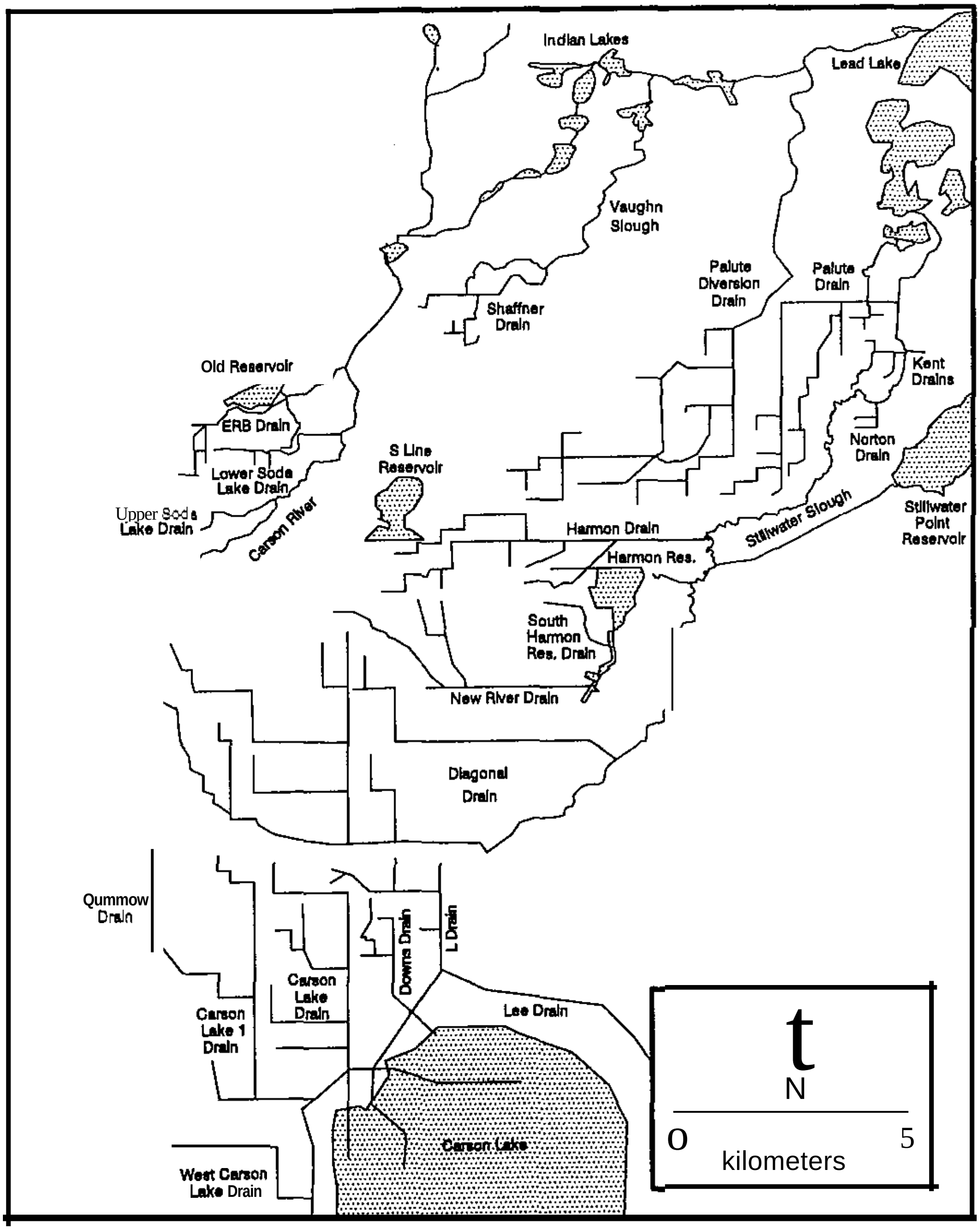

Figure 2. Mep showing msJor drslns of ths Newlsnds Project.

APPENDIX A

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APPENDIX A

Table A1. Physical data and total dissolved solids load estimates for agricultural drainage systems In the Carson Division of the Newlands Project in Churchill County, Nevada1hat discharga to StiJlwatar National Wildlila Refuge and Management Area.

Drain	**Draln Name**	Lateral 10	Site 10	Appendix B MepID **Number**	Date Sampled	**Segment Length** (mi.)	**Water** Temp. (C)	**Specific** Cond. (umho.)	**TOS** (mg/l)	Salinity (ppt)	**Flow** (cis)	TDS Load (lb/day)	TDS **Load** (tons/day)
Diagonal Drain	Lower Diagonal Dr.		DO 2	leh.Mnl8	10/23/90	2.0	13	600	372	0.0	59.93	120414	60.21
Diagonal Draln	**Lower Diagonal Or.**		DO 3	leh.Mnl7	10/23/90	1.0	13	510	320	0.2	53.08	91599	45.60
Diagonal Drain	Naw Rlver Slough	NO	DO NO	leh.Mnl7	10/23/90		DRY						
Diagonal Drain	New Rlver Slough	NI	DO NI.I	leh. Mnl 7	10/24/90	0.1	12	920	SS9	0.7	0.18	540	0.27
Diagonal Drain	New Alver Slough	NI	DD NI.2	leh. Mnl 7	10/24/90		DRY						
Diagonal Drain	**Lower Dlagonal Dr.**		DD 5	leh.Mnl7	10/24/90	1.5	14	600	373	0.1	24.76	49747	24.87
Diagonal Drain	Lower Diagonal Dr.		DD 6	Grimes Pt 4	10/24/90	3.5	14	600	489	0.3	10.64	28081	14.04
Diagonal Drain	L Une Canal	N2	DD N2	Grimes Pt 4	10/24/90	N/A	17	600	314	0.0	2.57	4359	2.18
Diagonal Drain	**lower Diagonal Or.**		DO 7	Grimes Pt 4	10/24/90	2.0	17	800	489	0.2	21.95	57930	28.96
Diagonal Drain	L Diagonal No.1	N3	DD N3.1	Grimes Pt 4	10/24/90	1.7	16	700	431.	O2	0.88	2580	129
Diagonal Drain	**L Diagonal No.1**	N3	DO N3NI	Grimes Pt4	11/13/90	0.5	3	890	542	0.8	0.00		
Diagonal Drain	L Diagonal No.1	N3	DO N3.2	Grimes Pt4	11/13/90	0.5	10	1220	735	0.9	0.51	2021	1.01
Diagonal Drain	L Diagonal No.1	N3	DO N3S1.1	Grimes Pt 4	11/13/90	O2	10	1850	1103	2.1	0.00		
Diagonal Drain	L Diagonal No.1	N3	DO N3S1.2	Grimes Pt 4	11/13/90		DRY						
Diagonal Drain	**L Diagonal No.1**	N3	DD N3N2.1	Grimes Pt4	11/13/90	0.6	9	900	S48	0.7	0.00		
Diagonal Drain	L Diagonal No.1	N3	DD N3N2.2	Grime. Pt 4	11/13/90	0.3	15	780	478	0.5	0.00		
Diagonal Drain	L Diagonal No.1	N3	DO N3.3	Grime. Pt 4	11/13/90	0.5	10	1190	717	1.0	0.54	2100	1.05
Diagonal Drain	L Diagonal No.1	N3	DO N3N3.1	Grime. Pt4	11/13/90	0.5	10	720	443	0.3	0.03	62	0.03
Diagonal Drain	L Diagonal No.1	N3	DO N3N3.2	Grimea Pt4	11/13/90		DRY						
Diagonal Drain	L Diagonal No.1	N3	DD N3N3.3	Grime. Pt 4	11/13/90		DRY						
Diagonal Drain	L Diagonal No.1	N3	DD N3.4	Grime. Pt3	11/13/90	0.5	10	810	495	0.8	0.47	1258	0.53
Diagonal Drain	L Diagonal No.1	N3	DD N3.6	Grimes Pt 3	11/13/90	0.9	9	900	S48	0.3	0.28	818	0.41
Diagonal Drain	L Diagonal No.1	N3	DO N3.7	Grimes Pt 5	11/14/90	0.1	8	750	460	0.5	0.05	129	0.06
Diagonal Drain	L Diagonal No.1	N3	DD N3.8	Grimes Pt 5	11/14/90	0.4	8	710	437	0.5	0.13	309	0.15
Diagonal Drain	L Diagonal No.1	N3	DO N3N5	Grimes Pt 5	11/14/90	0.3	10	1600	898	1.0	0.00		
Diagonal Drain	L Diagonal No.1	N3	DO N3.9	Grimes Pt 5	11/14/90		DRY						
Diagonal Drain	L Diagonal No.1	N3	DO N3N6	Grimes Pt 5	11/14/90		DRY						
Diagonal Drain	Pasture Road Dr.	N4	DO N4.1	Grimes Pt 1	11/14/90	0.8	13	2400	1424	1.8	0.05	376	0.19
Diagonal Drain	Pasture Road Dr.	N4	DO N4NI	Grimes Pt3	11/14/90		DRY						
Diagonal Drain	Pasture Road Dr.	N4	DO N4.2	Grimes Pt 3	11/15/90	0.5	7	1400	640	0.9	0.03	122	0.06

APPENDIX A

Table A1. (Continuadj

Primary Drain	Drain Name	Lalaral 10	Sila ID	Appendix B Map 10 Number	Dala Sampled	Segmenl Langth (ml.)	Walar Temp. (e)	Cond. (umho.)	TOS (mg/l)	Salinity (ppl)	Flow (cfs)	TDS Lead (lb/day)	TOS Lead (Ions/day)
Diagonal Drain	Road Dr.	N4	DD N4N2	Grimes Pt. 3	11/15/90		DRY						
Diagonal Drain	Road Dr.	N4	DO N4.3	Grime. Pt. 3	1"15/90	0.2	9	790	483	0.3	0.00		
Diagonal Drain	Lewer Diagonal Dr.		DO 8	Grime. Pt. 1	1"14/90	2.2	11	710	438	0.3	9.62	22664	11.33
Diagonal Drain	Unnamed	N5	DONS	Grime. Pt. 1	11/14/90	0.7	13	1750	1044	1.0	0.04	220	0.11
Diagonal Drain	Lewer Diagonal Dr.		DO 9	Grime. Pt. 1	11/14/90	0.5	11	700	431	0.2	8.53	19825	9.91
Diagonal Drain	Testolin Road Dr.	N6	DO N6.1	Grime. Pt.I	11/15/90	0.3	9	650	402	0.2	6.19	13407	6.70
Diagonal Drain	Road Dr.	N6	DO N8.2	Grime. Pt. 1	11/15/90	0.3	10	650	402	0.3	5.30	11475	5.74
Diagonal Draln	Road Dr.	N6	DO N6W1	Grime. Pt. 1	1"15/90	0.3	11	2000	1190	1.3	0.01	32	0.02
Diagonal Drain	Road Dr.	N6	DO N6.3	Grime. Pt. 3	11/15/90	0.5	10	620	384	0.2	5.79	11994	6.00
Diagonal Draln	Road Dr.	N6	DO N6W2	Grime. Pt. 3	11/15/90	0.3	8	1400	840	1.0	0.08	.362	0.18
Diagonal Drain	Testolln Road Dr.	N6	DO N6.4	Grime. Pt. 3	11/15/90	1.0	12	620	384	0.1	4.28	8817	4.41
Diagonal Drain	Road Dr.	N6	DO N8W3	Grime. Pt. 3	11/15/90	0.5	10	650	'402	0.3	0.91	1963	0.98
Diagonal Drain	Road Dr.	N6	DO N8W3N1	Fallon 4	12/04/90	0.5	10	880	419	0.5	0.50	1131	0.57
Diagonal Drain	Road Dr.	N6	DO N8W3.2	Fallon 4	12/04/90	0.5	5	560	349	0.1 .	1.00	1883	0.94
Diagonal Drain	Road Dr.	N6	DO N8W3N2	Fallon 4	12/04/90	0.3	6	660	408	0.1 ‘	0.00		
Diagonal Drain	Testolin Road Dr.	N6	DO N8W3.3	Fallon 4	12/04/90	0.2	8	690	425	0.4	0.00		
Diagonal Drain	Road Dr.	N6	DO N8W3.4	Fallon 4	12/04/90	0.2	6	700	431	0.5	0.00		
Diagonal Draln	Road Dr.	N6	DO N8W3.5	Fallon 4	12/04/90	0.4	5	790	483	0.2	1.00	2608	1.30
Diagonal Drain	Road Dr.	N6	DO N8W3N3	Fallon 4	12/04/90	0.4	6	875	533	1.0	0.00		
Diagonal Drain	Testolln Road Dr.	N6	DO N8W3.6	Fallon 4	12/04/90	0.6	5	800	489	0.5	0.00		
Diagonal Drain	Testolin Road Or.	N6	DO N8W3.7	Fallon 4	12/04/90	0.3	6	3020	1786	2.9	0.00		
Diagonal Drain	Road Dr.	N6	DO N6.5	Grime. Pt. 3	11/15/90	0.9	11	720	443	0.1	0.84	1997	'.00
Diagonal Drain	Tastolln Road Dr.	N6	DO N8W4.1	Grime. Pt. 3	11/15/90	0.5	11	590	387	0.1	3.'2	6168	3.08
Diagonal Drain	Road Dr.	N6	DO N8W4NI	Fallon 4	12/03/90	0.7	4	800	373	0.1	0.04	73	0.04
Diagonal Drain	Road Dr.	N6	DO N6W4.2	Fallon 4	12/03/90	0.5	3	480	302	0.'	1.30	2112	1.08
Diagonal Drain	Tastolln Road Dr.	N6	DO N6W4N2	Fallon 4	12/04/90	1.0	8	610	378	0.5	0.30	612	0.31
Diagonal Drain	Tastolln Road Dr.	N6	DO N6W4.3	Fallon 4	12/03/90	0.5	3	450	285	0.'	2.05	3149	1.57
Diagonaf Drain	Road Dr.	N6	DO N8W4S1	Fallon 4	12/04/90	0.2	3	350	227	0.1	0.20	244	0.12
Diagonal Drain	Road Dr.	N6	DO N8W4S2	Fallon 4	12/04/90	0.3	'1	550	343	0.4	0.00		
Diagonal Drain	Road Dr.	N6	DO N8W4.4	Fallon 4	12/04/90	0.2	3	480	302	0.2	2.00	3282	'.63

APPENDIX A

Table AI. (Continued)

Primary	Drain Name	Lateral ID	Site ID	Appendix B MapID Number	Date Sampled	Segmenl Length (mi.)	Waler Temp. (e)	Specific Cond. (umhos)	TOS (mg/l)	Salinity (ppt)	Flow (cfs)	TOS Load (lb/day)	TDS Load (Ions/day)
Diagonal Drain	Testolln Road Dr.	N6	DD N6W4N3	Fallon 4	12/04/90	0.3	5	490	308	0.3	1.00	1663	0.83
Diagonal Drain	Testolln Road Dr.	N6	DD N6W4.5	Fallon 4	12/04/90	0.3	5	520	326	0.4	3.00	5272	2.64
Diagonal Drain	Testolln Road Dr.	N6	DD N6W4.6	Fallon 4	12104/90	0.7	5	500	314	0.2	3.00	5083	2.54
Diagonal Drain	Testolln Road Dr.	N6	DD N6W4.7	Fallon 4	12104/90	0.6	6	500	314	0.2	3.00	5083	2.54
Diagonal Drain	**Testolin Road Dr.**	N6	DD N6W4.8	Fallon 6	12104/90	0.3	6	500	314	0.2	3.00	5083	2.54
Diagonal Oraln	Testolln Road Dr.	N6	DD N6W4N5	Fallon 6	12/03/90	0.2	7	520	326	0.3	0.00		
Diegonal Drain	Testolln Road Dr.	N6	DD N6W463	Fallon 6	12/03/90	0.3	6	450	285	0.2	0.05	77	0.04
Diegonal Drain	Testolln Road Dr.	N6	DD N6W4N6	Fallon 6	12/03/90	0.7	10	690	425	0.2	0.50	1146	0.57
Diagonal Drain	Testolln Road Dr.	N6	DD N6W4.10	Fallon 6	12/03/90	0.3	6	500	314	0.2	2.00	3388	1.69
Diagonal Drain	Testolln Road Dr.	N6	DD N6W4N7	Fallon 6	12/03/90	1.0	3	520	326	0.1	0.00		
Diagonal Drain	Testolln Road Dr.	N6	DD N6W4.11	Fallon 6	12/03/90	1.3	5	490	306	0.2	2.00	3325	1.66
Diagonal Drain	Testolln Road Dr.	N6	DD N6W4.12	Fallon 6	12104/90	0.7	10	500	314	0.1	0.00		
Diagonal Drain	Testolln Road Dr.	N6	DD N6W5	Grime. Pl. 5	11/15/90		DRY						
Diagonal Drain	Testolln Road Dr.	N6	DO N6W6	Grime. Pl. 5	11/15/90	0.5	10	890	542	0.5	0.37	1088	0.54
Dlagonal Drain	Testolln Road Dr.	N6	DO N6.7	Grime. Pl. 5	11/15/90	0.7	11	600	373	0.2	0.07	148	0.07
Diagonal Drain	Tastolln Road Dr.	N6	DO N8.8	Grime. Pl. 5	11/15/90	0.1	13	590	367·	0.2	0.00		
Diagonal Drain	Testolln Road Dr.	N8	DO N6W6NI	Fallon 8	11/15/90	0.2	10	700	431	0.3	0.05	122	0.06
Diagonal Drain	Testolln Road Dr.	N8	DO N6W6.2	Fallon 8	11/15/90	0.5	9	880	536	0.4	0.33	949	0.47
Diagonal Drain	Unnamed	SI	DD SI	Grime. Pl. 1	12104/90	0.4	8	1150	694 ..	0.9	0.01	37	0.02
Diagonal Drain	Lower Diagonal Dr.		DD 10	Grime. Pl. 1	12104/90	0.5	7	620	384	0.3	0.00		
Diagonal Drain	Lower Diagonal Dr.		DO 11	Fallon 2	12104/90	0.5	7	610	378	0.4	0.00		
Diagonal Drain	**Unnamed**	N7	DO N7	Fallon 2	12/04/90	0.9	4	600	373	0.2	0.00		
Dlagonol	Dr.		DO 12	2	12104/90	0.9	7	570	355	0.2	0.00		
Diagonal Drain	Road Dr.	N8	DO N8.1	Fallon 2	12104/90	0.5	7	900	548	0.2	0.50	1477	0.74
Diagonal Drain	Herrlgan Road Dr.	N8	DO N8.2	Fallon 4	12/04/90	0.3	8	760	466	0.7	0.25	628	0.31
Diagonal Drain	Harrigan Road Dr.	N8	DO N8WI.I	Fallon 4	12104/90	0.5	4	1110	670	1.0	0.25	904	0.45
Diagonal Drain	Harrigan Road Dr.	N8	DO N8W1.2	Fallon 4	12104/90	0.2	4	1420	851	1.3	0.10	459	0.23
Diagonal Drain	Lower Diagonal Dr.		DO 13	Fallon 2	12/07/90	1.0	2	490	308	0.2	3.00	4988	2.49
Diagonal Drain	Lower Diagonal Dr.		DO 15	Fallon 4	12/07/90	0.3	4	500	314	0.2	3.00	5083	2.54
Diagonal Drain	**Unnamed**	63	DO 63.1	Fallon 4	12/07/90	0.5	5	500	314	0.4	0.50	847	0.42

APPENDIX A

TableA1. (Continued)

Primary Drain	Orain Name	LetereJ 10	Site 10	Appendix B Map 10 Number	Date Sampled	Segment Length (mi.)	Water Temp. (C)	Specific Cond. (umhos)	TOS (mgJ1)	SeJinlty (ppt)	Flow (cis)	TDS Load (lb/day)	TOS Load (tons/day)
DlagoneJ Drain	Unnamed	53	DO 53.2	Fallon 4	12/07/90		DRY						
Diagonal Drain	Lower Diagonal Dr.		DO 16	Fallon 4	12/07/90	0.9	6	550	343	0.2	1.00	1852	0.93
Slough	Kent Drain	E1	KD E1	StIllwater 4	07/31/91	0.6	26	1450	869	0.5	0.00		
Slough	Kent Drain		KD 1	4	07/31/91	0.4	21	3500	2066	2.3	0.00		
Slough	Kent Drain	51	KD S1	Stillwater 4	07/31/91		DRY						
Slough	Kent Drain	N1	KD N1	Stillwater 4	07/31/91	0.4	23	S0000	33631	40.0	0.00		
Slough	Kent Drain		KD2	4	07/31/91		DRY						
Slough	Norton Drain		NO 1	2	07/24/91	0.1	26	20000	t3371	12.0	0.00		
Slough	Norton Drain	E1	NO E1	Sb1lwat8r 2	07/24/91	0.4	24	6000	5167	10.0	0.00		
Slough	Norton Drain	W1	NDW1	Stillwater 2	07/24/91		DRY						
Slough	Norton Drain	W2	NO W2.1	2	07/24/91	0.3	30	S0000	33631	40.0	0.00		
Slough	Norton Drain	W1	NDW2.2	Stillwater 2	07/24/91		DRY						
Slough	Norton DreJn		NO 2	Stillwater 2	07/24/91	0.7	30	S0000	33631	40.0	0.00		
Slough	Harmon Drain		HD2	Leh. Mnt. 7	12/10/90	1.5	5	1460	886	1.2	2.84	13580	6.79
Sll1lwater Slough	Harmon Oraln		HD3	Grima. Pt. 8	12/10/90	0.6	7	1600	957	1.3	2.84	14654	7.33
Slough	Harmon Drain	S1	HD S1.1	Grime. Pt. 8	12/10/90	0.7	2	12100	7983	12.2	0.25	9558	4.78
Stillwater Slough	Harmon Drain	51	HD S1W1	Grime. Pt. 8	12/10/90	0.3	1	870	530	1.0	0.00		
Stillwater Slough	Harmon Oraln	S1	HD 51.2	Grime. Pt. 8	12/18/90	0.4	3	16000	10643	15.2	0.20	10104	5.05
Slough	Harmon Oraln	S1	HD S1.3	Grime. Pt. 8	12/18/90	0.2	2	11800	7779	11.0	0.20	7458	3.73
Slough	Harmon Oral"	S1	HD S1.4	Grime. Pt. 8	12/18/90	0.3	2	5800	3687	6.3	0.20	3678	1.84
Slough	Harmon Drain	S1	HD 51.5	Grime. Pt. 8	12/18/90	0.1	1	2020	1202	2.0	0.20	1296	0.65
Stillwater Slough	Harmon Crain	S1	HD 51.6	Grima. Pt. 8	12/18/90	0.3	2	720	443	0.5	0.20	477	0.24
Stillwater Slough	Harmon Drain	S1	HD S1N1	Grime. Pt. 8	12/18/90	0.2	4	500	314	0.1	0.01	17	0.01
Stillwater Slough	Harmon Oraln	S1	HD S1.7	Grime. Pt. 8	12/18/90	0.3	5	320	209	0.1	0.20	225	0.11
Slough	Harmon Oraln	N1	HD N1.1	Grime. Pt. 8	12/10/90	0.3	3	7500	4846	8.5	0.01	237	0.12
Slough	Harmon Oraln	N1	HD N1.2	Grima. Pt. 8	12/10/90	0.6	4	1110	670	0.9	0.00		
Stillwater Slough	Harmon Crain	N1	HD N1W1	Grimea Pt. 8	12/10/90		DRY						
Stillwater Slough	Harmon Oraln	N1	HD N1E1	Grimea Pt. 8	12/10/90	0.1	6	10100	6619	8.9	0.00		
Slough	Harmon Drain		HD4	Grime. Pt. 8	12/10/90	0.4	6	980	594	0.9	2.59	8305	4.15
Stillwater Slough	Harmon Drain	52	HD 52.2	Grimea Pt. 8	12/10/90	0.4	2	1000	606	0.7	0.10	327	0.16
Slough	Harmon Drain		HD 5	Grime. Pt. 8	12/18/90	0.6	5	870	530	0.5	3.00	8579	4.29
Stillwater Slough	Harmon Drain		HD6	Grimes Pt. 8	12/18/90	0.6	6	650	402	0.3	3.00	6500	3.25

APPENDIX A

Table AI. (Continued)

Primary Drain	Drain Name	Lateral 10	Site 10	Appendix B Map 10 Number	Date Sampled	Sogment Length (mi.)	Temp. (0)	Speclflc Cond. (umhos)	TDS (mgll)	Salinity, (ppt)	Row (cfs)	TDS Load Ob/day)	TDS Load (tons/dsy)
StUlwalllr Slough	Hannon Drain		HD7	Grimes PI. 8	12/18/90	0.5	8	600	373	0.3	3,00	6028	3,01
StIllwater Slough	Harmon Drain		HD 8	Grimes PI. 8	12/18/90	0.7	7	600	373	0.2	3,00	6028	3.01
StIllwater Slough	Harmon DraJn	S4	HD S4	Grimes PI. 8	12/18/90		DRY						
StIllwater Slough	Hannon Draln		HD9	Grimes PI. 7	12/18/90	0.5	2	550	343	0,1	0.00		
StIllwater Slough	Harmon Drain		HD10	Grimes PI. 7	12/18/90	0.3	6	590	367	0.3	2.50	4944	2.47
Slough	Harmon Drain		HD 11	Grimes PI. 7	12/18/90	1.6	5	550	343	0.3	0,00		
StIllwater Slough	Harmon Oraln	SS	HDSS	Grimes PI. 7	12/18/90	0.5	5	600	489	0,8	0.00		
Slough	Hannon Drain	N3	HD N3.1	Grimes PI. 8	12/18/90	0.5	6	600	373	0.1	2.50	5023	2,51
StIllwater Slough	Harmon Draln	N3	HD N3EI	Grimes PI. 8	12/18/90	0.2	3	250	168	0.5	0,00		
StIllwater Slough	Hannon Drain	N3	HDN32	Grimes PI. 8	12/18/90	0,3	6	620	384	0.5	2.50	5180	2,59
StIllwater Slough	Harmon Drain	N3	HD N3.3	Grimes PI. 8	12/18/90	0,5	5	540	337	0.1	2,50	4550	2,28
Slough	Harmon Drain	N3	HD N3.4	Grimes PI. 8	t2/18/90	0.3	4	590	367	0.2	2,50	4944	2.47
Slough	Harmon Drain	N3	HD N3NI	Grimes PI. 7	12/18/90	0.7	3	710	437	0.2	0.00		
Slough	Harmon Oraln	N3	HD N3.5	Grimes PI. 7	12/18/90	0.2	2	510	320	0.2	0.00		
Slough	Harmon Drain	N3	HD N3.6	Grimes PI. 7	12/18/90	0,8	6	550	343	0.2	0,00		
StIllwater Slough	Harmon Drafn	N3	HDHDN3N2	Grimes PI. 7	12/18/90		DRY						
Slough	Harmon Drain	N3	HD N3.7	Grimes PI. 7	12/18/90	0.4	5	450	285	0.1	2,50	3842	1.92
Slough	Harmon Drain	N3	HD N3.8	Grimes PI. 7	12/18/90	0.3	7	400	256	0.1	2.50	3448	1.72
Slough	Harmon Drain	N3	HD N3.9	Grimes PI. 7	12/18/90	0,8	6	420	267	0.1	0,00		
Paiute Dr.	Upper Paiute Drain		UP 2	3	08/01/91	0.3	31	1550	927	0.5	0,00		
Paiute Dr.	Unnamed	SI	UP S1	Stillwater 3	08/01/91	0.3	28	410	262	0.0	5.36	7588	3.79
Paiute Dr.	Upper Paiute Drain		UP 3	Stillwater 3	08/01/91	0.8	28	1700	1015	0.5	0,98	5355	2.68
Paiute Dr.	Unnamed	WI	UP WI	Stillwater 3	08/01/91	1,0	27	Ina	1056	0.9	0.00		
Paiute Dr.	Upper Paiute Drain		UP 4	1	08/01/91	0,2	19	1450	869	0,7	0,65	3025	1.51
Dr.	Unnamed	W2	UP W2.1	1	08/01/91	1.7	19	2700	1599	1.8	0,00		
Dr.	Unnamed	W2WI	UP W2WI	1	08/14/91	1.0	22	600	373	0,6	0.43	862	0,43
Paiute Dr.	Unnamed	W2	UP W2.2	Stillwater 1	08/14/91	0.3	18	4850	2855	3,5	0,00		
Paiute Dr.	Unnamed	W2	UP W2.3	Stillwater 1	08/14/91		DRY						
Paiute Dr.	Unnamed	W2EI	UP W2EI	Stillwater 1	08/14/91		DRY						

APPENDIX A

Table A1. (Continued)

Primary Drain	Drain Name .	Lateral 10	Site 10	Appendix B Map 10 Number	Dale Sampled	Sogment Length (mi.)	Water Temp. (e)	Speclflc Cond. (umhos)	TDS (mg/l)	Salinity (ppt)	Flow (ofs)	TDS Load (lb/day)	TDS Load (tons/day)
Dr.	Upper Drain		UP 5	Stl1lwaler 1	08/01/91	0.3	20	1580	945	0.5	0.80	40n	2.04
Dr.	**Unnamed**	W3	UPW3	Stillwaler 1	08/01/91	0.6	18	11100	7301	7.8	0.00		
Dr.	Upper Drain		UP 6	Stillwater 1	*08101/91*	0.3	20	1450	869	0.5	1.82	8516	4.26
Dr.	**Unnamed**	W4	UPW4	Stillwater 1	*08101/91*	0.3	20	24000	16099	16.2	0.00		
Dr.	Upper Paiute Drain		UP 7	**Stillwater 1**	08/01/91	0.5	23	1270	764	0.0	1.67	6891	3.45
Dr.	**Unnamed**	S2	UP 52.1	Stillwaler 1	08/01/91	1.9	23	610	378	0.0	0.00		
Dr.	**Unnamed**	52	UP S2.2	**Stlllwater 1**	08/02/91	0.3	25	550	343	0.0	0.00		
Dr.	**Unnamed**	S2	UP S2W1.1	Stillwaler 1	08/02/91	0.6	20	300	197	0.0	0.00		
Dr.	**Unnamed**	S2	UP S2W1.2	Lah. Mnt 7	08/13/91	0.3	23	465	294	0.3	0.00		
Dr.	**Unnamed**	S2	UP S2W1W1	Lah. Mnt 7	08/13/91	0.8	20	400	256	0.3	0.00		
Dr.	**Unnamed**	W5	UP W5.1	Stillwaler 1	08/01/91	0.6	24	610	378	0.0	0.00		
Dr.	**Unnamed**	W5	UP WS.2	Stillwaler 1	08/02/91		DRY						
Dr.	Upper Drain		UP 8	Stillwaler 1	08/01/91	0.4	28	1550	986	1.0	1.42	7567	3.78
Palu1. Dr.	**Unnamed**	W6	UPW6	Stillwaler 1	*08/02191*	1.1	28	39500	26670	25.0	0.00		
Dlverolon. Dr.	Upper Paiute Drain		UP 9	Stillwal.r 1	08/02/91	2.5	21	940	571	0.3	0.99	3051	1.53
Dr.	S5A	W7	UPW7	**Stillwater 1**	08/13/91	0.9	25	480	302	0.3	0.00		
Dr.	**Unnamed**	W7	UP W7W1	Stillwaler 1	08/13/91	0.1	24	3500	2066	2.5	0.00		
Dr.	Branch 1 Drain	W8	UP W8.1	IndlanL2	08/02/91	0.3	23	890	542	0.2	0.29	836	0.42
Dr.	**Unnamed**	W8	UP W8S1	IndlanL2	08/02/91	0.6	31	2250	1336	1.0	0.00		
Paiute Dr.	**Branch 1 Drain**	W8	UP W8.2	Indian L2	08/02/91	0.5	24	880	536	0.0	0.00		
Dlverolon. Dr.	**Unnamed**	W8	UP W8N1	Indian L 2	08/02/91	0.3	28	920	559	0.0	0.00		
Dr.	1 Drain	W8	UP W8.3	IndlanL2	08/02/91	0.7	25	890	542	0.2	0.00		
Dr.	**Unnamed**	W8	UP W8N2	Indian L2	08/02/91	0.9	25	910	554	0.0	0.00		
Dr.	Branch 5 Drain	We	UP W8S2.1	Indian L2	08/02/91	0.6	27	900	548	0.0	0.00		
Dlverolon. Dr.	**Branch 5 Drain**	W8	UP W852.2	Grimes pt 8	08/13/91	0.3	25	650	402	0.5	0.00		
Dr.	Branch 5 Drain	W8	UP W8S2W1	Grime. pt 8	08/13/91	0.5	23	750	460	0.6	0.00		
Dr.	Branch 5 Drain	W8	UP W8S2.3	Grime. pt 8	08/13/91	0.9	22	600	373	0.5	0.00		
Dr.	Branch 5 Drain	W8	UP W8S2W2.1	Grime. pt 8	08/13/91	0.8	23	600	489	0.8	0.00		
Dlverolon. Dr.	**Unnamed**	W8	UP W8S2W2.2	Grime. pt 8	08/13/91		DRY						
Dlverolon. Dr.	**Branch 1 Drain**	W8	UP W8.5	Grime. pt 8	08/13/91	1.0	28	410	262	0.2	0.07	94	0.05
Paiute Diversion. Or.	Upper Palu1e Drain		UP 10	Grime. pt 8	08/13/91	0.8	25	1100	665	0.6'	0.00		
Paiute Diversion. Or.	**Unnamed**	83	UP 83.1	Grimes pt 8	08/13/91	1.3	22	650	402	0.3	0.00		

APPENDIX A

Table AI. (Continued)

Drain	Drain Name	Lateral 10	Site 10	Append.", B Map 10 Number	Date Sampled	Segmenl Length (mi.)	Temp. (0)	Specific Cond. (umhos)	TOS (mg/l)	Salinity (ppt)	Row (cis)	TDS Load (lb/day)	TOS Load (tons/day)
Drain	Balley Drain	SI	PO SI	4	07/31/91	1.3	25	1700	1015	0.8	0.08	454	0.23
Drain	Bailey Drain	SI	PO SIEI	StIllwater 4	07/31/91	0.3	26	8900	5801	0.5	0.00		
Drain	Draln		PO 1	StIllwater 4	07/25/91	0.3	27	400	256	0.0	5.26	15370	7.68
Draln	Swope Draln	WI	PO WI.I	StIllwater 4	07/25/91	1.4	27	1000	606	1.0	5.38	17575	8.79
Drain	Swope Drain	WI	PO W1WI	3	07/25/91	0.2	27	2000	1190	1.5	0.00		
Drain	Swope Drain	WI	PO W1.2	StIllwater 3	07/25/91	1.3	28	1800	957	1.0	0.00		
Drain	Swope Drain	WI	PO W1W2	1	07/25/91	0.2	29	1700	1015	0.5	0.00		
Drain	Swope Drain	WI	PO WI.3	Stillwater 1	07/25/91	0.5	27	890	542	0.0	0.00		
Drain	Swope Drain	WI	PD W1W3	StIllwater 1	07/25/91		DRY						
Drain	Swope Drain	WI	PO W1.4	StIllwater 1	07/25/91	0.3	24	700	431	0.0	0.00		
Drain	Swope Drain	WI	PO W1W4	1	07/25/91	1.2	20	490	308	0.0	0.00		
Drain	Swope Drain	WI	PO WI.5	1	07/25/91	0.3	24	500	314	0.0	0.00		
Drain	Swope Drain	WI	PDW1W5	1	07/25/91	0.5	28	1900	1132	1.0	0.00		
Drain	Swope Drain	WI	PO WI.6	1	07/25/91	0.5	21	500	314	0.0	0.16	263	0.13
Drain	Swope Drain	WI	PO W1W6	1	07/25/91	1.0	22	500	314	0.0	0.00		
Drain	Swope Drain	WI	PO W1.7	StIllwater 1	07/25/91	0.2	22	800	373	0.0	0.05	105	0.05
Drain	Swope Drain	WI	PO WI.8	1	07/25/91	0.2	–	800	373	0.0	0.00		
Drain	Swope Drain	WI	PO W1W7	Lah.Mnt. 7	08/13/91	0.3	23	550	343	0.5	0.00		
Drain	Swope Drain	WI	PO W1W7S1	Lah.Mnt 7	08/13/91		DRY						
Drain	Swope Drain	WI	PO W1.9	Lah.Mnt. 7	07/25/91	0.5	20	700	431	0.4	0.00		
Drain	Swope Drain	WI	PO W1W6	Lah.Mnt 7	07/25/91		DRY						
Drain	Unnamad	EI	PO EI	4	07/25/91	0.8	24	800	373	0.0	0.00		
Drain	Drain		PO 2	Stillwater 4	07/25/91	0.5	29	800	373	0.5	0.57	1145	0.57
Drain	Drain		PO 3	Stillwater 4	07/31/91	0.7	28	1730	1032	0.8	0.23	1271	0.64
Drain	Unnamed	W2	PDW2	4	07/31/91		DRY						
Drain	Drain		PO 4	Stillwater 4	07/31/91	0.6	28	1830	1091	0.8	0.25	1473	0.74
Drain	Unnamed	W3	PDW3	Stillwater 4	07/31/91	0.5	28	1680	1003	0.6	0.00		
Drain	Drain		PO 5	1	07/31/91	0.7	29	1200	723	0.4	0.00		
Drain	Unnamad	W4	PO W4.1	1	07/31/91		DRY						
Drain	Unnamed	W5	PO W5.1	Stillwater 1	07/31/91	0.4	23	520	326	0.2	0.01	14	0.01

APPENDIX A

Table AI. (Continued)

Primary DreJn	Oraln Name	lateral 10	Site 10	Appendix B Map 10 Number	Date Sampled	Segmenl L.englh (mi.)	Waler Temp. (0)	5peclfic Cond. (umhos)	TOS (mg/l)	SeJlnl1y (ppt)	Flow (cts)	TDS Load (lb/day)	TDS Load (tons/day)
PeJute DreJn	PeJule DreJn		PO 6	1	07/31/91	1.4	28	1280	770	0.4	0.00		
PeJute DreJn	PeJute DreJn		PO 7	StIllwater 1	07/31/91		DRY						
Shaffner DreJn	5haffner DreJn		SH 1	Indian L3	08/16/91	0.3	20	1650	966	1.0	0.41	2166	1.08
Shaffner DreJn	Branch 1	SI	SH 51.1	IndlanL3	08/16/91	0.2	24	2100	1249	1.3	0.00		
Shaffner DreJn	Branch 1	51	SH 51.2	IndlanL3	08/16/91		DRY						
Shaffner DreJn	Branch 1	51	SH 51WI	Indian L3	08/16/91		DRY						
5h r DreJn	F2DreJn		SH 2	IndlanL3	08/16/91	1.2	18	1550	827	1.2	0.00		
Shaffner DreJn	Unnamed	NI	SH NI	IndlanL3	08/16/91		DRY						
Shaffner DreJn	F 2 DreJn		SH 3	Indian L3	08/16/91		DRY						
ERB DreJn	ERB DreJn		ER 1	SodaLE.2	08/16/91	0.3	23	1600	9S7	1.2	1.66	8576	4.29
ERB DreJn	ERB DreJn		ER2	Soda LE. 2	08/16/91	0.1	17	1600	957	1.0	2.34	12060	6.03
ERB DreJn	Unnamed	NI	ER NI	Soda LE. 2	08/16/91	0.2	27	1700	1015	1.8	0.00		
ERB DreJn	Wade DreJn		ER 3	SodaLE.2	08/16/91	2.0	23	1600	957	1.0	2.83	14576	7.29
ERB DreJn	Unnamed	SI	ER 51	SodaLE.2	08/16/91	1.0	28	2000	1190	1.0	0.00		
ERB DreJn	Wade Drain		ER 4	Soda LE. 2	08/16/91	1.2	23	1500	898	1.0	2.53	12243	6.12
ERB DreJn	Unnamed	S2	ER S2	SodaLE.2	08/16/91	0.8	25	480	302	0.3	0.00		
ERB DreJn	Wade DreJn		ER 5	Soda LE. 2	08/14/91	1.2	21	700	431	0.5	0.00		
ERB DreJn	Wade DreJn		ER 6	SodaLE.2	08/14/91	0.1	21	720	443	0.5	0.00		
Lower Soda Dr.	L Soda Dr.		LSI	SodaLE.2	08/14/91	0.5	21	1100	665	0.8	0.00		
Lower Soda Dr.	L Soda Dr.		LS2	SodaLE. 2	08/14/91	0.3	22	1350	811	0.9	0.00		
Lower Soda Dr.	Unnamed	SI	LS SI	SodaLE.2	08/14/91	0.3	22	1150	B94	0.9	0.00		
Lower Soda Dr.	L Soda Dr.		LS 3	SodaLE.2	08/14/91	0.6	23	1350	811	1.0	0.00		
Lower Soda Lake Dr.	Unnamed	S2	LSS2	SodaLE.2	08/14/91	0.3	24	1520	910	1.0	0.00		
Upper Soda Dr.	U. Soda Lake Dr.		U5 1	FeJlon 7	08/14/91	0.9	25	1220	735	0.5	0.00		
Upper Soda Lake Dr.	U. Soda Lake 1 Dr.	WI	US WI	FeJlon 7	08/14/91	1.5	24	1700	1015	1.0	0.00		
New River DreJn	New River DreJn		NR 2	Grimes Pl. 6	12/07/90	1.0	3	1420	851	1.3	0.14	623	0.31
New River DreJn	Unnamed	SI	NR 51.1	Grimes Pt. 6	12/07/90	0.3	5	1200	723	0.9	0.00		
New River DreJn	Unnamed	SI	NR SI.2	Grimes Pl. 4	12/07/90	0.2	4	510	320	0.3	0.00		
New River DreJn	New River DreJn		NR3	Grime. Pl. 6	12/07/90	0.5	1	750	480	0.7	0.14	337	0.17
New River DreJn	Unnamed	S2	NRS2	Pl. 6	12/07/90	0.2	1	380	244	0.1	0.00		

APPENDIX A

Table AI. (Continued)

Drain	Drain Name	Lateral 10	Site 10	Appendlx B Map 10 Number	Date Sampled	Segmenl Length (ml.)	Water Temp. (e)	Speclflc Cond. (umhos)	TDS (mg/l)	Salinity (ppt)	Flow (cis)	TDS Load (lb/day)	TDS Loed (tons/day)
New Drain	Unnamed	NI	NR NI.I	Grimes PI. 6	12/07/90	0.3	2	1500	898	1.2	0.01	46	0.02
New Drain	Unnamed	NI	NRN12	Grimes PI. 6	12/07/90		DRY						
New Drain	Drain		NR4	Grimes PI. 5	12/07/90	0.5	2	500	314	0.5	0.00		
New Drain	Unnamed	N2	NR N2.1	Grimes PI. 5	12/07/90	0.7	5	610	376	0.7	0.00		
New Drain	Unnamed	N2	NR N2.2	Grimes PI. 5	12/07/90	0.5	5	620	384	0.3	0.00		
New Draln	Unnamed	N2	NR N2WI	Grimes PI. 5	12/07/90		DRY						
New Draln	Unnamed	N2	NR N2.3	Grimes PI. 5	12/07/90	1.0	1	1060	653	1.0	0.00		
New River Draln	Unnamed	N2	NR N2NI	Grimes PI. 5	12/07/90	0.9	2	1120	676	1.0	0.00		
New Drain	New Drain		NR5	Grimes PI. 5	12/07/90	1.2	5	650	402	0.1	0.00		
New Drain	Unnamed	S3	NR S3	Grimes PI. 5	12/07/90	0.2	1	2250	1336	2.0	0.05	360	0.18
New Drain	New Drain		NR6	Grimes PI. 5	12/10/90	0.4	12	800	373	0.1	5.00	10046	5.02
New Drain	Unnamed	N4	NRN3	Grimes PI. 6	12/10/90	0.7	5	430	273	0.2	0.20	295	0.15
New Drain .	New Drain		NR7	Grimes PI. 5	12/10/90	0.2	4	680	419	0.2	5.00	11306	5.65
New Drain	Unnamed	S4	NR S4.1	Grimes PI. 5	12/10/90	0.2	5	290	192	0.1	0.25	285	0.13
New Drain	Unnamed	S4	NR S4S1	Grimes PI. 6	12/10/90	0.2	4	390	250	0.3	0.00		
New Drain	Unnamed	S4	NR S4.2	Grime. PI. 5	12/07/90	0.4	5	350	227	0.2	0.25	305	0.15
New Draln	New Drain		NR8	Grimes PI. 5	12/07/90	0.3	5	620	384	0.3	5.00	10361	5.18
New Drain	New Drain		NR9	Grimes PI. 5	12/07/90	1.1	5	610	378	0.3	5.00	10203	5.10
New Draln	Unnamed	N5	NR N5.1	Grime. PI. 5	12/07/90	0.8	3	610	378	0.5	0.00		
New Draln	Unnamed	N5	NRN52	Grimes PI. 5	12/10/90	0.1	7	800	373	0.2	0.00		
New Drain	New Drain		NR 11	Fallon 6	12/07/90	0.7	6	620	384	0.7	0.00		
South Drain	South Harmon Dr.		HS 1	Grimes PI. 6	12/10/90	0.9	9	650	519	0.8	1.00	2797	1.40
South Harmon Drain	South Hannon Dr.	WI	HSWI	Grim. . PI. 6	12/10/90	1.2	9	530	332	0.2	0.00		
North Harmon Drain	North Harmon Dr.		HN 1	Grimes PI. 8	12/10/90	0.2	6	720	443	0.5	0.01	24	0.01
North Harmon Drain	North Harmon Dr.	WI	HNWI	Grimes PI. 8	12/10/90	0.7	5	1290	775	0.5	0.01	42	0.02

Table A2. Physical data and total dissolved solids load estimates for agricultural drainage systems In the Carson Division of the Newlands Project In Churchill County, Nevada that discharge to Carson Lake.

Prlmary Drain	Drain Name	Lateral 10	Site 10	Appendix B Map 10 Number	Dete Sampled	Segment Length (ml.)	Water Temp. (C)	Specific Cond. (umhos)	TOS (mg/l)	Salinity (ppl)	Flow (cts)	TDS Load (lb/day)	TDS Load (Ions/day)
West Carson Lake Dr.	Unnamed	Wl	WCWl	S. Fallon 4	06/04/91	0.5	28	2400	1424	1.0	0.00		
Weol Carson Leka Dr.	Unnamed	Wl	WCW2	S. Fallon 4	06/04/91	2.0	23	2100	1249	1.0	-0.02	-108	-0.05
West Carson Lake Or.	Unnamed	Sl	WCSl	S. Fallon 4	06/04/91	0.4	21	4500	2650	3.0	-0.02	-321	-0.16
Carson Lake '1'	Carson Lake ','		CL 1	S. Fallon 6	06/07/91	0.3	26	825	504·	0.0	0.12	313	0.16
Carson Lake ','	Carson Lake ','	Nl	CL Nl	S. Fallon 6	06/10/91	1.5	29	13500	8938	7.0	0.09	3731	1.87
Carson Lake '1'	Carson Lake '1'		CL 2	S. Fallon 6	06/07/91	0.5	25	580	361	0.0	0.00		
Carson Lake '1'	Carson Lake "1'	N2	CL N2	S. Fallon 6	06/07/91	1.0	22	410	262	0.0	0.41	574	0.29
Carson Lake ','	Unnamed		CL 3	S. Fallon 6	06/06/91	1.7	29	1520	910	1.0	0.00		
Carson Lake '1'	Unnamed	Wl	CL Wl.l	S. Fallon 6	06/06/91	0.0	26	1720	1027	0.8	0.62	3405	*1.70*
Carson Lake '1'	Unnamed	Wl	CL W1Nl	S. Fallon 8	06/06/91	0.2	28	3230	1908	1.5	*0.05*	525	0.26
Carson Lake '1'	Unnamed	Wl	CL Wl.2	S. Fallon 6	06/06/91	0.4	31	5800	3687	*3.0*	-0.00	-74	-0.04
Carson Lake '1'	Unnamed	Wl	CL W1N2	S. Fallon 6	06/06/91	1.4	31	6000	3623	3.2	0.09	1712	0.86
Carson Lake '1'	Carson Lake "1"		CL 4	S. Fallon 6	06/05/91	1.1	22	1400	840	0.5	0.00		
Carson Lake ','	Unnamed	W2	CL W2	S. Fallon 6	06/06/91	1.1	23	1180	711	0.5	0.00		
Carson Lake '1'	Carson Lake "1"		CL 5	S. Fallon 8	06/05/91	0.4	22	1050	635	0.0	1.65	5654	2.83
Carson Lake '1'	Unnamed	W3	CL W3.1	S. Fallon 8	06/05/91	0.1	22	1250	752	1.0	0.00		
Carson Lake ','	Unnamed	W3	CL W32	S. Fallon 8	06/05/91	0.2	20	1000	606	0.5	0.00		
Carson Lake '1'	Unnamed	W3	CL W3Nl	S. Fallon 8	*06105/91*	0.6	16	400	256	0.0	0.00		
Carson Lake '1'	Carson Lake "1'		CL 6	S. Fallon 8	06/13/91	0.5	20	1060	841	0.5	3.52	12169	*6.08*
Carson Lake '1'	Unnamed	W4	CLW4	S. Fallon 8	06/13/91	0.4	20	680	419	0.0	0.00		
Carson Lake '1'	Carson Lake '1'		CL 7	S. Fallon 8	06/13/91	0.5	25	700	431	0.0	2.00	4648	2.32
Carson Lake '1'	Unnamed	W5	CL W5	S. Fallon 8	06/13/91	3.5	22	700	431	*0.0*	0.68	1575	0.79
Carson Lake '1"	Carson Lake '1"		CL 8	S. Fallon 8	06/13/91	*0.5*	25	1000	606	*0.0*	0.31	*1009*	*0.50*
Carson Lake "1'	Unnamed	W6	CL W6.1	S. Fallon 8	06/13/91	0.1	27	1250	752	0.1	0.10	416	*0.21*
Carson Lake '1'	Unnamed	W6	CLW62	S. 8	06/13/91	0.4	21	1400	840	0.5	0.00		
Carson Leks '1'	Unnamed	W6	CL W6Nl	S. Fallon 8	06/13/91	0.6	25	2850	1687	1.5	0.00		
Carson Lake '1'	Unnamed	W7	CL W7	S. Fallon 8	06/26/91	0.8	23	600	373	0.0	0.00		
Carson Lake "1"	Carson Lake "1"		CL 9	S. Fallon 8	06/26/91	0.2	26	680	419	0.0	0.00		

APPENDIX A

Table A2. (Continuad)

Primary Drain	Oraln Name	Lalaral 10	Site 10	Appendix B Map 10 Number	Date Samplad	Sagment Length (mi.)	Tamp. (C)	Spaclllc Cond. (umho.)	TDS (mg/l)	Salinity (ppt)	Flow (cfs)	TDS Load (lb/day)	TDS load (Ions/day)
Ca"",n Lake Drain	Carson Lake Drain		CD 1.1	Carson LS	06/07/91	0.6	16	31SO	1862	2.0	1.92	19260	9.64
Carson Lake Drain	Carson Lake Drain		CD 1.2	Ca"",n L 5	06/07/91	0.1	20	3200	1891	2.0	2.04	20791	10.40
Ca"",n Lake Drain	Ca"",n Lake DraIn		CO2	Carson L 7	06/07/91	0.6	22	3350	1979	1.9	1.70	18127	9.06
Ca"",n Lake Drain	Unnamed	Wl	COWl	Carson L 7	06/07/91	2.1	27	2300	1__	1.0	0.12	867	0.43
Ca"",n Lake Drain	Unnamed	W2	CDW2	Ca"",n L 7	06/07/91		DRY						
Ca"",n Lake Drain	Ca"",n Lake Drain		CD4	Carson L 7	06113/91	0.5	14	2790	1651	2.0	0.64	5722	2.86
Carson Lake DraIn	Carson Lake ·1·	W3	CDW3.1	Ca"",n L 7	06113/91	1.0	25	3900	2300	4.4	0.00		
Cs"",n Lake Drain	Carson Lake 11·	W3	CDW3.2	S. Falbn8	06113191	0.7	19	8000	3823	4.0	0.00		
. Ca"",n Lake Drain	Carson Lake ·1·	W3	CDW3Nl	S. Falbn8	06113/91	1.3	17	11200	7389	8.0	0.02	531	0.27
Ca"",n Lake DraIn	Carson Lake ·1·	W3	CDW3.3	S. Falbn 8	06113191	0.3	26	10650	6994	6.5	0.00		
Ca"",n Lake Drain	Carson Lake ·1·	W3	CDW3N2	S. Falbn8	06113/91	0.2	19	8000	5187	5.3	0.00	38	0.02
Carson Lake Drain	Ca"",n Lake Drain		CDS	Carson L 7	06112/91	0.5	22	3700	2183	2.2	0.00		
Ca"",n Lake DraIn	Unnamed	W4	CDW4	Carson L 7	06112/91	0.4	22	2050	1219	1.0	0.28	1849	0.92
Carson Lake DraIn	Unnamed	WS	CDWSN1W1Wl.l	S.Falbn8	07/12/91	0.3	31	710	437	0.0	0.00		
Ca"",n Lake Drain	Unnamed	W5	CD W5N1W1Wl.2	S. Falbn 8	07/12/91	0.7	26	730	448	0.0	0.00		
Carson Lake Drain	Unnamed	WS	CDWSN1Wl.l	S. Falbn8	07/12/91	0.4	30	970	589	0.3	0.33	1059	0.53
Carson Lake DraIn	Unnamed	WS	CDWSN1Wl.2	Falbn 2	07/12/91	0.1	28	14SO	869	0.6	0.00		
Carson Lake DraIn	Unnamed	W5	CDWSN1W1W2	Falbn 2	07/12/91	0.4	32	1500	898	0.5	0.00		
Ca"",n Lake Drain	Ca"",n Lake Drain		CD7	Ca"",n L 7	06/10/91	0.8	31	2080	1237	1.0	1.40	9346	4.57
Carson Lake Drain	Unnamed	W6	CDW6	Carson L 7	06110/91	0.6	34	8000	3823	2.5	0.00		
Ca"",n Lake Drain	Ca"",n Lake Drain		CD8	Grimes Pl. 1	06111/91	1.5	27	2490	1476	1.0	0.69	5454	2.73
Ca"",n Lake Drain	Unnamed	W7	CDW7	Falbn 2	07/12/91	0.2	27	700	431	0.0	0.00		
Carson Lake Drain	Carson Lake Oraln		CD9	Falbn 2	07/12/91	0.5	27	700	431	0.0	3.15	7313	3.66
Down', Oraln	Down'. Drain		00 1	Ca"",n L 7	06/04/91	1.2	29	14SO	869	1.0	0.30	1406	0.70
Down'. Drain	Unnamed	Wl	OOWl	Ca"",n L 7	06112/91	0.5	26	7900	5119	4.5	0.00		
Down'. Drain	Down'. Drafn		002	Carson L 7	06112/91	0.4	27	8000	5187	4.5	0.00		
Down'. Drain	Unnamed	W2	00W2	Grimes Pl. 1	06/12/91	0.3	21	2800	1657	2.0	0.00		
Downle Oraln	Down'. Drain		003	Grimes Pl. 1	06/12/91	0.3	20	2280	1354	1.5	0.00		
Gummow Oraln	Gummow Drain		GDl	Falbn 1	06/26/91	3.5	20	600	373	0.0	1.98	3968	1.98
Gummow Oraln	East Drain	El	GO El	Falbn 1	06/26/91	0.3	21	350	227	0.0	0.08	101	0.05
Gummow Oraln	West Drain	Wl	GDWl	Falbn 1	06/26/91	0.3	21	1340	805	0.5	0.00		

APPENDIX A

Table A2. .(Continuad)

Primary Drain	Crain Name	Lataral ID	Site ID	Appandb' B MapID Number	Data Samplad	50gmanl Langth (mi.)	Watar Temp. (C)	Spaclfic Cond. (umho.)	TDs (mgJl)	Salinity (ppt)	Aow (cis)	IOS Load (lb/day)	TDS Load (Ions/day)
-l" Oraln	'L' Drain		LD I	Carson L 7	06/04/91	0.8	25	800	489	0.0	9.22	24333	12.17
'L" Orain	Unnamed	WI	LD WI	Grimee Pt. 1	06/12/91	0.8	29	890	542	0.0	0.00		
'L" Drain	"L' Drain		IO2	Grime. Pl. 1	06/12/91	0.7	28	880	524	0.0	5.06	14310	7.16
"L' Drain	Unnamed	NI	LD NI	Grimes Pl. 1	06/12/91	0.5	27	1500	898	0.7	0.00		
"L" Drain	"L" Drain		LD 3	Grime. Pt. 1	06/12/91	0.6	27	900	548	0.0	3.54	10449	5.22
"L" Drain	Unnamed	N2	LD N2	Grime_ Pl. 1	06/11/91	0.4	25	880	524	0.0	0.00		
"L" Drain	"L" Drain		IO4	Grime. Pl. 1	06/1 1/91	0.4	27	900	548	0.5	3.76	11093	5.55
"L' Drain	'L" Drain		IOS	Grime. Pl. 1	*06111/91*	0.5	26	900	548	0.5	5.96	17609	8.80
"L' Drain	Unnamed	N3	LD N3	Grime. Pl. 1	06/11/91	0.8	27	900	548	0.3	0.00		
"L' Drain	Unnamed	N4	IO N4	Grime. Pl. 1	06/1 1/91	0.9	29	910	·554	0.0	0.00		
'L' Orain	'L' Oraln		LD 6	Grime. Pl. 1	06/11/91	3.1	27	890	542	0.0	3.02	8834	4.42
Lae Drain	West Drain		WLI	S. Fallon 6	06/04/91	0.9	22	850	519	0.0	15.12	42285	21.14
Lao Drain	Unnamed	WI	WLWI	S. Fallon 6	06/04/91	0.3	22	850	519	0.1	10.27	28733	14.37
Lao Drain	Lae Drain		WL2	Carson L 5	06/07/91	0.5	23	7000	4505	4,0	0.00		
Lao Drain	Unnamed	SI	WLSI	Carson L 5	06/04/91		DRY						
Lae Drain	Unnamed	EI	WLEI	Carson L5	06/04/91		29	8200	5323	5.0	0.00		
Lao Drain	Drain		WL3	Carson L 5	06/04/91	1.2	25	8000	5187	5,0	0.00		
Lao Drain	North Drain	NI	WLNI	Carson L 7	06/04/91	2.2	26	750	460	0.0	0.00		
Lao Drain	Drain		WL4	Carson L 7	06/04/91	0.2	25	870	530	0.2	0,00		
Lao Drain	Unnamed		WL8	Carson L 7	06/04/91	0.0	25	790	483	0.3	10.26	26752	13,38

APPENDIX B

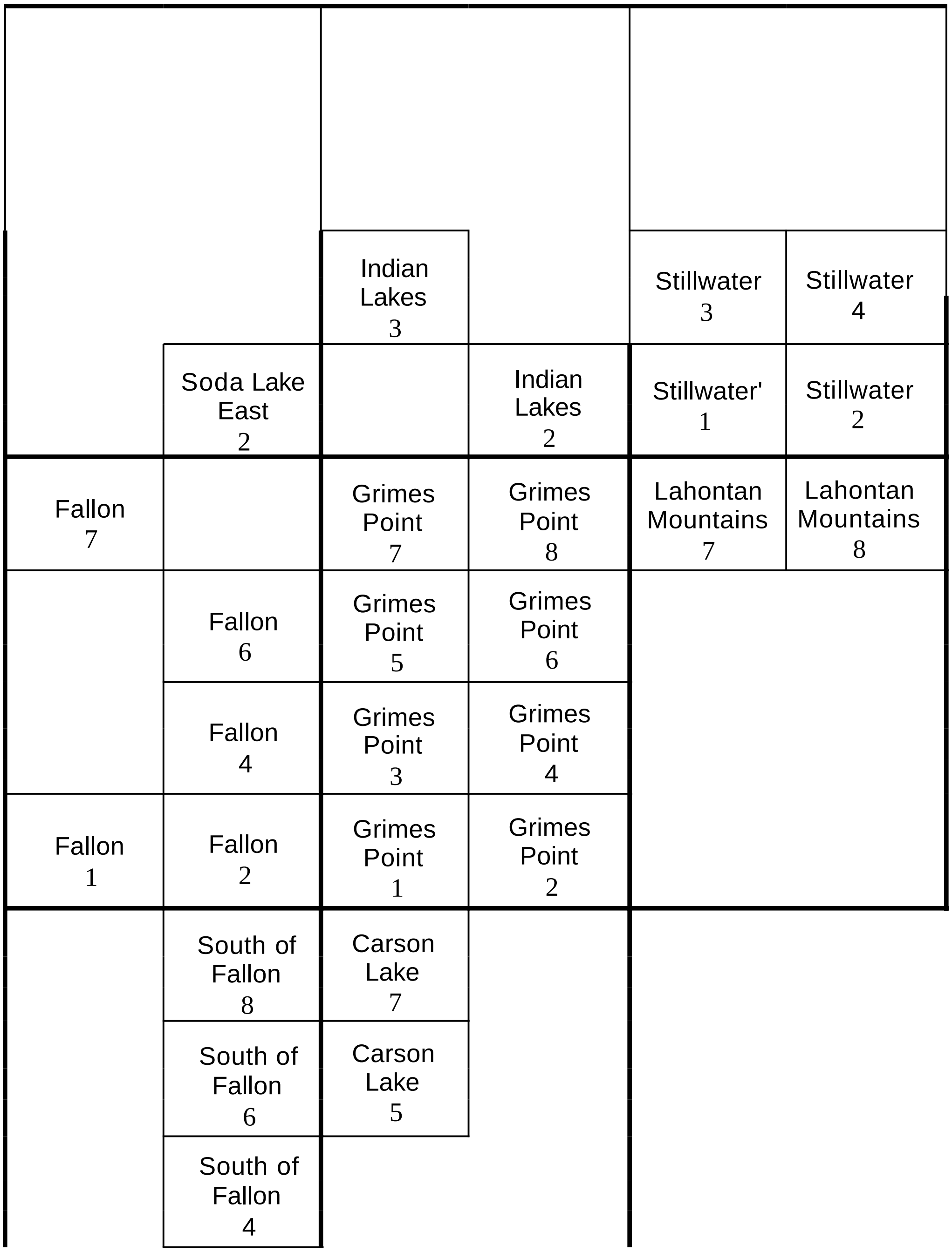

FIgure B1. US Geological Survey 7.5 minute quadrangles corresponding to Quadrangles are divided into 8 **sections. Drains found in each section are illustrated on the following maps.**

.

ID
2

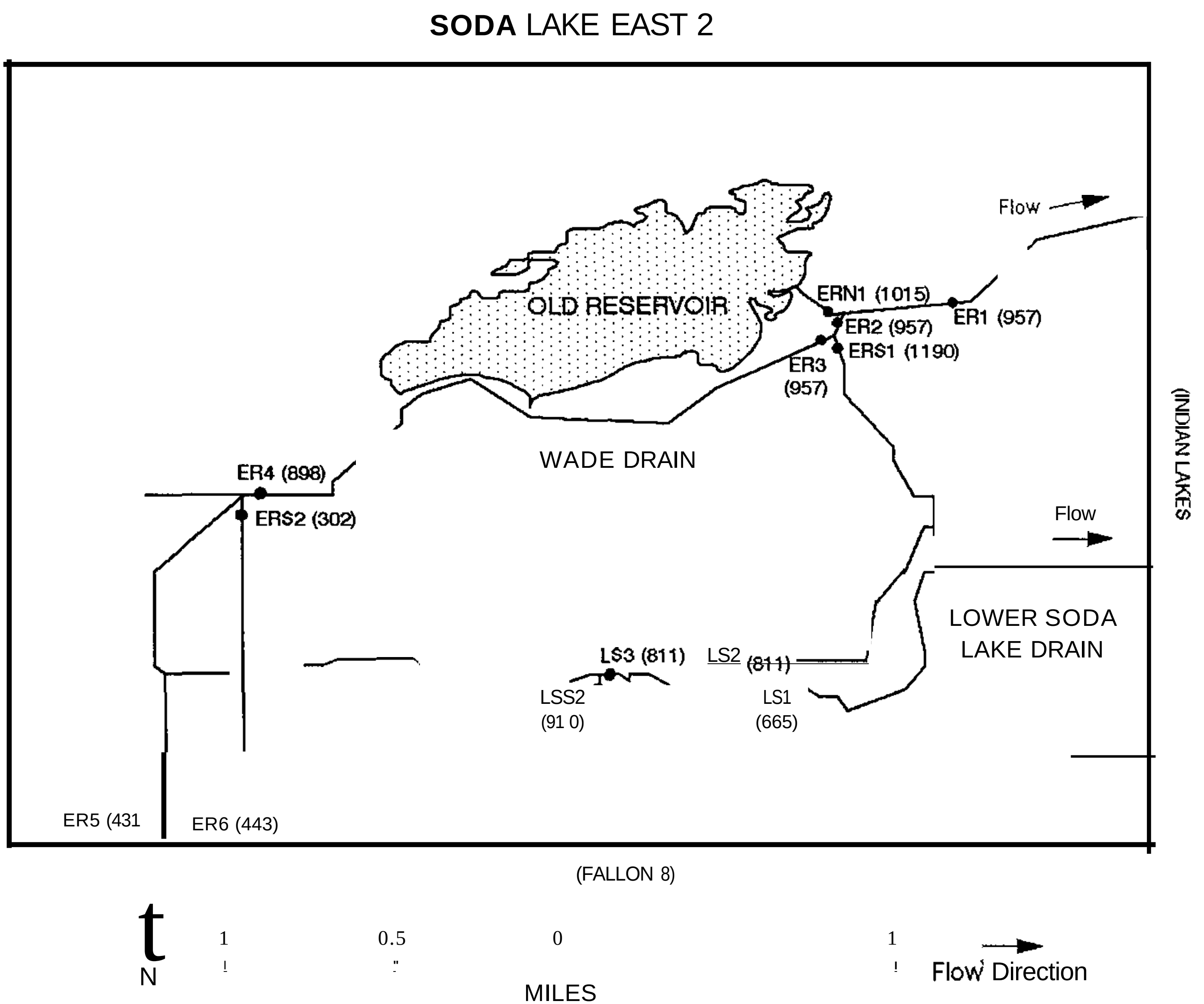

Figure B2. Sampling sites on agricultural drains in section 2 of the USGS Soda Lake East 7.5 minute quadrangle. Total dissolved solids concentrations are given in parentheses.

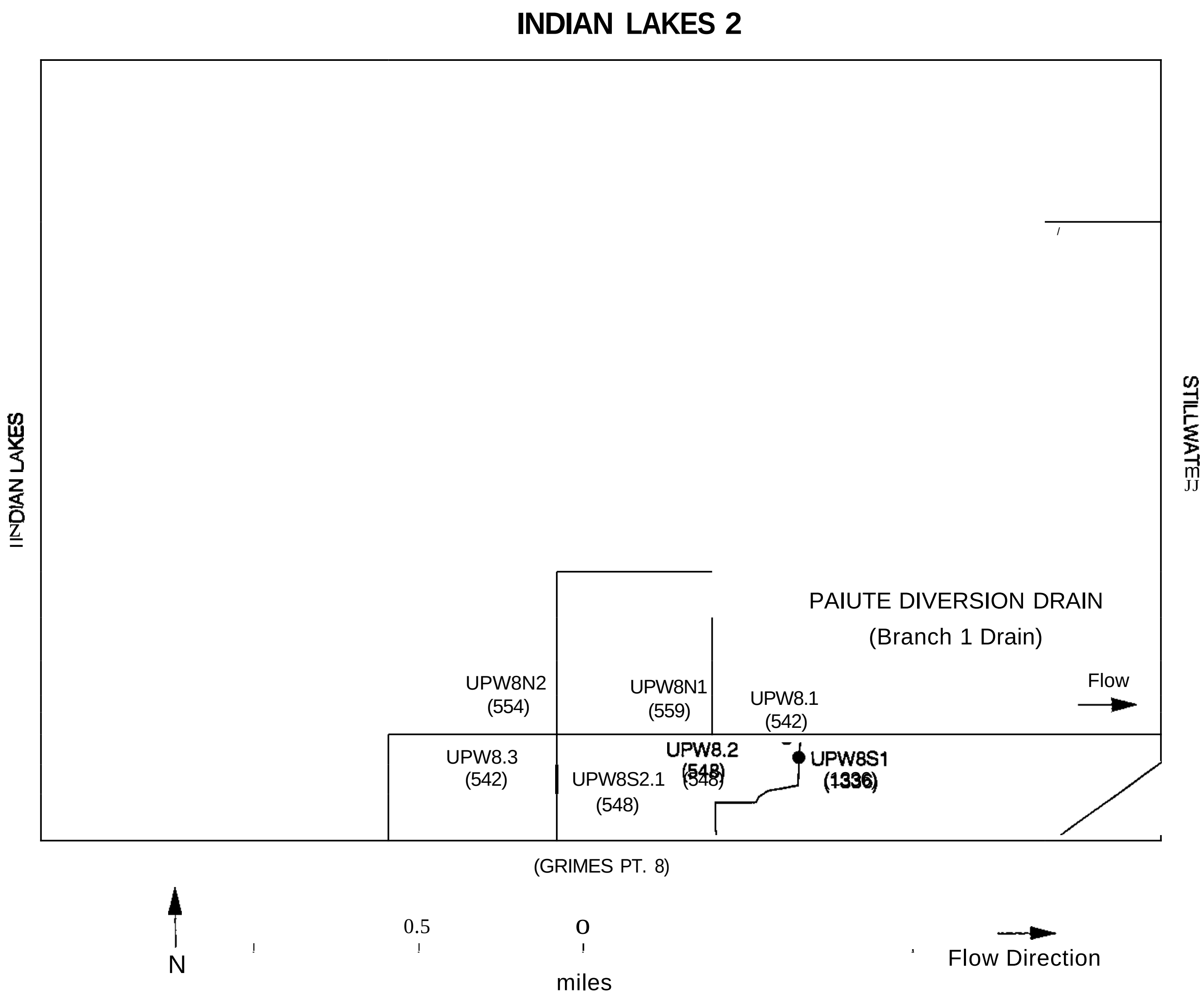

Figure 83. Sampling sites on agricultural drains in section 2 of the Lakes 7.5 minute quadrangle. Total dissoived solids **concentrations are given in parentheses.**

INDIAN LAKES 3

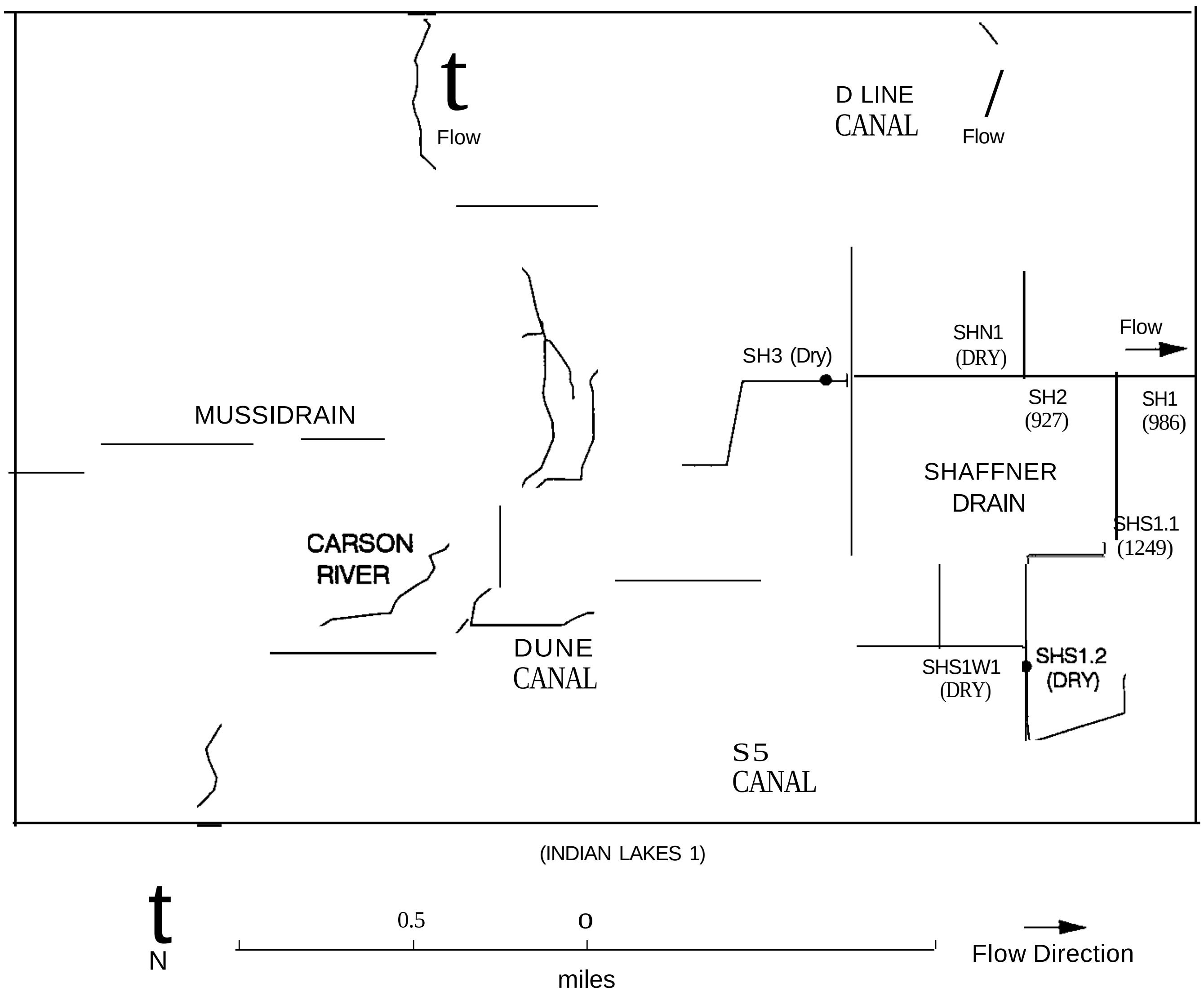

Figure 84. Sampling sites on agricultural drains in section 3 of the Lakes 7.5 minute quadrangle. Total dissolved solids concentrations are given in parentheses.

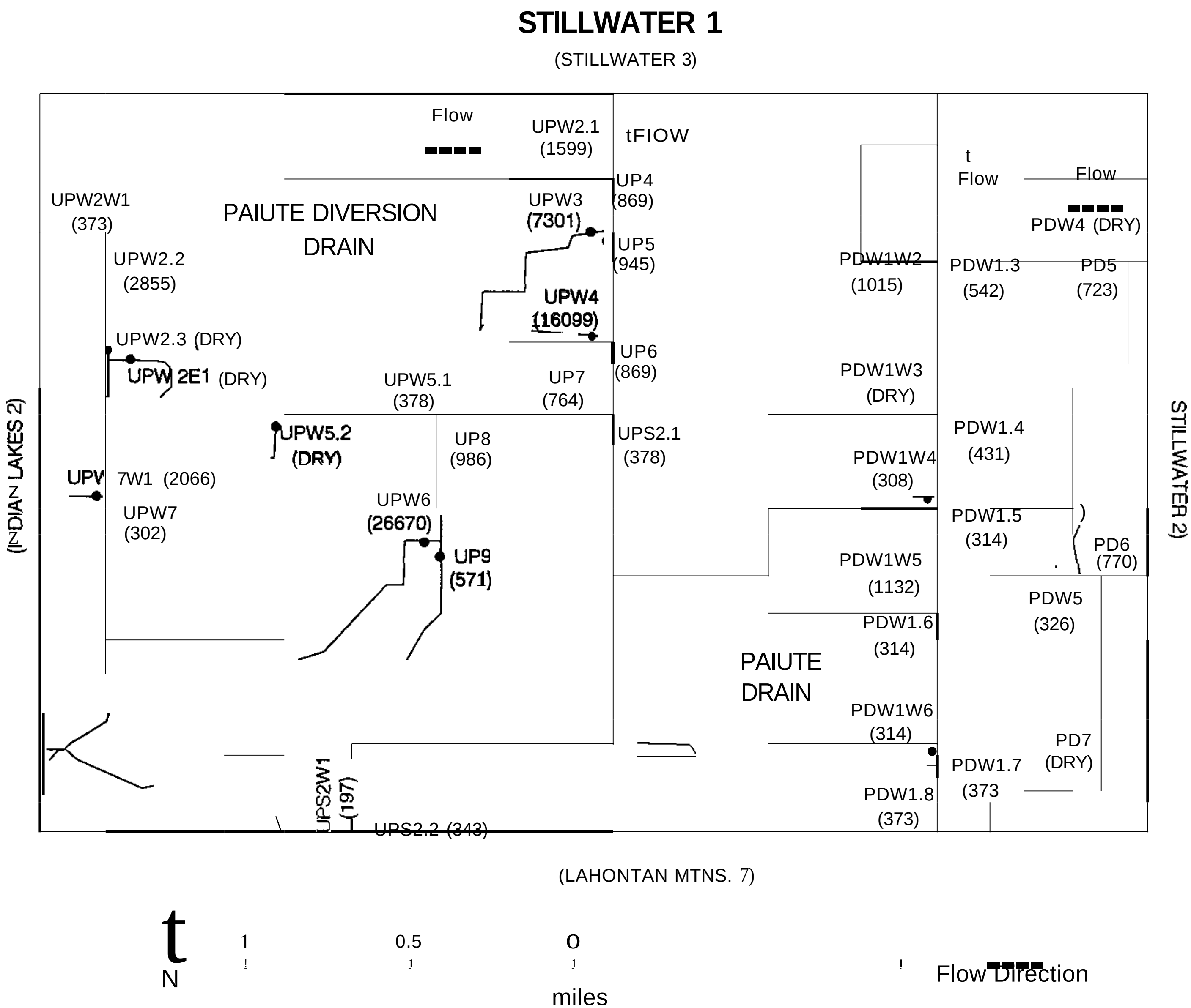

Figure 85. Sampling sites on agricultural drains in section 1 of the USG Stillwater 7.5 minute quadrangle. Total dissolved solids concentrations are given in parentheses.

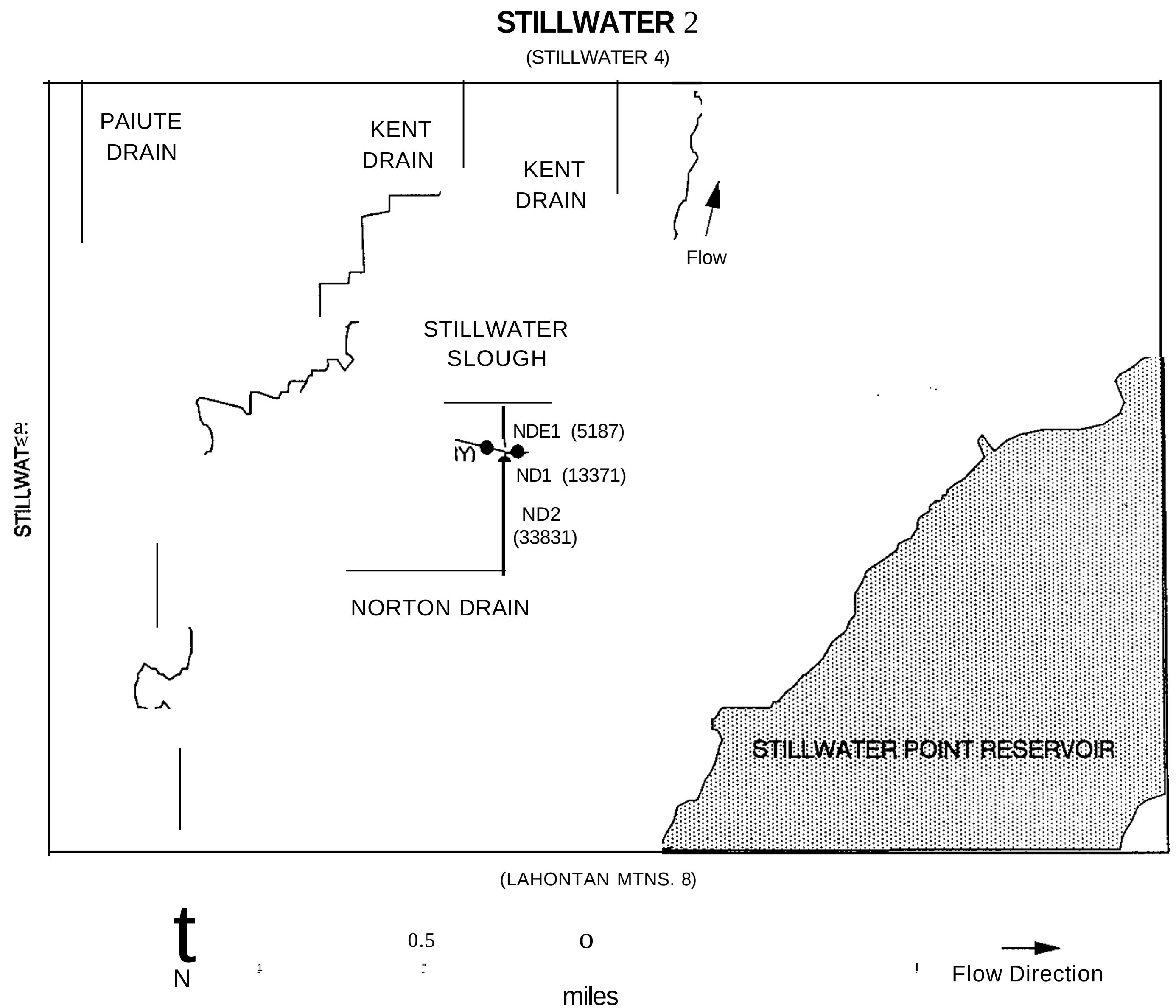

Figure 86. Sampling sites on agricultural drains in section 2 of the 7.5 minute quadrangle. Total dissolved solids **concentrations are given in parentheses.**

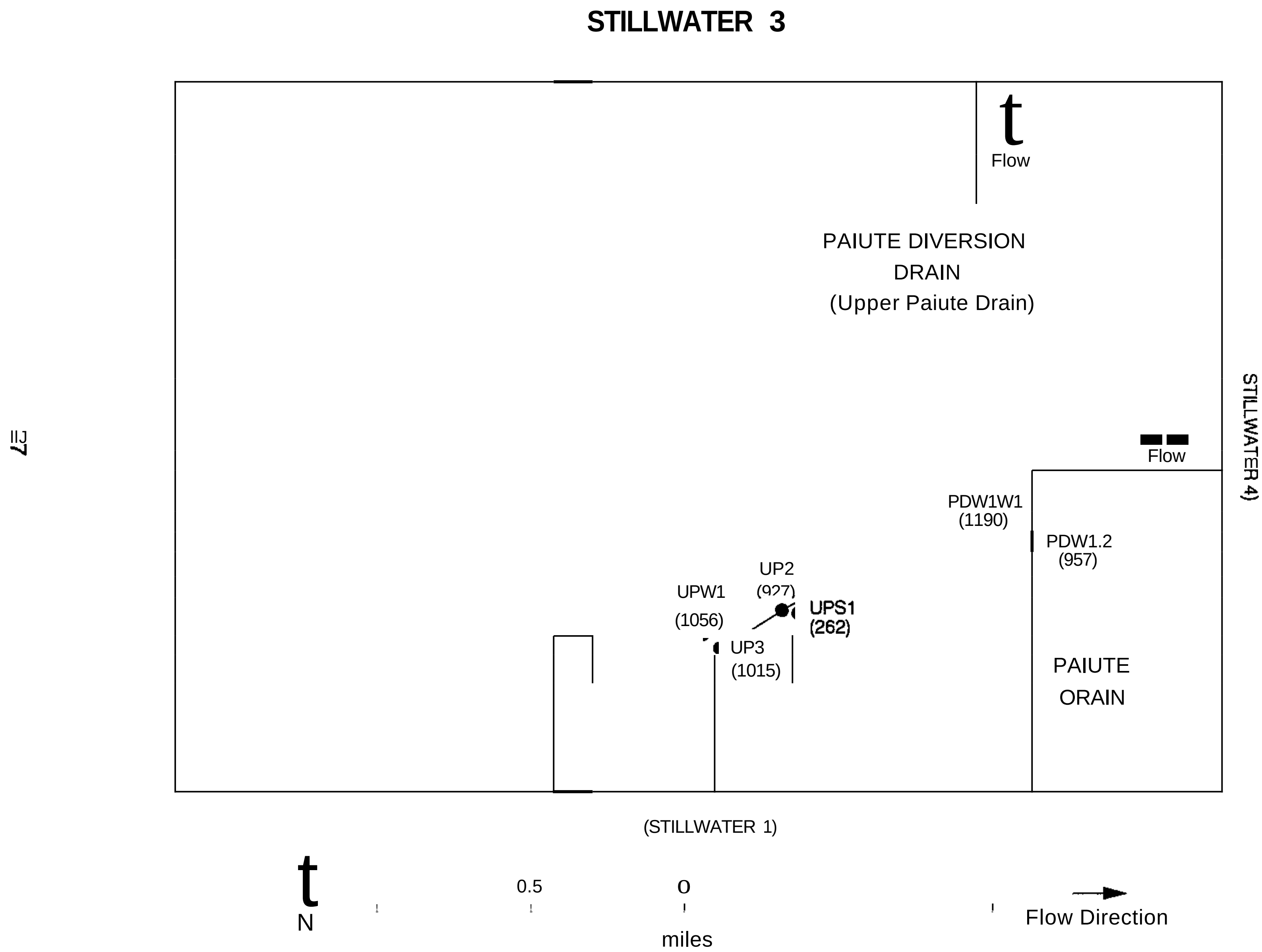

Figure 87. Sampling sites on agricultural drains in section 3 of the USGStillwater 7.5 minu1e quadrangle. Total dissolved solids concentrations are given in parentheses.

STILLWATER 4

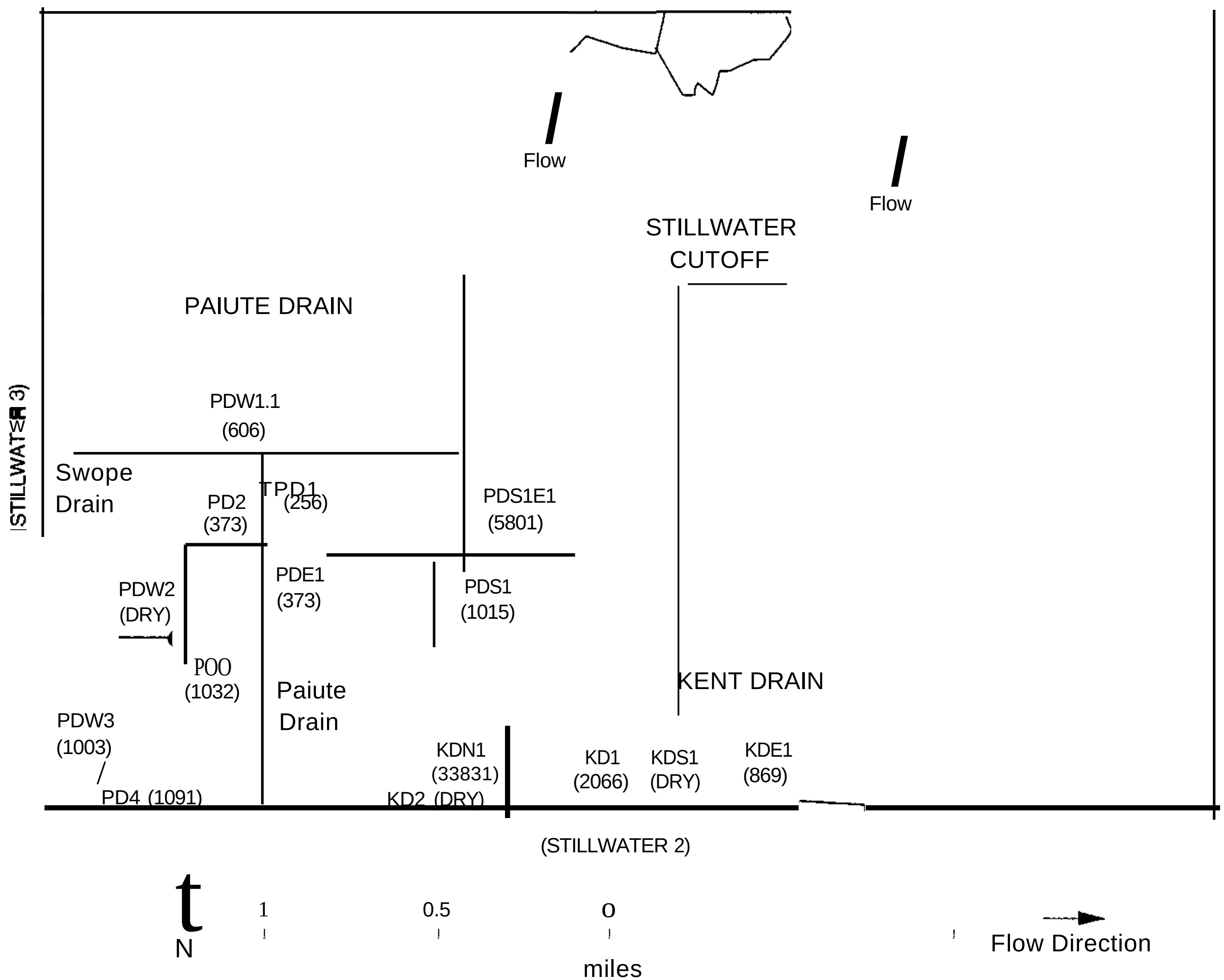

Figure 88. Sampling sites on agricultural drains in section 4 of the USGStiliwater 7.5 minute quadrangle. Total dissolved solids concentrations are given in parentheses.

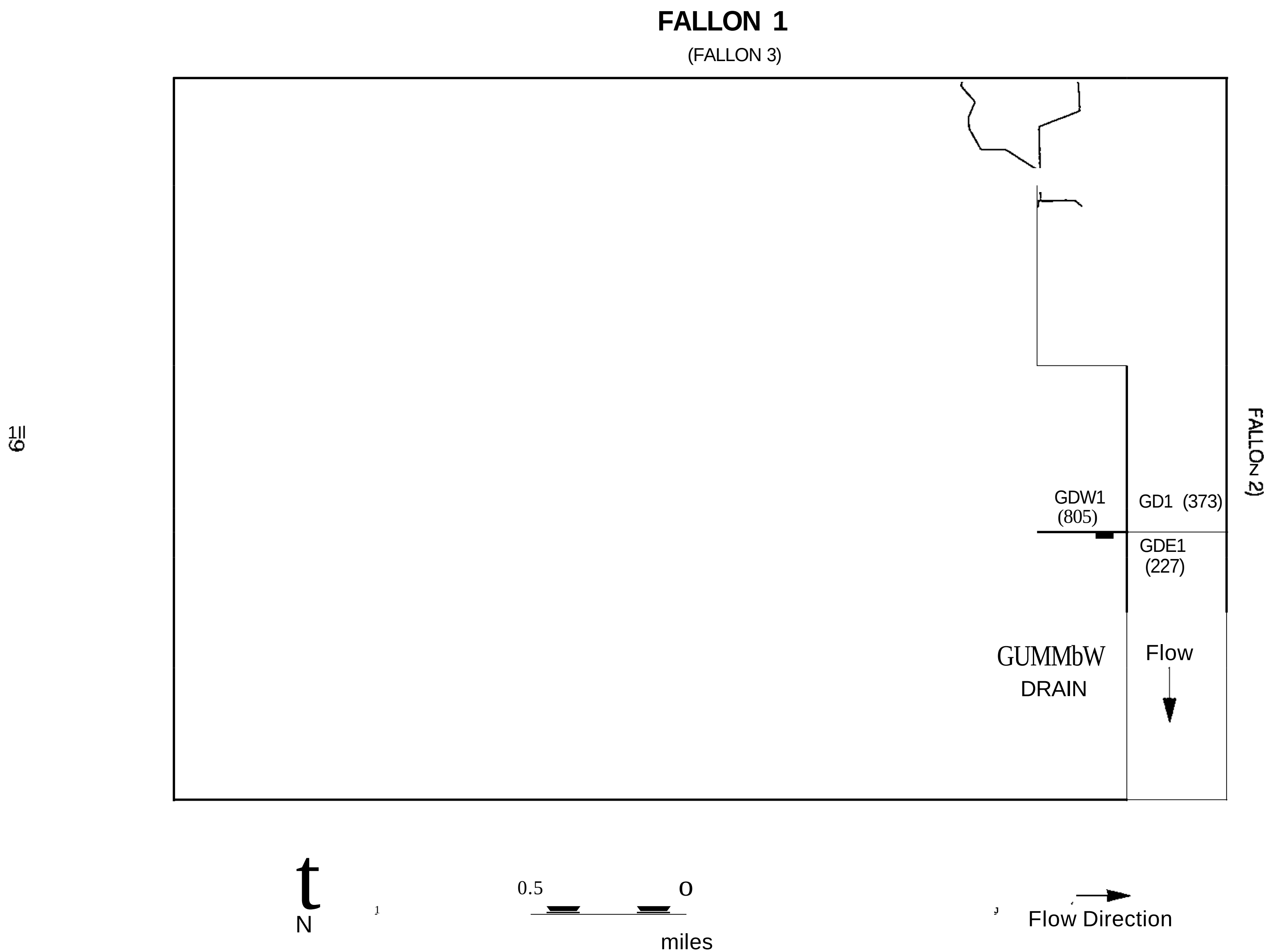

Figure 89. Sampling **sites** on **agricultural** drains in section 1 of the USGS Fallon 7.5 minute quadrangle. Total dissolved soiids **concentrations are given in parentheses.**

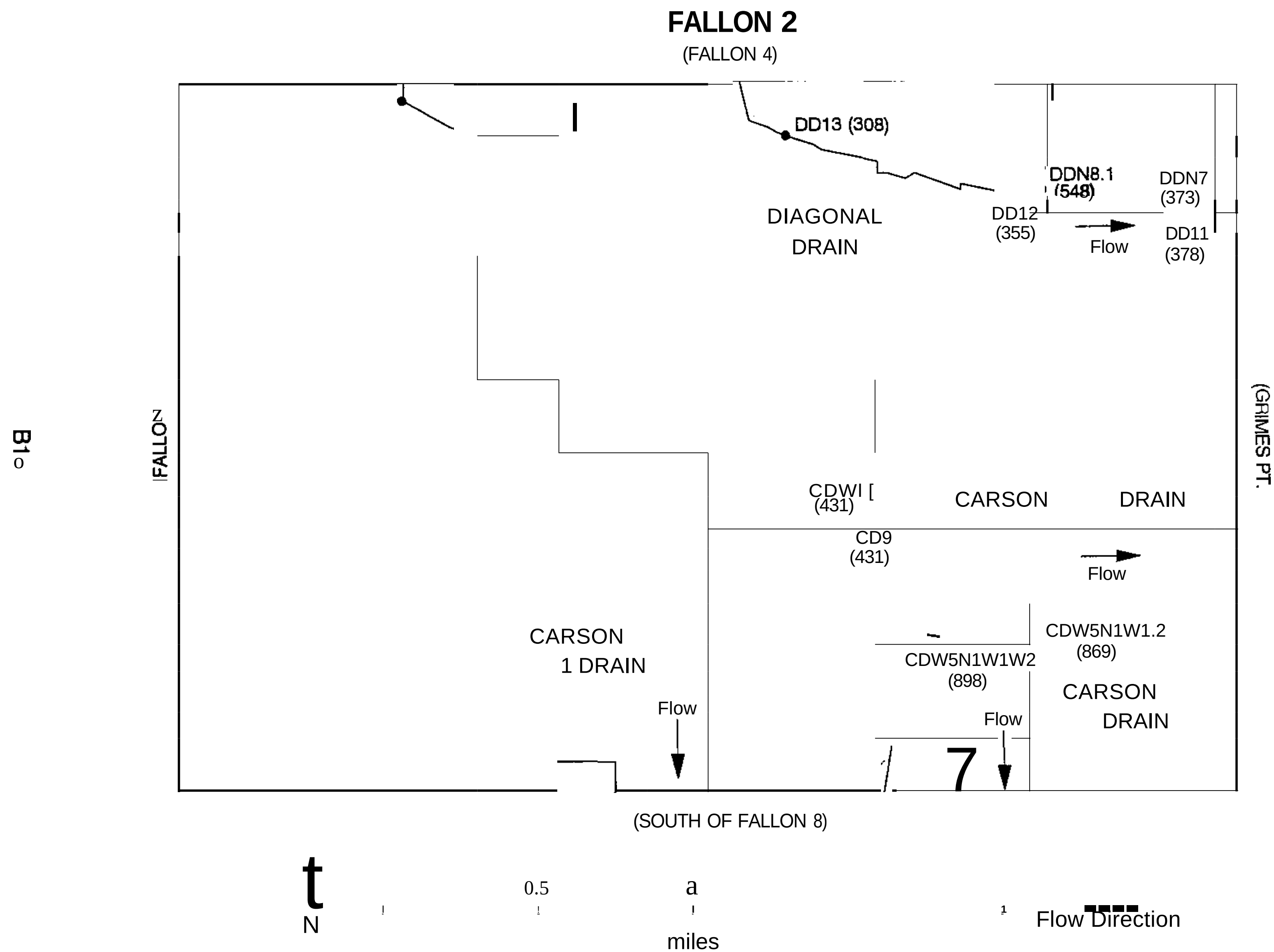

Figure 810. Sampling **sites** on drains in section 2 of the USGS Fallon 7.5 minute quadrangle. Total dissolved solids **concentrations are given in parentheses.**

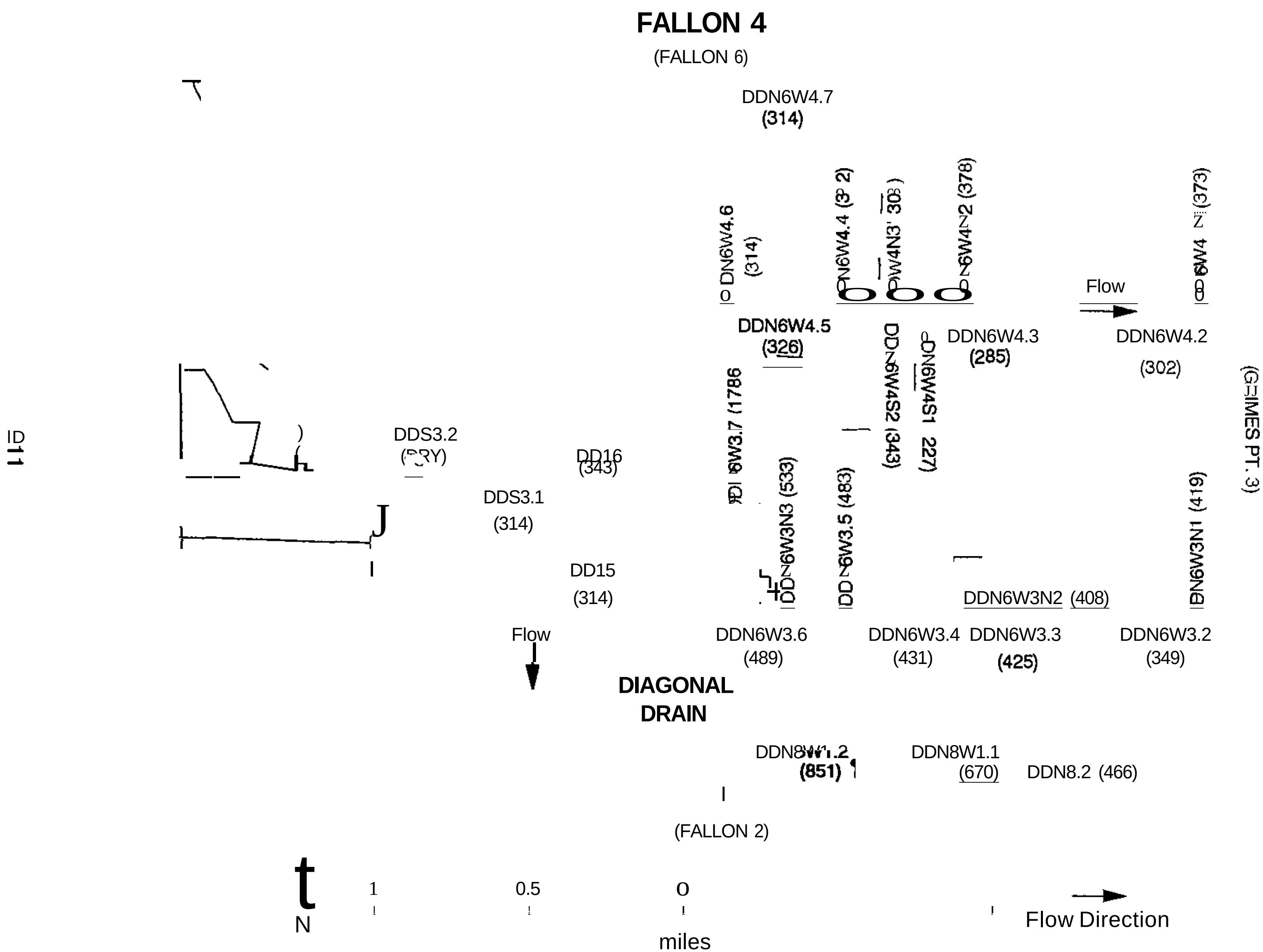

Figure 811. Sampling on agricultural drains in section 4 of the USGS Fallon 7.5 mlnu1e quadrangle. Total dissolved solids **concentrations are given in parentheses.**

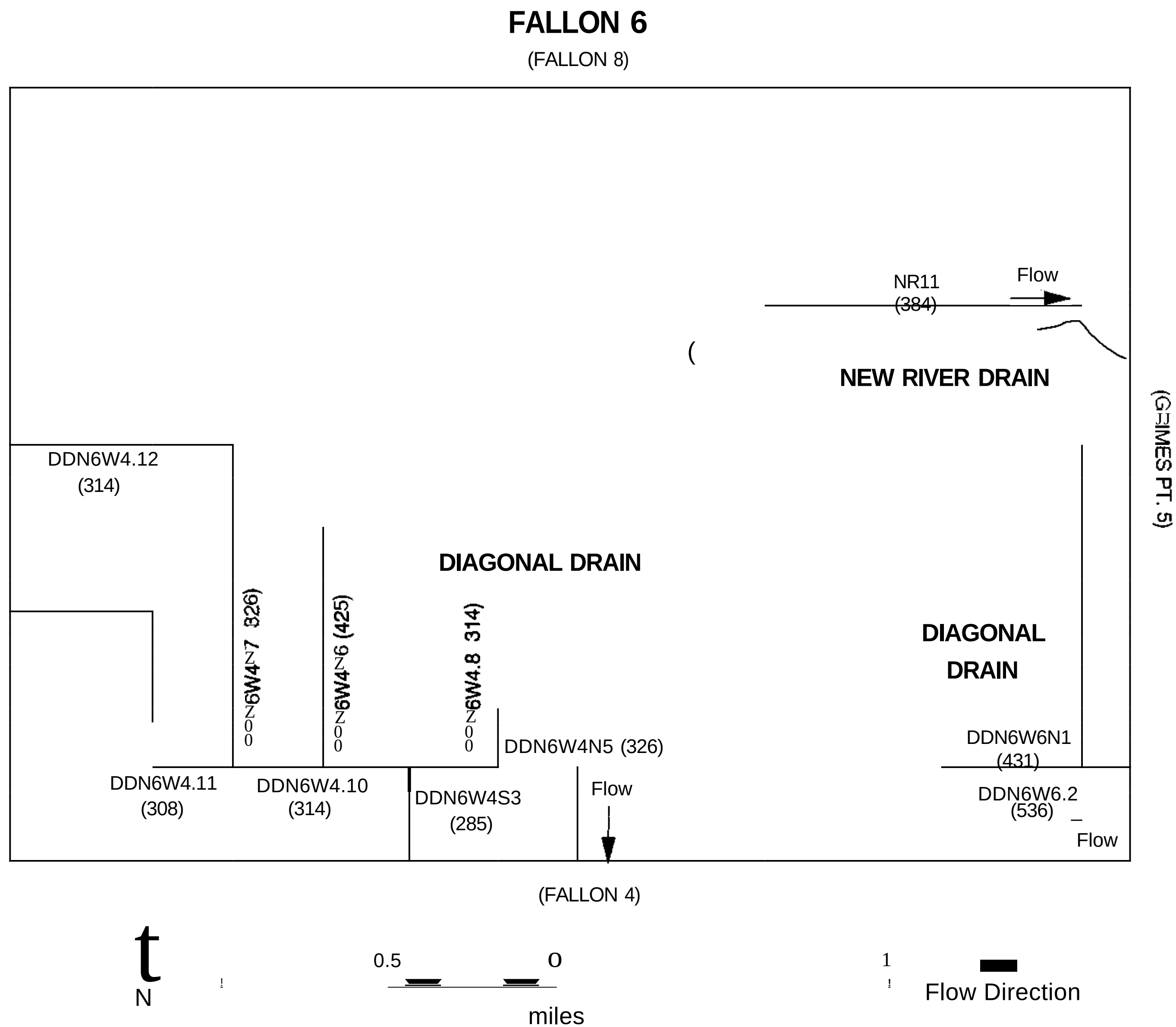

Figure 812. Sampling **sites** on agricultural drains in section 6 of the USGS Falton 7.5 minute quadrangle. Total dissolved solids **concentrations are given in parentheses.**

FALLON 7

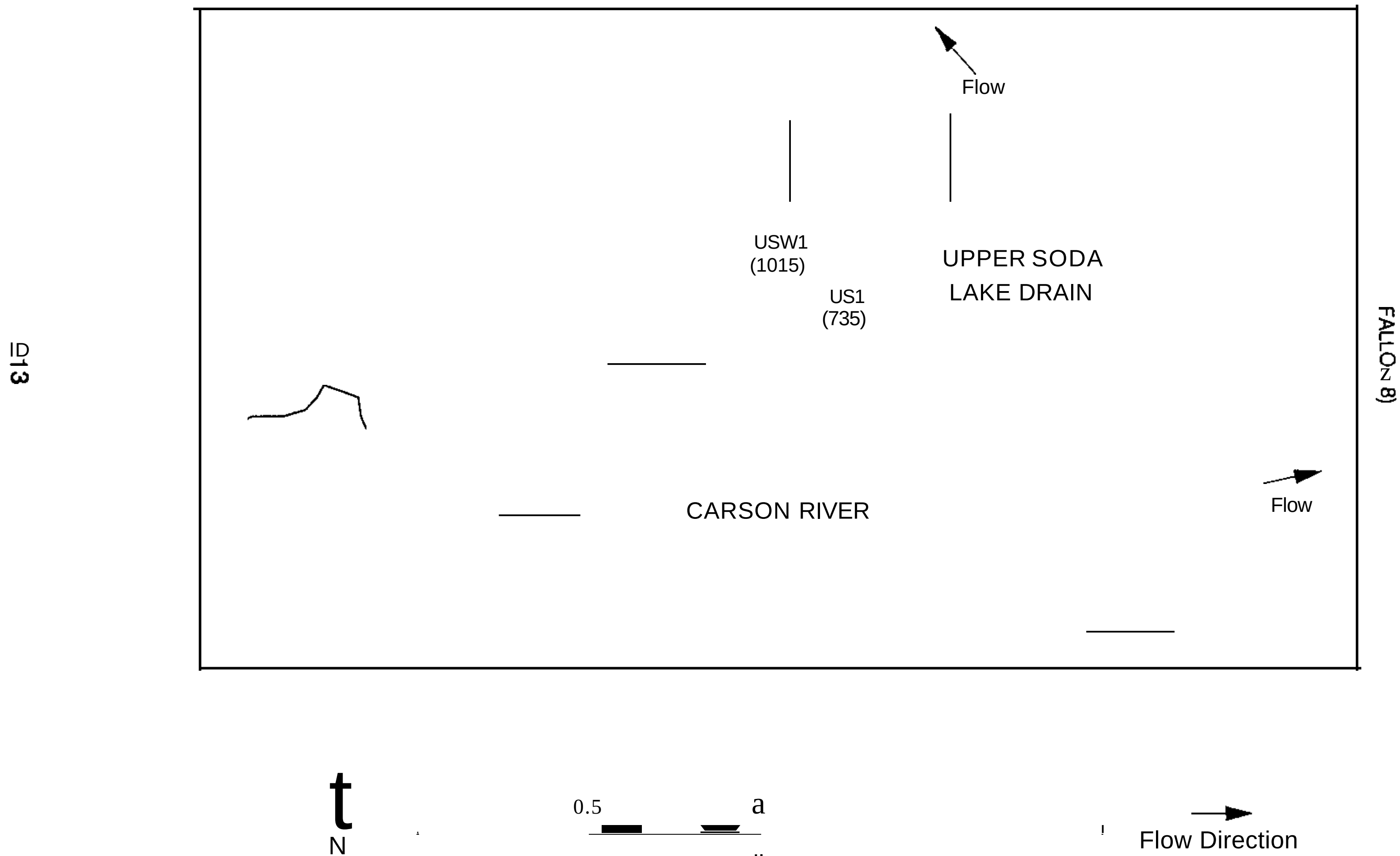

Figure 813. Sampling on drains in section 7 of the USGS Fallon 7.5 minute quadrangle. Total dissolved solids **concentrations are given in parentheses.**

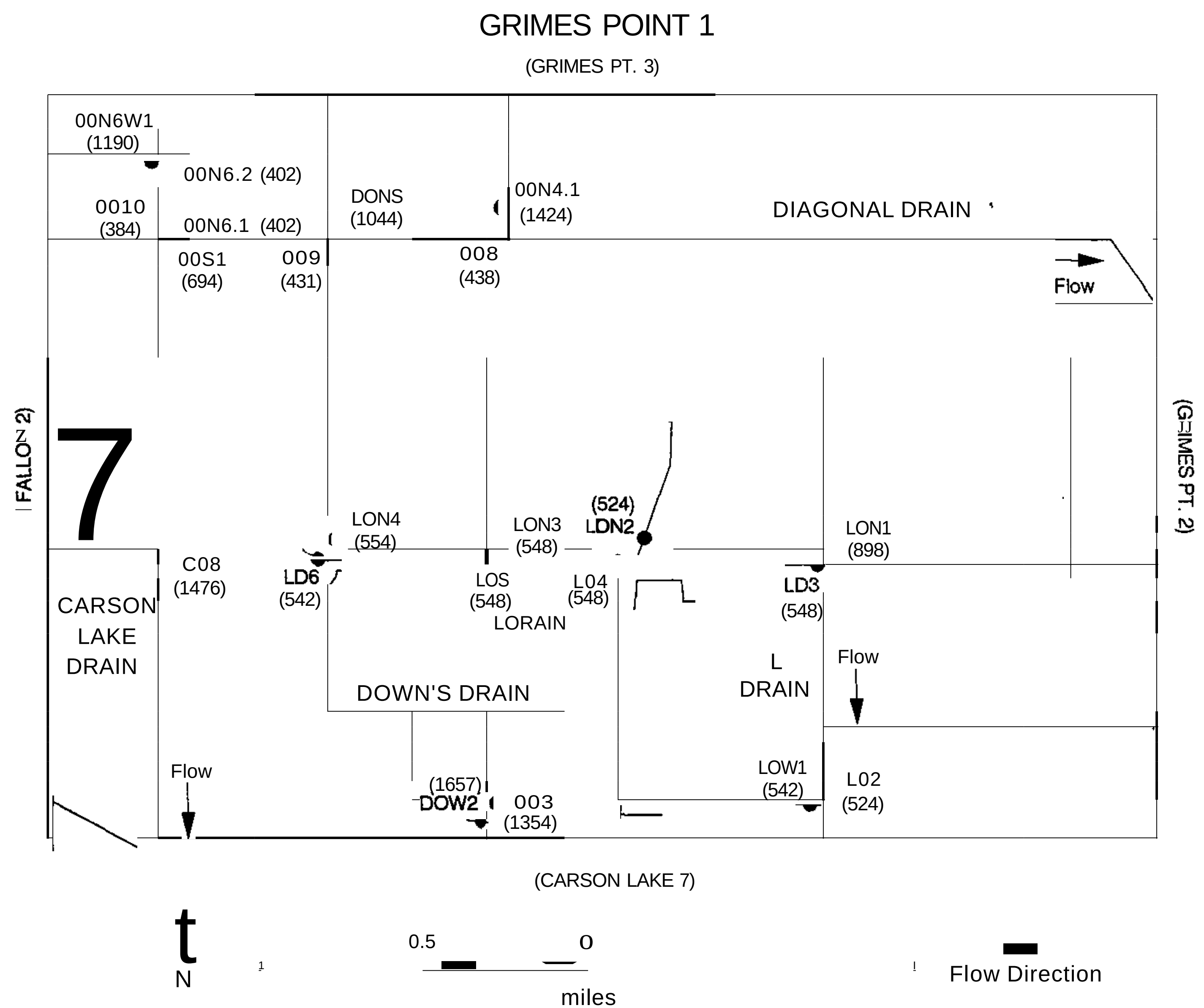

Figure 814. Sampling sites on agricultural drains in section 1 of the USGS Grimes Point 7,5 minute quadrangle, Total dissolved solids concentrations are given in parentheses.

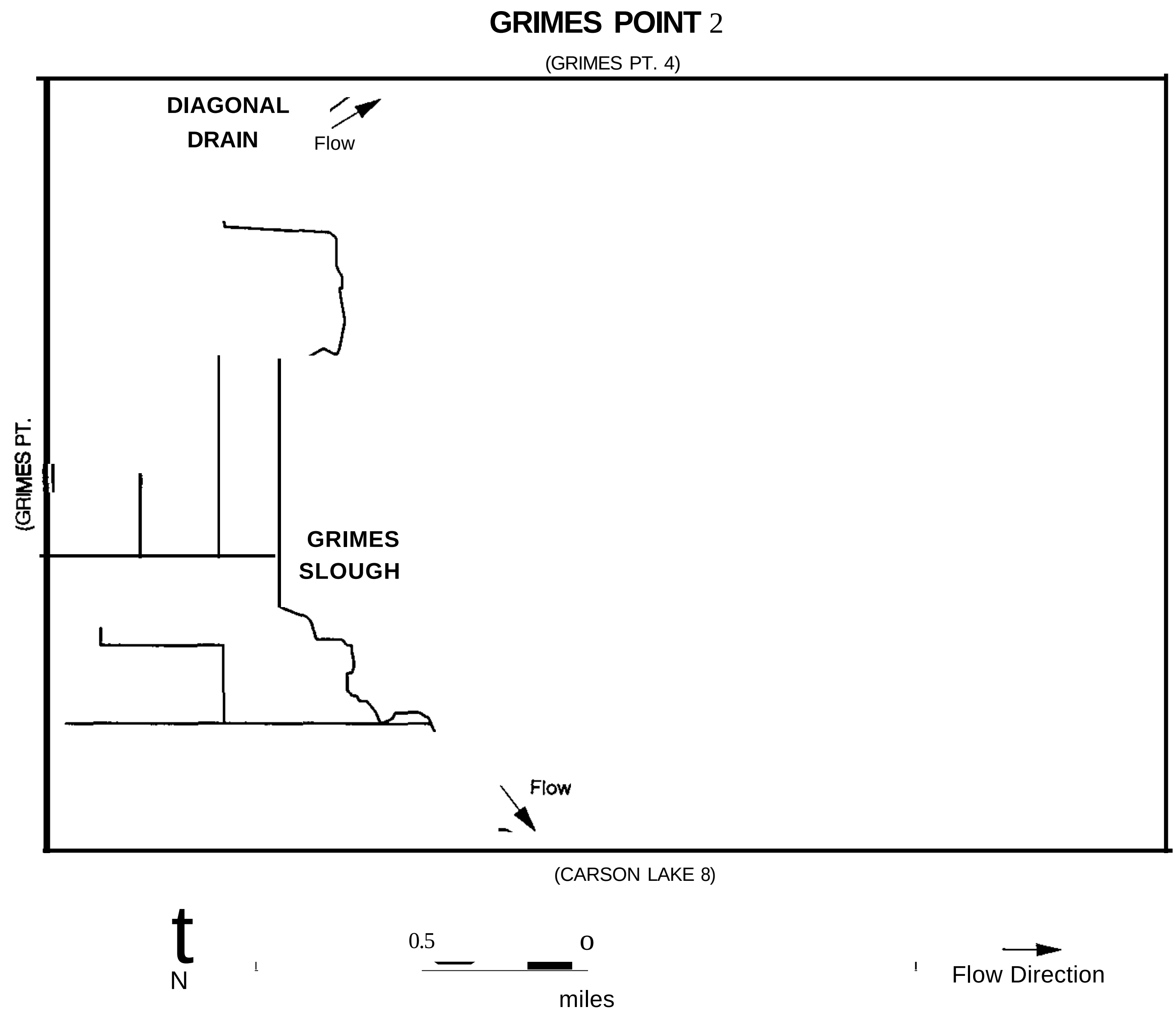

Figure 815. Sampling sites on agricultural drains in section 2 01 the USGS Grimes Point 7.5 minute quadrangle. Total dissolved solids concentrations are given in parentheses.

D15

B1O

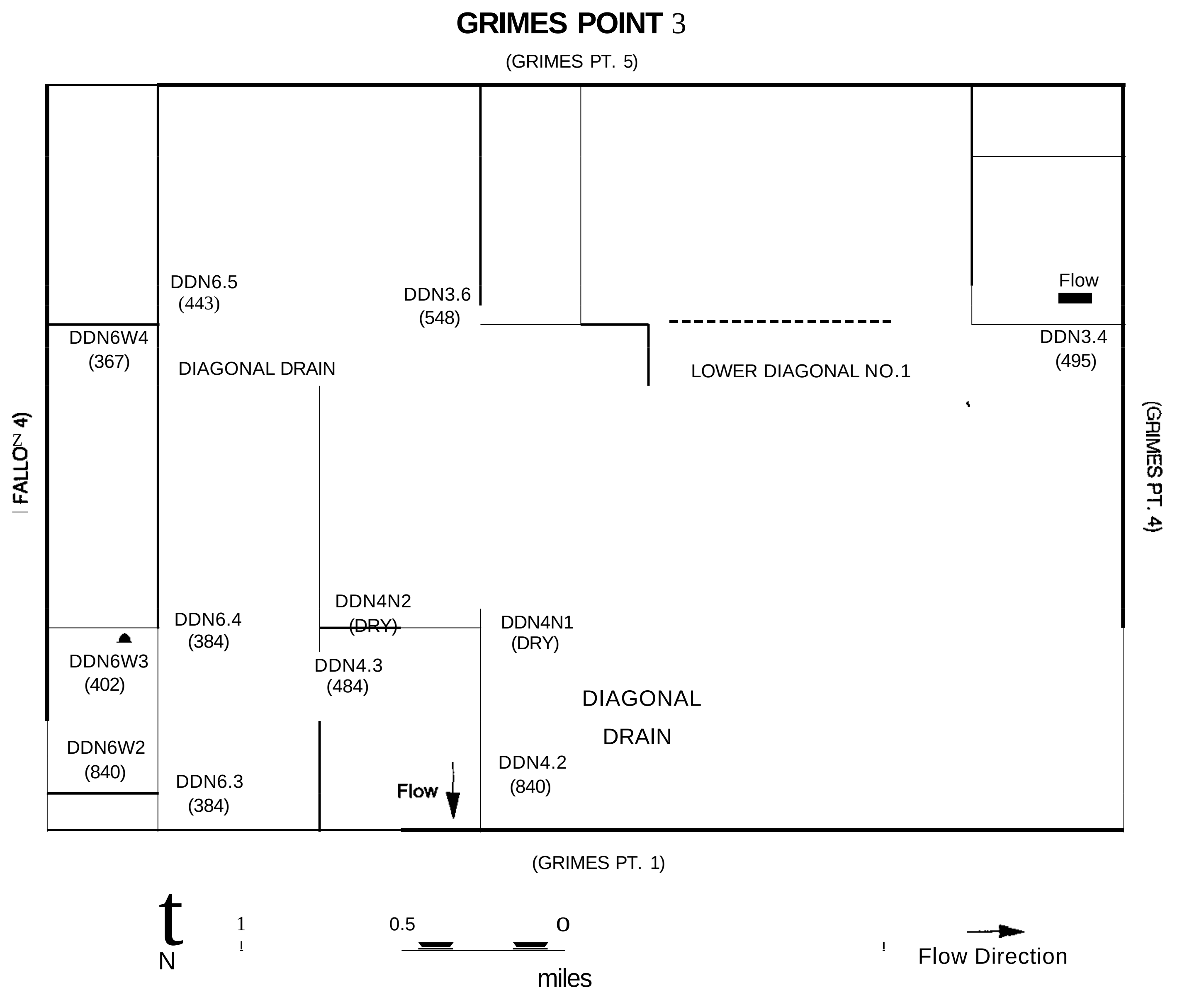

Figure 816. Sampling sites on agricultural drains In section 3 01 the USGS Point 7.5 minute quadrangle. Total dissolved solids concentrations are given in parentheses,

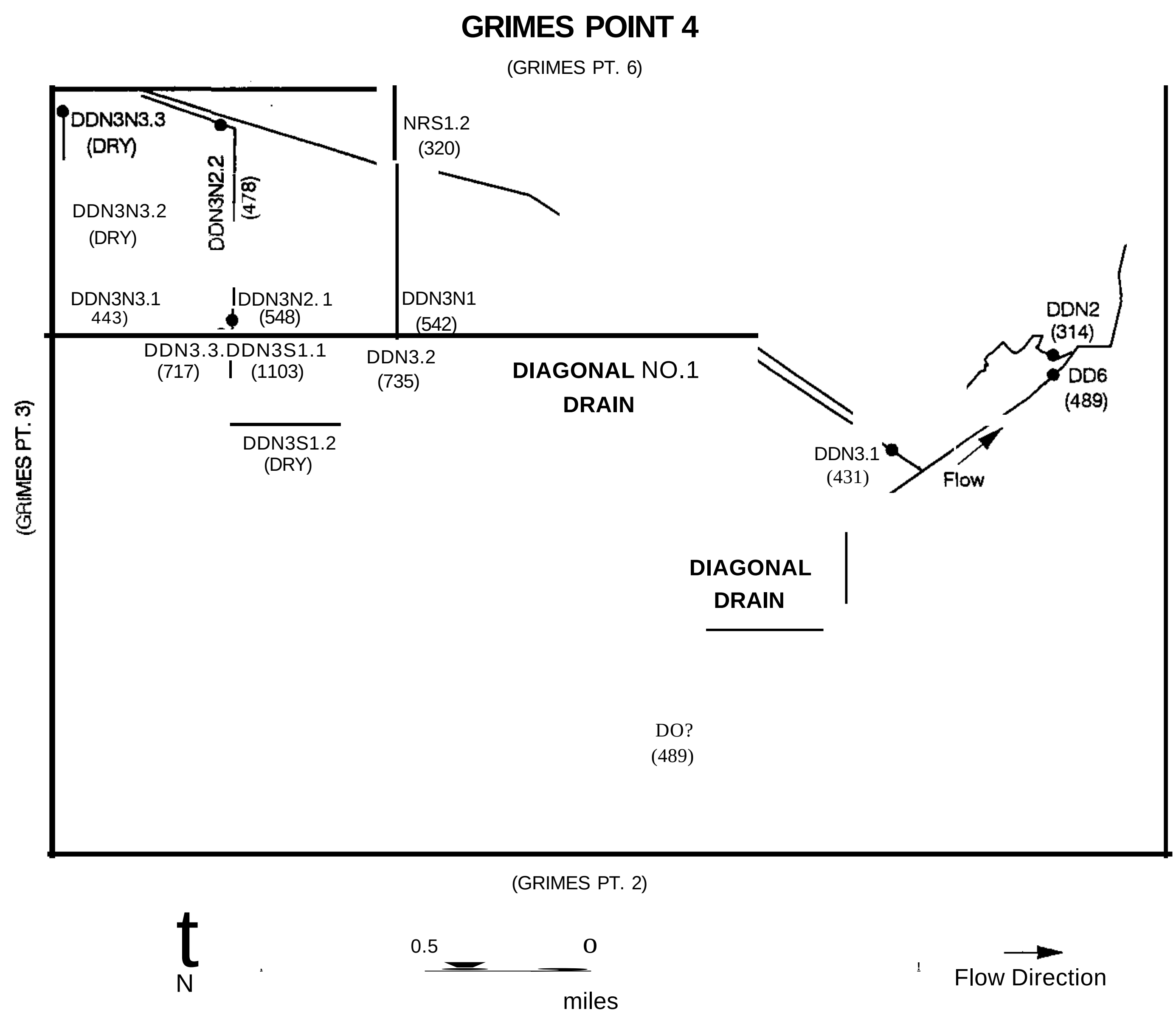

Figure 817. Sampling on drains in section 4 of the USGS Grimes Point 7.5 minute quadrangle. Total dissolved solids **concentrations are given in parentheses.**

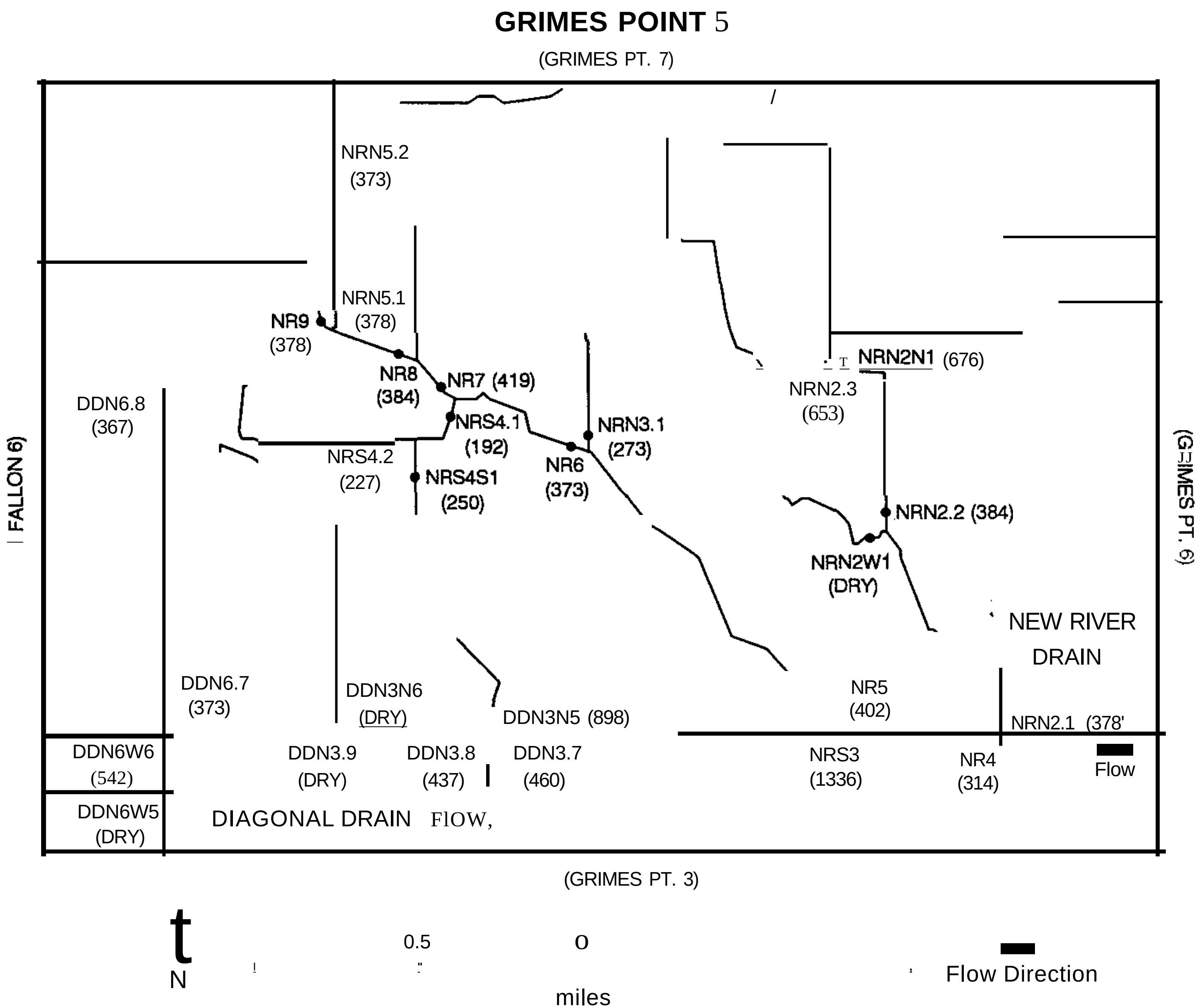

Figure 818. Sampling sites on agricultural drains in section 5 01 the USGS Grimes Point 7,5 minute quadrangle. Total dissolved solids concentrations are given in parentheses.

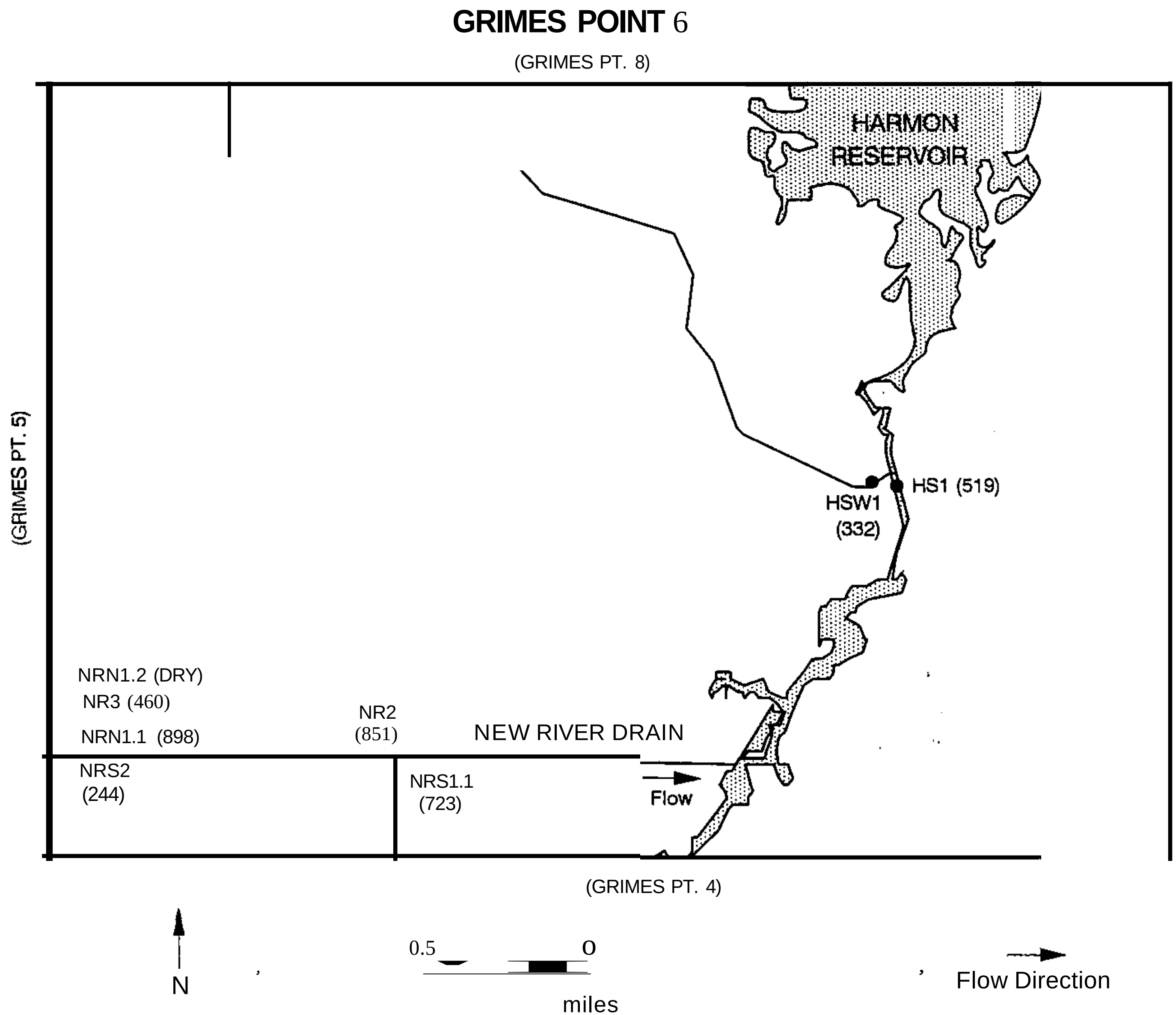

Figure 619. Sampling on drains in section 6 01 the USGS Grimes Point 7.5 minute quadrangle. Total dissolved soiids **concentrations are given in parentheses.**

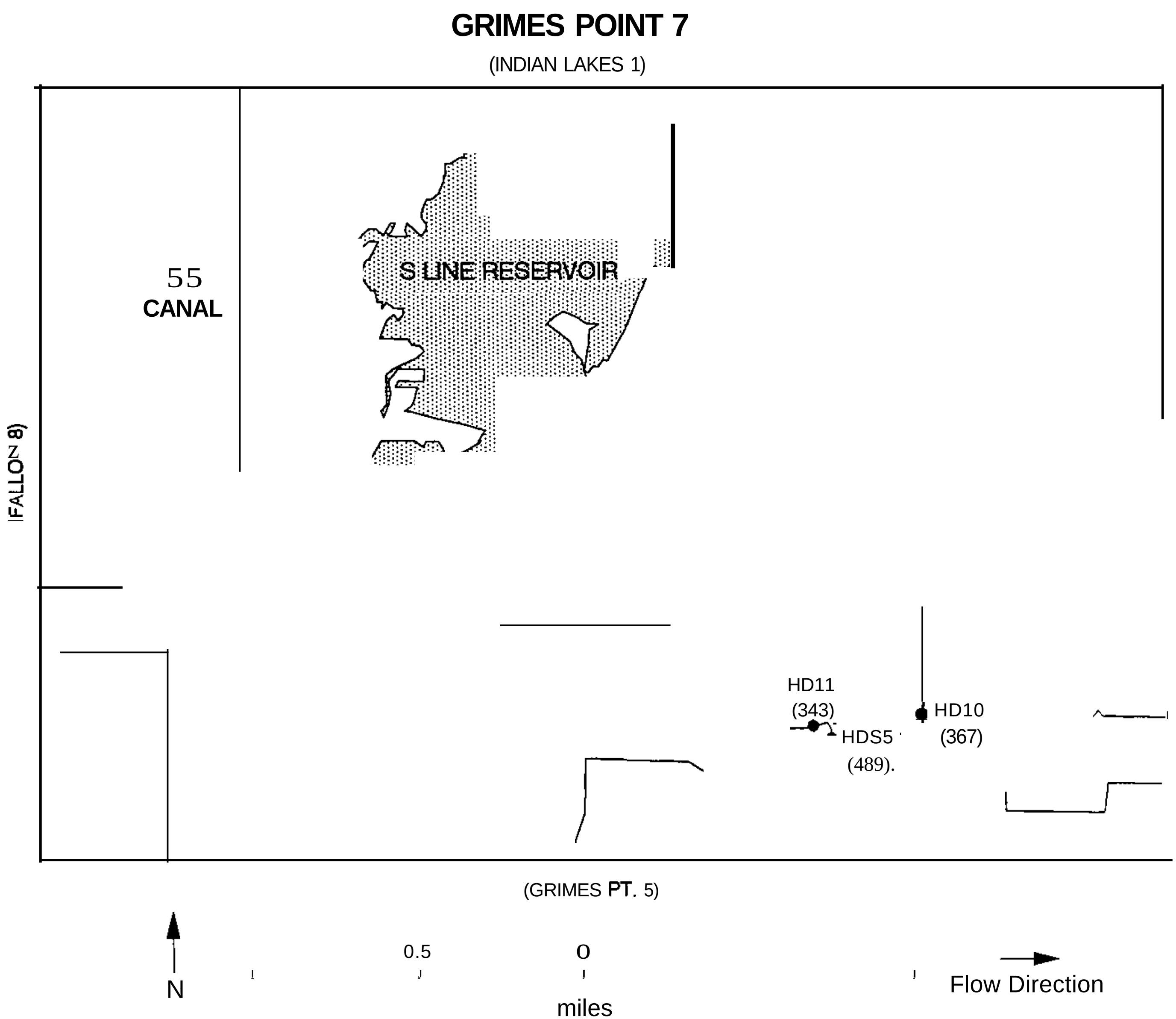

Figure 820. Sampling on drains in section 7 of the USGS Grimes Point 7.5 minute quadrangle. Total dissolved solids **concentrations are given in parentheses.**

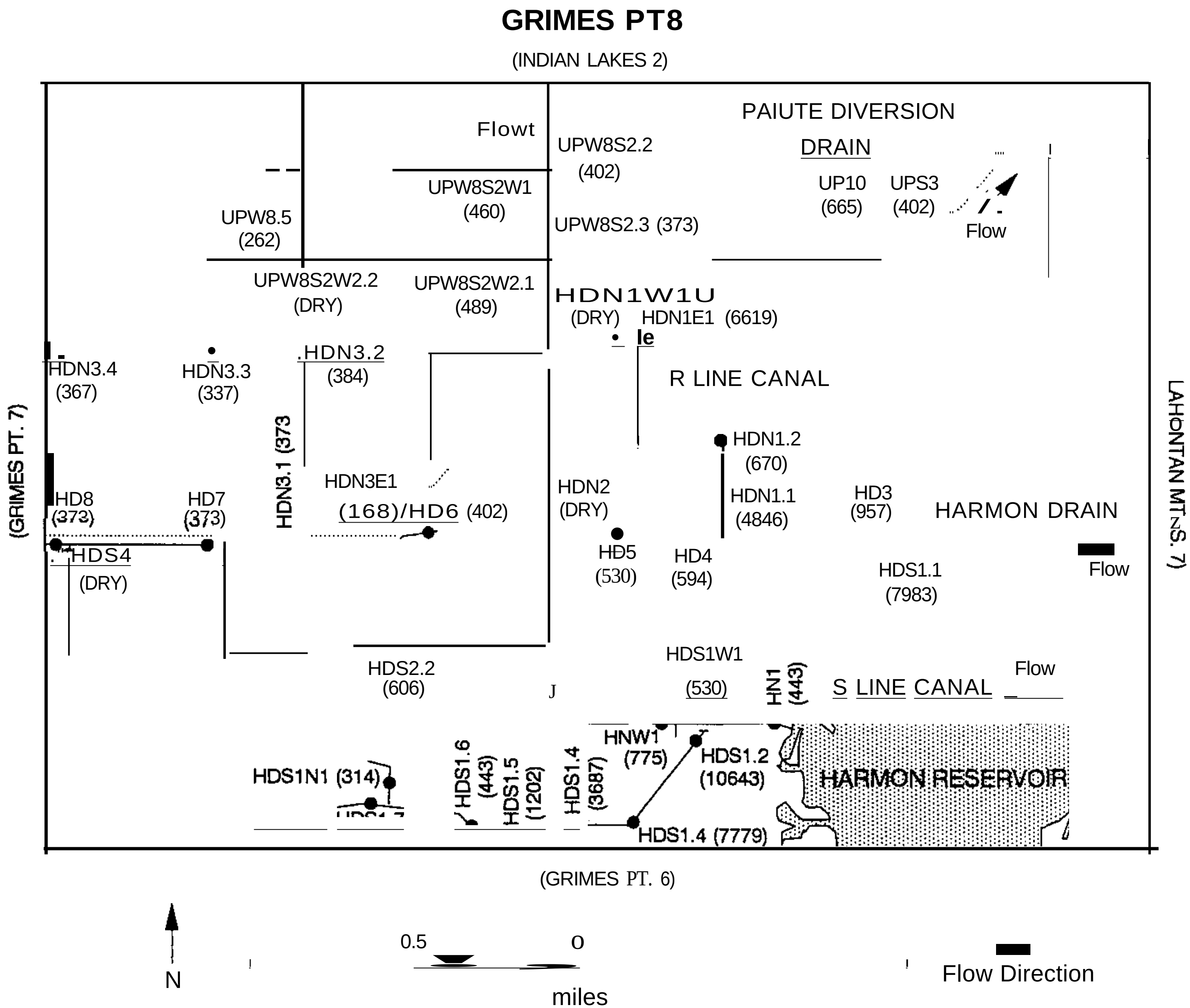

Figure 821. Sampling on agricultural drains in section 8 of the USGS Grimes Point 7.5 minute quadrangle. Total dissolved solids **concentrations are given in parentheses.**

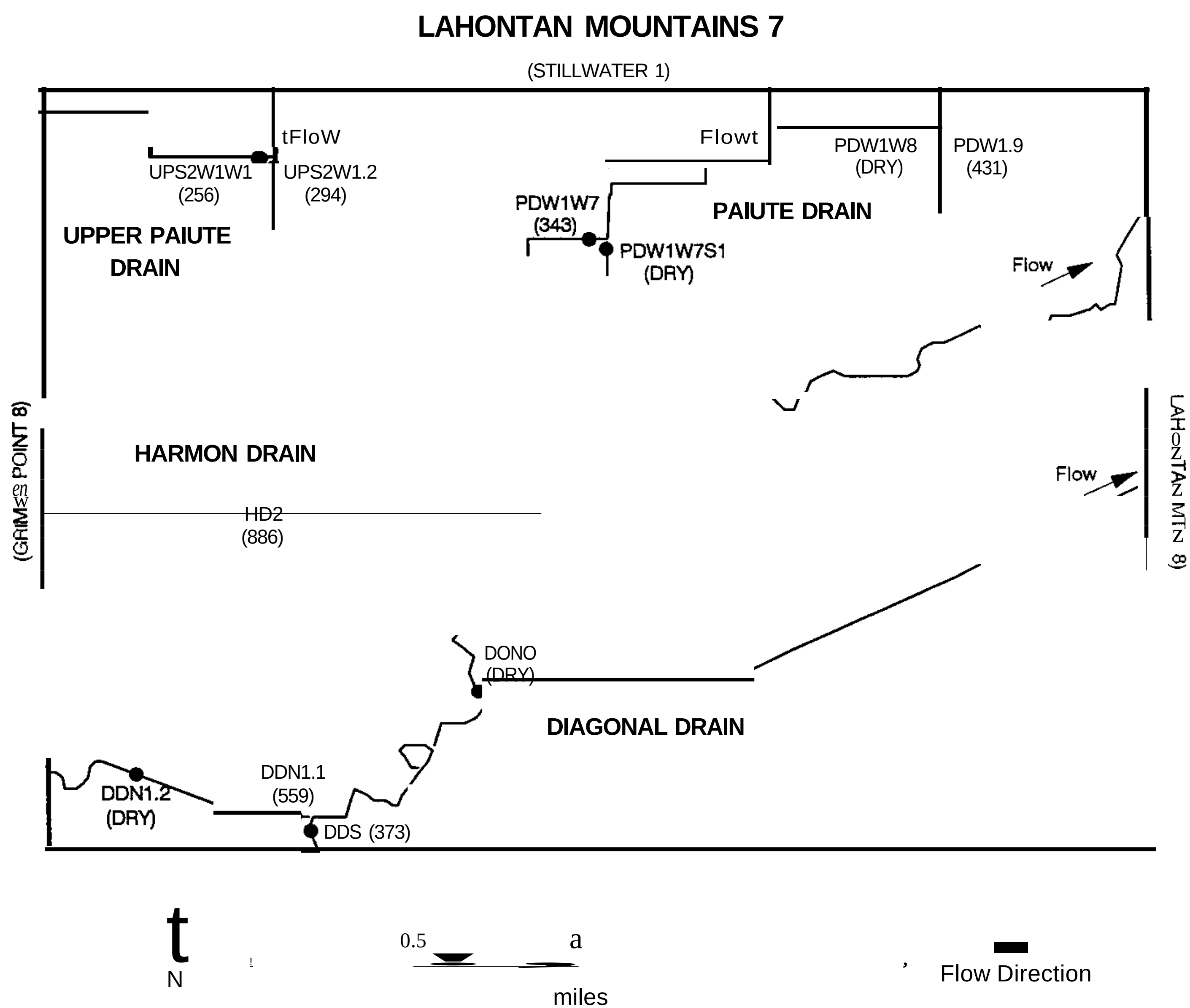

Figure 822. Sampling sites on agricultural drains in section 7 of the Lahontan Mountains 7.5 minute quadrangle. Total dissolved solids concentrations are given in parentheses.

LAHONTAN MOUNTAINS 8

(STILLWATER 2)

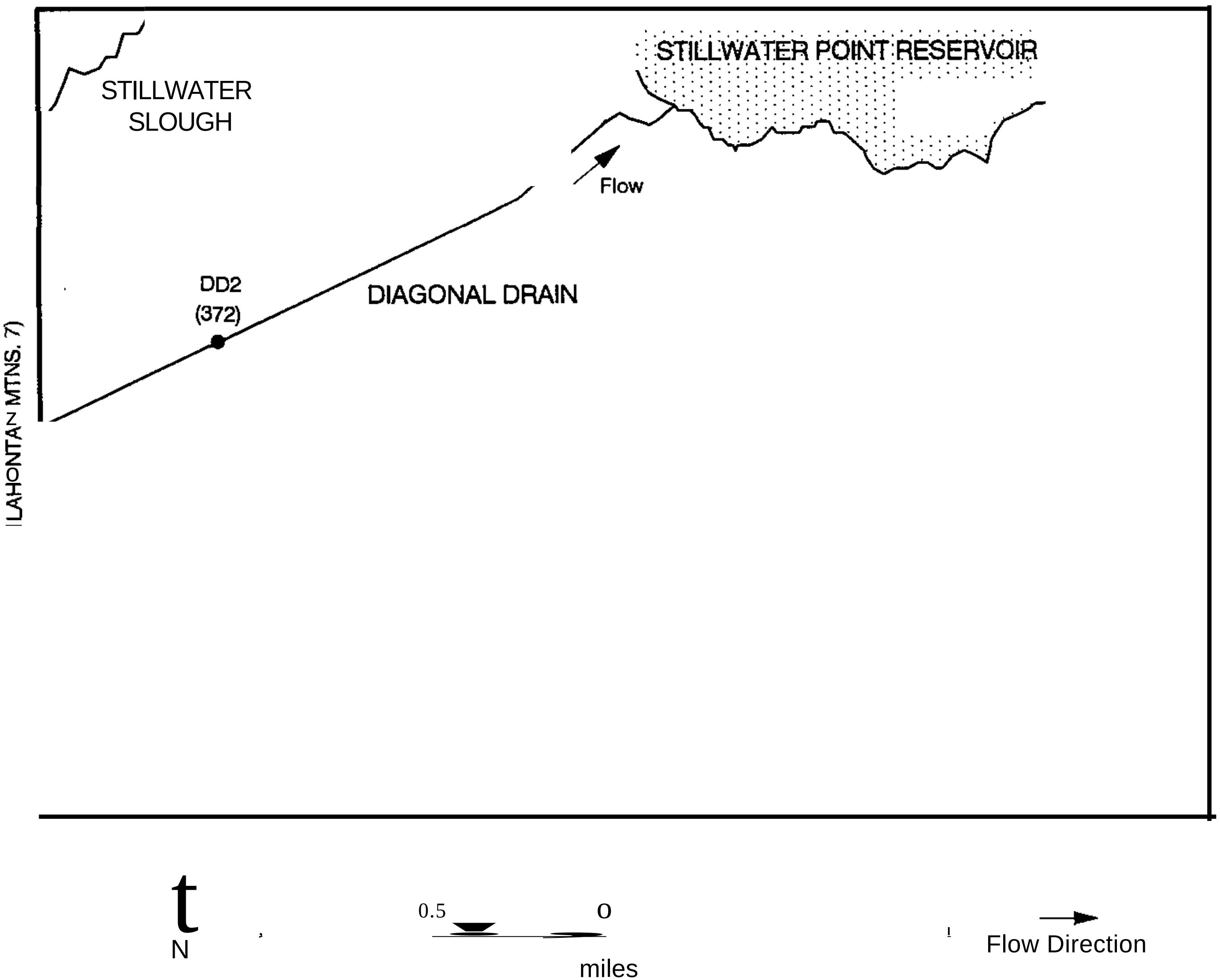

Figure 823. Sampling on drains in section 8 of the USGSahontan Mountain 7.5 minute quadrangle. Total dissolved solids **concentrations are given in parentheses.**

SOUTH OF FALLON 4

(SOUTH OF FALLON 6)

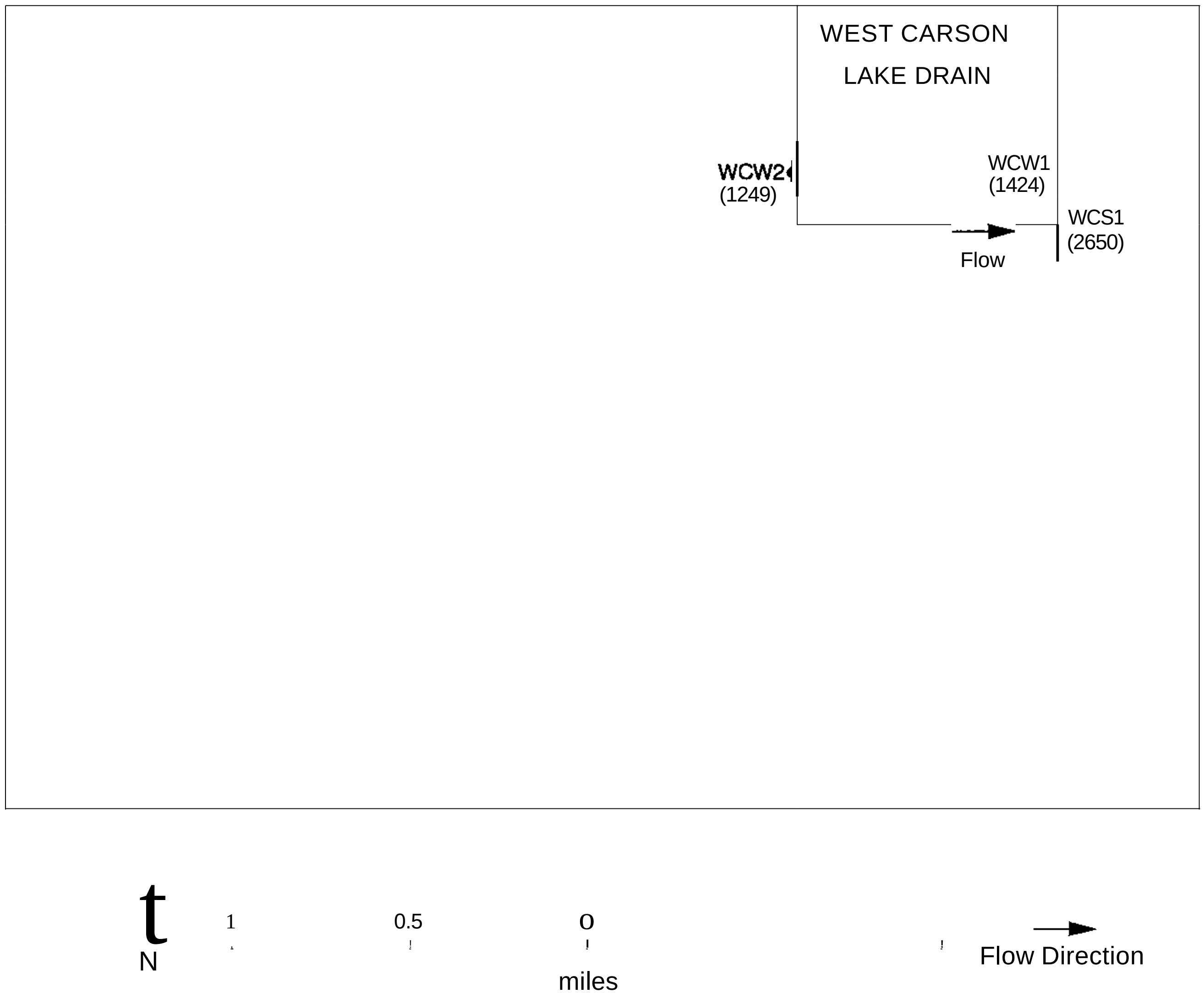

Figure 824. Sampling sites on agricultural drains in section 4 of the USGS South of Fallon 7.5 minute quadrangle. Total dissolved solids **concentrations are given in parentheses.**

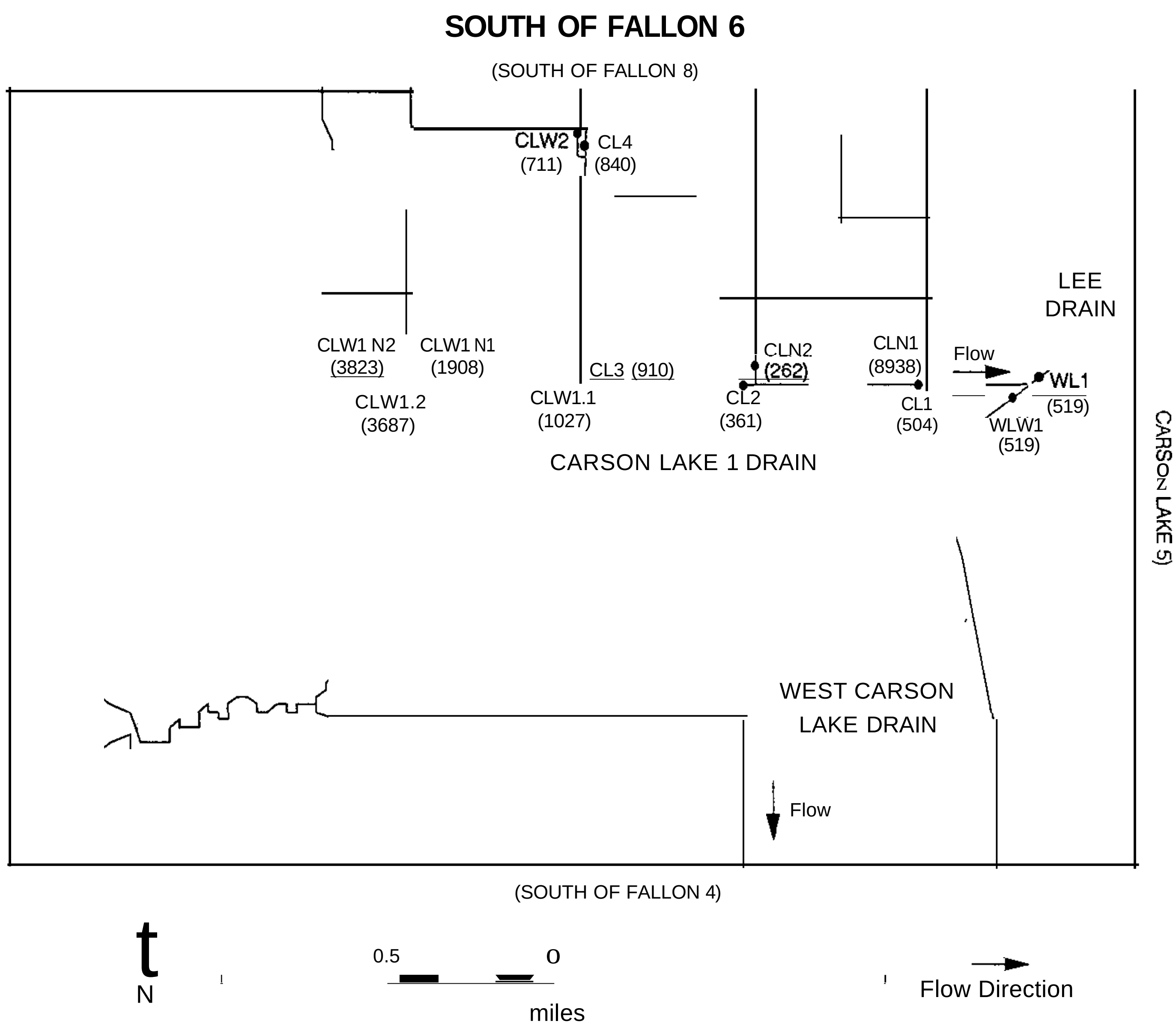

Figure 825. Sampling on drains in section 6 of the USGSouth of Fallon 7.5 minute quadrangle. Total dissolved solids **concentrations are given in parentheses.**

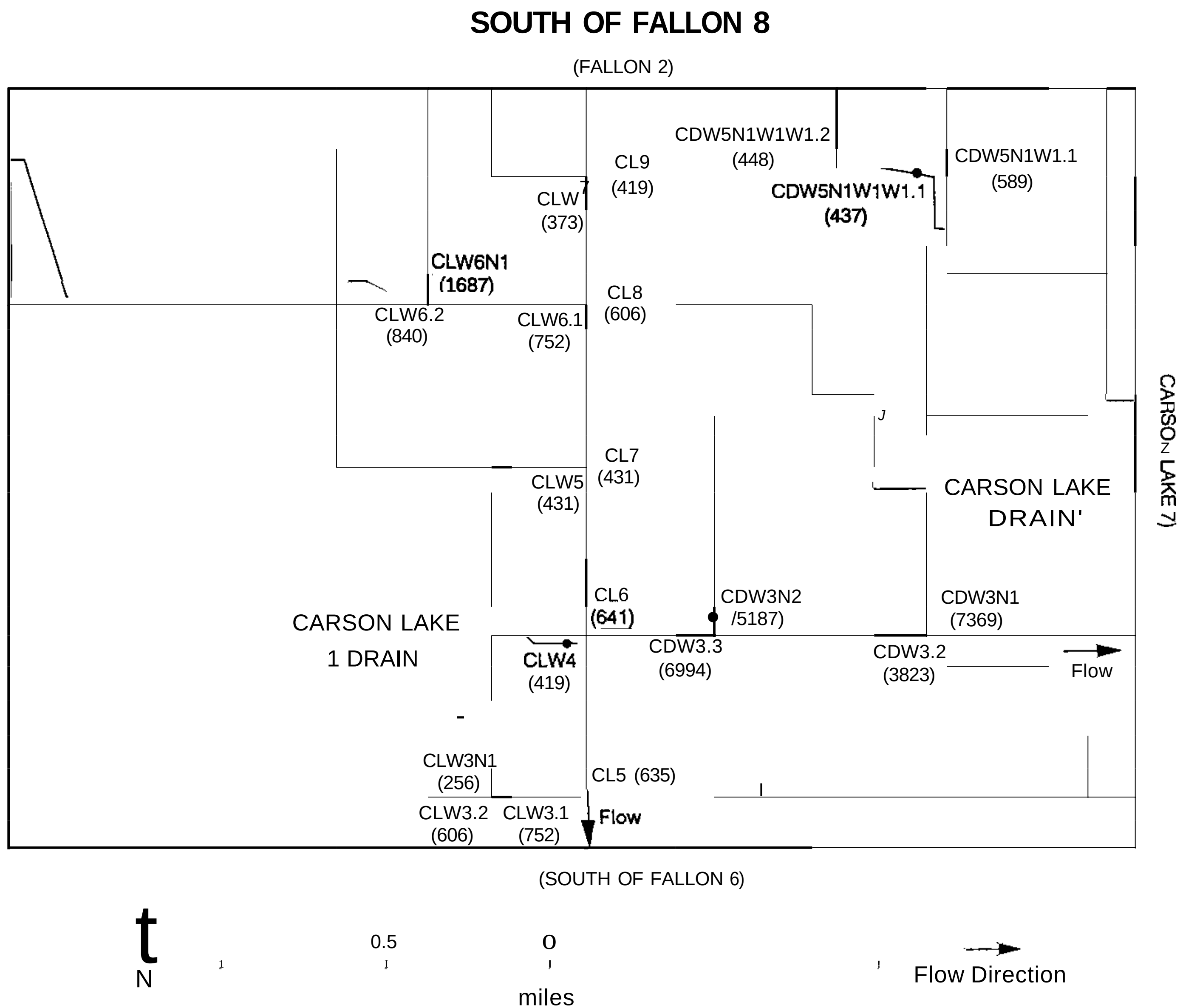

Figure 826. Sampling sites on agricultural drains in section 8 of the USGS South of Fallon 7.5 minute quadrangle. Total dissolved solids concentrations are given in parentheses.

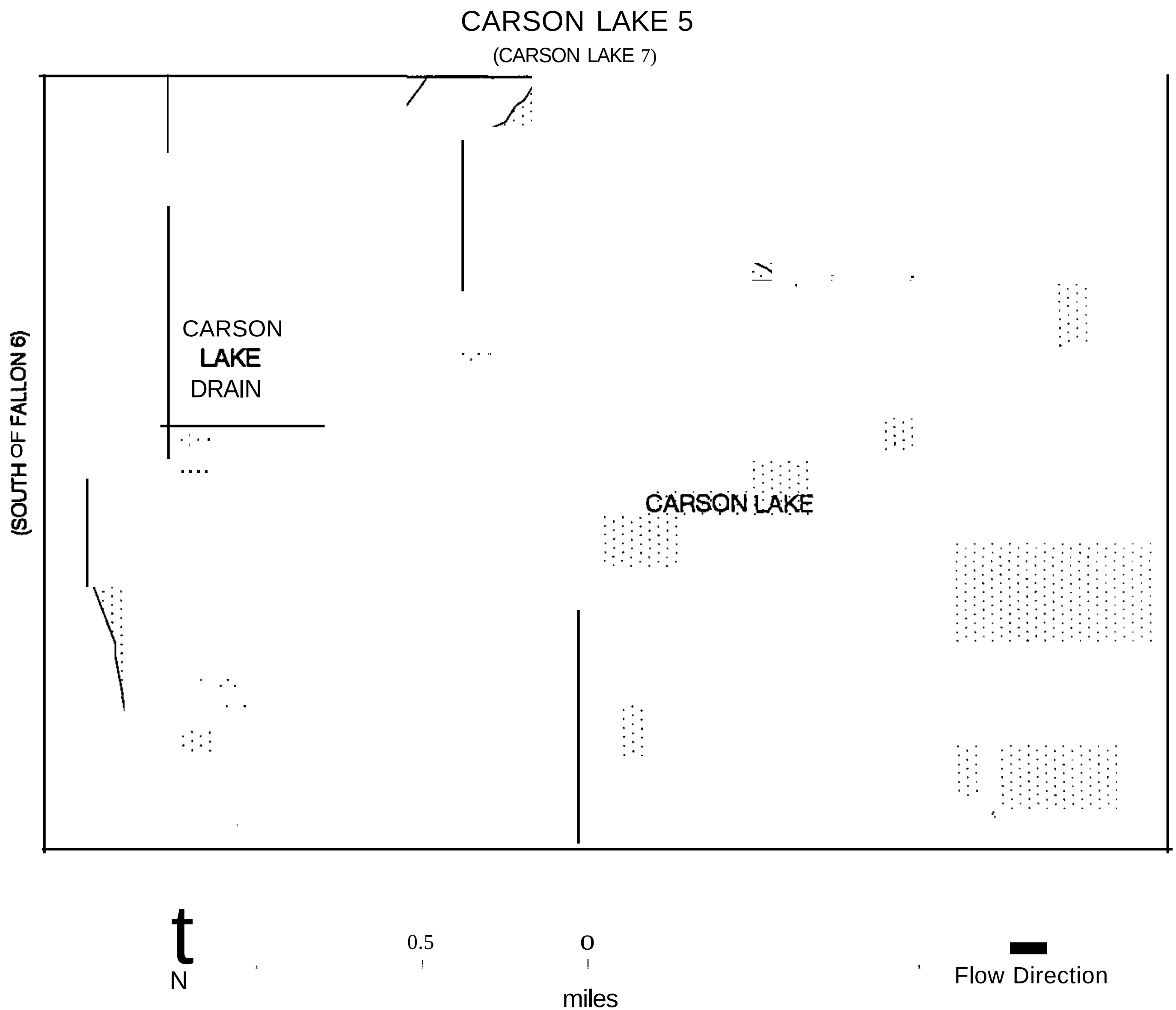

Figure 827. Sampling sites on agricultural drains in section 5 of the USGSarson Lake 7.5 minute quadrangle. Totai dissolved solids concentrations are given in parentheses.

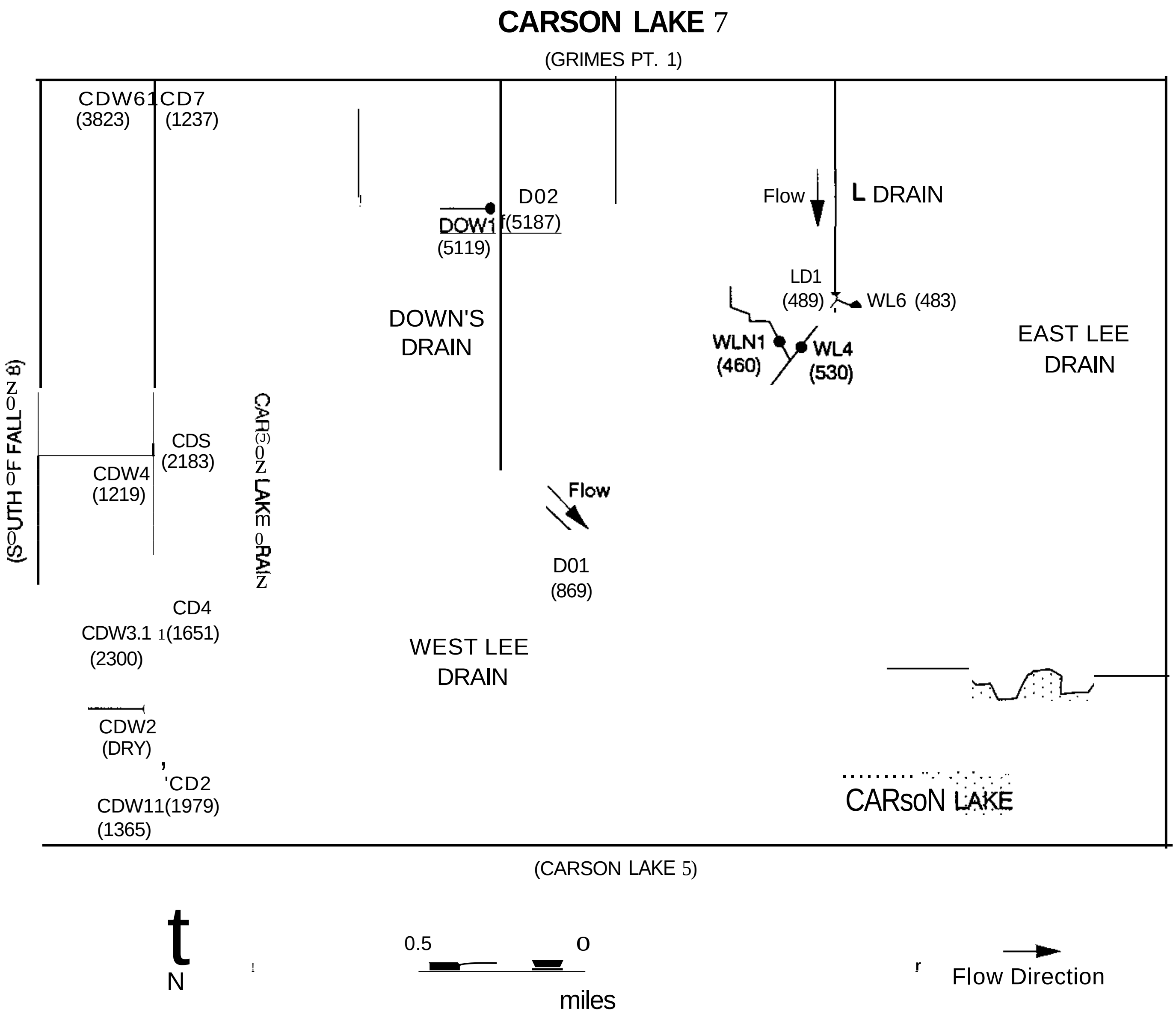

Figure 828. Sampling sites on agricultural drains in section 7 of the USGSarson Lake 7.5 minute quadrangle. Total dissolved solids **concentrations are given in parentheses.**