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Bottomland Hardwoods Wetland Investigation: Nevins Creek Wetland Mitigation Project

Mark A. Gross, Duane C. Wolf, John F. Murdoch

Final Report

1998

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BOTTOMLAND HARDWOODS WETLAND

BOTTOMLAND HARDWOODS WETLAND INVESTIGATION: NEVINS CREEK WETLAND MITIGATION PROJECT TRC-9603

FINAL REPORT

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Prepared for

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NOTICE

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16. Abstract

Natural wetlands can be destroyed during highway construction and a replacement wetland must be developed. The objectives of this study were to assess the hydrology, hydrophytic vegetation, and hydric soil components at a newly constructed wetland known as the Nevins Creek Mitigation site.

To create a functional wetland, adequate water must be present for sufficient time to allow the hydrophytic vegetation to develop. The hydrologic data collected would suggest that ground and surface water conditions are suitable for wetland development.

The second component of a wetland is hydrophytic vegetation. To determine the appropriate tree species to plant at the mitigation site, vegetation was surveyed at a natural wetland and recommendations were developed.

Soil properties are also important and the results showed that soil fertility levels were low and the initial stages of hydric soil development were indicated at the site.

From the information obtained, it is recommended that periodic monitoring be conducted to assess (i) survival and growth of the planted tree species, (ii) development of hydric soil properties, (iii) soil fertility levels, and (iv) ground and surface water hydrology. The results from this study will provide guidance for future wetland replacement activities involving bottomland hardwood areas.

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EXECUTIVE SUMMARY

Natural wetlands can be destroyed during highway construction. When wetland destruction occurs, a replacement wetland must be developed. This report represents information obtained during a 30-month study of a newly constructed wetland known as the Nevins Creek Mitigation site. The objectives of the study were to assess the hydrology, hydrophytic vegetation, and hydric soil components at the created wetland site. The project was a cooperative research effort involving scientists from the Arkansas Highway and Transportation Department and the University of Arkansas.

To create a functional wetland, adequate water must be present for sufficient time to allow the hydrophytic vegetation to develop. The hydrologic data collected at the Nevins Creek site would suggest that ground and surface water conditions are suitable for wetland development.

The second critical component of a wetland is hydrophytic vegetation. To determine the appropriate tree species to plant at the mitigation site, hydrophytic vegetation was surveyed at a natural wetland. At the natural wetland, 16 principal forest community types were identified and were found to be associated with a moisture gradient. Based upon the field data obtained, recommendations were developed for establishment of bottomland hardwood species at the Nevins Creek mitigation site. The recommendations were formulated based upon hydrologic data obtained at the Nevins Creek site.

Soil properties are also important in facilitating wetland development. Soil chemical, biological, and morphological properties were evaluated at the Nevins Creek site. The results showed that soil fertility levels were generally low, but biological activity was adequate. The initial stages of hydric soil development were also indicated at the site.

From the information obtained thus far, it is recommended that periodic monitoring be conducted for the next 20 years to assess (i) survival and growth of the planted tree species, (ii) development of hydric soil properties, (iii) soil fertility levels, and (iv) ground and surface water hydrology.

The results from this study will provide guidance for future wetland replacement activities involving bottomland hardwood areas. By using the extensive baseline data developed for the Nevins Creek mitigation wetland, long-term monitoring of the site will allow scientists to quantitate the functional development of a created wetland.

INTRODUCTION

During highway construction in a wetland area, portions of the wetland may be altered or destroyed as the highway is built. In addition, highways through wetland areas require large volumes of fill material to elevate the roadway above the flood elevation. When wetlands are destroyed, as in the case of the U.S. Highway 65 bypass around Pine Bluff, Arkansas, replacement of the wetland is required. In the study area, known as the Nevins Creek area, the replacement wetland was planned as a bottomland hardwood wetland mitigation area. As much a 30 feet of borrow was removed from the mitigation site, and the borrow material was used in the approaches to the bridge crossing Nevins Creek. This report summarizes the results of a 30-month study of the Nevins Creek wetland mitigation area.

The primary objective of the study was to determine if a wetland could be created in the Nevins Creek area similar to a natural wetland. The study compared a physically similar, but natural or undisturbed wetland to the created wetland at the Nevins Creek site. The physical or hydrological characteristics, along with selected biological and chemical parameters were measured at the Nevins Creek site to determine if the mitigation area was developing as a wetland site similar to the undisturbed wetland. The specific objectives of the project were to:

1. Select a natural wetland in the same geographic area to serve as a reference wetland for comparison to the created wetland. The hydrophytic vegetation in the natural area was characterized for comparison to the created wetland. The preserved vegetation in the created wetland was evaluated.
2. Determine the hydrological functioning and water quality of the created wetland.
3. Assess the survival and composition of the established vegetation in the created wetland.
4. Quantify the soil morphological, physical, chemical, and biological changes in the created wetland.
5. Compare the composition and relative abundance of fish, bird, and mammal species at the immature created wetland site to an established natural wetland reference site.

The major thrust of this project was to evaluate several factors of "functionality" of the wetland, among which are hydrology, hydrophytic vegetation, and hydric soils. The resources of the project budget were aimed at assessing these functions. Although other parameters may affect the "functionality" of the wetland, the most important is hydrology, particularly having adequate water in the area for an adequate length of time (hydroperiod) to create conditions suitable for wetland development.

BENEFITS and IMPLEMENTATION

The results of this study will provide guidance for future wetland replacement activities involving hardwoods in upland areas. In fact, as the study has progressed, the Arkansas Highway and Transportation Department, Environmental Division personnel have implemented facets of this research in wetland mitigation areas across the State. Successful development of the Nevins Creek wetland mitigation site will provide options for future highway construction to comply with Section 404 of the Clean Water Act. One of the steps in the Section 404 process includes replacing disturbed wetlands with

equivalent wetlands (mitigation). The research efforts at the Nevins Creek site has and will provide guidance for future mitigation areas to include uplands being developed into bottomland hardwood wetlands.

IMPLEMENTATION OF THE WORK PLAN

A coordinated effort by AHTD researchers, AHTD surveying and mapping crews, AHTD drill crews, and the University of Arkansas research team was required to complete the project. Due to contract schedules, some soil and aerial photographic information was not obtained prior to replacement of the topsoil at the study site, thus the project work plan was implemented with some revision to compensate for the missed data. The work plan was implemented to meet the stated objectives as follows:

OBJECTIVE 1. Select a natural wetland in the same geographical area to serve as a reference for comparison to the created wetland. The hydrophytic vegetation in the reference wetland and the preserved vegetation in the created wetland was evaluated.

A reference wetland was selected in the Bayou Meto Game Management Area. This reference site was selected due to its proximity to the mitigation site and its close similarity to modeling the principal vegetation types occurring in wetlands elsewhere in Arkansas. The Bayou Meto Game Management Area is also public land, and is easily accessible by road or trail.

Sixteen different principal forest community types were identified and quantitatively sampled at Bayou Meto. Also, a principal community type was sampled at the top edge of the borrow area of the Nevins Creek site. Sweetgum was identified at both the Nevins Creek site and the reference site. This is a common species in areas that have been disturbed such as the Nevins Creek site, and in the drier areas of natural wetlands. It typically occurs in areas flooded from two weeks to one month annually and is rarely found in deep swamps or backwater areas. The sweetgum at the Nevins Creek site is associated with weedy species such as common privet, Japanese honeysuckle, greenbrier, and poison ivy. In the reference site, the sweetgum is associated with Nuttall oak. Willow oak was identified in the reference, or mature wetland. The Willow oak was associated with Persimmon. Secondary species in the wet gradient of the Willow oak community included water hickory, buttonbush, tupelo, and overcup oak. Water oak occurred at the drier end of the gradient. Vines such as rattan vine, greenbrier, and eardrop vine were associated with the Willow oak sites. Water oak was identified in areas experiencing periodic flooding lasting from only a few days to up to two weeks during the growing season. Shagbark hickory, sweetgum, willow oak, and cherrybark oak were associated with the water oak community along with vines such as poison ivy and climbing dogbane. The forest floor in the water oak area was dominated by poison ivy vines. One area of the Bayou Meto reference site had apparently been disturbed many years ago, and had trees characteristic of both wetlands and dry uplands. Although the area contained 15 different species of overstory trees, the most important species in this mixed area is water locust. Southern hackberry and red mulberry were of secondary importance. Other important species included green ash, cherrybark oak, willow oak, overcup oak, post oak, American elm, and cedar elm. A dense stand of winged elm in the

high understory is another evidence of disturbance, since winged elm is a common invader of abandoned fields or cleared areas. Rattan vine, Virginia creeper, and poison ivy were common vine species in the high understory. The mixed site is essentially flat and poorly drained. On sites somewhat drier than the willow oak sites, shagbark hickory is the dominant species. This species is intolerant of flooding for more than two weeks to a month during the growing season. Southern hackberry is codominant with the shagbark hickory. Secondary species associated with the shagbark hickory are winged elm, willow oak, nuttall oak, American elm, and green ash. In wet areas such as depressions and sloughs, wetland species such as overcup oak, water locust, and cedar elm are present. Virginia creeper and poison ivy vine comprise most of the forest floor plant cover, with some palmetto at a few locations. Overcup oak occurs in areas with saturated soil subject to flooding from one to three moths. Some green ash is associated with the overcup oak sites on the higher ground. The green ash is less tolerant of flooding than the overcup oak, but the ash can survive flooding for as much as six weeks during the growing season. Principal high understory vines are poison ivy and rattan vines, with a nearly bare forest floor except for poison ivy and willow oak seedlings. Cherrybark oak occupies nearly the same habitat as the shagbark hickory, but the cherrybark oak can tolerate flooding for up to six weeks. Red mulberry and nuttall oak are the principal secondary species in the overstory of the cherrybark oak site. The high understory is dominated by shagbark hickory, southern hackberry, rough-leaf dogwood, winged elm, and American elm saplings. Poison ivy and Virginia creeper vines dominate the forest floor cover. Swamp privet was found in the poorly drained backwater areas and in low, wet places behind natural levees. It can tolerate flooding for as long as three months. The high understory has green ash, water hickory, water locust, and black willow saplings associated with poison ivy, rattan, eardrop, and greenbrier vines. Water hickory occurred as the dominant species of one area of the natural wetland. It shares dominance with southern hackberry in some drier areas. Blue beech, overcup oak, southern hackberry, winged elm, American elm, and cedar elm are secondary species in the water hickory sites. Poison ivy, rattan, Virginia creeper, and eardrop vines are associated with the water hickory site. Other woody species such as southern hackberry, deciduous holly, and swamp privet were associated with the water hickory area. The natural wetland also contained areas of water elm, which is very tolerant of saturated soils and flooding. It is associated with water locust, buttonbush, and swamp privet. Rattan vine is present in the high understory of this area. Loblolly pine, a species less tolerant of flooding, and only being able to survive flooding for less than two weeks, is found in upland areas of the natural wetland. High understory dominants of willow oak, cherrybark oak, post oak, winged elm, and cedar elm were associated with the loblolly pine. Tupelo occurs in the backwater areas of the natural wetland, and can grow in open water on low, poorly-drained places, edges of oxbow lakes, or along sluggish streams. Tupelo can tolerate standing water and saturated soil all year, but most stands are found on dry ground during part of the year. Bald cypress was a secondary species associated with the tupelo.

The principle plant communities in the preserved vegetation at the Nevins Creek study site were also inventoried in July 1996. Observations were made of size and species of trees present around the rim of the borrow pit. Species and size were recorded at roughly 150-ft intervals starting at edge of the bridge by the railroad track and then

clockwise around the area.

The tree habitats have been subjected to various degrees of disturbance such as cutting, clearing of understories, etc., but it was possible to determine a general wet to dry gradient of principal tree species present. Principal species are listed in arbitrarily designated types of habitats that occur around the borrow pit (Tables 1 and 2).

Table 1. Summary of Principal Species of Preserved Vegetation at the Nevins Creek Site along a Dry to Wet Gradient.

Dry Rim Next to Railroad Track	Top of Creek Bank Next to Borrow Pit	Top of Steep Bank downward to creek	Flat Swale-Like Area on East Side
Post oak	Water oak	Blue beech	Willow oak
Pine	Sweetgum	Sycamore	Sweetgum
Cherrybark oak		Black river birch	Overcup oak
Water oak		Black willow	Water hickory
Willow oak			Buttonbush
Sweetgum			Black river birch
			Black willow

Table 2. Principal Communities at the Nevins Creek Site along a Dry to Wet Gradient from Top Edge of Borrow Pit to Areas with Standing Water[1].

Wheat

Hogwort -- *Croton capitatus* Michx.

Black willow -- *Salix nigra* Marsh. -- seedlings

Senna -- *Chamaecrista fasciculata* (Michx.) Greene

Fuzzy panic grass -- *Panicum scoparium* Lam. (this was in a dry swale)

Tickseed -- *Coreopsis tinctoria* Nutt.

Barnyard grass -- *Echinochloa muricata* (Beauv.) Fern.

Note: some perennial foxtail grass (*Setaria geniculata* (Lam.) Beauv. was mixed with the barnyard grass

Beggerticks -- *Bidens aristosa* (Michx.) Britt.

Cattail -- *Typha latifolia* L., a rush -- *Juncus effusus* L. and a tall sedge -- *Scirpus cyperinus* (L.) Kunth occur in similar types of wet areas

Tooth cup -- *Rotala ramosier* (L.) Koehne

False pimpernel -- *Lindernia dubia* (L.) Pinnell

Rush -- *Juncus diffusissimus* Buckl.

Water primrose or seedcup -- *Ludwigia peploides* (H.B.K.) Raven

Other common species noted as present include *Conyza canadensis* Cronq. (horseweed), *Ludwigia alternifolia* L. (seedbox), *Ammannia coccinea* Rottb. (toothcup), and *Eupatorium perfoliatum* L. (tall bonset).

[1] Note that all species present along a hypothetical gradient will seldom occur along gradients in the field. This can be caused by differences in soil moisture conditions in adjacent areas. For example, dense communities of water primrose can occur next to a barnyard grass community if a steep bank is present between the two communities.

Based upon the inventory at Bayou Meto and the preserved vegetation at the Nevins Creek site, the tree species have been classified into four categories for comparison of the natural wetland to the constructed wetland, and to give some guidance for planting in the constructed wetland area (Fig. 1). Nonwetland species are pine and upland hardwood. Trees with intermediate tolerance to flooding or saturated soils include shagbark hickory, cherrybark oak, water oak, willow oak, sweetgum, nuttall oak, American elm, and hackberry. These species can be expected to tolerate flooding from one week to one month. Tree species tolerant of flooding or saturated soil conditions include green ash, cedar elm, water hickory, overcup oak, water locust, and swamp privet. These species can tolerate flooding from one to three months. Tree species very tolerant of flooding or saturated soils include water elm, buttonbush, bald cypress, tupelo, black river birch, and black willow. These species can tolerate flooding from three months to constant flooding.

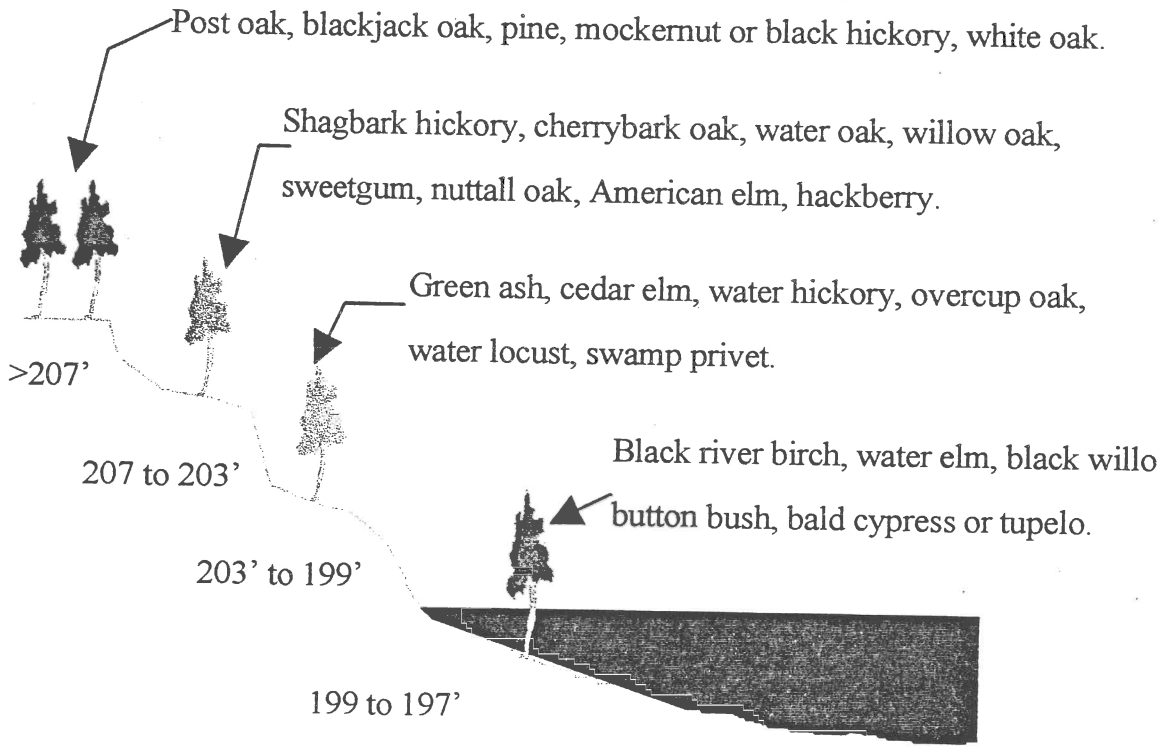


Figure 1. Tree Species Recommended for Planting at Associated Elevations of the Nevins Creek Study Site.

These species classifications have been correlated with the hydrology and flooding frequency of the constructed wetland. Figure 1 graphically represents the elevations in the Nevins creek constructed wetland area that correspond to the flooding and saturated soil tolerance of the tree species found in the reference wetland. The figure shows that post oak, blackjack oak, pine, mockernut or black hickory, and white oak would be expected to survive at elevations above 207 ft in the Nevins Creek study site. Shagbark hickory, cherrybark oak, water oak, willow oak, sweetgum, nuttall oak, American elm, and hackberry could survive at elevations from 203 to 207 ft in the Nevins Creek site. Green ash, cedar elm, water hickory, overcup oak, water locust, and swamp privet would be recommended for planting at elevations between 199 and 203 ft. Black river birch, water elm, black willow, buttonbush, bald cypress, and tupelo are the recommended species for planting at elevations from 197 to 199 ft of the constructed wetland.

Appendix A is the complete, detailed report of the vegetation studies performed for this project. Dr. E.E. Dale performed the study and prepared the report to fulfill requirements of Objective 1. Appendix B includes Dr. Dale's recommendations for establishment of wetland tree species at the Nevins Creek mitigation site.

OBJECTIVE 2. Determine the hydrological functioning and water quality of the created wetland.

The wetland hydrology was addressed in the study to evaluate both the surface water and the groundwater aspects. Initial efforts were aimed at installing appropriate instrumentation and monitoring techniques for collecting supporting data. Thirty-five shallow monitoring wells were installed in cooperation with the Arkansas Highway and Transportation Department (AHTD) drill and maintenance crews. The wells were located at approximate transects across the wetland study area, and the well depth varied from five feet deep below ground surface to ten feet deep below ground surface. The monitoring wells were gauged for depth to groundwater every two weeks during the study period. Figure 2 represents the profile of a typical monitoring well.

In addition, the AHTD survey crews collected data and developed ground surface contour maps of the site prior to the study period. The monitoring well locations and surface contour maps were input to CAICE, the surface modeling software used by AHTD to prepare an integrated map for data recording. The AHTD survey crews established control points in the wetland so that all data would be integrated and kept in relation to each other with reference to established control locations.

Surface water elevation monitoring equipment was also installed. Staff gauges were installed in low areas of the wetland site for monitoring inundation, or water level, in the pools that were formed in the wetland. The staff gauges were manually observed, and depth readings were recorded every two weeks for the study period. Dr. Henry Langston, of the AHTD, took the responsibility for recording both the groundwater elevations and the surface water elevations from the staff gauges. The data was transmitted to the University of Arkansas research team for data entry, compilation, and graphical representation and analysis. Continuous recording electronic stage recording equipment was constructed and installed at the inlet of Nevins Creek to the wetland area

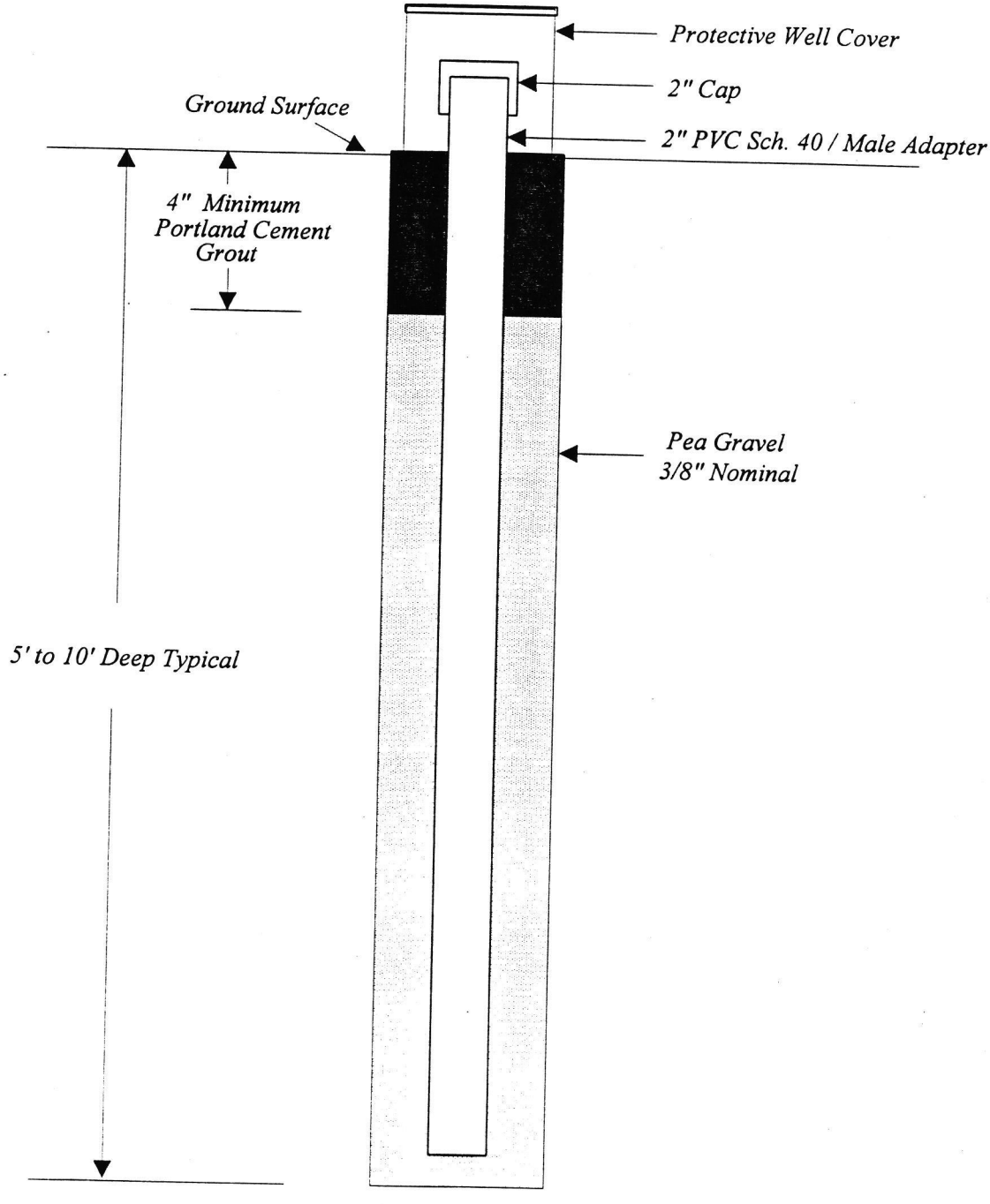


Figure 2. Profile of a Typical Piezometer Used to Monitor Groundwater Elevation.

and at the outlet of Nevins Creek to Bayou Bartholomew. Continuous stage recorders were also installed in pools near the channel of Nevins Creek as it flows through the constructed wetland. A tipping-bucket rain gauge with continuous data collection capability was located on the island in the wetland. Figure 3 graphically illustrates the locations of the instrumentation installed for groundwater, surface water, and rainfall monitoring. In Figure 3, the piezometers are indicated as P1 through P35 which are the same as well numbers 1010 through 1350. The middle two digits of the well number code correspond to the piezometer code (e.g. Well 1120 is the same as Piezometer P12).

The surface water elevation readings have been graphically presented so that they illustrate the water level in the wetland every two weeks from 13 April 1996 to 17 November 1997. The figures are presented as Appendix C. The figures show the soil surface contour and also show the routine staff gage and stage recorder readings in the pools around the wetland. The water elevations in the pools can be visualized by reading the level of water in the pools and following that contour around the soil surface. It is important to note that the pools are not all at the same elevation. Some of the pools upstream in the wetland may have water elevations higher than the pools at the downstream areas of the wetland. In addition to the elevation readings when water was pooled at various disconnected locations in the wetland, the figures also show the water elevations during storm events such as on 30 July 1996, 22 October 1996, 25 November 1996, 17 December 1996, 4 February 1997, 3 March 1997, and 18 April 1997. In this case, a large area of the wetland was inundated, and the water level is shown as large white areas in the wetland. Appendix D is a calculated graphical representation of the percentages of the wetland inundated with standing water elevations as shown on the figures. Figure 4 below shows the percentage of the wetland inundated at various elevations. The figures in Appendix D are based upon the study site area of 26.336 acres and were developed from the surface contours provided by the AHTD survey crew and the CAICE model.

Figures 5, 6 and 7 are the hydrographs for the Nevins Creek inlet to the wetland site, the Nevins Creek outlet to the wetland site, and the Bayou Bartholomew inlet to the Nevins Creek site. Although these locations are called inlets and outlet, the water could actually be flowing into or out of the study area depending upon the stage on Nevins Creek and the stage on Bayou Bartholomew. The hydrographs presented in these figures indicate the surface water elevation with time at the study site.

Nevins Creek Mitigation Area

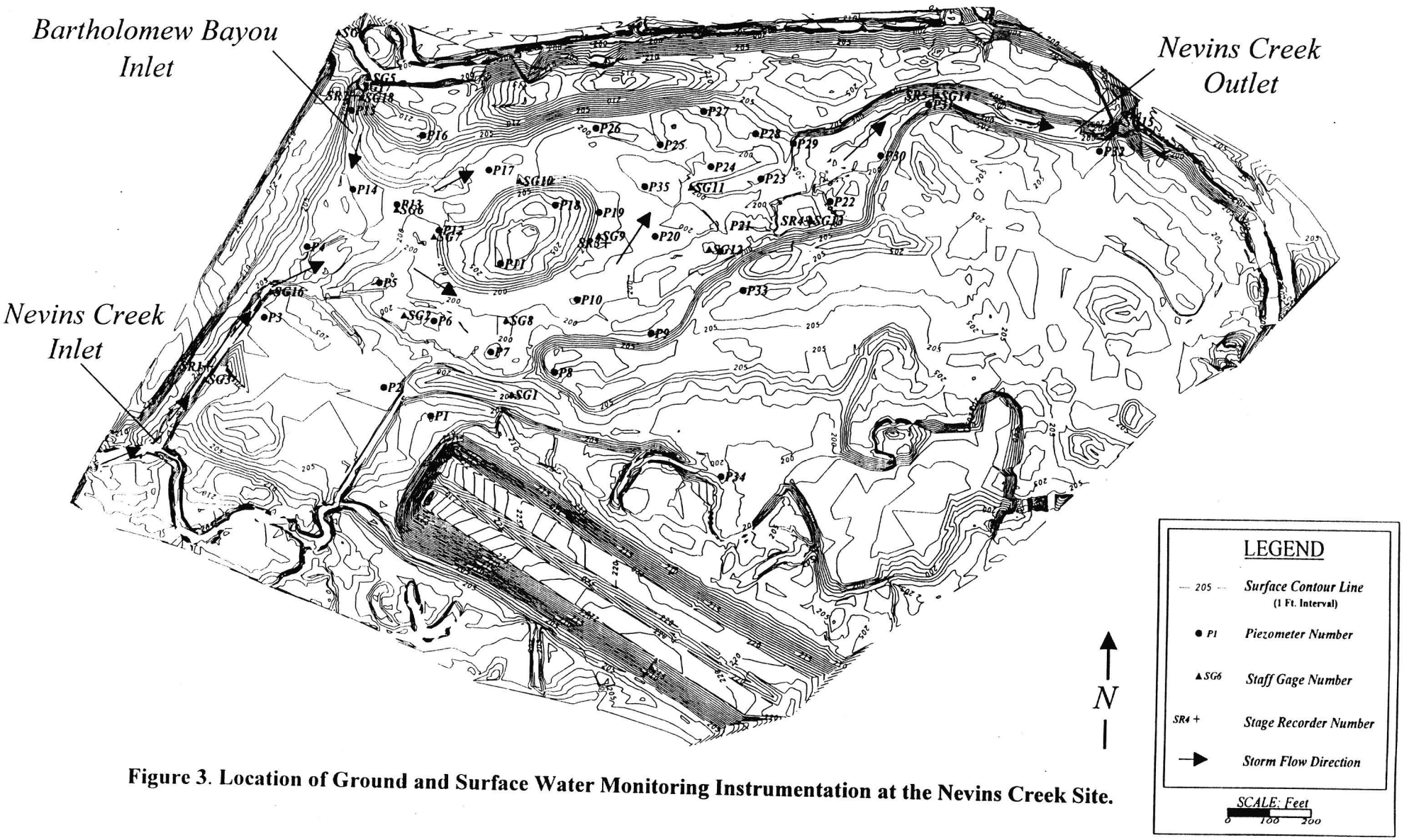
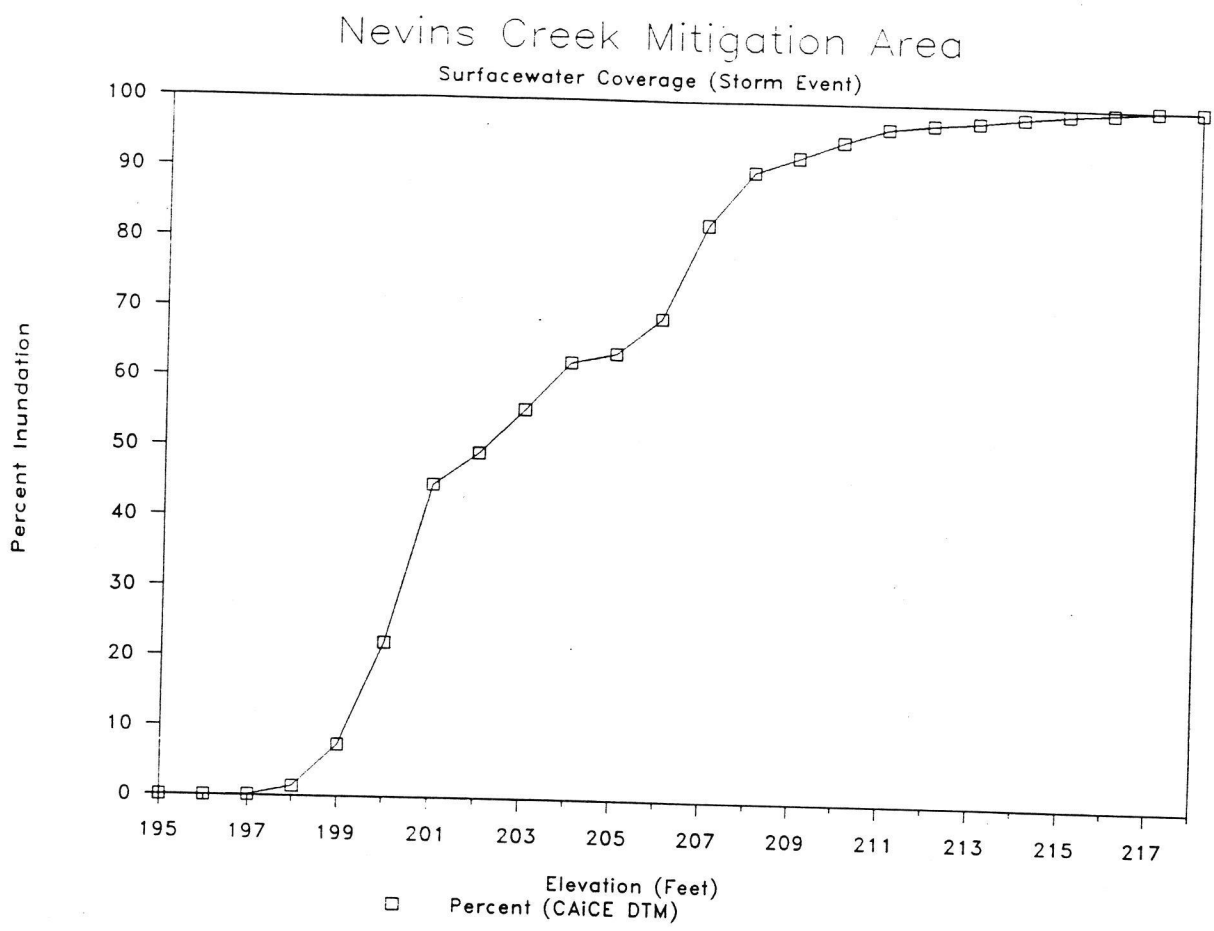


Figure 3. Location of Ground and Surface Water Monitoring Instrumentation at the Nevins Creek Site.



ELEV. (Ft.)	INUN. (%)
195	0.00
196	0.01
197	0.13
198	1.38
199	7.35
200	22.00
201	44.67
202	49.27
203	55.51
204	62.42
205	63.84
206	68.97
207	82.45
208	90.12
209	92.25
210	94.58
211	96.63
212	97.29
213	97.76
214	98.47
215	99.09
216	99.55
217	99.98
218	100.00

Figure 4. Percentage of Inundation of the Nevins Creek Site Calculated from Surface Water Elevation Information.

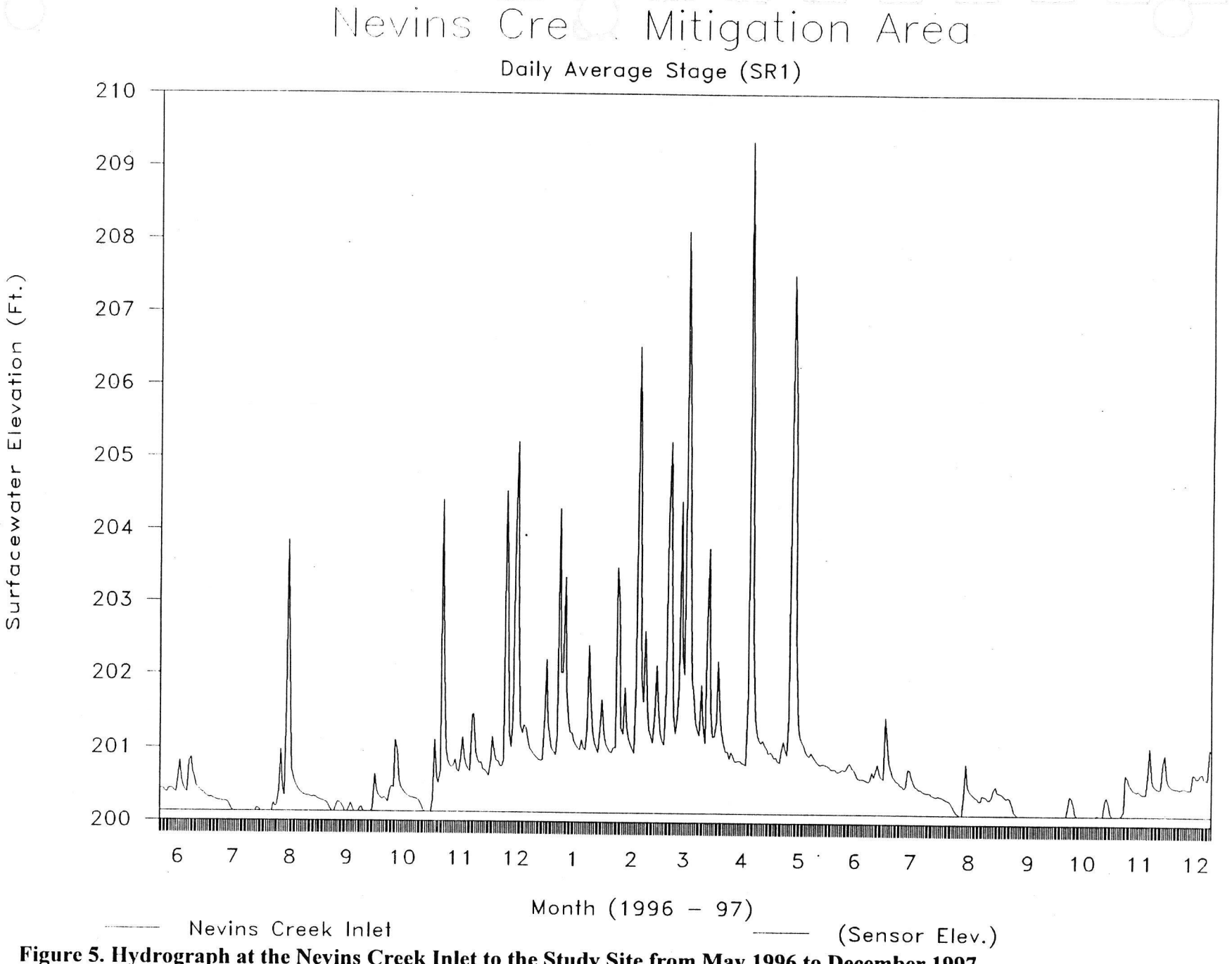


Figure 5. Hydrograph at the Nevins Creek Inlet to the Study Site from May 1996 to December 1997.

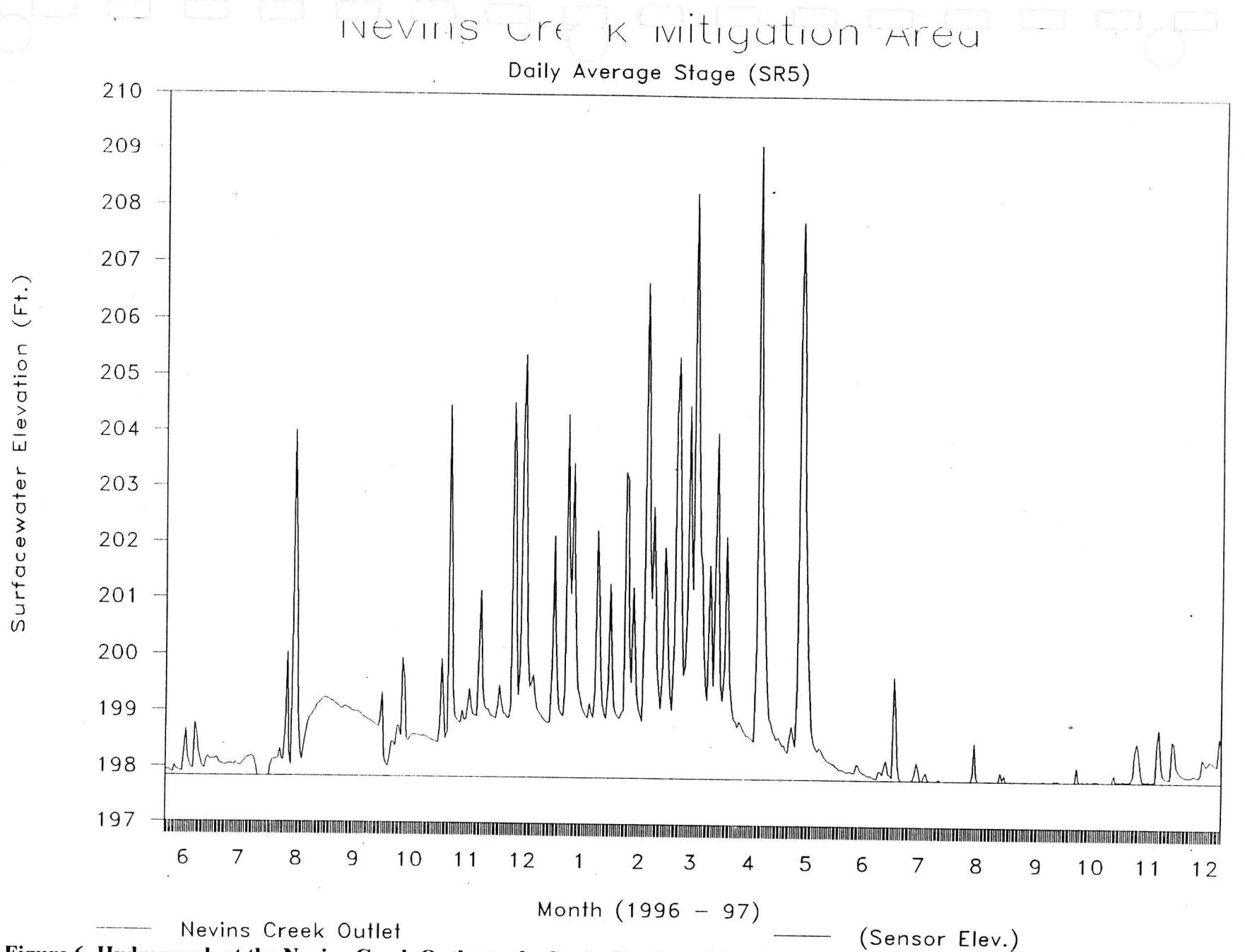


Figure 6. Hydrograph at the Nevins Creek Outlet to the Study Site from May 1996 to December 1997.

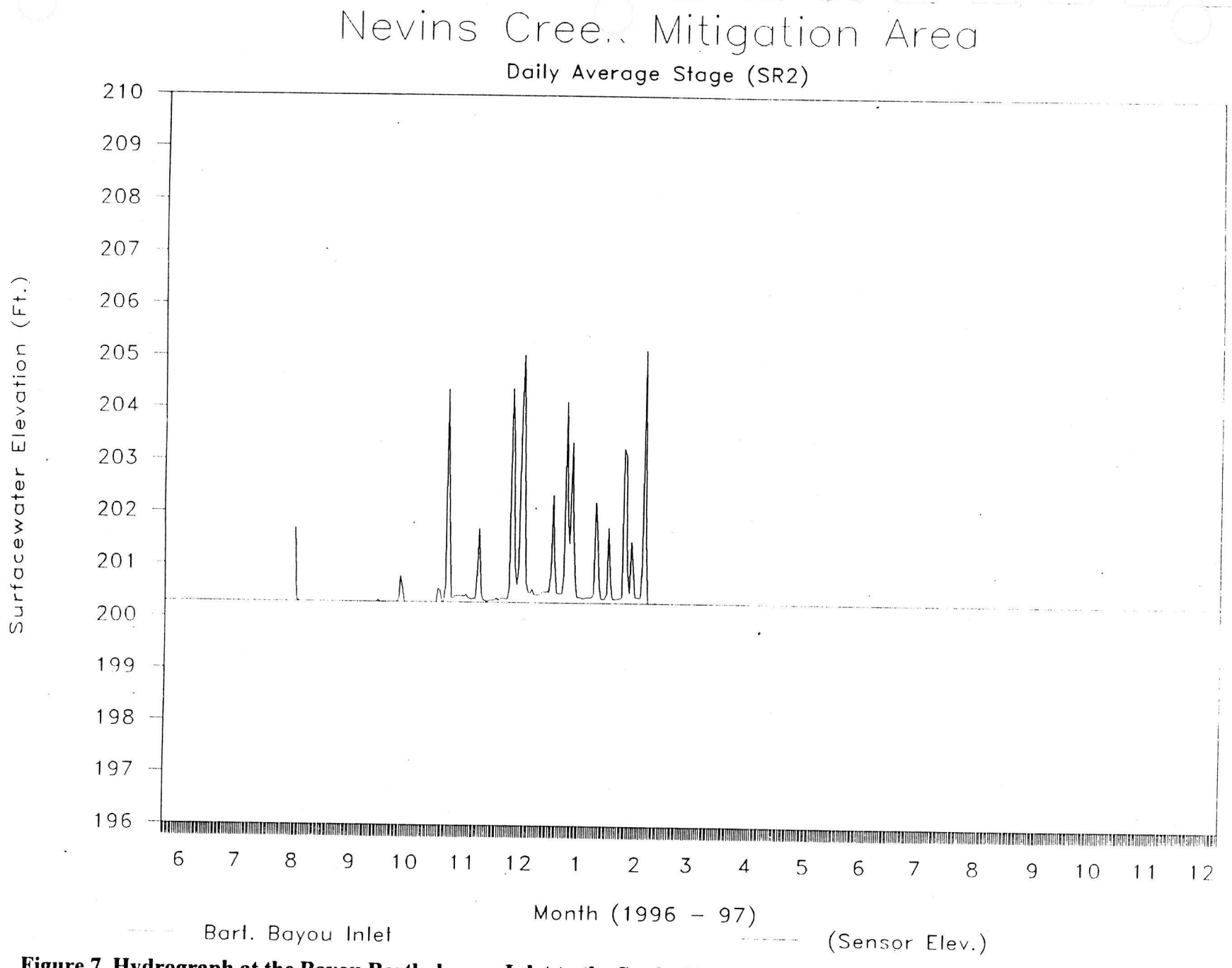


Figure 7. Hydrograph at the Bayou Bartholomew Inlet to the Study Site.

The groundwater elevations in the piezometers were observed every two weeks during the study. The groundwater elevations vary across the site, and some piezometers were observed to have water flow over the top of the well during some observations. Appendix E is a set of groundwater elevation maps that were prepared using CAICE and SURFER, a surface contouring software package. All elevations are referenced to the established data control points provided by the AHTD. Even during the hot and dry part of the year (June through September) the groundwater was near the surface in the wetland. It is expected that the hydrophytic vegetation will survive the dry conditions if their roots can reach the shallow groundwater in these areas. The figures in Appendix E are groundwater maps for every two weeks from December 1, 1995 through December 31, 1997. The maps show the groundwater elevations as well as the soil surface elevations. Appendix F indicates groundwater readings for each of the piezometers for the entire monitoring period. These graphs show hydrographs for all 35 piezometers in the study. The surface water monitoring data are presented in Appendix G.

During the early phase of the study, immediately after completing the piezometers, slug tests were performed upon the piezometers. The purpose of the slug tests was to get an understanding of the in-situ hydraulic conductivity of the soil at the site in the soil horizons penetrated by the piezometers. The slug test analysis was based upon limited data in terms of total depth of the aquifer at the site, depth to the aquiclude , and other input data into the Bouwer and Rice method for slug test analysis. The hydraulic conductivities ranged from 3.48E-5 ft/min (1.77E-5 cm/sec) at piezometer P5 (Well 1050) to 4.08E-01 ft/min (2.07E-1cm/sec) at piezometer P7 (Well 1070). Some preliminary groundwater modeling using MODFLOW software was performed by Doug Melton, a Professional Geologist and Civil Engineer. Mr. Melton's complete report is included as Appendix H.

As previously mentioned, the site was instrumented with rain gauges to obtain rainfall data on the study area (Figure 8). Specific rainfall amounts are presented in Appendix G.

Groundwater samples were periodically collected and returned to the Arkansas Water Resources Center Water Quality Laboratory in Fayetteville, AR for analysis. The results are presented in Appendix I and show low levels of the chemical species tested. Piezometers P19, P21, and P 22 exhibited elevated Na and Cl levels which suggests salt accumulations at the lower elevations. The nutrient elements of nitrogen and phosphorus were generally low.

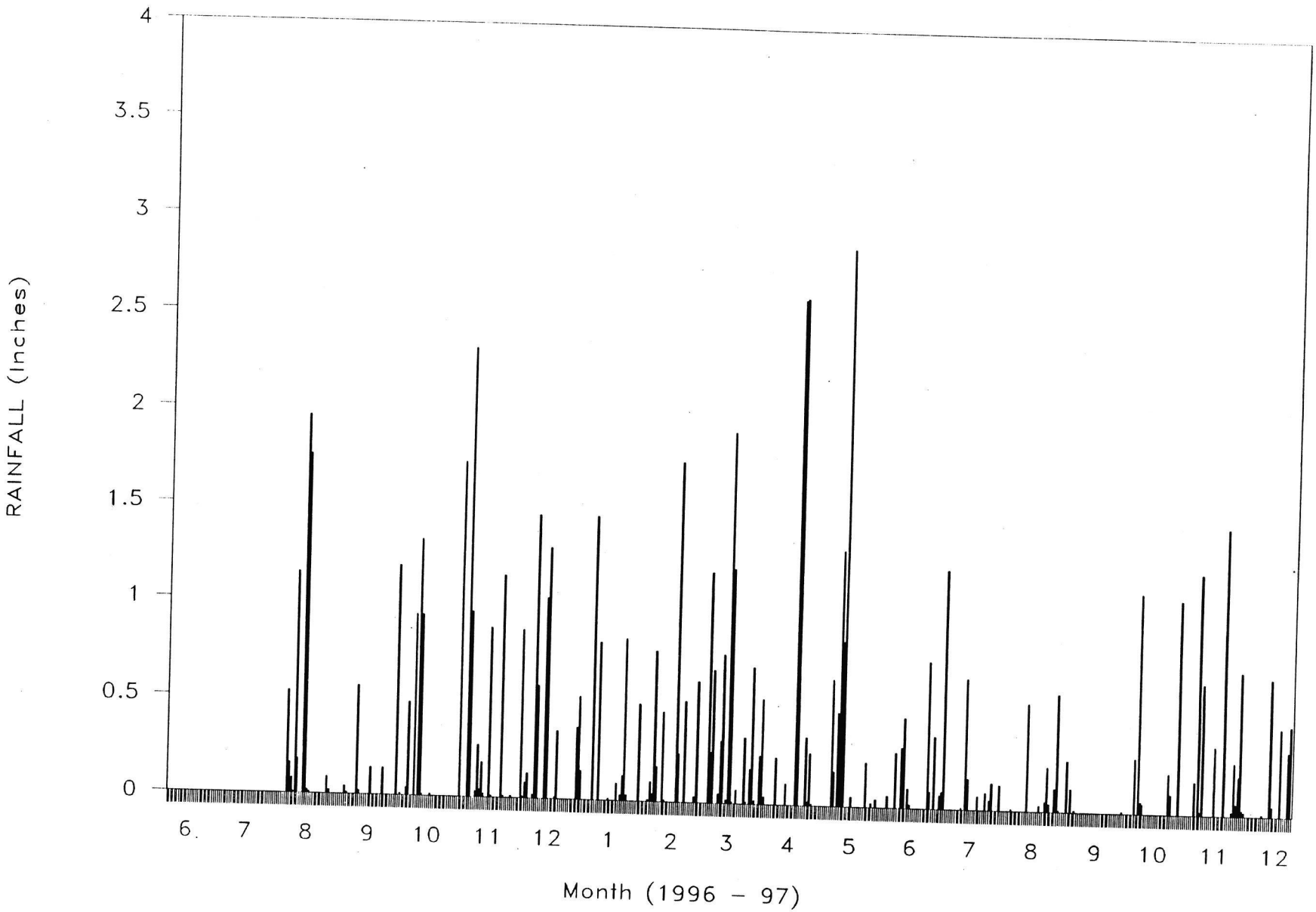


Figure 8. Total Rainfall at the Nevins Creek Site from July 1996 to December 1997.

OBJECTIVE 3. Assess the survival and composition of the established vegetation in the created wetland.

Some aspects of objective 3 were discussed earlier with regard to Dr. Dale's work to assess the native species in the wetland area compared to similar vegetation in the reference, or natural wetland. The Nevins Creek site was observed during the course of the study to determine the establishment of wetland species as the created wetland developed. In addition, AHTD contracted planting the wetland with various tree species independently from the research project. A schedule of the species and locations of trees planted by AHTD as an independent activity is not included in this report. The research team was also released from the responsibility of assessing the survival of the contracted planting. The AHTD will address the re-establishment and survival of the planted trees with respect to Section 404 of the Clean Water Act. Since the trees were planted in the winter of 1996-1997, their survival could not be addressed before the end of the study period. However, a survey was made of the hydrophytic vegetation in the created wetland, and the map of the hydrophytic vegetation is shown as Figure 9. Dr. Henry Langston provided the locations of the hydrophytic vegetation boundaries while the AHTD survey team tied the boundary into established control points. This enables the hydrophytic vegetation map to be referenced to all other maps for the site.

In evaluating survival of trees planted at the Nevins Creek Mitigation Site, it is necessary to determine how may trees to survey to obtain a statistically valid sampling. According to Dr. Ed Gbur, a statistician in the University of Arkansas Agricultural Statistics Laboratory, it would require evaluating 35 trees to give a 80% confidence of being within 10% of the true mean. The other numbers are:

% Confidence	Number of Trees to Survey
72.4	25
80	35
85	44
90	57
95	81

Using the specified number of trees would give the respective % confidence that we would be within +/- 10% of the actual value. Considering all factors, 35 trees per species appears to represent a reasonable and valid sample size.

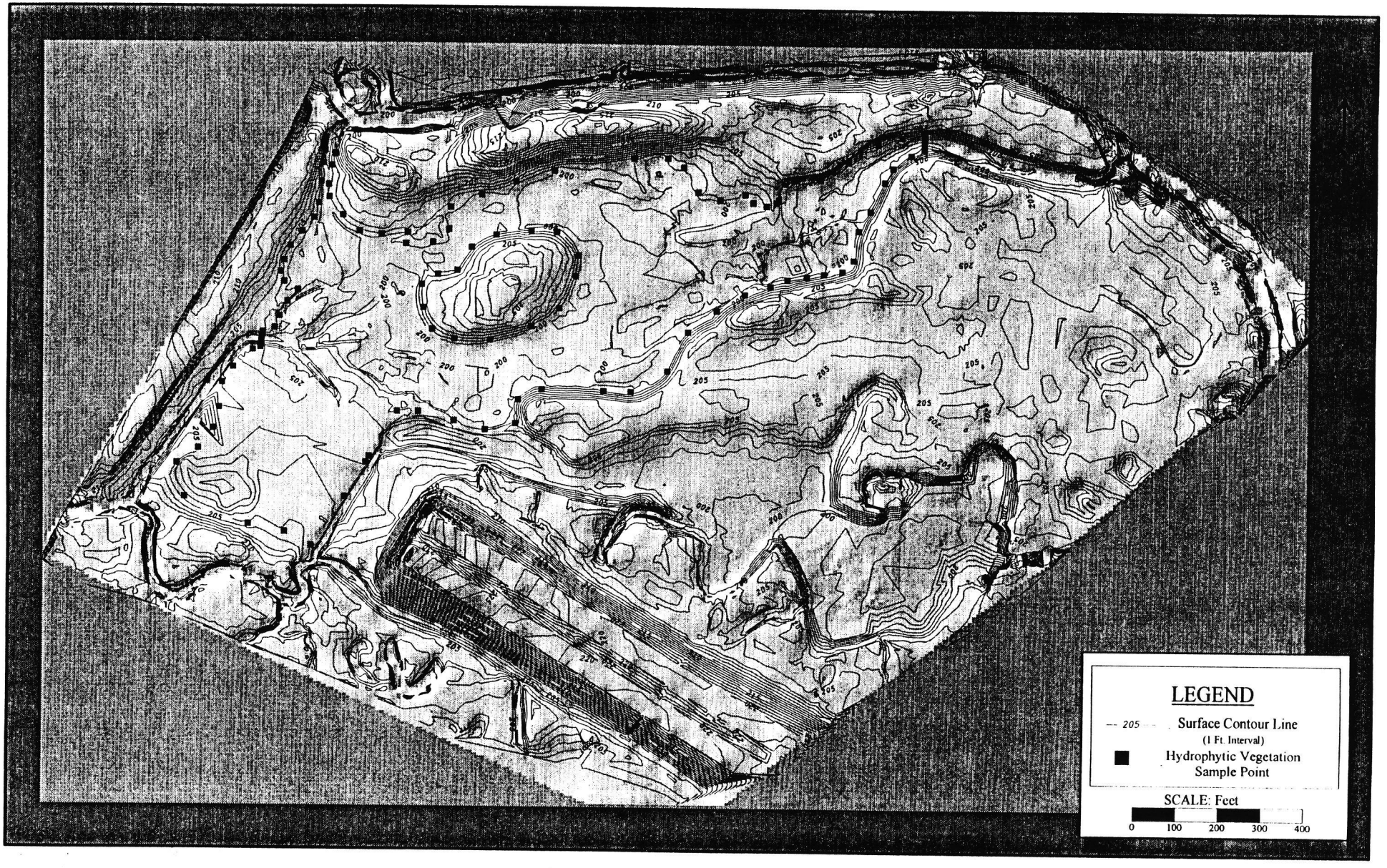


Figure 9. Map of Hydrophytic Vegetation Conducted during Fall 1997 by Dr. Henry Langston.

OBJECTIVE 4. Quantify the soil morphological, physical, chemical, and biological changes in the created wetland.

The site was sampled once per year to determine soil chemical parameters. Surface soil samples were taken from the 0 to 6 inch depth using a tube-type soil sampler, and analyzed for Mehlich III extractable phosphorus, potassium, calcium, magnesium, iron, manganese, and sulfur. In addition to the surface samples, a piezometer borehole cutting was sampled and archived for analysis in the future if the AHTD chooses. The borehole description from piezometer P1 is given in Appendix J. A summary of results of surface soil chemical analyses are shown in Table 3 and Appendix K.

Table 3. Surface Soil Mean Mehlich III Extractable Element Concentrations.

Analyte	Extractable Nutrient Concentrations		
	October 1995	July 1996	May 1997
	---------- lbs/acre ----------		
Phosphorus	40	34	26
Potassium	166	142	112
Calcium	962	900	815
Magnesium	344	344	253
Iron	522	358	353
Manganese	216	214	181
Sulfur	60	60	40

The numbers of soil microorganisms were also determined and the results are presented in Table 4. The data are typical of bacterial and fungal populations found in many Arkansas soils and suggest that the soil in the created wetland was adequately populated with soil microorganisms.

Table 4. Number of Bacteria and Fungi in Soil Samples Collected from Eight Locations at the Nevins Creek Site on 17 July 1996.

Soil near well number [a]	Bacteria $X10^6$	Fungi $X10^5$
	Colony Forming Units/g dry soil	
1050	4.16	1.09
1100	4.70	3.72
1120	6.89	1.93
1150	5.20	1.09
1210	4.36	1.23
1230	2.81	0.65
1290	2.27	0.81
1330	7.07	1.96
MEAN	4.39	1.35

[a] Four soil cores of 0 to 6" were collected approximately 3' from the designated well location and composited for analyses. Bacteria were plated on 0.1X Tryptic Soy Agar and fungi were plated on Martin's Medium.

The site was surveyed during the early winter of 1997 to examine the elements of hydric soils. The low areas of the created wetland, where water is present for most of the winter exhibit reduced conditions in the soil. In the edges and near the pools, approximately 5 to 10 feet from the edge of the water, low chroma soil colors and reoxidized rhizospheres were observed. These two characteristics are consistent with and indicative of wetland soils. The iron in the soil becomes reduced in the absence of oxygen and the presence of organic matter. The soil microbes consume all of the free oxygen and begin to metabolize organic matter by reducing iron and manganese compounds in the soil under anaerobic metabolism. The result is the presence of low chroma (reduced iron) colors. In wetland areas where wetland plants translocate oxygen from the atmosphere to the plant roots, the oxygen re-oxidizes the iron in the soil around the roots, resulting in "reoxidized" rhizospheres. The reoxidized rhizospheres appear as red areas of oxidized iron along and near the root channels. The wet areas of the Nevins Creek site are beginning to exhibit hydric soils indicative of a wetland.

Dr. Moye Rutledge, a University of Arkansas soil morphologist surveyed the site for hydric soil evaluation in the Autumn and Winter of 1997. Dr. Rutledge used the Natural Resources Conservation Service (NRCS) Field Indicators of Hydric Soils in the United States as a guide to assess the hydric soil in the mitigation area. Initial investigation indicated that the parent material had a great influence upon the hydric soil indicators. Additional site visits and evaluations were necessary to delineate between the parent material effects and the effects of soil formation upon the hydric soil indicators. The conclusion of Dr. Rutledge's survey and evaluation was that most of the wetland toward the southwest end of the mitigation area exhibits hydric soil formation. Some of the hydric soil formation is due to compaction of the surface by heavy equipment, and repeated freeze-thaw cycles could potentially reverse the effects of compaction. The area is apparently developing the indicators of hydric soil, however, a long term, more detailed evaluation of the wetland would be necessary to determine the extent of hydric soil formation after the wetland matures. Some additional mapping and infrared photography would be required for the long term evaluation. A complete copy of Dr. Rutledge's report is included as Appendix L.

Objective 5. Compare the composition and relative abundance of fish, bird, and mammal species at the immature created wetland site to an established natural wetland reference site.

Originally, the project objectives included assessing the composition and relative abundance of the fish, bird, and mammal species at the immature created wetland and comparing this composition to the natural, mature site. However, as the project progressed, this comparison was obviously beyond the scope and budget of the project. Casual observations of bird and mammal species were made during site visits, however a full-scale scientific study of the fauna was not undertaken as part of this project. Qualitative assessment of biological indicators was conducted at the Nevins Creek Site during September 1997 by Dr. Richard L. Meyer. The wetland site had a diversity of species with representatives from all major groups of freshwater algae. The algae present at the site were typical of mesotrophic-to-slightly eutrophic conditions (Appendix M).

RECOMMENDATIONS AND CONCLUSIONS

The Nevins Creek Bottomland Hardwood Wetland Mitigation Site appears to be developing as a wetland in terms of the functions of hydrology (groundwater and surface water), hydric soils (NRCS indicators of hydric soils), and hydrophytic vegetation. Currently, the hardwood trees that have been planted are young - less than one year old. More time will be required to assess the site's development into a bottomland hardwood wetland. The site is expected to evolve and develop over time, with soil development, changes in the vegetation, as well as significant changes in the surface hydrology. During the past two and a half years of active study at this site, the Nevins Creek channel through the wetland and the Bayou Bartholomew inlet and outlet have experienced erosion and deposition as well as backwater development due to the dam-building activities of beavers.

Particular recommendations for this site include the following:

1. The inlet (upstream) of Bayou Bartholomew should be monitored closely and possibly, should be stabilized using rip-rap to prevent further erosion toward the railroad right-of-way. The researchers recommend that a qualified crew from AHTD visit the site and evaluate the stability of the Bayou Bartholomew inlet area.
2. The site should be monitored for development as a bottomland hardwood wetland over the next 20 years or more. Specifically, the following evaluations should be performed.
    a. The hardwood species that were planted should be monitored for survival and growth.
    b. The natural plant species such as black willow, sweetgum, and water primrose that have begun to establish themselves in the wetland should be monitored to determine the mitigation area's ability to "remake" itself from an upland to a wetland due to the changes in topography by the removal of borrow material.
3. The soil should be evaluated at least once per year for development of hydric soil indicators. A grid of sampling stations could be established and tied to the existing survey control system.
4. The piezometers should be monitored periodically. The monitoring interval may be established through discussions with the AHTD and the University of Arkansas research team.
5. The staff gauges will be left in the wetland for monitoring the surface water levels. Again, a monitoring interval should be established through discussions with the AHTD and the University of Arkansas research team.
6. Soil samples should be collected periodically, possibly once per year, and analyzed for typical indicators of soil fertility.

APPENDIX A

Evaluation of Vegetation in the Bayou Meto Game Management Area

EVALUATION OF VEGETATION IN BAYOU METO GAME MANAGEMENT AREA

Final Report on Vegetation Studies

by

Edward E. Dale, Jr.

INTRODUCTION

Vegetation studies were directed primarily toward fulfilling Objective 1 and the first part of Objective 3 as described in the proposed study.

Objective 1. Select a natural wetland in the same geographical area to serve as a reference for comparison to the created wetland. The hydrophytic vegetation in the reference wetland and the preserved vegetation in the created wetland will be evaluated.

A search was made of the available literature for areas suitable for use in the study. In most instances, areas were selected where at least some quantitative information on vegetation communities was known. Examples include studies in Bayou Meto Wildlife Management Area (Jefferson County) by Huffman (l976a) and Dale (1984), in Wattensaw (Prairie County) and Dagmar (Monroe County) Wildlife Management Areas, a site west of Colt on the L'Anguille River (St. Francis County) and several other sites on Bayou Deview and Bayou Bartholomew (Dale, 1984). In addition, other sites considered included an area on the lower White River (Bedinger, 1971), sites in the Ouachita River Basin investigated by Huffman (l976b), and sites along the Saline River, Moro Bay, and in Felsenthal National Wildlife Refuge (Kuroda, 1979; Dale et al., 1981).

Bayou Meto Game Management Area was selected as the most suitable area for the vegetation studies. It is a relatively large game management area (over 33,000 acres) characterized by level to gently undulating terrain. It includes lakes, streams, backwater swamps, bayous and oxbow lakes.

The hydrologic environment is variable. At the lowest elevations, below 175 feet mean sea level, the area is generally covered with water all year. On slightly higher elevations, 175 to 179 feet, inundation can occur for several months. Between 179 and 180 feet, floods are less frequent, usually occurring for less than 30 days. Elevations of 181 feet or more on the higher ridges and terraces are rarely or never flooded (Huffman, l976a).

The topographic and hydrologic features of the area result in a large variety of habitats reflected by vegetation communities varying from those that are typically aquatic to different lowland types and communities of the uplands. The area closely approaches being a microcosm of principal vegetation types occurring in wetlands elsewhere in Arkansas and in the central Mississippi Delta Region.

Practical considerations for choosing Bayou Meto include the fact that it is public land and available for study. The vegetation of the area is best known of other wetland areas in the vicinity. Most of the area is easily accessible by road or trail which expedites locating representative vegetation types for sampling and it is conveniently located within a few miles of the Nevins Creek Mitigation Area. The present investigation is concerned with evaluation of vegetation in the natural wetland only.

A survey of the literature showed that at least two studies have been made of vegetation communities in Bayou Meto. Huffman (1976a) made an extensive study of vegetation communities of the area. This study provided much useful information, but it was not designed to meet the objectives of this investigation. Dale (1984) in a study of the wetlands of Arkansas included a quantitative study of two sites in Bayou Meto, but other principal community types known to be present were not described. Therefore, it was determined that further field investigations were necessary.

METHODS

A field reconnaissance was initiated in June, 1996 to locate suitable areas for sampling, become acquainted with the area, and plan the field work. The field sampling was accomplished in July.

Field methods used were similar to those used by Dale et al. (1981) and Dale (1984). Briefly, these methods consisted of first locating representative stands of forest in uplands and areas known to be subject to periodic flooding. A starting point was then randomly selected within each stand on which was placed the corner of one of a series of systematically arranged sample plots.

Trees and woody understory were sampled in a minimum of six 72.6 x 6-foot (1/100 acre) rectangular plots (22 x 118 m, .004 ha) arranged with the long axis parallel to the moisture gradient.

These plots were usually 50 feet (15.23 m) apart. Data recorded for trees over 3 inches (7.62 cm) in diameter measured at 4.5 feet (1.37 m) above the ground, often referred to as diameter breast high (DBH), were species present, basal area, and density. The DBH of each species present in the plot was measured with a log scale stick and assigned to one of a series of size classes. The field data were converted to relative frequency, relative density, relative basal area (dominance), and importance value (Curtis and McIntosh, 1951). The importance value (I.V.) is a single number representing a combined measure of distribution, number, and size of tree species present. Also, density and basal area per acre (.405 ha) were determined. Sample adequacy for trees was determined by a running mean technique (Mueller-Dombois and Ellenberg, 1974) in which the variation between mean density values of the dominant trees was calculated first in 5 plots and then in 6. If the variation exceeded 15 percent, other plots were added until sample adequacy was obtained.

Data for high understory woody species such as saplings, shrubs, and vines greater than 4.5 feet above the ground and less than 3 inches DBH were taken from the plots and presented as density (number of stems) per acre.

Percent cover of forest floor species less than 4.5 feet tall was estimated in 3 x 6-foot plots located at the center of each rectangle used to sample the overstory.

The understory was sampled in four strata: (1) bare ground, mulch, moss, and lichens, (2) ground level to less than 6 inches (.15 m), (3) greater than 6 inches to less than 2 feet (.61 m), and (4) greater than 2 feet to less than 4.5 feet. The vegetation cover in all plots from each stand was averaged and each stratum was assigned a percent cover value.

A determination was made of how principal species in different community types as they occur along wet to dry gradients in Bayou Meto compared with gradients in other wetland communities. This was accomplished by first compiling a list of principal species in different wetland communities of the central Mississippi Delta Region including Arkansas as they occur along moisture gradients relative to frequency and duration of flooding. The list is based upon over 200 quantitatively sampled sites. This was compared with occurrence of similar communities supporting the same principal species as they occur along moisture gradients in Bayou Meto. The degree of correlation was tested by regression analysis.

Soil samples were taken at each site at Bayou Meto and analyzed by the University of Arkansas, Soil Testing and Research Laboratory. The different soil factors were then correlated with the different community sites using canonical correspondence analysis (CCA).

Photographs were taken at each site showing vegetation present and general characteristics of the site. Also noted were the compass directions of gradients, any low places such as channels or depressions, and slightly elevated places that were drier than the rest of the site.

Voucher specimens of plant species present were collected periodically during the investigation. These were pressed, dried, and identified, and are available for study at the Department of Biological Sciences, University of Arkansas, Fayetteville.

Finally, a map and table were prepared that indicate the location of sampling sites in Bayou Meto (Fig. 1) and the dominant species (Table 1).

DESIGNATION OF DOMINANTS

A dominant species is a plant that is in community control (Clements, 1916; Oosting , 1956). This means that at least to some extent the establishment and growth of species of secondary importance in a plant community are determined by the influence of dominant species through their influence on the habitat by competition or allelopathy. Dominants are usually large plants, good competitors that tend to eventually crowd out most secondary species, numerous, and except in serial communities, present all during the year for several growing seasons. In forests, community dominants are the trees. As used by many authors, trees with an I.V. of 75 or more are considered as dominants and those with an I.V. greater than 15 but less than 75 are regarded as important secondary species. Tree species with an I.V. less than 15 are considered as interstitial. Since trees in three sites at Bayou Meto have an I.V. of almost 74, for purposes of this study trees in these sites are regarded as dominants.

Dominance has been shown to occur in different strata of the understory also. Saplings and other woody understory over 4.5 feet tall with densities of 100 or more per acre and understory species of the forest floor with cover percentages of 10 or more are considered as dominants in their strata. Field observations at Bayou Meto seem to support these values.

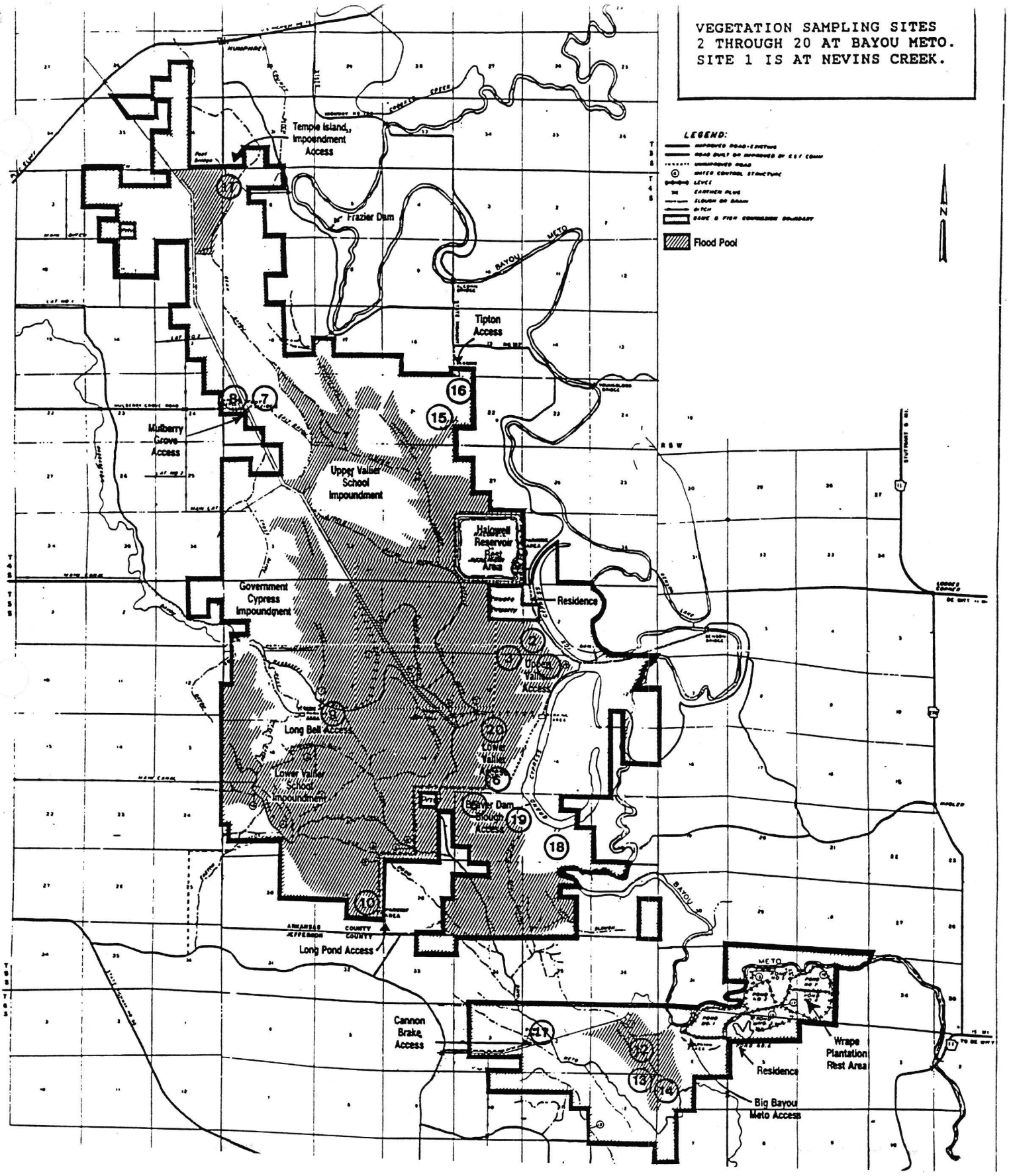


Fig. 1. The vegetation sampling sites 2 through 20 at Bayou Meto. Site 1 is at Nevins Creek.

Table 1. Summary of location, dominant species and importance values (I.V.) of dominants in each site. Map locations of Sites are shown in Figure 1.

Site Number	Location of Site	Dominant Species Present		I.V.
1	Nevins Creek	Sweetgum	-	189
2	Edge of campground S. of Gill Property	Willow Oak	-	81
3	Adjacent and W. of Site 2	Water Oak	-	126
4	Across road W. of campground	Mixed Site	- No Dominant	
5	75 yds S. of Lower Vallier Parking Lot	Willow Oak	-	260
6	E. edge of Lower Vallier access Rd.	Sweetgum	-	127
		Nuttall Oak	-	87
7	Mulberry Grove Access	Shagbark Hickory	-	102
		Southern Hackberry	-	73
8	Mulberry Grove Access	Overcup Oak	-	102
		Green Ash	-	74
9	Long Bell Access	Shagbark Hickory	-	88
10	N. of Long Pond Access	Cherrybark Oak	-	161
11	Cannon Break Access	Swamp Privet	-	104
12	Big Bayou Meto Access	Swamp Privet	-	218
13	Big Bayou Meto Access	Water Hickory	-	169
		Southern Hackberry	-	104
14	Big Bayou Meto Access	Water Hickory	-	80
15	Tipton Access	Willow Oak	-	90
		Persimmon	-	84

16	Tipton Access	Persimmon	-	100
17	Temple Island Access	Shagbark Hickory	-	75
18	Beaver Dam Slough S. of Grand Cypress Lake	Water Elm Water Locust	- -	93 74
19	100 yds NW. of Beaver Dam Slough	Loblolly Pine	-	174
20	S. of Rd. approx. 1 mile W. of Grand Cypress Lake	Tupelo	-	189

RESULTS AND DISCUSSION

General

The different forest community types based upon dominants of the tree overstory were easily recognizable entities characterized by the presence of specific populations of trees dominated by one or more species. These communities usually support characteristic sapling, shrub, and herbaceous strata in their understories. It was noted also that different community types occur in specific types of habitats, which in Bayo Meto, are those with different moisture regimes. In some instances boundaries between communities are fairly distinct, but in other instances they are not. Where boundaries are not distinct, the intervening areas between communities are regarded as transition zones.

It is realized that many ecologists do not recognize the existence of plant communities and contend that vegetation assemblages occur as continua along different types of gradients. However, the vegetation community concept is used here because the vegetation units are readily discernible and also as a matter of practicality and convenience.

Sixteen different principal forest community types were identified and quantitatively sampled at Bayou Meto. Also a principal community type was sampled at the top edge of the borrow pit at Nevins Creek. The Nevins Creek Site consisted of the preserved vegetation and was sampled to serve as a reference. It is the driest major community type surrounding the borrow pit.

Further sampling would probably make it possible to locate and identify other types, but they would be of less frequent occurrence and rarely encountered. Examples include sites dominated by cedar elm (*Ulmus crassifolia*) or blue beech (*Carpinus caroliniana*), but these often occur as understories of other types. Also some river banks near Bayou Meto are dominated by such species as black willow (*Salix nigra*) or black river birch (*Betula nigra*), but they are represented in Bayou Meteo as a few trees in small stands or an occasional large tree growing along the edges of streams.

Some communities are dominated by a single species, but in others dominance is shared by two species. Frequently codominants occur as single dominants in other stands.

Descriptions of Vegetation Communities

Sixteen different community types are present at the 19 sampling sites at Bayou Meto.

Some of these are dominated by one species and others by two. Observations in Arkansas, Mississippi, and Louisiana indicate that many species occurring as codominants are frequently present as a single dominant in other stands. This occurs in Bayou Meto also.

The physical characteristics of the site where a vegetation type occurs and a discussion of principal species in the type are presented in the discussion of types that follows. A list of all species present and quantitative data for each are given in Appendix 1.

For purposes of this study, the dominant species will be used to designate each community type. Also the name of the community type is followed by the site number(s) where the community was sampled.

Sweetgum Type -- Sites 1 and 6.

Site 1 at the Nevins Creek Mitigation Area was included for reference purposes because it is located on the rim of the borrow pit and largely represents the drier part of the mitigation area. Other parts of the rim support species that usually occur in drier areas than sweetgum, but they are present mostly as narrow strips on the west side of the mitigation area next to the railroad track and on the north side as a fringe of preserved vegetation between Bayou Bartholomew and the top of the borrow pit. This information is based upon observational data as a part of a study on principal vegetation communities of the borrow pit, and presented elsewhere in this report.

The Sweetgum Type sampled at Nevins Creek is located in the area of preserved vegetation on the high ground north of and immediately above the cypress plantings.

Sweetgum (*Liquidambar styraciflua*) is widely distributed in the Bayou Meto and throughout Arkansas. It typically occurs in areas subject to periodic flooding from two weeks up to about one month annually and is rarely found in large numbers in deep swamps or backwater areas except on ridges. Also, it is common in areas that have been disturbed and is usually associated with weedy species. At Nevins Creek, the most common associated species include common privet (*Ligustrum vulgare*), Japanese honeysuckle (*Lonicera japonica*), greenbrier *Smilax* spp., and poison ivy (*Toxicodendron radicans*), all of which are weedy.

At Site 6, sweetgum is associated with Nuttall oak (*Quercus texana*) which occurs as a codominant. This site is not as weedy as the Nevins Creek Site, but previous disturbance of this site is indicated by the occurrence of winged elm (*Ulmus alata*) as a dominant in the high understory and

of poison ivy which dominates in both the high understory and the forest floor. Other important species present include shagbark hickory (*Carya ovata*), rattan vine (*Berchemia scandens*), Virginia creeper (*Parthenocissus quinquefolia*), and muscadine grape (*Vitis rotundifolia*) which are dominant in the high understory.

Willow Oak Type -- Sites 2, 5, and 15.

Willow oak (*Quercus phellos*) is one of the most widely distributed trees of wetland areas. It is present in 11 sites in Bayou Meto and is the single dominant in Sites 2 and 5. It is a codominant with persimmon (*Diospyros virginiana*) at Site 15. Here persimmon occupies drier, more open parts of the site. It is not typical as a dominant in Willow Oak Sites and can be considered as a small site within a larger Willow Oak Site. It will be discussed further in the description of Site 15 where it occurs as the only dominant.

Willow oak usually occurs in flat areas that are flooded two or three weeks annually, but it can tolerate flooding for several months during the growing season. Willow Oak Sites are often characterized by shallow channels that form a network between trees and low humps of ground.

At Site 2, the sampling rectangles extended from the edge of Grand Cypress Lake and extended along a gentle slope upward toward a drier area. Important secondary species present at the wet end of the gradient include water hickory (*Carya aquatica*), buttonbush (*Cephalanthus occidentalis*), tupelo (*Nyssa aquatica*), and overcup oak (*Quercus lyrata*) with water oak (*Quercus nigra*) occurring on the drier end. Willow oak occupies enough of the area in between to become the only dominant.

Site 5 is on a large, flat area and is typical of most Willow Oak Sites. The overstory occurs as almost a pure stand (I.V. of 260) with shagbark hickory and cedar elm present as interstitial species.

Understories in the Willow Oak Type vary considerably because of the many different types of microhabitats common in willow oak forests. High understories in the drier areas of the Bayou Meto sites are dominated by persimmon and winged elm. Green ash (*Fraxinus pennsylvanica*) saplings are dominant in more mesic areas of Site 15.

Common vines include rattan vine, greenbrier, and eardrop vine (*Brunnichia ovata*) in either the high understory or on forest floors.

Sedges (mostly *Cyperus* sp. and *Carex* spp.) covered much of the forest floors in all sites.

Water Oak Type -- Site 3.

Water oak occurs on better drained ridges and flats of wetland areas that are flooded from only a few days up to about two weeks during the growing season. Also, it has been found in moister non-wetland areas.

Water oak is the only dominant in the site sampled at Bayou Meto. Important secondary species of the overstory include shagbark hickory, sweetgum, willow oak, and cherrybark oak (*Quercus falcata* var. *pagodaefolia*). Dominant saplings of the high understory are shagbark hickory and winged elm. Common vines present are poison ivy and climbing dogbane (*Trachleospermum difforme*). Forest floors at this site are dominated by poison ivy.

Mixed Site -- Site 4.

This site is essentially flat and poorly drained. Apparently, it was extensively disturbed many years ago as indicated by the high density of the overstory and the presence of trees characteristics of both wetlands and dry uplands. None of the trees in the sample plots are very large.

Fifteen different species of overstory trees are present in this site with none of them occurring as dominants. Water locust (*Gleditsia aquatica*) is the most important species with an I.V. of 61, followed by southern hackberry (*Celtis laevigata* Willd.) and red mulberry (*Morus rubra*) with an I.V. of 36 for each. Other important secondary species are green ash, cherrybark oak, willow oak, overcup oak, post oak (*Quercus stellata*), American elm (*Ulmus americana*), and cedar elm.

Another evidence of disturbance is the dense stand of winged elm in the high understory throughout most of the area. This indicates that the site must have been at least partially cleared at one time and later abandoned. Winged elm is a common invader of abandoned fields or cleared areas.

Other dominant high understory species present include cedar elm, American elm, rattan vine, Virginia creeper, and poison ivy.

The forest floor is almost bare with poison ivy and Virginia creeper occurring in a few places.

Shagbark Hickory Type -- Sites 7, 9, and 17.

Shagbark hickory is almost as widely distributed in Bayou Meto as willow oak, but on slightly drier sites. It is a codominant with southern hackberry at Site 7 and the only dominant in

Sites 9 and 17. It occurs on drier sites throughout most of the Mississippi Delta Region and in moist areas, usually along the sides of upland ravines in the Ouachitas and the Ozarks. It is intolerant of flooding for more than two weeks to a month during the growing season.

Southern hackberry often occurs as a single dominant in wetland stands elsewhere, but it is present in Bayou Meto as a codominant, important secondary species, or as an interstitial species. It is frequently found on uplands, but it can tolerate flooding or saturated soil conditions for several weeks in lowland habitats.

Principal secondary species at Shagbark Hickory Sites in Bayou Meto include persimmon, winged elm, and willow oak on drier areas and Nuttall oak, American elm, and green ash in moister places. Wet areas, such as low depressions and sloughs within the site, support low wetland species such as overcup oak, water locust, and cedar elm. The most common species that occur in all three Shagbark Hickory Sites are rattan vine, Virginia creeper, and poison ivy. Forest floors are almost bare, with Virginia creeper and poison ivy comprising most of the plant cover. An exception was in Site 9, where palmetto (*Sabal minor*) is present.

Overcup Oak Type -- Site 8.

Overcup oak typically occurs in areas with saturated soil subject to flooding from one to three months. It is present at this site in a swale that runs through the site.

Green ash is present here on the higher ground. It is less tolerant of flooding than overcup oak, but it can survive flooding for up to as much as six weeks during the growing season. It is common in wetlands throughout the Mississippi Delta Region, but it also occurs as a dominant on floodplains of larger rivers in the Ouachitas and the Ozarks.

Important secondary species at this site are southern hackberry and willow oak. The high understory is dominated by winged elm. Principal vines of the high understory are rattan vine and poison ivy. The forest floor is almost bare with willow oak seedlings and poison ivy comprising most of the vegetation cover.

Cherrybark Oak Type -- Site 10.

Cherrybark oak occupies almost the same type of habitat as shagbark hickory in wetland areas. It can tolerate flooding for up to six week, but it usually occurs in areas that flood three weeks or less annually. Its distribution is more southern than shagbark hickory and it is seldom found in

uplands. Red mulberry and Nuttall oak are the principal secondary species in the overstory at this site. Dominant saplings of the high understory are shagbark hickory, southern hackberry, rough-leaf dogwood (*Cornus drummondii*), winged elm, and American elm. Dominant high understory vines are Carolina moonseed (*Cocculus carolinus*), greenbrier (*Smilax rotundifolia*) and poison ivy.

Eighteen different species are present on the forest floor, but poison ivy and Virginia creeper constitute most of the cover.

Swamp Privet Type -- Sites 11 and 12.

Swamp privet (*Forestiera acuminata*) is a large shrub that occurs mostly along sluggish streams or in poorly drained backwater areas such as old river channels or oxbow lakes. Frequently it is found in low, wet places behind natural levees. It can tolerate flooding or saturated soils for as long as three months. Swamp privet generally occurs as almost pure stands, but it is sometimes associated with cypress, tupelo, or overcup oak as an understory species on the edges of backwater lakes.

Swamp privet is the only dominant in the two stands sampled at Bayou Meto. The most important saplings of the high understories at both sites are green ash, water hickory, water locust, and black willow. Dominant high understory vines are rattan vine, eardrop vine, and greenbrier. The forest floor at Site 11 was almost devoid of vegetation, but 14 species were present in the sample plots at Site 12, although the cover percentage was low.

Water Hickory Type -- Sites 13 and 14

Water hickory occurs as the only dominant at Site 14, but it shares dominance with southern hackberry at Site 13 where it is present on a drier part of the site. Water hickory is common in habitats that are frequently flooded during the growing season. It is often present in backwater areas, but it is common also on the banks of faster moving streams as narrow, almost pure stands that reflect spring flood levels along the stream. Important secondary species of the overstory in Site 13 include blue beech, overcup oak, southern hackberry, winged elm, American elm, and cedar elm. The only important secondary species at Site 14 is cedar elm.

Poison ivy is the only vine dominant at both sites. Rattan vine dominates at Site 13, but is present at Site 14. Other dominant vines in the high understory at Site 14 are eardrop vine and Virginia creeper.

A few sedges comprised most of the cover at Site 13, but ground cover at Site 14 was much more varied. Principal woody species present include southern hackberry seedlings, poison ivy, deciduous holly (*Ilex decidua*), and swamp privet. Also several herbaceous species are present.

Persimmon Type -- Site 16

Persimmon occurs in both wetlands and in dry uplands, light being the primary limiting factor. It is a weedy species that invades cut over areas, abandoned fields, or edges of fence rows in uplands. It generally occurs as trees larger than saplings on edges of streams in both uplands and lowlands exposed to sunlight most of the day. It occupies the drier exposed areas of this site.

Understories of persimmon communities are highly variable. At this site, the woody understory is dominated by persimmon, green ash, willow oak, and winged elm seedlings, and ratten vine.

No dominants were noted among the 21 species present in the plots on the forest floor. Greenbrier, Virginia creeper, and rattan vine are species with the highest percent cover.

Water Elm Type -- Site 18.

Water elm (*Planera aquatica*) is very tolerant of saturated soils and flooding. It can occur in almost pure stands, but it is frequently associated with buttonbush, swamp privet, water locust or overcup oak. It is often present in the bottom of swales formed behind natural levees.

At Site 18, water elm shares dominance with water locust. Usually water locust occurs in small stands and is rarely numerous enough in any one site to become a dominant species. It is only slightly less tolerant of flooding than water elm. The only dominants in the high understory at this site are swamp privet and rattan vine. The forest floor is almost bare, as is typical of most water elm sites. The only other species present at Site 18 is eardrop vine.

Lobolly Pine -- Site 19.

Loblolly pine (*Pinus taeda*) is an upland species that can tolerate flooding for not more than about 2 weeks. Site 19 is an upland site sampled during the study for reference purposes. It is suggested that the pine was planted. Fourteen trees, some typical of uplands and some of lowlands were present, with pine as the only dominant.

High understory dominants are willow oak, cherrybark oak, post oak, winged elm and cedar elm. Dominant vines are rattan vine and poison ivy.

No dominants were present on the forest floor, but poison ivy was the most important species.

Tupelo Type -- Site 20

Tupelo occurs in backwater areas often growing in open water on low, poorly drained places, edges of oxbow lakes, or along sluggish streams. It can tolerate standing water and saturated soil all year, but most stands are usually found on dry ground during part of the year. The tupelo community sampled in Bayou Meto was at Site 20 where it is the only dominant. Bald cypress (*Taxodium distichum*) is present as an important secondary species. Bald cypress and tupelo can occur as codominants as they do in Big Cypress Lake near Site 2, but often they are present as single stands. The presence of almost pure stands of either species can be attributed to lumber operations. The two species when growing together are seldom of the same age or size class, thus, one is usually logged separately leaving the other to grow to merchantable size. Although not present at this site, woody species commonly associated with cypress and tupelo, such as on the edges of Grand Cypress Lake include buttonbush, water elm, and swamp privet.

The soil where the tupelo is growing was saturated and almost devoid of understory species.

Sweetgum occurs as a secondary species also, but it is present on higher ground. Typically, it does not grow with cypress and tupelo.

Occurrence of dominant species along a moisture gradient

Occurrence of dominant species along a moisture gradient in Bayou Meto was compiled on the basis of data from the quantitatively sampled sites (Appendix 2) and field observations. It should be noted that a complete sequence of species or communities that are present along a composite gradient for a large area rarely occurs at one location.

A composite of vegetation sequences from different sites over the Bayou Meto area as a whole was developed (Fig. 2). Most dominant species or community types may be present at locations where wet to dry gradients are gradual, but on steeper slopes many types may be absent. Thus, it is possible for one type to be adjacent to any other type. For example, a post oak type on the upper part of a steep ridge may be adjacent to a bald cypress type in a flooded area immediately below it.

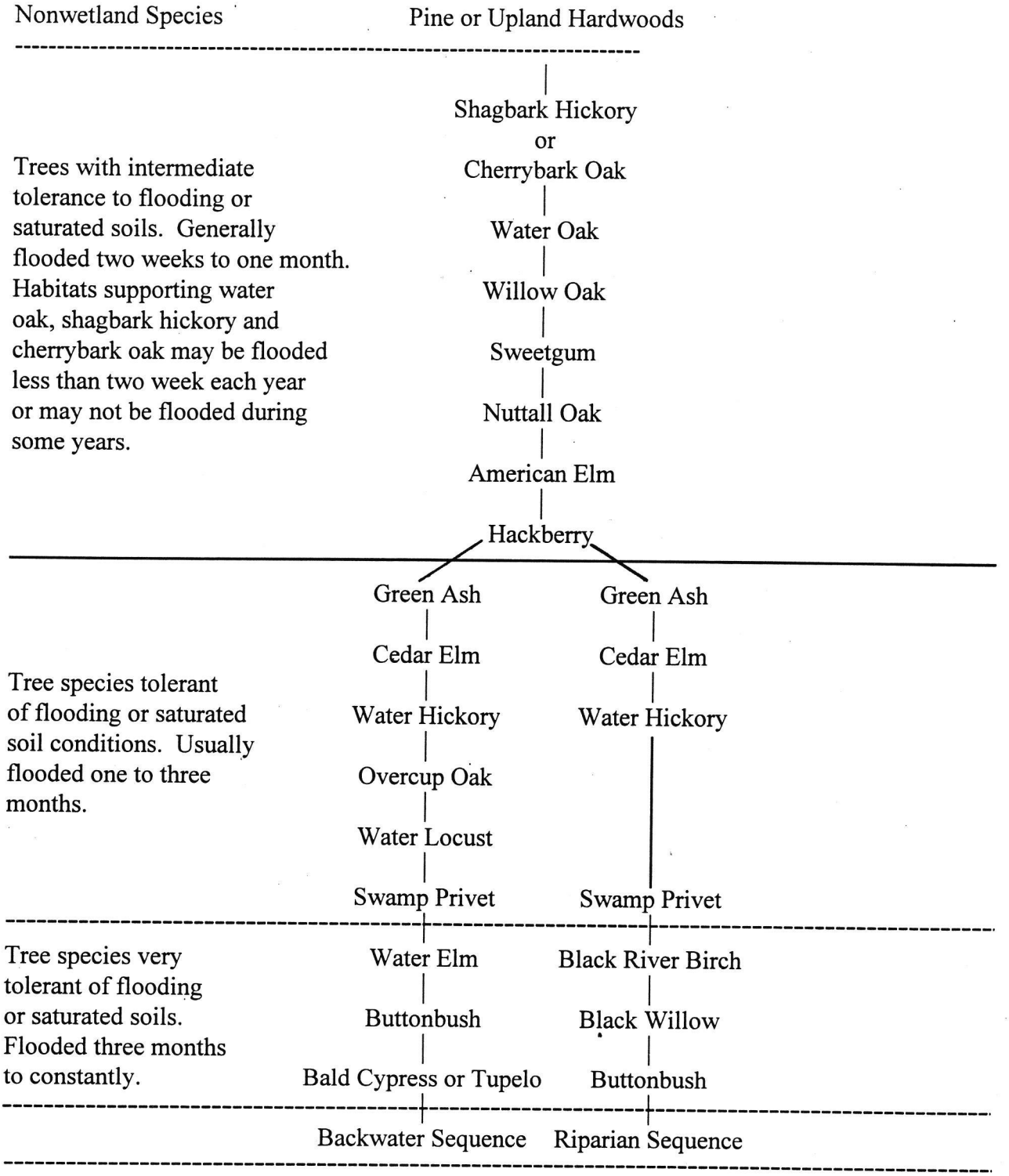


Fig. 2. Summary of relative sequences of common wetland forest trees along a moisture gradient in Bayou Meto Game Management Area. Some species may be found in either wetland or nonwetland habitats. Also, some typically riparian species may occur in backwater areas and vice-versa, but the may not dominant under such conditions.

Regression analysis based upon a comparison gradient of species present at each site in Bayou Meto with a composite gradient derived from other studies in the Mississippi Delta region shows strong correlation (Table 2). Both correlation coefficients (r) and Spearman rank correlation coefficients were mostly greater than .857. Exceptions were at Site 12 where the Spearman rank is .500 and at Site 18 with an r value of .559 and a Spearman rank of .200. At Site 16, persimmon occurs on a high, exposed place in the site next to a low area that supports water hickory and swamp privet. Samples were taken with the long axis of the plots across a swale with water oak occurring on a steep hillside next to swamp privet.

Correlations between occurrence of sites and soil factors

Canonical correspondence analysis between sites and soil factors show Person and Kendall correlations along ordination axis 1 with r values over .5 for pH, Ca, and Mg. Negative r correlations are present along axis 2 with conductivity (EC), K, S, and Cu and a negative tau correlation with EC. No correlations over .5 are present along axis 3.

How these results should be interpreted is unclear. They are presented here primarily for future reference (Appendix 3). Extractable soil nutrient levels are also presented (Appendix 4).

CONCLUSIONS AND RECOMMENDATIONS

It is concluded that the vegetation of Bayou Meto Game Management Area is typical of wetland vegetation that occurs elsewhere in Arkansas and much of the Central Mississippi Delta Region. Also the sequence of tree species is representative.

In regard to species that should be planted at the mitigation area, it is recommended that any species occurring at or below sweetgum along the gradient at Bayou Meto would be suitable where comparable flooding or saturated soil conditions are present.

Soil factors of importance to establishment and growth of tree species in Bayou Meto are not well known. However, the species at Bayou Meto occur over a wide geographical range in wetlands throughout the Mississippi Delta Region, thus variable soil nutrient levels may not be a crucial factor concerning vegetation establishment and growth in wetlands.

Table 2. Correlation (r) and Spearman rank coefficients between a composite species gradient from the Mississippi Delta Region and gradients from each site at Bayou Meto Game Management Area. Correlations were not made from Sites 5 and 10.

Site Numbers	Correlation Coefficients (r)	Spearman Rank Coefficients
1	.813	.800
2	.859	.857
3	.859	.857
4	.859	.952
6	.961	1.000
7	.961	1.000
8	.943	.950
9	.965	1.000
11	.866	.875
12	.778	.500
13	1.000	1.000
14	.866	.875
15	.944	.950
16	.730	.675
17	.923	.950
18	.559	.200
19	.866	.875
20	.866	.875

Acknowledgments

Grateful acknowledgment is made to Harvey Gill, Humphrey, Arkansas, for providing general information about the vegetation and flooding regimes in Bayou Meto and for indicating on a map the principal access points and roads within the area. Thanks are due also to Tim Moser, Waterfowl Research Biologist, for other information about Bayou Meto and the Arkansas Game and Fish Commission for providing a base map of the area. Special thanks go to Jason Krutz and Jason Pulley, students at the University of Arkansas, and John Murdoch, Research Specialist, Agronomy Department, for help with the field work and to Dr. E. B. Smith, Plant Taxonomist and Professor, Department of Biological Sciences, for assistance with identification of the more difficult plant specimens.

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Appendix 1. Summary of Importance Values (I.V.) at each site at Bayou Meto Game Management Area.

SPECIES	Site Number -->	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20
Acer Rubrum		5																			24
Betula nigra		40																			
Carpinus caroliniana															22						
Carya aquatica			37										57	169	80				45		
Carya myristicaeformis																		61			
Carya ovata				54		20	60	102	16	88							29	75		31	
Celtis laevigata					36			74	33		23	18		104	61			15			
Cephalanthus occidentalis			35																		
Disopyros virginiana		29	9					31	16				25			84	100				
Forestiera acuminata			4						8			104	218						53		
Fraxinus americana					25			21													
Fraxinus pennsylvanica									74	20		69				54	47			18	
Gleditisia aquatica					61					68		39						23	74	20	
Ilex decidua			4																		
Liquidambar styraciflua		189		51			127														53
Morus rubra					36						31										
Nyssa aquatica			63																		189
Pinus taeda																				174	
Planera aquatica			4									14							93		
Quercus alba				28																	
Quercus falcata v. pagodaefolia				20	15						161					27	45	7		10	
Quercus lyrata			34		25				103	18					38			46			
Quercus nigra		37	28	126															35		
Quercus phellos			82	22	25	260	26		23	51						90	47	39		10	
Quercus texana							87	21			30										
Quercus stellata					25												33			18	
Salix nigra												39									
Taxodium distichum																					34
Ulmus alata								17	8						33	27		11			
Ulmus americana					25			17	8	23	10	17			22	18				18	
Ulmus crassifolia					25	20		17	12	31	23			27	44			23			
Zanthoxlylum clava-herculis											23										
Totals		300	300	300	300	300	300	300	301	299	301	300	300	300	300	300	301	300	300	299	300

Appendix 2. Comparison of wetland gradients of vegetation of the Mississippi Delta Region with gradient at Nevins Creek and Bayou Meto. Species at all sites are assigned numbers along a decreasing moisture gradient from 1 (bottom), 2, 3, 4, etc., toward the top of the column. Species with I.V.'s of 25 or more are listed in site columns.

Mississippi Delta Wetlands Order: Dry (Top) Wet (Bottom)		Nev. Cr.	Bayou Meto Sites -->							
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10
SPECIES	Rank										
Quercus stellata	17	Quenig	Quenig	Quealb	Queste	Quephe	Carova	Diovir	Cellae	Quephe	Quefal
Pinus taeda	17	Diovir	Quephe	Carova	Quephe		Liqsty	Carova	Frapen	Cellae	
Ulmus alata	17	Liqsty	Quelyr	Quenig	Fraame		Quetex	Cellae	Ulmcra	Ulmcra	
Diospyros virginiana	16	Betnig	Nysaqu	Liqsty	Cellae				Quelyr	Gleaqu	
Quercus alba	16		Caraqu		Morrub						
Fraxinus americana	15		Cepocc		Ulmame						
Quercus falcata	14				Ulmcra						
Carya ovata	14				Quelyr						
Quercus nigra	13				Gleaqu						
Quercus phellos	12										
Liquidambar styraciflua	11										
Quercus texana	10										
Carya myristicaeformis	9										
Ulmus americana	8										
Morus rubra	8										
Celtis laevigata	8										
Fraxinus pennsylvanica	8										
Ulmus crassifolia	7										
Carpinus caroliniana	7										
Carya aquatica	6										
Quercus lyrata	6										
Gleditsia aquatica	5										
Forestiera acuminata	4										
Planera aquatica	3										
Betula nigra	2										
Salix nigra	2										
Cephalanthus occidentalis	1										
Nyssa aquatica	1										
Taxodium distichum	1										

	Site 11	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20
	Cellae	Diovir	Cellae	Carcar	Diovir	Quefal	Carova	Quenig	Pintae	Liqsty
	Frapen	Foracu	Ulmcra	Ulmcra	Quephe	Carova	Carmyr	Foracu	Quefal	Taxdis
	Foracu	Caraqu	caraqu	Caraqu	Ulmame	Diovir	Caraqu	Plaaqu	Carova	Nysaqu
				Quelyr	Frapen	Quephe	Quelyr	caraqu		
						Frapen		Gleaqu		

Appendix 3. Canonical correspondence analysis between sites and soil factors.

AXIS:	1			2			3		
	r	r-sq	tau	r	r-sq	tau	r	r-sq	tau
pH	.542	.294	.466	-.302	.091	-.190	.373	.139	-.116
EC	.028	.001	.074	-.601	.362	-.505	.372	.139	.147
P	-.278	.077	.207	-.276	.076	-.196	.170	.029	.016
K	.472	.222	.411	-.539	.290	-.421	.024	.001	-.063
Ca	.514	.265	.495	-.395	.156	-.274	-.049	.002	-.063
Mg	.518	.268	.442	-.377	.142	-.284	.022	.000	.074
Na	.386	.149	.284	-.247	.061	-.263	.179	.032	.209
S	.473	.224	.417	-.569	.323	-.417	.082	.007	-.016
Fe	.188	.035	-.237	-.245	.060	-.069	.398	.159	.058
Mn	.303	.092	.389	.058	.003	-.105	.260	.067	.147
Zn	-.285	.081	.053	-.252	.064	-.148	.185	.034	-.011
Cu	-.170	.029	.313	-.516	.266	-.366	.332	.111	.143
B	.436	.190	.424	-.439	.193	-.392	-.043	.002	-.065

Appendix 4. Extractable Nutrient Levels from Bayou Meto Background Wetland Site Soil Samples Collected July 1996.

Sample[2]	pH	EC	Mehlich III Extractable[1]										
			P	K	Ca	Mg	Na	S	Fe	Mn	Zn	Cu	B
		μS	lbs/A										
BM2	4.38	74.1	9	101	409	310	35	27	394	4	2.0	1.0	0.2
BM3	4.51	56.5	10	243	176	259	15	15	400	7	10.3	1.2	0.2
BM4	4.92	46.5	66	193	1443	393	20	26	236	354	5.5	2.3	0.2
BM5	4.95	46.9	10	109	1165	714	42	18	427	19	3.0	1.0	0.2
BM6	4.95	40.6	51	140	866	274	13	18	333	46	4.4	1.2	0.1
BM7	6.29	103.6	37	388	8880	2937	92	74	213	81	2.5	3.6	0.8
BM8	5.29	60.8	20	460	5843	2444	156	53	294	91	2.4	2.7	0.6
BM9	5.65	56.0	25	399	5671	2024	124	50	309	53	3.8	3.1	1.5
BM10	5.75	40.4	22	235	4923	1397	20	41	317	37	4.2	2.2	0.9
BM11	5.52	67.0	14	532	6359	2643	172	56	316	29	3.8	1.6	1.0
BM12	5.38	72.0	27	394	4524	1558	64	49	312	103	6.0	2.4	0.6
BM13	5.75	109.3	29	607	7104	1915	20	64	280	88	7.3	4.8	1.4
BM14	5.59	61.4	33	513	4279	1540	26	40	335	33	4.4	1.5	0.7
BM15	4.74	51.4	14	150	712	302	10	16	349	34	4.1	1.3	0.1
BM16	4.63	98.2	19	211	2151	632	32	34	349	58	8.0	1.1	0.4
BM17	5.23	127.0	28	641	6313	2243	141	63	269	111	4.3	4.7	0.9
BM18	4.66	101.3	13	194	2012	801	63	42	465	50	7.1	1.5	0.3
BM19	5.06	45.4	22	197	1778	707	32	23	258	218	5.8	1.7	0.1
BM20	4.65	117.2	72	222	1438	485	20	33	319	68	12.0	6.2	0.3

[1] Samples were subjected to Mehlich III extraction and analysis by ICP. The analytical procedures were performed by Agricultural Diagnostic Services Laboratory at the University of Arkansas. All samples were collected at a depth of 0 to 6 inches.

[2] Sample numbers correspond to Bayou Meto sample sites.

APPENDIX B

Recommendations for Establishment of Wetland Tree Species at the Nevins Creek Mitigation Site

Recommendations for Establishment of Wetland Tree Species at the Nevins Creek Mitigation Site

Edward E. Dale Jr.
10 July 1997

The establishment of wetland tree species in natural wetlands such as Bayou Meto Game Management Area occurred many years ago under environmental conditions much different than those present in the mitigation area today. Unlike the mitigation area, typical natural wetlands are characterized by alluvial soils originating from the watershed above the wetland. Also the fluctuations of flood levels are usually greater, of longer duration, and the water levels change more gradually.

It is possible to restore vegetation in the mitigation area so that it will closely resemble a natural wetland. When wetland trees become well established they can survive and prosper under conditions very different than those under which they originated. Examples of this can be seen in the frequent occurrence of such species as bald cypress, hackberry, American elm, green ash, Nuttall oak, willow oak and water oak that have been planted in upland parks and yards many years ago.

In order for a restored wetland to appear natural, the occurrence of different tree species should be planted in habitats essentially similar to those in a natural wetland. However, plantings need not include all species listed in Table 1 showing principal species present in the model natural wetland (Bayou Meto Game management Area). It is seldom that all of these species listed are present at any one site.

It is recommended that tree species should be planted in areas with similar topographical features and flood regimens as those occurring in natural wetlands within the zones indicated in Table 1. The order of species occurrence within the zones is from wetter areas (bottom) to drier (top) habitats. They should be planted in relative order from wet to dry conditions within and between zones.

Most species should survive almost anywhere within their respective zones provided that the seedlings receive needed care during the time of establishment.

On the basis of quantitative studies in Bayou Meto and elsewhere in the Central Mississippi Delta Region, it was noted that some species usually occur in larger stands only in certain habitats. For example, cypress and tupelo can tolerate permanent or near permanent standing water and should be planted in such areas. These and other species such as buttonbush became established initially in such sites.

Some species in natural wetlands also occur in habitat conditions different from those where they first became established. Species such as black willow and black river birch can tolerate constant flooding, but they cannot tolerate standing water. Although black willow often occurs in flowing water at the edges of streams and rivers, it and other typical streamside species such as black river birch, water hickory and buttonbush are frequently present on dry banks several feet above flowing streams or bayous. These species became established during wet periods but survive and grew well on formerly flooded dry banks. Buttonbush can be established in either wet or dry areas.

Water elm and swamp privet typically dominate along the sides and in the bottom of ravines that are flooded for several months during the spring but are dry during most of the late summer and

fall.

Larger stands of willow oak almost always occur in relatively flat areas that are dissected with shallow rivulets occurring between the trees. Willow oak communities are by far the largest and most extensive type of community in Bayou Meto. Other species listed were present as much smaller stands.

Elevation zones recommended for planting different species are based on a topographic map of the mitigation area and the frequency and duration of flooding (Fig. 1).

Some problems with arriving at the proper zones for planting center on the fact that the frequency and duration of flooding are different at the inlet area than at the outlet, and that it is difficult to appraise the importance of slope and exposure between some zones. Finally, it should be expected that some natural shifting of species between zones will occur later.

Table 1. Categories of tolerance to flooding, elevation zones, and recommended species for planting in each zone at Nevins Creek Mitigation Area. Species listed are in approximate order along an increasing moisture gradient (bottom to top) between zones and within each zone.

Tolerance to flooding	Elevation Zones (ft)	Species
Trees with little or no tolerance to flooding.	>207	Typical upland species such as post oak, blackjack oak, pine, mockernut or black hickory, white oak.
Trees with intermediate tolerance to flooding or saturated soil. Generally flooded two to four weeks. No flooding during some years.	207 to 203	Shagbark Hickory Cherrybark Oak Water Oak Willow Oak Sweetgum Nuttall Oak American Elm Hackberry
Tree species tolerant of flooding or saturated soil conditions. Usually flooded four to twelve weeks.	203 to 199	Green Ash Cedar Elm Water Hickory Overcup Oak Water Locust Swamp Privet
Tree species very tolerant of flooding or saturated soils. Flooded twelve weeks to constantly.	199 to 197	Black River Birch Water Elm Black Willow Buttonbush Bald Cypress Tupelo

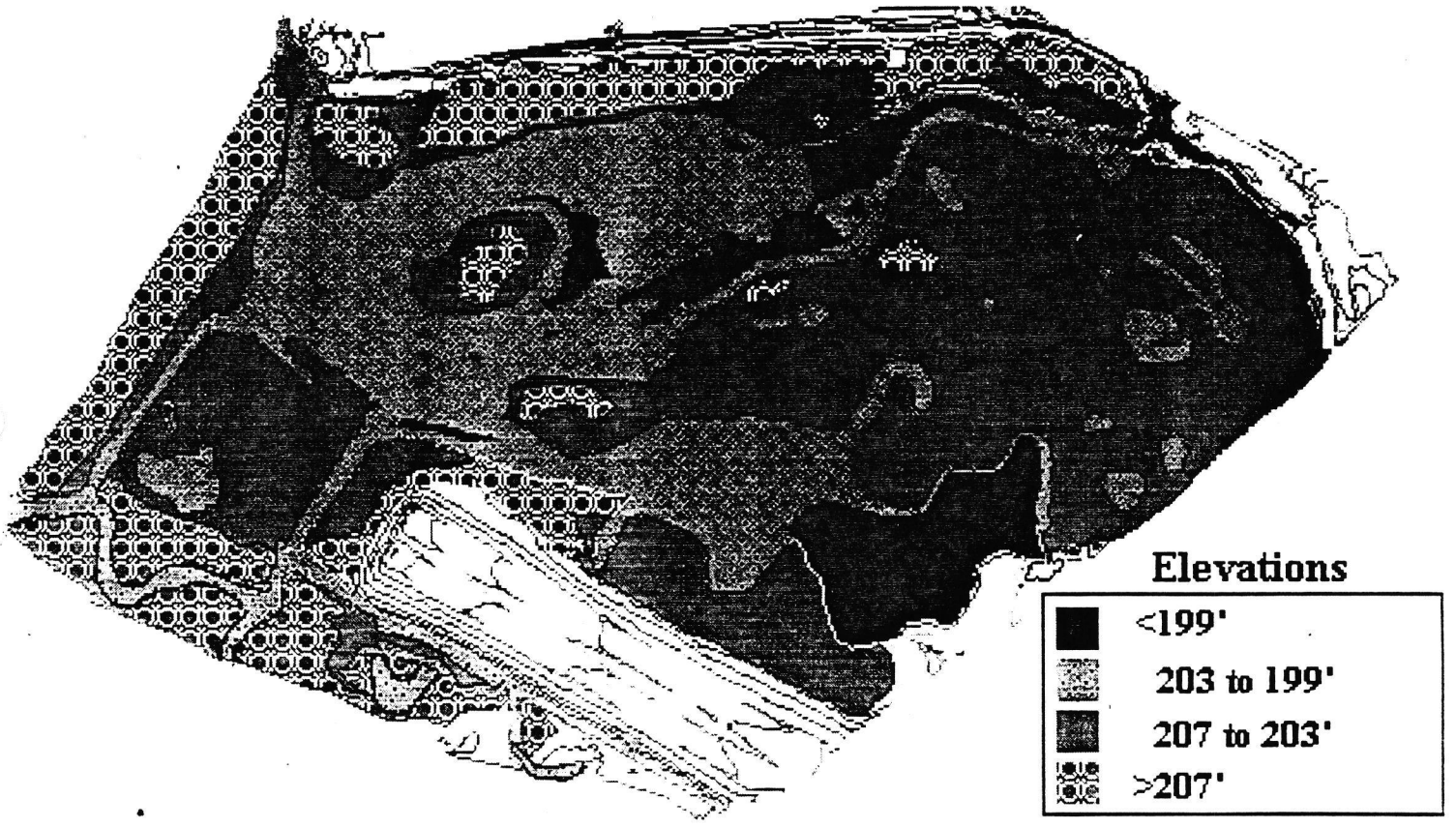
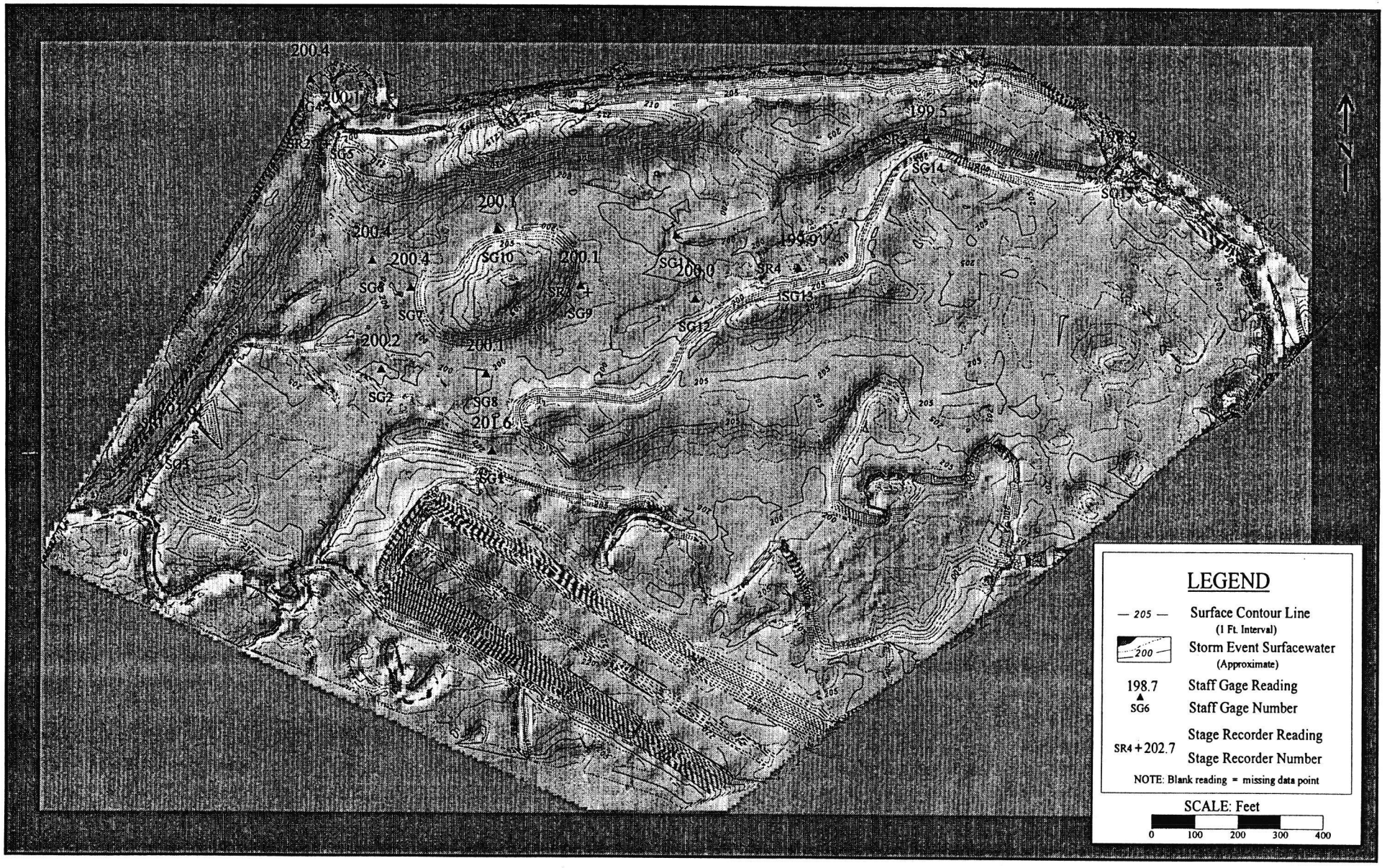


Fig. 1. Elevations at the Nevins Creek Mitigation Site.

APPENDIX C

CAICE and SURFER Surface Water Elevation Maps

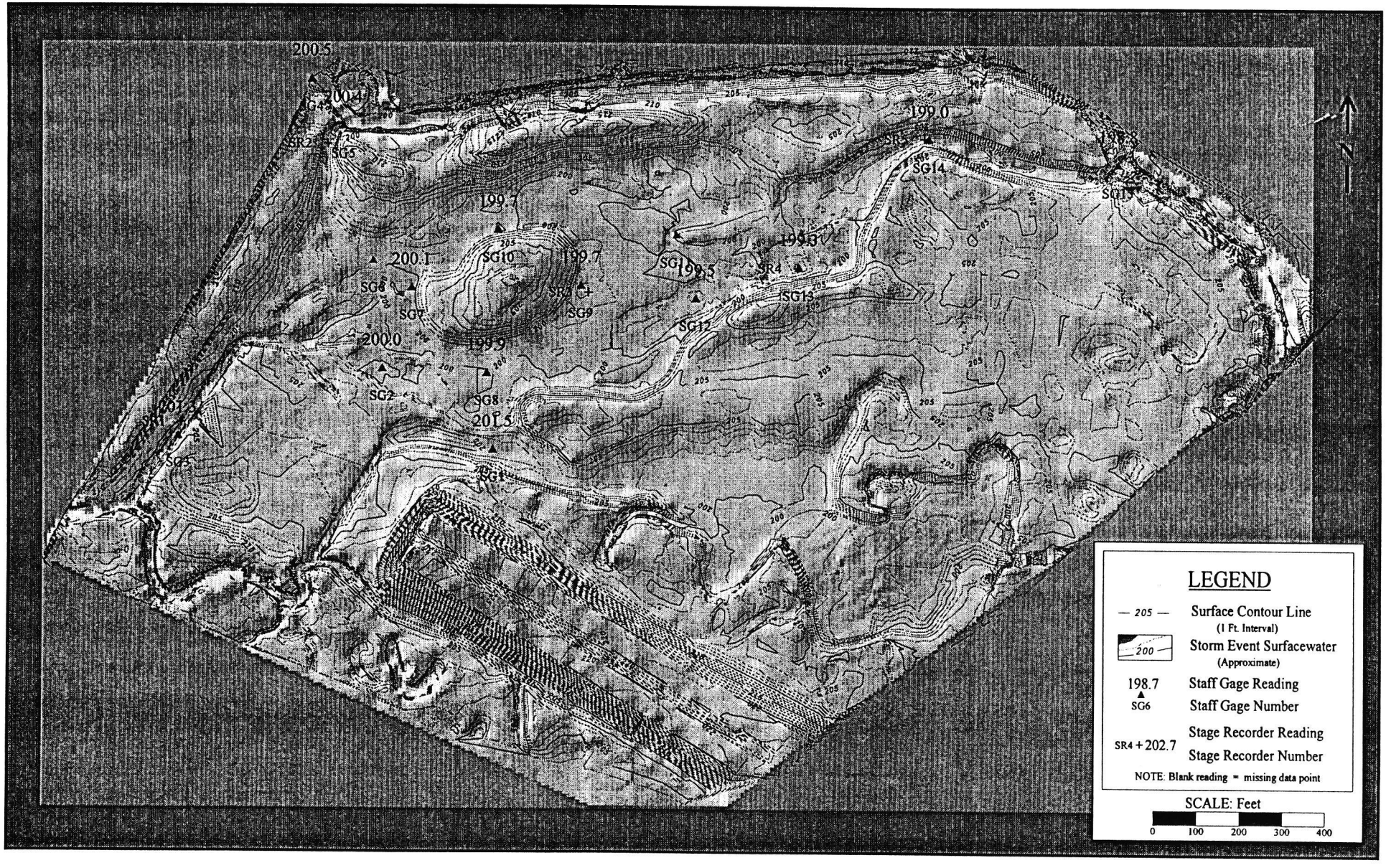
Nevins Creek Mitigation Area



Surfacewater Elevations

(04/13/96)

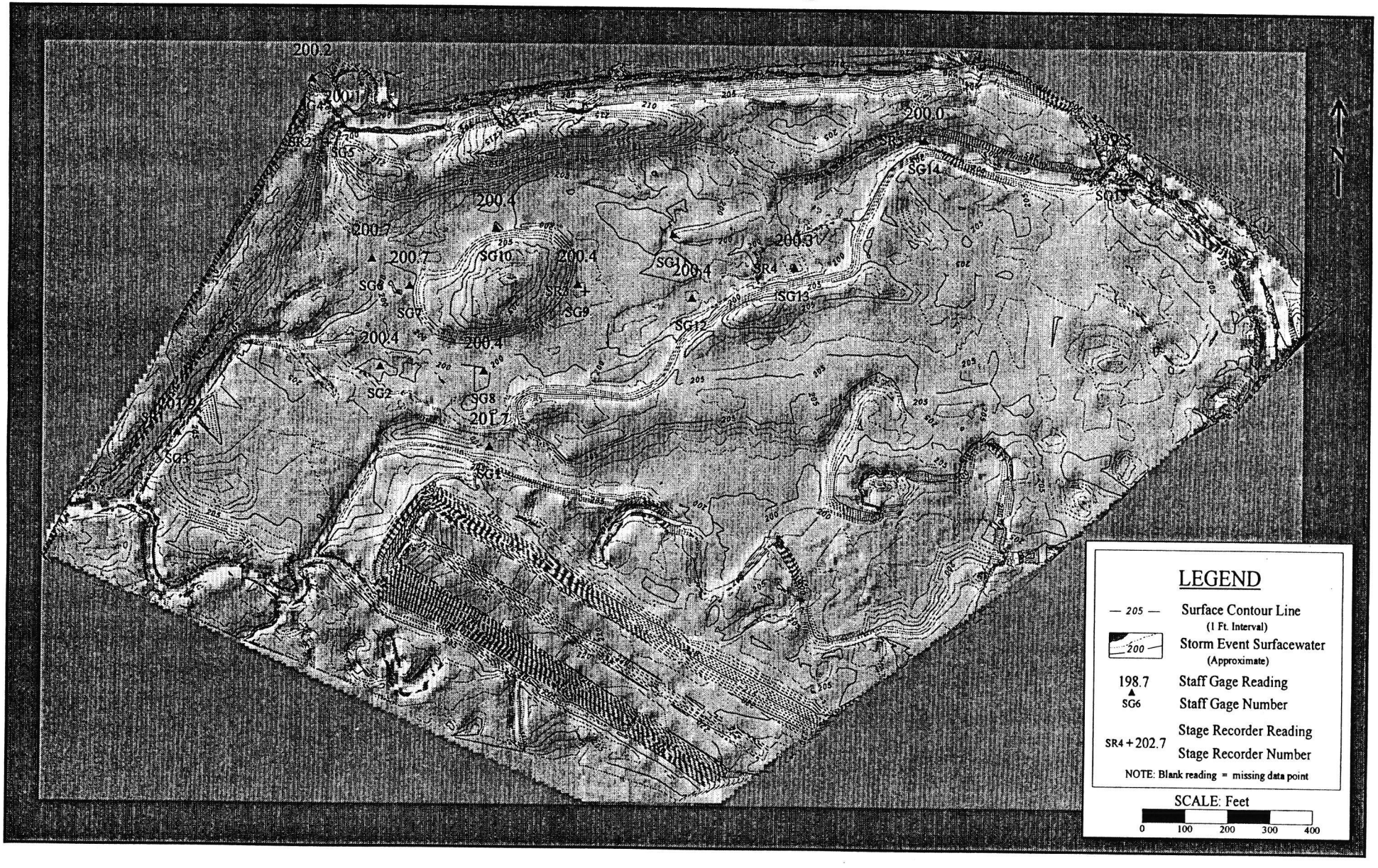
Nevins Creek Mitigation Area



Surfacewater Elevations

(04/15/96)

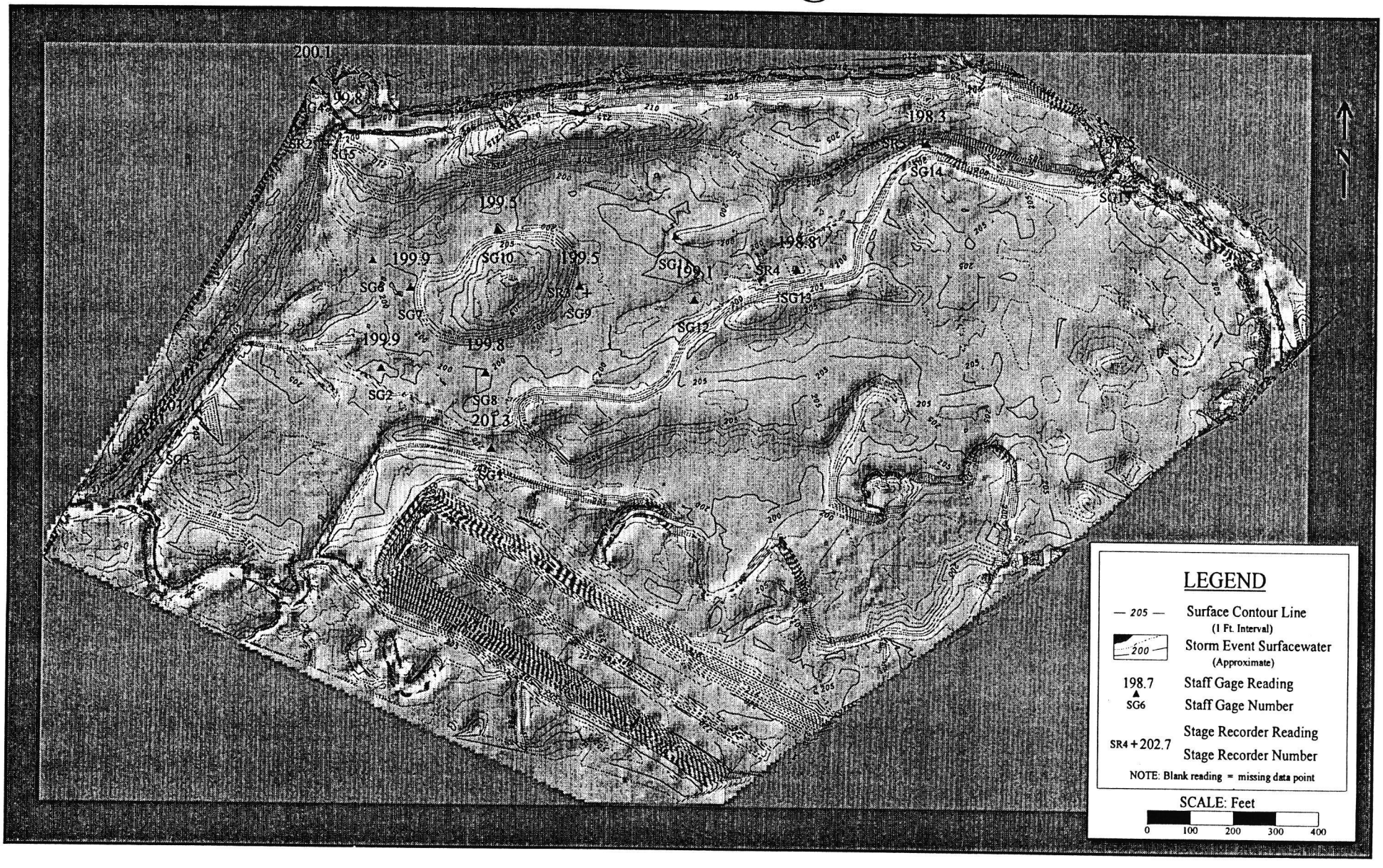
Nevins Creek Mitigation Area



Surfacewater Elevations

(04/21/96)

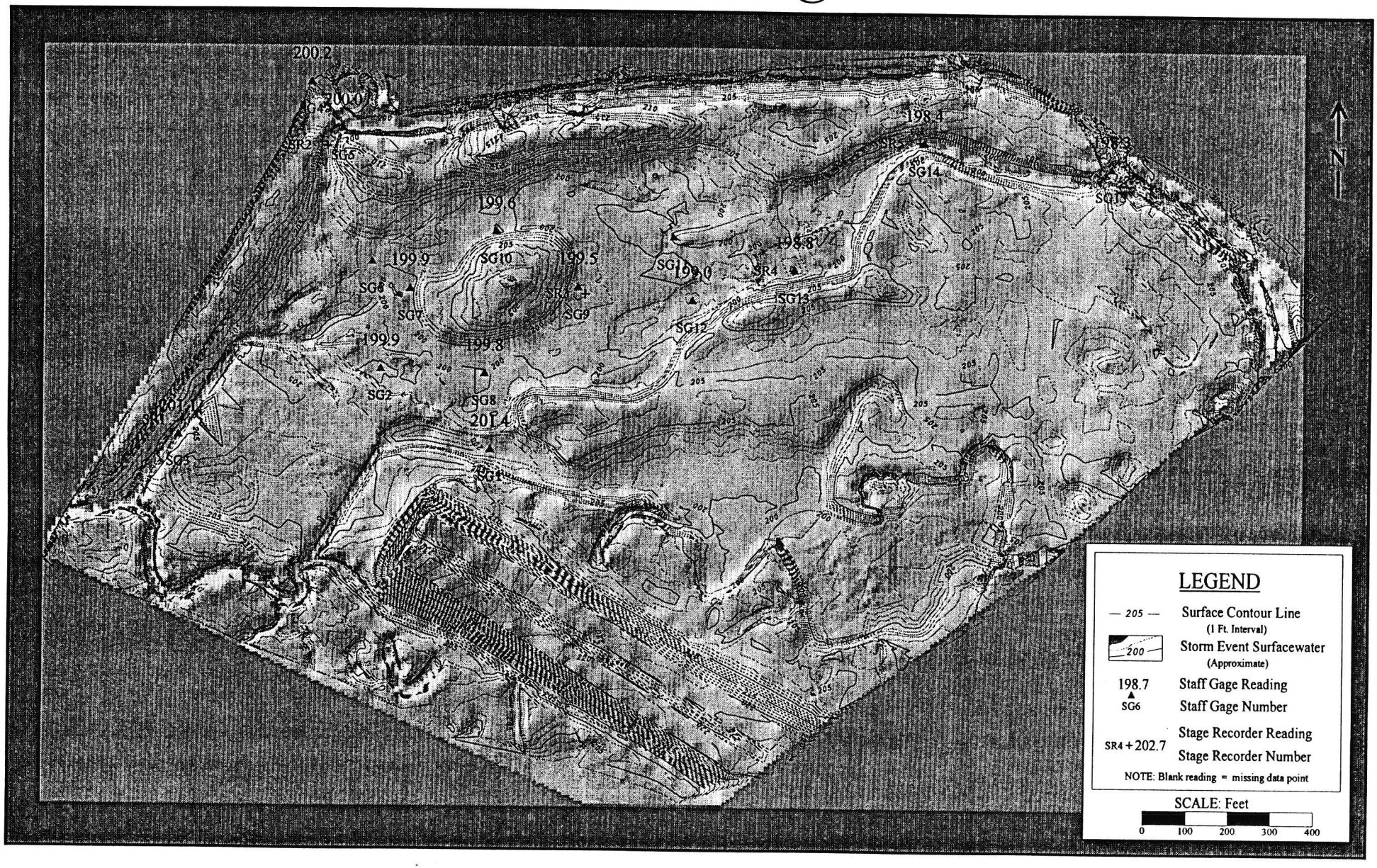
Nevins Creek Mitigation Area



Surfacewater Elevations

(04/25/96)

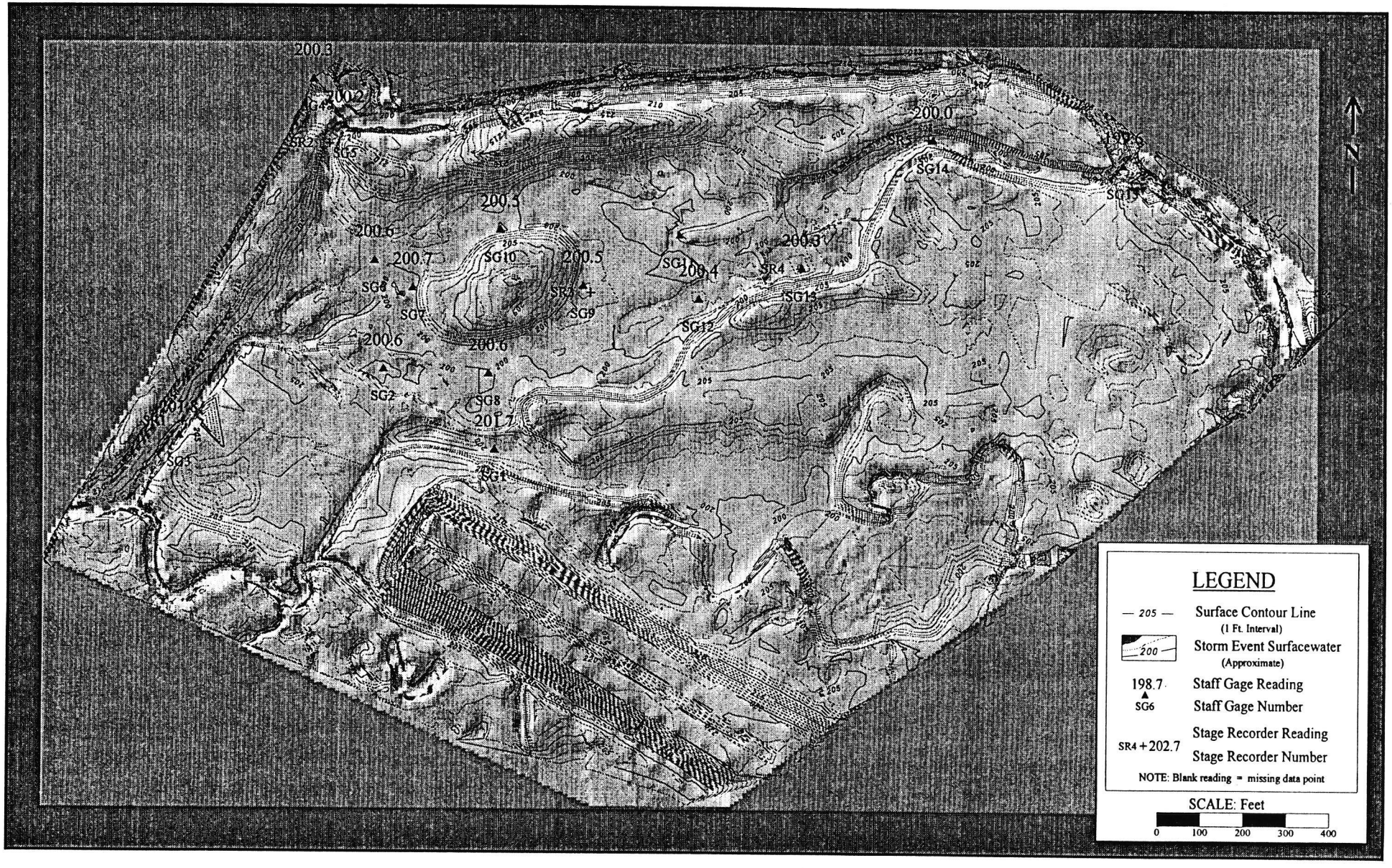
Nevins Creek Mitigation Area



Surfacewater Elevations

(05/01/96)

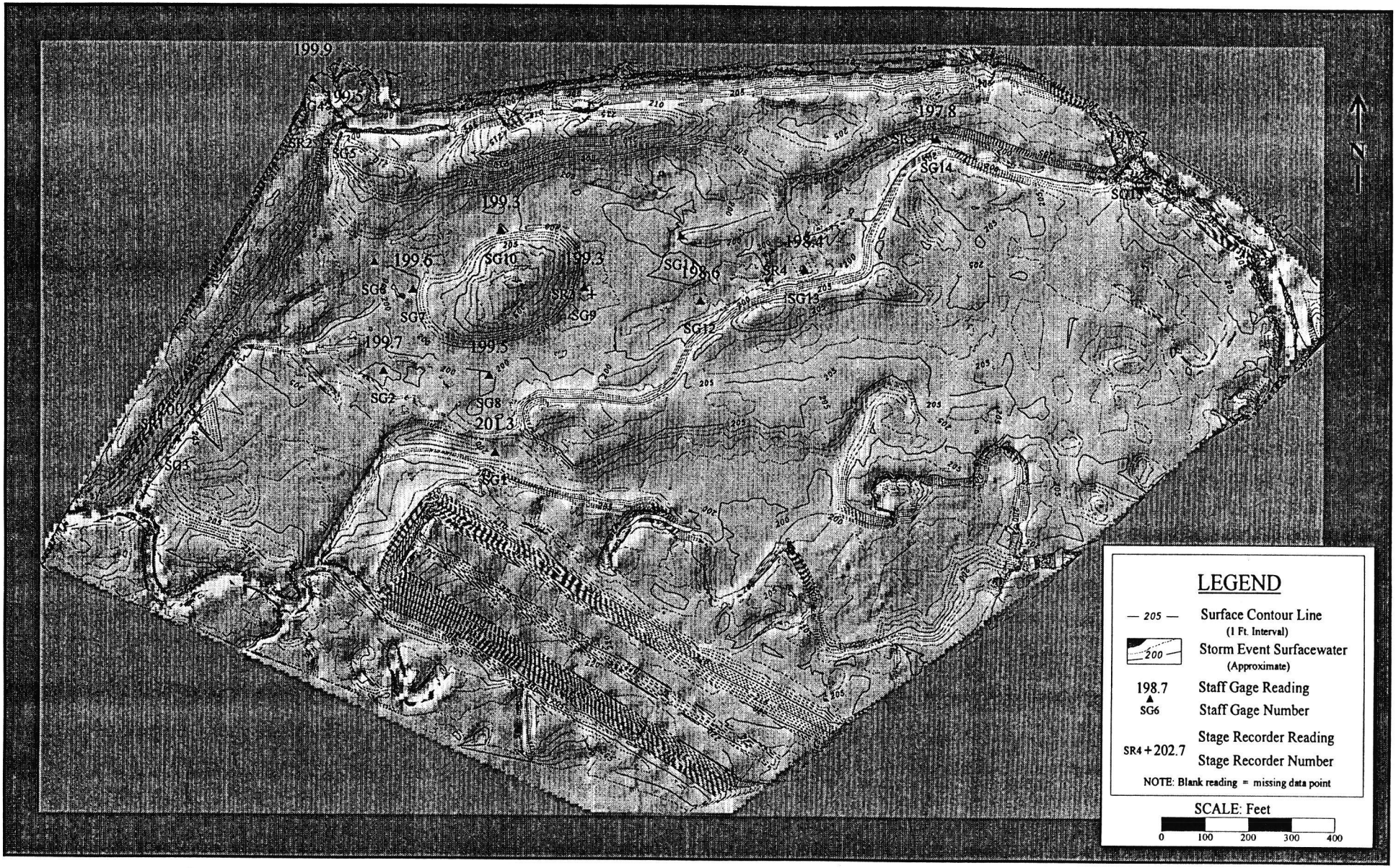
Nevins Creek Mitigation Area



Surfacewater Elevations

(05/07/96)

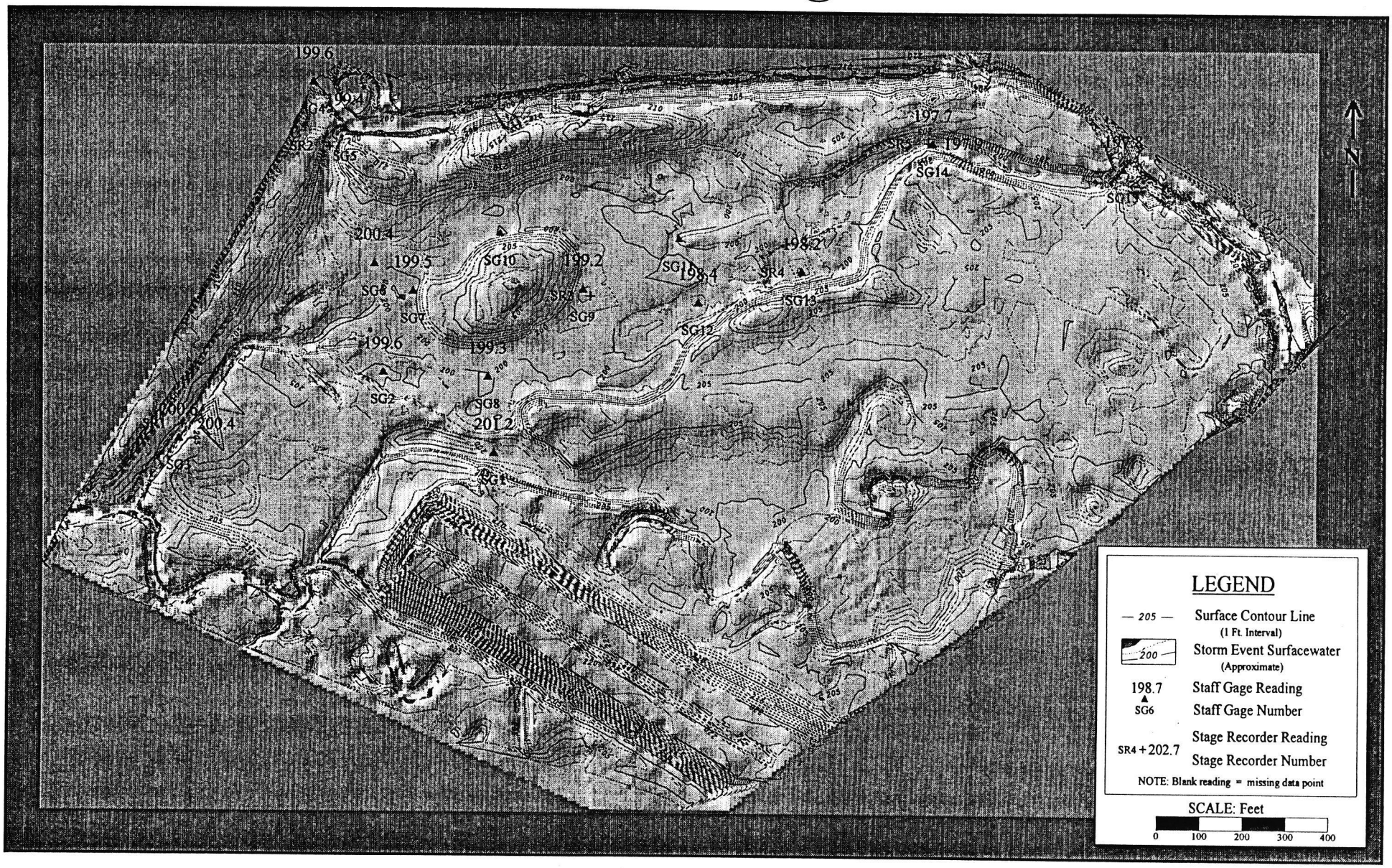
Nevins Creek Mitigation Area



Surfacewater Elevations

(05/19/96)

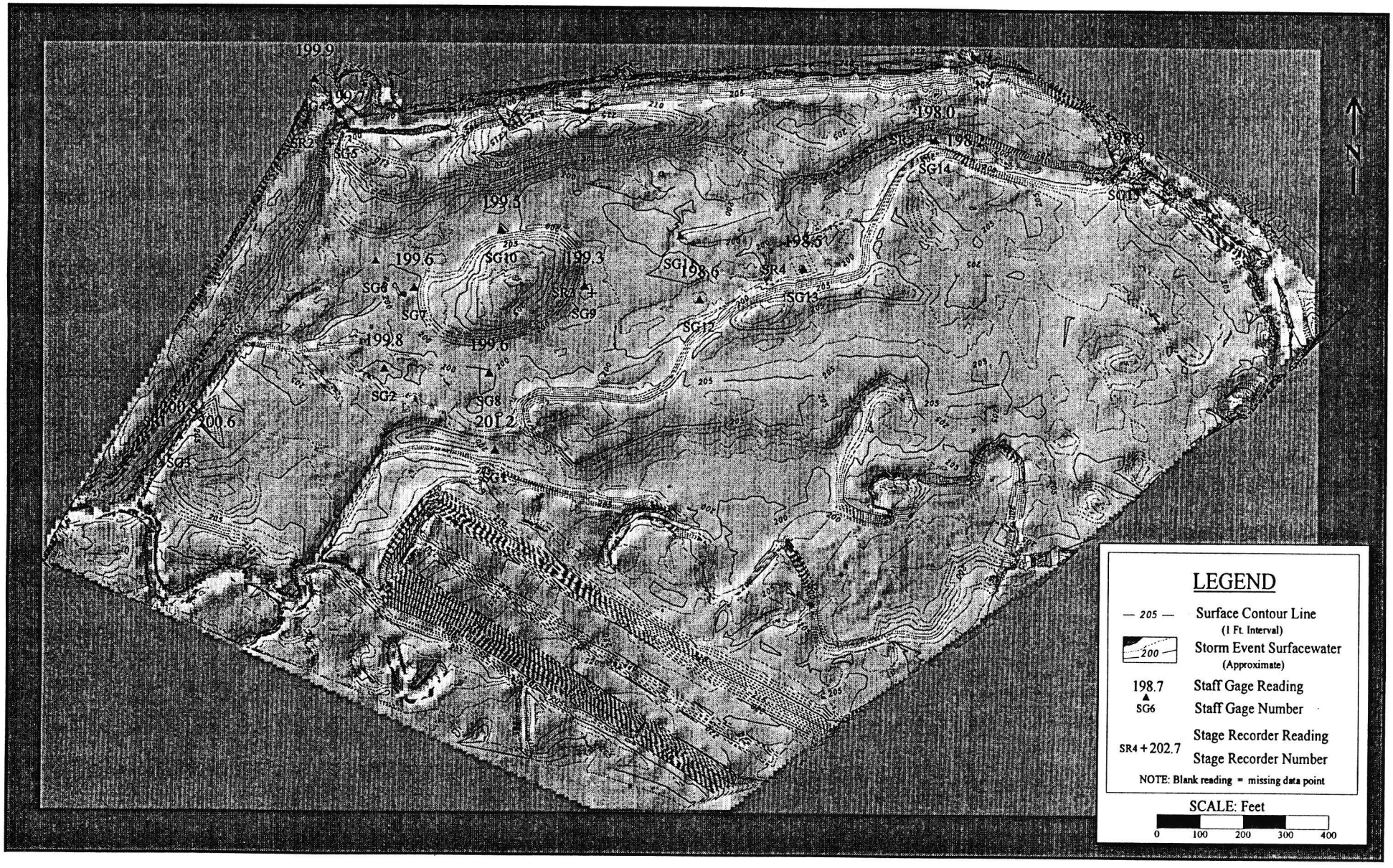
Nevins Creek Mitigation Area



Surfacewater Elevations

(05/31/96)

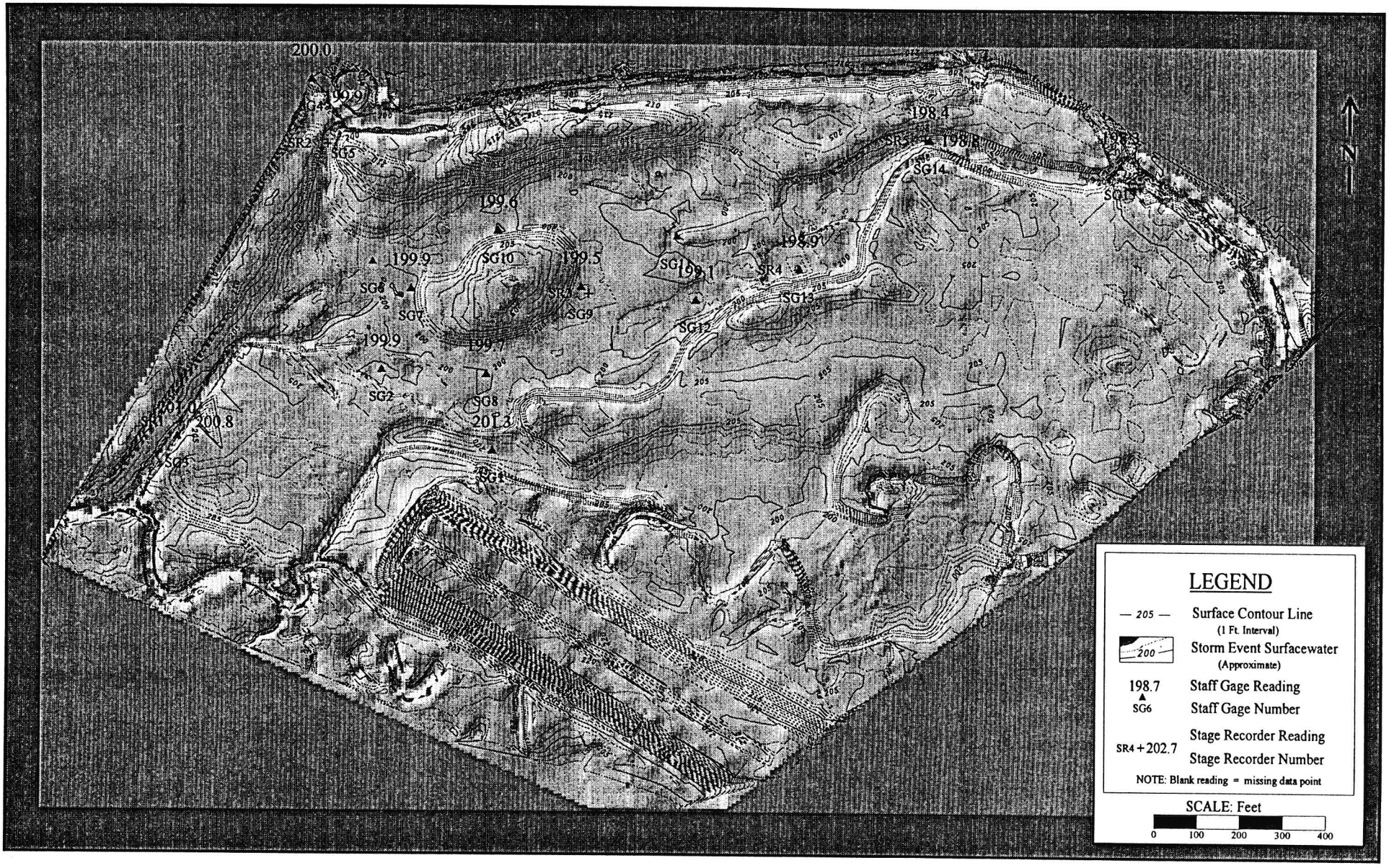
Nevins Creek Mitigation Area



Surfacewater Elevations

(06/03/96)

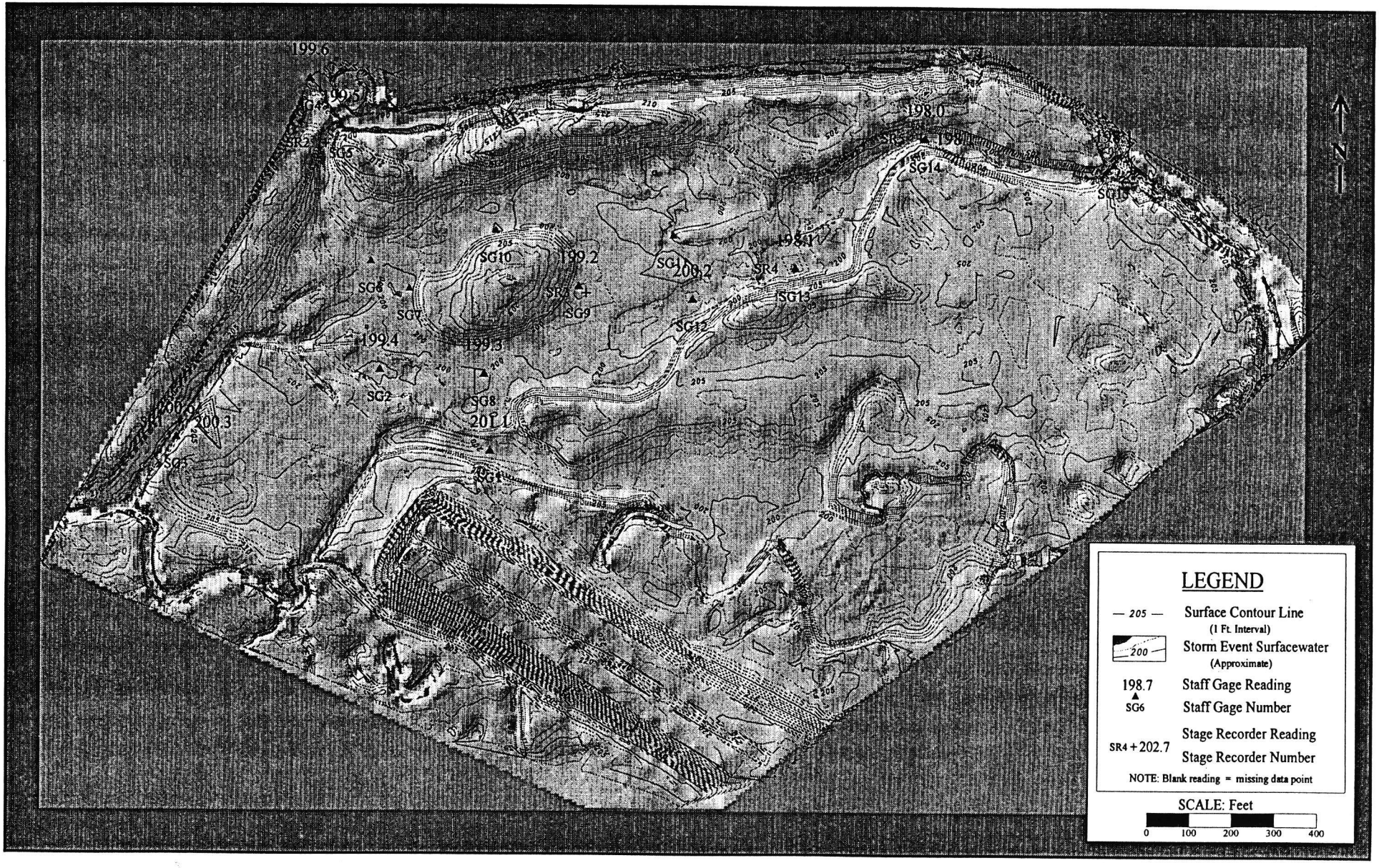
Nevins Creek Mitigation Area



Surfacewater Elevations

(06/07/96)

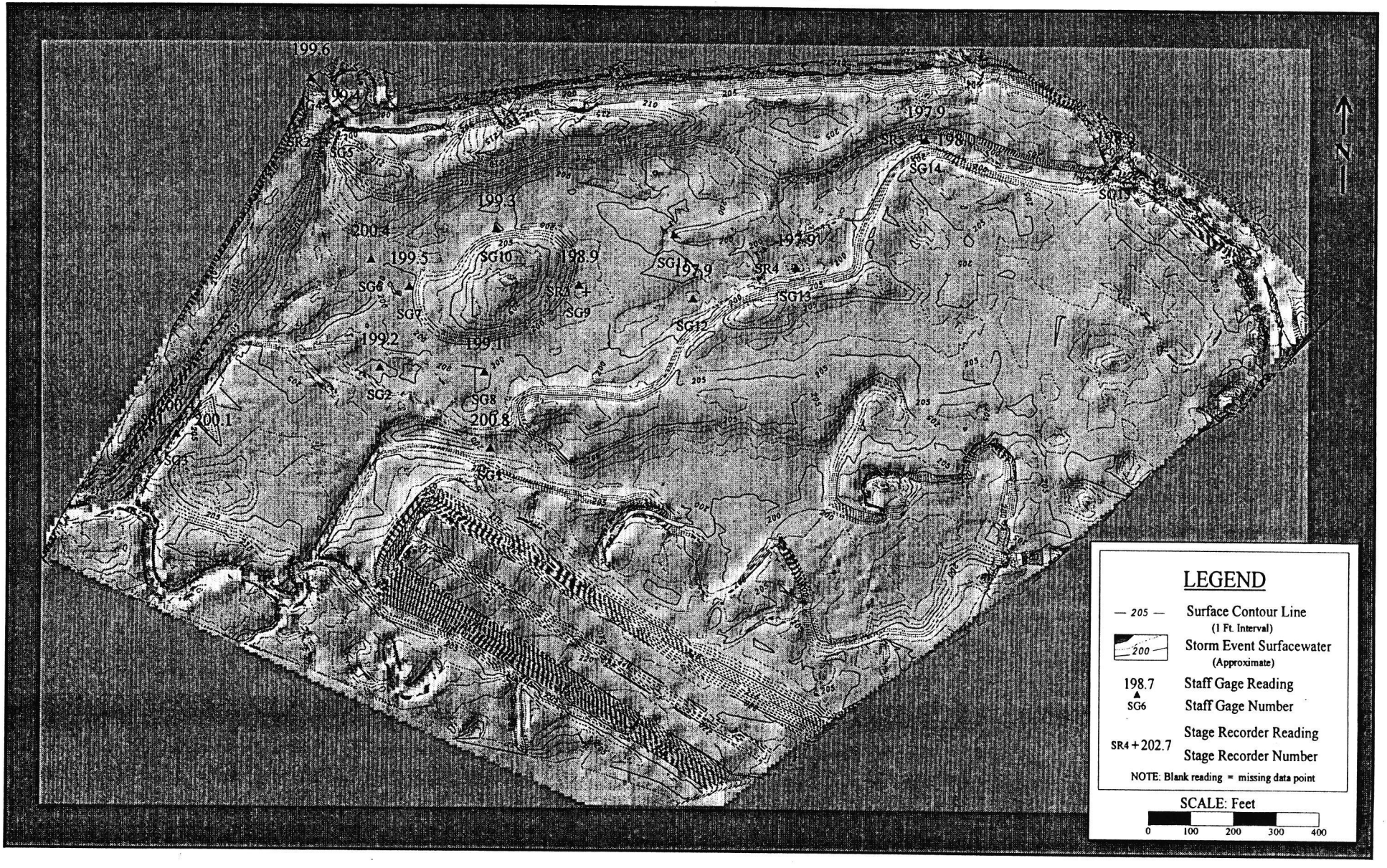
Nevins Creek Mitigation Area



Surfacewater Elevations

(06/17/96)

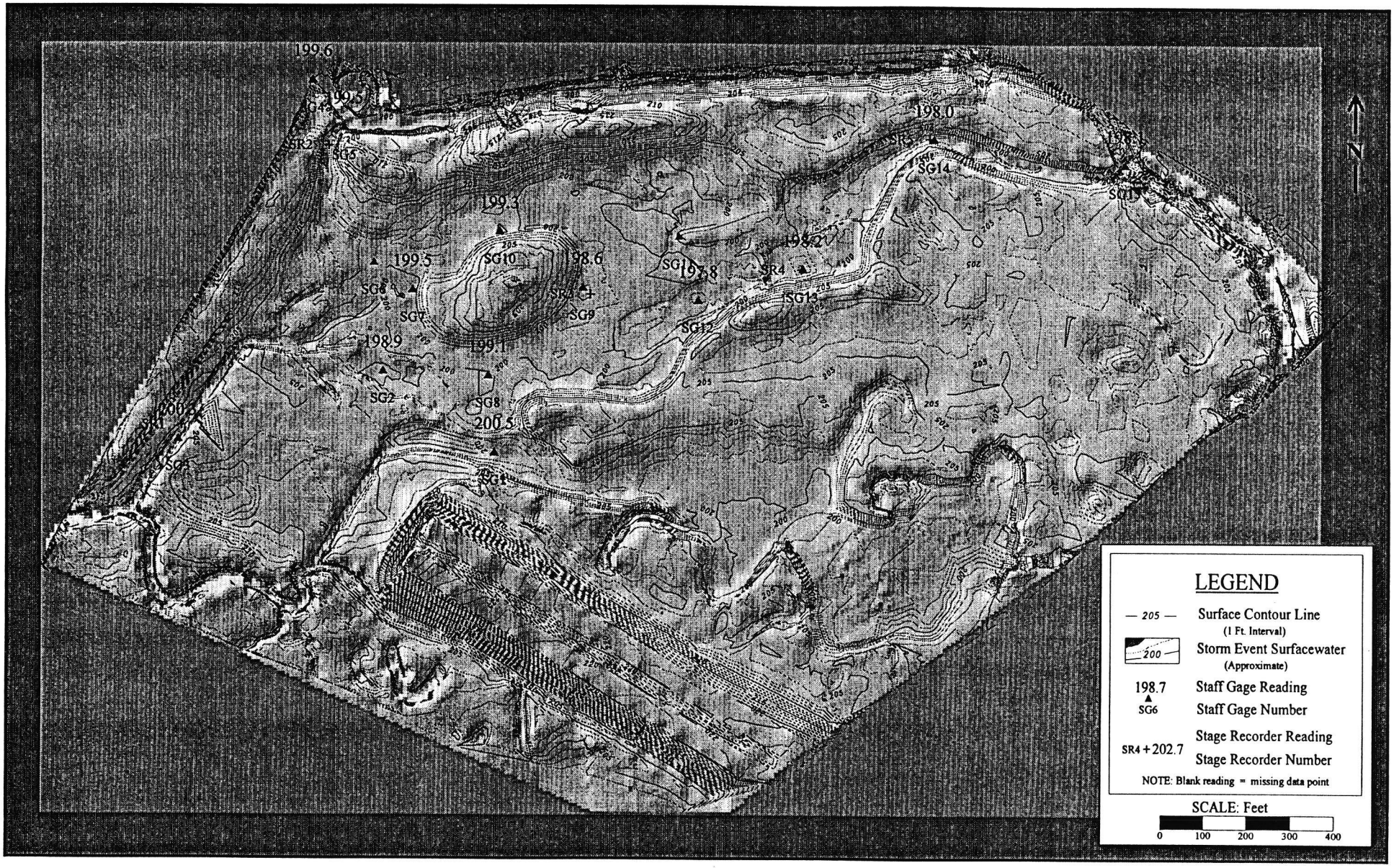
Nevins Creek Mitigation Area



Surfacewater Elevations

(06/30/96)

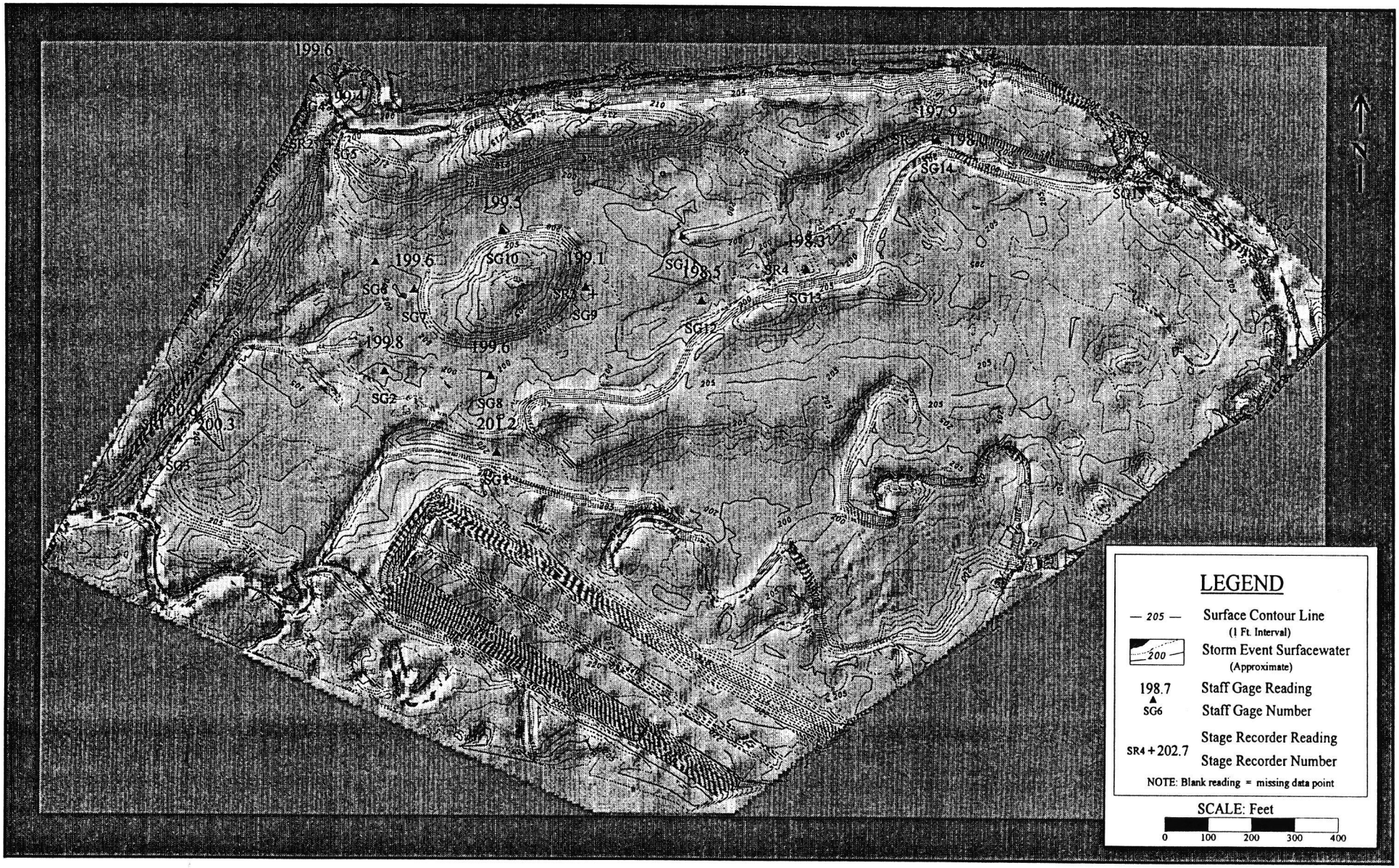
Nevins Creek Mitigation Area



Surfacewater Elevations

(07/16/96)

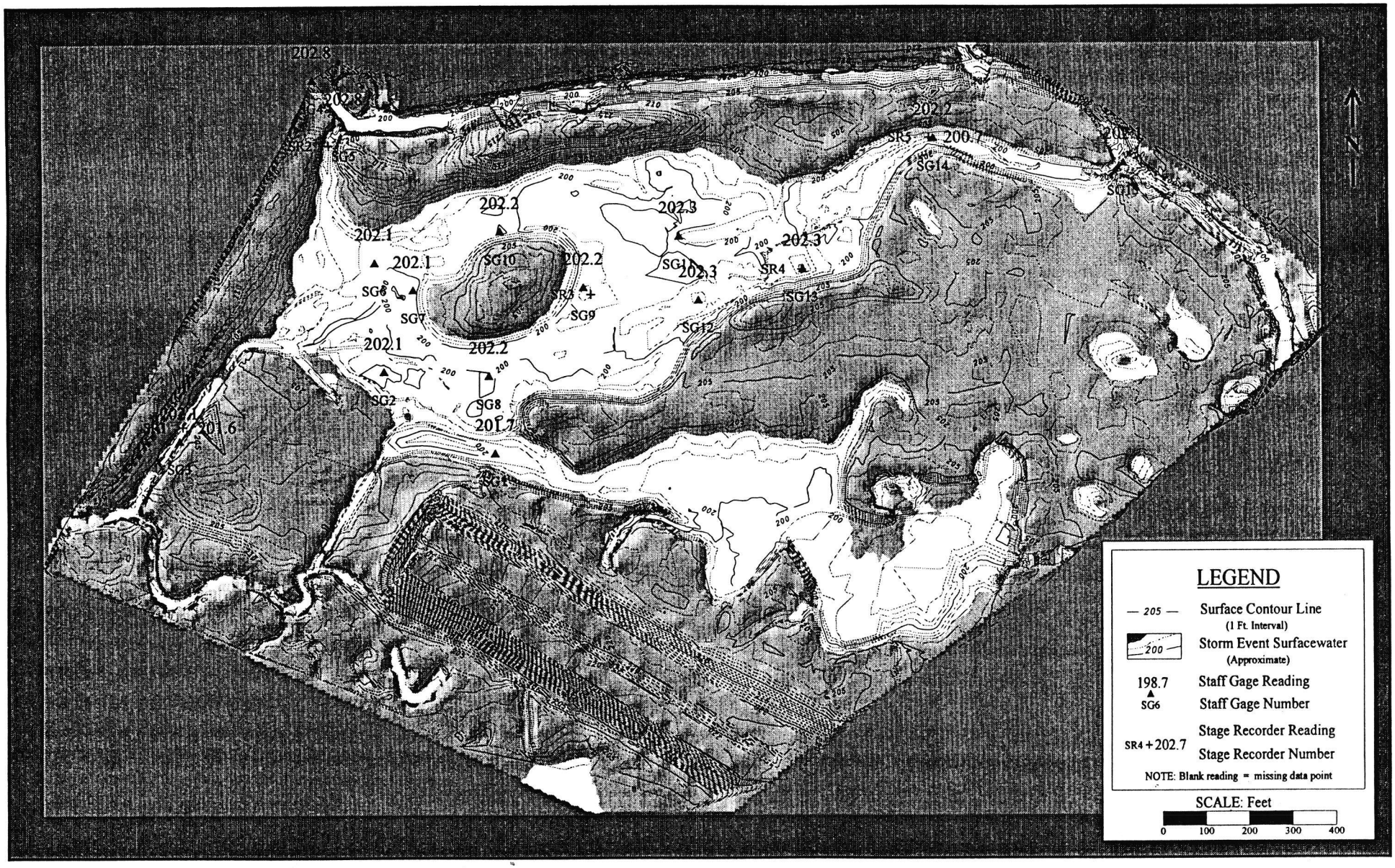
Nevins Creek Mitigation Area



Surfacewater Elevations

(07/29/96)

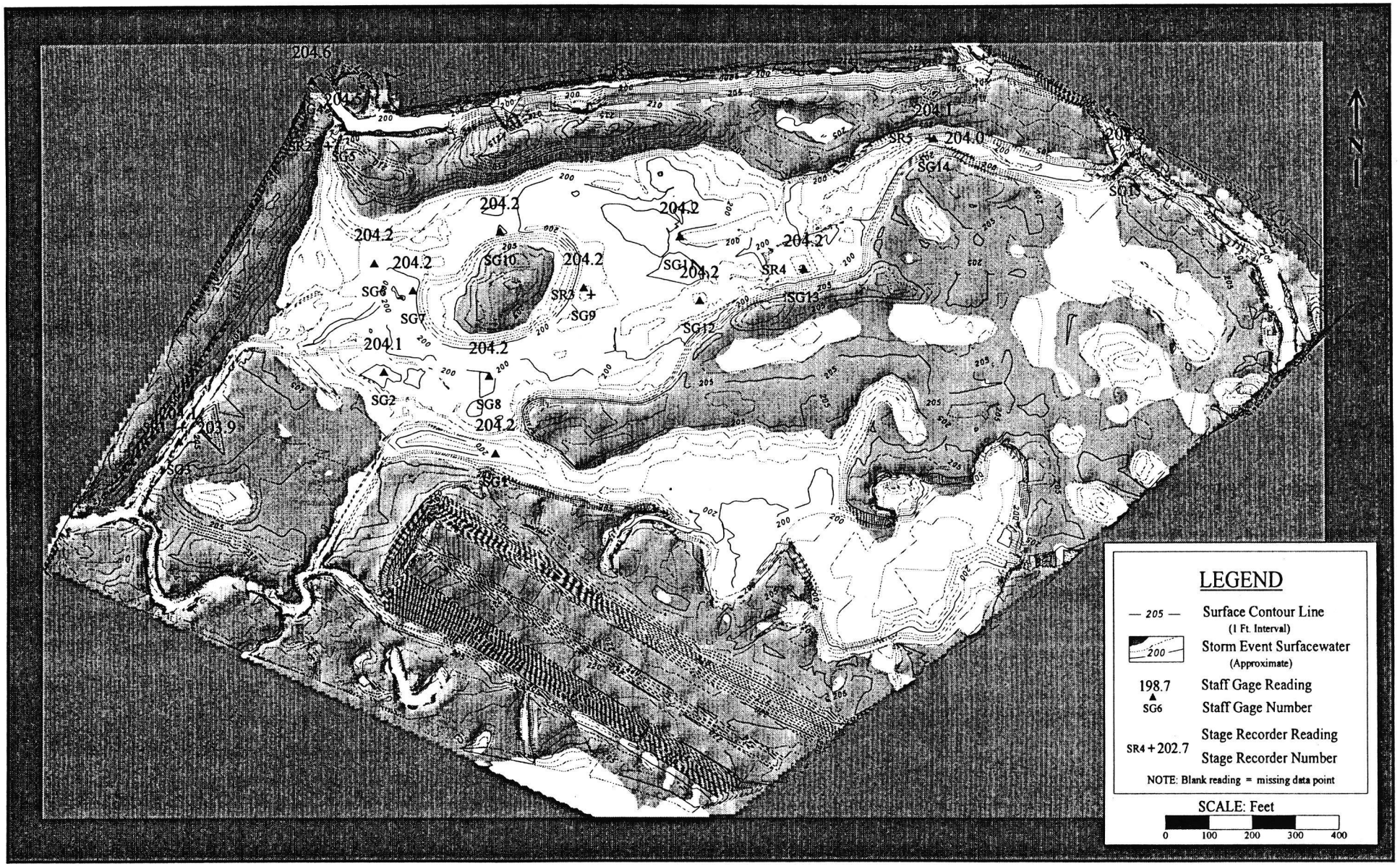
Nevins Creek Mitigation Area



Surfacewater Elevations

(07/30/96)

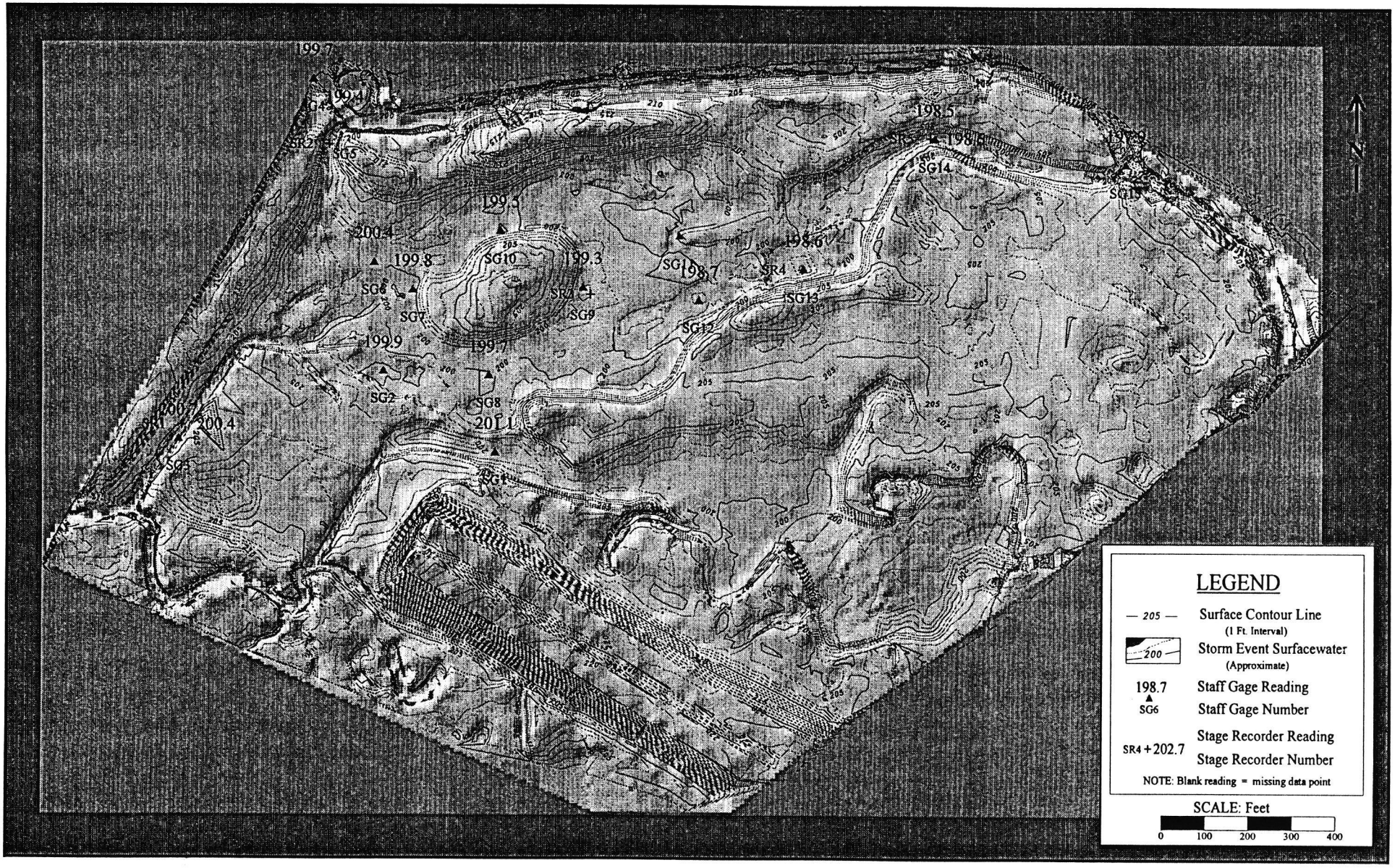
Nevins Creek Mitigation Area



Surfacewater Elevations

(07/31/96)

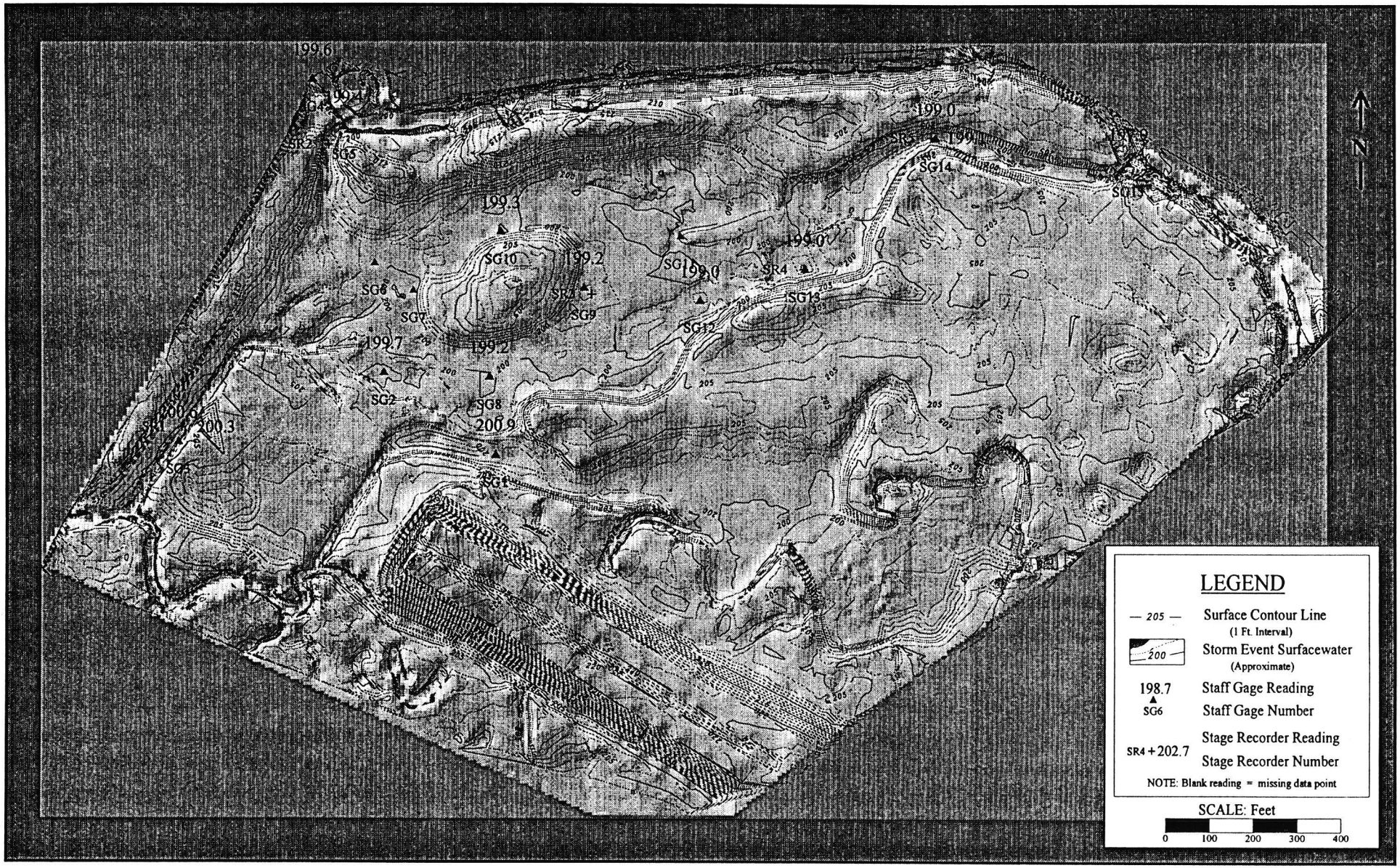
Nevins Creek Mitigation Area



Surfacewater Elevations

(08/06/96)

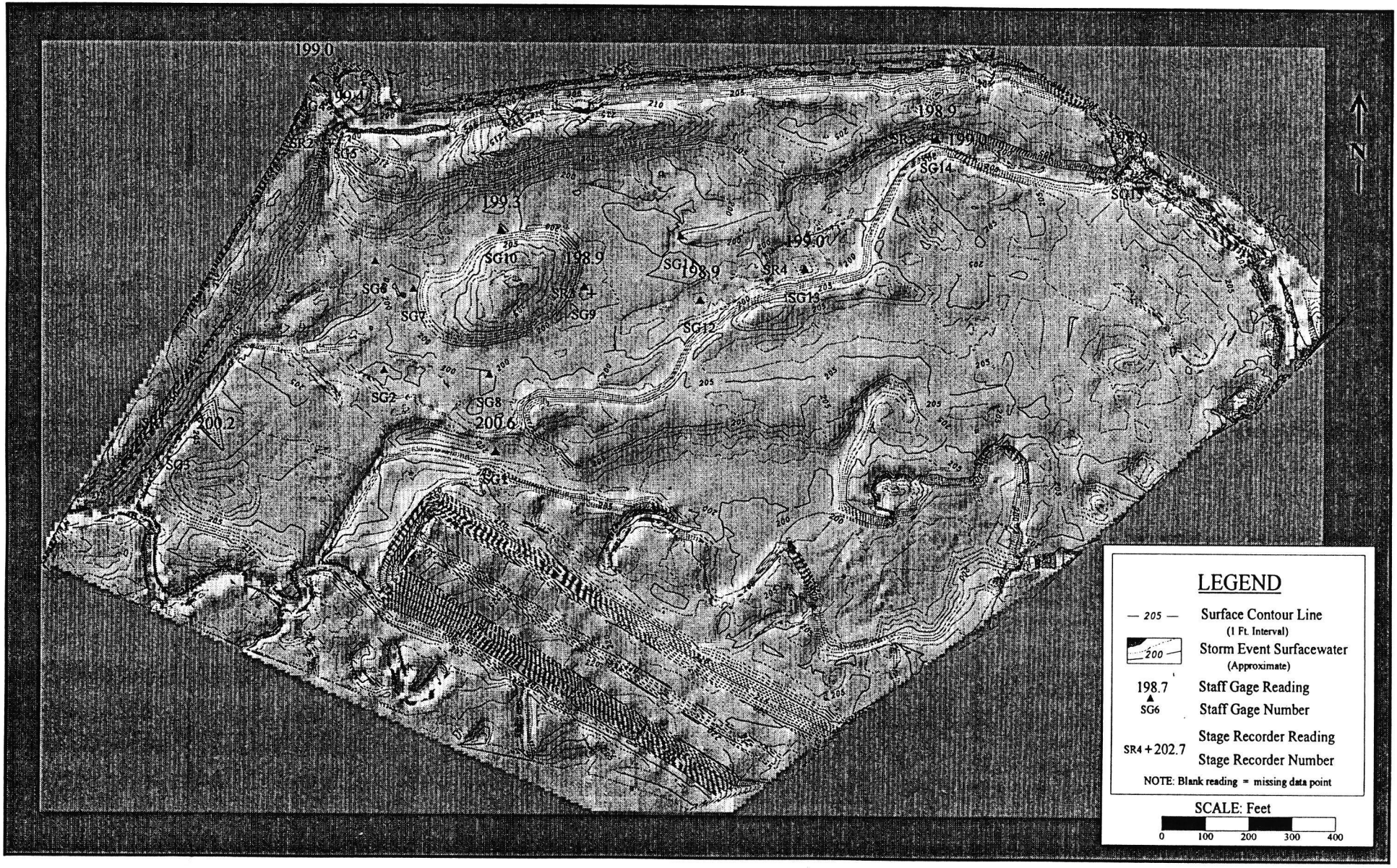
Nevins Creek Mitigation Area



Surfacewater Elevations

(08/13/96)

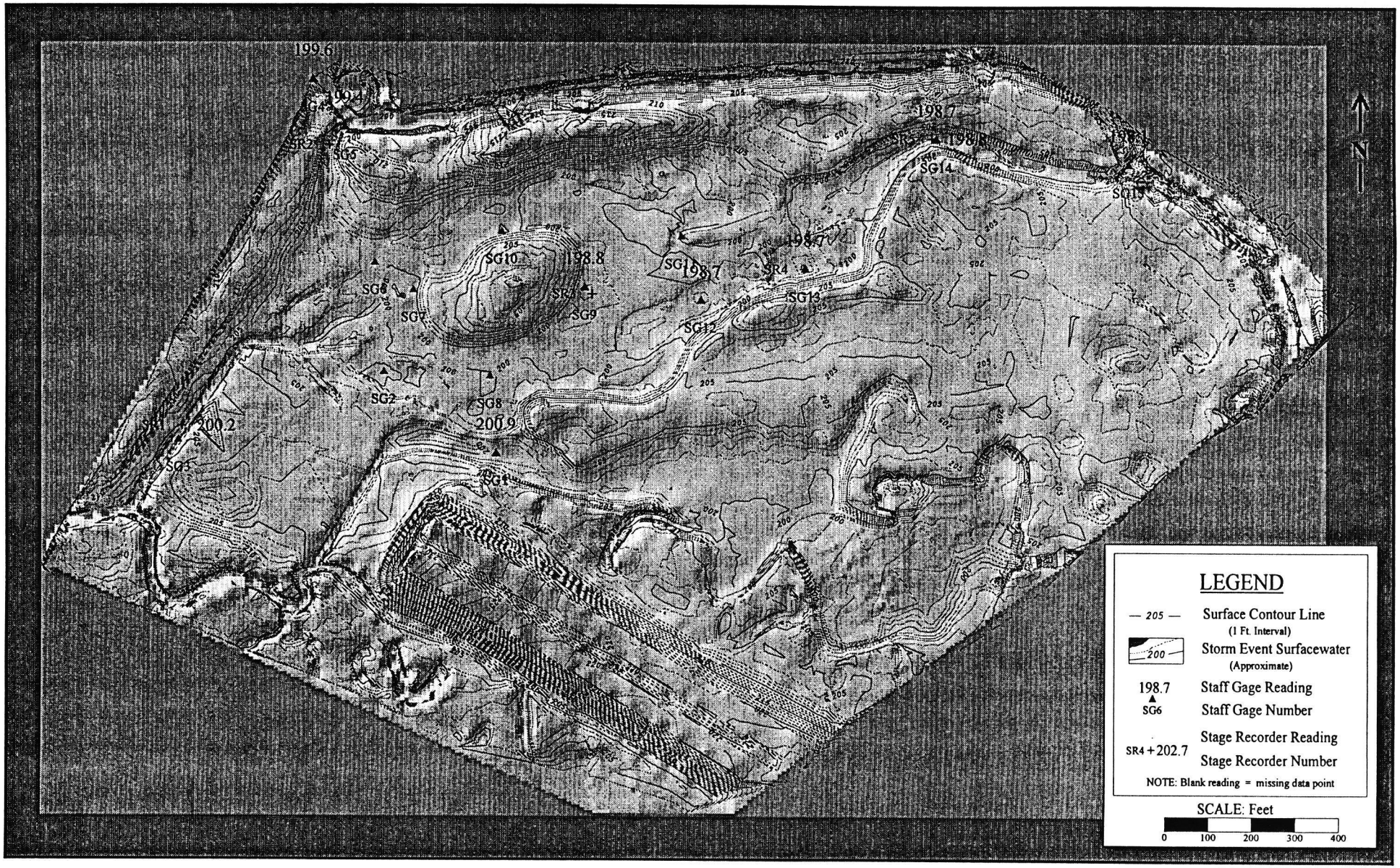
Nevins Creek Mitigation Area



Surfacewater Elevations

(08/26/96)

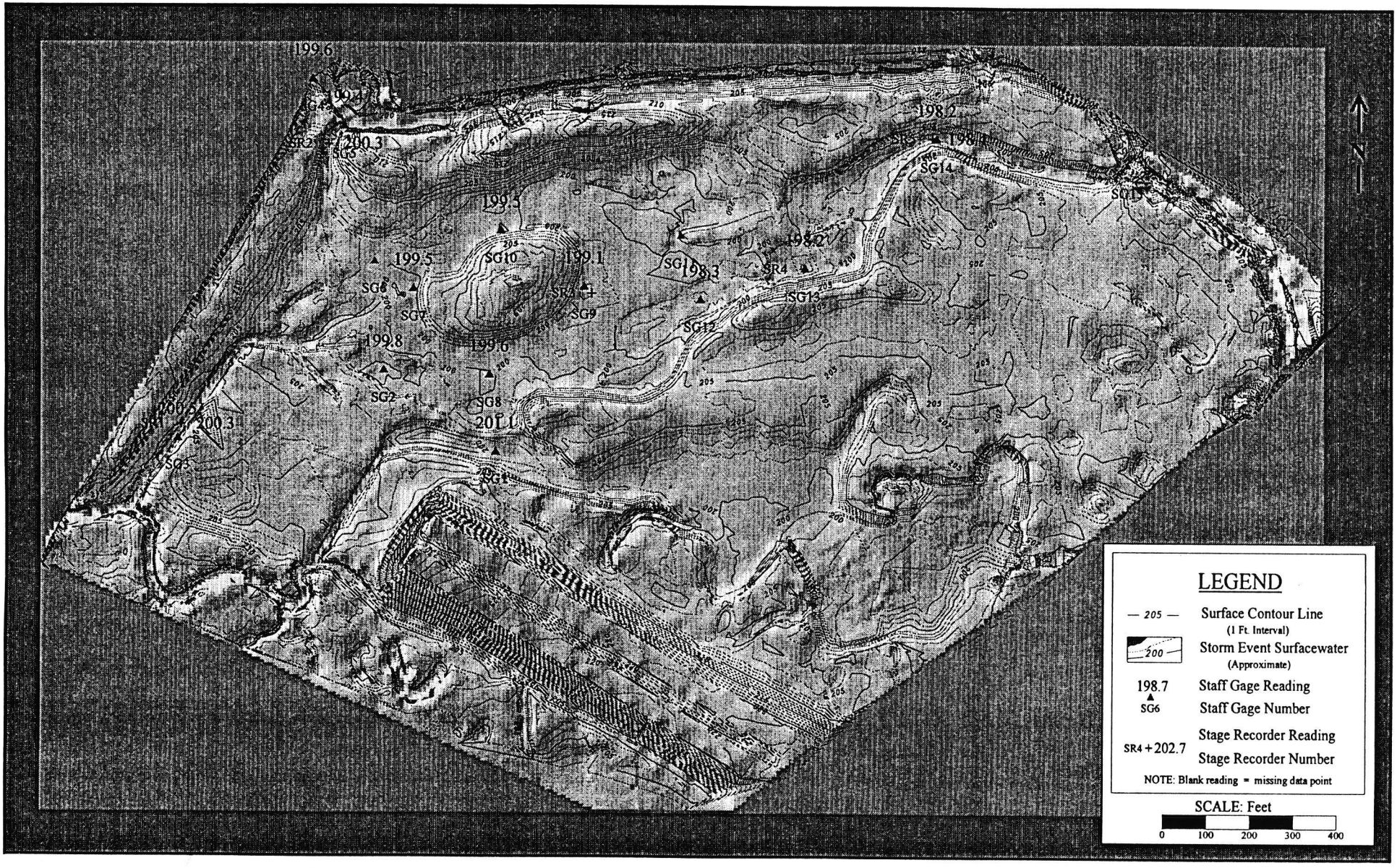
Nevins Creek Mitigation Area



Surfacewater Elevations

(09/09/96)

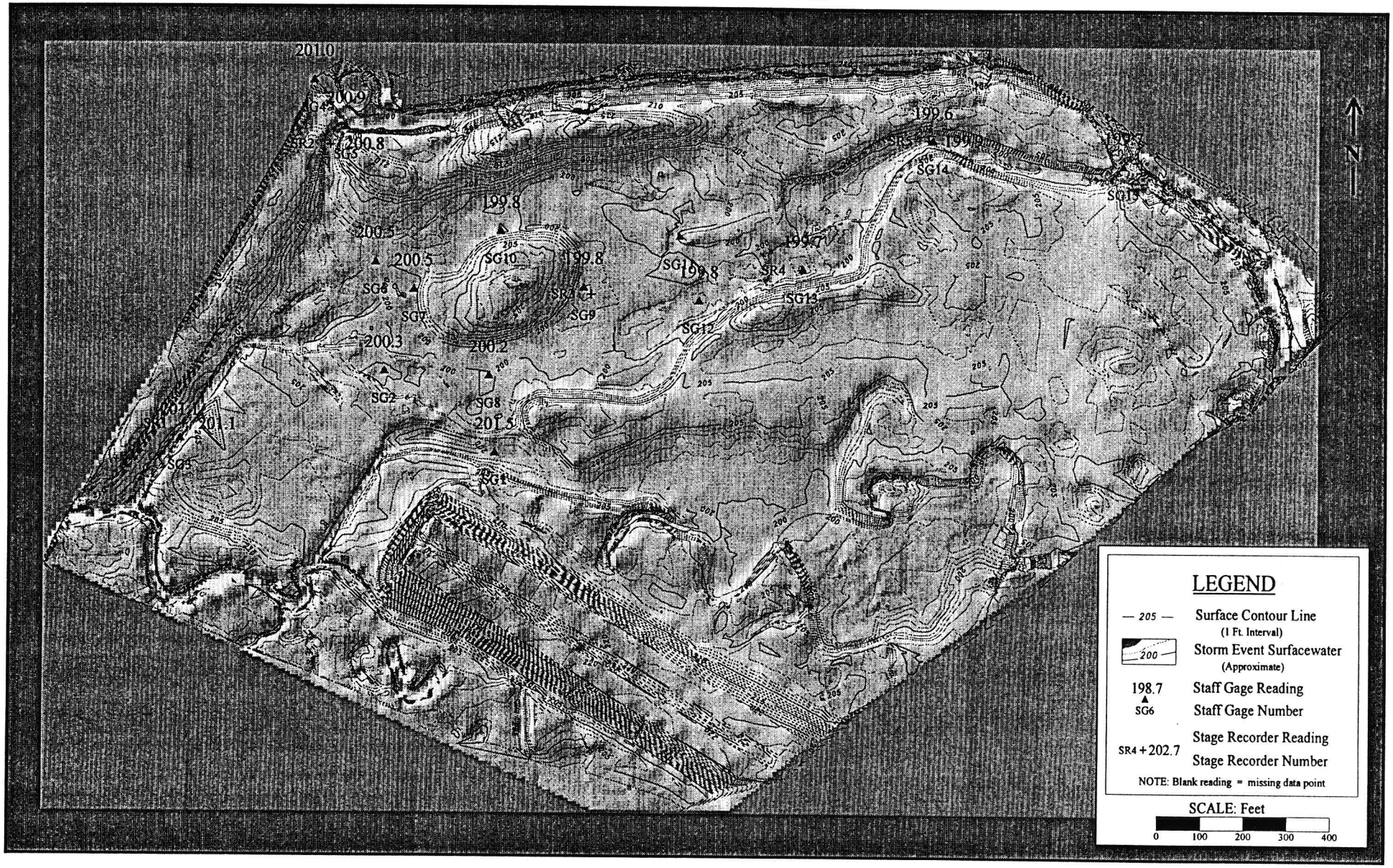
Nevins Creek Mitigation Area



Surfacewater Elevations

(09/23/96)

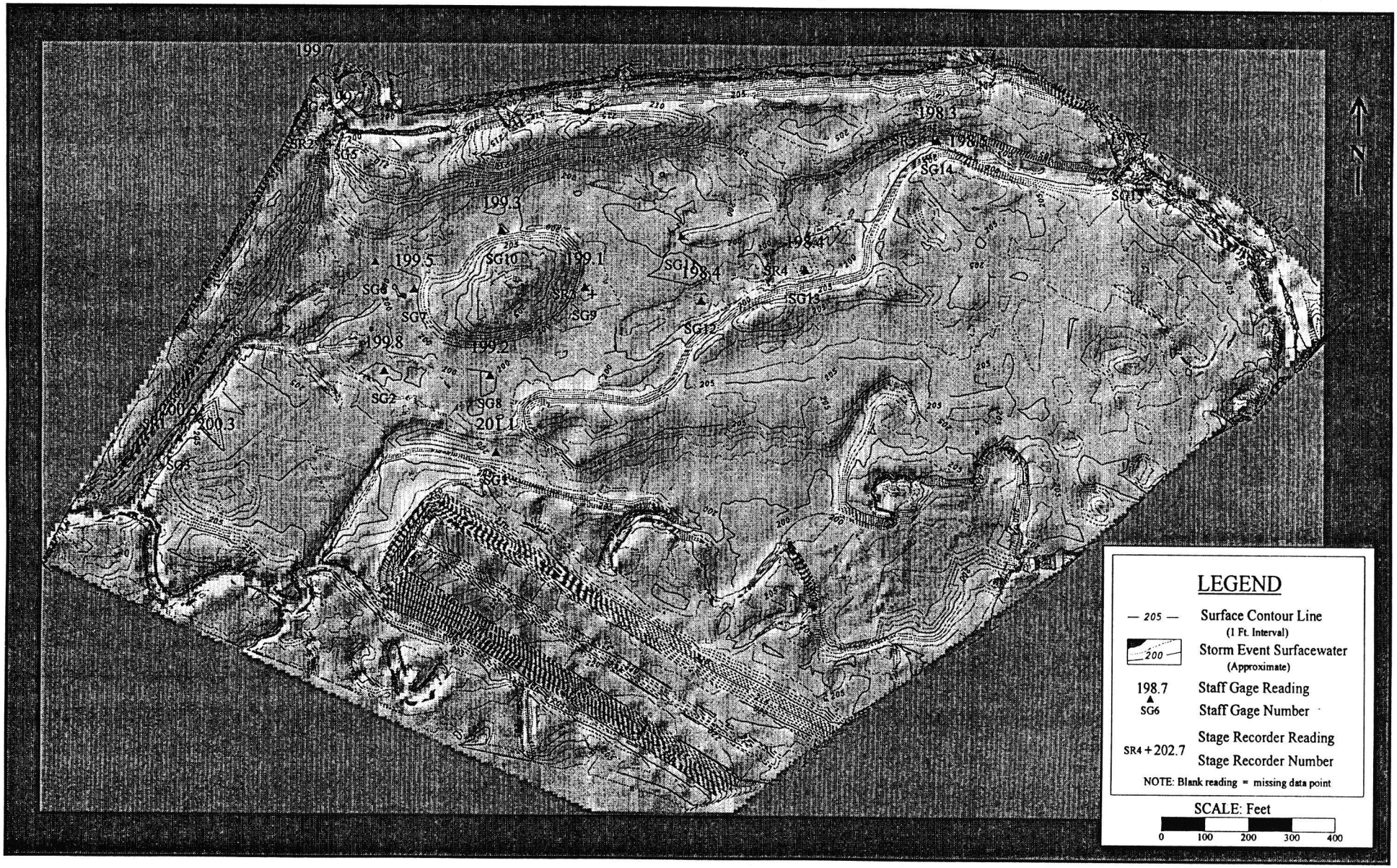
Nevins Creek Mitigation Area



Surfacewater Elevations

(09/27/96)

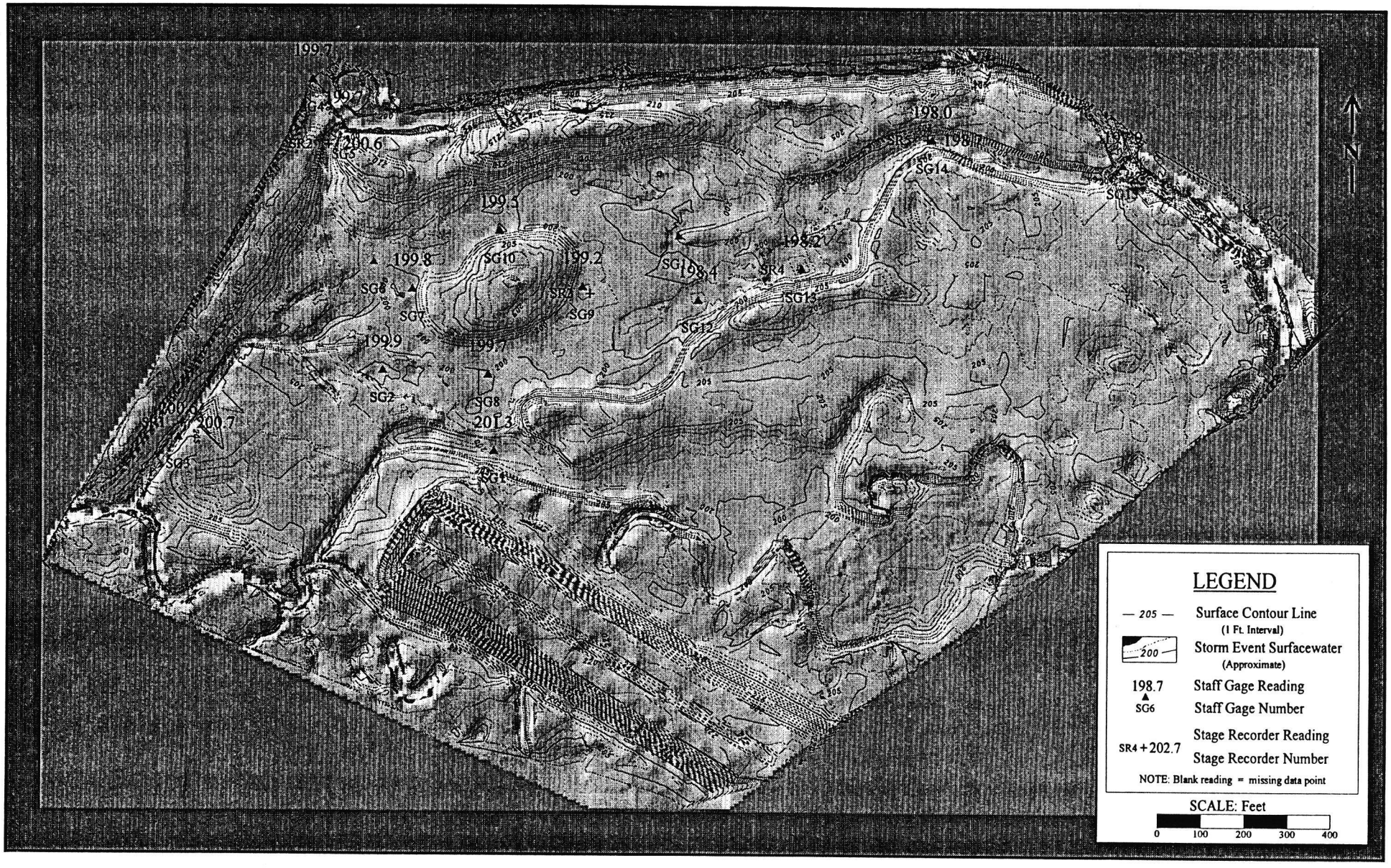
Nevins Creek Mitigation Area



Surfacewater Elevations

(10/10/96)

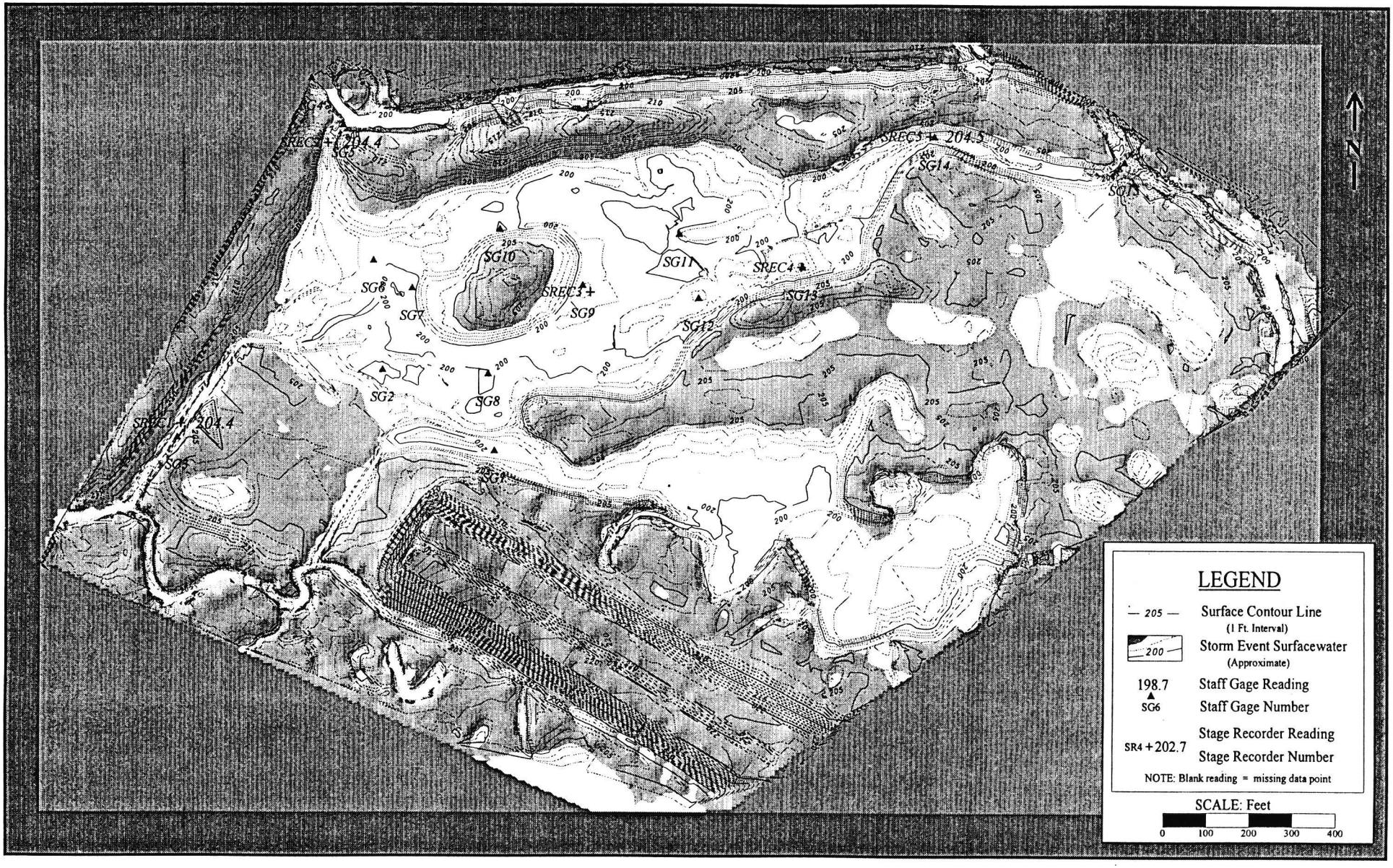
Nevins Creek Mitigation Area



Surfacewater Elevations

(10/21/96)

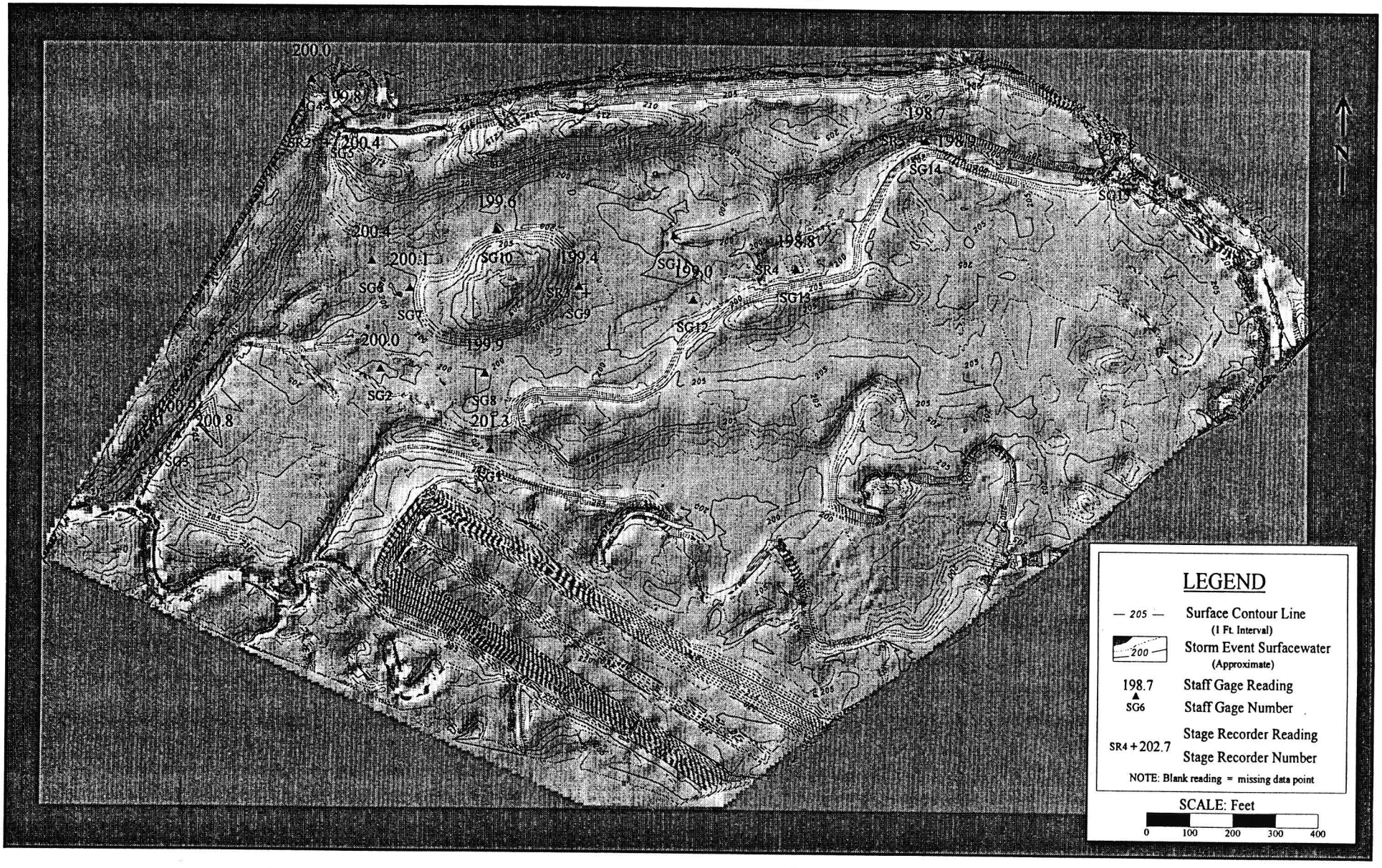
Nevins Creek Mitigation Area



Surfacewater Elevations

(10/22/96)

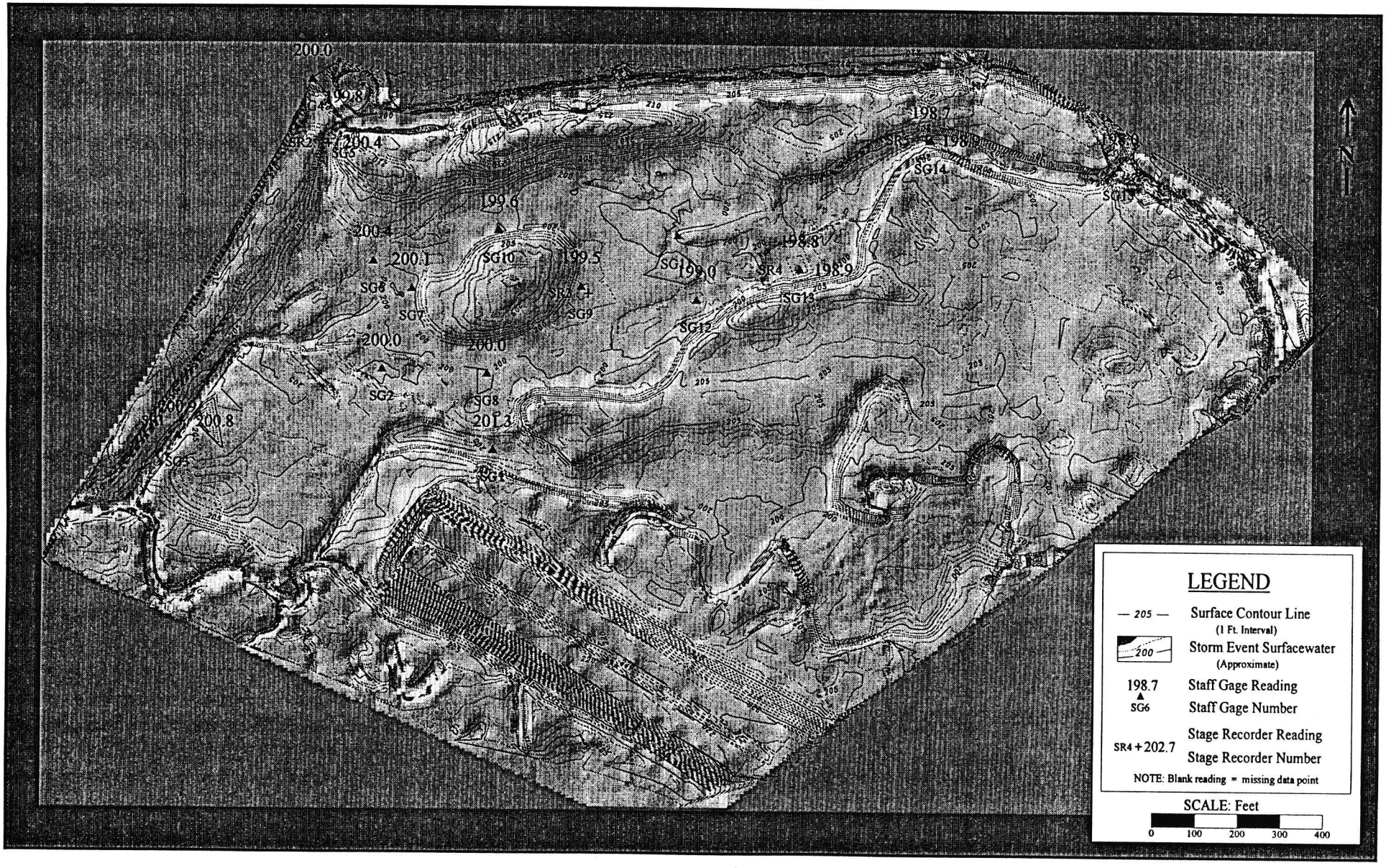
Nevins Creek Mitigation Area



Surfacewater Elevations

(10/25/96)

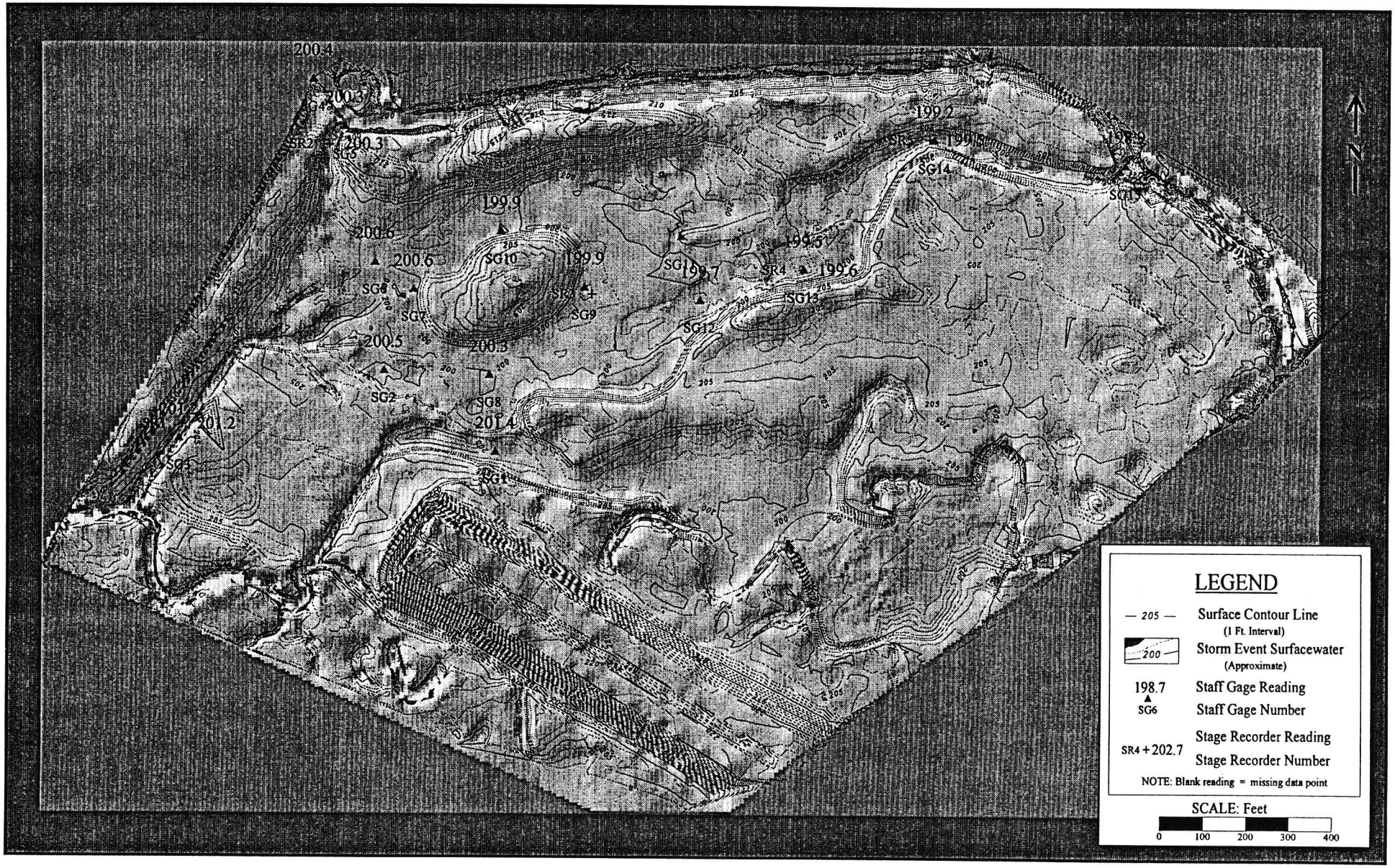
Nevins Creek Mitigation Area



Surfacewater Elevations

(11/04/96)

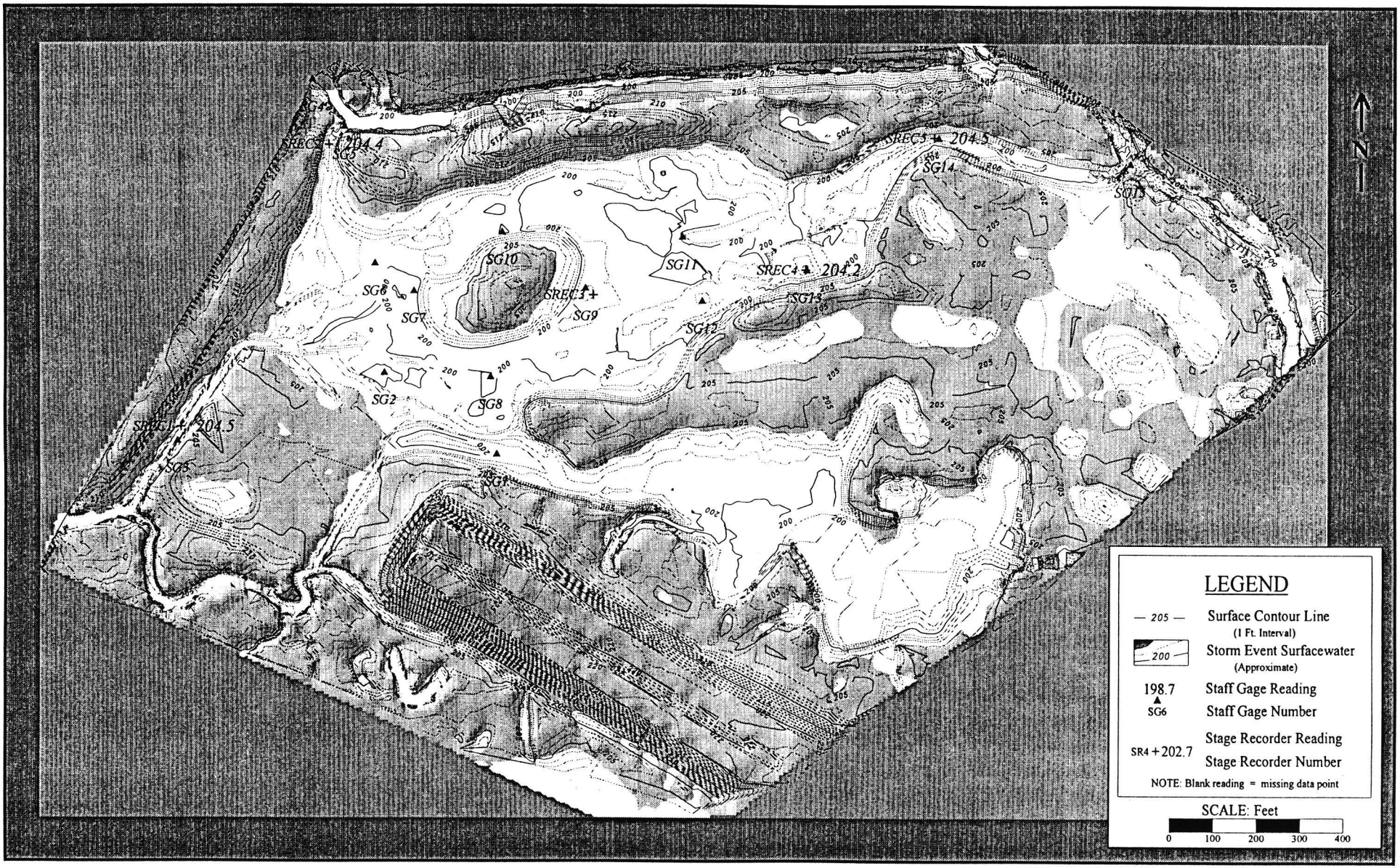
Nevins Creek Mitigation Area



Surfacewater Elevations

(11/18/96)

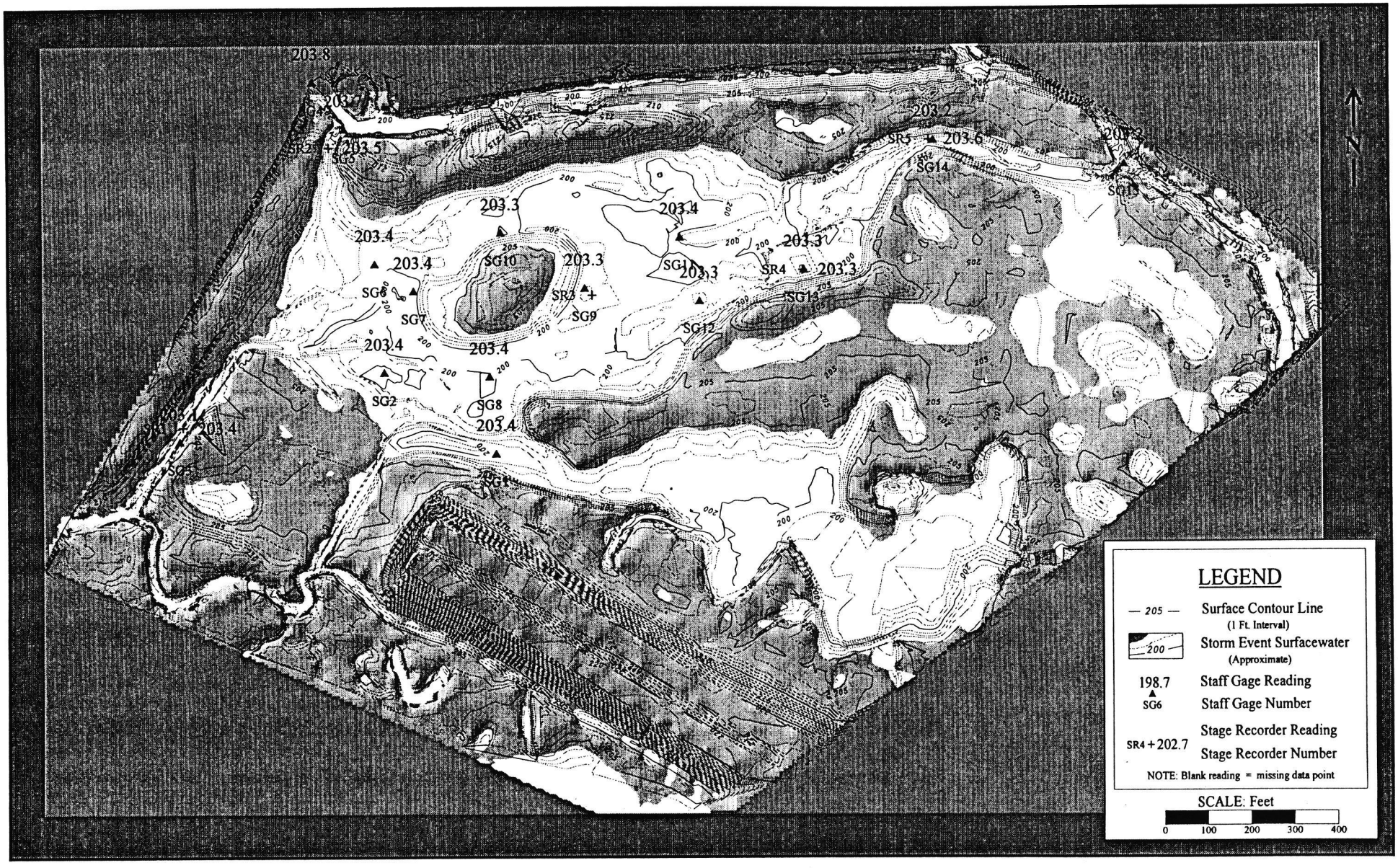
Nevins Creek Mitigation Area



Surfacewater Elevations

(11/25/96)

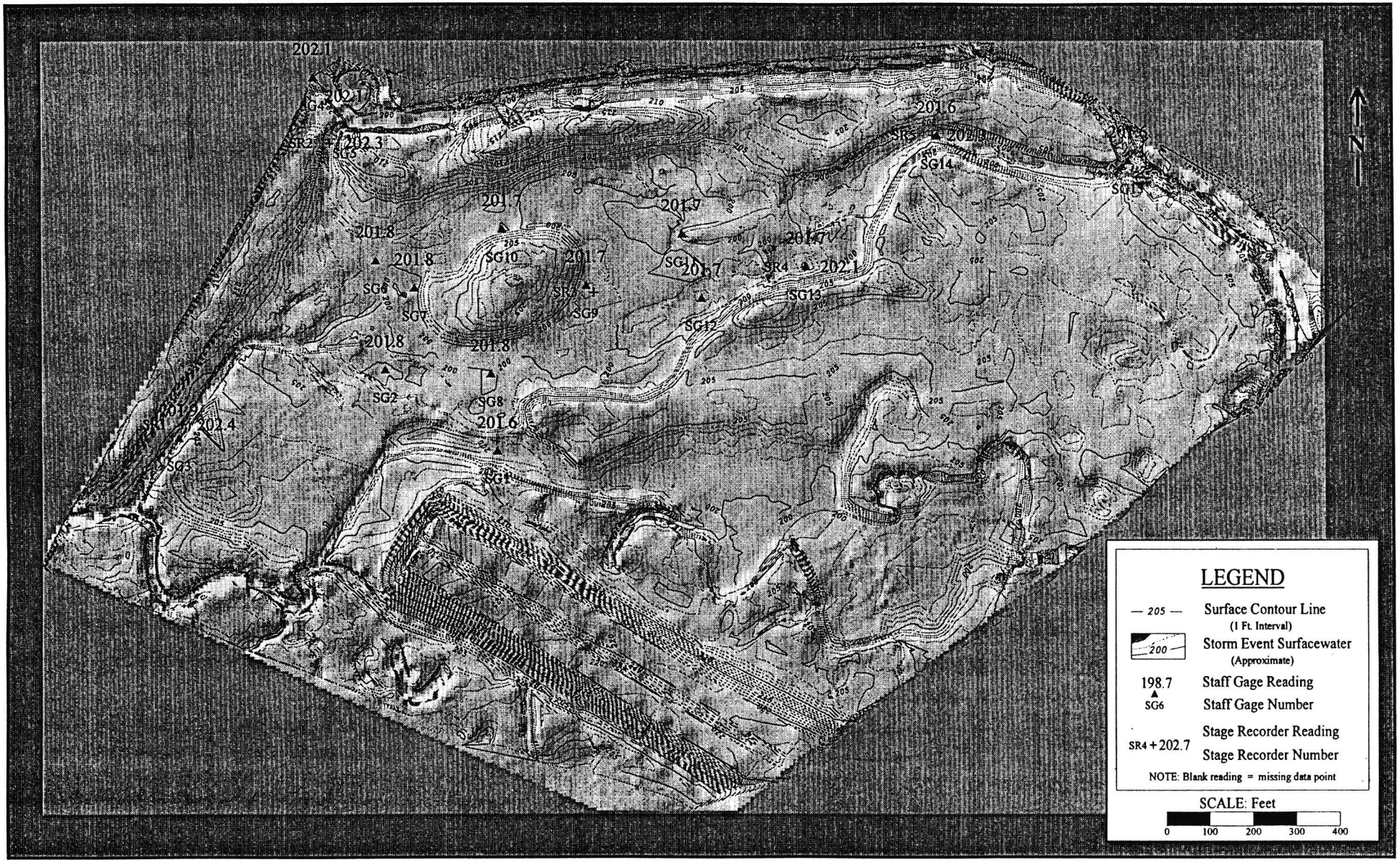
Nevins Creek Mitigation Area



Surfacewater Elevations

(11/26/96)

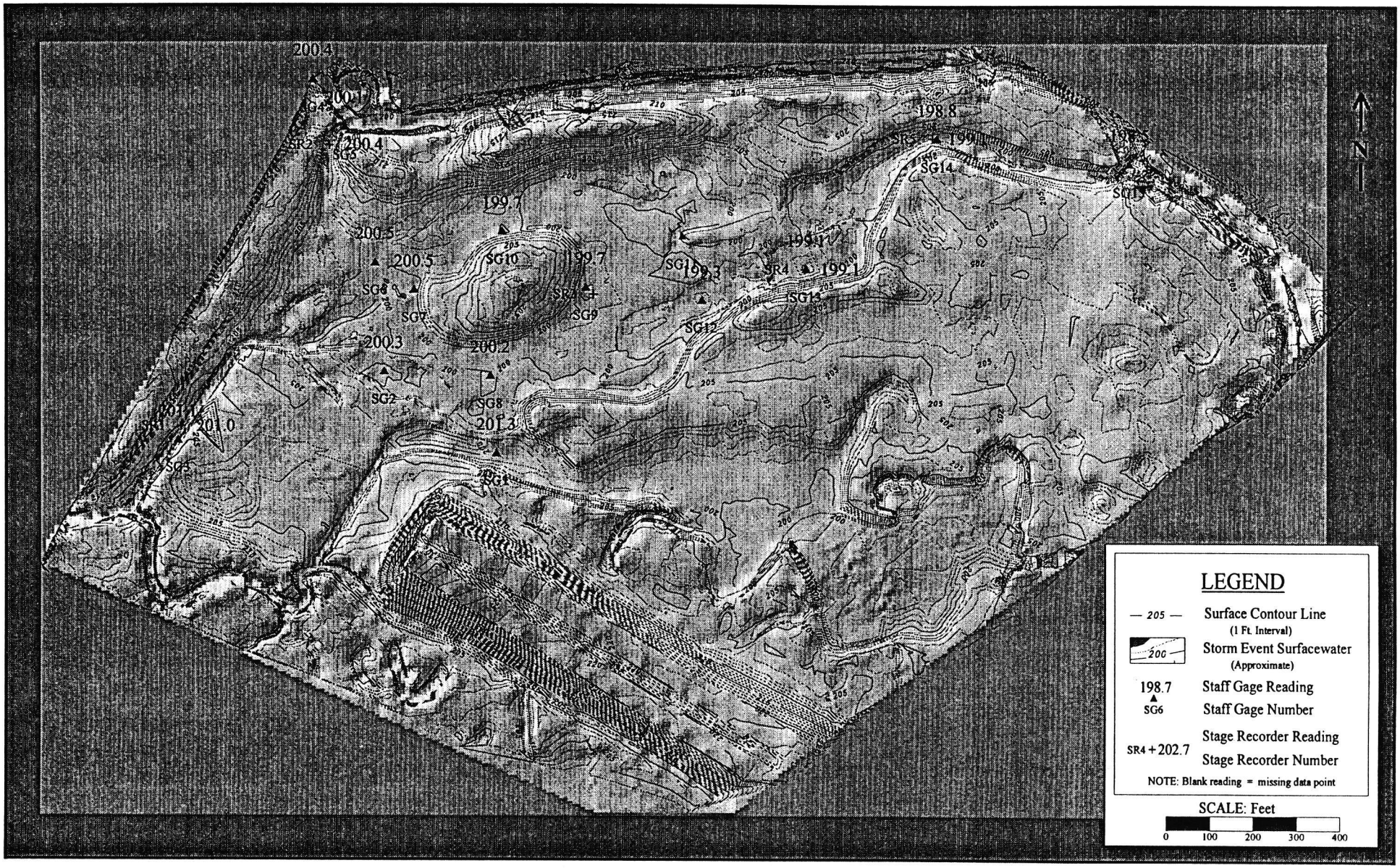
Nevins Creek Mitigation Area



Surfacewater Elevations

(12/02/96)

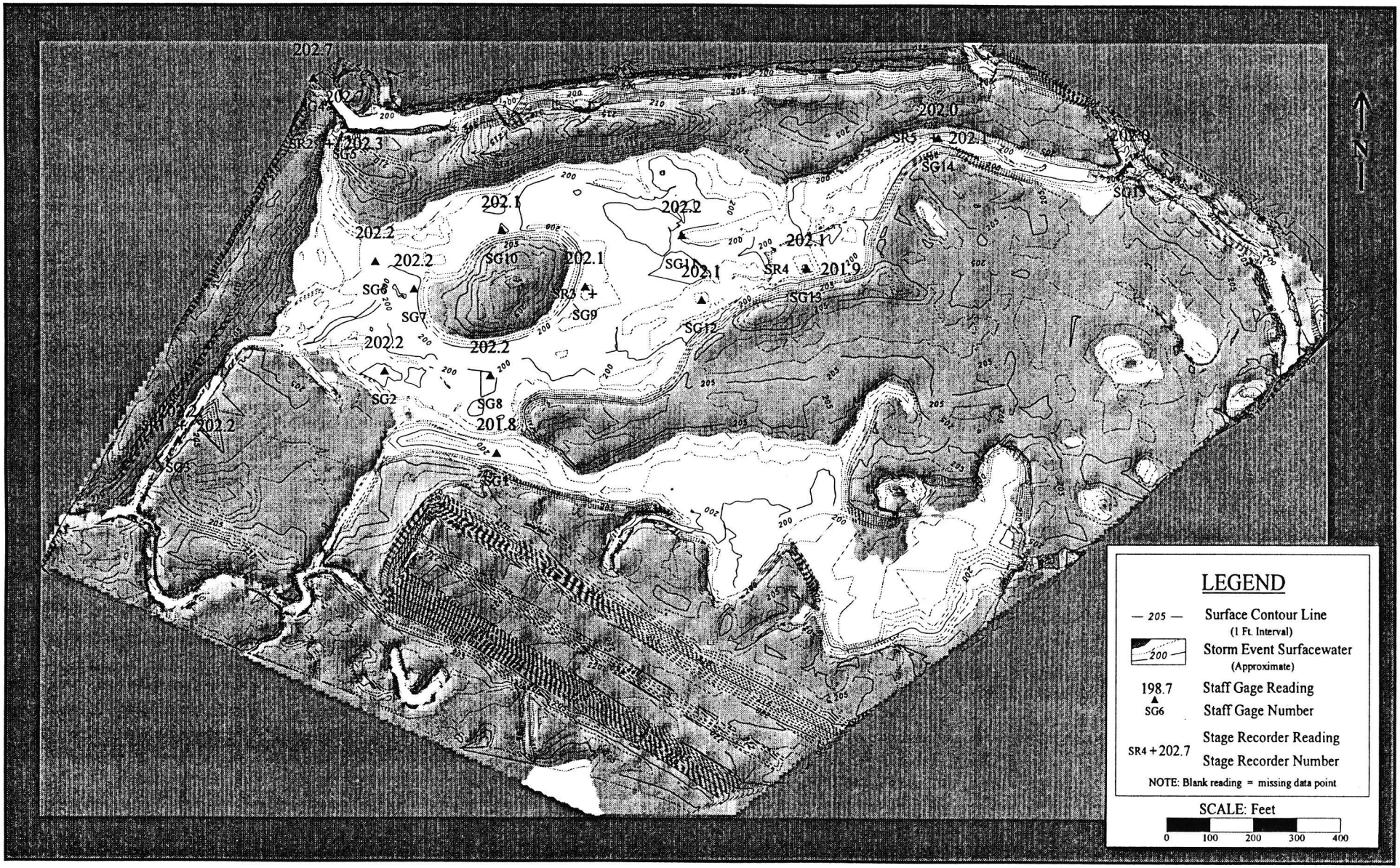
Nevins Creek Mitigation Area



Surfacewater Elevations

(12/08/96)

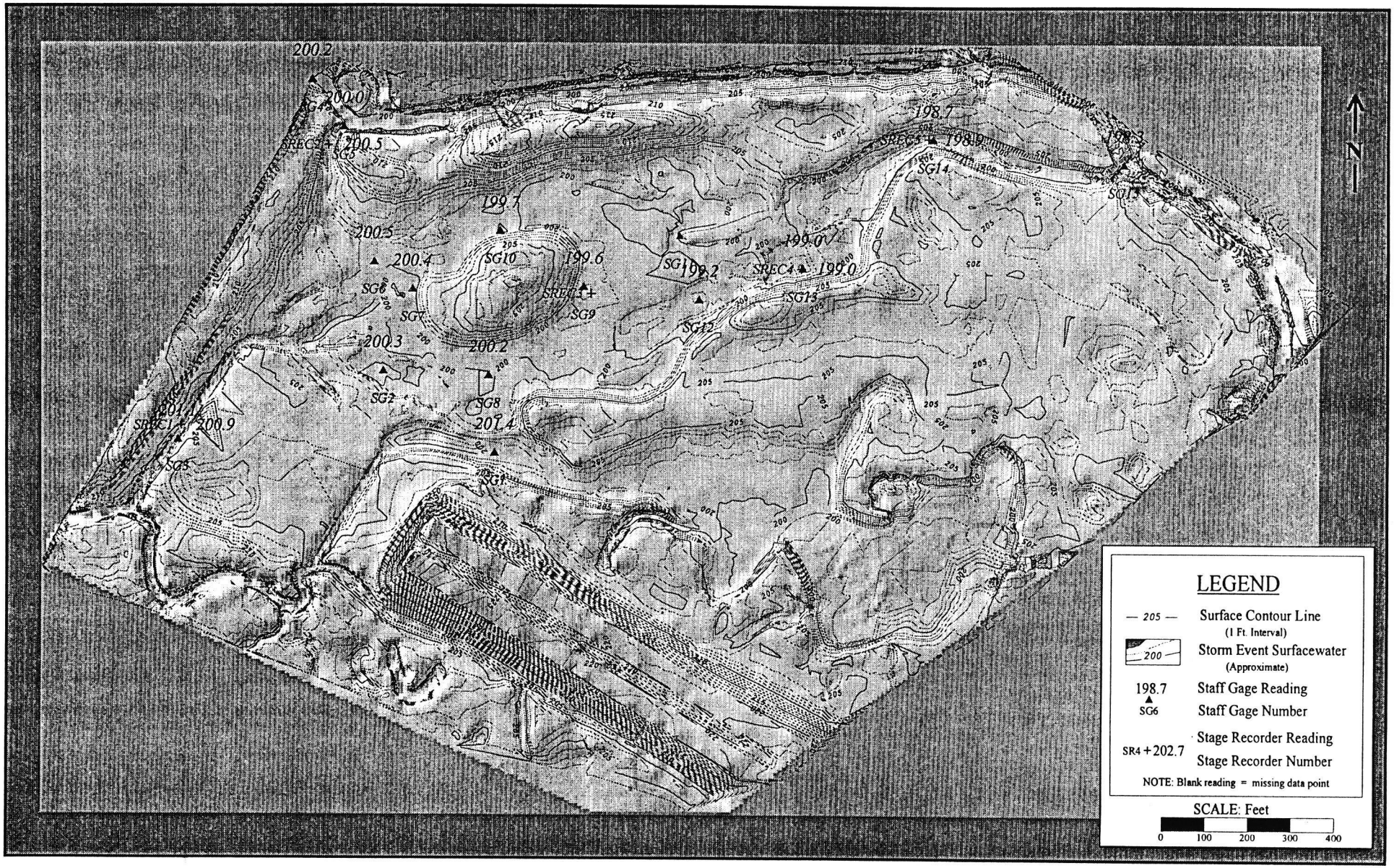
Nevins Creek Mitigation Area



Surfacewater Elevations

(12/17/96)

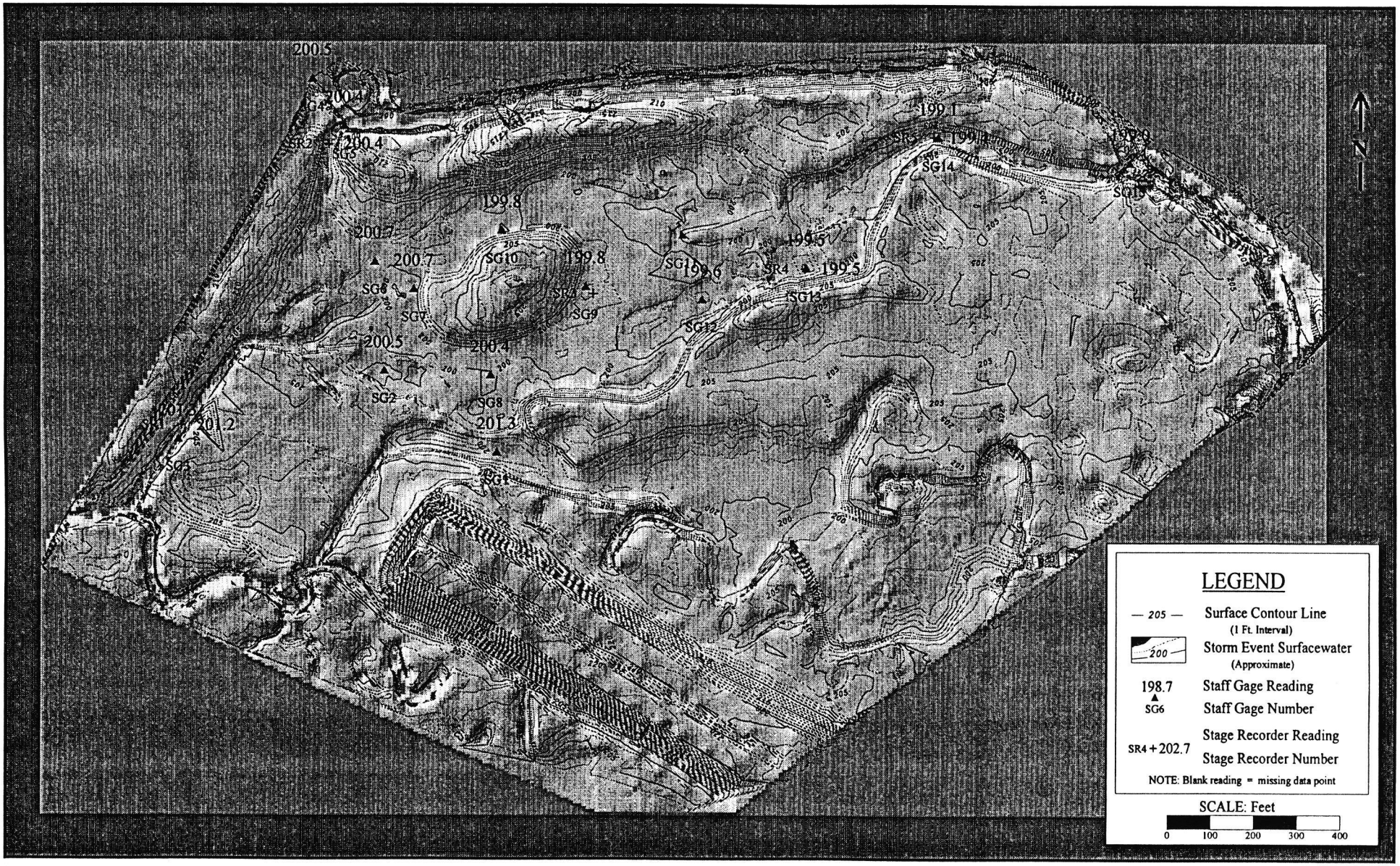
Nevins Creek Mitigation Area



Surfacewater Elevations

(12/22/96)

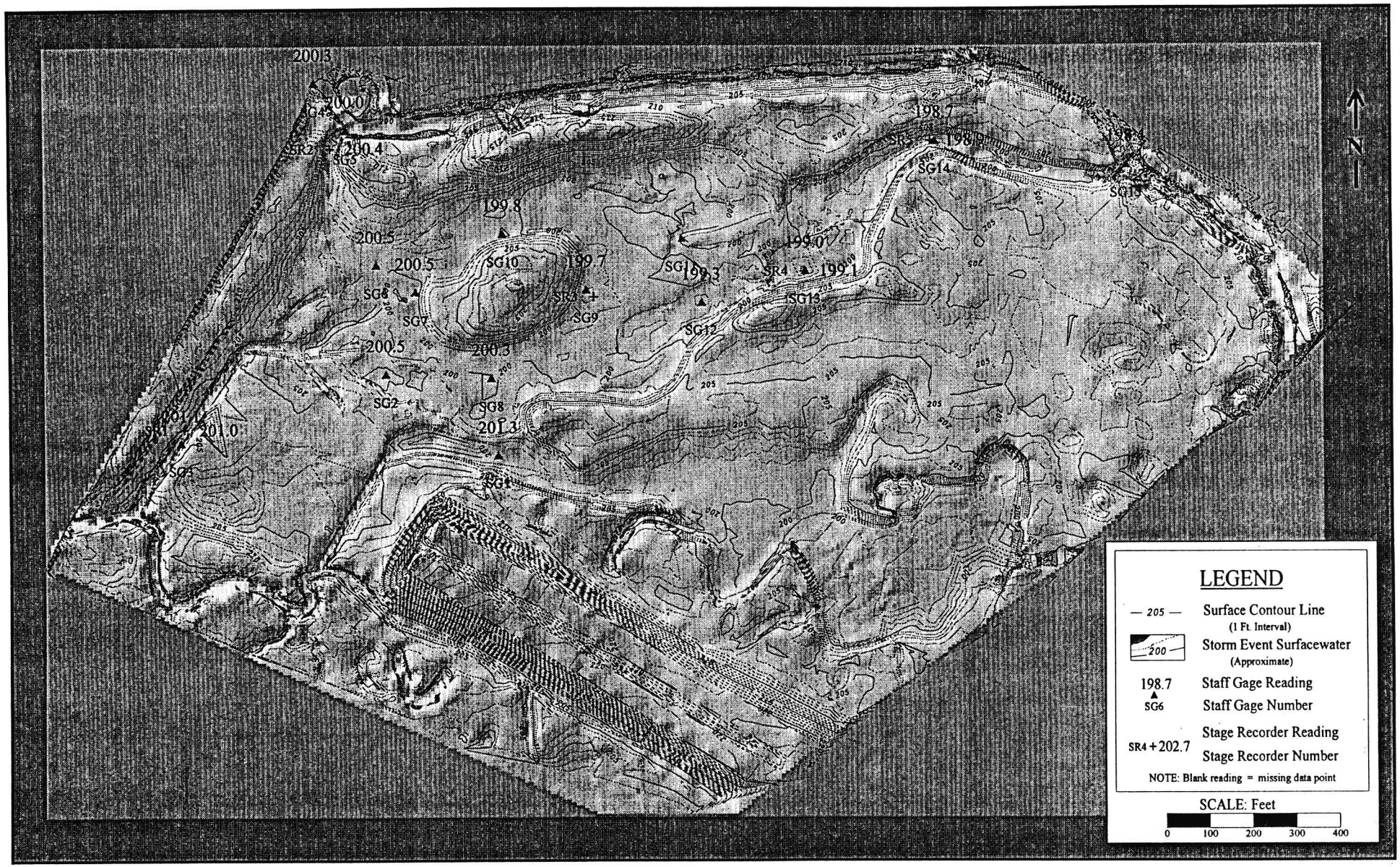
Nevins Creek Mitigation Area



Surfacewater Elevations

(12/30/96)

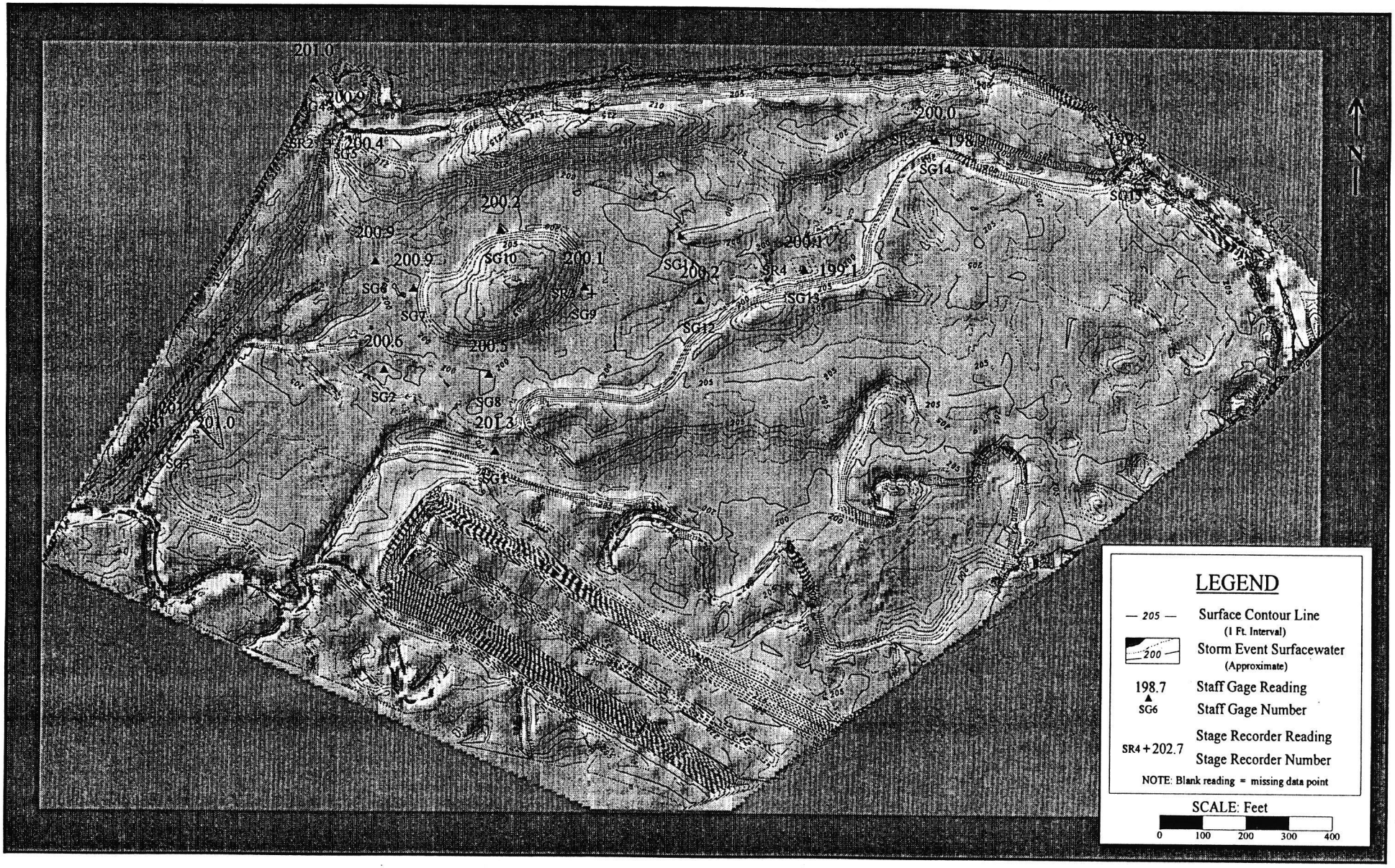
Nevins Creek Mitigation Area



Surfacewater Elevations

(01/03/97)

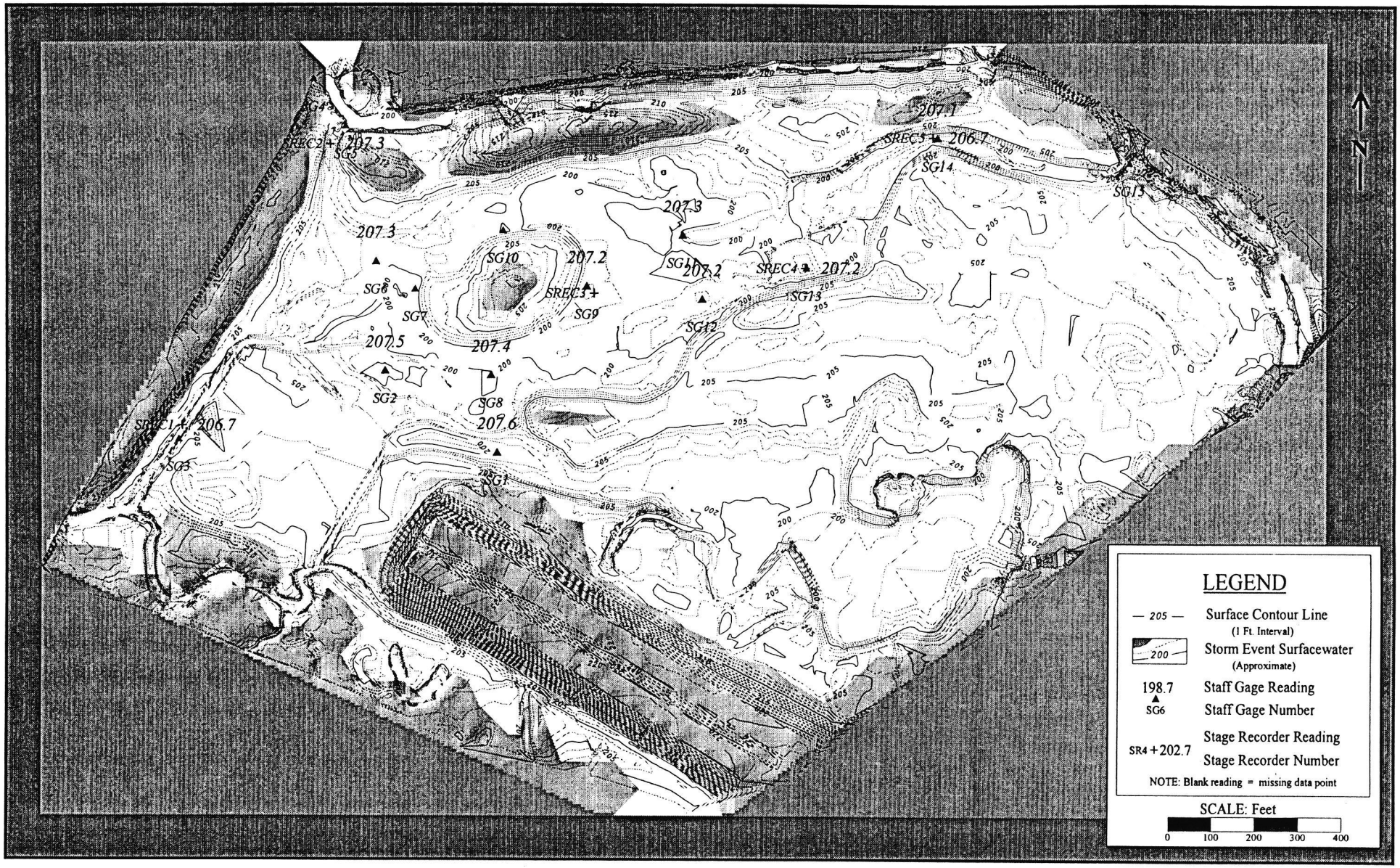
Nevins Creek Mitigation Area



Surfacewater Elevations

(01/20/97)

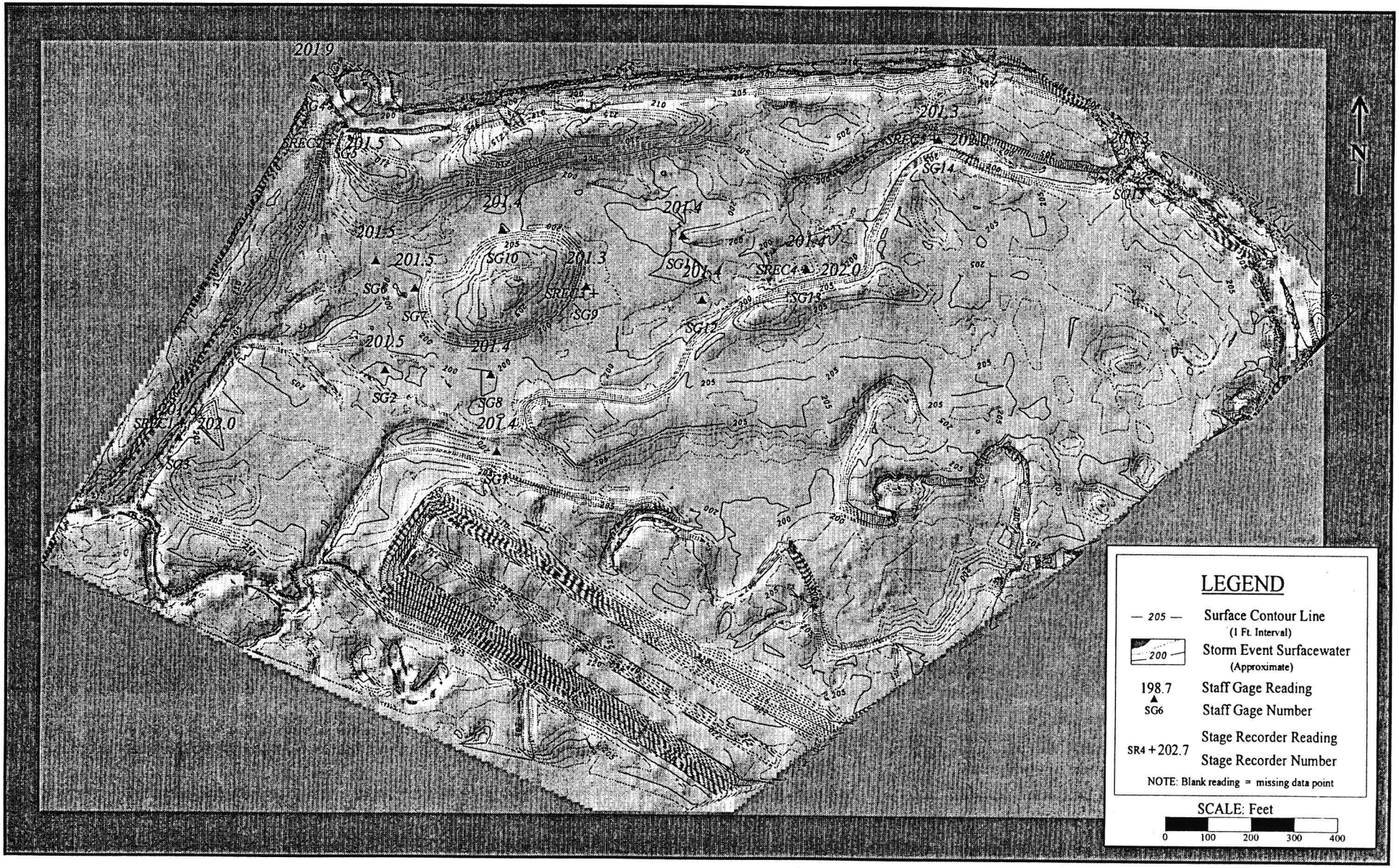
Nevins Creek Mitigation Area



Surfacewater Elevations

(02/04/97)

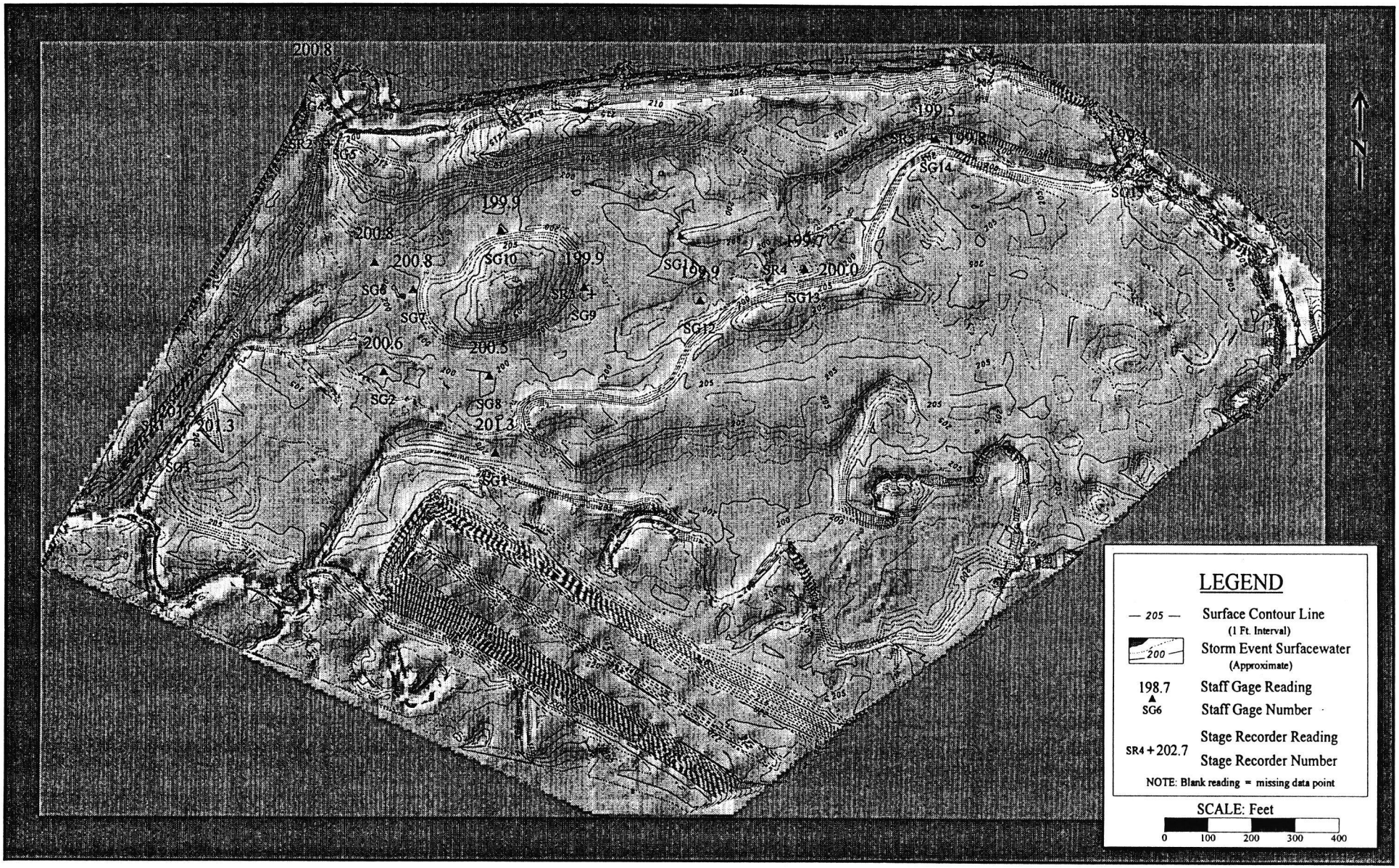
Nevins Creek Mitigation Area



Surfacewater Elevations

(02/06/97)

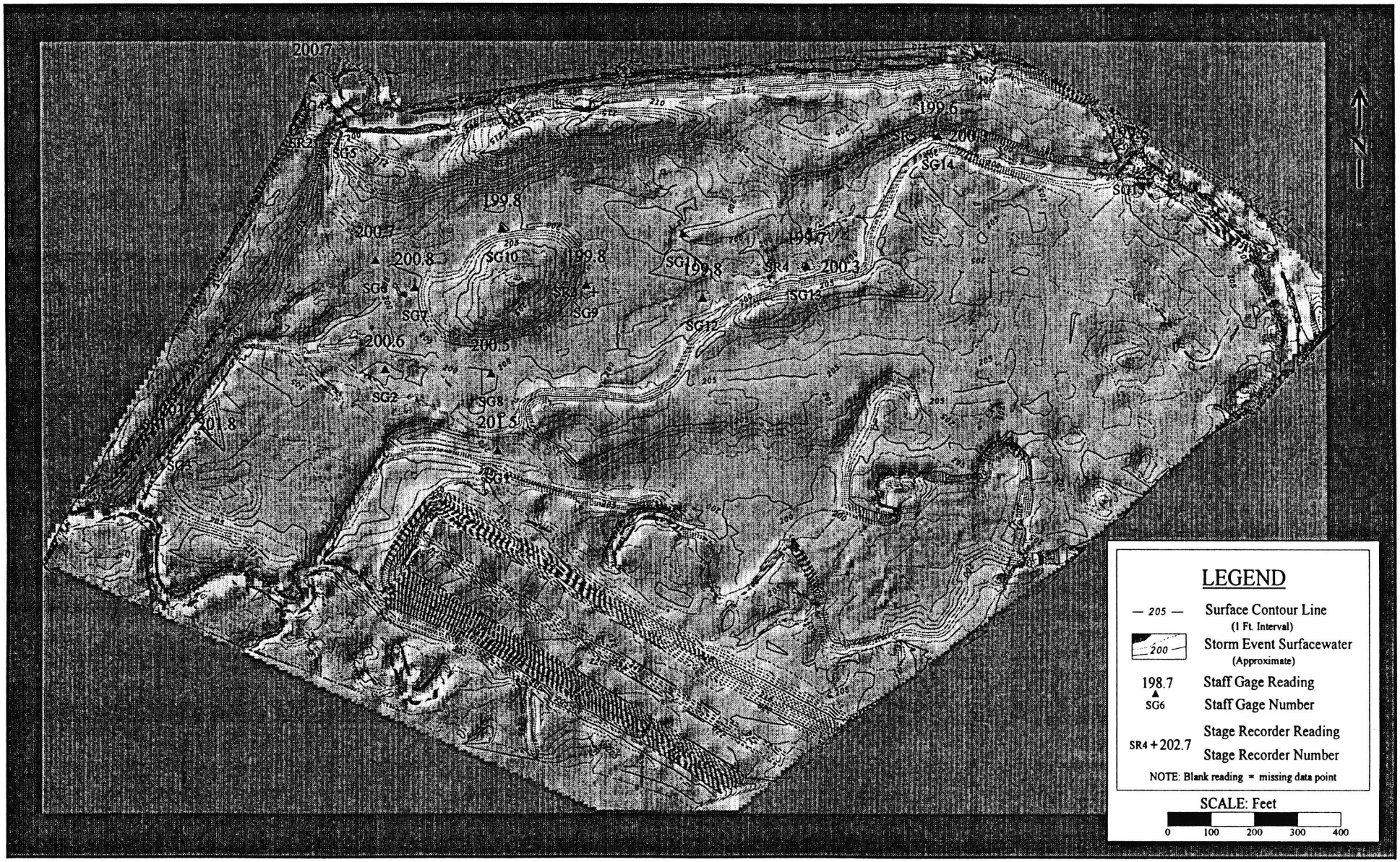
Nevins Creek Mitigation Area



Surfacewater Elevations

(02/10/97)

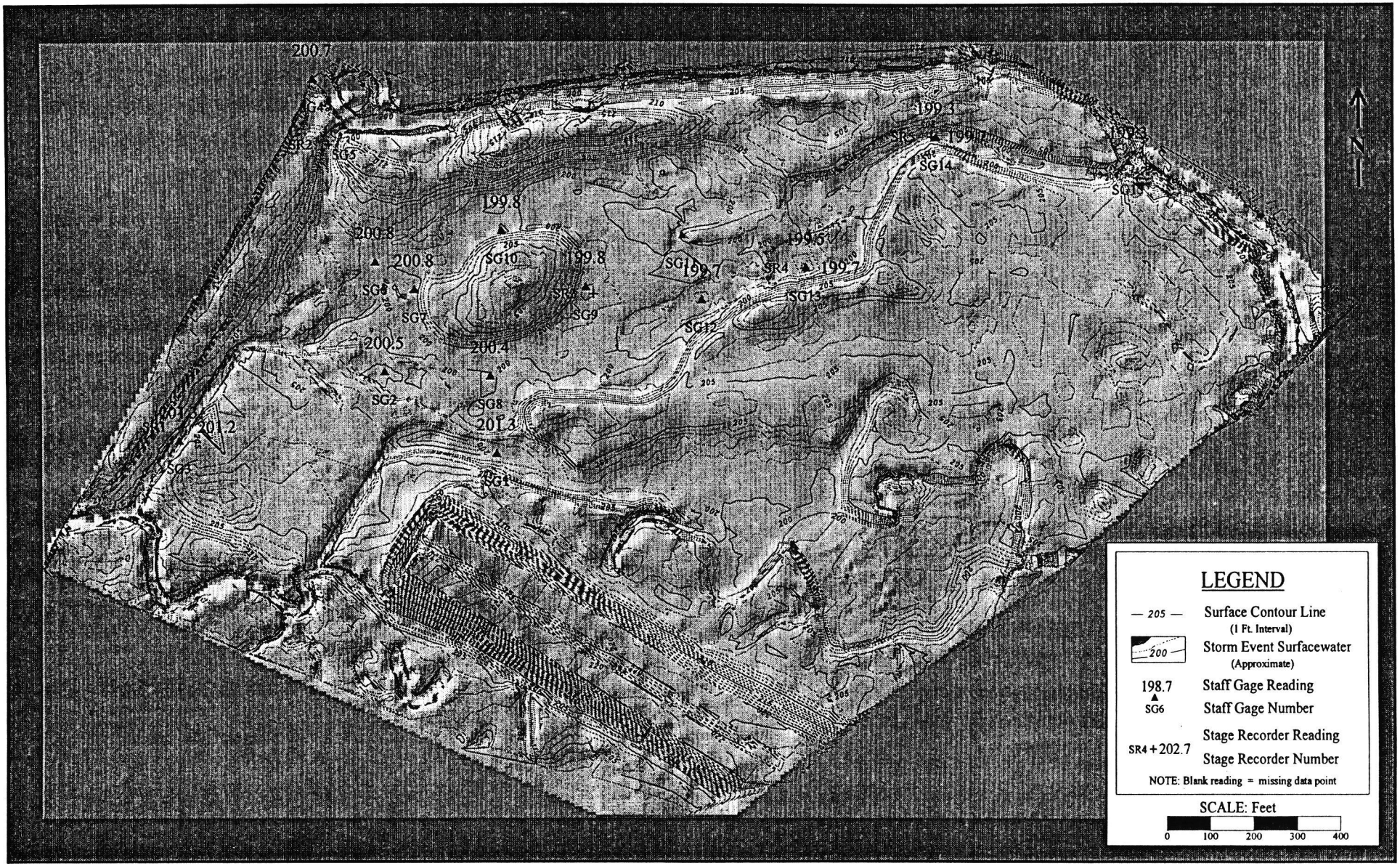
Nevins Creek Mitigation Area



Surfacewater Elevations

(02/19/97)

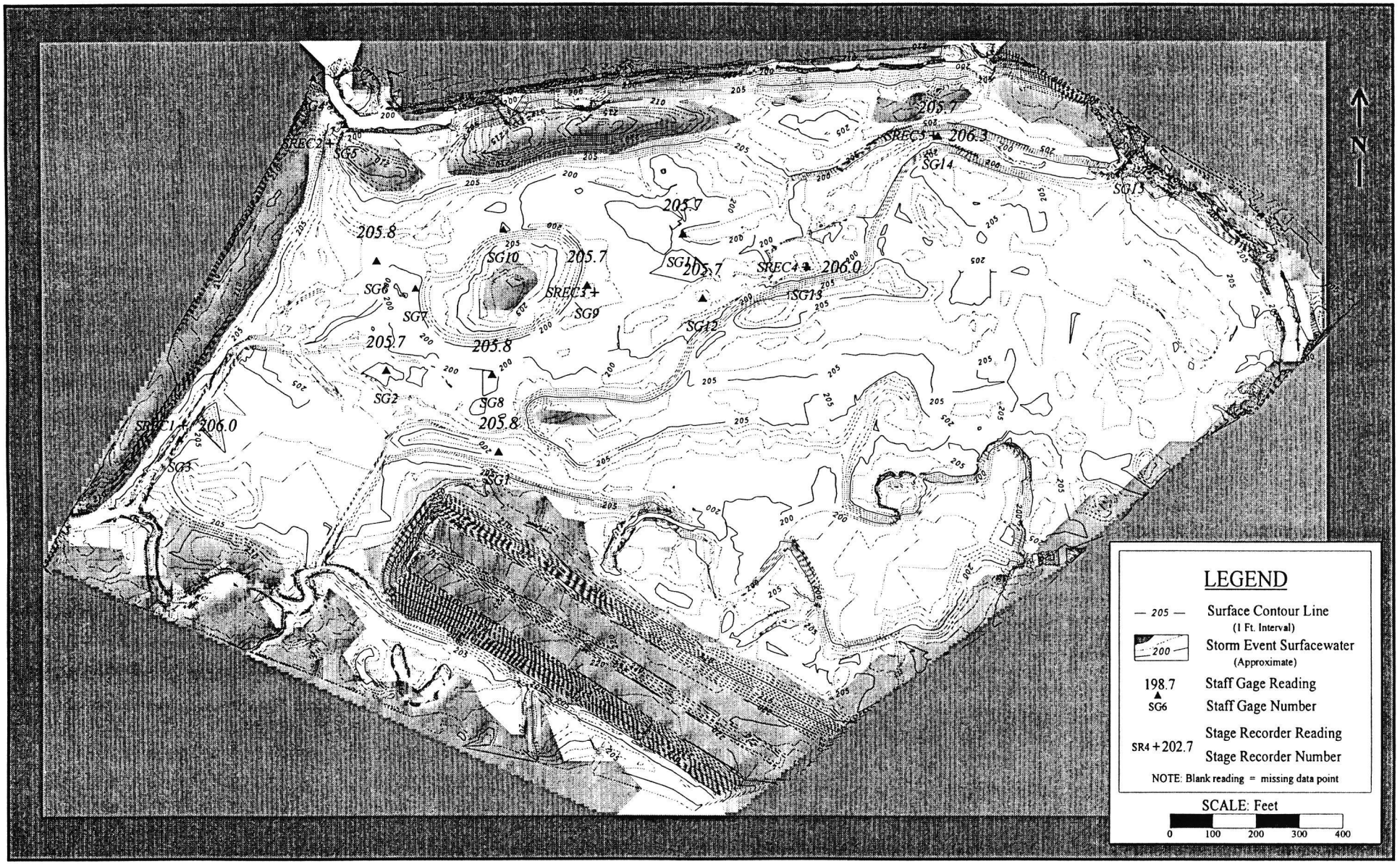
Nevins Creek Mitigation Area



Surfacewater Elevations

(02/24/97)

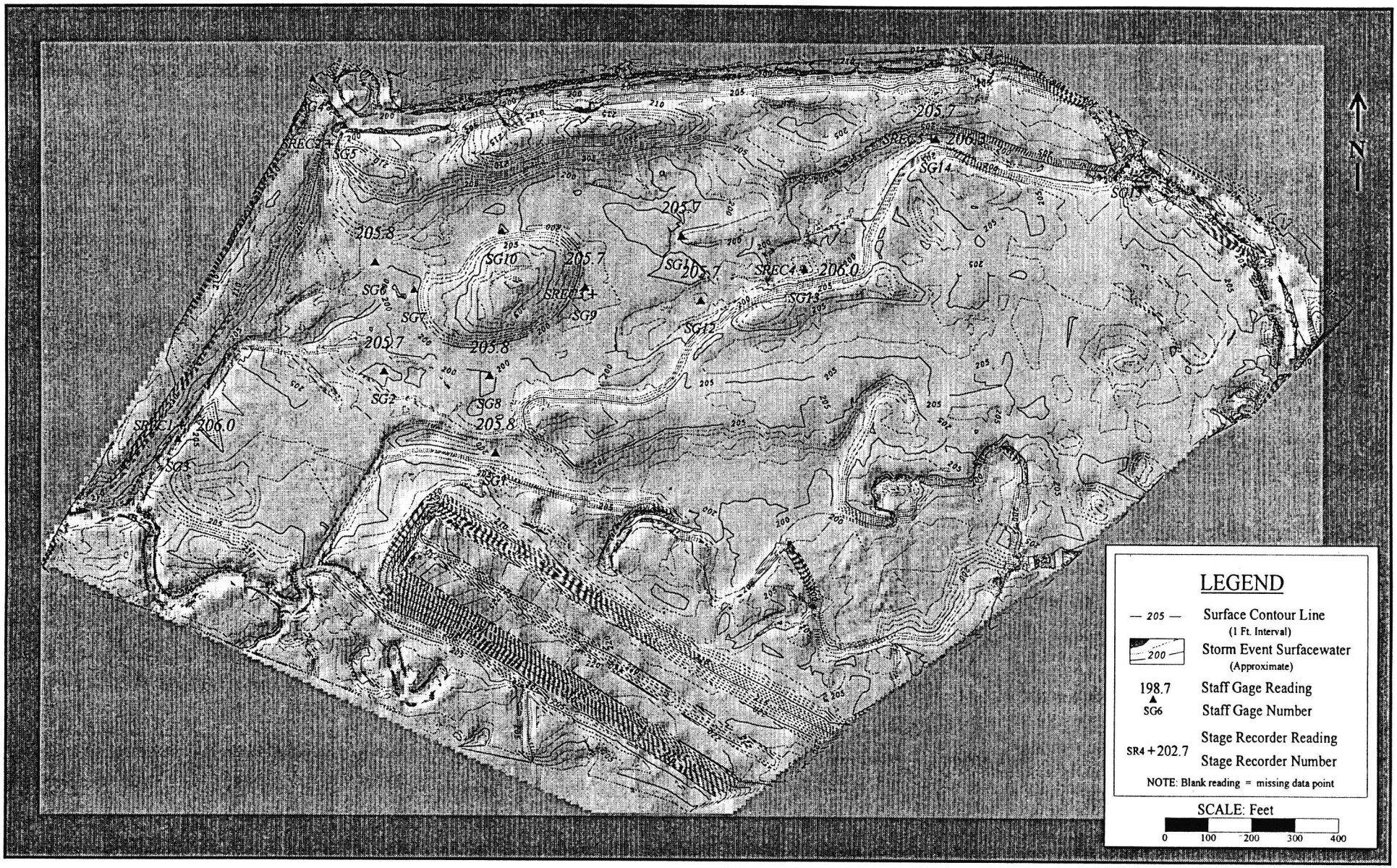
Nevins Creek Mitigation Area



Surfacewater Elevations

(03/03/97)

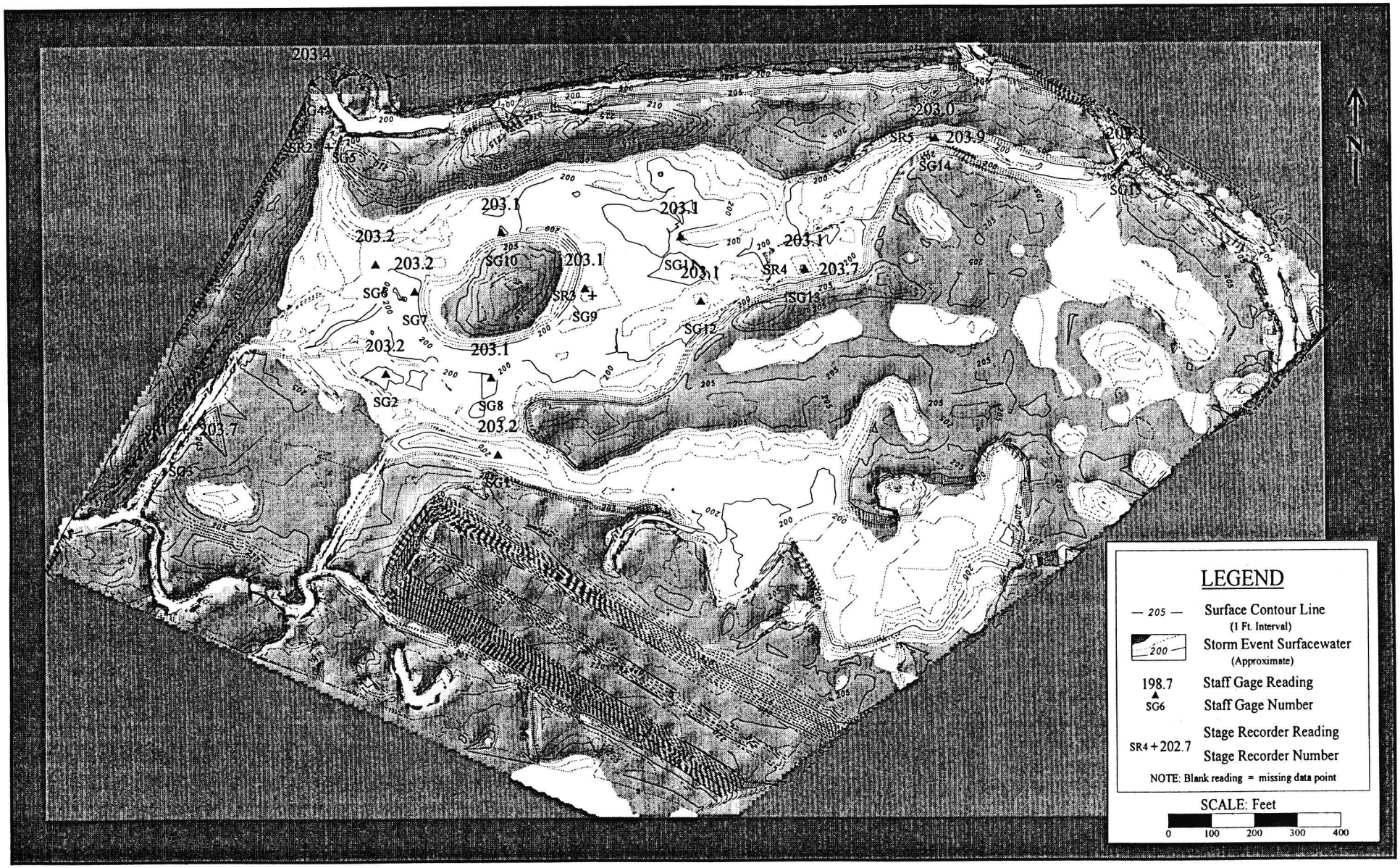
Nevins Creek Mitigation Area



Surfacewater Elevations

(03/03/97)

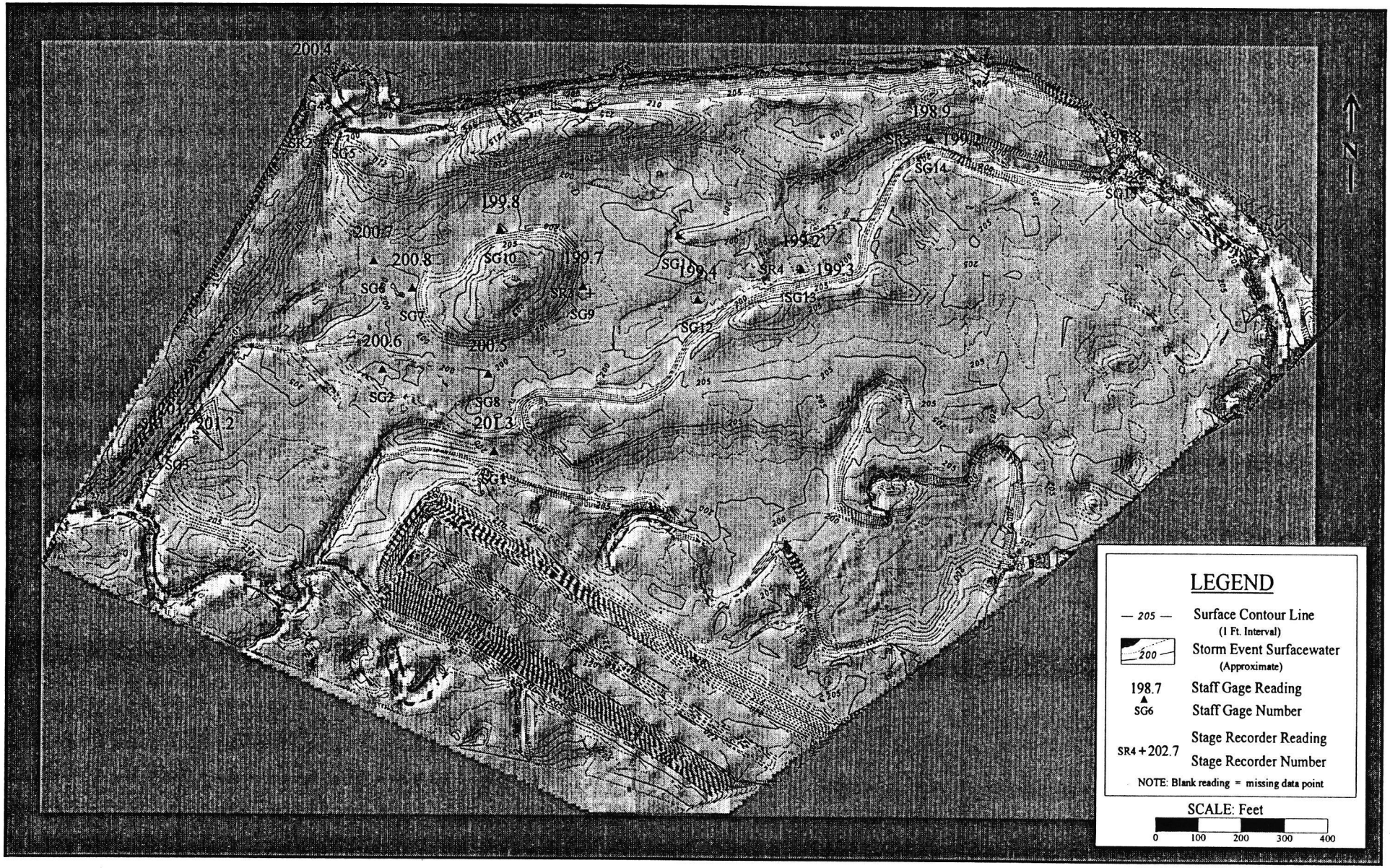
Nevins Creek Mitigation Area



Surfacewater Elevations

(03/04/97)

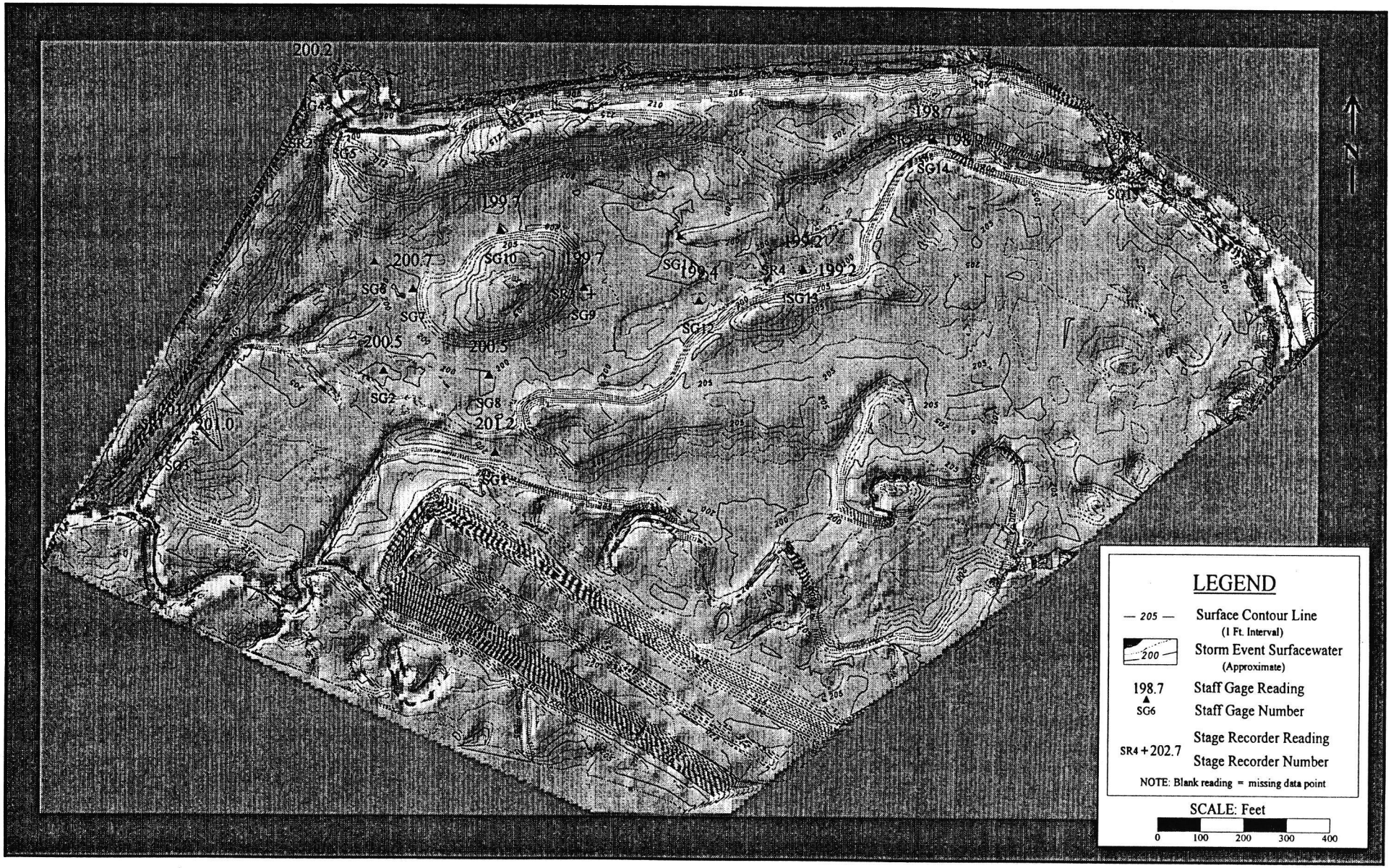
Nevins Creek Mitigation Area



Surfacewater Elevations

(03/09/97)

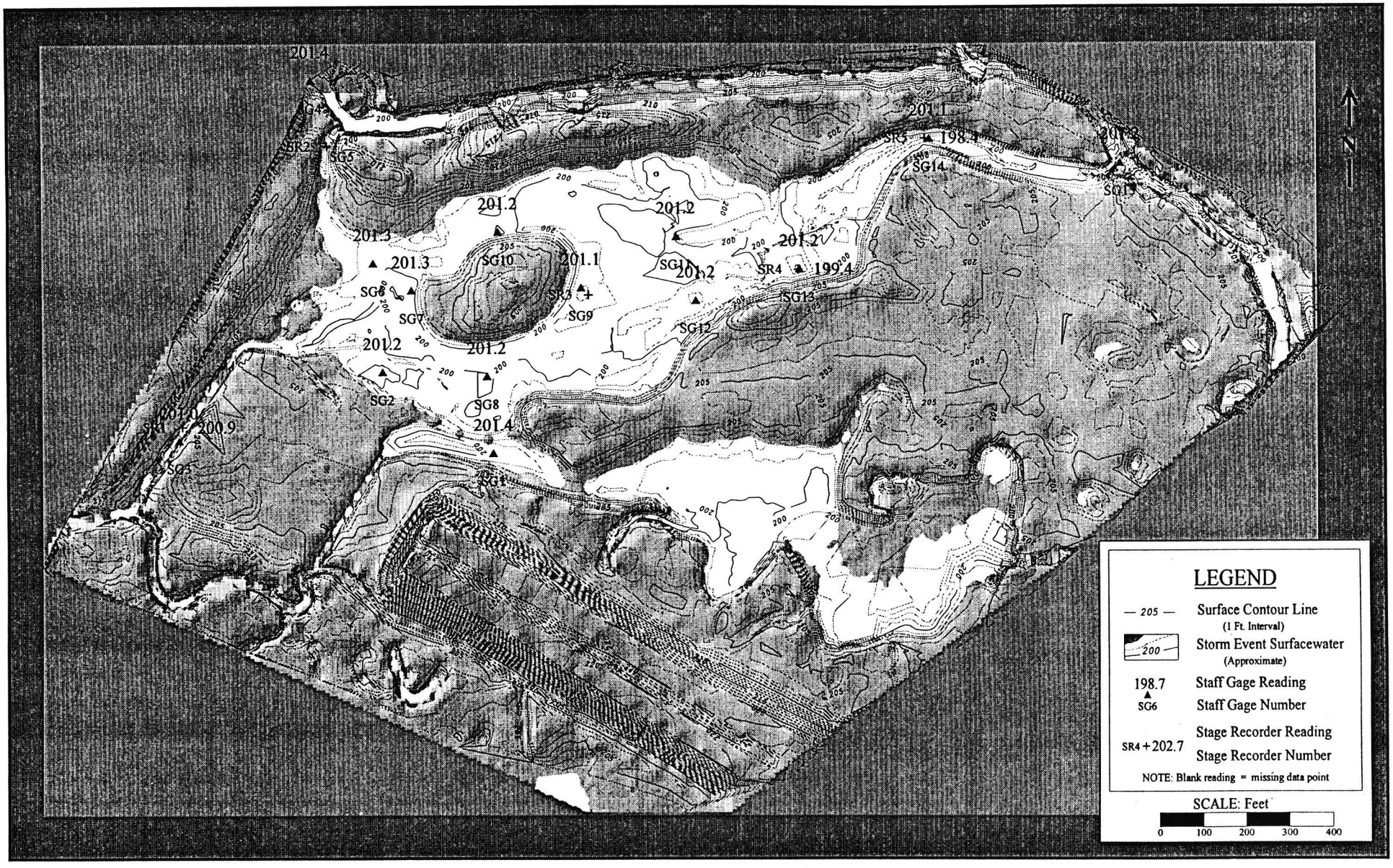
Nevins Creek Mitigation Area



Surfacewater Elevations

(03/24/97)

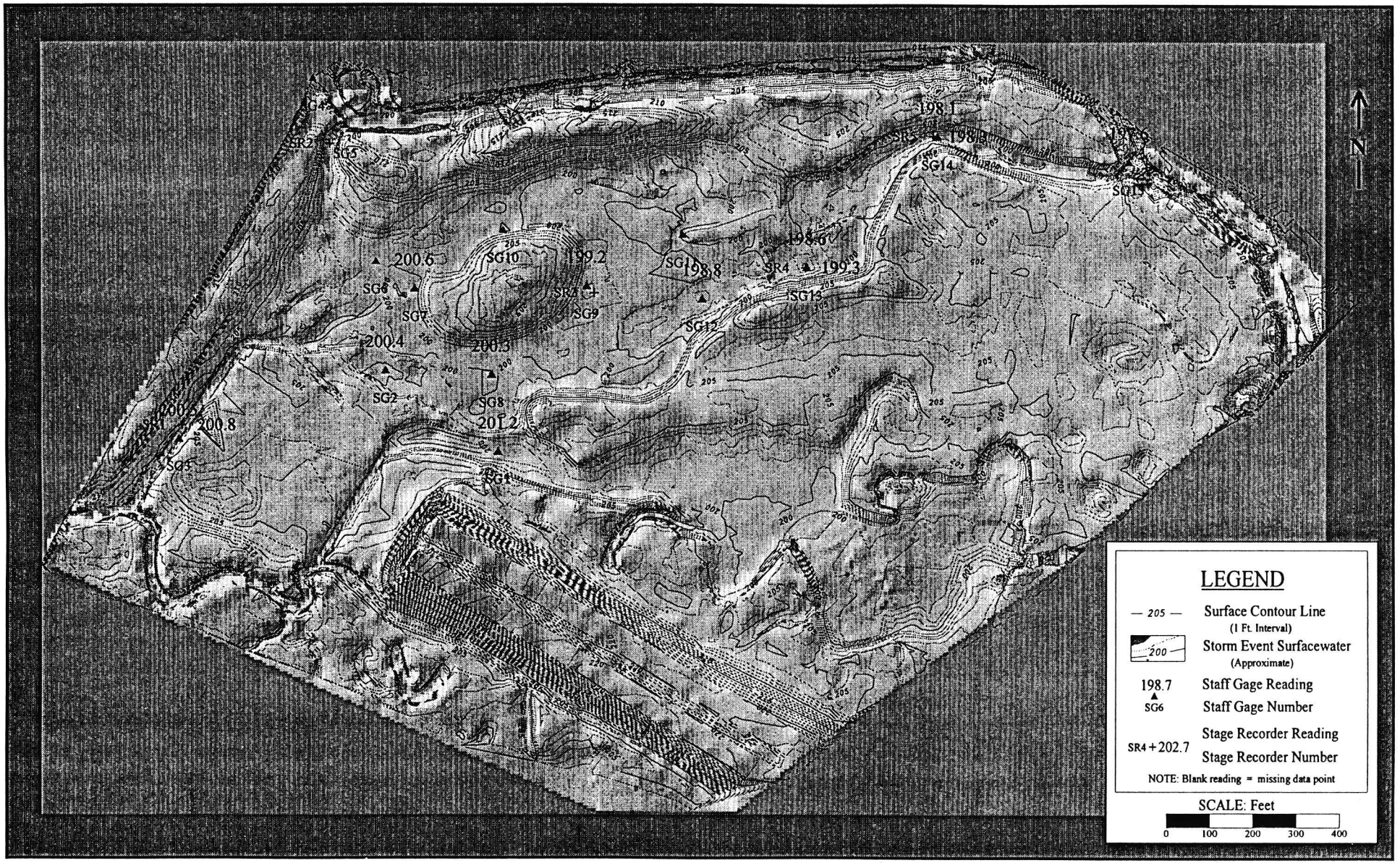
Nevins Creek Mitigation Area



Surfacewater Elevations

(04/18/97)

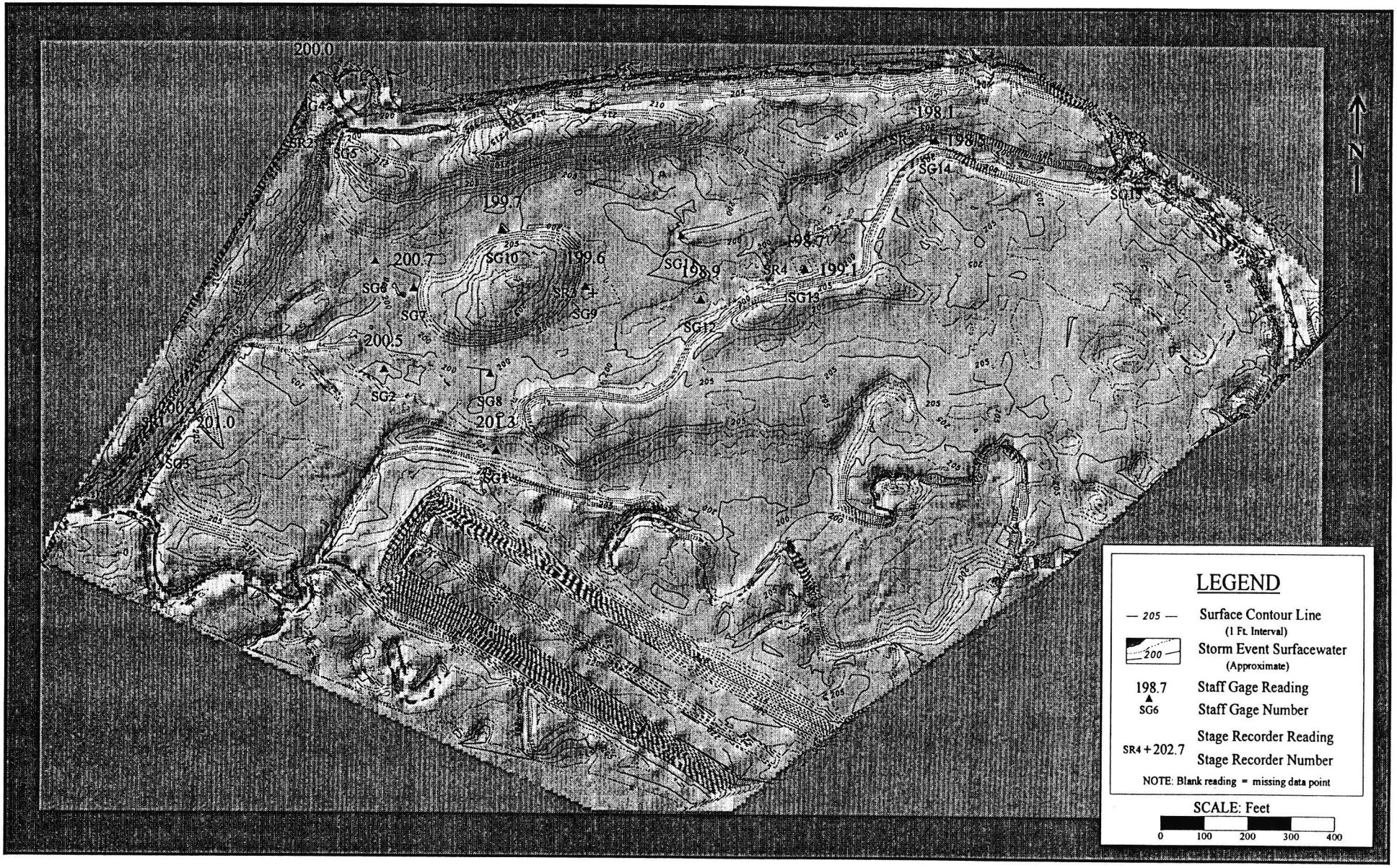
Nevins Creek Mitigation Area



Surfacewater Elevations

(04/21/97)

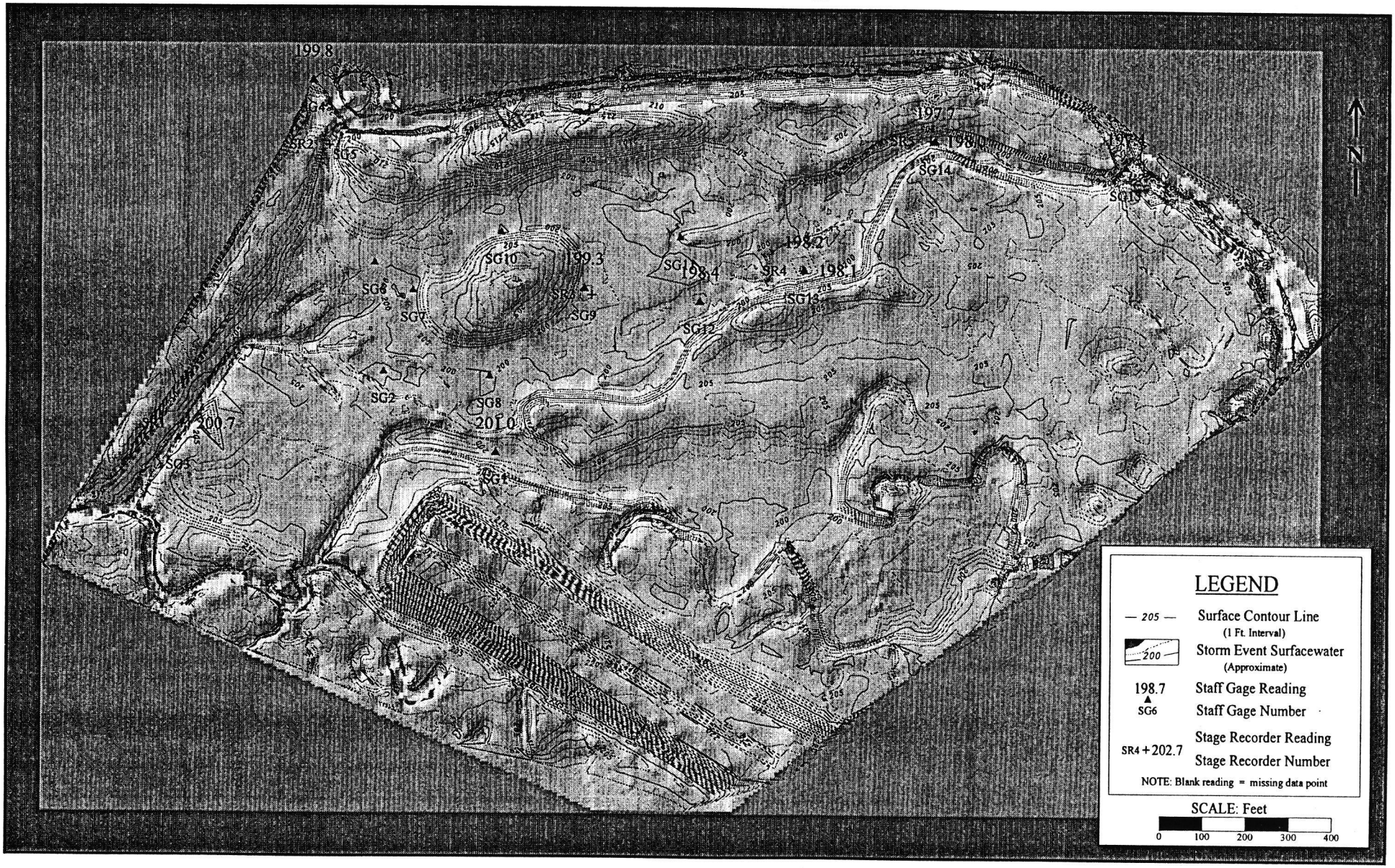
Nevins Creek Mitigation Area



Surfacewater Elevations

(05/05/97)

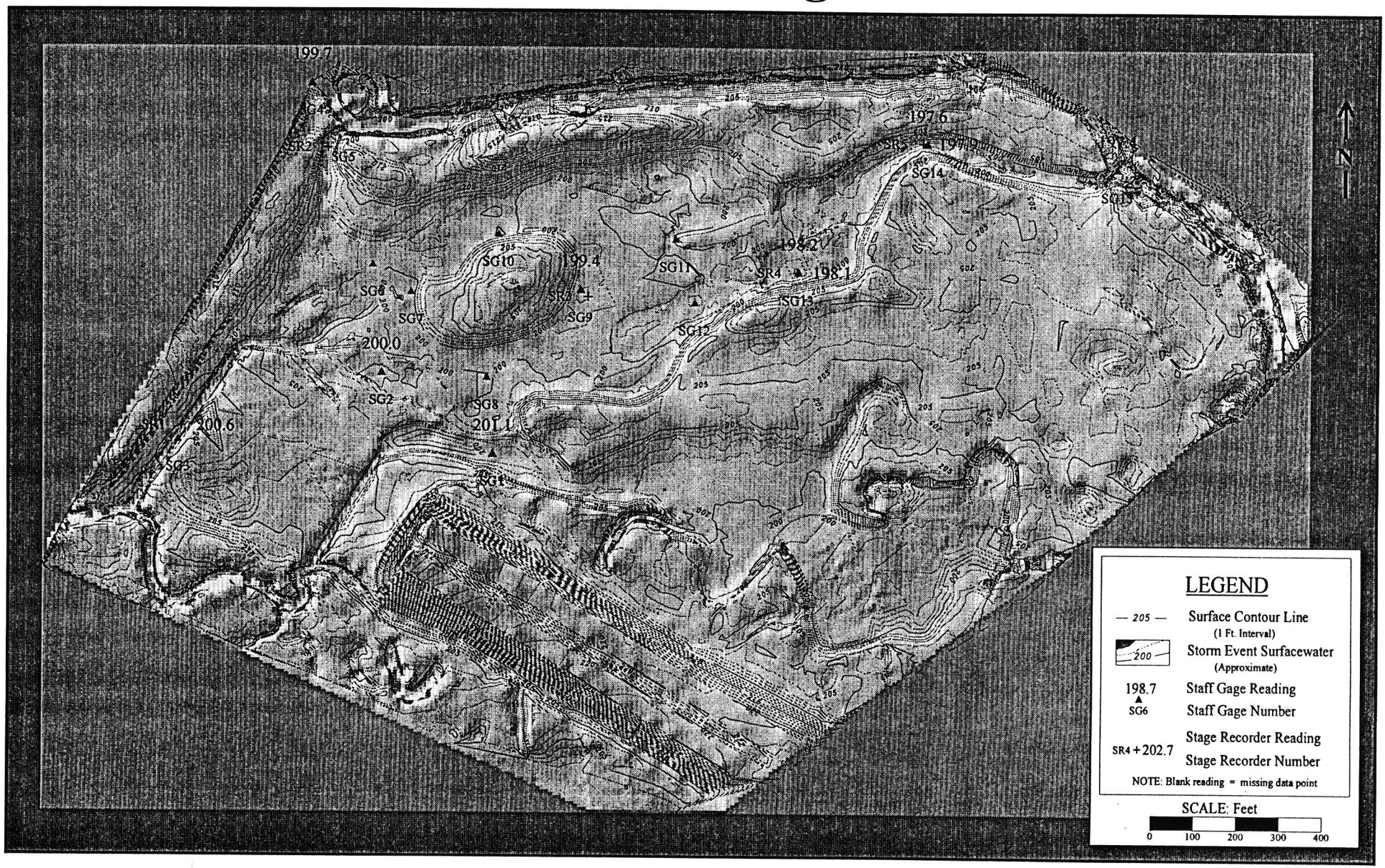
Nevins Creek Mitigation Area



Surfacewater Elevations

(05/23/97)

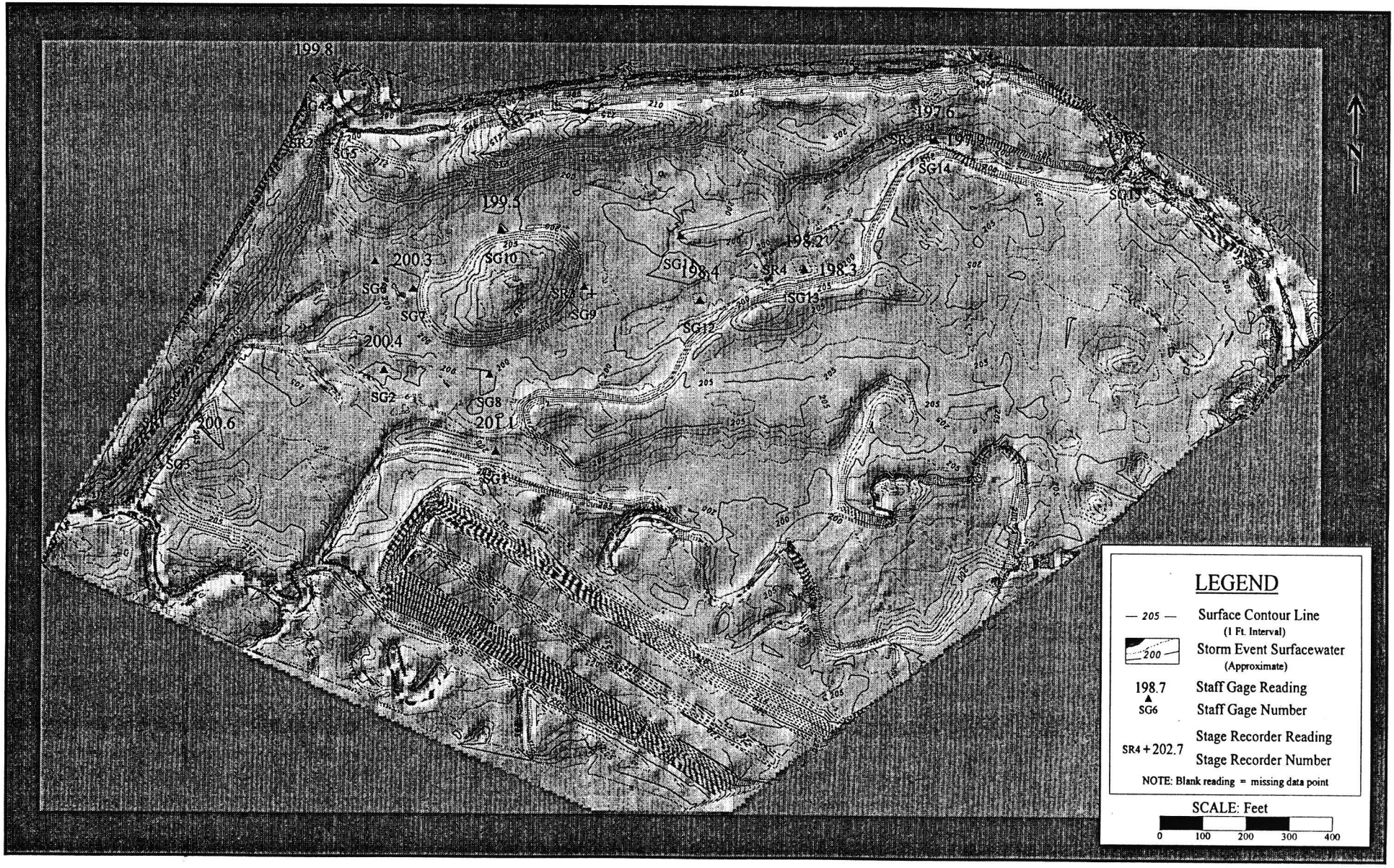
Nevins Creek Mitigation Area



Surfacewater Elevations

(06/02/97)

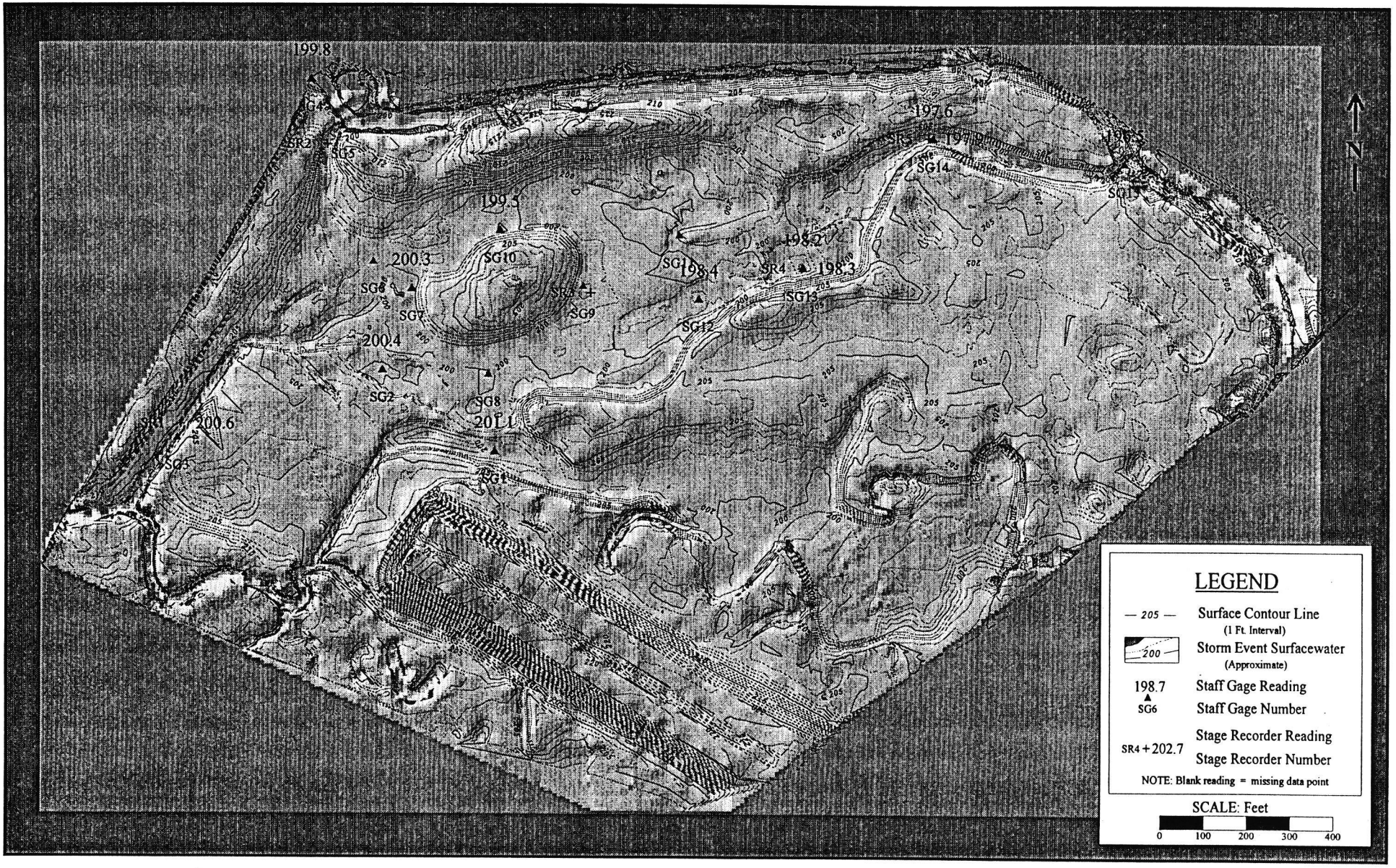
Nevins Creek Mitigation Area



Surfacewater Elevations

(06/16/97)

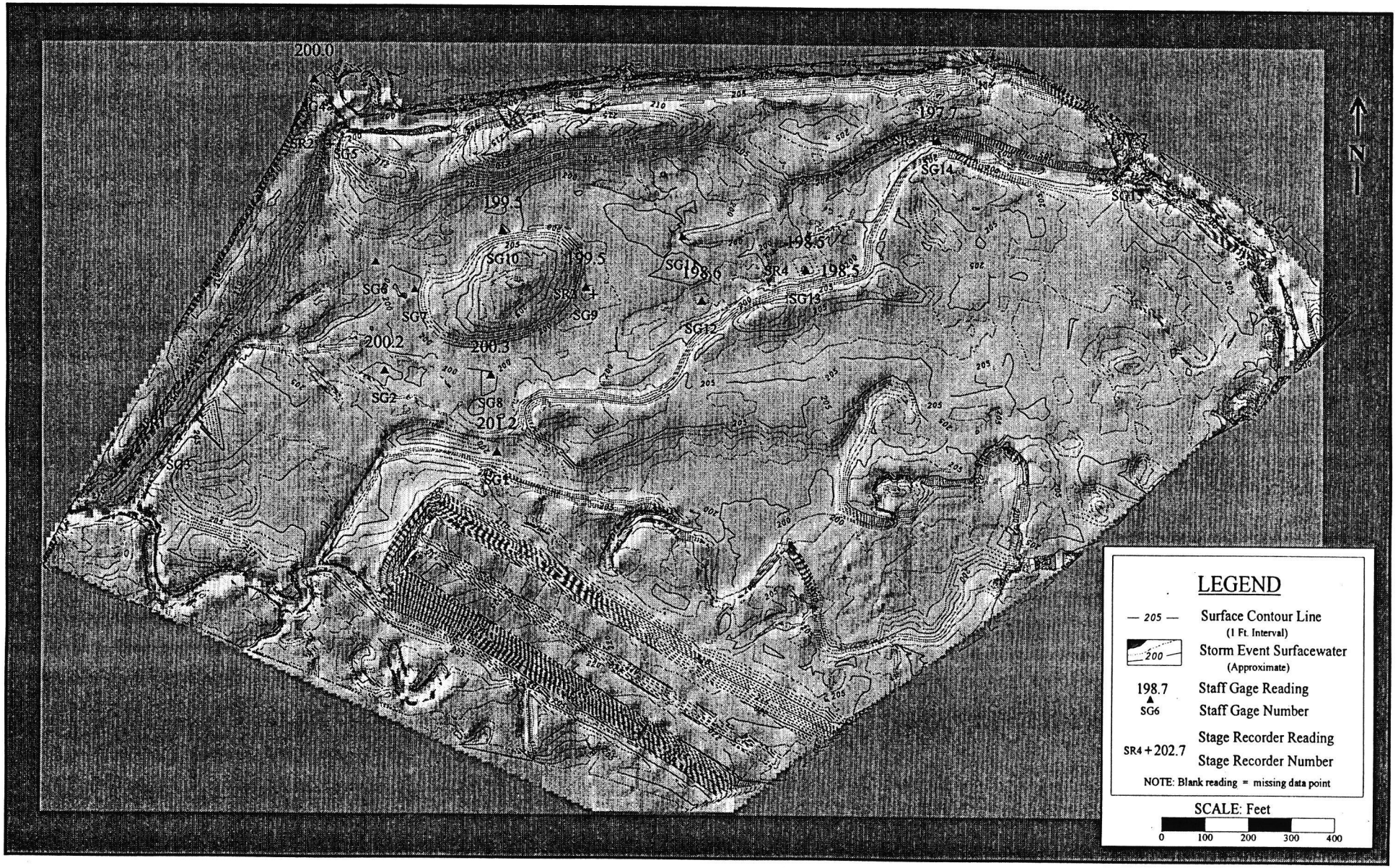
Nevins Creek Mitigation Area



Surfacewater Elevations

(16/16/97)

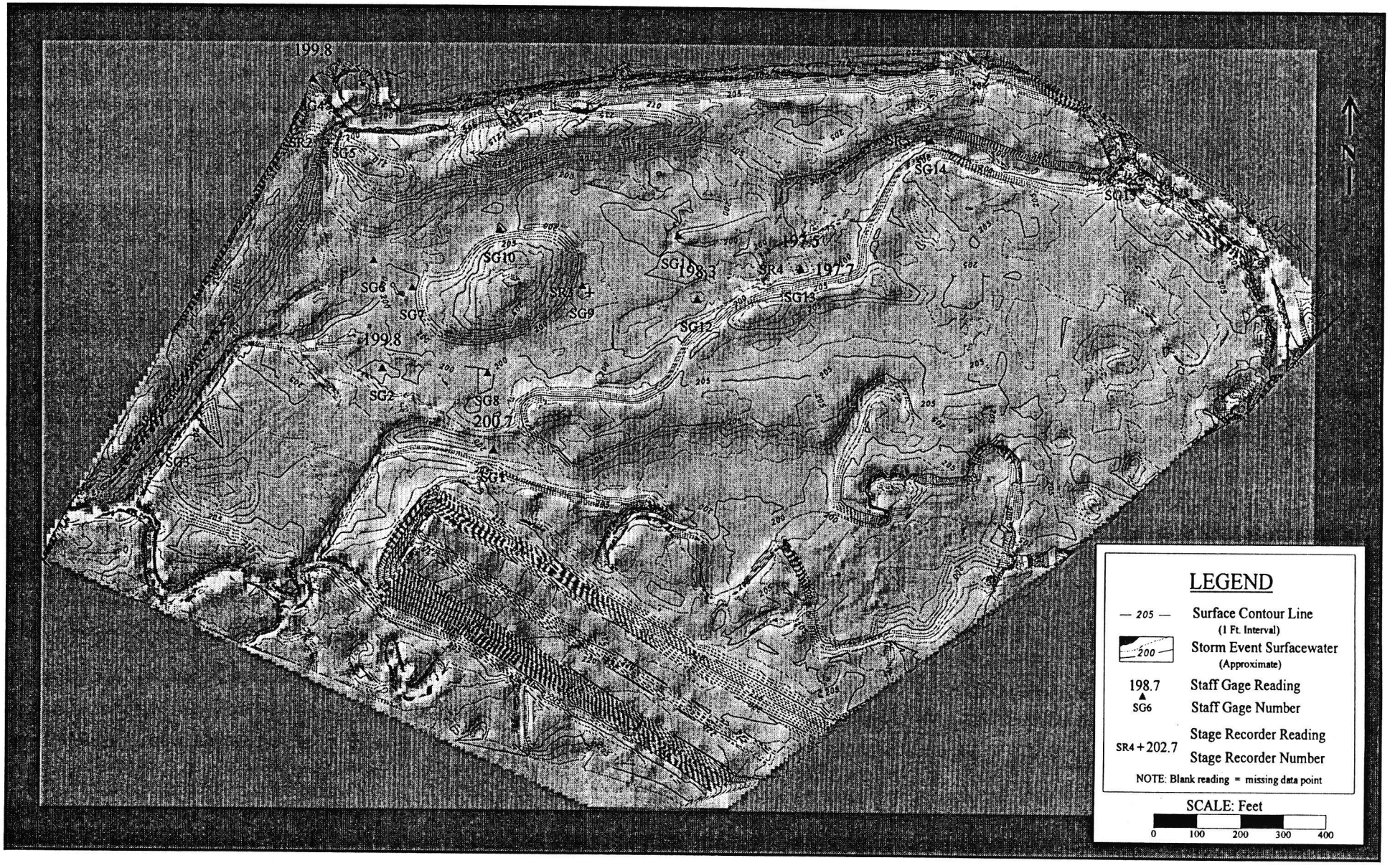
Nevins Creek Mitigation Area



Surfacewater Elevations

(07/01/97)

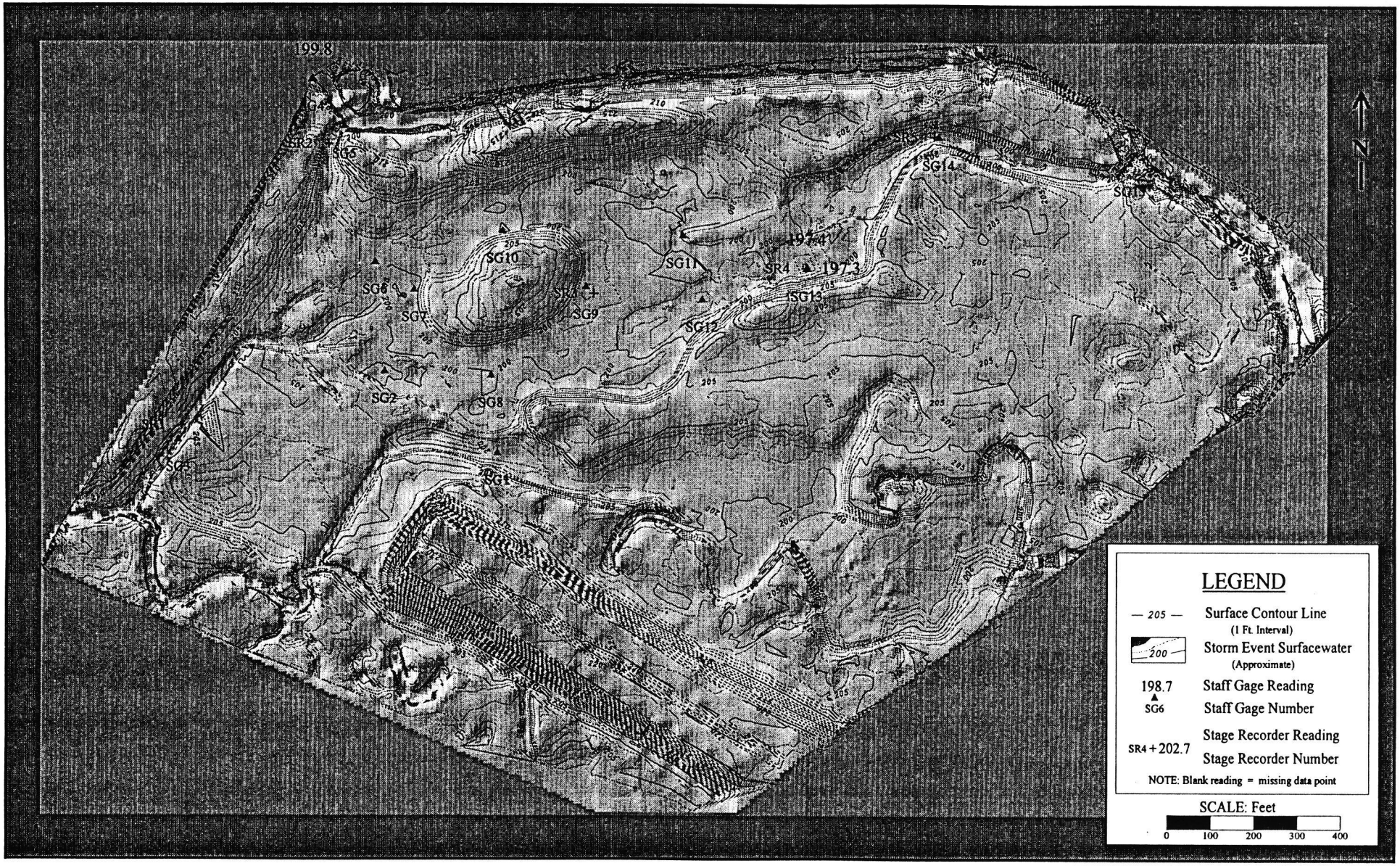
Nevins Creek Mitigation Area



Surfacewater Elevations

(07/18/97)

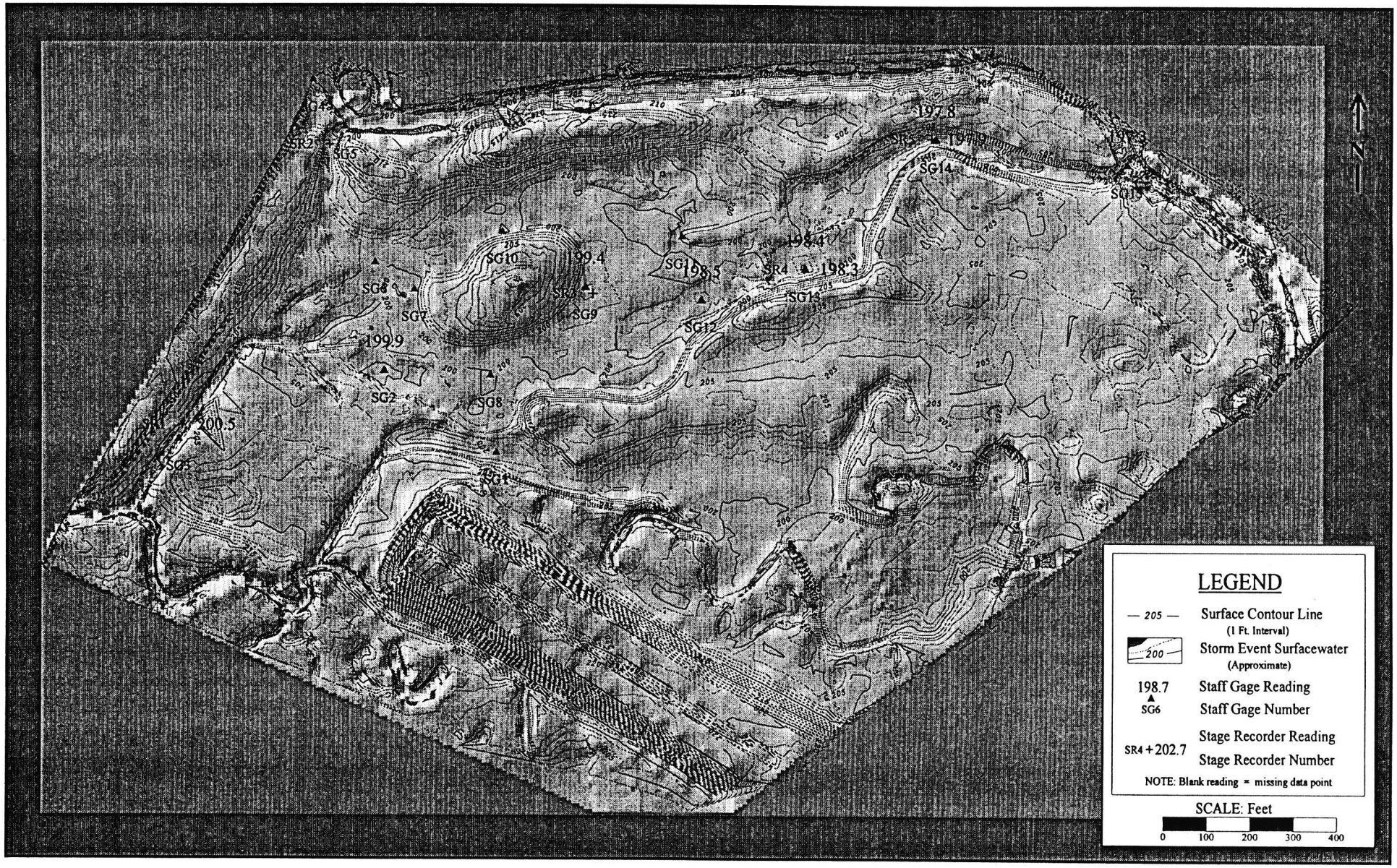
Nevins Creek Mitigation Area



Surfacewater Elevations

(07/28/97)

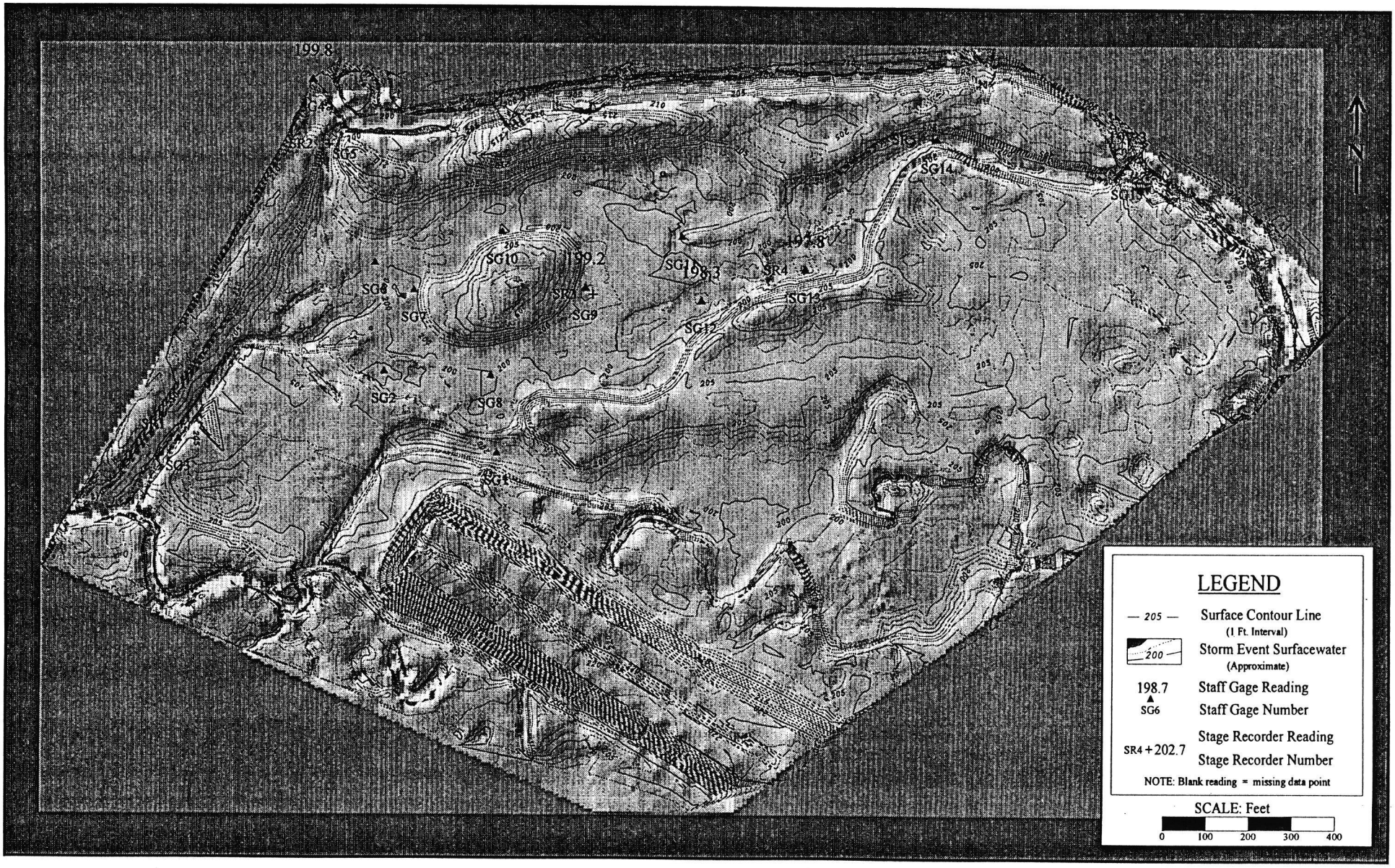
Nevins Creek Mitigation Area



Surfacewater Elevations

(08/15/97)

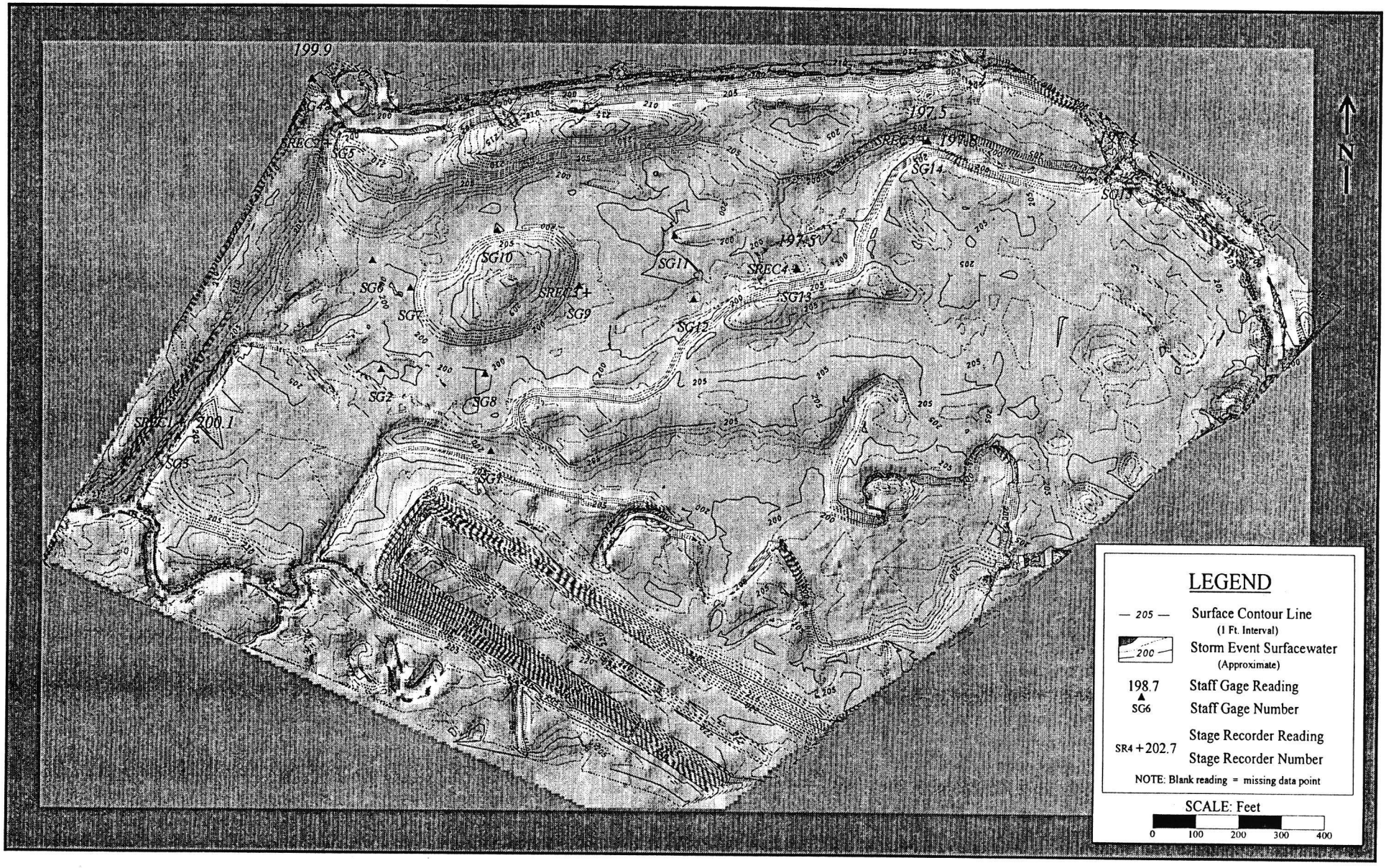
Nevins Creek Mitigation Area



Surfacewater Elevations

(08/25/97)

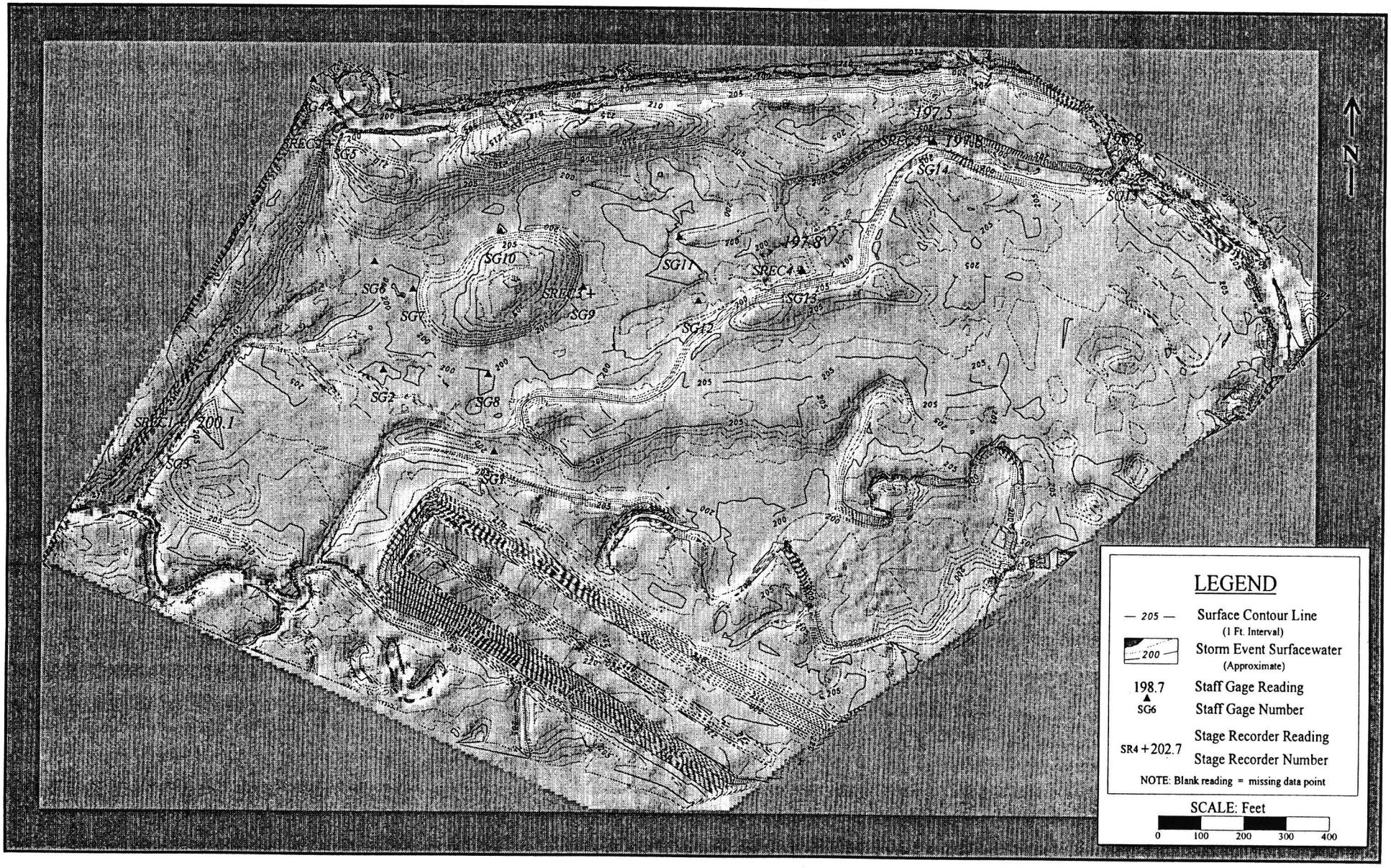
Nevins Creek Mitigation Area



Surfacewater Elevations

(09/08/97)

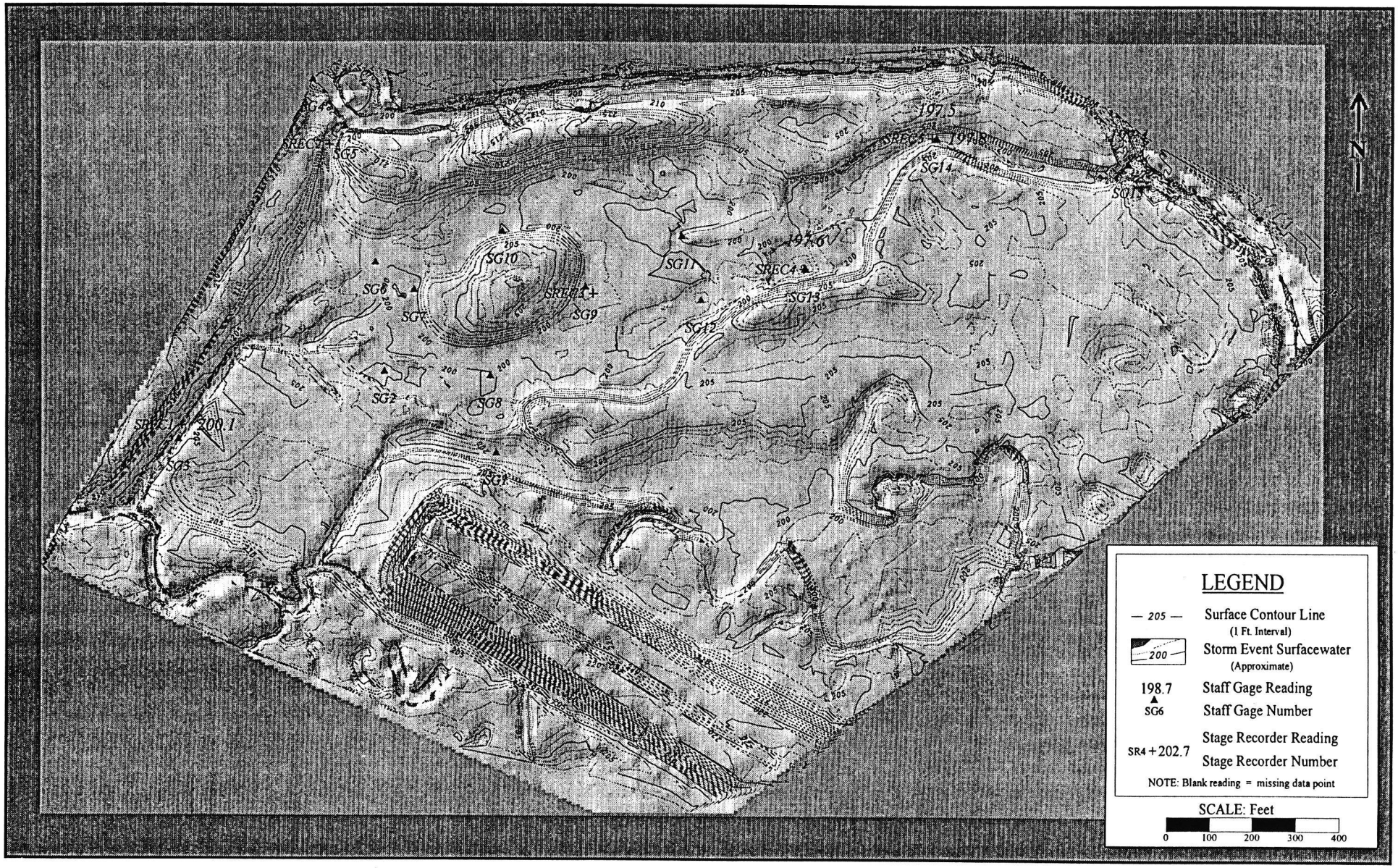
Nevins Creek Mitigation Area



Surfacewater Elevations

(09/30/97)

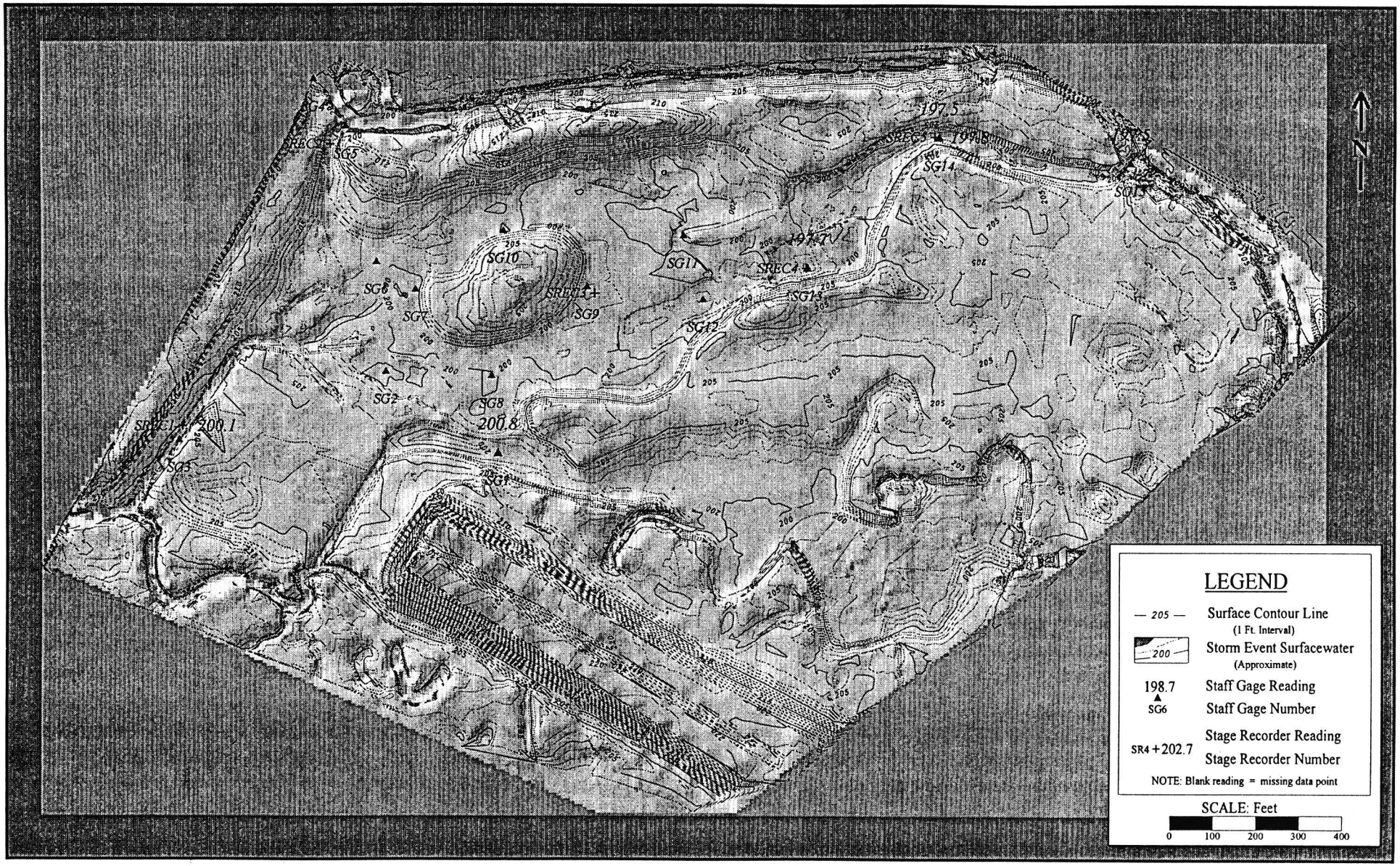
Nevins Creek Mitigation Area



Surfacewater Elevations

(10/06/97)

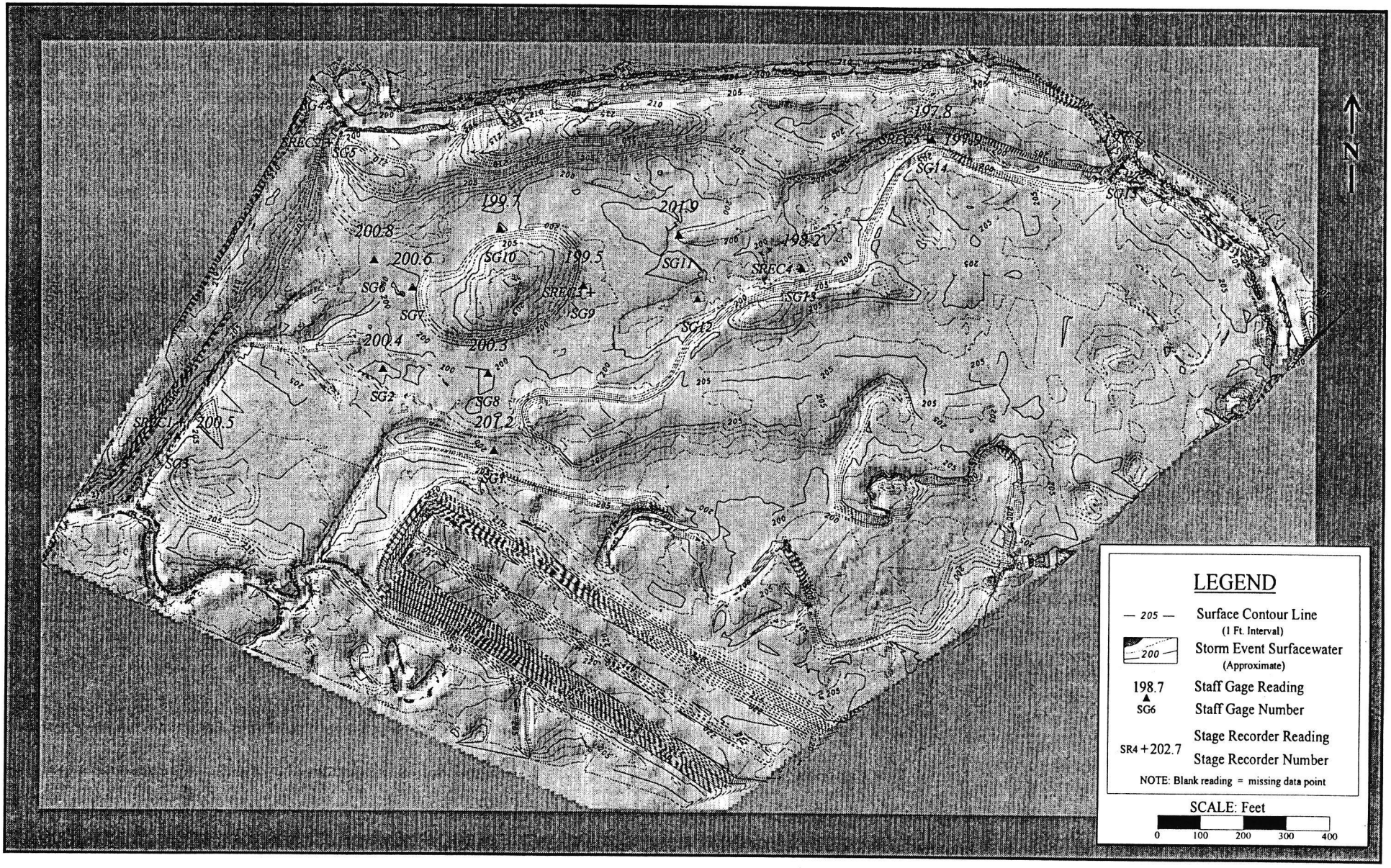
Nevins Creek Mitigation Area



Surfacewater Elevations

(10/19/97)

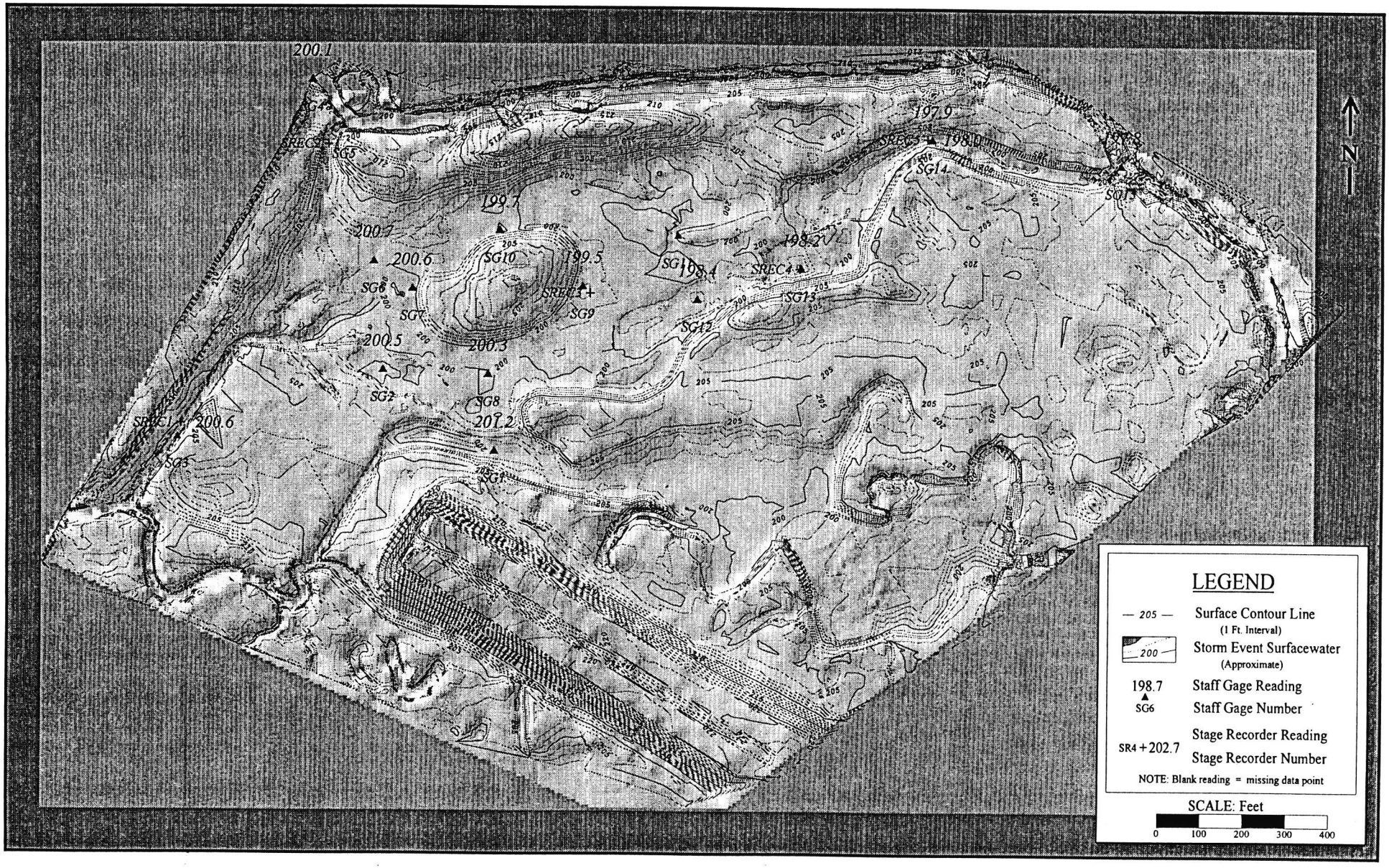
Nevins Creek Mitigation Area



Surfacewater Elevations

(11/10/97)

Nevins Creek Mitigation Area



Surfacewater Elevations

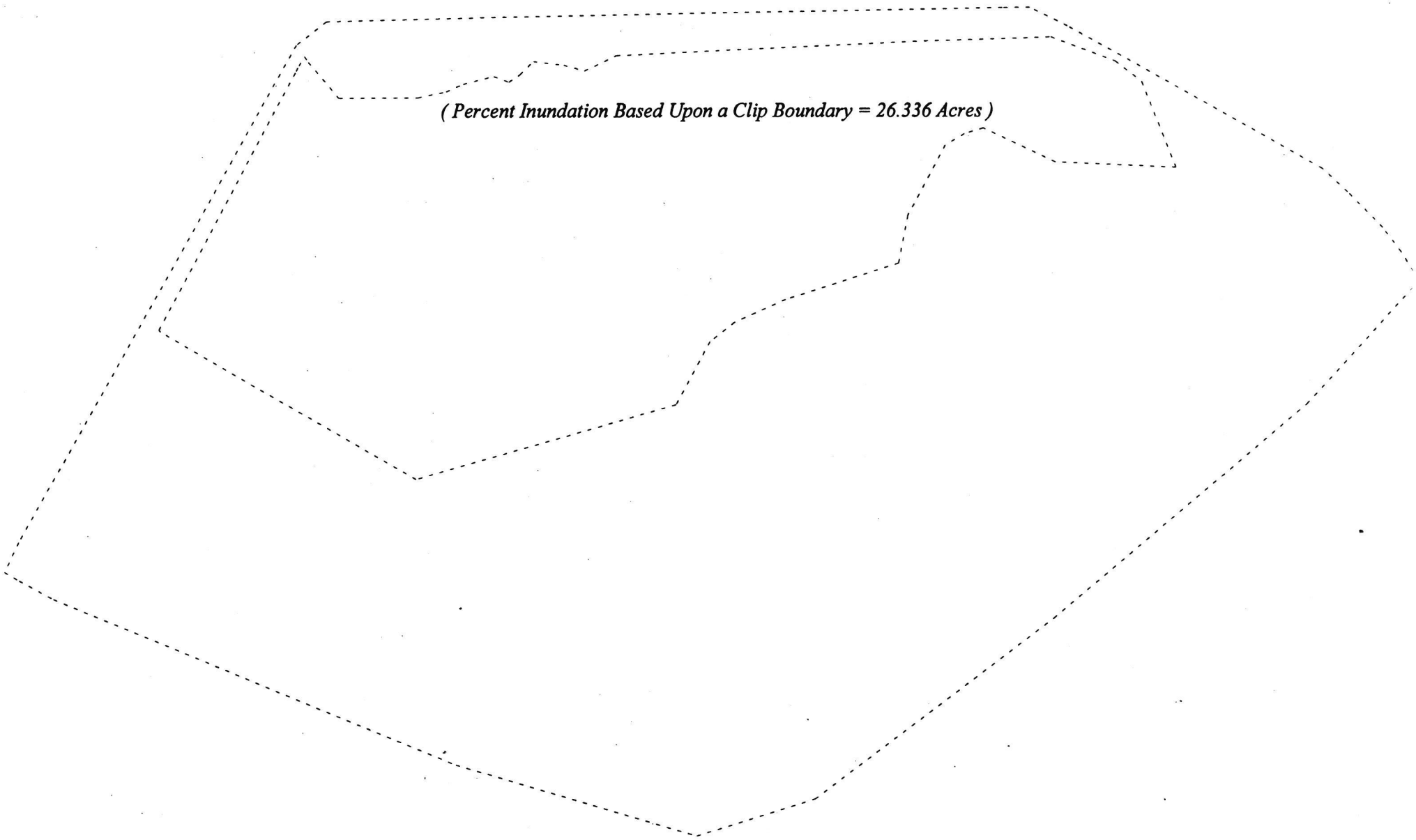
(11/17/97)

APPENDIX D

Calculated Percentages of Inundation with Elevation

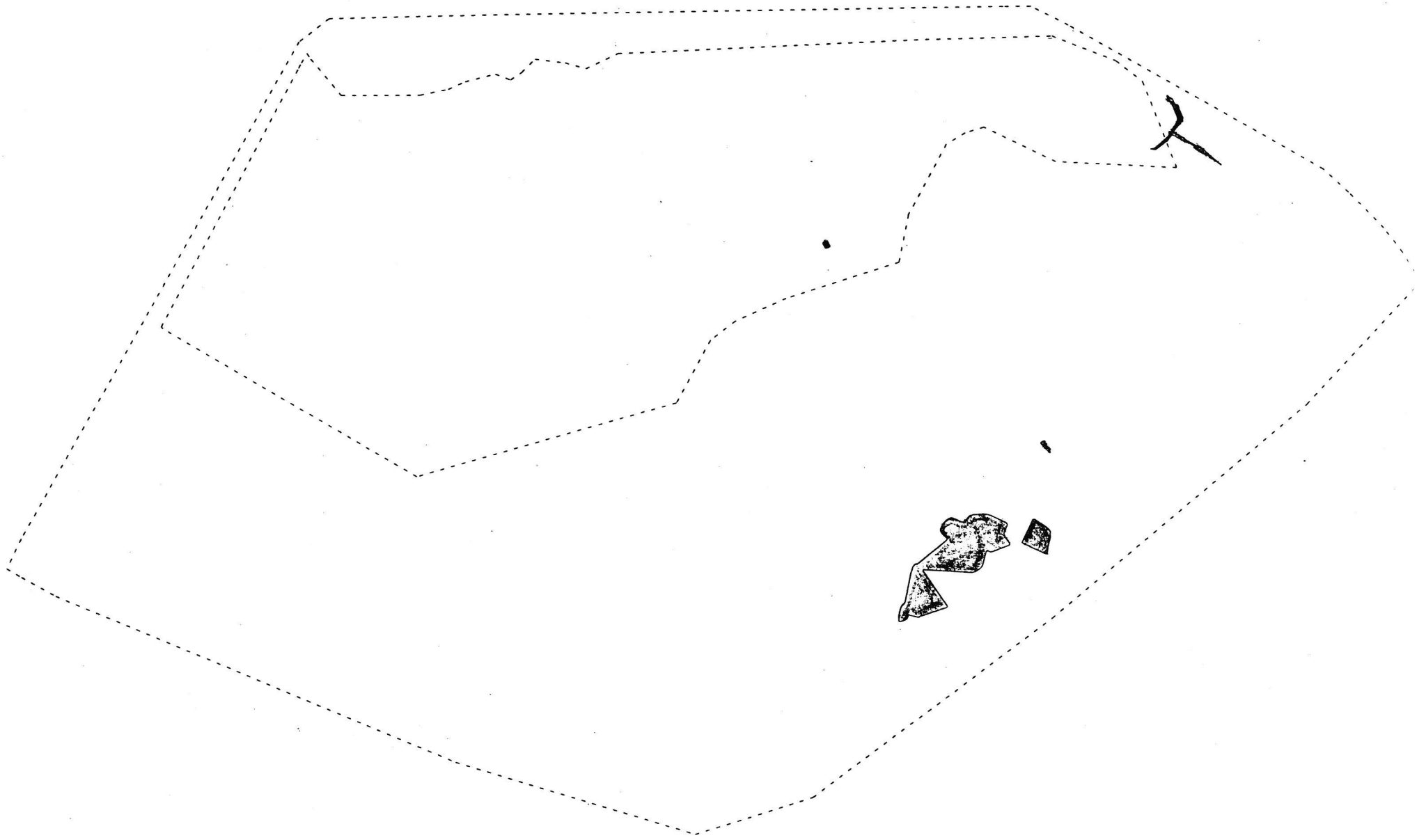
Nevins Creek Mitigation Area

Percent Inundation Compared to Surfacewater Elevation



Nevins Creek Mitigation Area

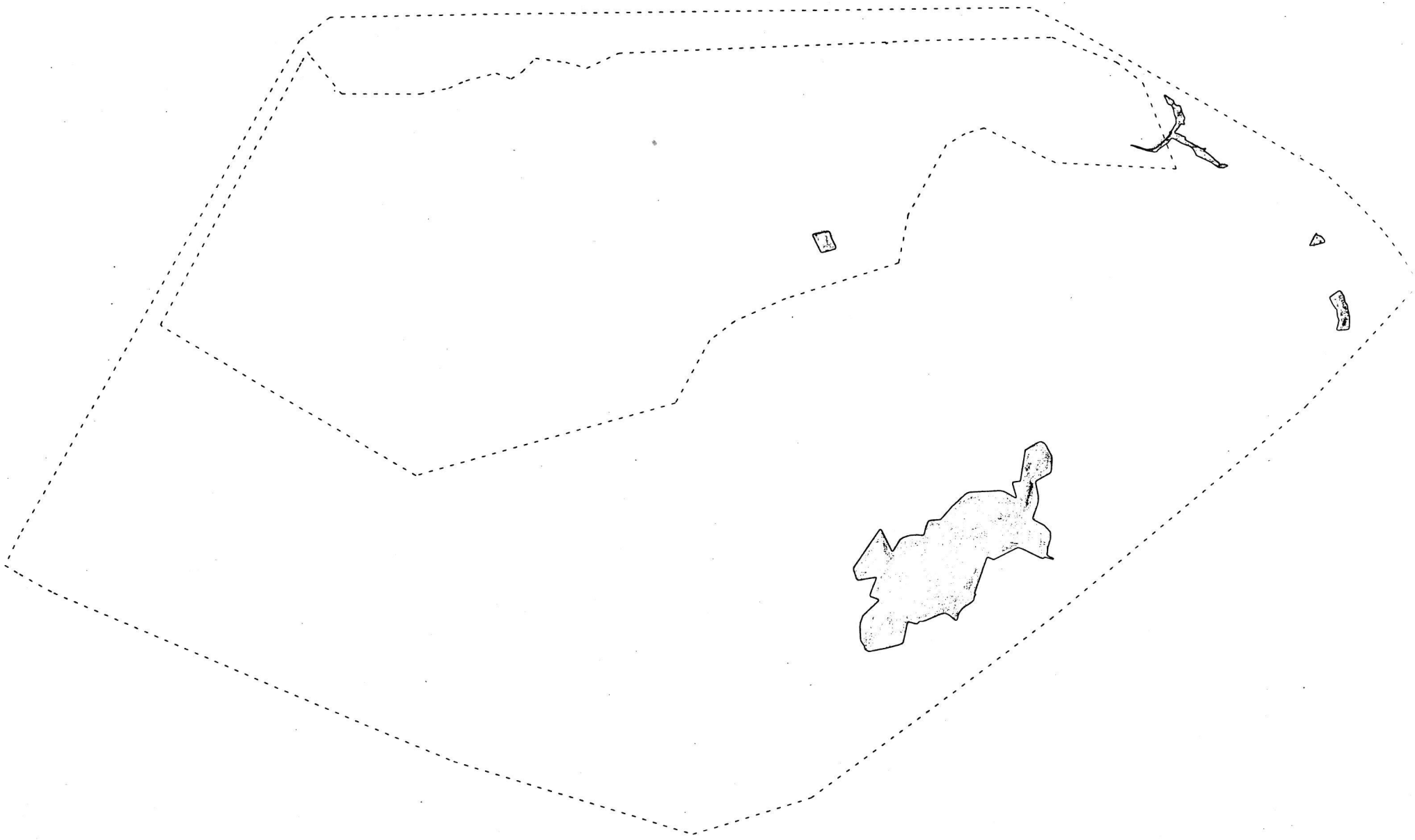
Percent Inundation Compared to Surfacewater Elevation



(00.01% @ Surfacewater Elevation=196')

Nevins Creek Mitigation Area

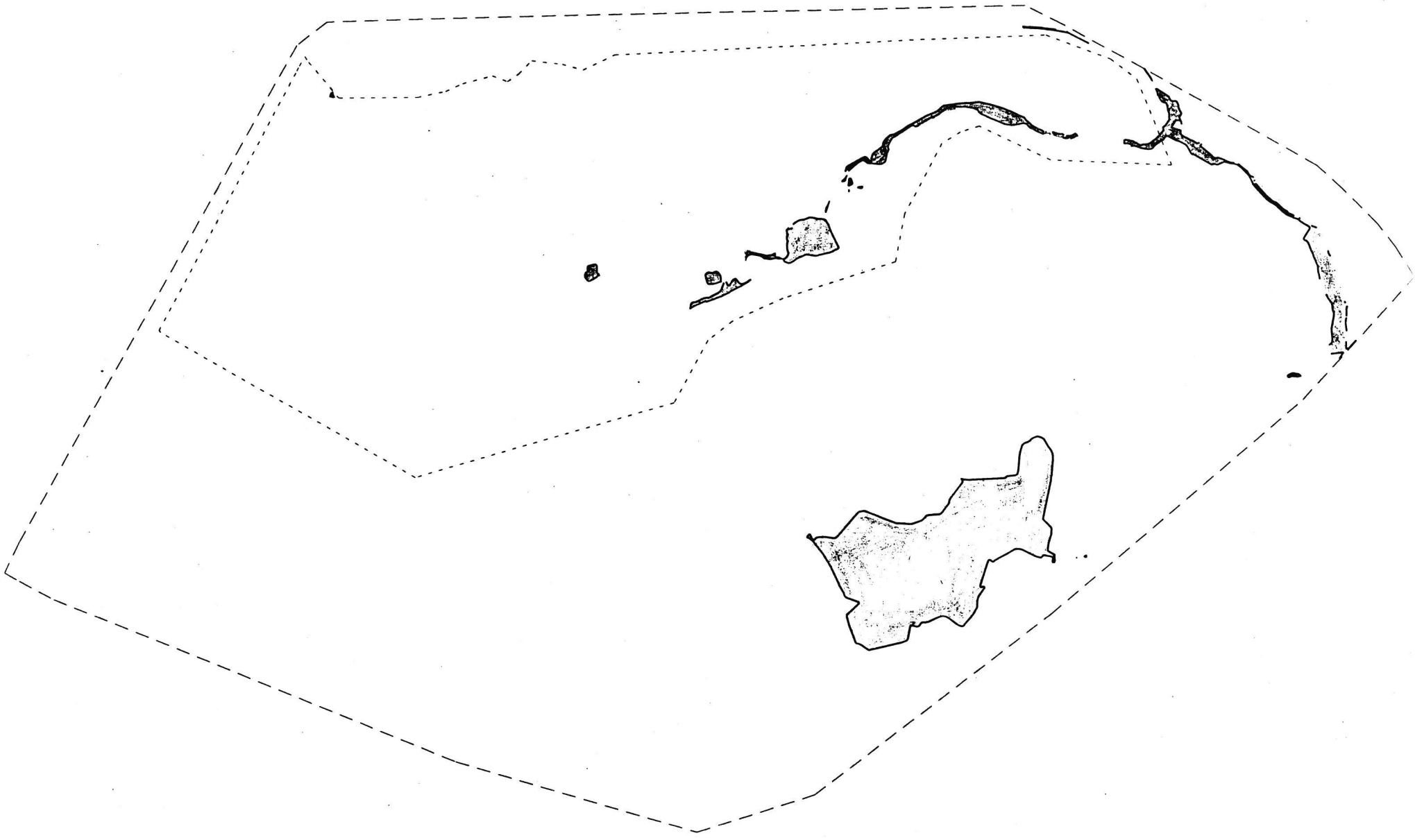
Percent Inundation Compared to Surfacewater Elevation



(00.13% @ Surfacewater Elevation=197')

Nevins Creek Mitigation Area

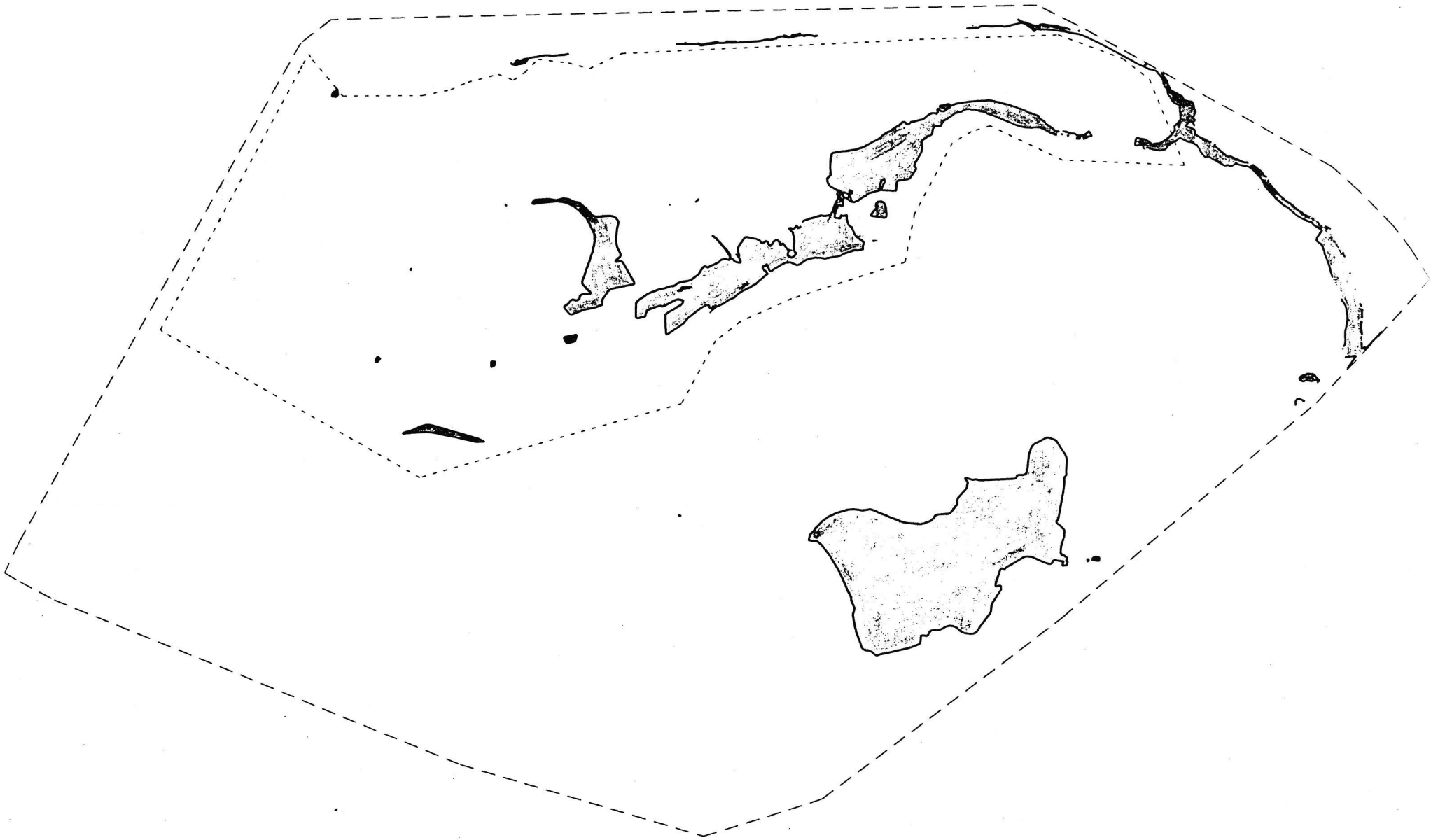
Percent Inundation Compared to Surfacewater Elevation



(1.38% @ Surfacewater Elevation=198')

Nevins Creek _ litigation Area

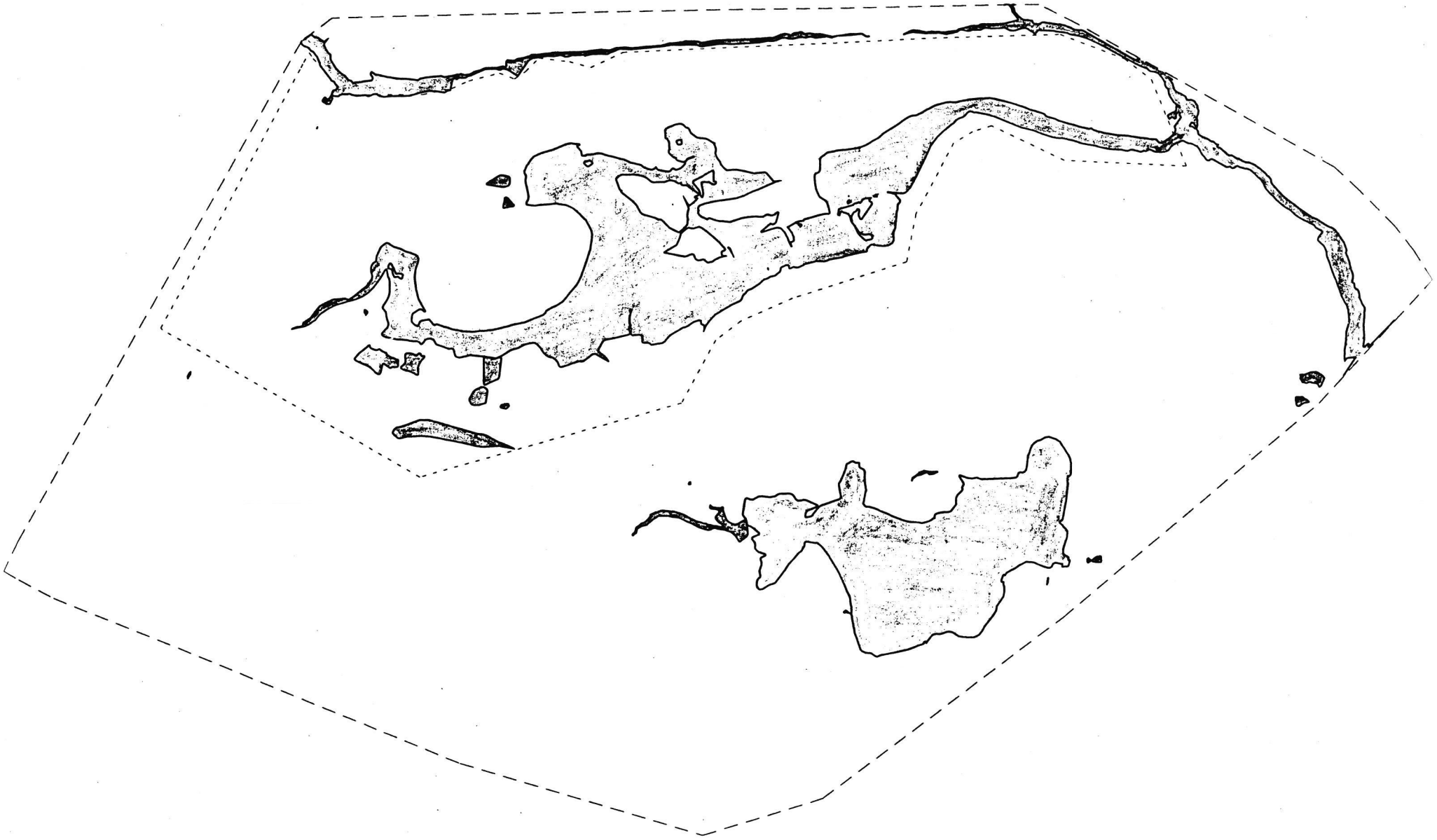
Percent Inundation Compared to Surfacewater Elevation



(7.35% @ Surfacewater Elevation=199')

Nevins Creek ..litigation Area

Percent Inundation Compared to Surfacewater Elevation



(22.00% @ Surfacewater Elevation=200')

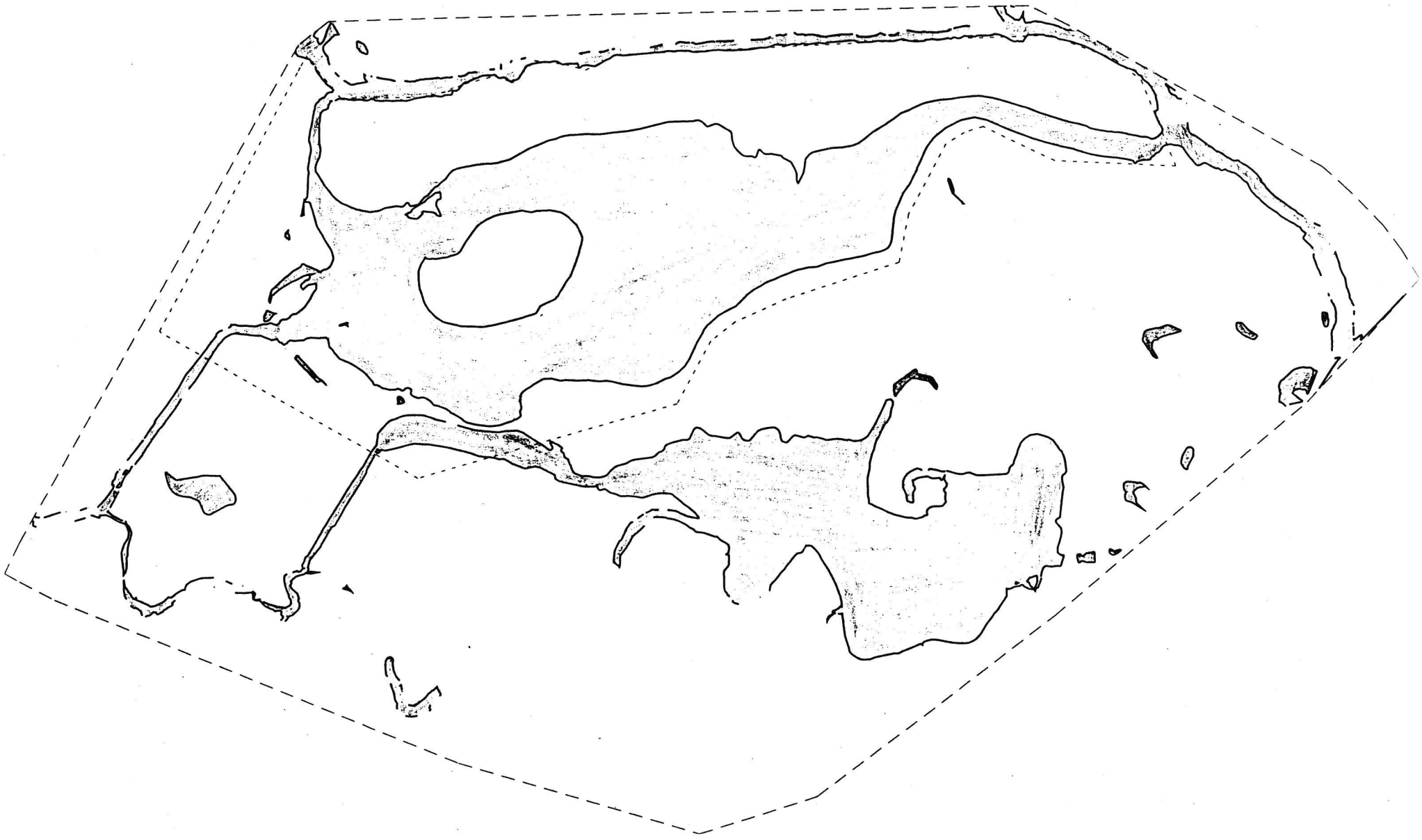
Nevins Creek Mitigation Area

Percent Inundation Compared to Surfacewater Elevation

(44.67% @ Surfacewater Elevation=201')

Nevins Creek ..litigation Area

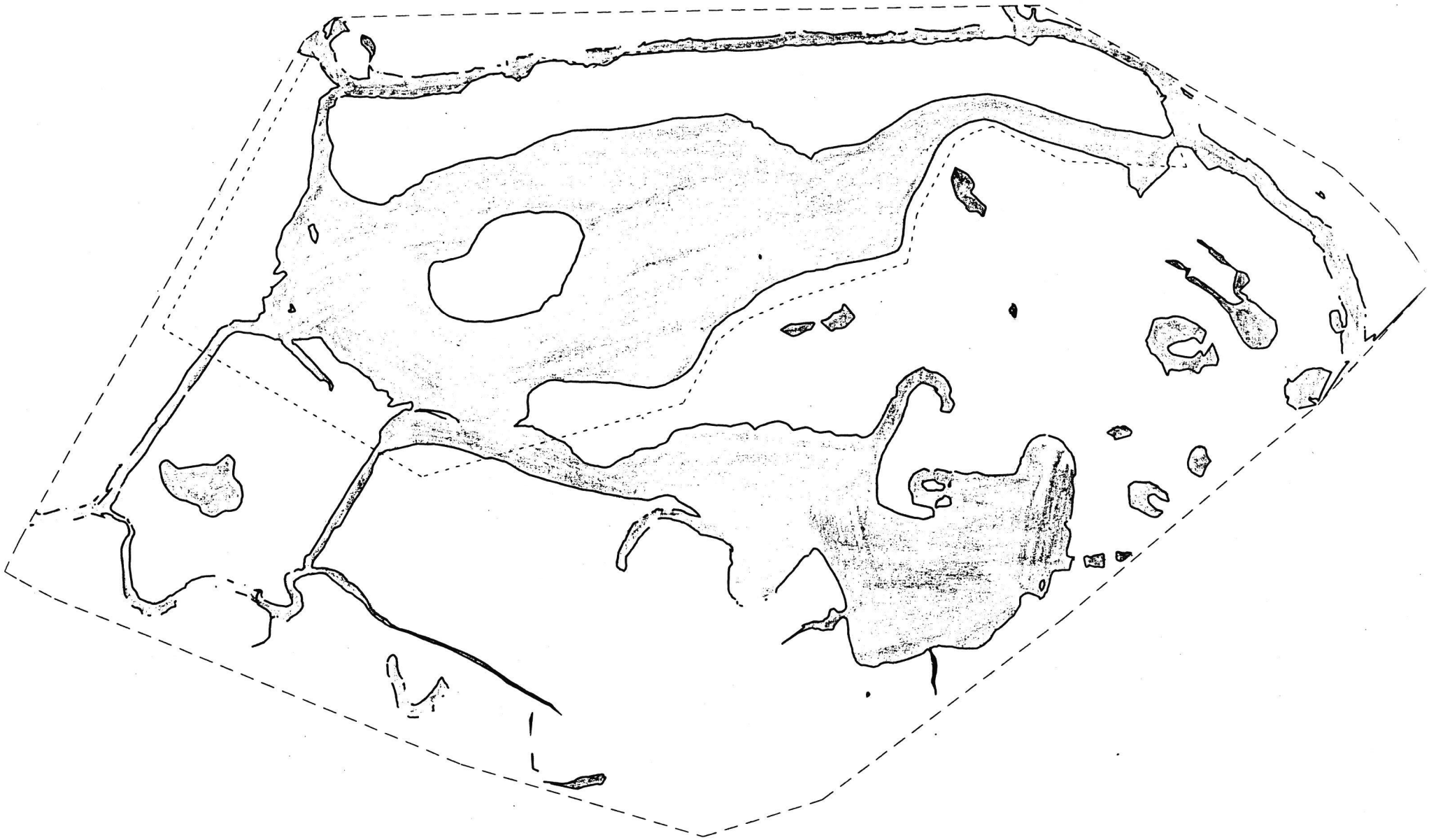
Percent Inundation Compared to Surfacewater Elevation



(49.27% @ Surfacewater Elevation=202')

Nevins Creek ..Iitigation Area

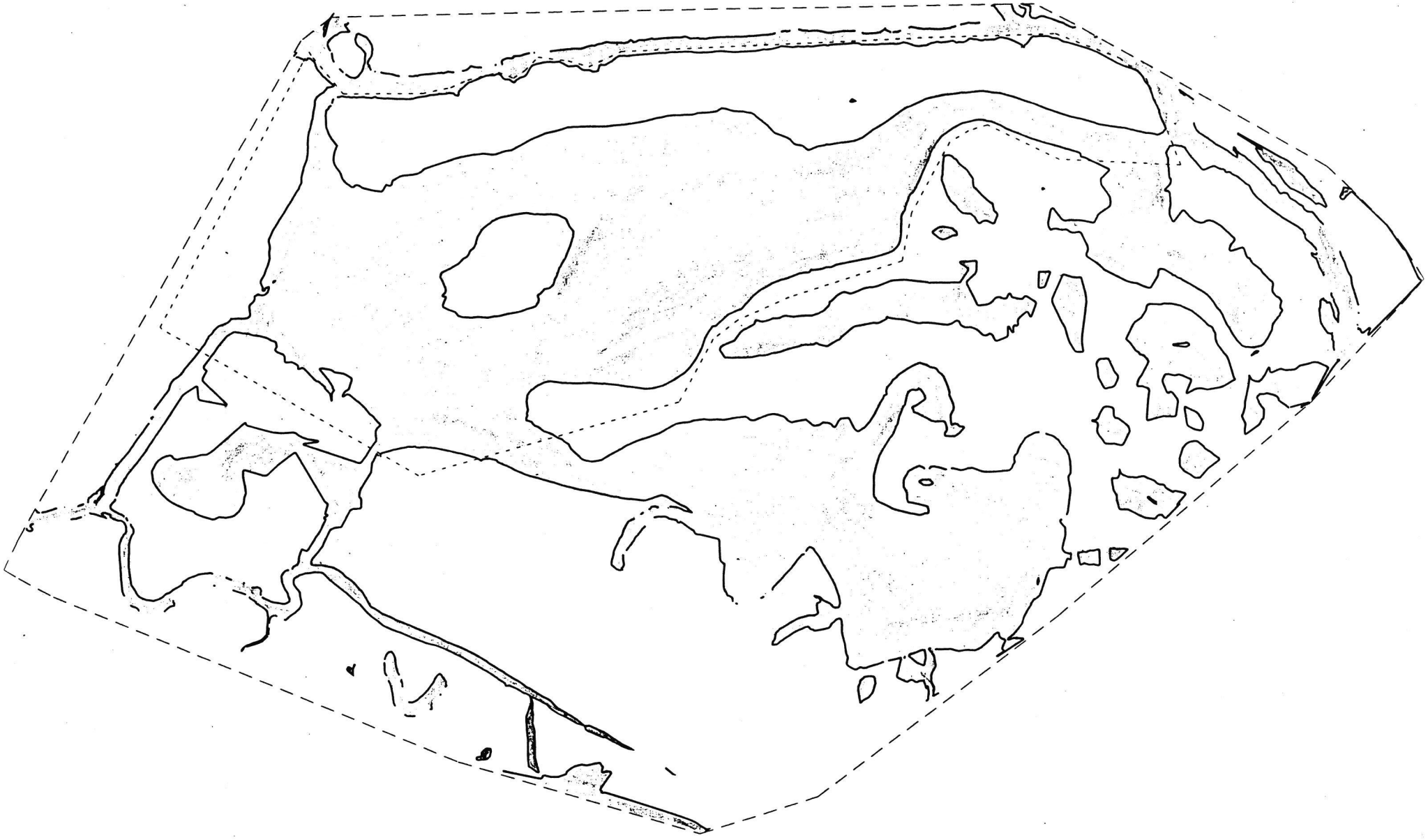
Percent Inundation Compared to Surfacewater Elevation



(55.51% @ Surfacewater Elevation=203')

Nevins Creek Mitigation Area

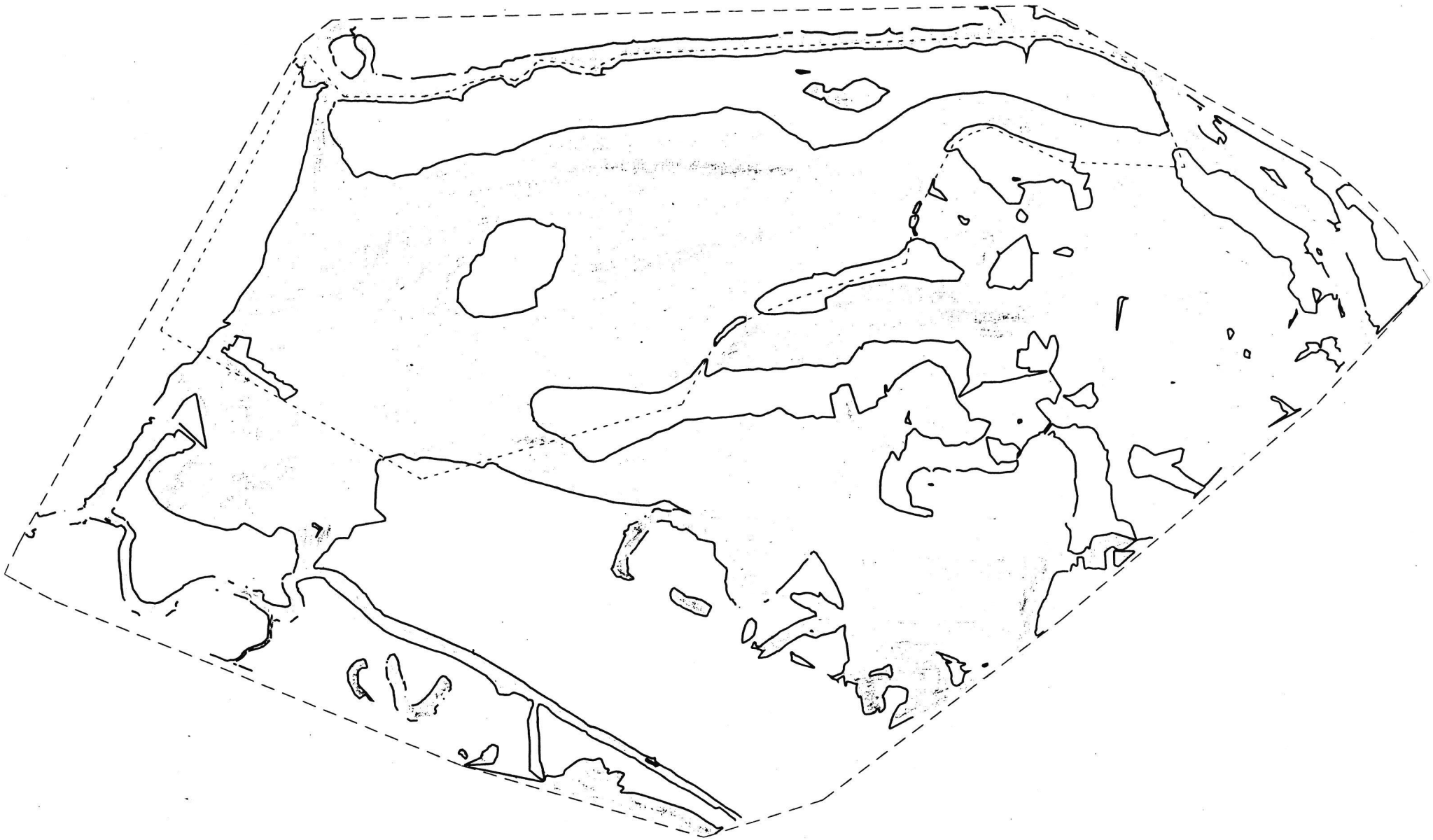
Percent Inundation Compared to Surfacewater Elevation



(62.42% @ Surfacewater Elevation=204')

Nevins Creek Mitigation Area

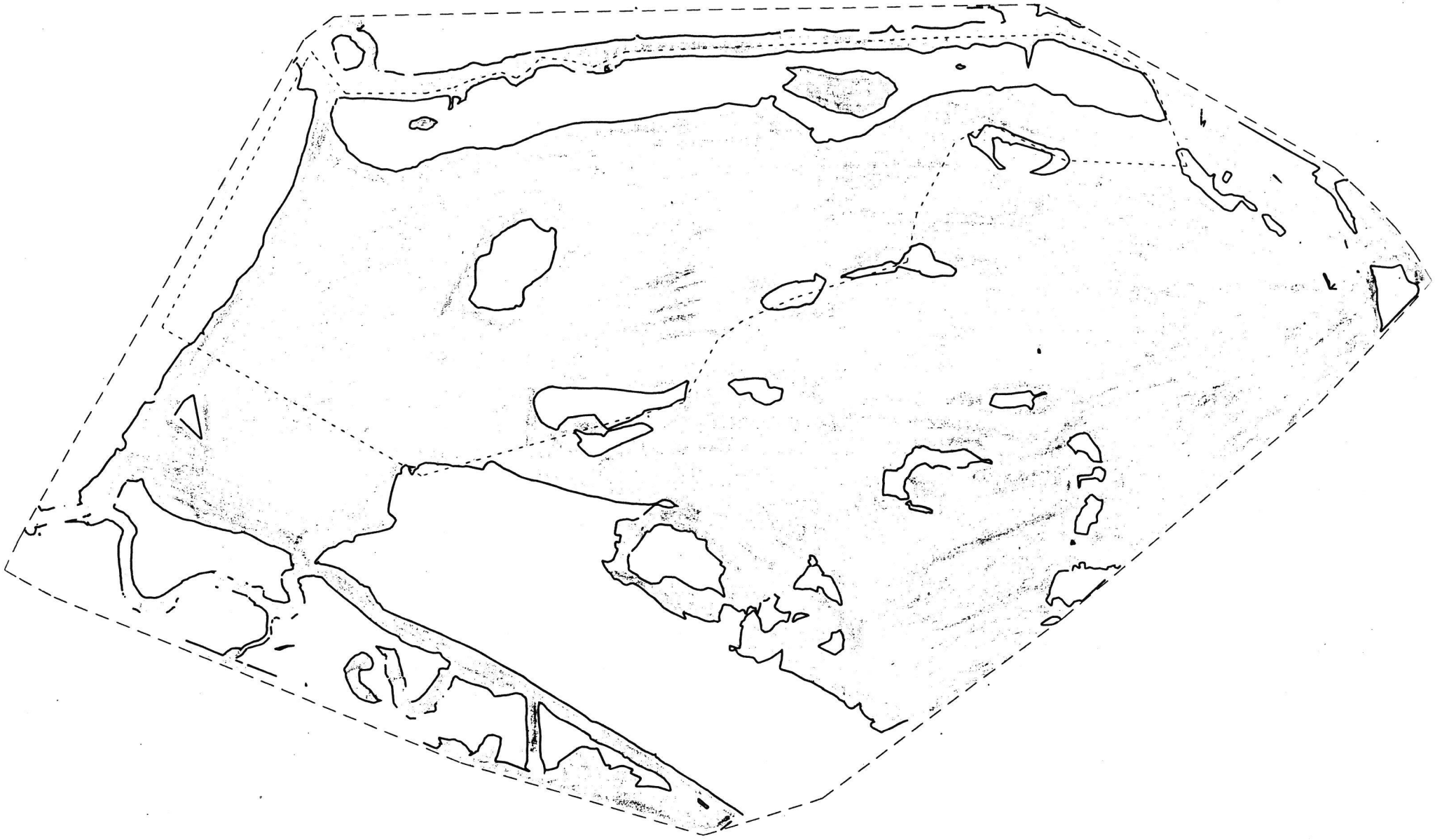
Percent Inundation Compared to Surfacewater Elevation



(63.84% @ Surfacewater Elevation=205')

Nevins Creek ..Iitigation Area

Percent Inundation Compared to Surfacewater Elevation



(68.97% @ Surfacewater Elevation=206')

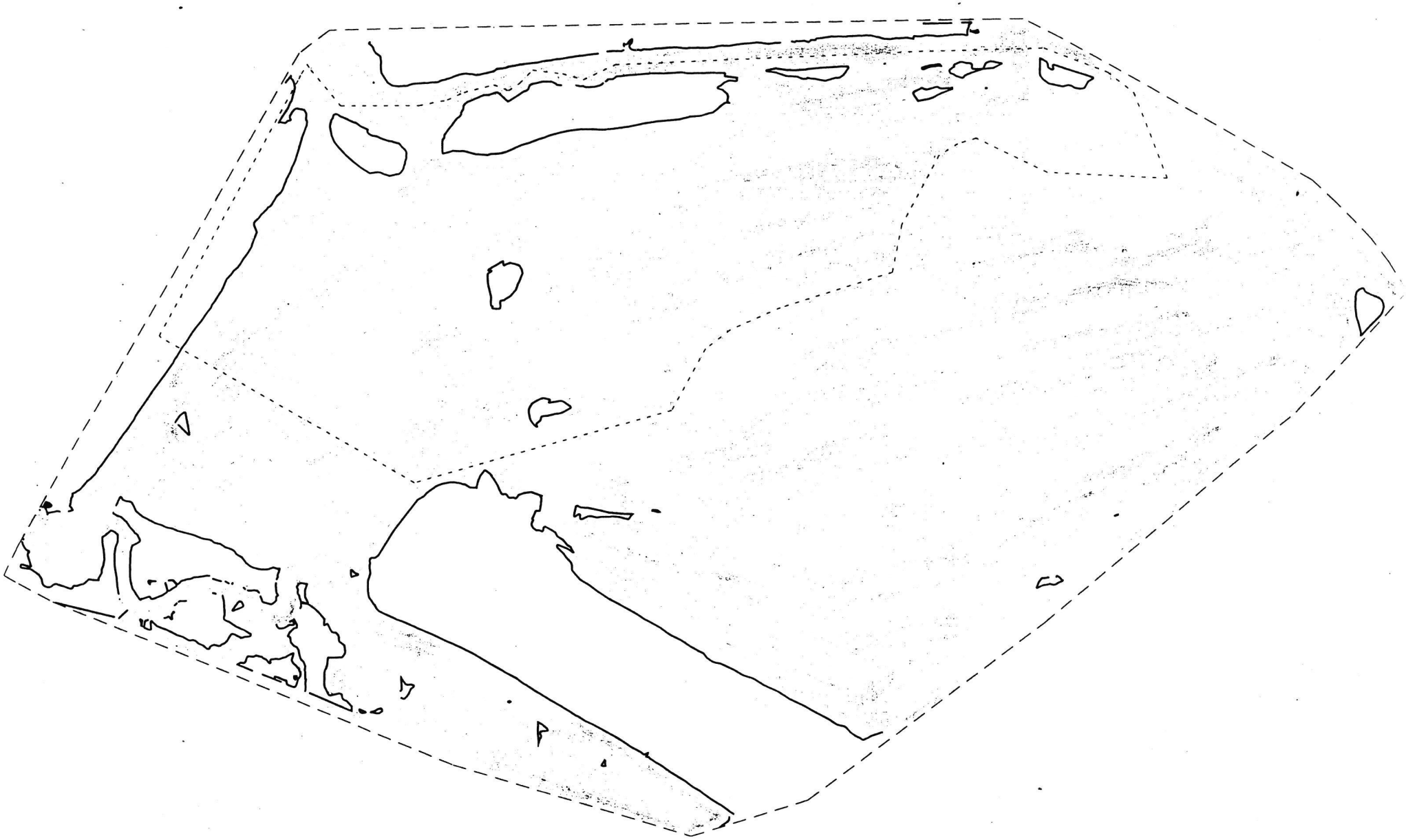
Nevins Creek Mitigation Area

Percent Inundation Compared to Surfacewater Elevation

(82.45% @ Surfacewater Elevation=207')

Nevins Creek ..Iitigation Area

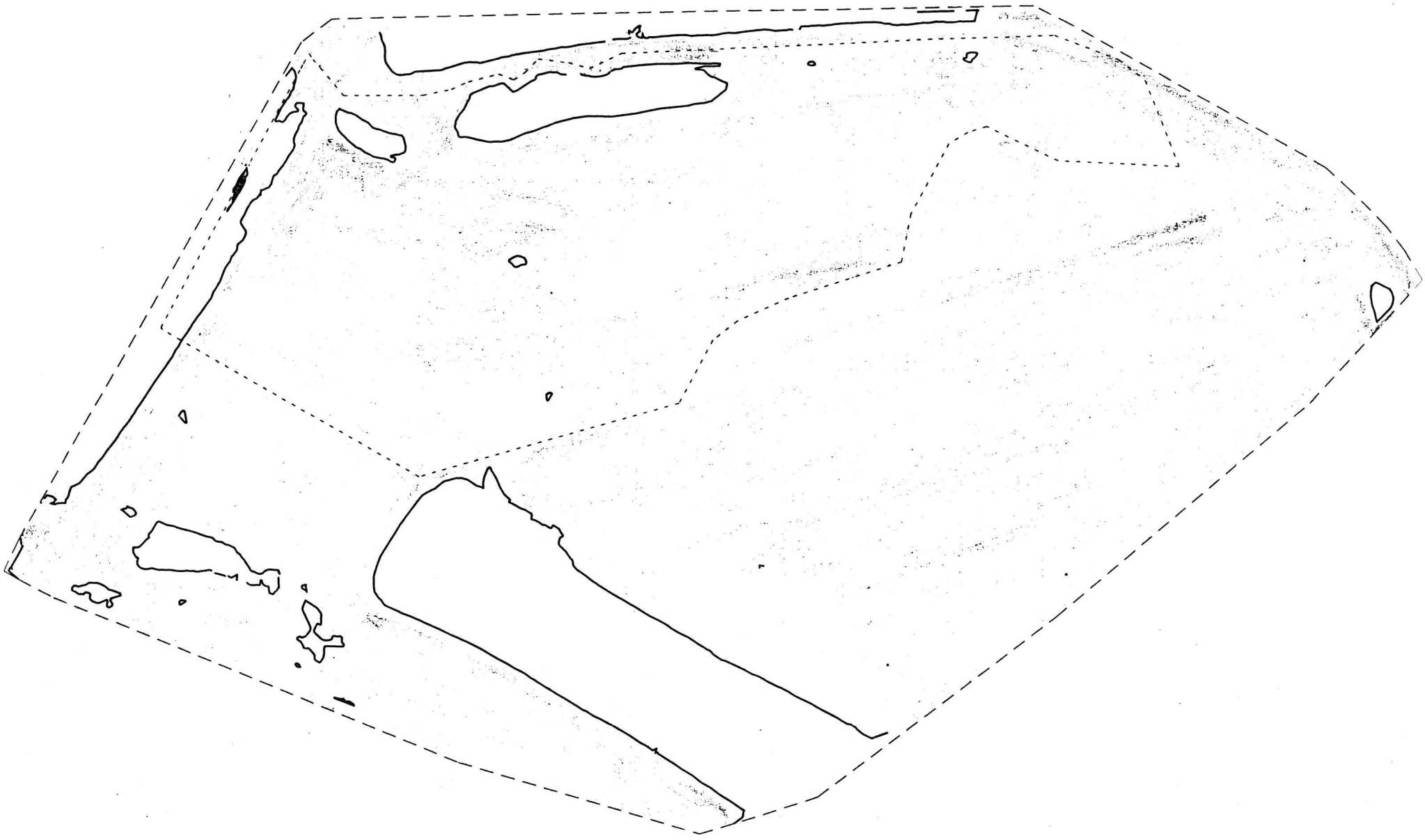
Percent Inundation Compared to Surfacewater Elevation



(90.12% @ Surfacewater Elevation=208')

Nevins Creek Mitigation Area

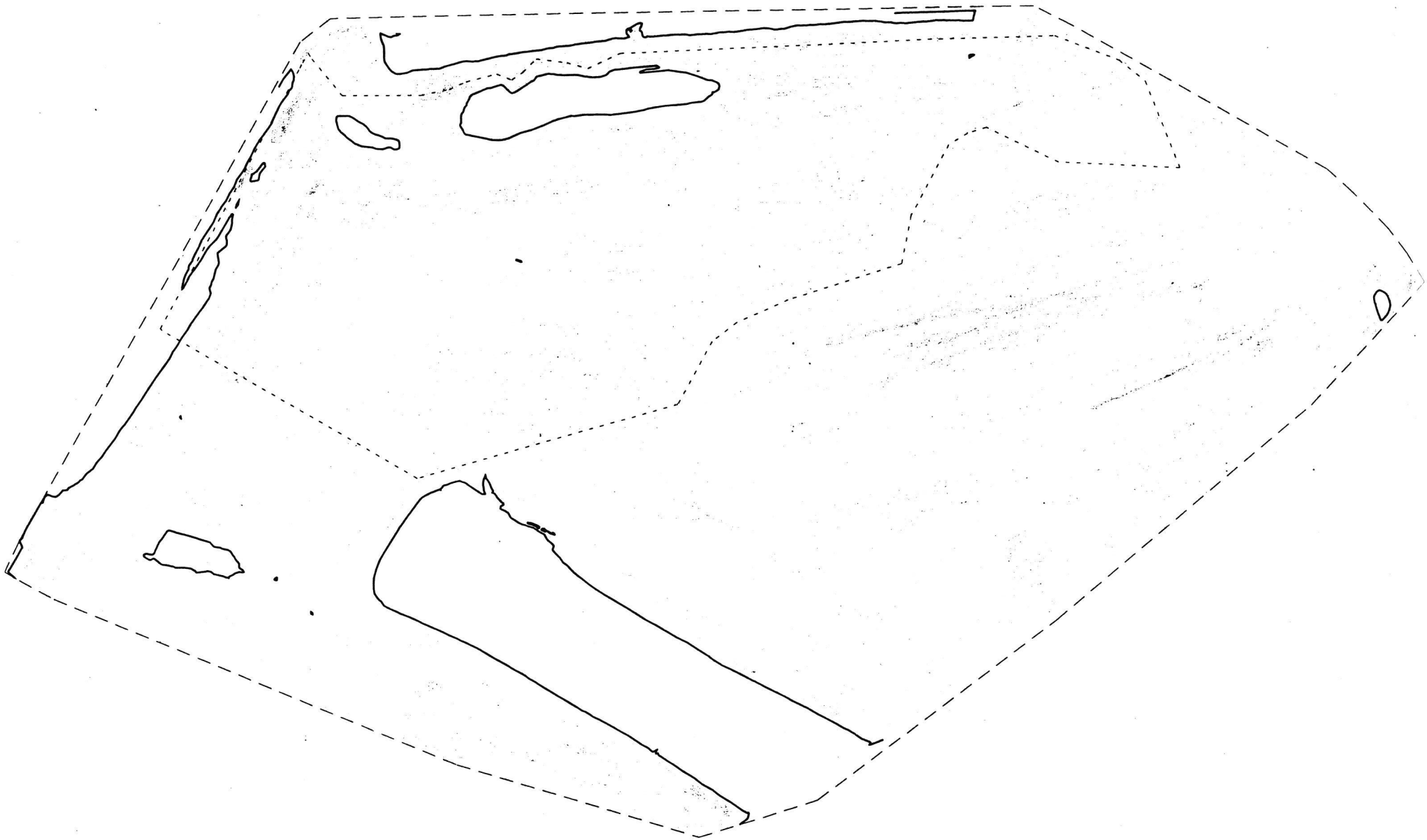
Percent Inundation Compared to Surfacewater Elevation



(92.25% @ Surfacewater Elevation=209')

Nevins Creek _ litigation Area

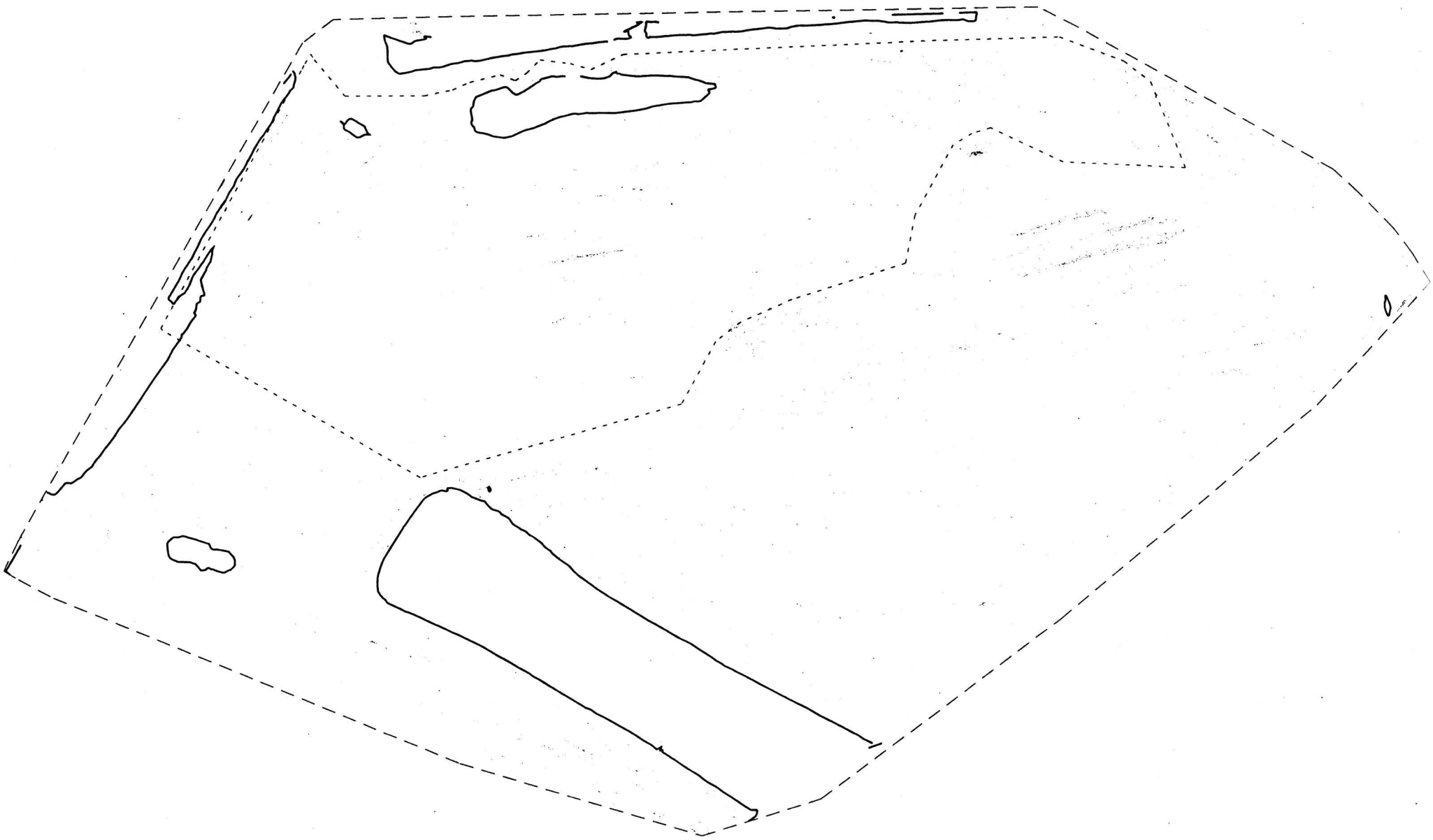
Percent Inundation Compared to Surfacewater Elevation



(94.58% @ Surfacewater Elevation=210')

Nevins Creek litigation Area

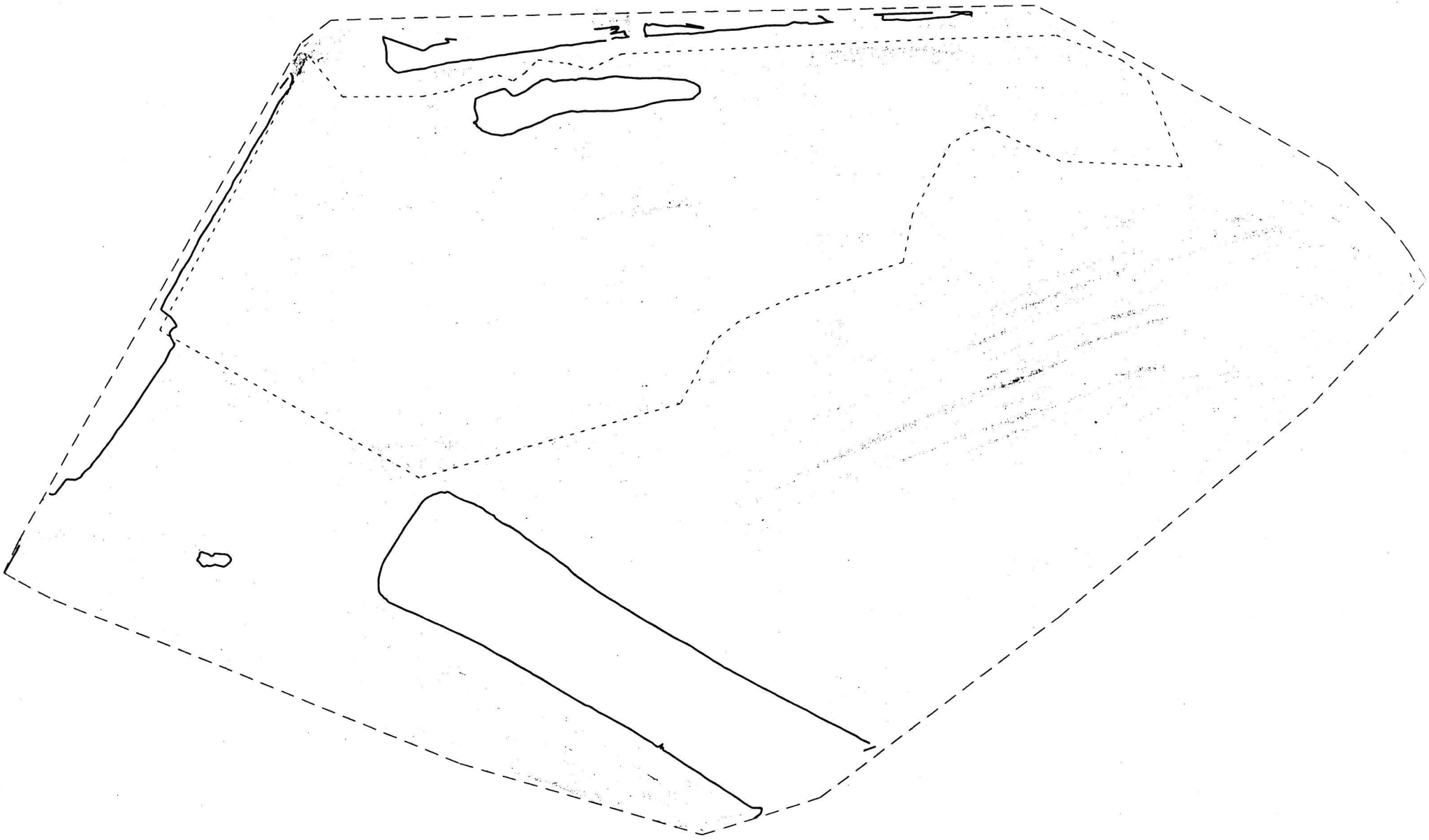
Percent Inundation Compared to Surfacewater Elevation



(96.63% @ Surfacewater Elevation=211')

Nevins Creek Mitigation Area

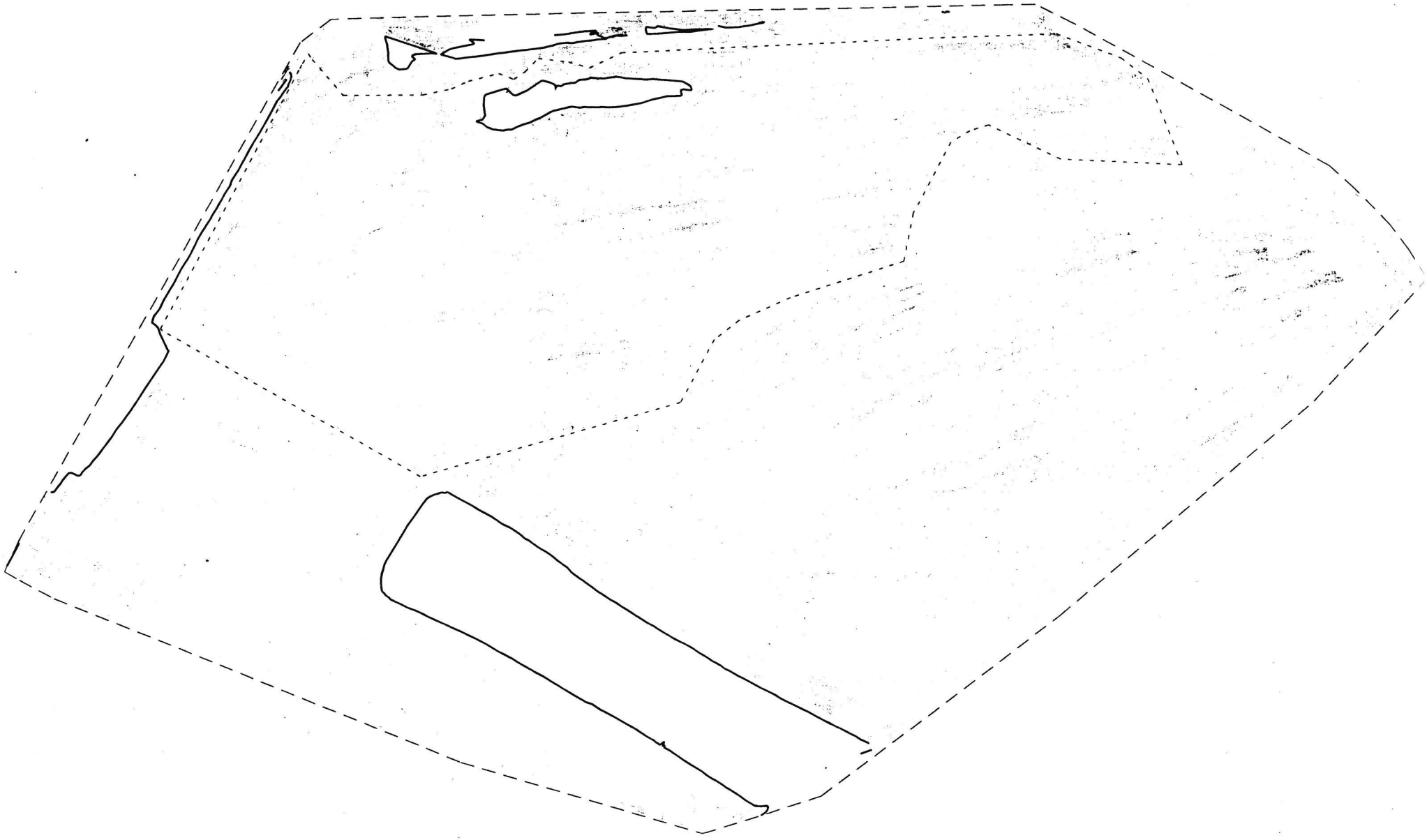
Percent Inundation Compared to Surfacewater Elevation



(97.29% @ Surfacewater Elevation=212')

Nevins Creek ..Iitigation Area

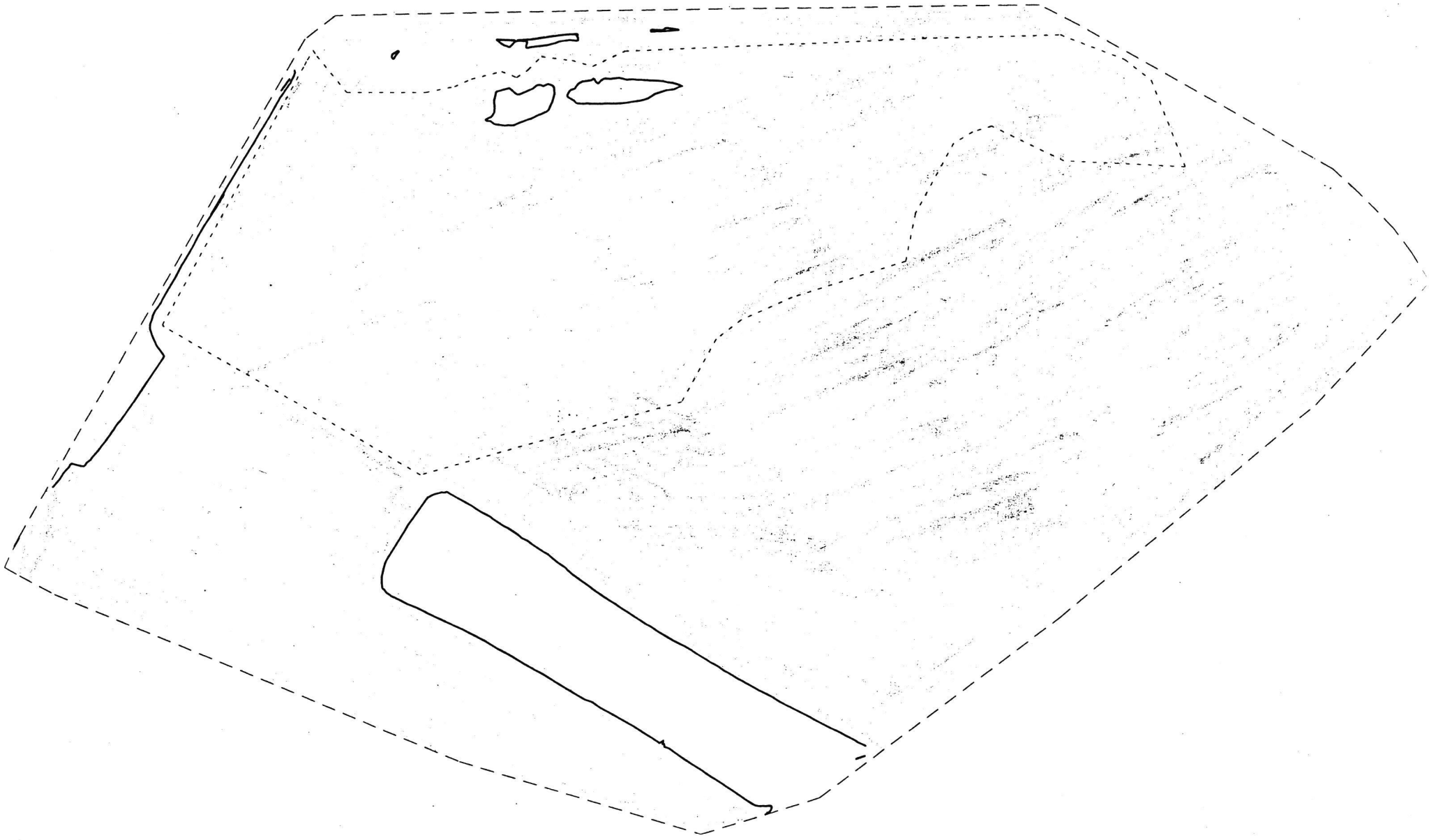
Percent Inundation Compared to Surfacewater Elevation



(97.76% @ Surfacewater Elevation=213')

Nevins Creek ..litigation Area

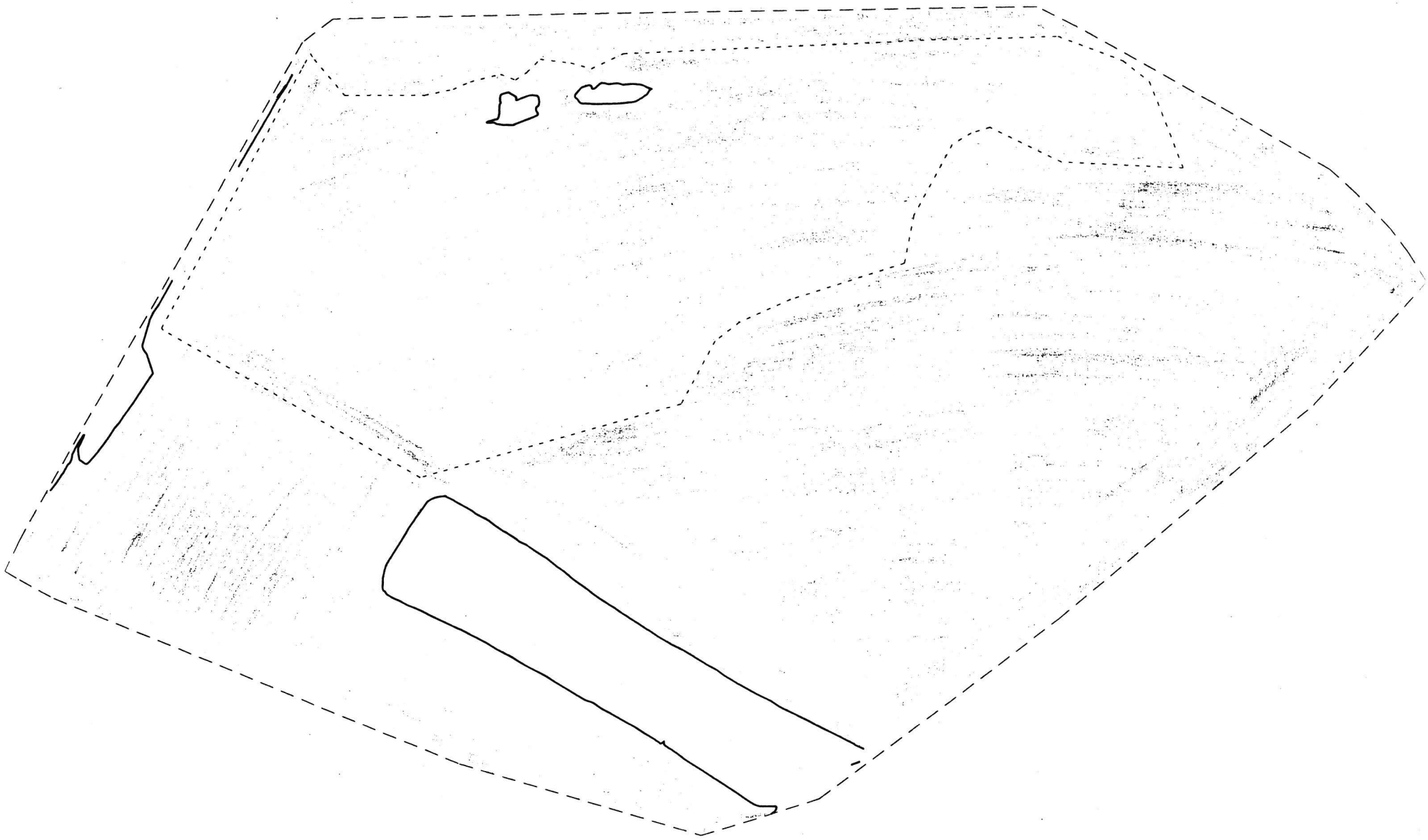
Percent Inundation Compared to Surfacewater Elevation



(99.19% @ Surfacewater Elevation=214')

Nevins Creek Mitigation Area

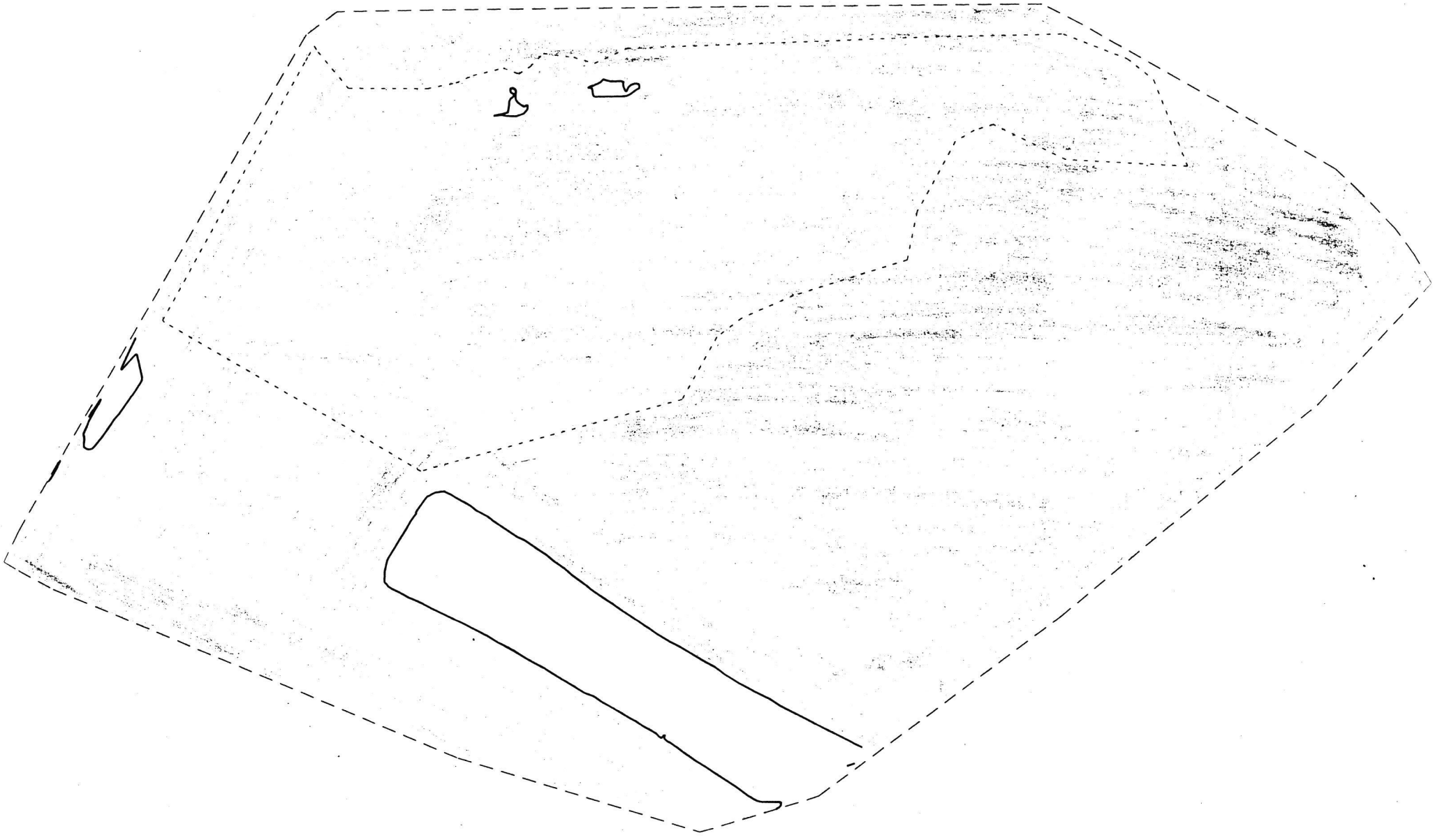
Percent Inundation Compared to Surfacewater Elevation



(99.51% @ Surfacewater Elevation=215')

Nevins Creek Mitigation Area

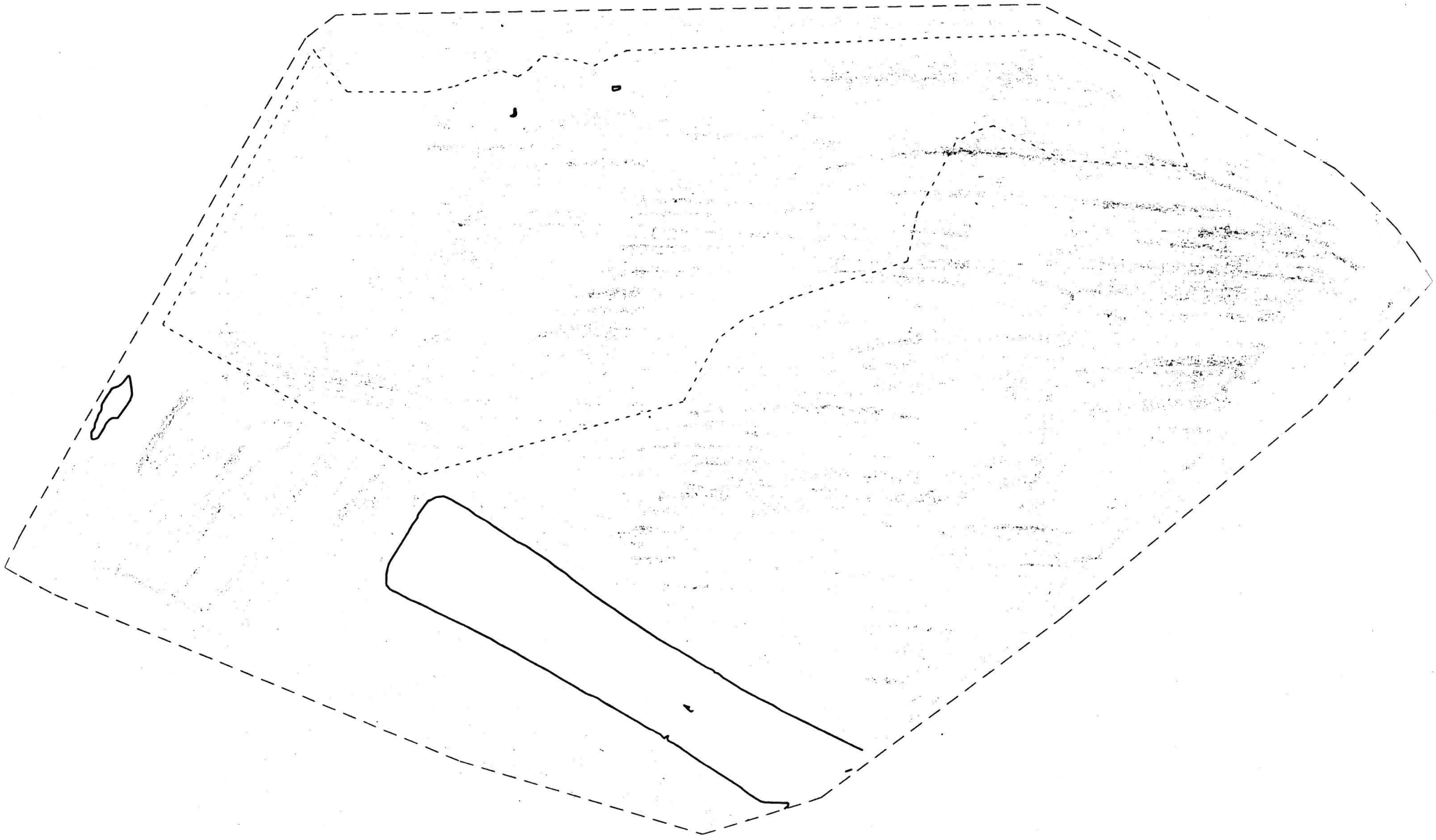
Percent Inundation Compared to Surfacewater Elevation



(99.88% @ Surfacewater Elevation=216')

Nevins Creek Mitigation Area

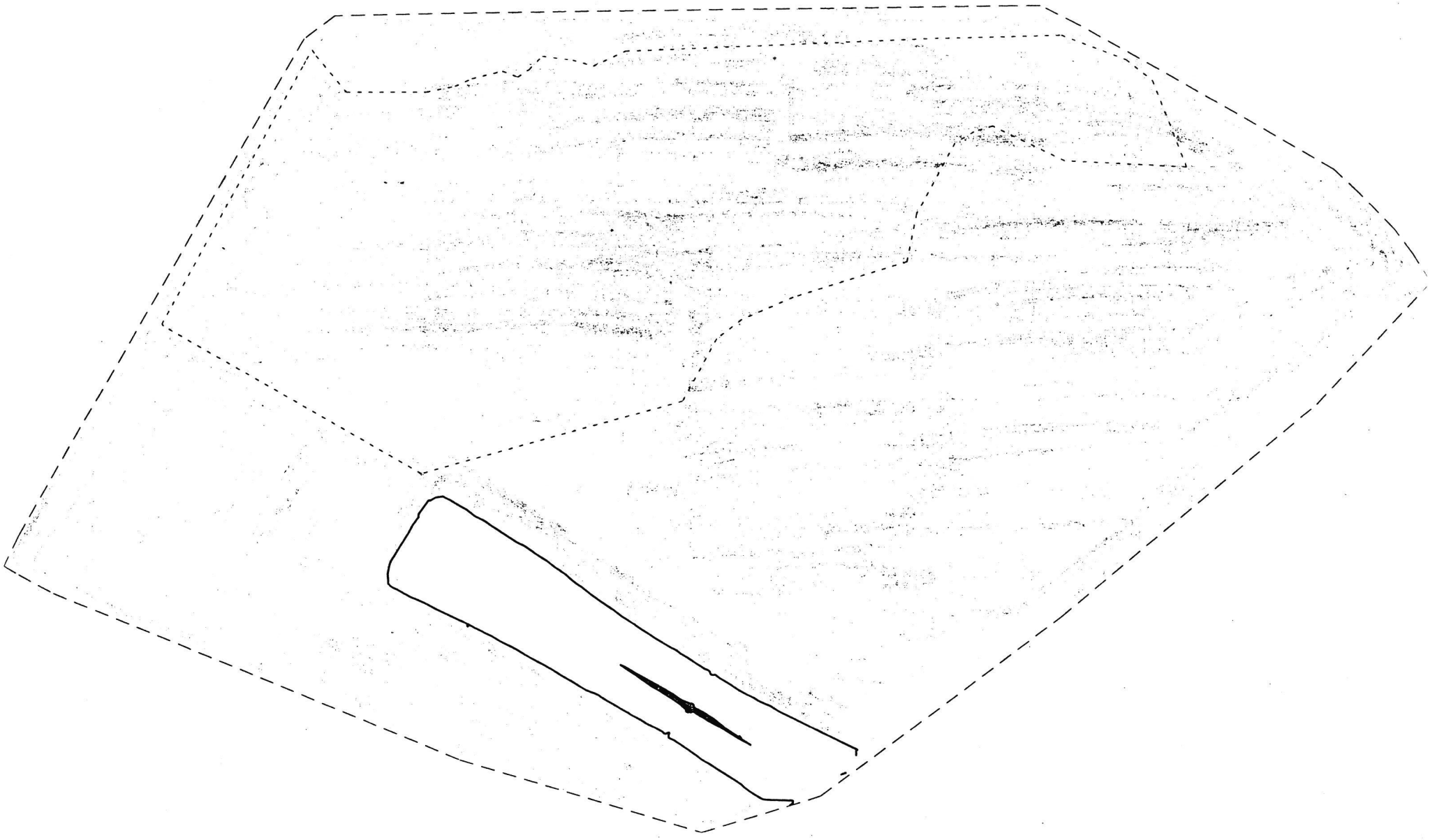
Percent Inundation Compared to Surfacewater Elevation



(99.96% @ Surfacewater Elevation=217')

Nevins Creek ..Iitigation Area

Percent Inundation Compared to Surfacewater Elevation

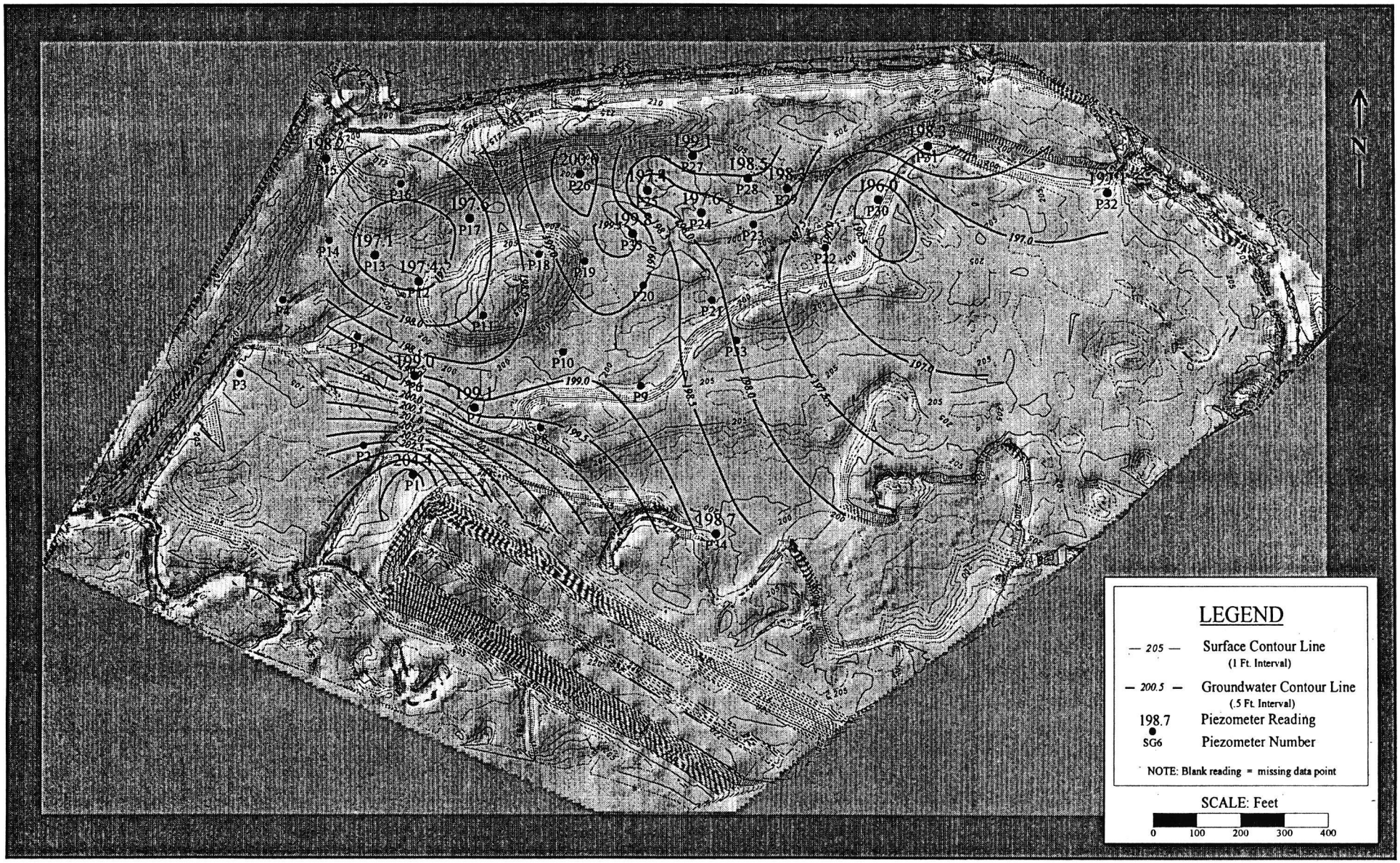


(100.00% @ Surfacewater Elevation=218')

APPENDIX E

CAICE and SURFER Groundwater Elevation Maps

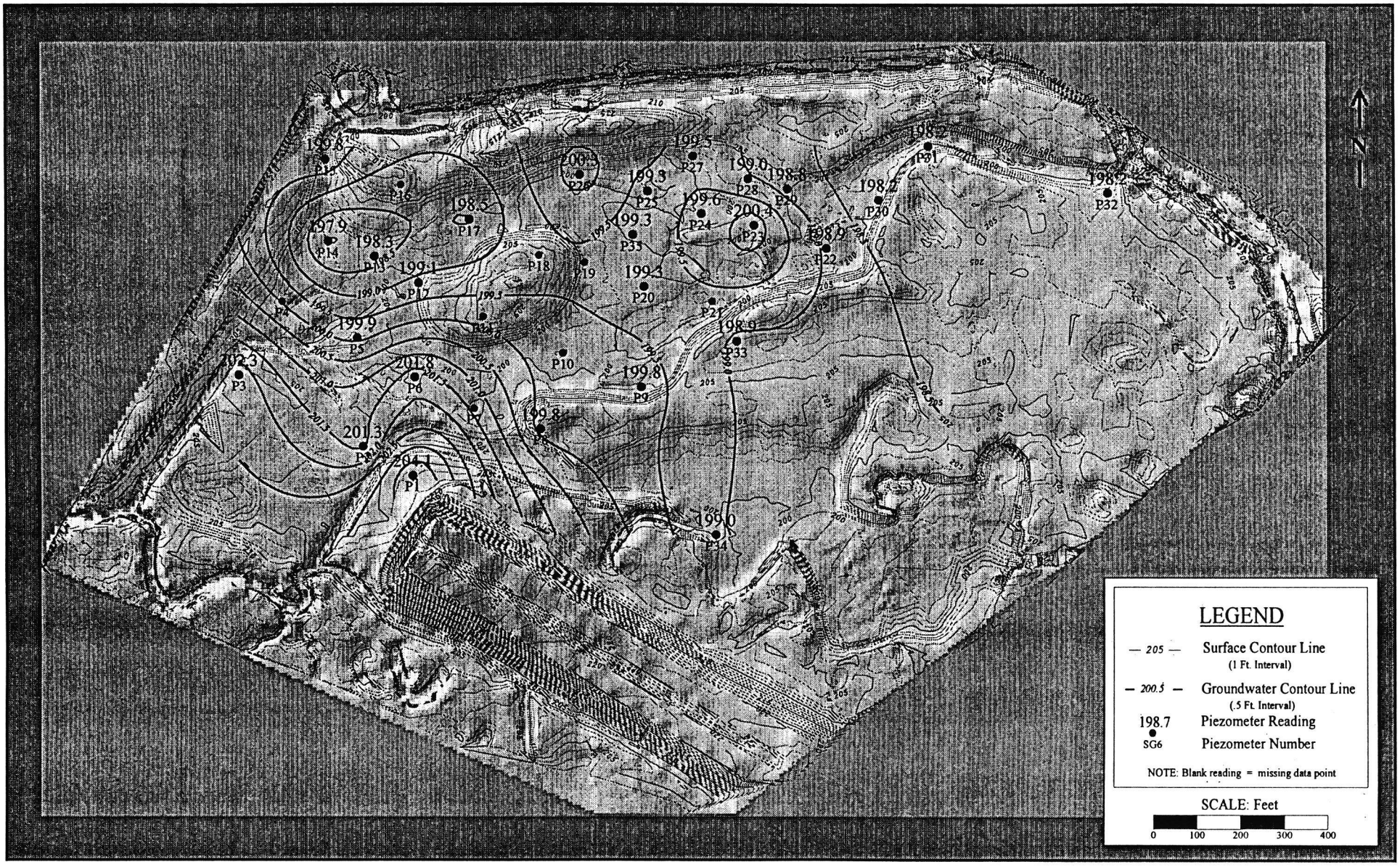
Nevins Creek Mitigation Area



Groundwater Elevations

(12/01/95)

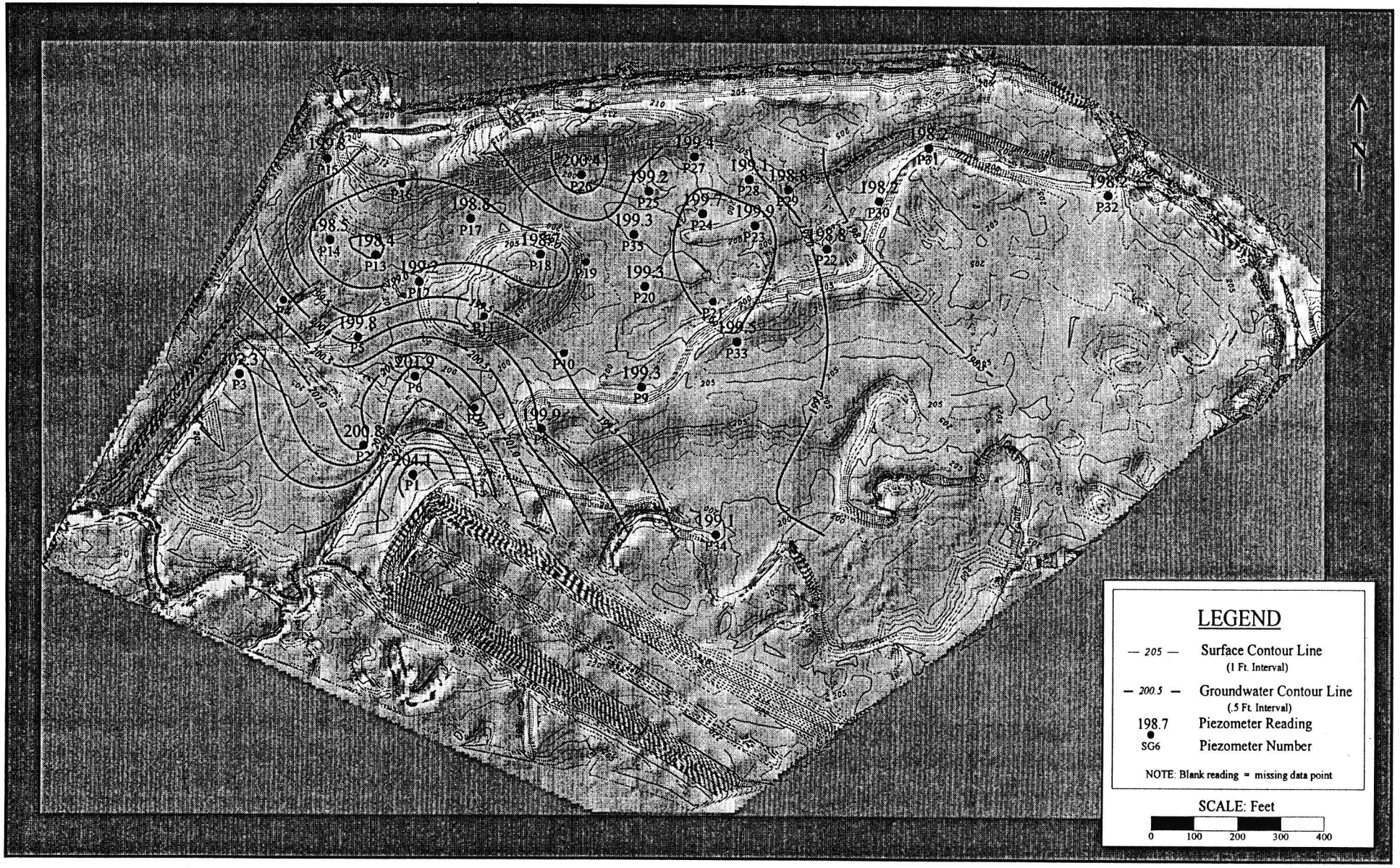
Nevins Creek Mitigation Area



Groundwater Elevations

(01/14/96)

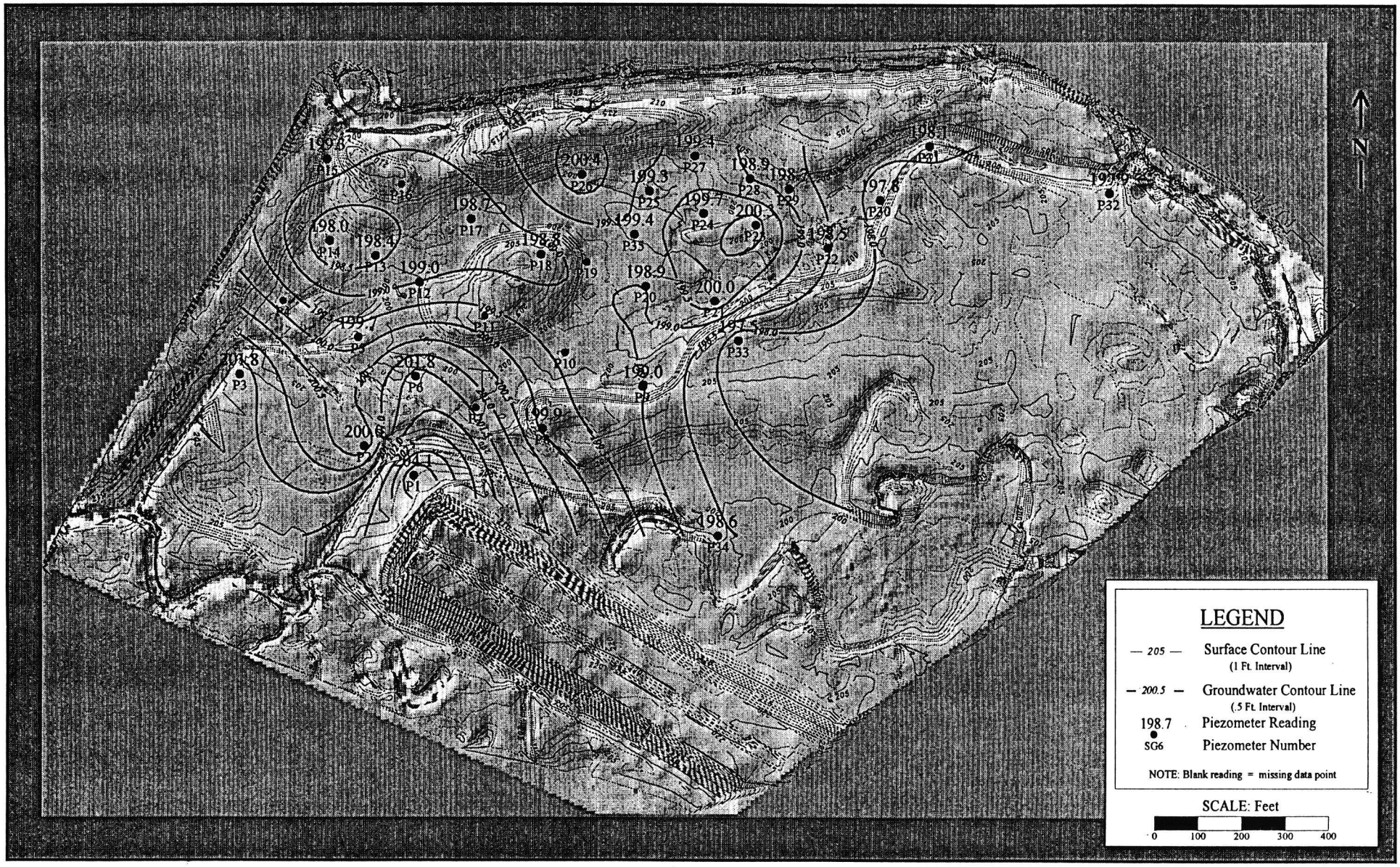
Nevins Creek Mitigation Area



Groundwater Elevations

(01/29/96)

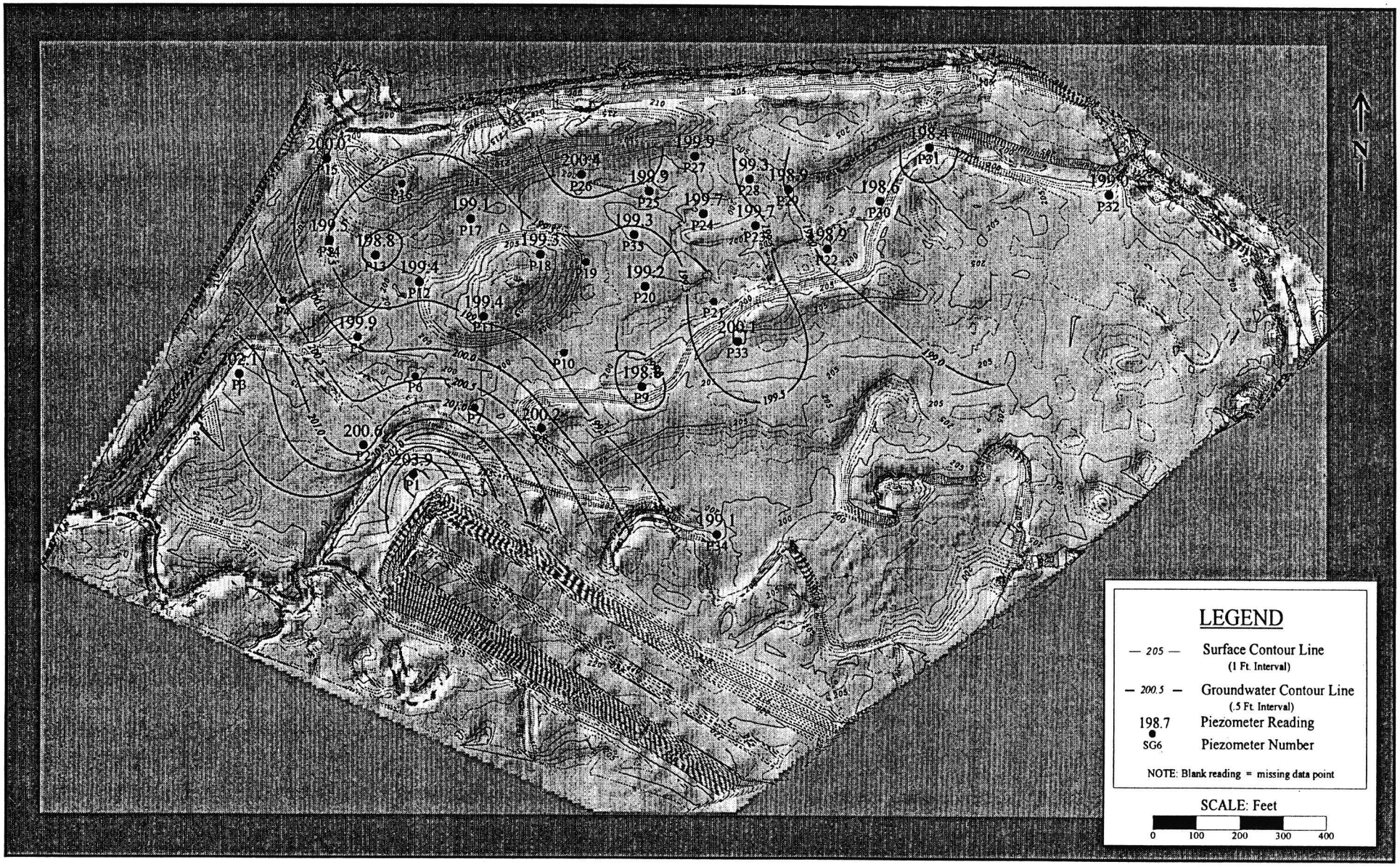
Nevins Creek Mitigation Area



Groundwater Elevations

(02/12/96)

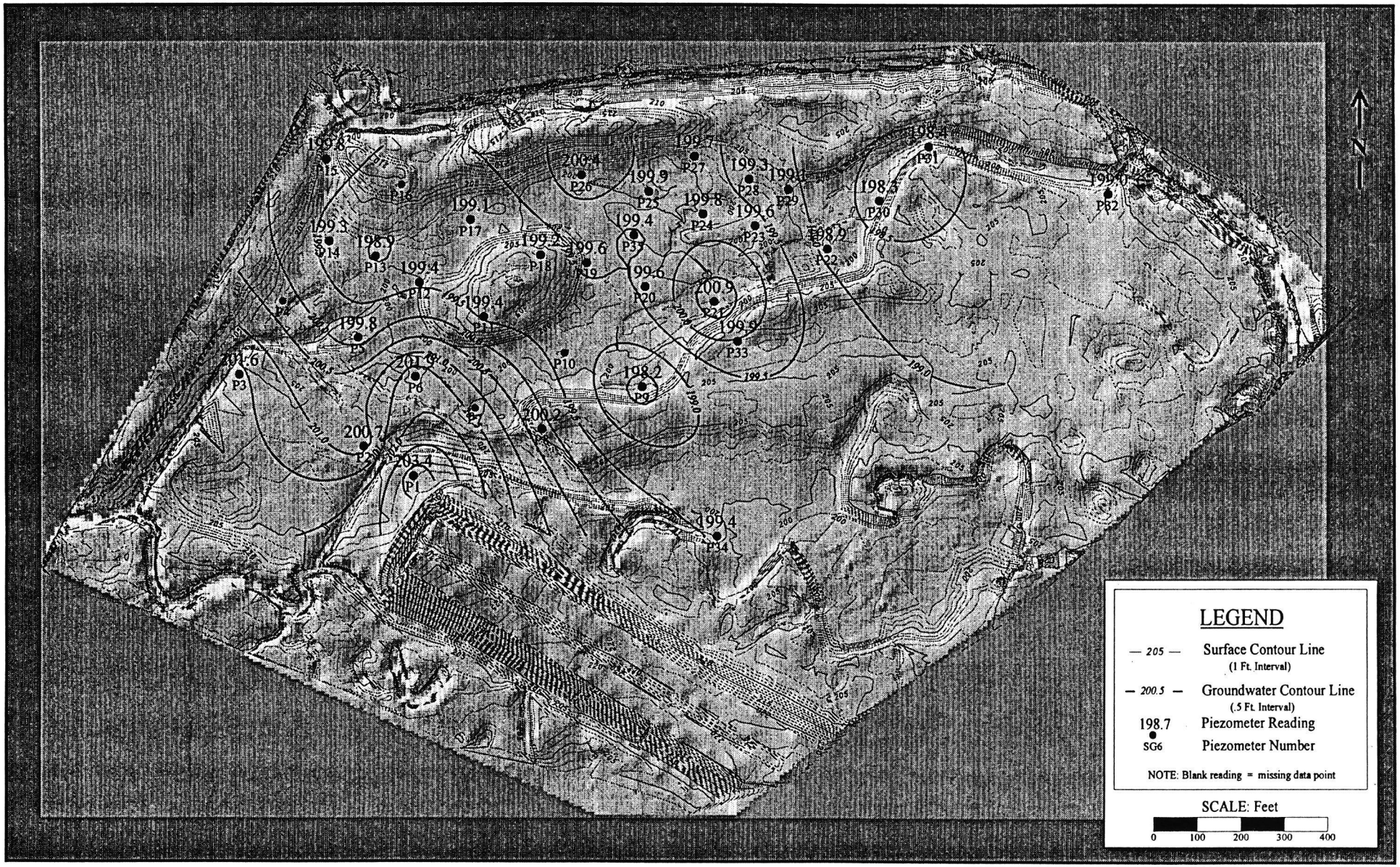
Nevins Creek Mitigation Area



Groundwater Elevations

(02/25/96)

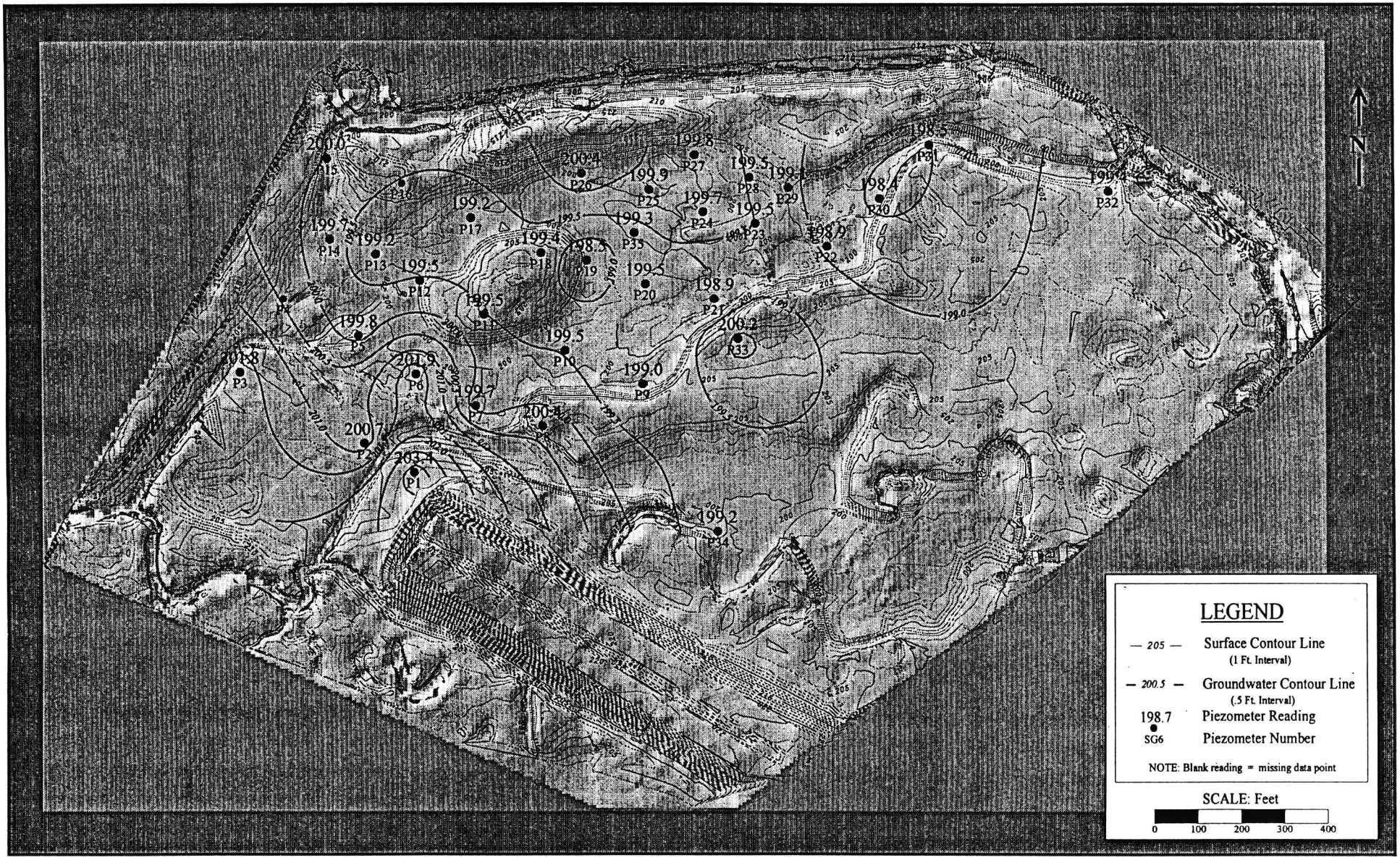
Nevins Creek Mitigation Area



Groundwater Elevations

(03/11/96)

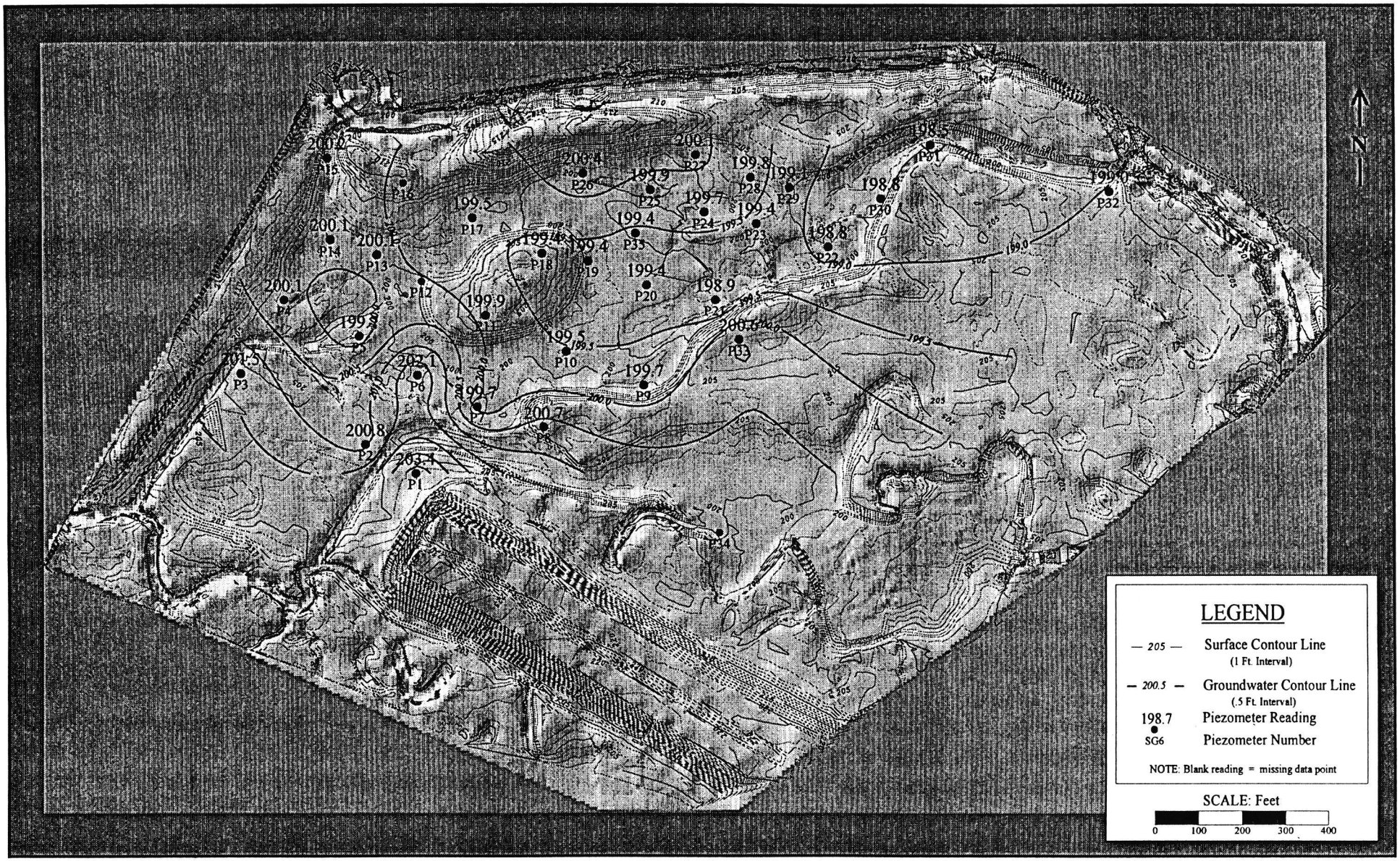
Nevins Creek Mitigation Area



Groundwater Elevations

(03/23/96)

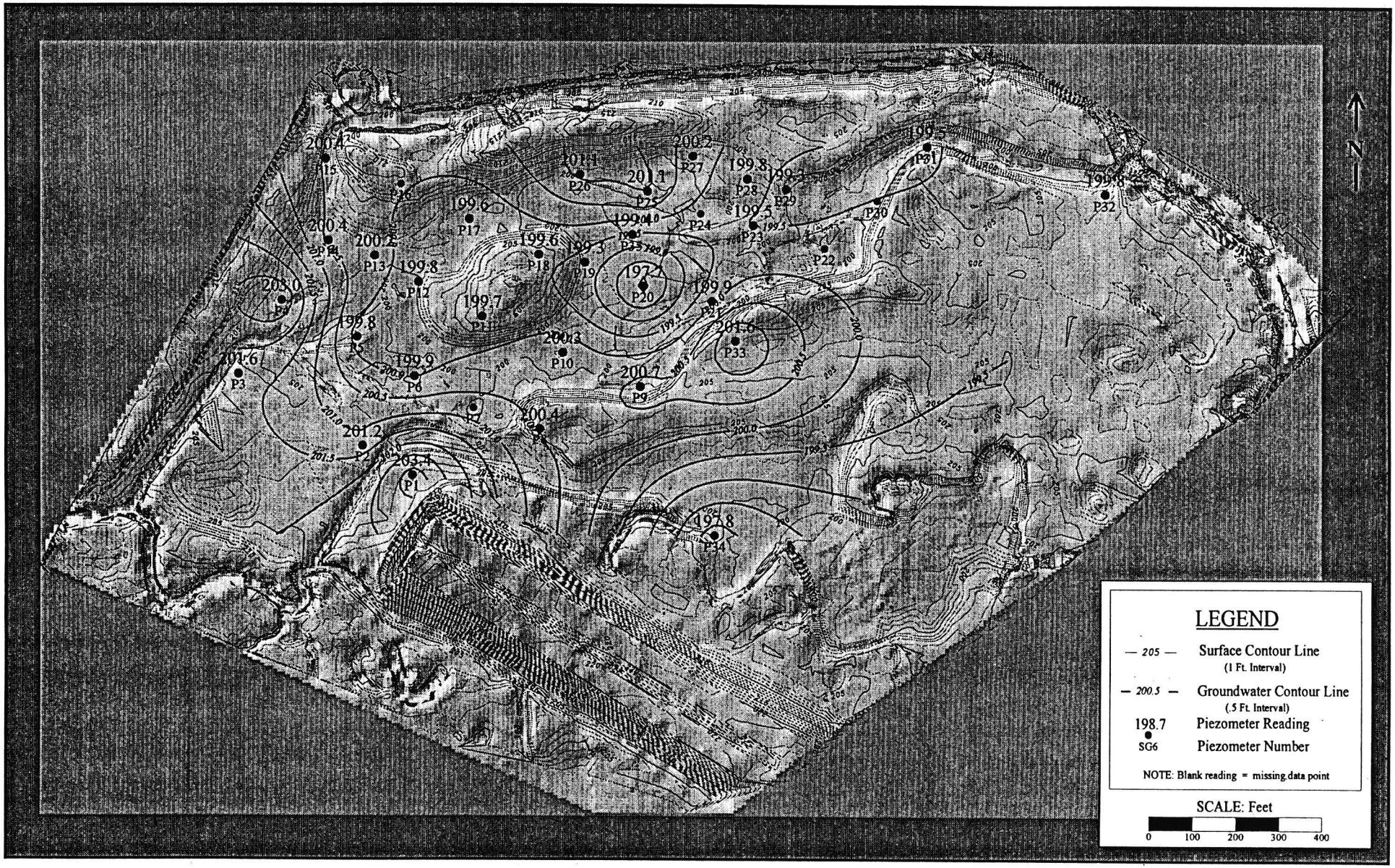
Nevins Creek Mitigation Area



Groundwater Elevations

(04/17/96)

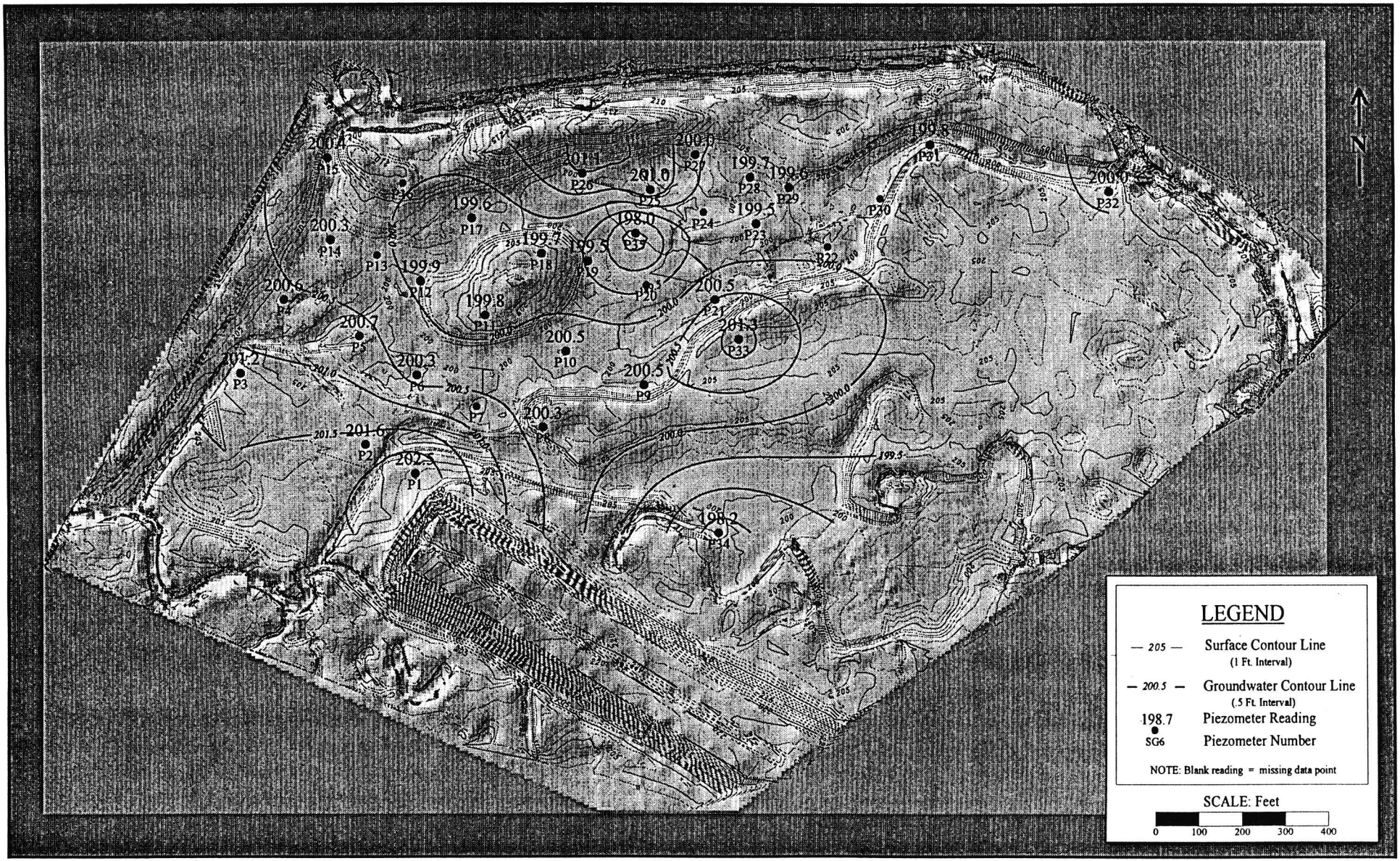
Nevins Creek Mitigation Area



Groundwater Elevations

(04/21/96)

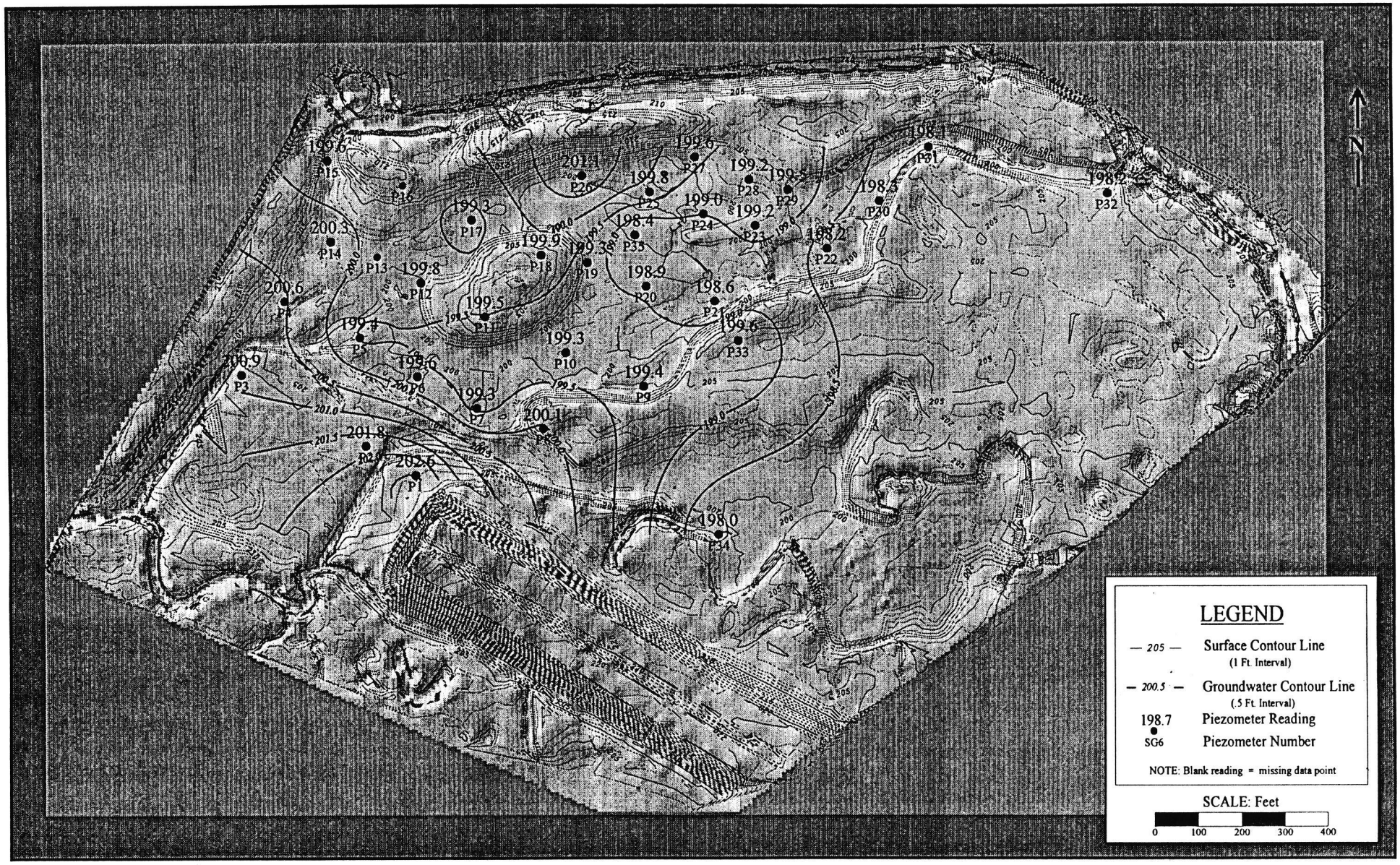
Nevins Creek Mitigation Area



Groundwater Elevations

(05/07/96)

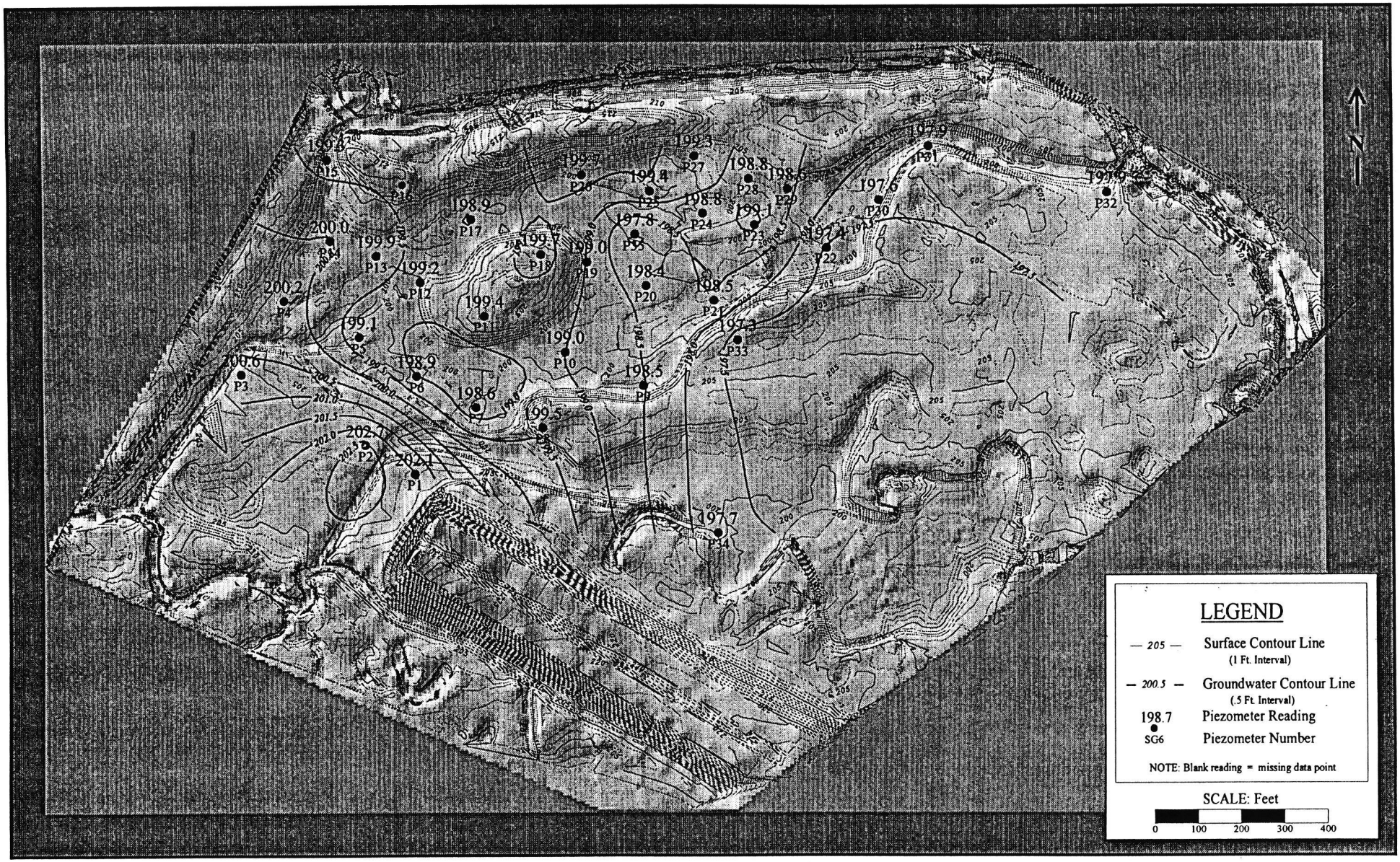
Nevins Creek Mitigation Area



Groundwater Elevations

(05/19/96)

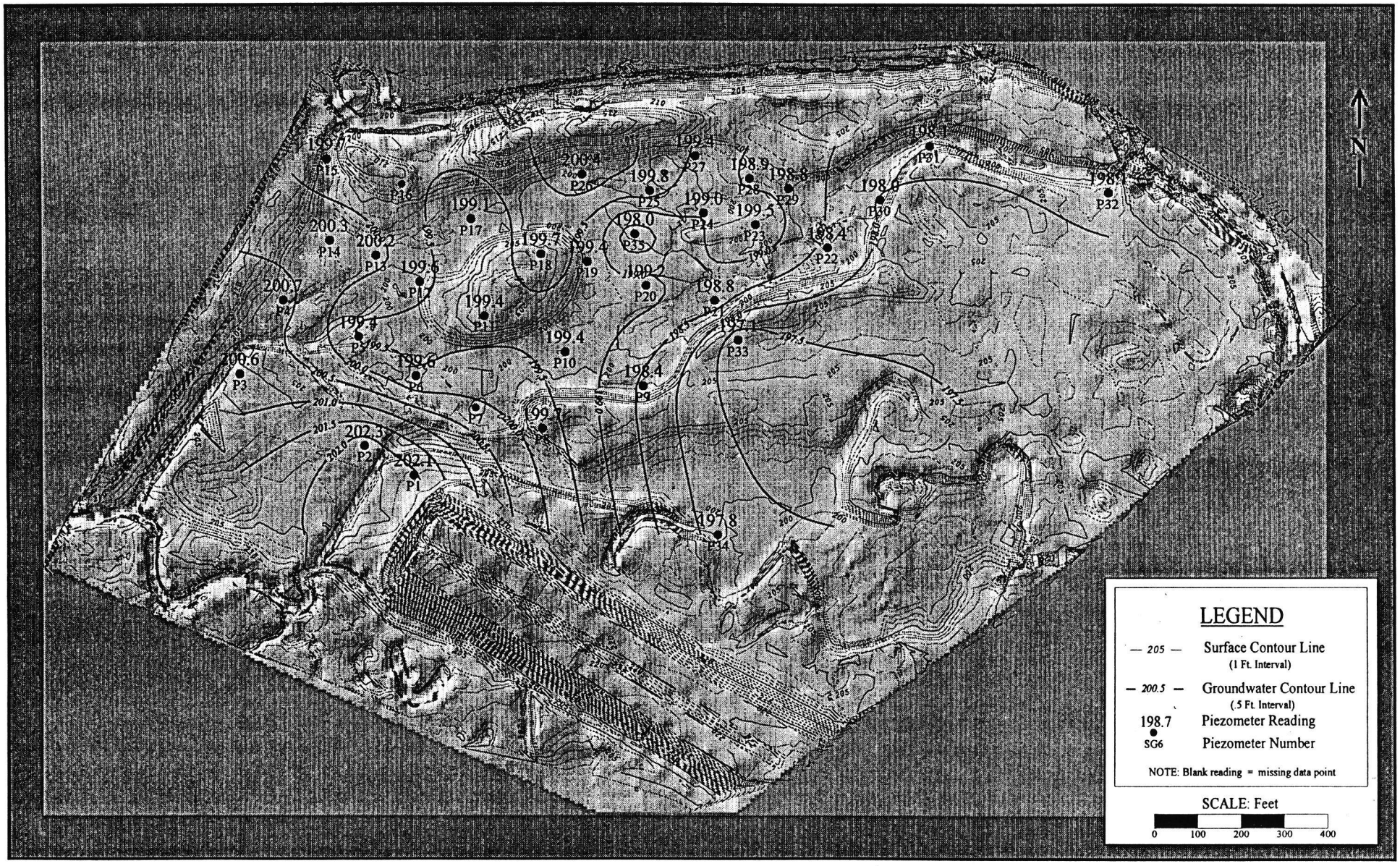
Nevins Creek Mitigation Area



Groundwater Elevations

(05/31/96)

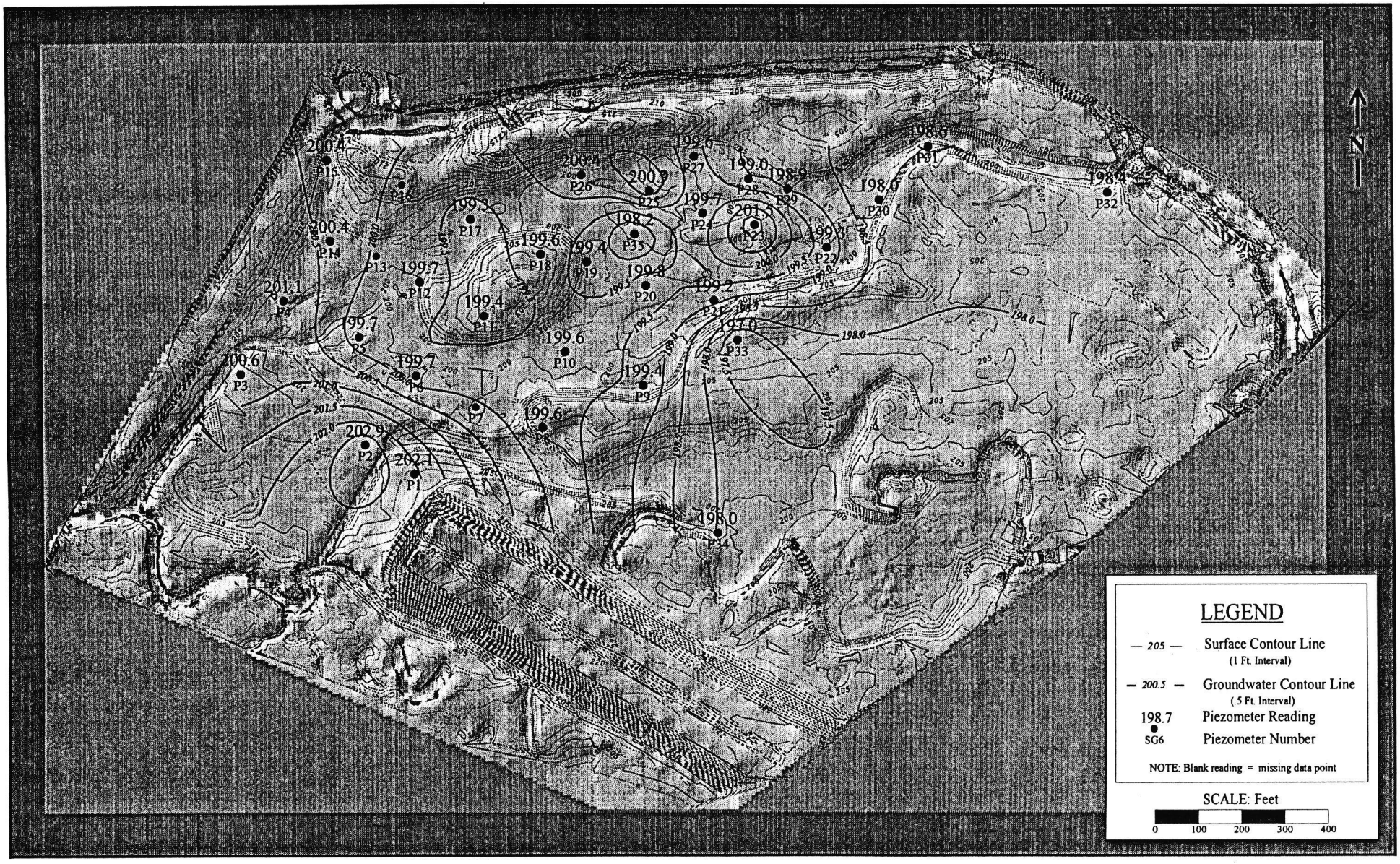
Nevins Creek Mitigation Area



Groundwater Elevations

(06/03/96)

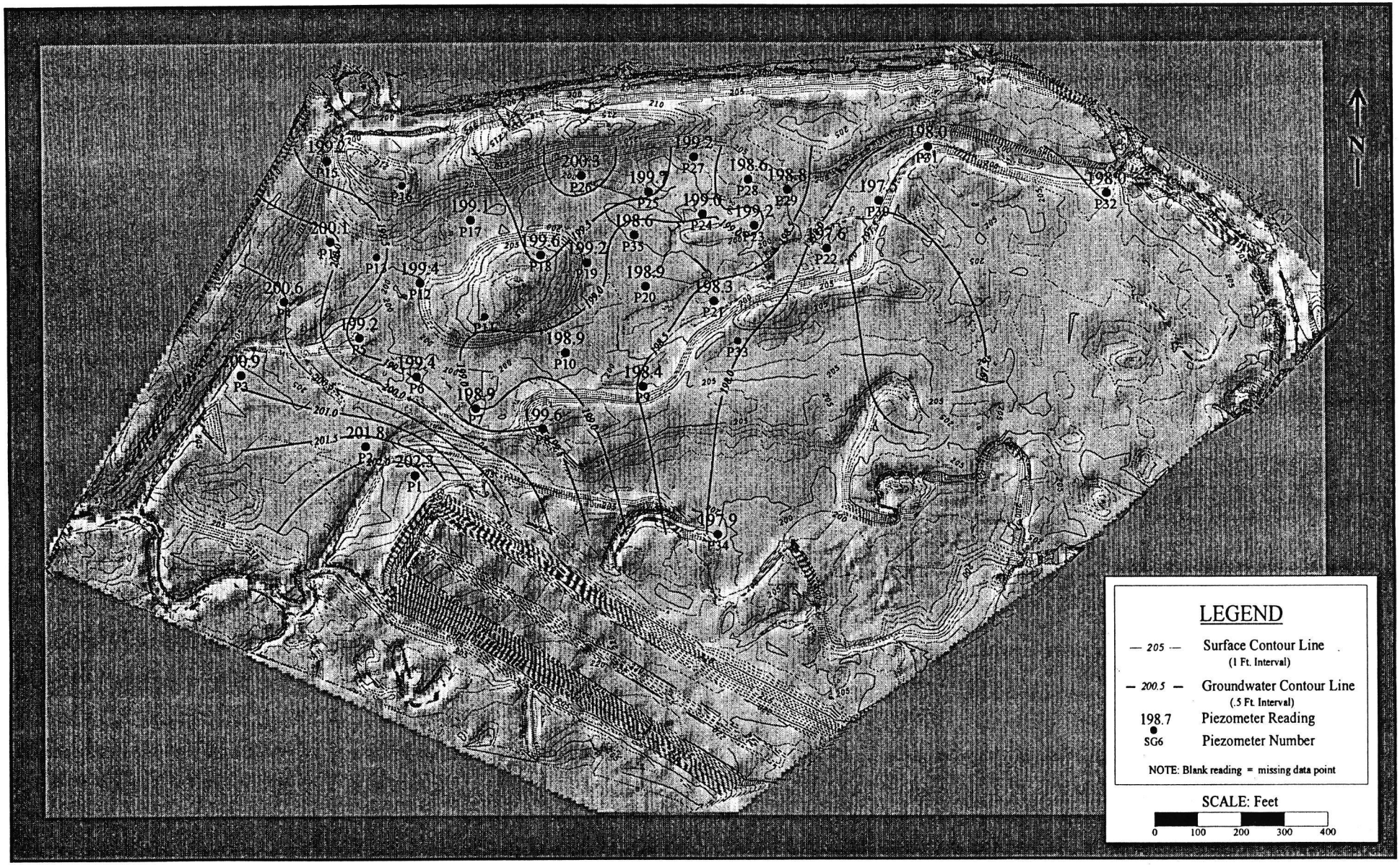
Nevins Creek Mitigation Area



Groundwater Elevations

(06/07/96)

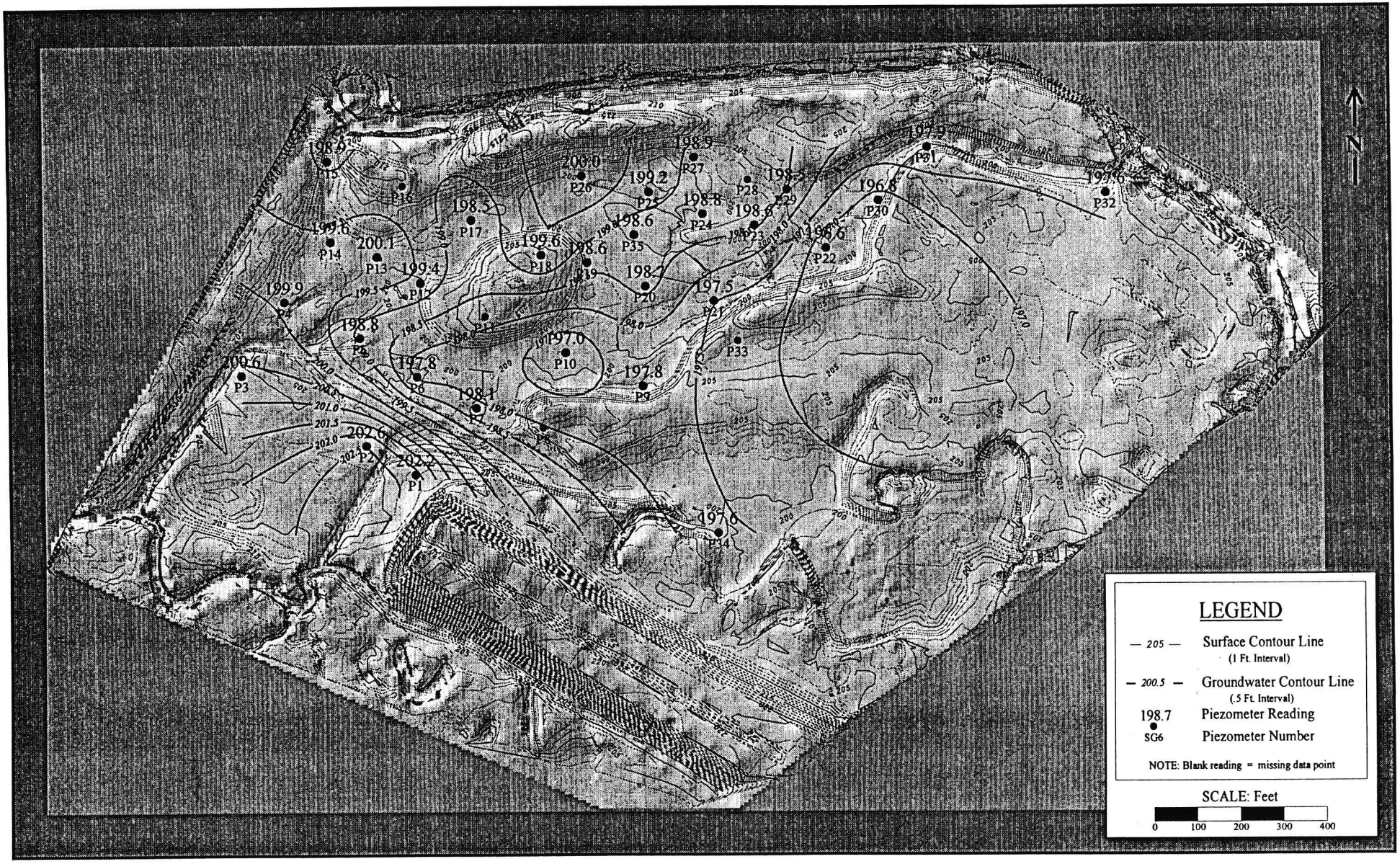
Nevins Creek Mitigation Area



Groundwater Elevations

(06/17/96)

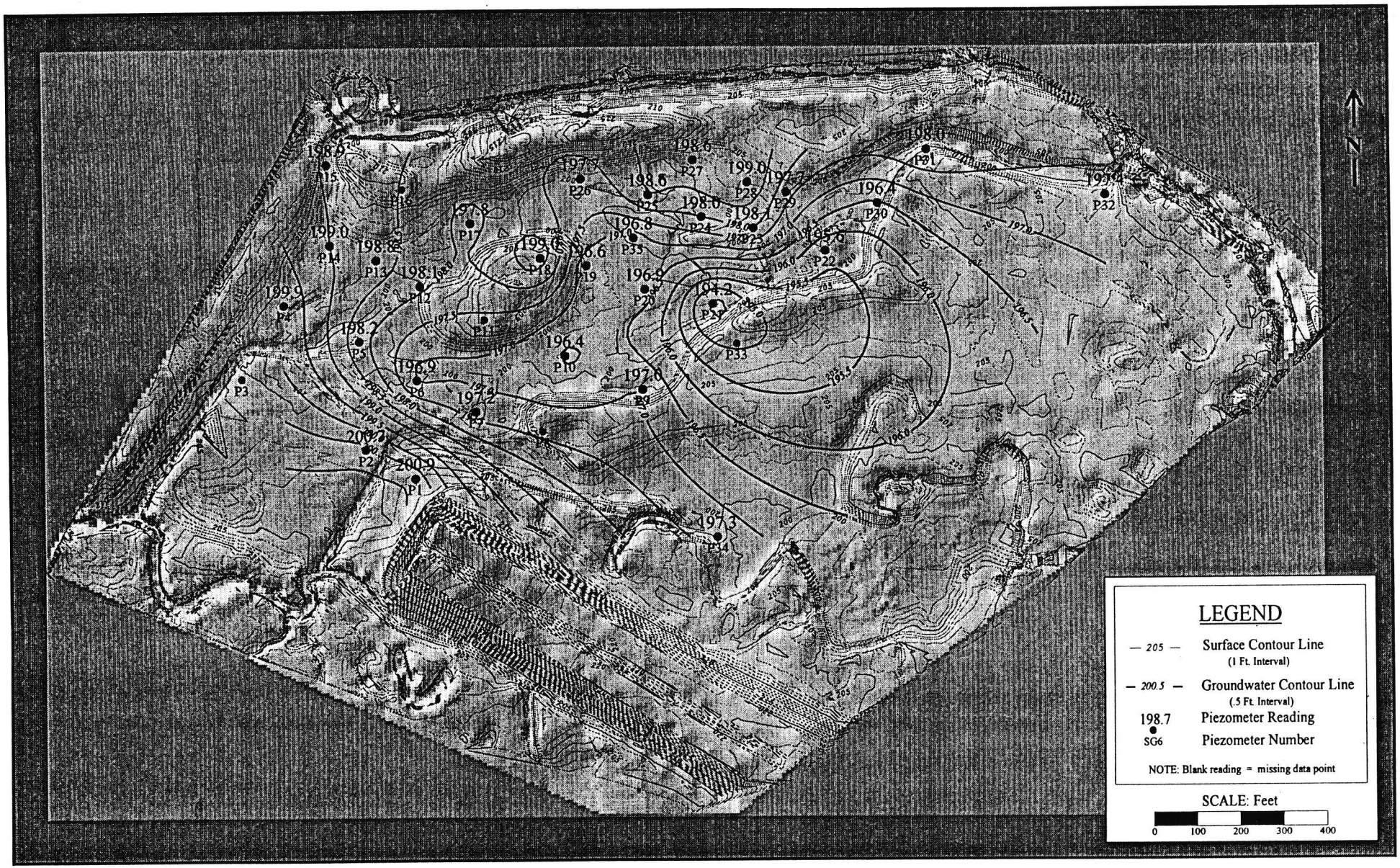
Nevins Creek Mitigation Area



Groundwater Elevations

(06/30/96)

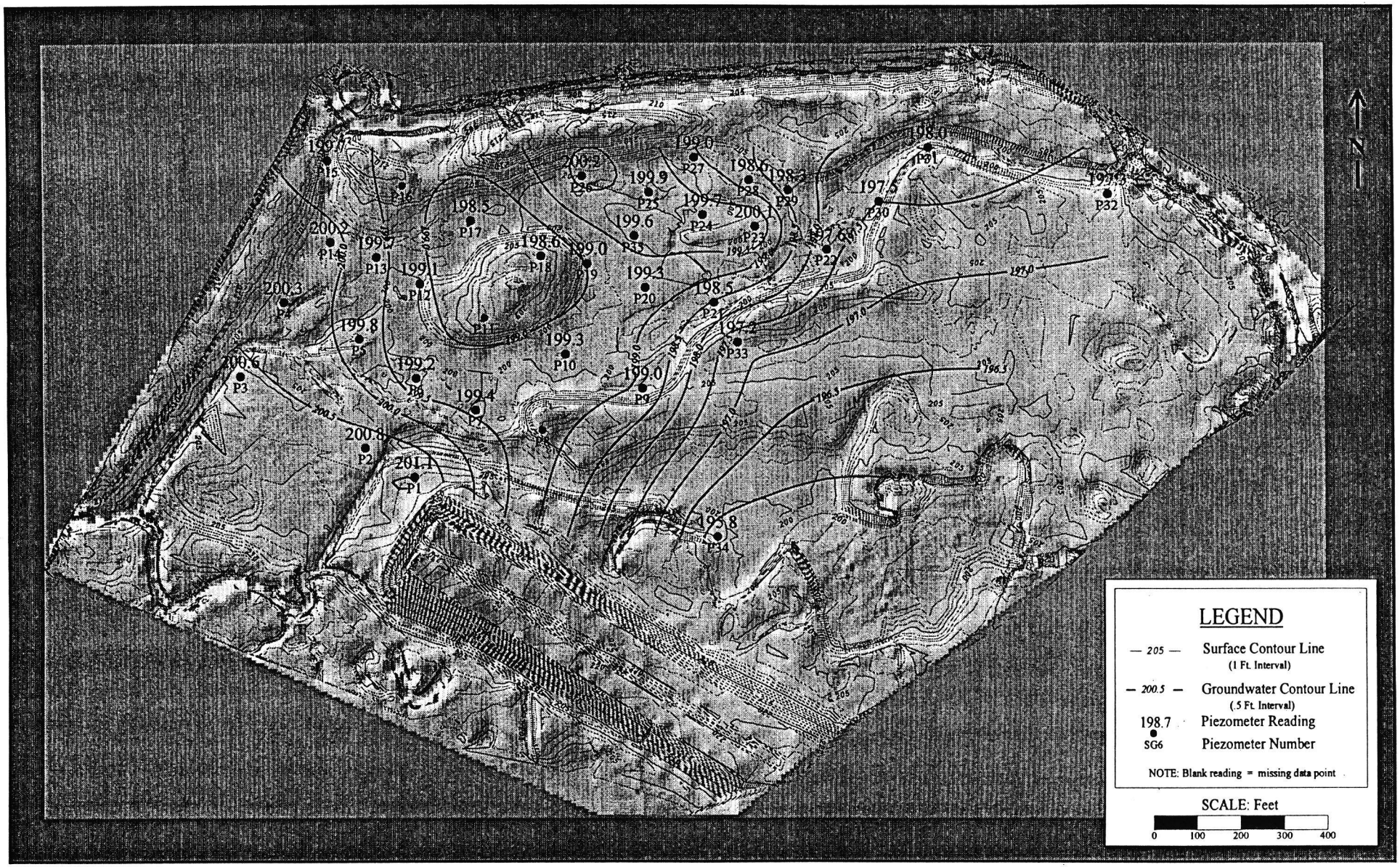
Nevins Creek Mitigation Area



Groundwater Elevations

(07/16/96)

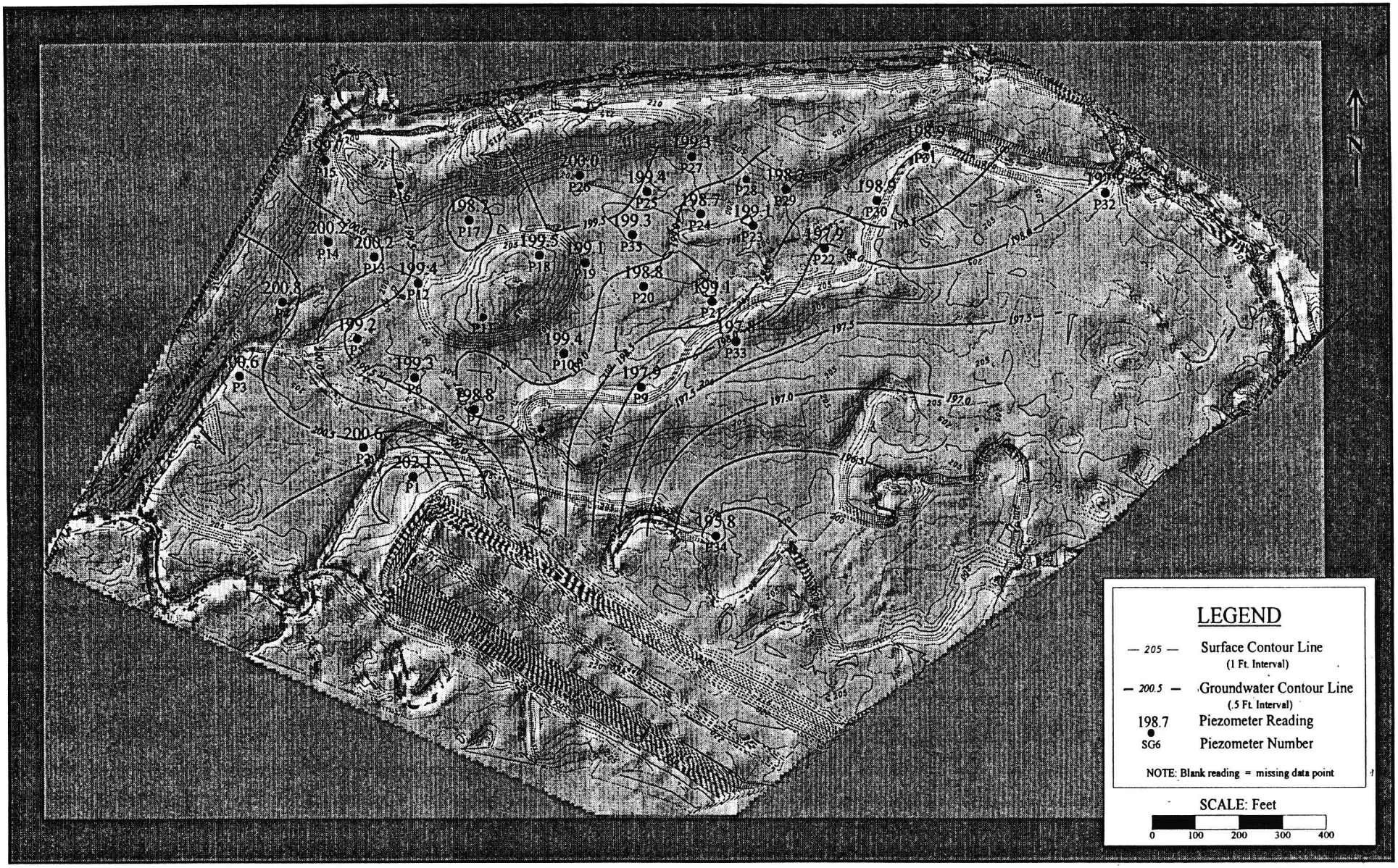
Nevins Creek Mitigation Area



Groundwater Elevations

(07/29/96)

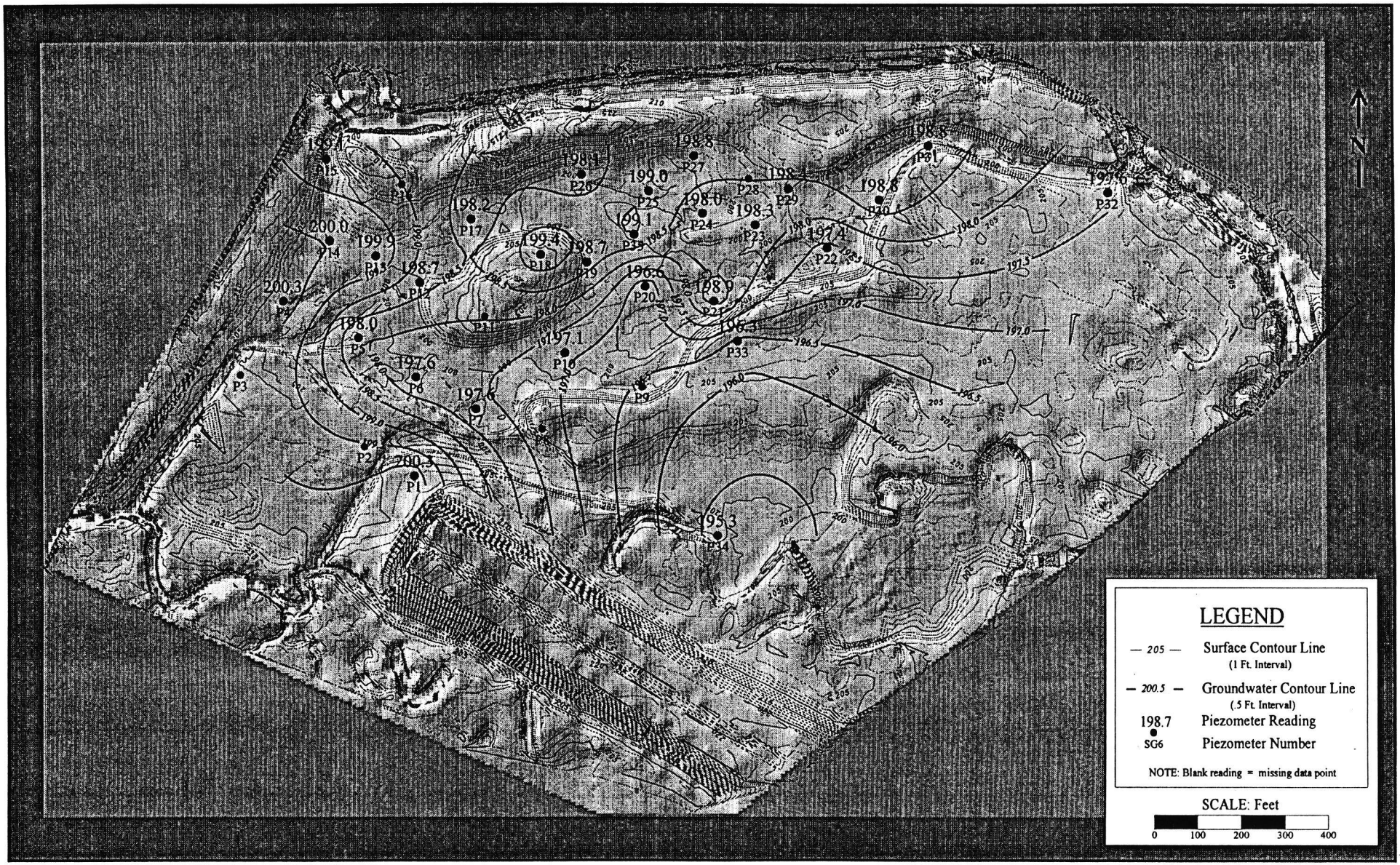
Nevins Creek Mitigation Area



Groundwater Elevations

(08/06/96)

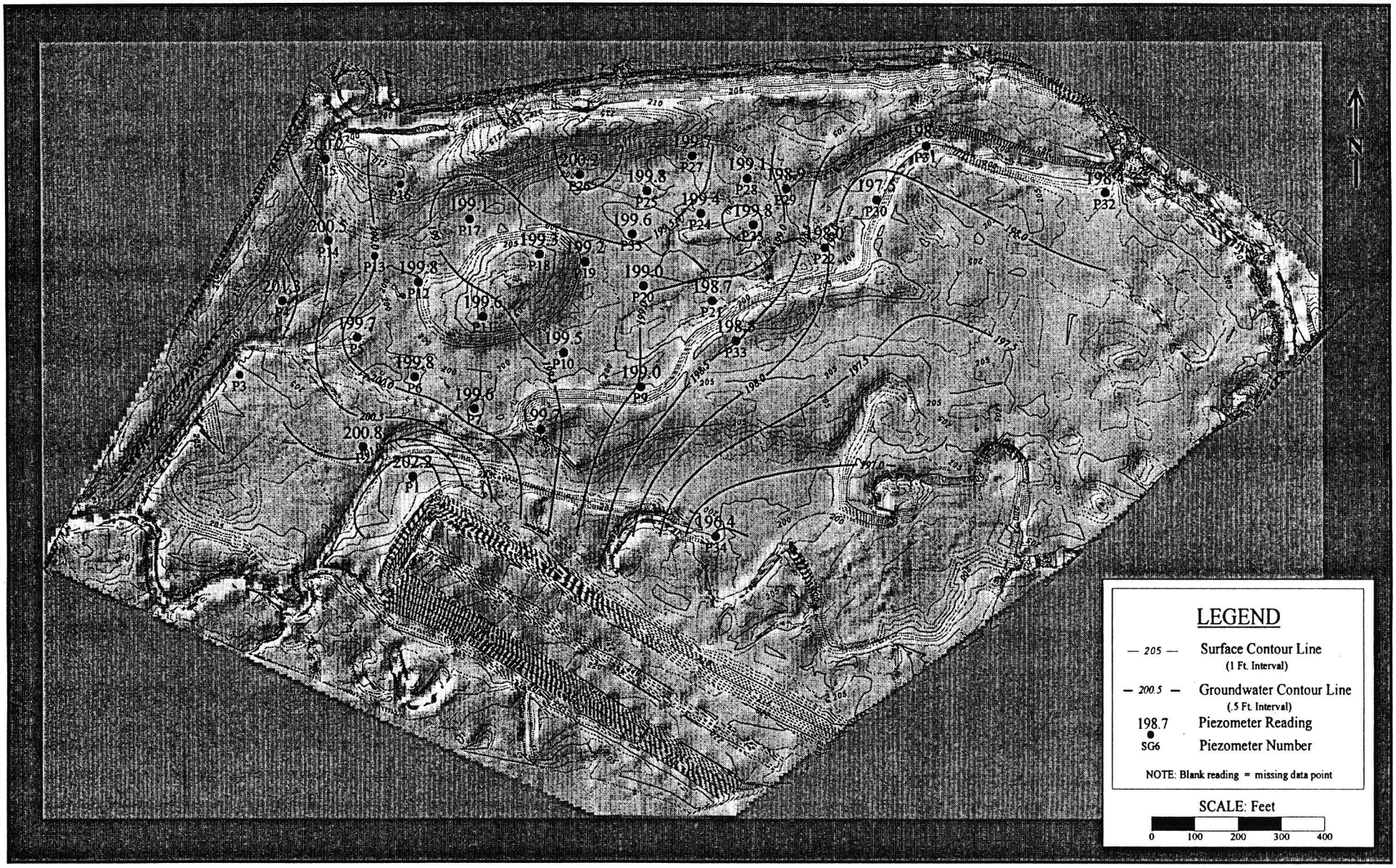
Nevins Creek Mitigation Area



Groundwater Elevations

(08/13/96)

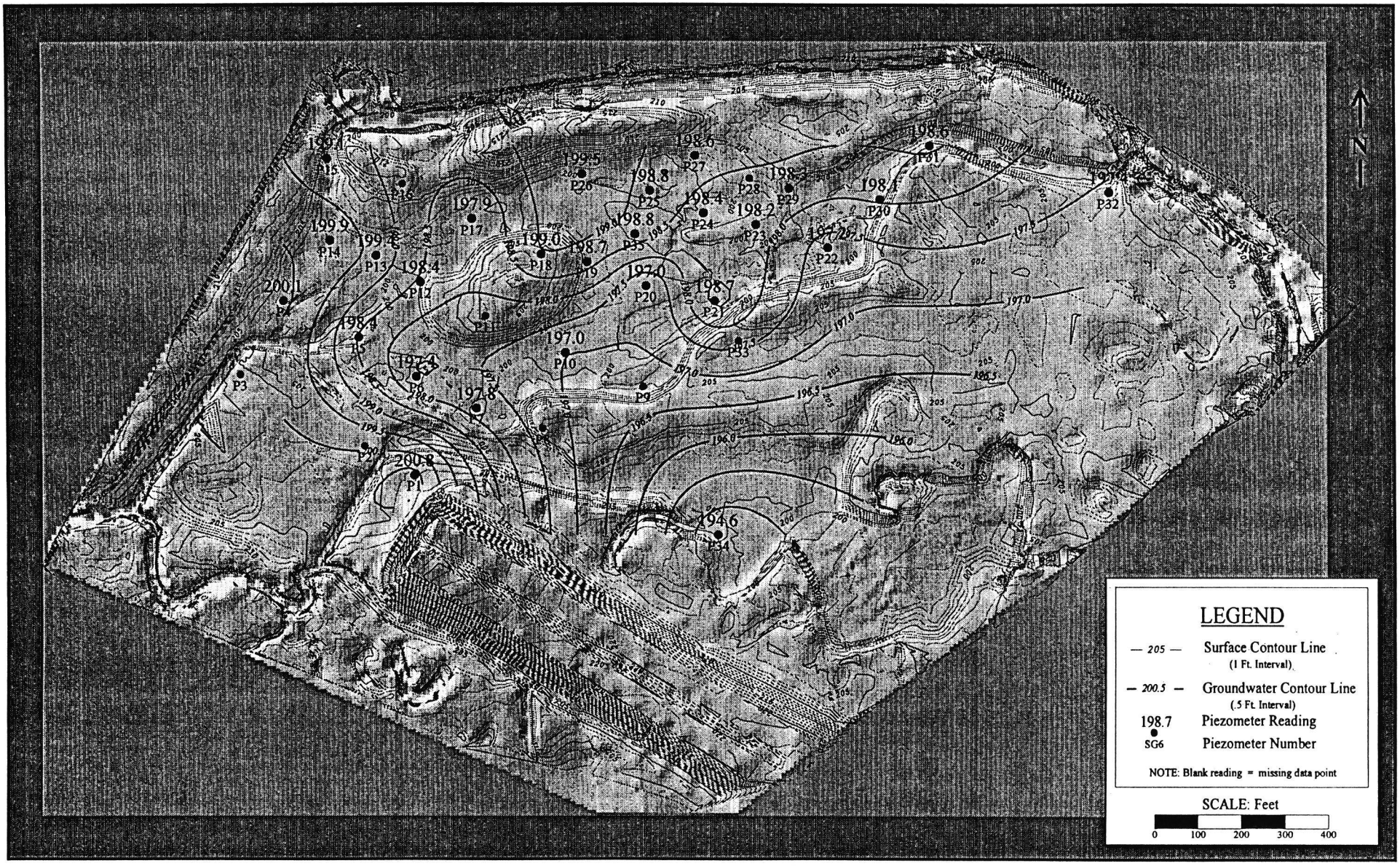
Nevins Creek Mitigation Area



Groundwater Elevations

(08/26/96)

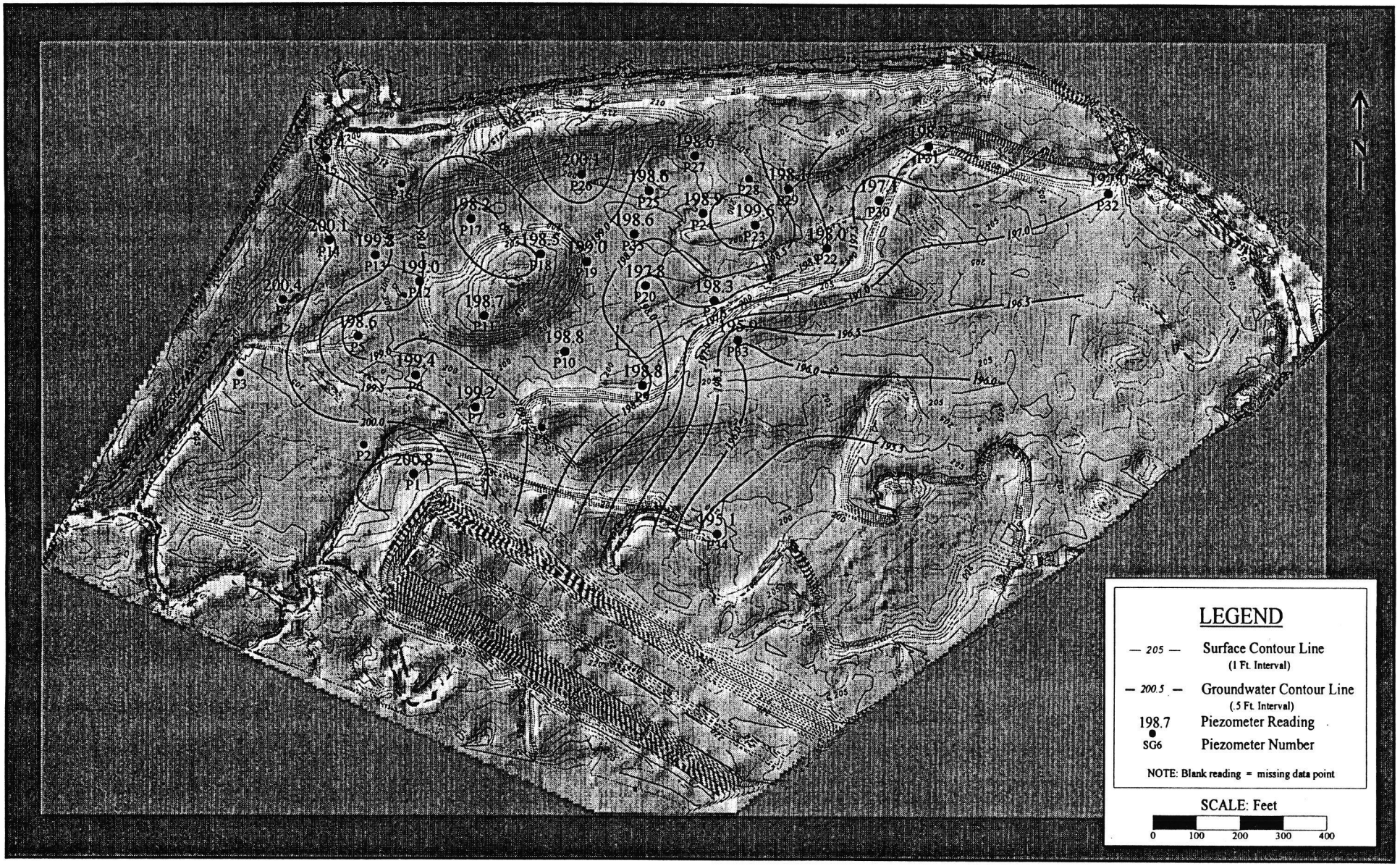
Nevins Creek Mitigation Area



Groundwater Elevations

(09/09/96)

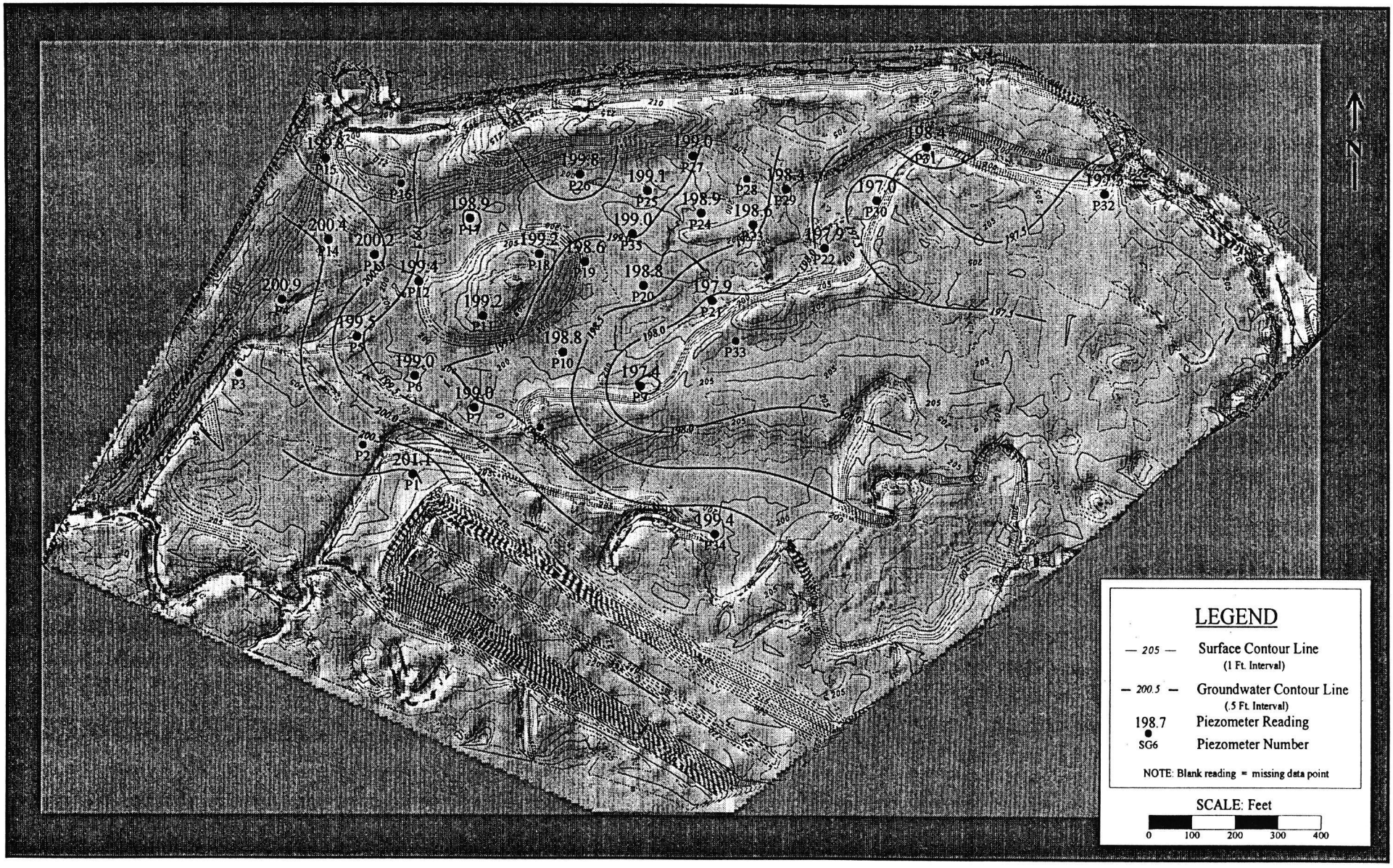
Nevins Creek Mitigation Area



Groundwater Elevations

(09/23/96)

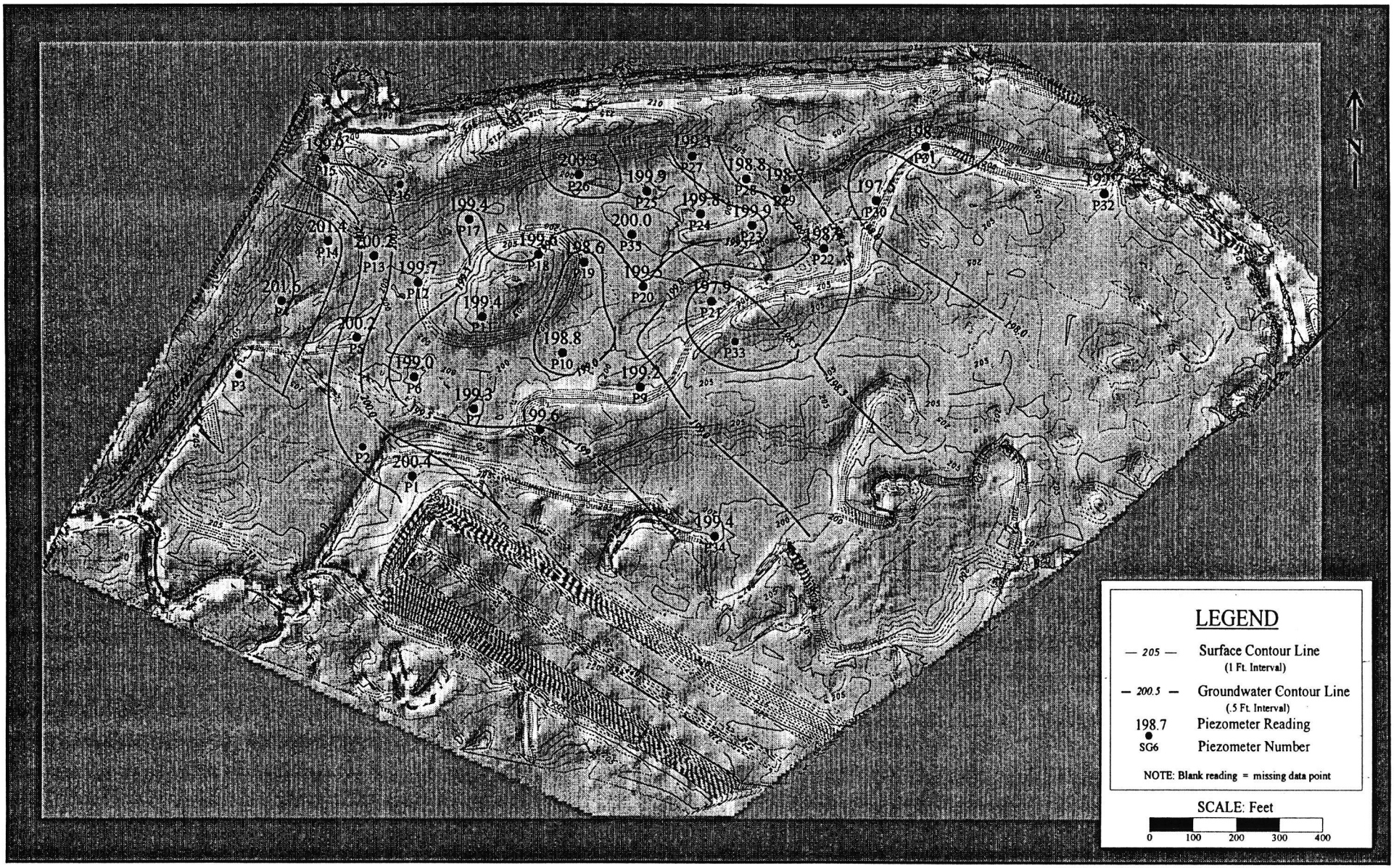
Nevins Creek Mitigation Area



Groundwater Elevations

(10/10/96)

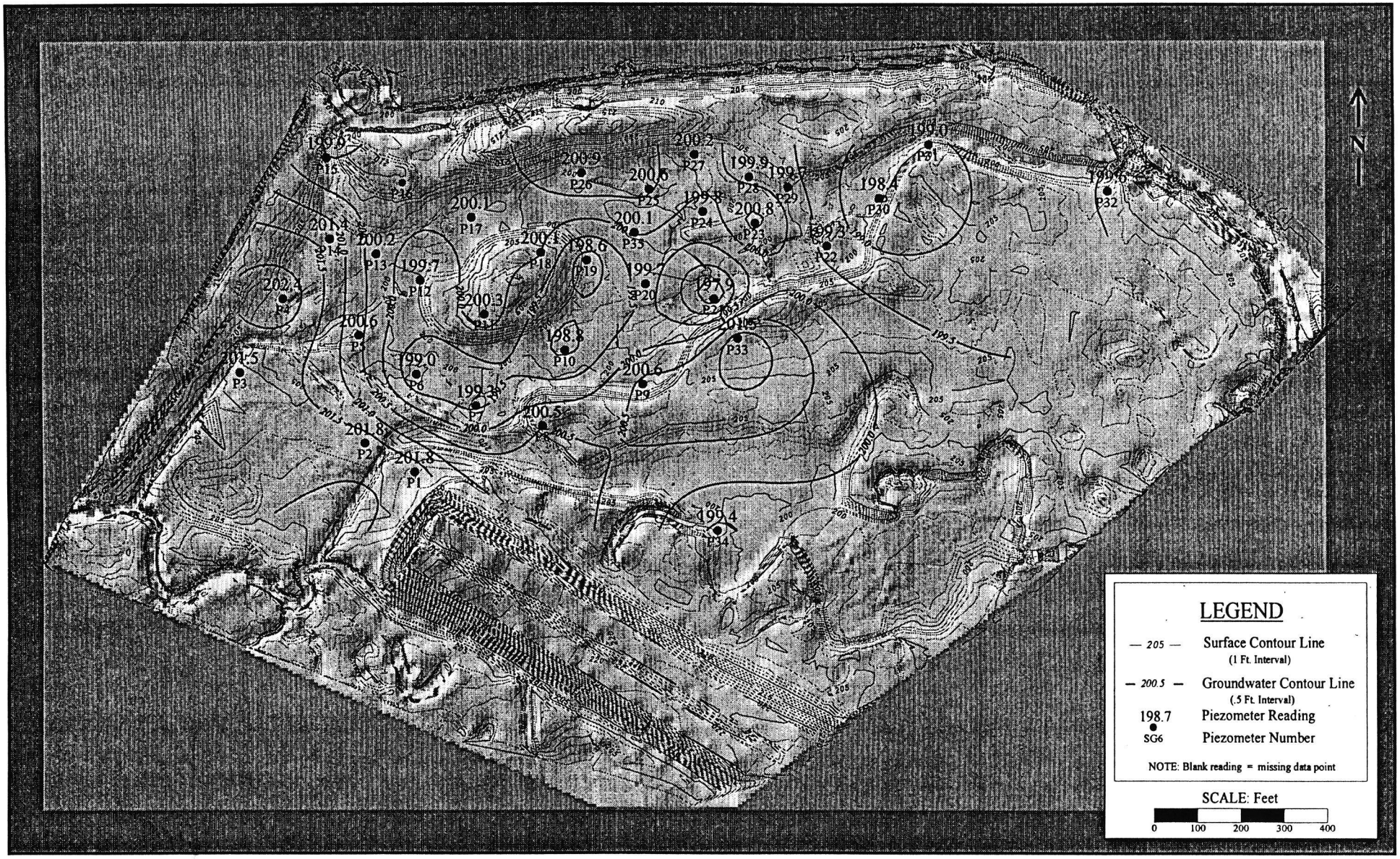
Nevins Creek Mitigation Area



Groundwater Elevations

(10/21/96)

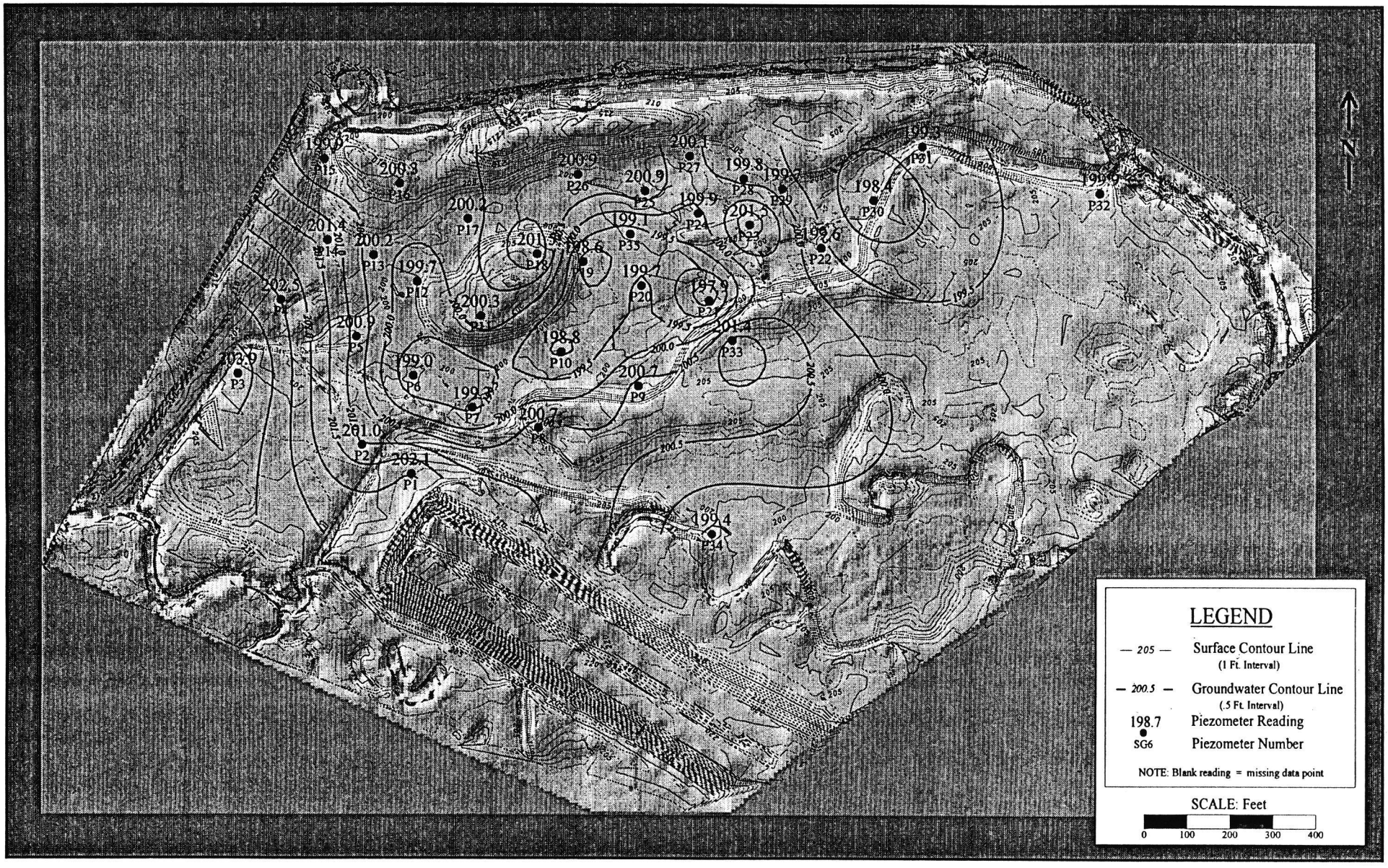
Nevins Creek Mitigation Area



Groundwater Elevations

(10/25/96)

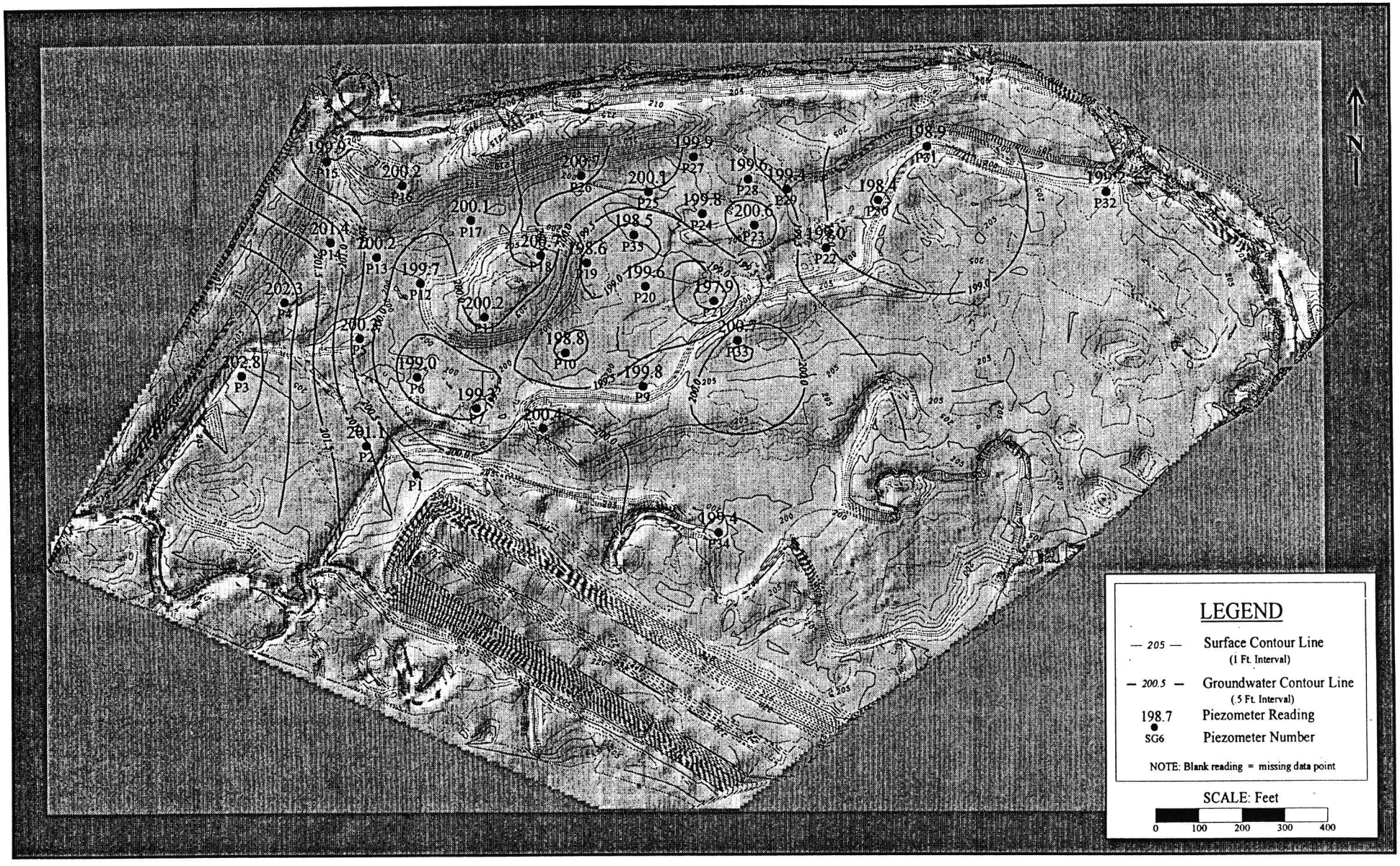
Nevins Creek Mitigation Area



Groundwater Elevations

(11/18/96)

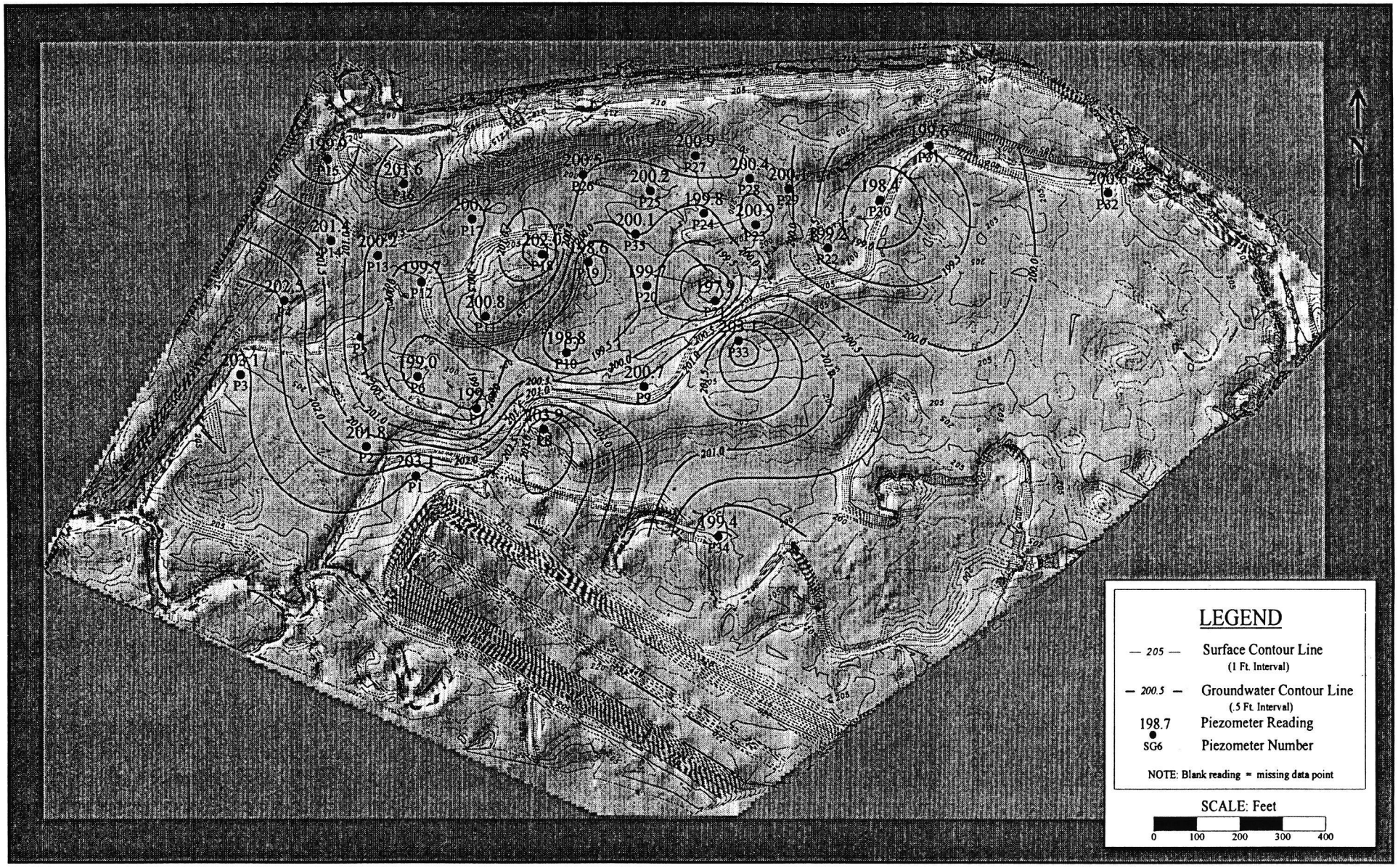
Nevins Creek Mitigation Area



Groundwater Elevations

(11/04/96)

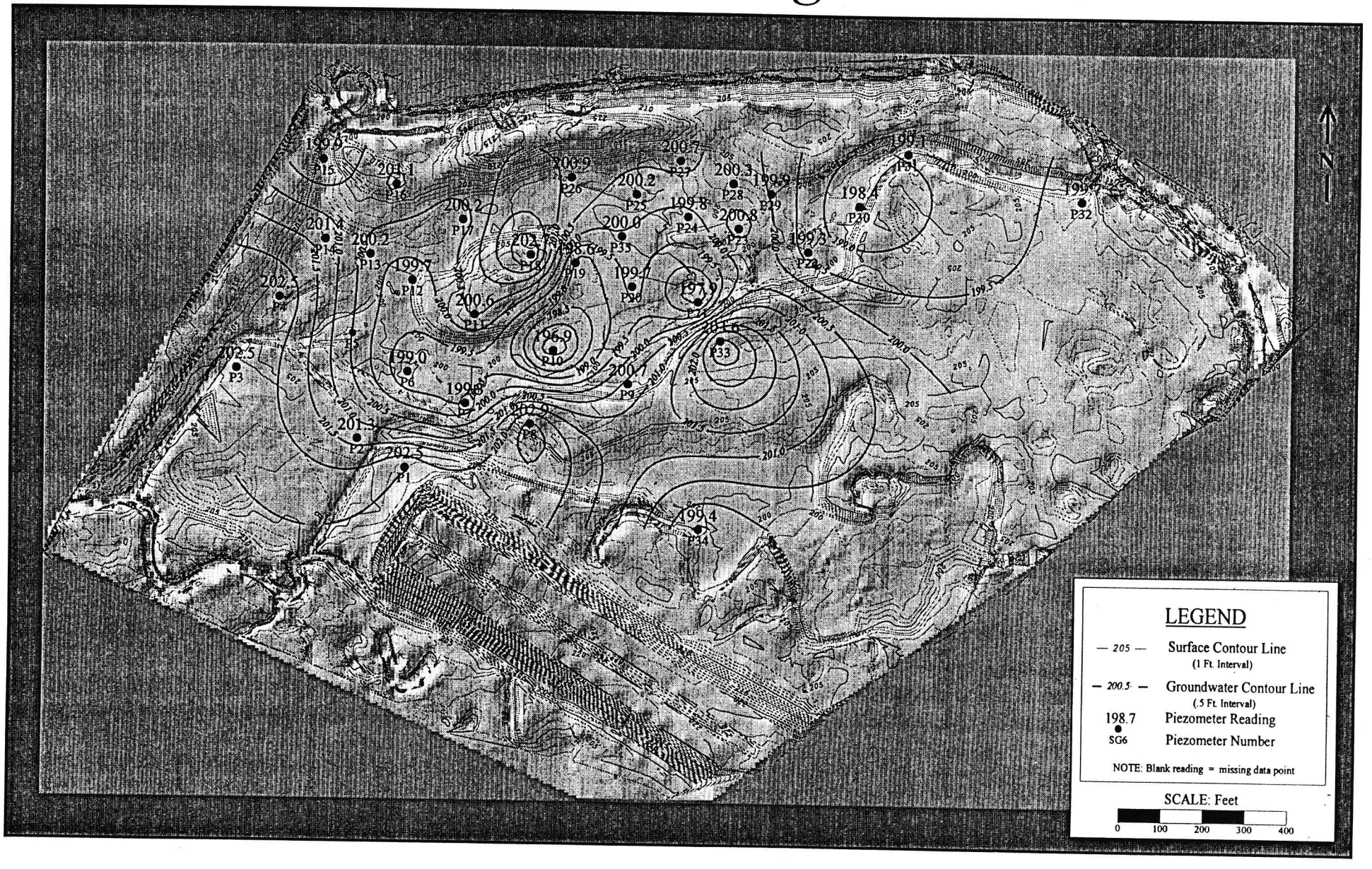
Nevins Creek Mitigation Area



Groundwater Elevations

(12/08/96)

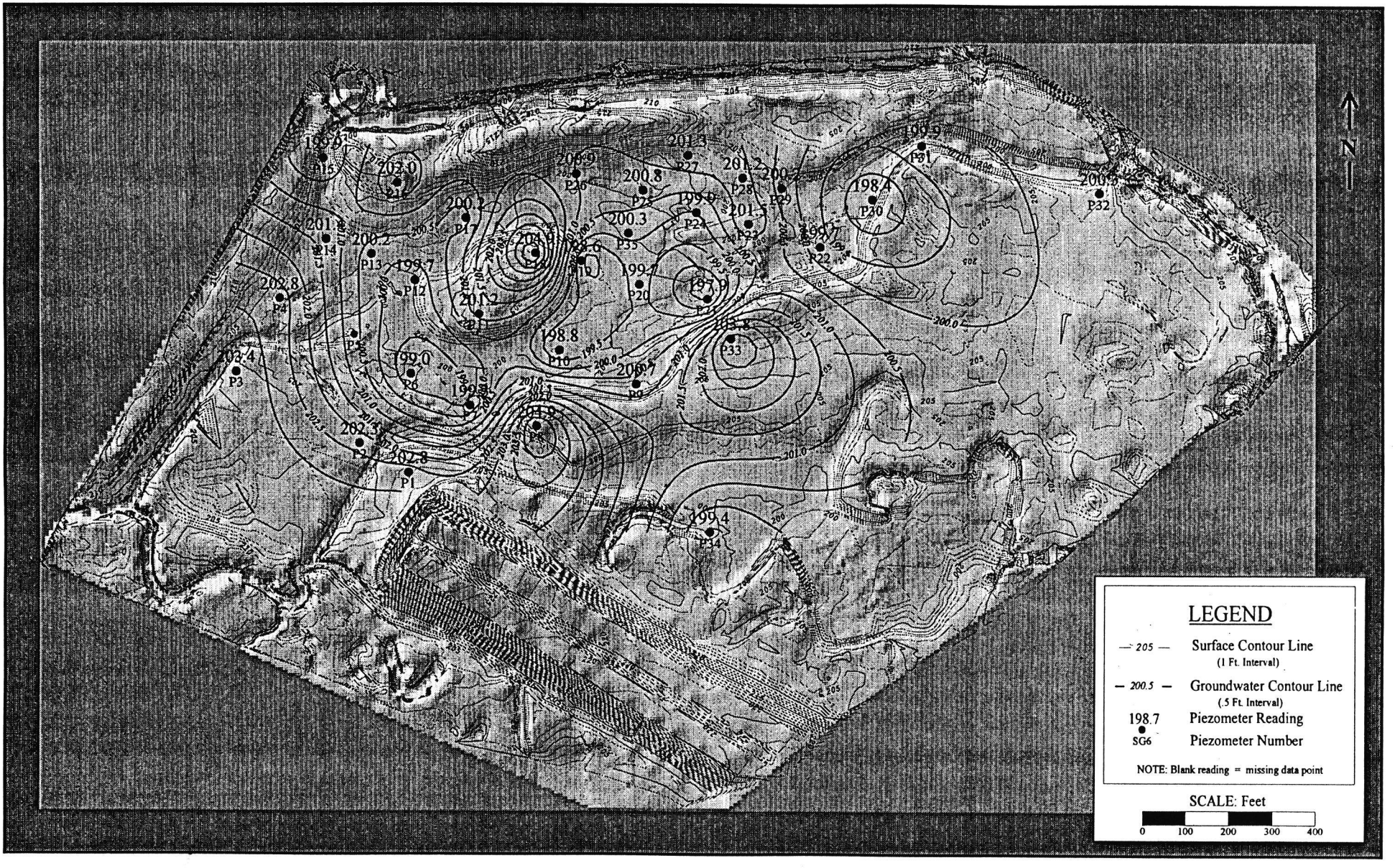
Nevins Creek Mitigation Area



Groundwater Elevations

(12/22/96)

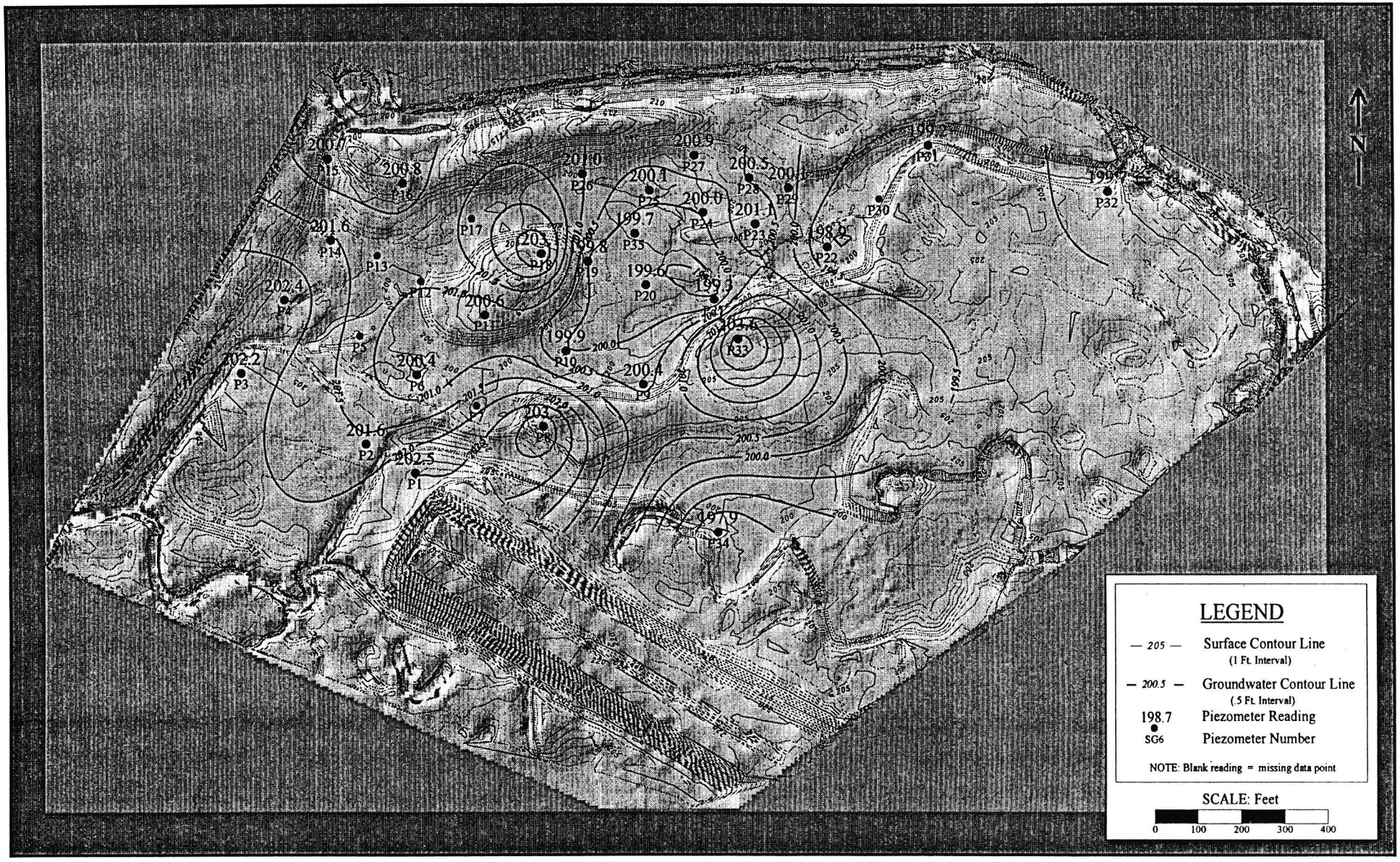
Nevins Creek Mitigation Area



Groundwater Elevations

(12/30/97)

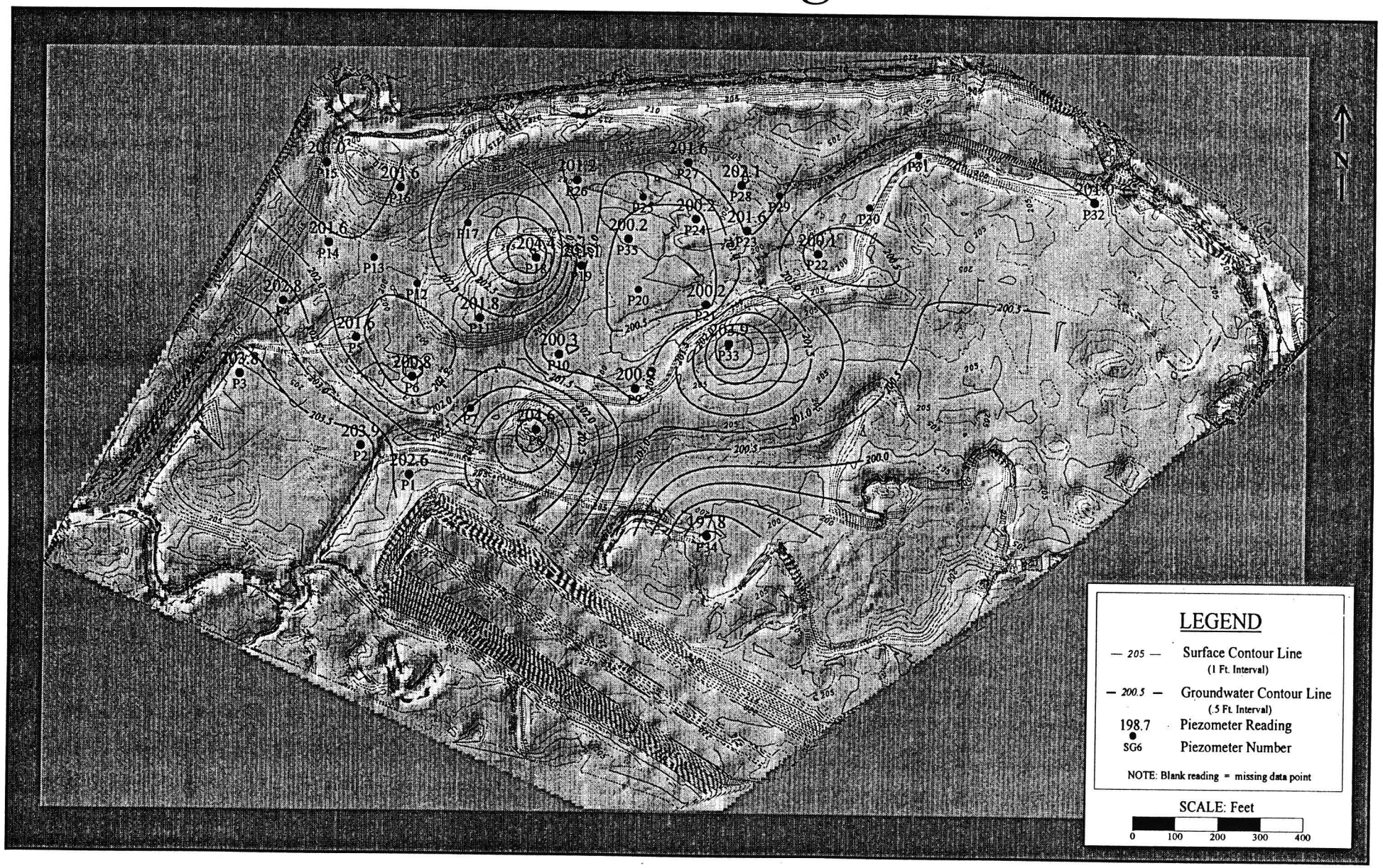
Nevins Creek Mitigation Area



Groundwater Elevations

(01/13/97)

Nevins Creek Mitigation Area



Groundwater Elevations

(01/26/97)

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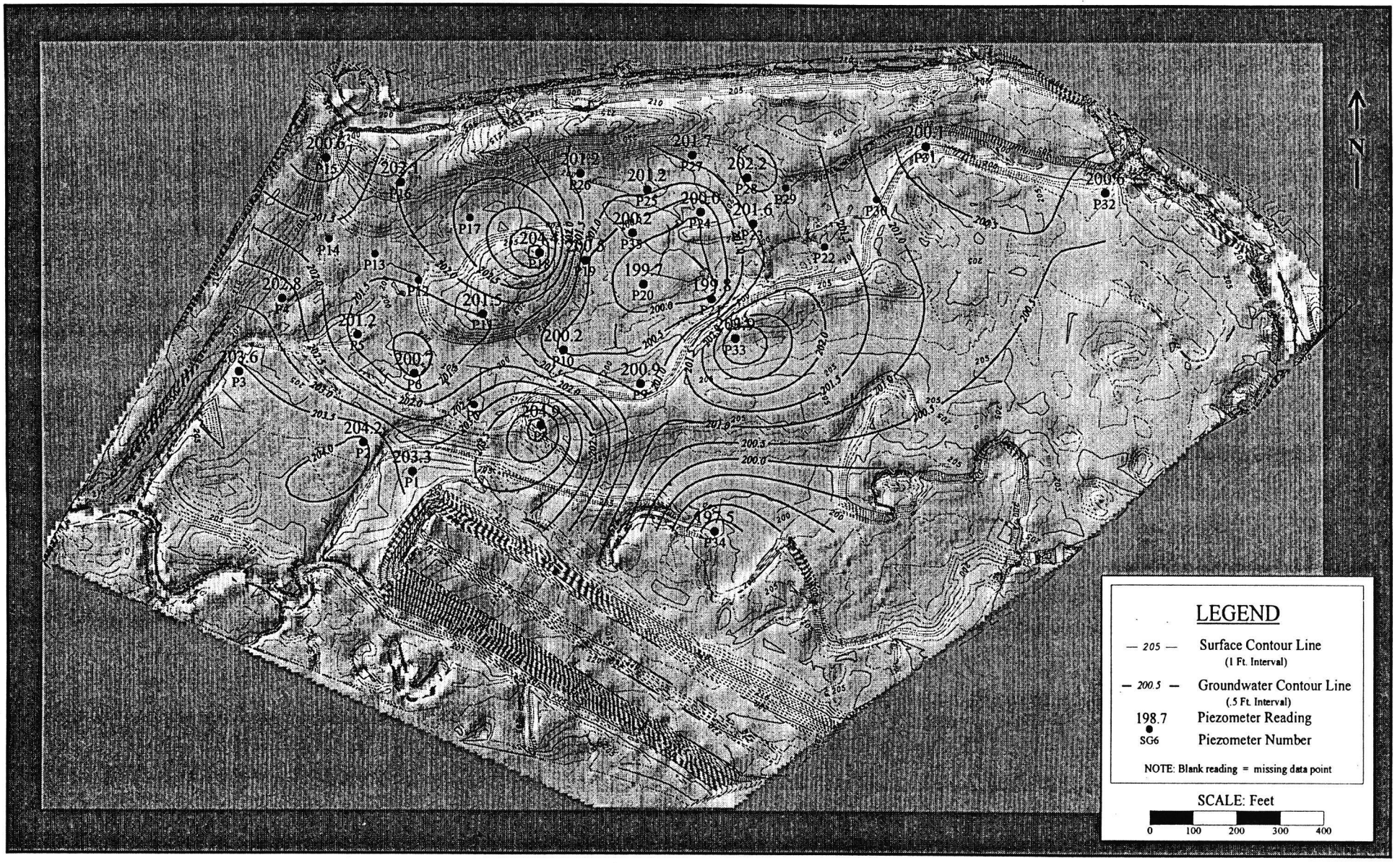
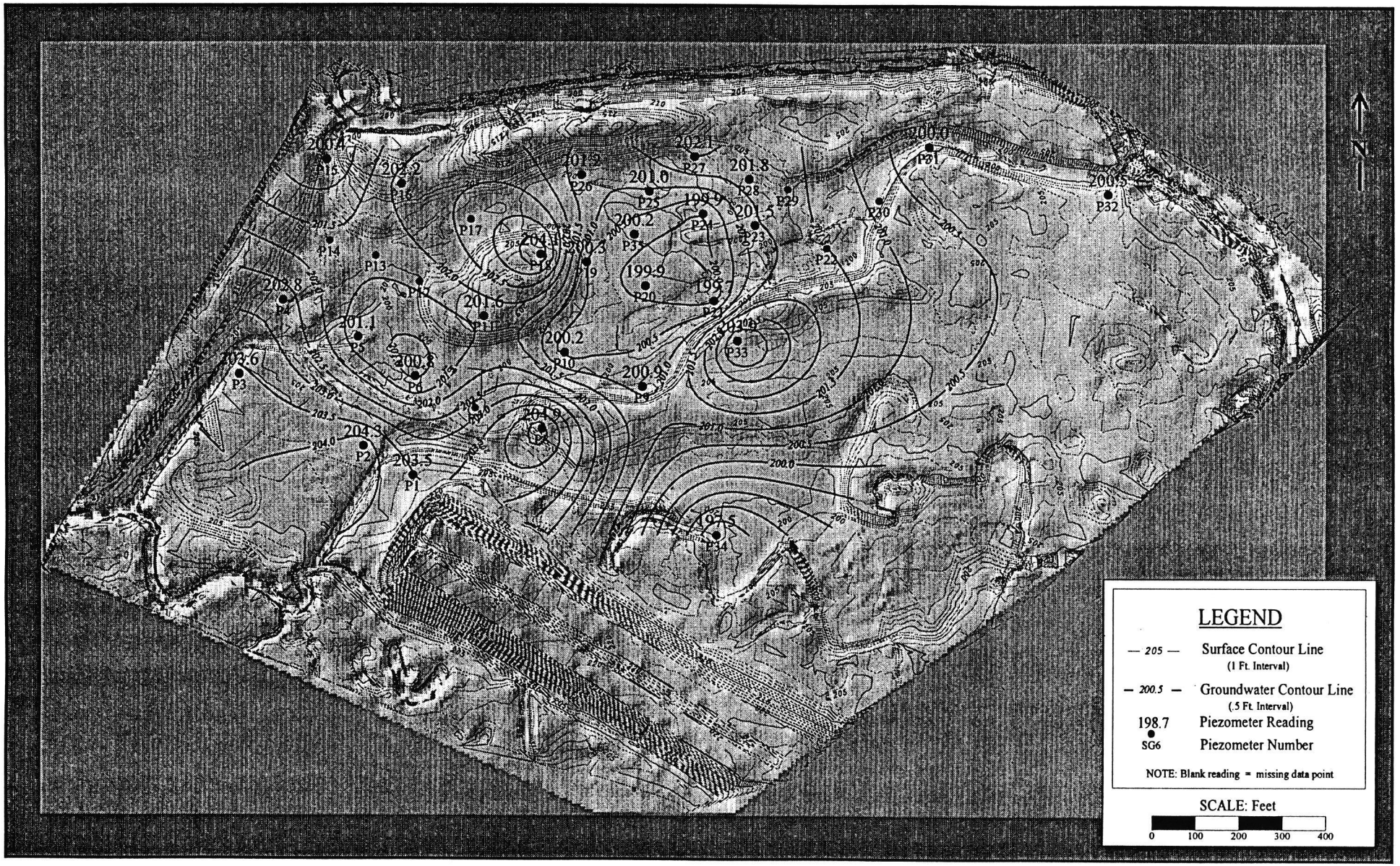


Groundwater Elevations

(02/10/97)

Nevins Creek Mitigation Area



Groundwater Elevations

(02/24/97)

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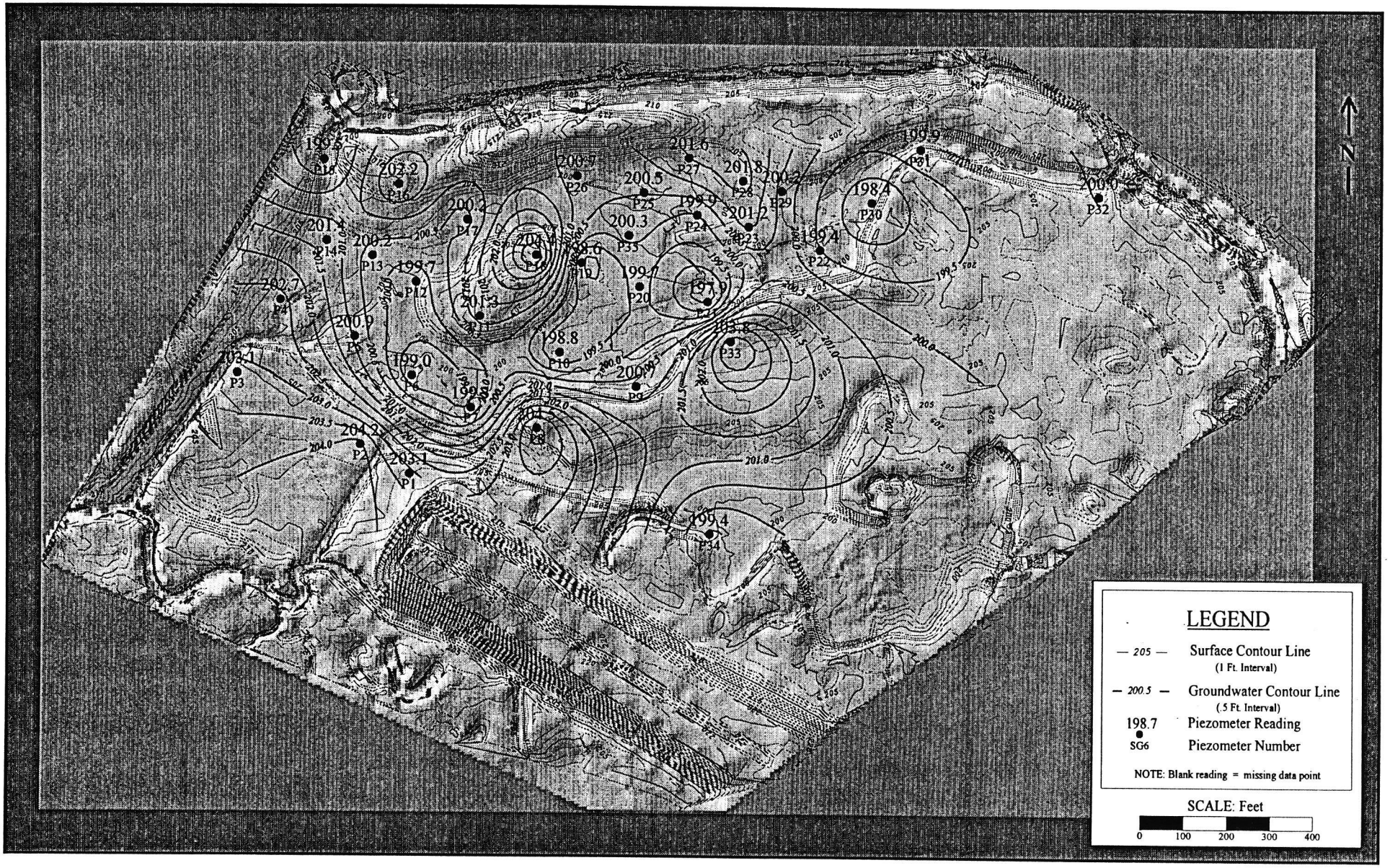
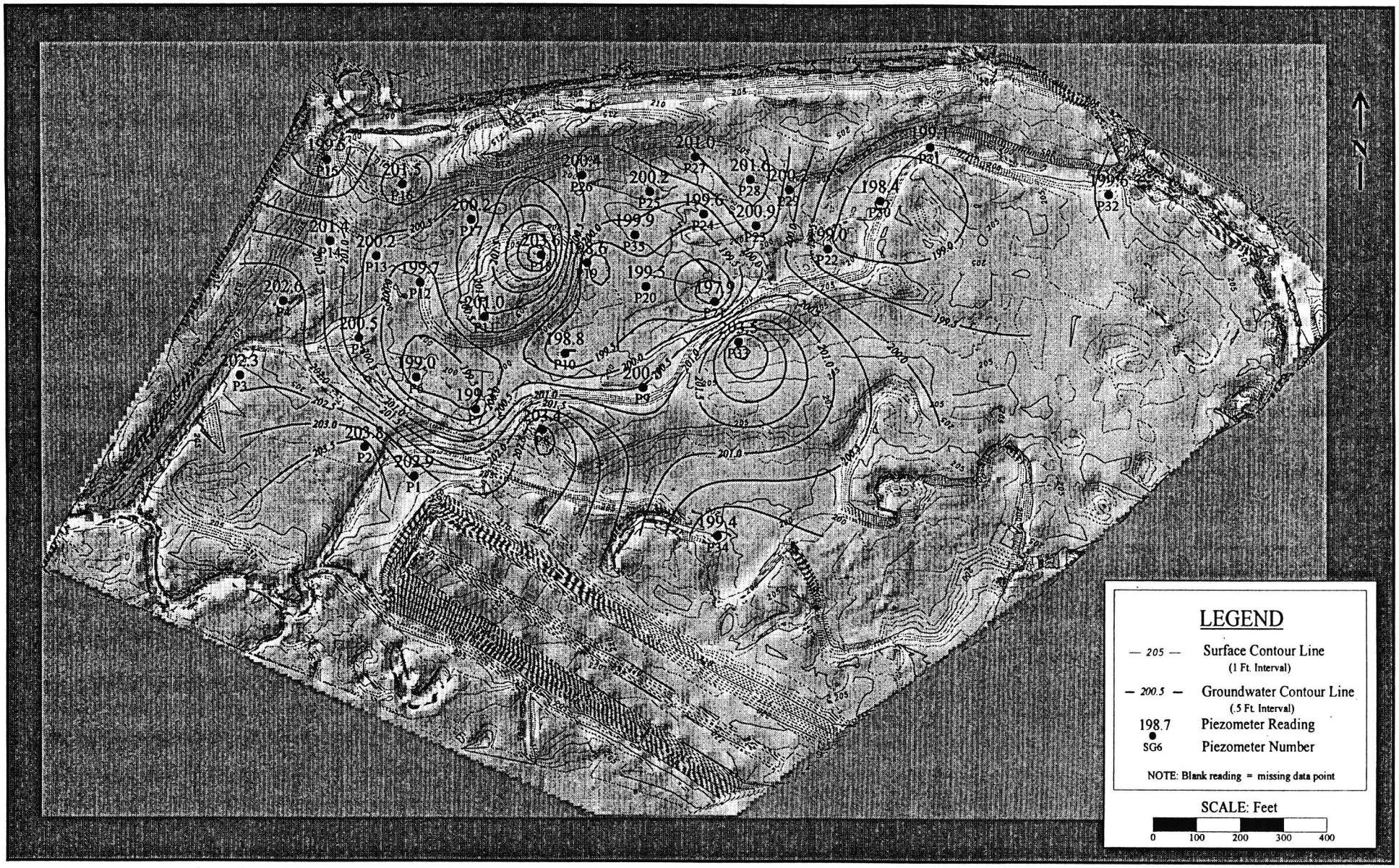


Groundwater Elevations

(03/09/97)

Nevins Creek Mitigation Area



Groundwater Elevations

(03/24/97)

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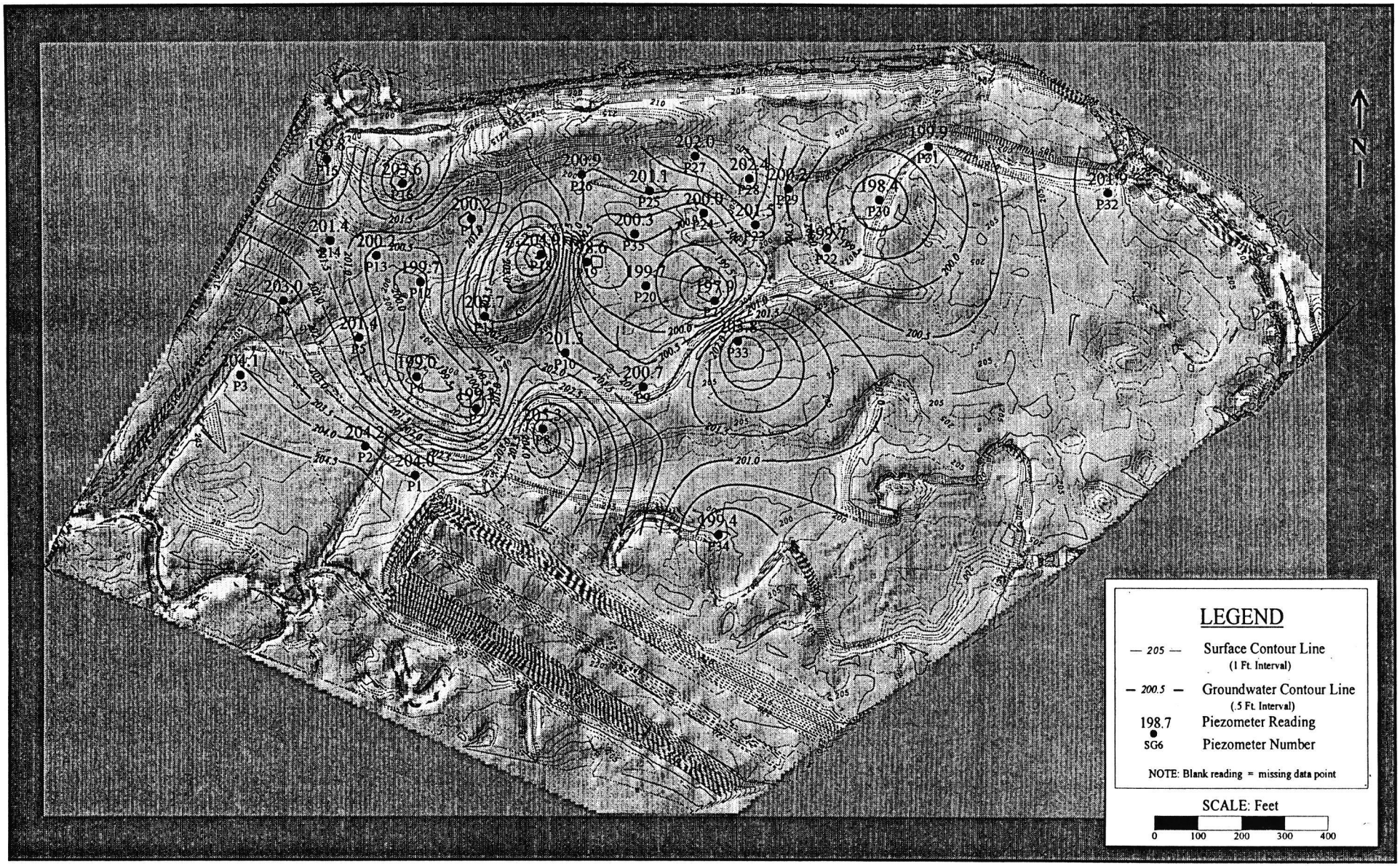
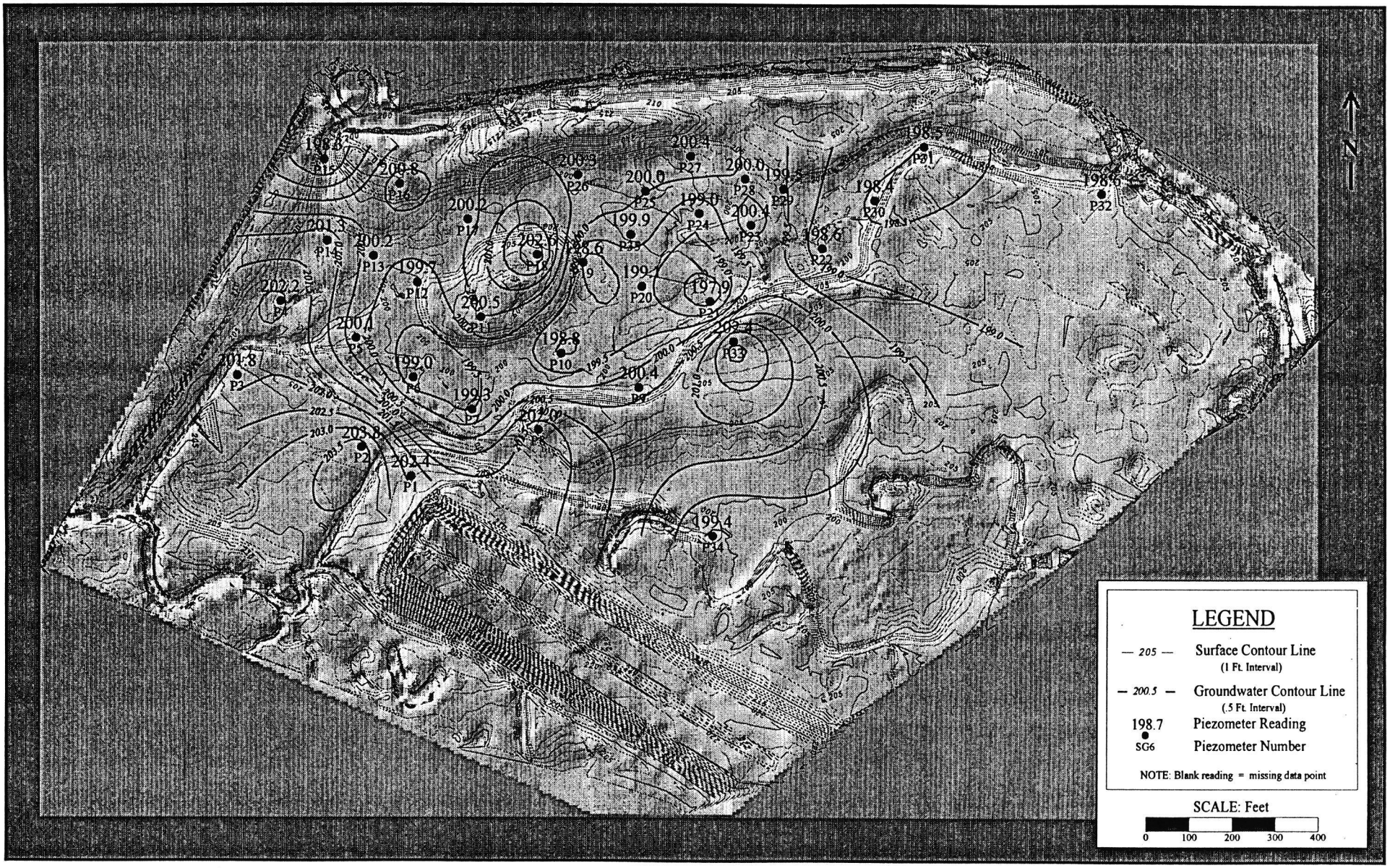


Groundwater Elevations

(04/08/97)

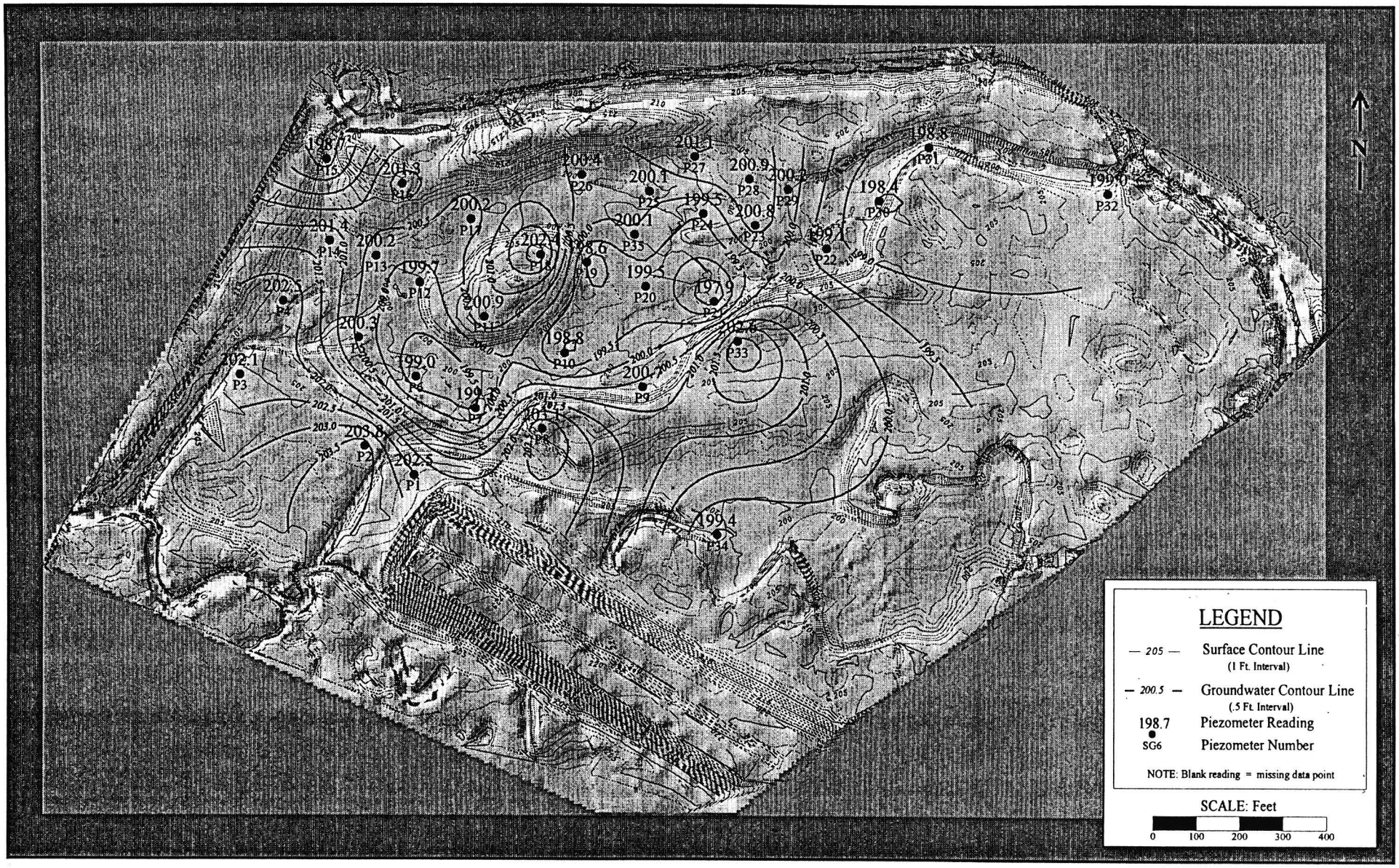
Nevins Creek Mitigation Area



Groundwater Elevations

(04/21/97)

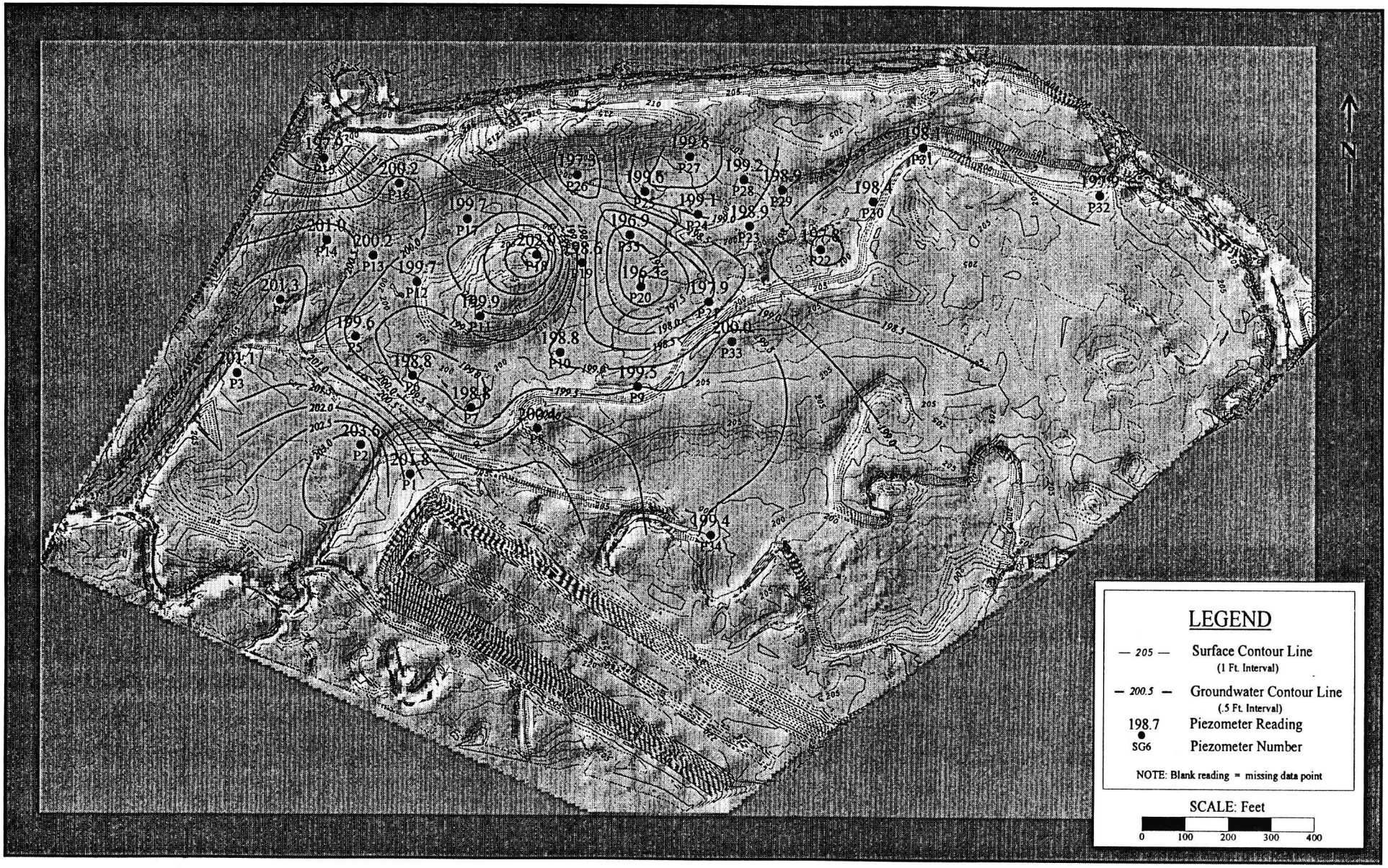
Nevins Creek Mitigation Area



Groundwater Elevations

(05/04/97)

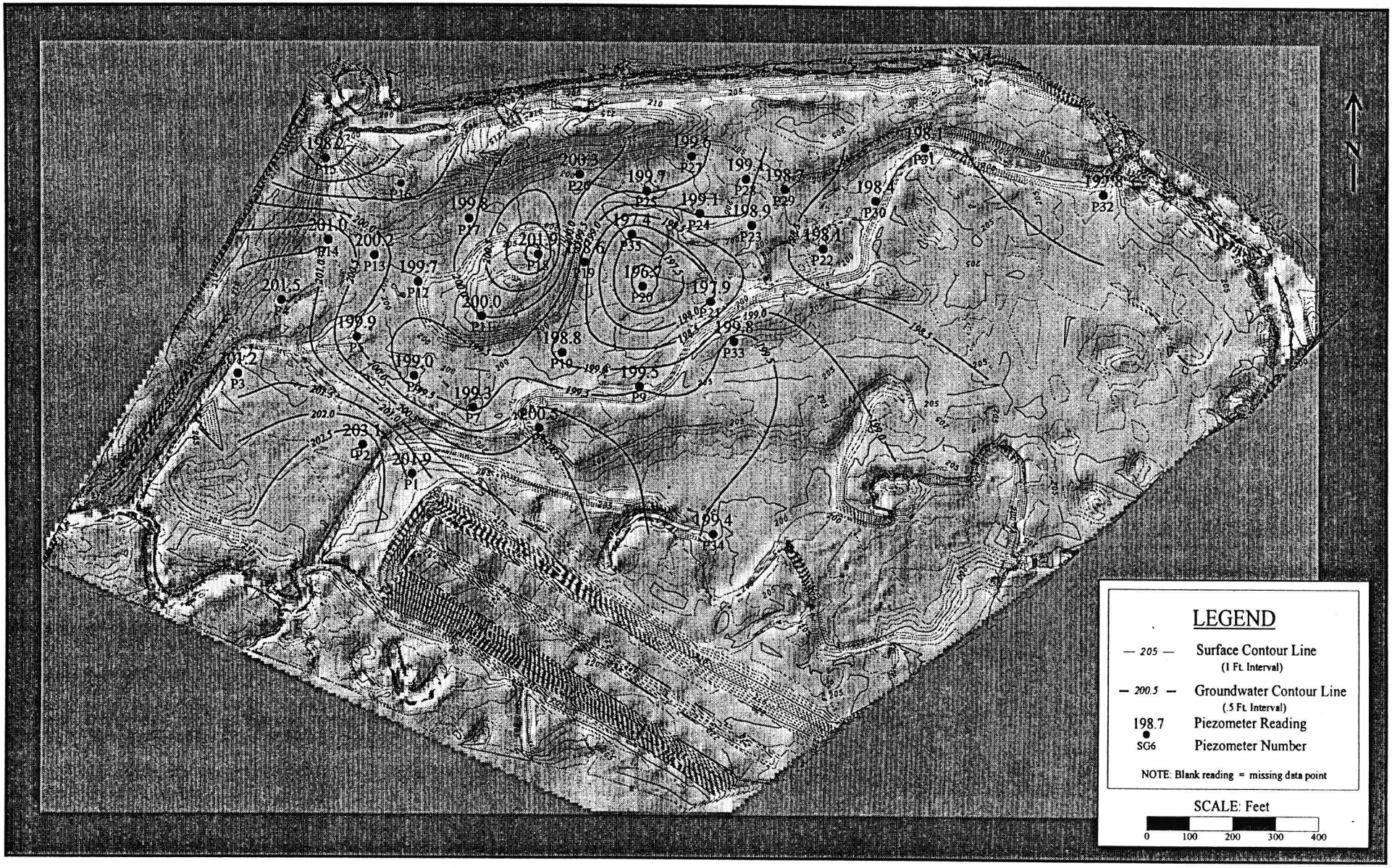
Nevins Creek Mitigation Area



Groundwater Elevations

(05/23/97)

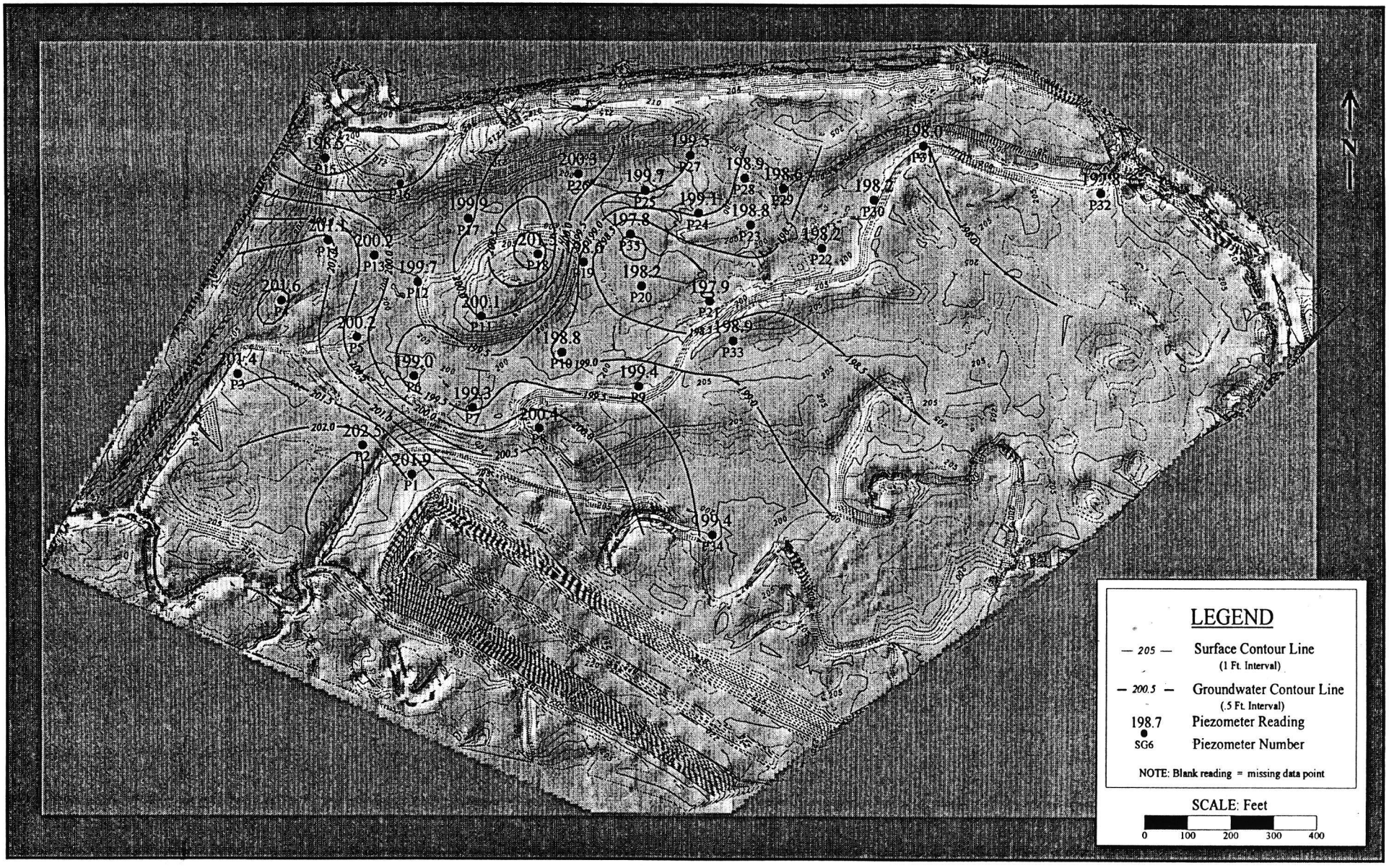
Nevins Creek Mitigation Area



Groundwater Elevations

(06/02/97)

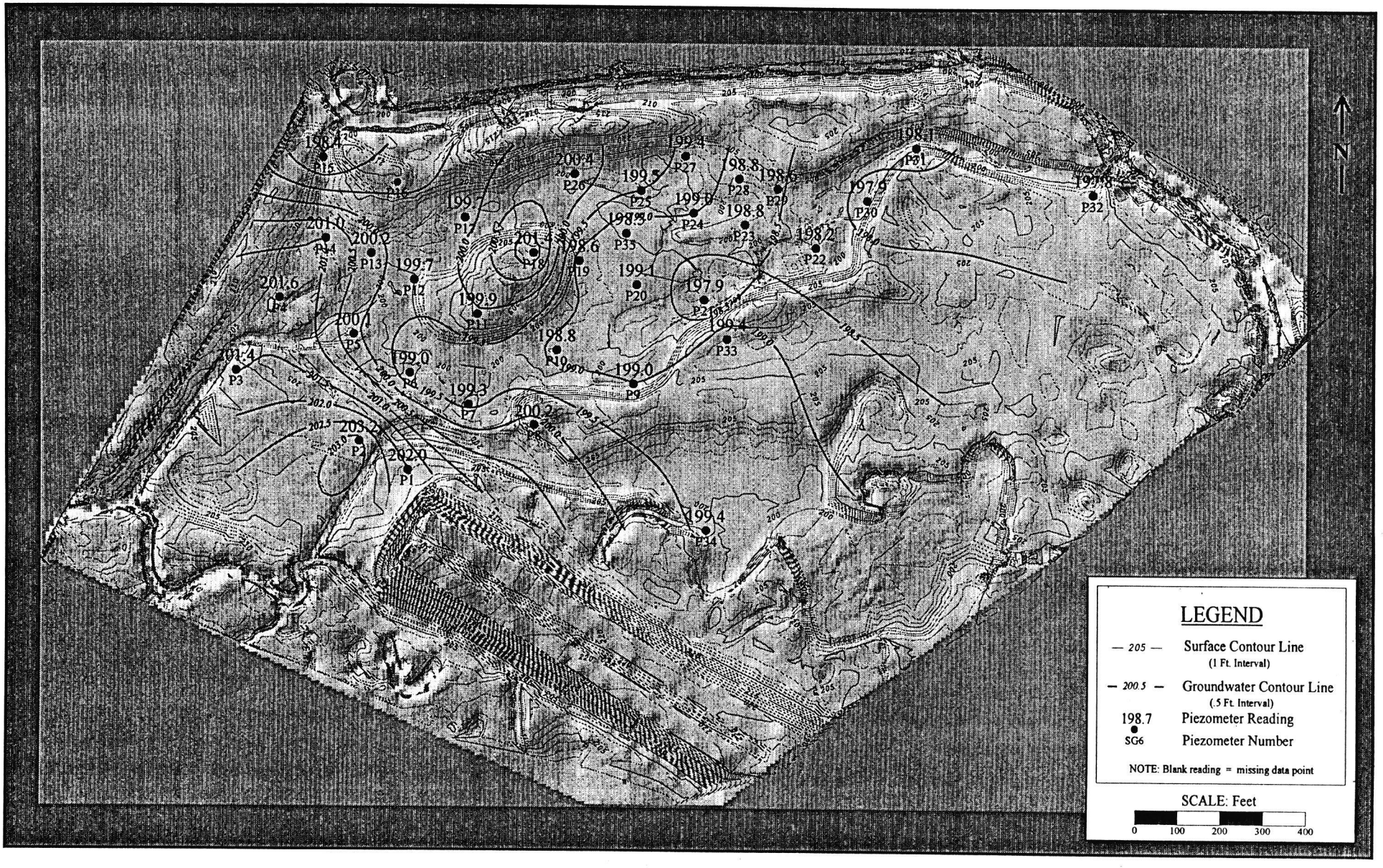
Nevins Creek Mitigation Area



Groundwater Elevations

(06/16/97)

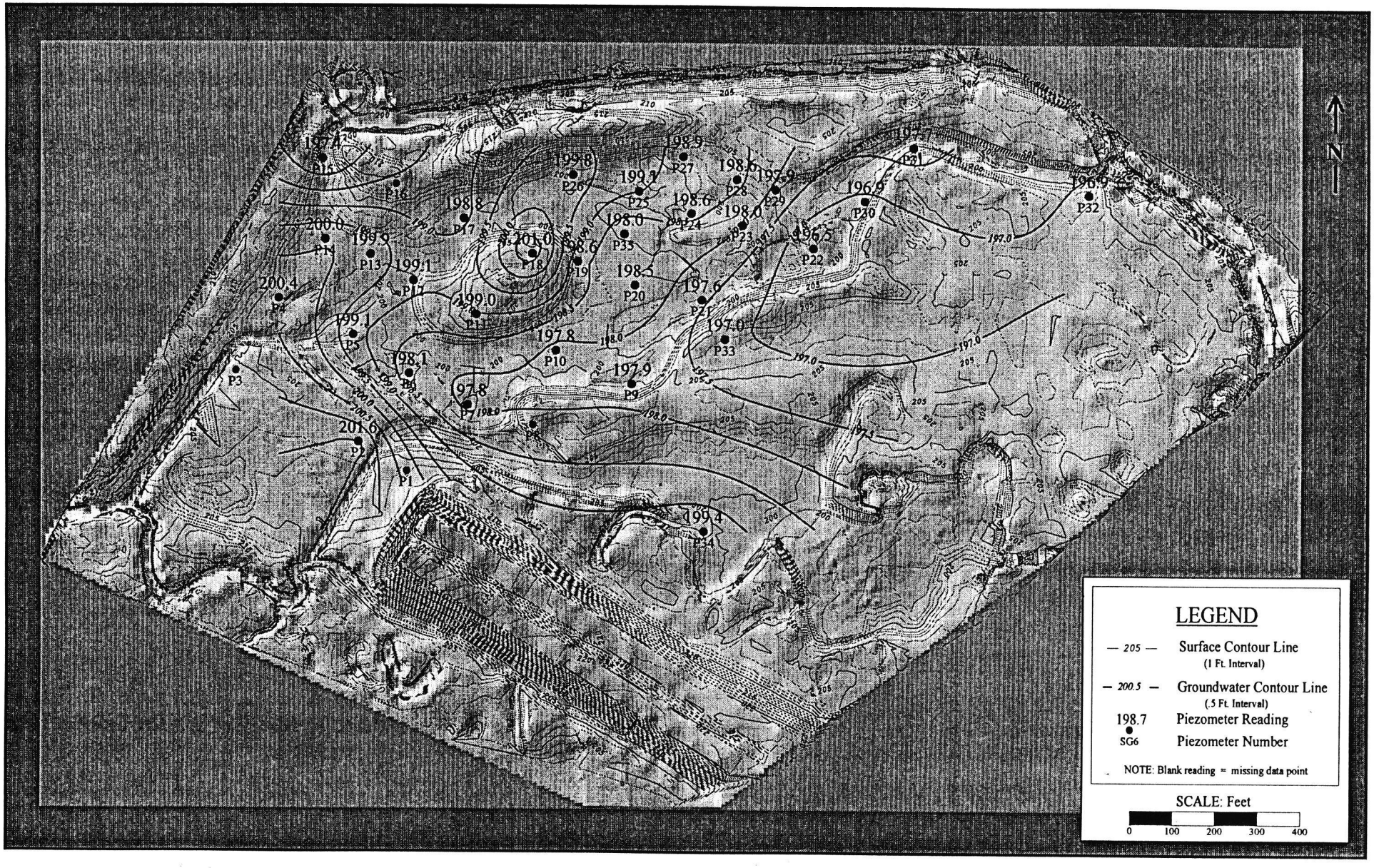
Nevins Creek Mitigation Area



Groundwater Elevations

(07/01/97)

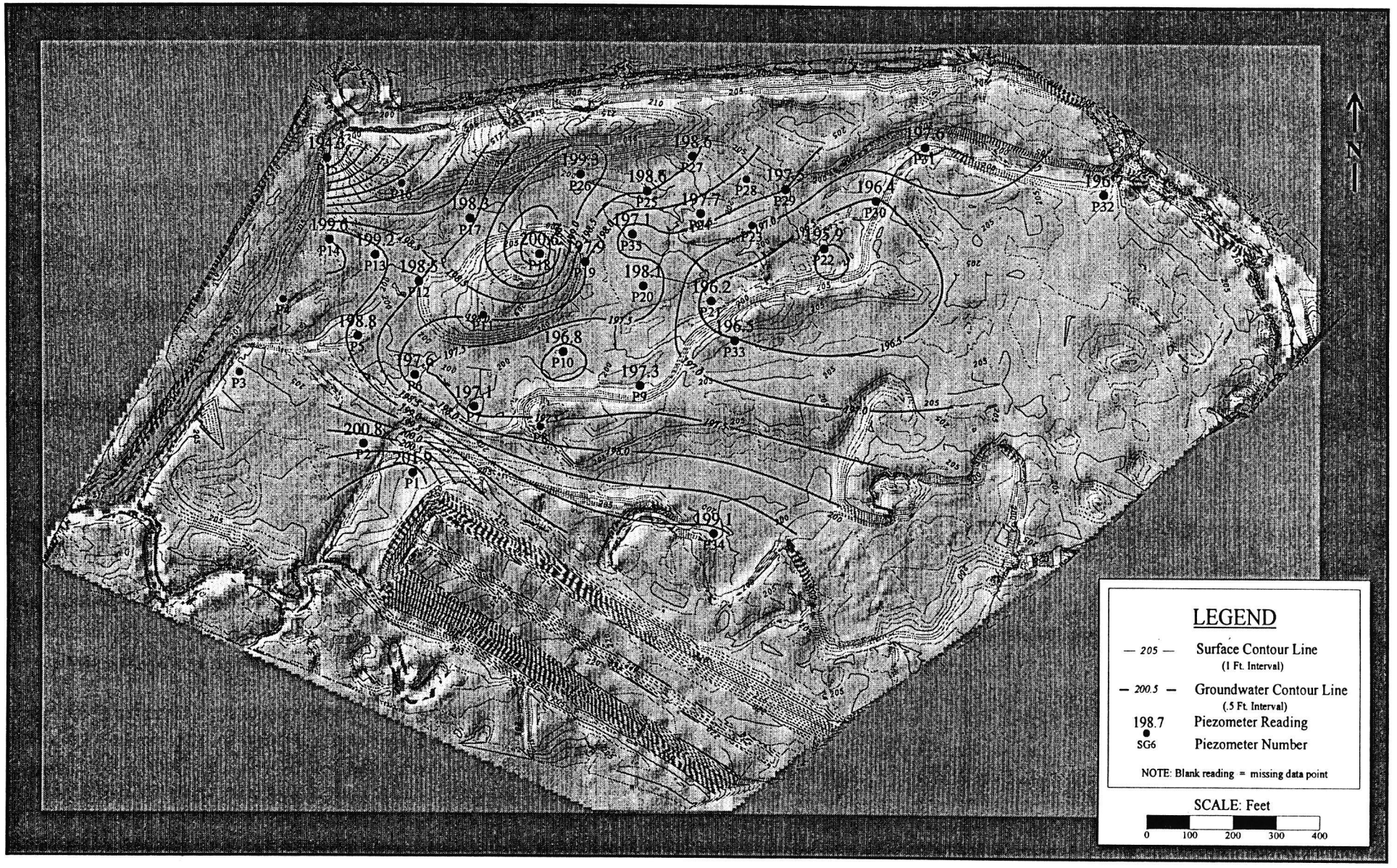
Nevins Creek Mitigation Area



Groundwater Elevations

(07/18/97)

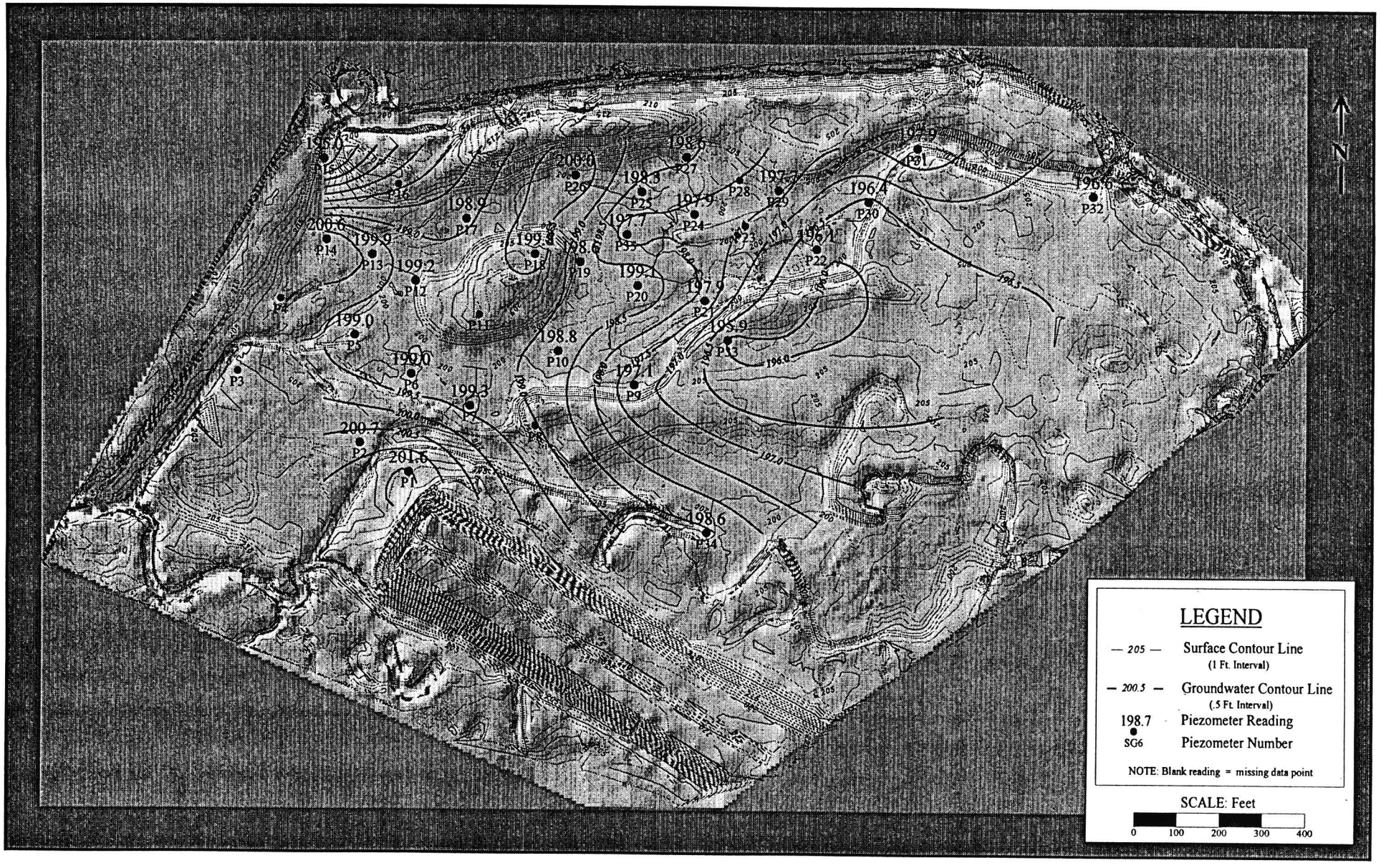
Nevins Creek Mitigation Area



Groundwater Elevations

(07/28/97)

Nevins Creek Mitigation Area



Groundwater Elevations

(08/15/97)

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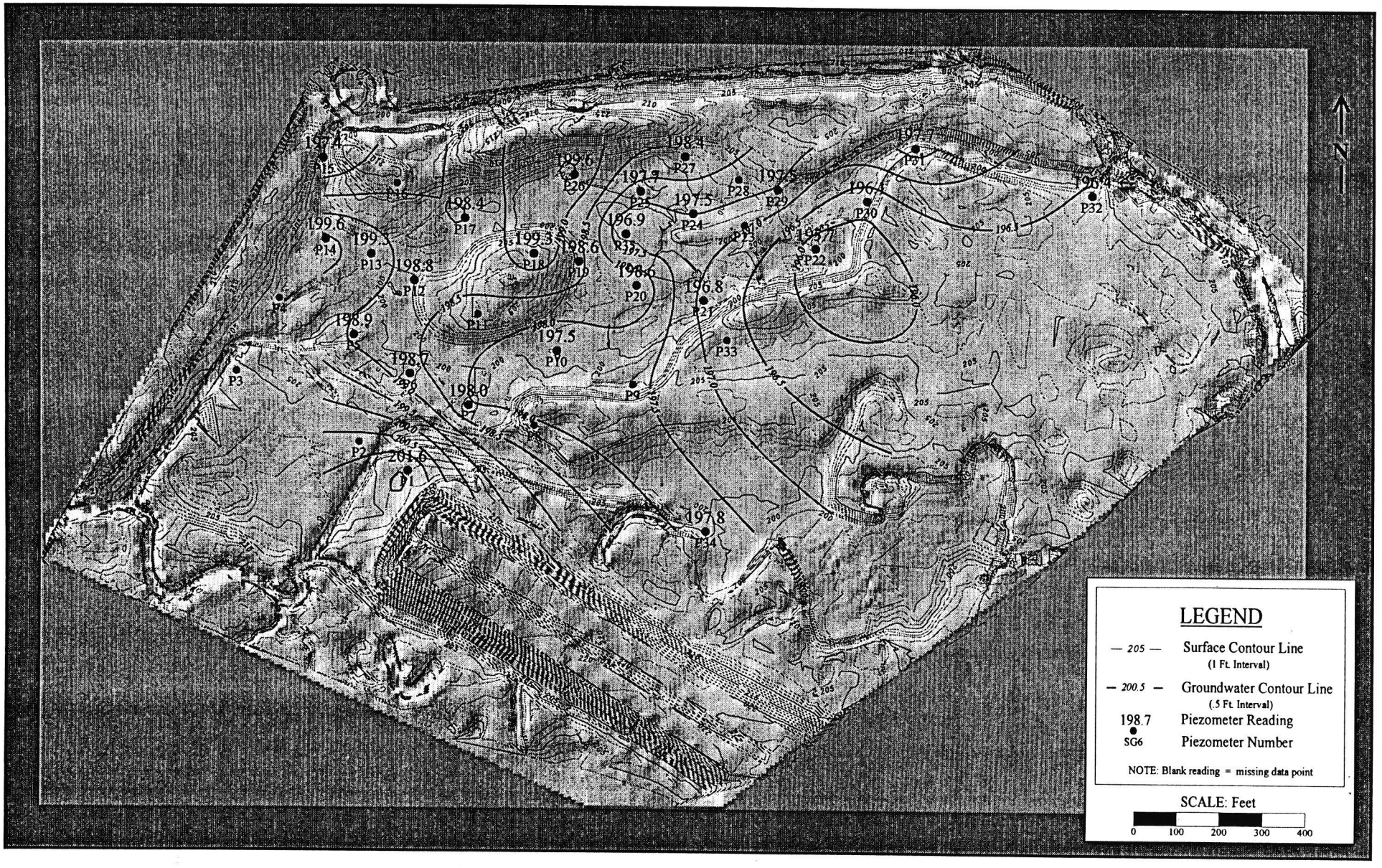
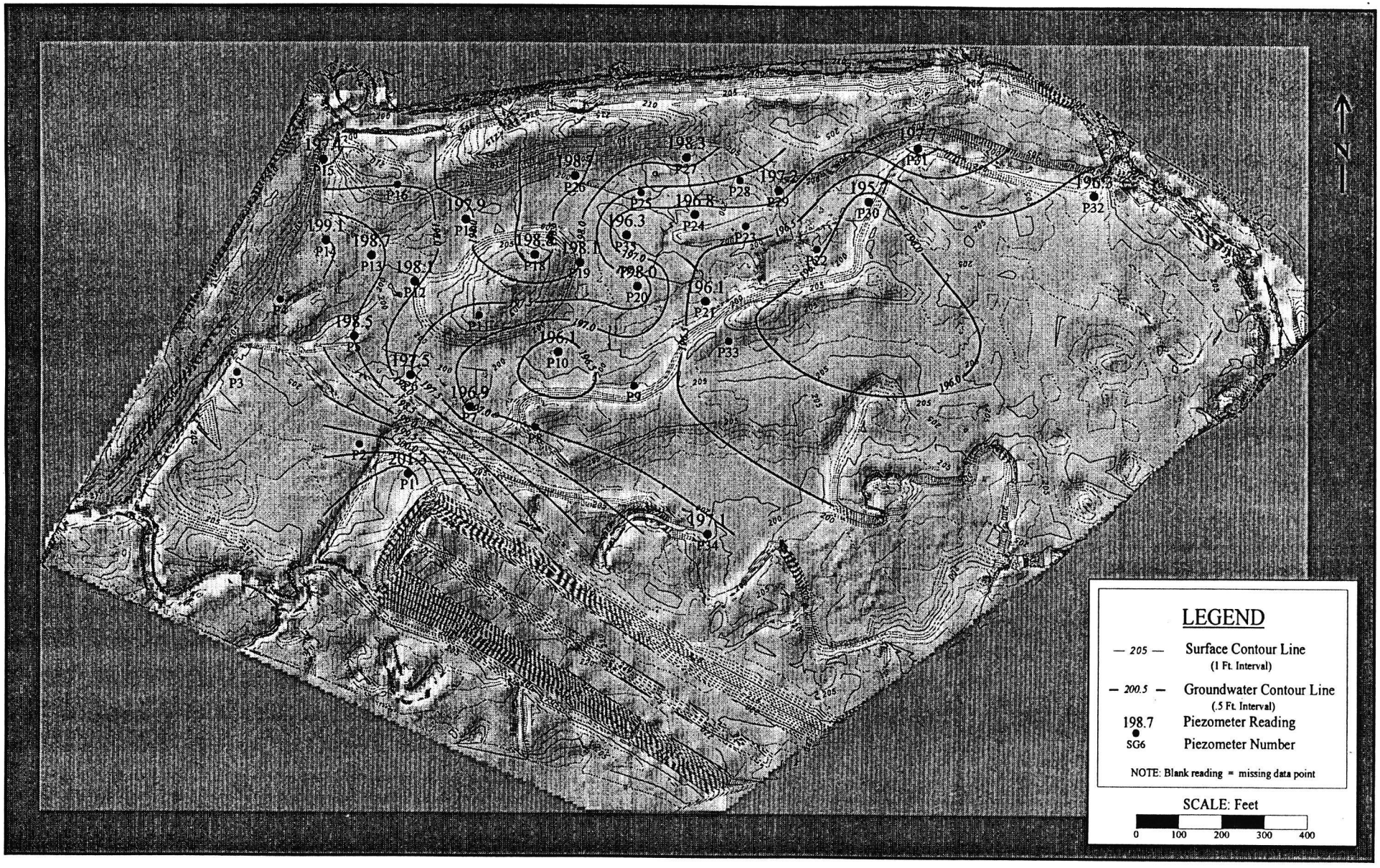


Groundwater Elevations

(08/25/97)

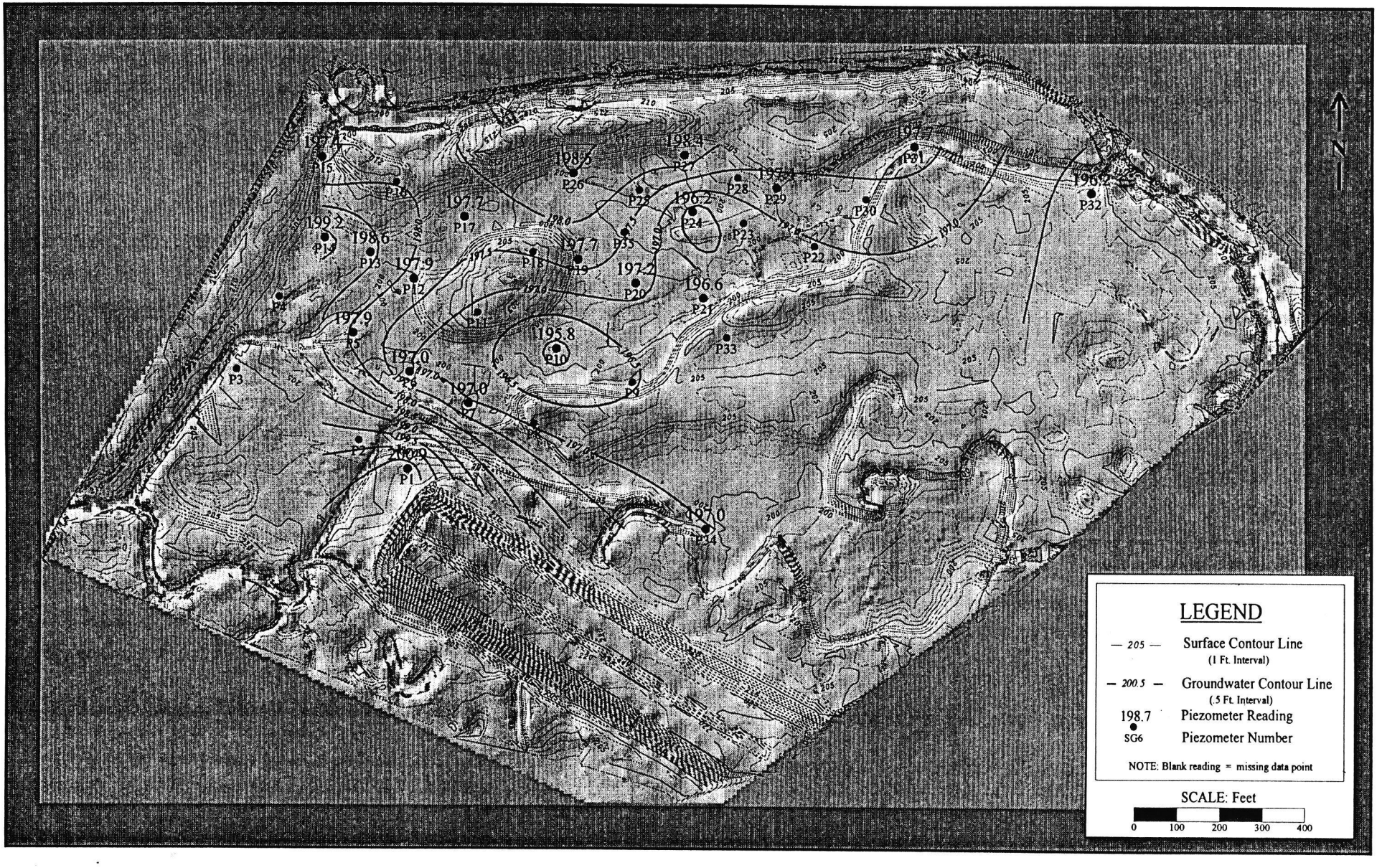
Nevins Creek Mitigation Area



Groundwater Elevations

(09/08/97)

Nevins Creek Mitigation Area



Groundwater Elevations

(09/30/97)

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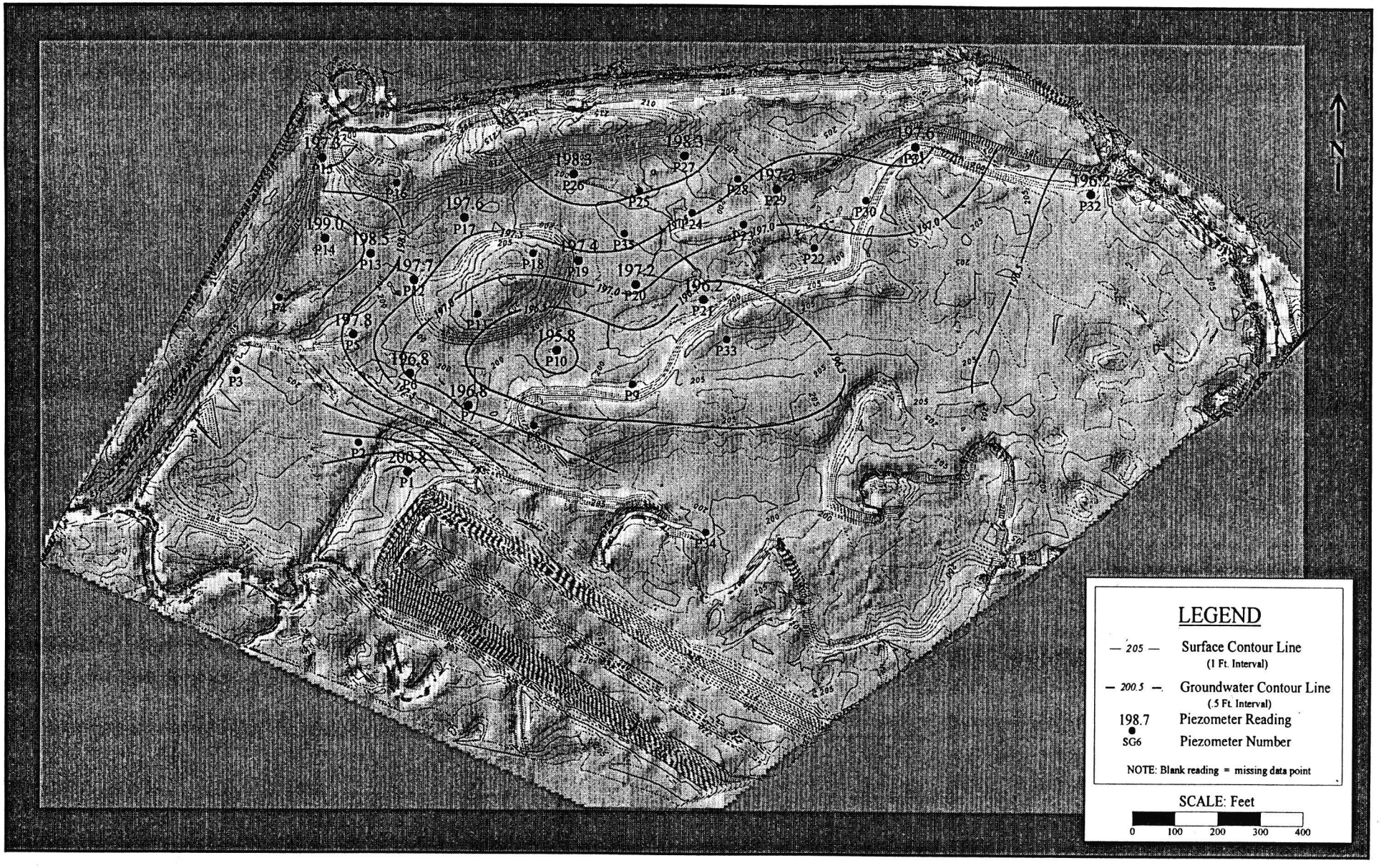

Groundwater Elevations

(10/06/97)

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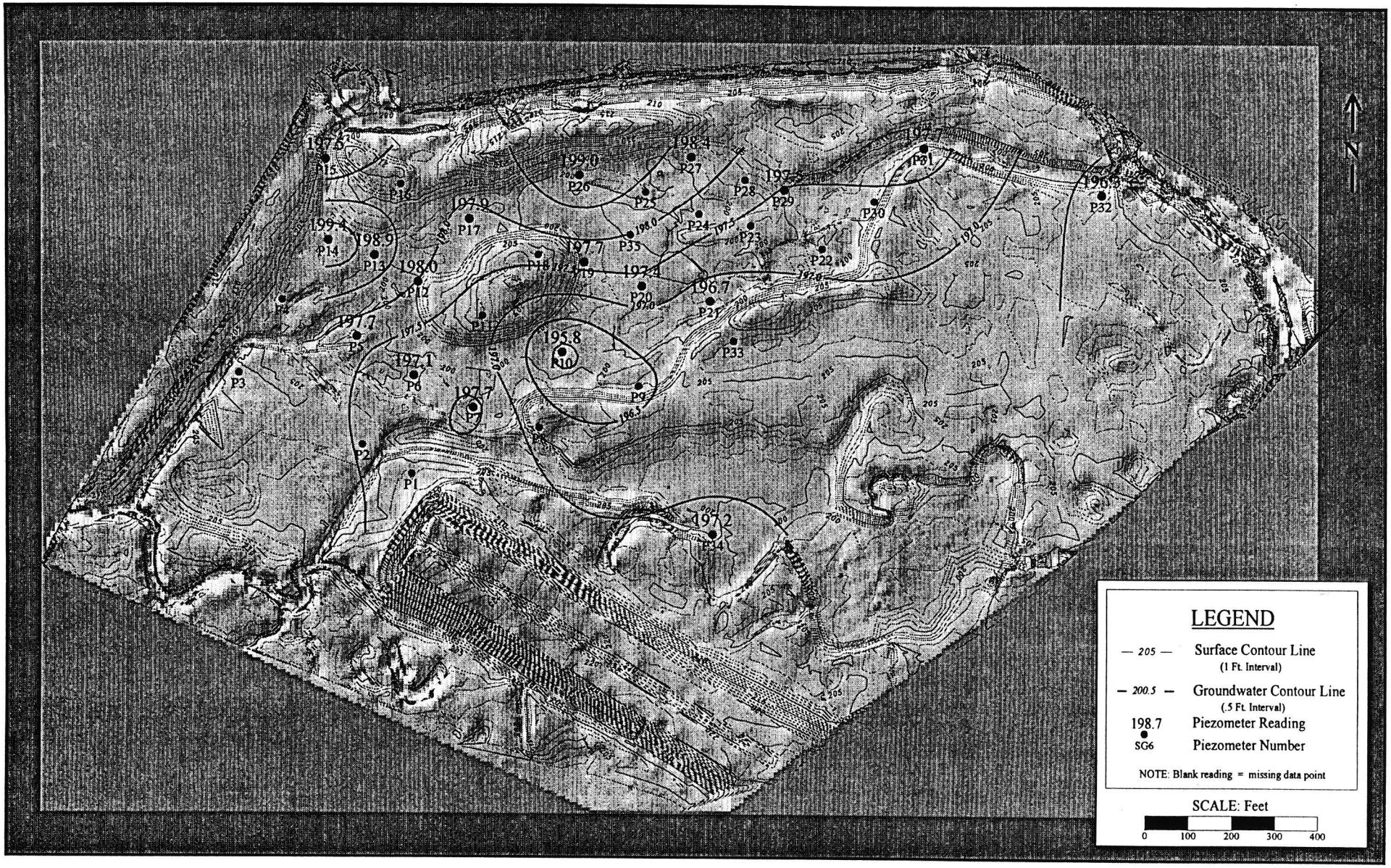

Groundwater Elevations

(10/19/97)

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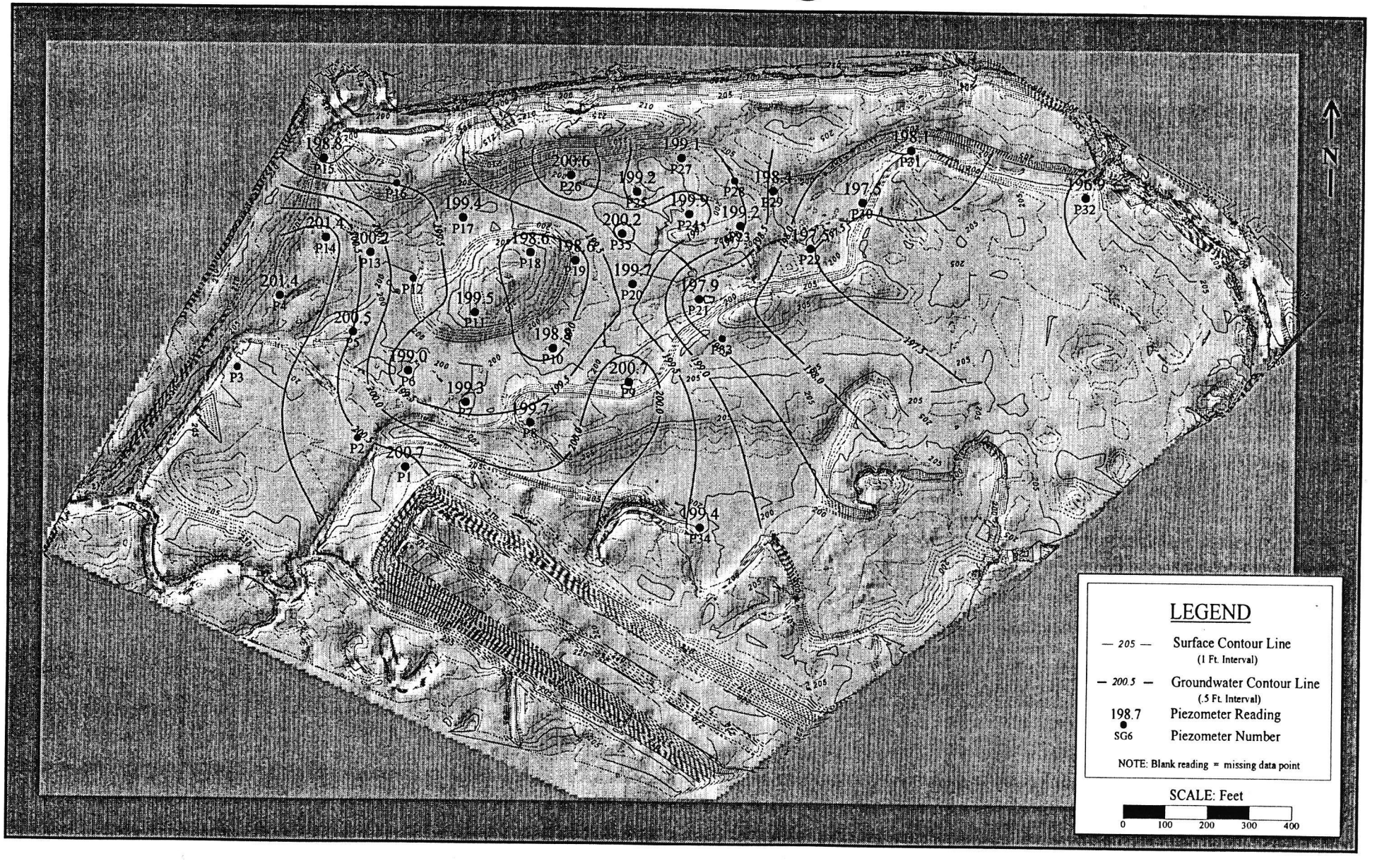
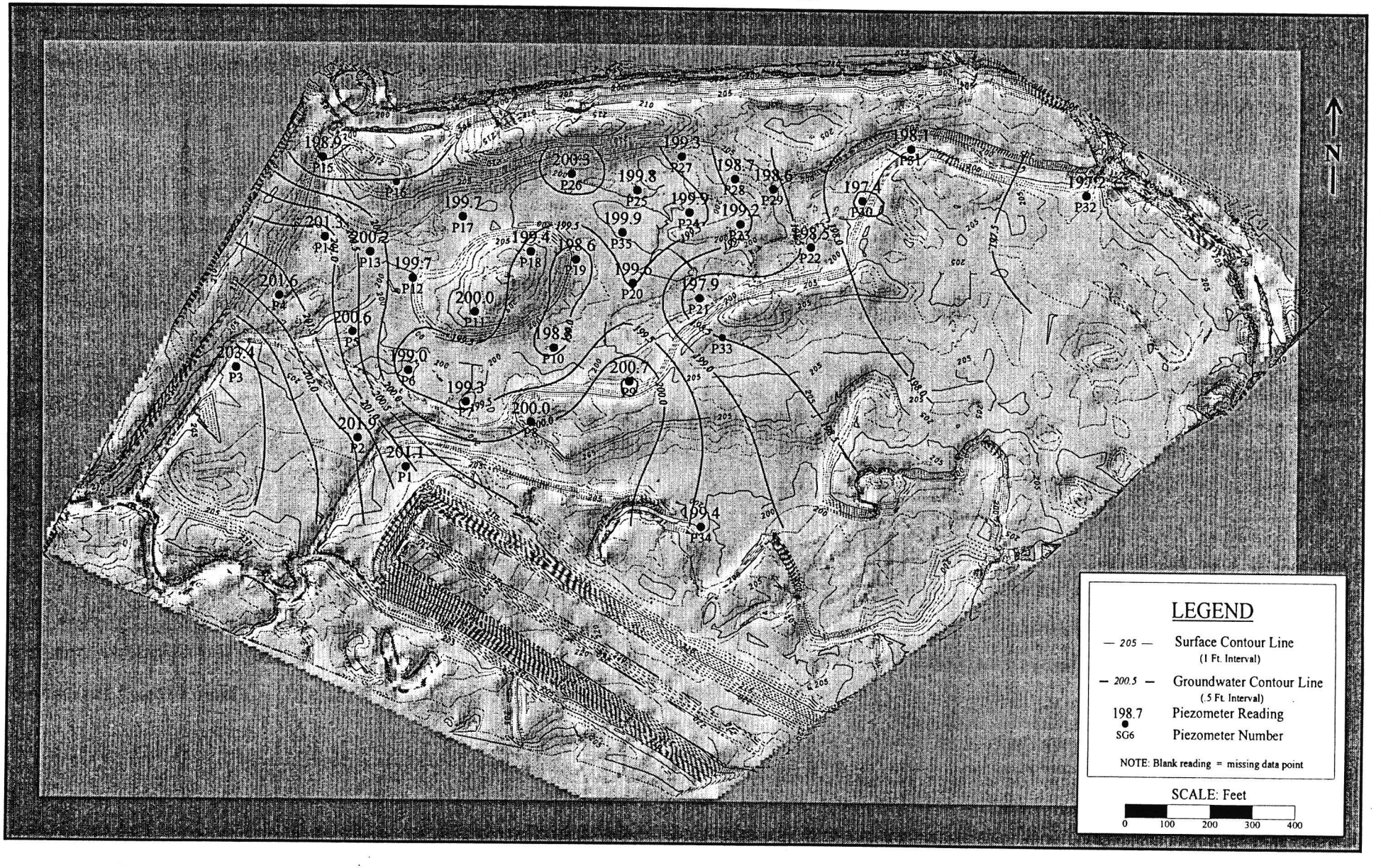


Groundwater Elevations

(11/10/97)

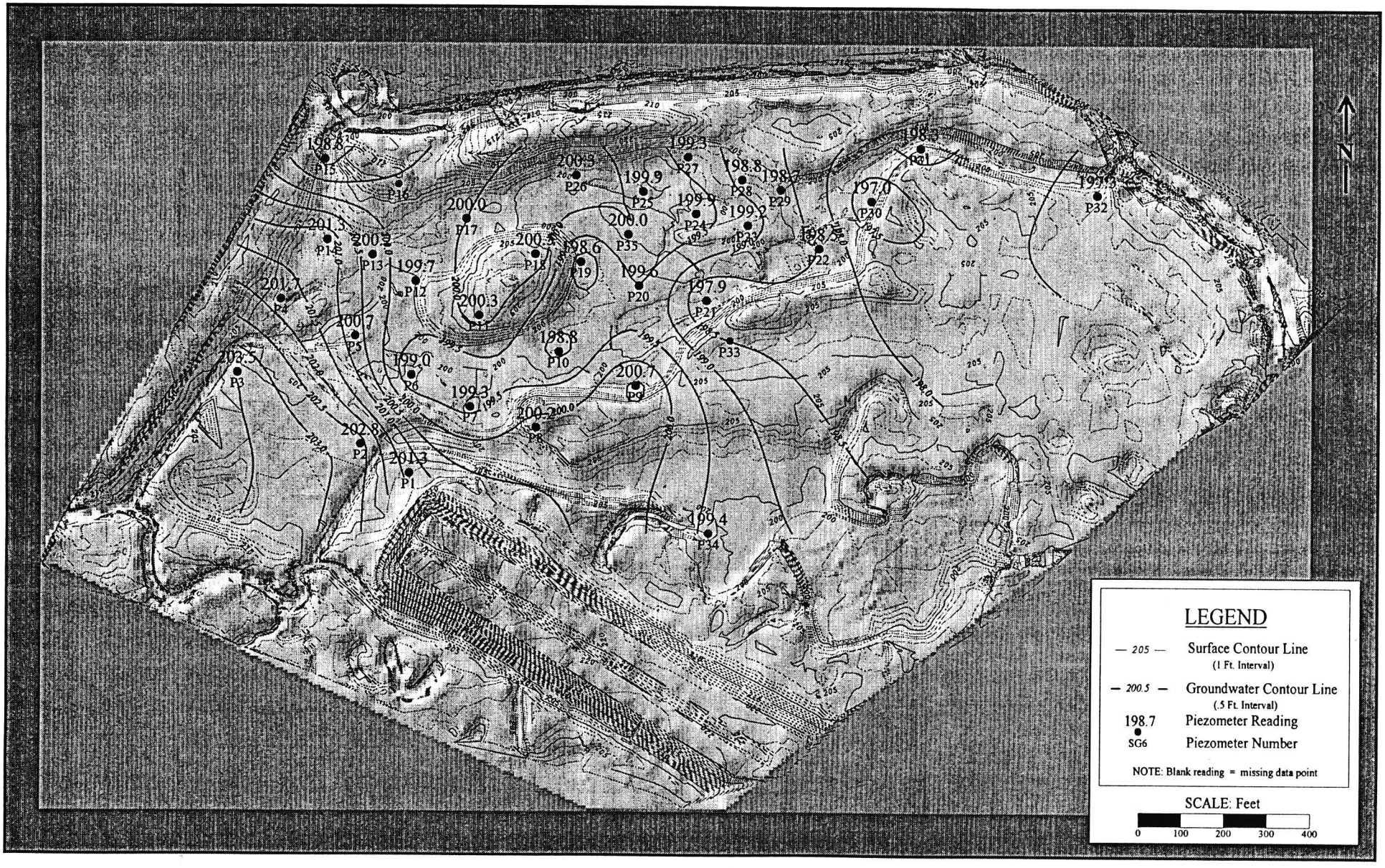
Nevins Creek Mitigation Area



Groundwater Elevations

(11/17/97)

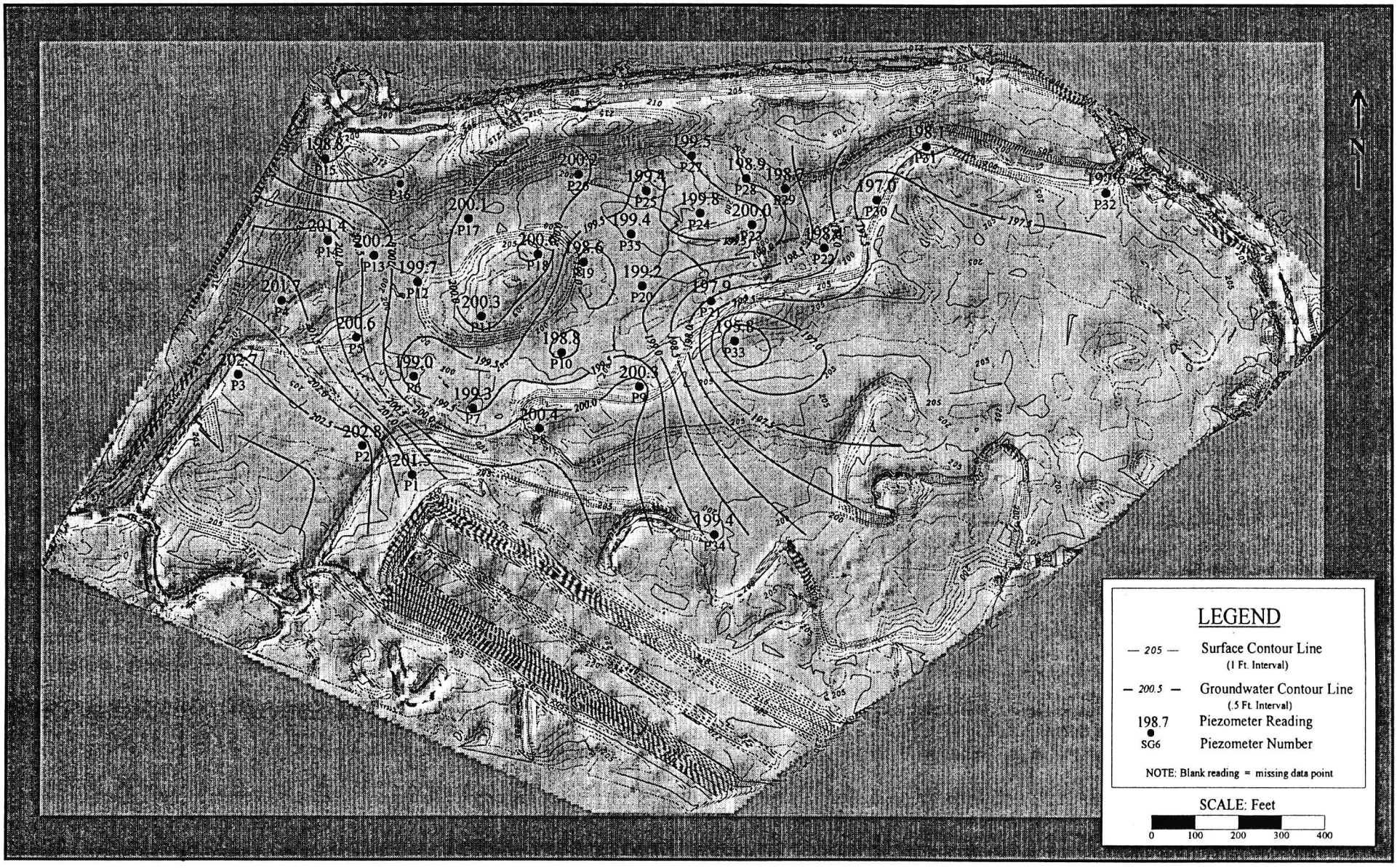
Nevins Creek Mitigation Area



Groundwater Elevations

(12/02/97)

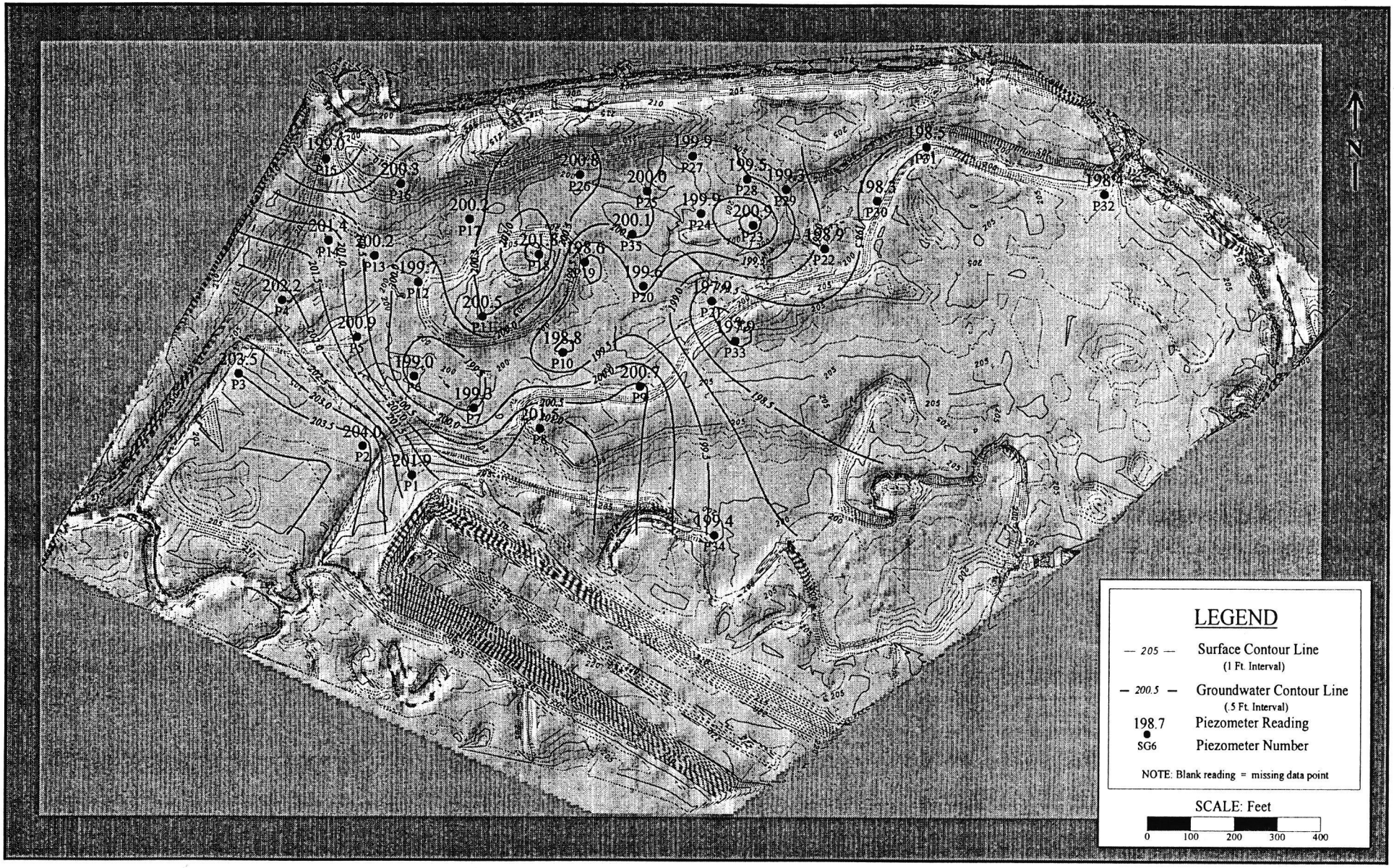
Nevins Creek Mitigation Area



Groundwater Elevations

(12/20/97)

Nevins Creek Mitigation Area



Groundwater Elevations

(12/31/97)

APPENDIX F

Groundwater Monitoring Data

WELL LEVEL READINGS

Date	Well# 1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180
									(Ft)									
12/01/95	1.61	-111.00	-222.00	-111.00	-444.00	2.30	0.66	-111.00	-111.00	-444.00	-111.00	2.82	3.28	-111.00	5.51	-111.00	2.89	-111.00
01/02/96	1.80	-111.00	3.15	-111.00	0.79	0.85	-333.00	7.51	2.82	-333.00	-111.00	1.51	2.92	3.51	3.38	-111.00	2.72	-111.00
01/14/96	1.84	3.15	2.69	-111.00	1.84	0.33	-333.00	7.48	1.31	-333.00	-111.00	1.05	2.07	3.81	3.90	-111.00	1.74	-111.00
01/29/96	1.87	3.74	2.72	-111.00	1.90	0.26	-333.00	7.38	1.80	-333.00	-111.00	1.02	1.97	3.18	3.90	-111.00	1.41	7.09
02/12/96	1.90	-444.00	3.18	-111.00	1.97	0.36	-333.00	7.42	2.03	-333.00	-111.00	1.21	2.00	3.67	4.40	-111.00	1.48	6.99
02/25/96	2.10	3.94	2.95	-111.00	1.84	-333.00	-333.00	7.05	2.30	-333.00	7.81	0.79	1.61	2.23	3.71	-111.00	1.08	6.50
03/11/96	2.59	3.77	3.35	-111.00	1.94	0.23	-333.00	7.12	2.82	-333.00	7.84	0.75	1.48	2.36	3.94	-111.00	1.15	6.63
03/23/96	2.59	3.81	3.22	-222.00	1.90	0.20	0.07	6.92	2.10	2.20	7.74	0.66	1.21	2.00	3.74	-111.00	0.98	6.40
04/17/96	2.62	3.74	3.54	3.97	1.97	0.10	0.10	6.59	1.35	2.17	7.38	-333.00	0.30	1.61	3.54	-111.00	0.66	6.43
04/21/96	2.62	3.31	3.38	-444.00	1.94	2.23	-333.00	6.89	0.39	1.35	7.55	0.36	0.23	1.31	3.28	-111.00	0.59	6.20
05/07/96	3.45	2.85	3.84	3.51	0.98	1.87	-333.00	7.02	0.59	1.21	7.45	0.30	-333.00	1.44	3.35	-111.00	0.62	6.10
05/19/96	3.35	2.66	4.13	3.51	2.30	2.53	0.46	7.22	1.71	2.40	7.74	0.43	-333.00	1.41	4.10	-111.00	0.89	5.87
05/31/96	3.90	1.80	-222.00	3.87	2.56	3.22	1.18	7.81	2.53	2.69	-111.00	1.02	0.49	1.67	4.40	-111.00	1.25	6.07
06/03/96	3.87	2.20	-222.00	3.41	2.33	2.59	-333.00	7.55	2.66	2.33	-111.00	0.59	0.23	1.44	4.00	-111.00	1.15	6.07
06/07/96	3.84	1.61	-222.00	2.99	2.00	2.49	-333.00	7.64	1.64	2.13	7.84	0.49	-333.00	1.31	3.35	-111.00	0.92	6.14
06/17/96	3.64	2.69	4.10	3.51	2.49	2.72	0.89	7.74	2.62	2.79	-111.00	0.85	-333.00	1.57	4.49	-111.00	1.15	6.20
06/30/96	3.74	1.90	-222.00	4.13	2.89	4.40	1.67	-111.00	3.28	4.66	-111.00	0.82	0.30	2.13	4.82	-111.00	1.67	6.23
07/16/96	5.09	3.77	-222.00	-111.00	3.54	5.28	2.53	-111.00	4.04	5.28	-111.00	2.10	1.61	2.72	4.79	-111.00	2.36	6.82
07/29/96	4.92	3.71	-222.00	3.81	1.94	2.99	0.36	-111.00	2.10	2.43	-111.00	1.08	0.72	1.54	4.04	-111.00	1.74	7.22
08/06/96	3.81	3.71	-222.00	2.79	2.00	2.40	0.13	7.58	2.07	2.23	7.61	0.43	-333.00	1.18	3.51	-111.00	1.08	6.50
08/13/96	3.84	3.87	-111.00	3.31	2.49	2.89	0.98	-111.00	3.18	2.33	-111.00	0.82	0.23	1.54	4.07	-111.00	1.48	6.27
08/26/96	5.67	-111.00	-111.00	3.77	3.69	4.60	2.14	-111.00	-111.00	4.59	-111.00	1.49	0.45	1.70	4.65	-111.00	1.98	6.38
09/09/96	5.21	-111.00	-111.00	3.95	3.28	4.73	1.98	-111.00	-111.00	4.69	-111.00	1.76	1.00	1.85	4.64	-111.00	2.26	6.75
09/23/96	5.18	-111.00	-111.00	3.65	3.11	2.78	0.58	-111.00	2.26	2.85	8.55	1.17	0.60	1.64	4.35	-111.00	1.96	7.32
10/10/96	4.85	-111.00	-111.00	3.12	2.18	2.72	0.75	-111.00	3.70	2.66	8.03	0.81	0.20	1.25	3.96	-111.00	1.60	7.13
10/21/96	5.57	-111.00	-111.00	2.43	1.53	2.26	-333.00	7.84	1.83	2.29	7.80	0.31	-333.00	0.31	3.33	-111.00	1.08	6.77
10/25/96	4.18	2.72	3.50	1.67	1.07	2.10	-333.00	6.85	0.41	2.09	6.91	-333.00	-333.00	0.16	3.12	-111.00	0.38	6.29
11/04/96	3.82	3.41	2.18	1.77	1.45	2.11	-333.00	6.95	1.30	2.05	7.00	-333.00	-333.00	0.18	3.12	9.34	0.45	5.62
11/18/96	3.89	3.50	1.13	1.55	0.83	1.70	-333.00	6.67	0.34	1.64	6.90	-333.00	-333.00	0.28	3.09	9.21	0.21	4.81
12/08/96	2.93	2.71	1.85	1.53	-444.00	1.79	-333.00	3.54	0.22	1.82	6.49	-333.00	-333.00	0.14	3.04	7.94	-333.00	4.36
12/22/96	3.48	3.19	2.52	1.60	-444.00	1.84	-333.00	4.51	0.23	4.84	6.63	-333.00	-333.00	0.22	3.05	8.37	-333.00	3.61
12/30/96	3.20	2.18	1.58	1.30	-444.00	1.55	-333.00	2.53	0.20	1.70	6.03	-333.00	-333.00	0.10	3.02	7.48	-333.00	1.50
01/13/97	3.46	2.91	2.83	1.67	-444.00	1.76	-333.00	3.75	0.68	1.79	6.60	-333.00	-333.00	0.13	3.04	8.19	-333.00	2.64
01/26/97	3.33	0.56	1.20	1.27	0.10	1.34	-333.00	2.67	0.21	1.35	5.43	-333.00	-333.00	0.14	2.73	7.39	-333.00	1.44
02/10/97	2.72	0.31	1.42	1.25	0.48	1.41	-333.00	2.35	0.21	1.48	5.76	-333.00	-333.00	-444.00	3.14	6.87	-333.00	1.42
02/24/97	2.49	0.17	1.41	1.28	0.56	1.39	-333.00	2.36	0.19	1.51	5.65	-333.00	-333.00	-333.00	3.29	6.74	-333.00	1.72
03/09/97	2.83	0.14	1.93	1.36	0.77	1.34	-333.00	2.93	0.08	1.49	5.93	-333.00	-333.00	-333.00	4.19	7.32	-333.00	2.00
03/24/97	3.07	0.67	2.68	1.50	1.20	1.45	-333.00	3.98	0.53	1.52	6.28	-333.00	-333.00	0.15	4.25	8.01	-333.00	2.72
04/08/97	2.01	0.18	0.88	1.10	0.17	0.54	-333.00	2.14	-333.00	0.35	4.57	-333.00	-333.00	0.09	3.95	5.93	-333.00	1.47
04/21/97	3.63	0.65	3.20	1.90	1.56	1.67	-333.00	5.43	0.70	1.76	6.73	-333.00	-333.00	0.36	5.40	8.71	0.30	3.75
05/04/97	3.46	0.69	2.90	1.59	1.36	1.48	-333.00	4.25	0.26	1.61	6.37	-333.00	-333.00	0.25	5.06	8.19	-333.00	3.92
05/23/97	4.22	0.89	3.95	2.73	2.05	3.31	0.99	6.95	1.54	1.94	7.33	0.23	-333.00	0.66	5.79	9.28	0.82	4.36
06/02/97	4.13	1.40	3.80	2.53	1.81	2.00	0.15	6.86	1.59	1.94	7.22	0.05	-333.00	0.71	5.56	-111.00	0.71	4.49
06/16/97	4.08	1.99	3.61	2.45	1.53	1.84	-333.00	6.95	1.64	1.93	7.18	0.12	-333.00	0.55	5.27	-111.00	0.64	4.83
07/01/97	3.96	1.28	3.56	2.51	1.61	1.81	-333.00	7.19	2.06	1.93	7.29	-333.00	-333.00	0.67	5.31	-111.00	0.78	4.91
07/18/97	3.97	2.87	-111.00	3.62	2.58	4.05	1.93	-111.00	3.19	3.85	8.26	1.06	0.51	1.74	6.29	-111.00	1.71	5.37
07/28/97	4.06	3.71	-111.00	-111.00	2.90	4.59	2.64	-111.00	3.78	4.91	-111.00	1.70	1.17	2.10	9.42	-111.00	2.20	5.71
08/15/97	4.33	3.75	-111.00	-111.00	2.70	1.74	-333.00	-111.00	4.00	2.15	-111.00	1.02	0.51	1.13	8.77	-111.00	1.64	6.57
08/25/97	4.38	-111.00	-111.00	-111.00	2.82	3.47	1.78	-111.00	-111.00	4.22	-111.00	1.41	1.11	2.05	6.29	-111.00	2.06	7.01
09/08/97	4.65	-111.00	-111.00	-111.00	3.22	4.66	2.88	-111.00	-111.00	5.59	-111.00	2.13	1.69	2.62	6.38	-111.00	2.62	7.59
09/30/97	5.09	-111.00	-111.00	-111.00	3.81	5.16	2.73	-111.00	-111.00	5.87	-111.00	2.35	1.76	2.52	6.38	-111.00	2.77	-111.00
10/06/97	5.17	-111.00	-111.00	-111.00	3.94	5.35	2.97	-111.00	-111.00	5.92	-111.00	2.53	1.94	2.73	6.46	-111.00	2.89	-111.00
10/19/97	5.27	-111.00	-111.00	-111.00	4.03	5.09	2.11	-111.00	-111.00	5.89	-111.00	2.22	1.55	2.31	6.24	-111.00	2.64	-111.00
11/10/97	5.26	-111.00	-111.00	2.70	1.18	1.72	-333.00	7.73	0.17	1.95	7.75	-444.00	-333.00	0.26	4.92	-111.00	1.13	7.71
11/17/97	4.85	2.56	1.58	2.43	1.05	1.68	-333.00	7.40	0.20	1.92	7.24	0.07	-333.00	0.40	4.88	-111.00	0.83	6.93
12/02/97	4.66	1.74	1.50	2.35	0.98	1.57	-333.00	7.17	0.20	1.70	6.99	-333.00	-333.00	0.36	4.93	-111.00	0.52	5.88
12/20/97	4.46	1.69	2.28	2.40	1.07	1.62	-333.00	7.01	0.79	1.79	6.93	-333.00	-333.00	0.29	4.90	-111.00	0.45	5.73
12/31/97	4.08	0.53	1.47	1.88	0.84	1.43	-333.00	5.87	0.18	1.56	6.71	-333.00	-333.00	0.21	4.75	9.18	0.23	4.54

Key: -111.00 = dry well -222.00 = "moist" = dry well -333.00 = water top of well -444.00 = missing data (or under water)

WELL LEVEL READINGS (cont.)

Date	Well# 1190	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350
									(Ft)								
12/01/95	-444.00	-111.00	-444.00	-111.00	-111.00	2.72	4.13	1.44	3.31	4.59	2.33	3.05	1.97	5.84	-111.00	4.00	0.82
01/02/96	-444.00	0.62	-444.00	0.85	0.82	1.80	1.08	1.31	3.18	3.94	2.30	0.16	1.38	3.84	4.92	0.26	0.92
01/14/96	-444.00	0.66	-444.00	1.25	1.48	0.66	2.26	1.15	2.92	4.07	1.84	0.85	2.03	4.69	5.74	0.49	0.95
01/29/96	-444.00	0.66	-444.00	1.35	2.00	0.59	2.40	0.98	2.95	4.00	1.84	0.85	2.07	4.66	5.15	0.43	0.92
02/12/96	-444.00	1.05	-444.00	1.64	1.57	0.59	2.26	1.02	2.99	4.13	1.87	1.21	2.17	4.99	7.12	0.92	0.82
02/25/96	-444.00	0.82	-444.00	1.31	2.20	0.56	1.81	1.05	2.53	3.74	1.67	0.43	1.84	3.90	4.53	0.43	0.92
03/11/96	-444.00	0.43	-444.00	1.31	2.23	0.52	1.71	1.05	2.69	3.77	1.48	0.72	1.84	3.87	4.69	0.07	0.89
03/23/96	3.08	0.46	2.56	1.25	2.36	0.56	1.71	1.05	2.62	3.61	1.51	0.62	1.77	3.54	4.43	0.36	0.92
04/17/96	2.20	0.59	2.56	1.35	2.46	0.59	1.71	1.05	2.30	3.31	1.48	0.20	1.80	3.87	4.07	-333.00	0.85
04/21/96	2.23	2.33	1.64	-333.00	2.40	-333.00	0.43	0.26	2.23	3.28	1.31	-333.00	0.79	3.12	3.05	1.77	0.85
05/07/96	2.07	-333.00	0.98	-333.00	2.33	-333.00	0.52	0.30	2.36	3.41	0.98	-333.00	0.43	2.85	3.38	1.28	2.23
05/19/96	2.30	1.05	2.92	1.94	2.69	1.31	1.74	0.36	2.79	3.90	1.12	0.75	2.20	4.66	5.09	1.54	1.87
05/31/96	2.56	1.64	3.02	2.76	2.72	1.54	2.13	1.74	3.08	4.30	2.00	1.38	2.36	4.99	7.38	1.84	2.46
06/03/96	2.20	0.79	2.69	1.77	2.33	1.31	1.74	1.02	2.95	4.20	1.80	1.05	2.13	4.76	7.51	1.71	2.26
06/07/96	2.17	0.20	2.30	0.85	0.36	0.56	0.66	0.98	2.76	4.10	1.71	1.02	1.71	4.49	7.68	1.54	2.03
06/17/96	2.36	1.05	3.22	2.56	2.69	1.28	1.90	1.08	3.15	-222.00	1.77	1.48	2.30	4.86	-111.00	1.64	1.71
06/30/96	2.95	1.31	4.04	3.54	3.22	1.51	2.36	1.41	3.51	-222.00	2.07	2.20	2.36	5.28	-111.00	1.90	1.61
07/16/96	4.95	3.15	7.28	4.56	3.74	2.30	2.99	-444.00	3.77	4.10	2.95	2.59	2.30	5.54	-111.00	2.20	3.51
07/29/96	2.56	0.72	3.05	2.53	1.74	0.62	1.64	1.21	3.38	4.43	2.36	1.51	2.23	5.61	7.48	3.77	0.62
08/06/96	2.33	0.98	2.79	2.13	2.10	0.89	1.77	1.25	2.72	3.94	1.71	1.48	1.77	4.46	6.10	3.12	0.62
08/13/96	2.46	1.21	2.46	2.30	2.82	1.57	2.13	1.44	3.12	-222.00	1.94	0.07	1.38	4.95	6.82	3.77	0.92
08/26/96	2.81	3.40	2.61	2.82	3.55	2.26	2.53	3.31	3.58	-111.00	2.19	0.19	1.49	5.32	8.39	4.20	1.21
09/09/96	2.84	3.04	2.79	2.94	3.69	1.94	2.79	1.91	3.76	-111.00	2.27	0.95	1.67	5.47	-111.00	4.91	1.43
09/23/96	2.54	2.22	3.25	2.13	2.30	1.36	2.96	1.28	3.74	-111.00	2.49	1.93	2.08	5.88	8.76	4.45	1.64
10/10/96	2.57	1.21	3.12	2.23	3.27	1.41	2.48	1.58	3.37	-111.00	2.25	2.05	1.89	5.55	-111.00	2.44	1.54
10/21/96	2.42	0.46	3.19	1.24	2.02	0.50	1.68	1.13	3.13	4.30	1.91	1.49	2.04	5.15	-111.00	2.07	0.62
10/25/96	1.74	0.19	2.56	0.84	1.12	0.49	0.96	0.48	2.22	3.18	0.90	0.33	1.30	3.34	3.13	2.01	0.49
11/04/96	2.15	0.42	2.55	1.16	1.25	0.51	1.51	0.68	2.48	3.51	1.21	0.03	1.39	3.70	3.97	1.69	2.04
11/18/96	1.93	0.13	1.80	0.57	0.31	0.43	0.63	0.27	2.31	3.24	0.88	-333.00	0.92	2.95	3.23	1.39	1.43
12/08/96	1.82	0.31	2.10	1.00	0.99	0.49	1.34	0.91	1.53	2.64	0.55	-333.00	0.70	2.33	1.56	1.50	0.45
12/22/96	1.87	0.24	2.32	0.89	1.08	0.48	1.35	0.31	1.73	2.78	0.66	-333.00	1.20	3.23	1.02	1.36	0.57
12/30/96	1.33	0.05	1.87	0.50	0.35	0.43	0.80	0.23	1.08	1.92	-333.00	-333.00	-333.00	2.59	0.84	1.67	0.18
01/13/97	1.74	0.42	2.24	1.28	0.81	0.30	1.41	0.39	1.52	2.61	0.47	-333.00	1.08	3.19	0.99	1.63	0.53
01/26/97	0.50	-333.00	1.33	0.06	0.26	0.14	-333.00	0.20	0.80	1.03	-333.00	-333.00	-333.00	1.89	0.75	1.72	0.06
02/10/97	1.06	0.30	1.68	-333.00	0.24	0.33	0.38	0.21	0.71	0.89	-333.00	-333.00	0.21	2.29	0.77	1.98	0.04
02/24/97	1.21	0.07	1.85	0.28	0.39	0.40	0.57	0.25	0.25	1.32	-333.00	-333.00	0.30	2.38	0.77	2.05	0.04
03/09/97	1.63	0.05	2.13	0.72	0.69	0.45	1.05	0.70	0.80	1.27	-333.00	-333.00	0.40	2.87	0.82	2.12	0.13
03/24/97	1.76	0.48	2.11	1.18	0.97	0.66	1.35	1.02	1.36	1.53	0.36	-333.00	1.13	3.34	1.18	2.31	0.64
04/08/97	-333.00	-333.00	0.31	-333.00	0.24	-333.00	0.21	0.15	0.27	0.51	-333.00	-333.00	-333.00	0.96	0.70	1.63	0.07
04/21/97	1.84	0.86	2.72	1.52	1.52	1.26	1.53	1.11	1.95	3.10	1.07	-333.00	1.77	4.27	2.27	2.31	0.71
05/04/97	1.78	0.52	2.61	1.03	1.08	0.82	1.43	1.05	1.32	2.21	0.32	-333.00	1.51	3.93	2.05	2.27	0.53
05/23/97	2.05	3.72	3.15	2.38	2.94	1.20	2.01	4.07	2.58	3.86	1.75	0.24	2.17	4.95	4.66	2.49	3.63
06/02/97	1.92	3.33	3.18	2.06	2.92	1.19	1.86	1.14	2.75	4.02	1.88	0.52	2.21	5.05	4.84	2.51	3.17
06/16/97	1.93	1.79	3.20	1.96	3.03	1.22	1.89	1.10	2.88	4.18	1.99	0.77	2.25	5.13	5.76	2.47	2.76
07/01/97	1.88	0.95	2.98	1.96	3.10	1.28	2.02	1.05	2.96	4.28	2.05	1.15	2.18	5.05	5.24	2.38	2.04
07/18/97	2.52	1.52	3.93	3.69	3.85	1.70	2.51	1.62	3.53	4.44	2.70	2.14	2.54	5.94	7.60	2.91	2.54
07/28/97	3.66	1.89	5.35	4.26	-111.00	2.58	2.97	2.10	3.82	-111.00	3.07	2.59	2.61	6.18	8.11	3.61	3.50
08/15/97	2.14	0.88	3.05	4.10	-111.00	2.43	3.28	1.39	3.80	-111.00	2.93	2.64	2.32	6.28	-111.00	4.13	2.91
08/25/97	2.38	1.45	4.68	4.46	-111.00	2.79	3.84	1.81	3.95	-111.00	3.12	2.89	2.55	6.46	-111.00	4.93	3.70
09/08/97	3.50	2.01	5.42	-111.00	-111.00	3.51	-111.00	2.71	4.14	-111.00	3.41	3.32	2.56	6.58	-111.00	5.61	4.31
09/30/97	3.82	2.78	4.87	-111.00	-111.00	4.07	-111.00	2.88	4.03	-111.00	3.26	-111.00	2.54	6.67	-111.00	5.72	-111.00
10/06/97	4.16	2.83	5.28	-111.00	-111.00	-111.00	-111.00	3.10	4.12	-111.00	3.38	-111.00	2.61	6.73	-111.00	-111.00	-111.00
10/19/97	3.89	2.63	4.83	-111.00	-111.00	-111.00	-111.00	2.38	4.04	-111.00	3.14	-111.00	2.54	6.60	-111.00	5.54	-111.00
11/10/97	2.29	0.06	3.18	2.68	2.71	0.45	2.38	0.84	3.27	-111.00	2.23	1.47	2.21	5.99	-111.00	2.97	0.39
11/17/97	2.17	0.41	3.13	1.71	2.67	0.44	1.79	1.12	3.06	4.35	2.00	1.66	2.12	5.72	-111.00	2.70	0.65
12/02/97	2.05	0.44	2.82	1.65	2.63	0.44	1.68	1.07	3.08	4.27	1.93	1.97	2.00	5.56	-111.00	2.61	0.55
12/20/97	2.06	0.80	3.03	1.82	1.89	0.47	2.20	1.24	2.88	4.18	1.89	2.05	2.12	5.32	8.80	2.36	1.15
12/31/97	1.87	0.35	2.60	1.32	0.97	0.42	1.59	0.65	2.50	3.59	1.35	0.71	1.79	4.49	6.76	2.26	0.45

Key: -111.00 = dry well -222.00 = "moist" = dry well -333.00 = water top of well -444.00 = missing data (or under water)

GROUNDWATER ELEVATIONS

Date	Well# 1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180
	(Ft)																	
12/01/95	204.37	-111.00	-111.00	-111.00	-444.00	199.01	199.11	-111.00	-111.00	-444.00	-111.00	197.38	197.12	-111.00	198.22	-111.00	197.62	-111.00
01/02/96	204.18	-111.00	201.85	-111.00	200.91	199.01	199.34	199.88	198.24	198.79	-111.00	198.69	197.48	198.19	199.94	-111.00	197.79	-111.00
01/14/96	204.14	201.34	202.31	-111.00	199.86	199.01	199.34	199.91	199.75	198.79	-111.00	199.15	198.33	197.89	199.83	-111.00	198.77	-111.00
01/29/96	204.11	200.75	202.28	-111.00	199.80	199.01	199.34	200.01	199.26	198.79	-111.00	199.18	198.43	198.52	199.83	-111.00	199.10	199.26
02/12/96	204.08	-444.00	201.82	-111.00	199.73	199.01	199.34	199.97	199.03	198.79	-111.00	198.99	198.40	198.03	199.33	-111.00	199.03	199.36
02/25/96	203.88	200.55	202.05	-111.00	199.86	199.01	199.34	200.34	198.76	198.79	199.43	199.41	198.79	199.47	199.94	-111.00	199.43	199.85
03/11/96	203.39	200.72	201.65	-111.00	199.76	199.01	199.34	200.27	198.24	198.79	199.40	199.45	198.92	199.34	199.79	-111.00	199.36	199.72
03/23/96	203.39	200.68	201.78	-111.00	199.80	199.01	199.34	200.47	198.96	198.79	199.50	199.54	199.19	199.70	199.94	-111.00	199.53	199.95
04/17/96	203.36	200.75	201.46	200.10	199.73	199.01	199.34	200.80	199.71	198.79	199.86	199.71	200.10	200.09	199.94	-111.00	199.85	199.92
04/21/96	203.36	201.18	201.62	-444.00	199.76	199.01	199.34	200.50	200.66	198.79	199.69	199.71	200.17	200.39	199.94	-111.00	199.92	200.15
05/07/96	202.53	201.64	201.16	200.56	200.72	199.01	199.34	200.37	200.47	198.79	199.79	199.71	200.21	200.26	199.94	-111.00	199.89	200.25
05/19/96	202.63	201.83	200.87	200.56	199.40	199.01	199.31	200.17	199.35	198.79	199.50	199.71	200.21	200.29	199.63	-111.00	199.62	200.48
05/31/96	202.08	202.69	-111.00	200.20	199.14	198.93	198.59	199.58	198.53	198.79	-111.00	199.18	199.91	200.03	199.33	-111.00	199.26	200.28
06/03/96	202.11	202.29	-111.00	200.66	199.37	199.01	199.34	199.84	198.40	198.79	-111.00	199.61	200.17	200.26	199.73	-111.00	199.36	200.28
06/07/96	202.14	202.88	-111.00	201.08	199.70	199.01	199.34	199.75	199.42	198.79	199.40	199.71	200.21	200.39	199.94	-111.00	199.59	200.21
06/17/96	202.34	201.80	200.90	200.56	199.21	199.01	198.88	199.65	198.44	198.79	-111.00	199.35	200.21	200.13	199.24	-111.00	199.36	200.15
06/30/96	202.24	202.59	-111.00	199.94	198.81	197.75	198.10	-111.00	197.78	197.03	-111.00	199.38	200.10	199.57	198.91	-111.00	198.84	200.12
07/16/96	200.89	200.72	-111.00	-111.00	198.16	196.87	197.24	-111.00	197.02	196.41	-111.00	198.10	198.79	198.98	198.94	-111.00	198.15	199.53
07/29/96	201.06	200.78	-111.00	200.26	199.76	199.01	199.34	-111.00	198.96	198.79	-111.00	199.12	199.68	200.16	199.69	-111.00	198.77	199.13
08/06/96	202.17	200.78	-111.00	201.28	199.70	199.01	199.34	199.81	198.99	198.79	199.63	199.71	200.21	200.52	199.94	-111.00	199.43	199.85
08/13/96	202.14	200.62	-111.00	200.76	199.21	199.01	198.79	-111.00	197.88	198.79	-111.00	199.38	200.17	200.16	199.66	-111.00	199.03	200.08
08/26/96	200.31	-111.00	-111.00	200.30	198.01	197.55	197.63	-111.00	-111.00	197.10	-111.00	198.71	199.95	200.00	199.08	-111.00	198.53	199.97
09/09/96	200.77	-111.00	-111.00	200.12	198.42	197.42	197.79	-111.00	-111.00	197.00	-111.00	198.44	199.40	199.85	199.09	-111.00	198.25	199.60
09/23/96	200.80	-111.00	-111.00	200.42	198.59	199.01	199.19	-111.00	198.80	198.79	198.69	199.03	199.80	200.06	199.38	-111.00	198.55	199.03
10/10/96	201.13	-111.00	-111.00	200.95	199.52	199.01	199.02	-111.00	197.36	198.79	199.21	199.39	200.20	200.45	199.77	-111.00	198.91	199.22
10/21/96	200.41	-111.00	-111.00	201.64	200.17	199.01	199.34	199.55	199.23	198.79	199.44	199.71	200.21	201.37	199.94	-111.00	199.43	199.58
10/25/96	201.80	201.77	201.50	202.40	200.63	199.01	199.34	200.54	200.65	198.79	200.33	199.71	200.21	201.37	199.94	-111.00	200.13	200.06
11/04/96	202.16	201.08	202.82	202.30	200.25	199.01	199.34	200.44	199.76	198.79	200.24	199.71	200.21	201.37	199.94	200.17	200.06	200.73
11/18/96	202.09	200.99	203.87	202.52	200.87	199.01	199.34	200.72	200.66	198.79	200.34	199.71	200.21	201.37	199.94	200.30	200.21	201.54
12/08/96	203.05	201.78	203.15	202.54	-444.00	199.01	199.34	203.85	200.66	198.79	200.75	199.71	200.21	201.37	199.94	201.57	200.21	201.99
12/22/96	202.50	201.30	202.48	202.47	-444.00	199.01	199.34	202.88	200.66	196.85	200.61	199.71	200.21	201.37	199.94	201.14	200.21	202.74
12/30/96	202.78	202.31	203.42	202.77	-444.00	199.01	199.34	204.86	200.66	198.79	201.21	199.71	200.21	201.37	199.94	202.03	200.21	204.85
01/13/97	202.52	201.58	202.17	202.40	-444.00	199.01	199.34	203.64	200.38	198.79	200.64	199.71	200.21	201.37	199.94	201.32	200.21	203.71
01/26/97	202.65	203.93	203.80	202.80	201.39	199.01	199.34	204.72	200.66	198.79	201.81	199.71	200.21	201.37	199.94	202.12	200.21	204.91
02/10/97	203.26	204.18	203.58	202.82	201.22	199.01	199.34	205.04	200.66	198.79	201.48	199.71	200.21	-444.00	199.94	202.64	200.21	204.93
02/24/97	203.49	204.19	203.59	202.79	201.14	199.01	199.34	205.03	200.66	198.79	201.59	199.71	200.21	201.37	199.94	202.77	200.21	204.63
03/09/97	203.15	204.19	203.07	202.71	200.93	199.01	199.34	204.46	200.66	198.79	201.31	199.71	200.21	201.37	199.54	202.19	200.21	204.35
03/24/97	202.91	203.82	202.32	202.57	200.50	199.01	199.34	203.41	200.53	198.79	200.96	199.71	200.21	201.37	199.48	201.50	200.21	203.63
04/08/97	203.97	204.19	204.12	202.97	201.39	199.01	199.34	205.25	200.66	201.34	202.67	199.71	200.21	201.37	199.78	203.58	200.21	204.88
04/21/97	202.35	203.84	201.80	202.17	200.14	199.01	199.34	201.96	200.36	198.79	200.51	199.71	200.21	201.34	198.33	200.80	200.21	202.60
05/04/97	202.52	203.80	202.10	202.48	200.34	199.01	199.34	203.14	200.66	198.79	200.87	199.71	200.21	201.37	198.67	201.32	200.21	202.43
05/23/97	201.76	203.60	201.05	201.34	199.65	198.84	198.78	200.44	199.52	198.79	199.91	199.71	200.21	201.04	197.94	200.23	199.69	201.99
06/02/97	201.85	203.09	201.20	201.54	199.89	199.01	199.34	200.53	199.47	198.79	200.02	199.71	200.21	200.99	198.17	-111.00	199.80	201.86
06/16/97	201.90	202.50	201.39	201.62	200.17	199.01	199.34	200.44	199.42	198.79	200.06	199.71	200.21	201.15	198.46	-111.00	199.87	201.52
07/01/97	202.02	203.21	201.44	201.56	200.09	199.01	199.34	200.20	199.00	198.79	199.95	199.71	200.21	201.03	198.42	-111.00	199.73	201.44
07/18/97	202.01	201.62	-111.00	200.45	199.12	198.10	197.84	-111.00	197.87	197.84	198.98	199.14	199.89	199.96	197.44	-111.00	198.80	200.98
07/28/97	201.92	200.78	-111.00	-111.00	198.80	197.56	197.13	-111.00	197.28	196.78	-111.00	198.50	199.23	199.60	194.31	-111.00	198.31	200.64
08/15/97	201.65	200.74	-111.00	-111.00	199.00	199.01	199.34	-111.00	197.06	198.79	-111.00	199.18	199.89	200.57	194.96	-111.00	198.87	199.78
08/25/97	201.60	-111.00	-111.00	-111.00	198.88	198.68	197.99	-111.00	-111.00	197.47	-111.00	198.79	199.29	199.65	197.44	-111.00	198.45	199.34
09/08/97	201.33	-111.00	-111.00	-111.00	198.48	197.49	196.89	-111.00	-111.00	196.10	-111.00	198.07	198.71	199.08	197.35	-111.00	197.89	198.76
09/30/97	200.89	-111.00	-111.00	-111.00	197.89	196.99	197.04	-111.00	-111.00	195.82	-111.00	197.85	198.64	199.18	197.35	-111.00	197.74	-111.00
10/06/97	200.81	-111.00	-111.00	-111.00	197.76	196.80	196.80	-111.00	-111.00	195.77	-111.00	197.67	198.46	198.97	197.27	-111.00	197.62	-111.00
10/19/97	200.71	-111.00	-111.00	-111.00	197.67	197.06	197.66	-111.00	-111.00	195.80	-111.00	197.98	198.85	199.39	197.49	-111.00	197.87	-111.00
11/10/97	200.72	-111.00	-111.00	201.37	200.52	199.01	199.34	199.66	200.66	198.79	199.49	-444.00	200.21	201.37	198.81	-111.00	199.38	198.64
11/17/97	201.13	201.93	203.42	201.64	200.65	199.01	199.34	199.99	200.66	198.79	200.00	199.71	200.21	201.30	198.85	-111.00	199.68	199.42
12/02/07	201.32	202.75	203.50	201.72	200.72	199.01	199.34	200.22	200.66	198.79	200.25	199.71	200.21	201.34	198.80	-111.00	199.99	200.47
12/20/97	201.52	202.80	202.72	201.67	200.63	199.01	199.34	200.38	200.27	198.79	200.31	199.71	200.21	201.37	198.83	-111.00	200.06	200.62
12/31/97	201.90	203.96	203.53	202.19	200.86	199.01	199.34	201.52	200.66	198.79	200.53	199.71	200.21	201.37	198.98	200.33	200.21	201.81

Key: -111.00 = dry well -444.00 = missing data

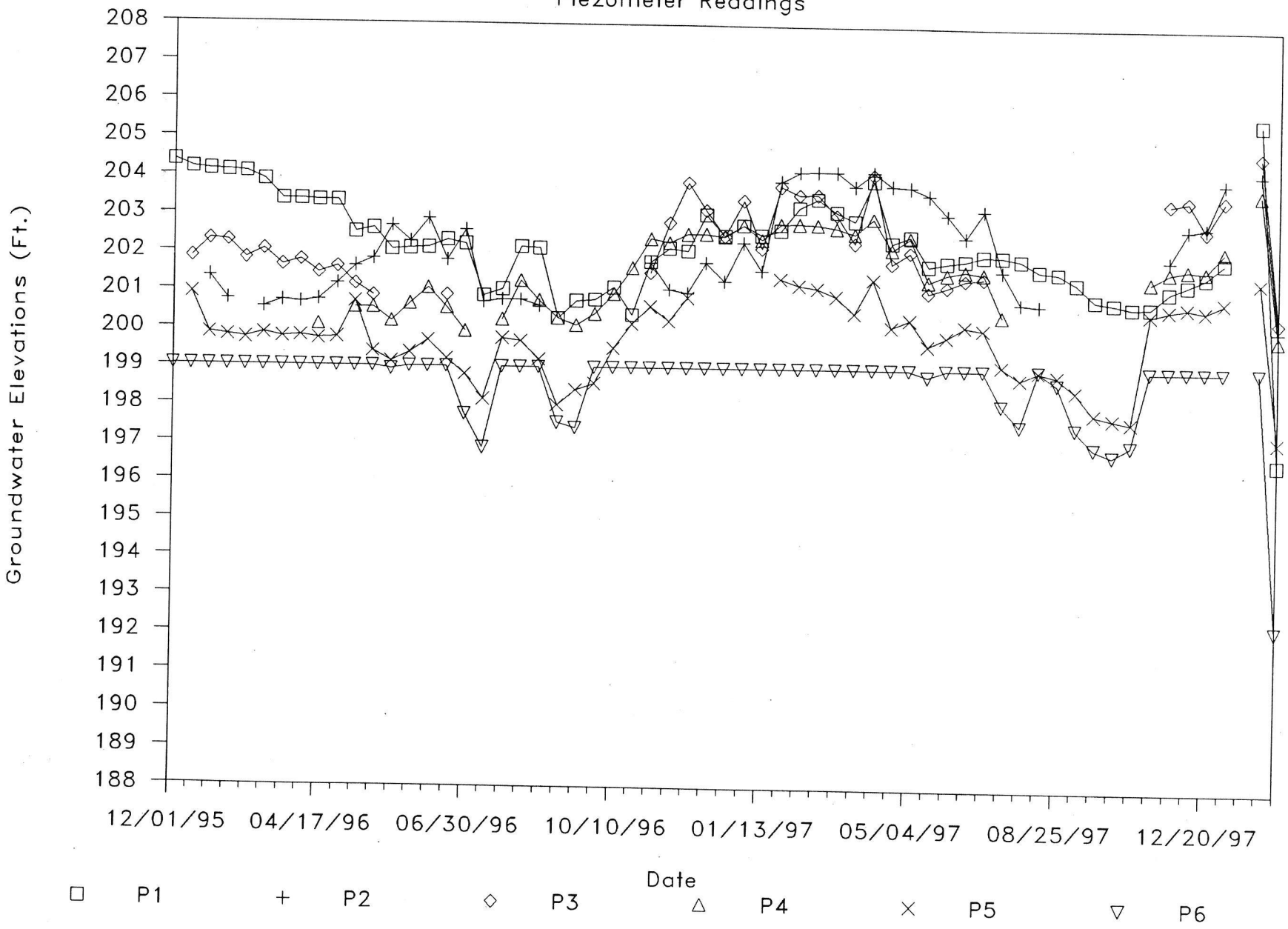
GROUNDWATER ELEVATIONS (cont.)

Date	Well# 1190	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350
									(Ft)								
12/01/95	-444.00	-111.00	-444.00	-111.00	-111.00	197.58	197.43	199.97	199.08	198.49	198.28	195.96	198.29	197.05	-111.00	198.74	199.76
01/02/96	-444.00	199.38	-444.00	199.32	201.05	198.50	200.48	200.10	199.21	199.14	198.31	198.43	198.88	199.05	199.72	199.39	199.66
01/14/96	-444.00	199.34	-444.00	198.92	200.39	199.64	199.30	200.26	199.47	199.01	198.77	198.16	198.23	198.20	198.90	199.39	199.63
01/29/96	-444.00	199.34	-444.00	198.82	199.87	199.71	199.16	200.43	199.44	199.08	198.77	198.16	198.19	198.23	199.49	199.39	199.66
02/12/96	-444.00	198.95	-444.00	198.53	200.30	199.71	199.30	200.39	199.40	198.95	198.74	197.80	198.09	197.90	197.52	199.39	199.76
02/25/96	-444.00	199.18	-444.00	198.86	199.67	199.74	199.95	200.36	199.86	199.34	198.94	198.43	198.42	198.99	200.11	199.39	199.66
03/11/96	-444.00	199.57	-444.00	198.86	199.64	199.78	199.85	200.36	199.70	199.31	199.13	198.29	198.42	199.02	199.95	199.39	199.69
03/23/96	198.47	199.54	197.91	198.92	199.51	199.74	199.85	200.36	199.77	199.47	199.10	198.39	198.49	199.35	200.21	199.39	199.66
04/17/96	198.63	199.41	197.91	198.82	199.41	199.71	199.85	200.36	200.09	199.77	199.13	198.43	198.46	199.02	200.57	199.39	199.73
04/21/96	198.63	197.67	197.91	199.73	199.47	199.99	201.11	200.92	200.16	199.80	199.30	198.43	199.47	199.77	201.59	199.39	199.73
05/07/96	198.63	199.72	197.91	199.73	199.54	199.99	201.04	200.92	200.03	199.67	199.63	198.43	199.83	200.04	201.26	199.39	198.35
05/19/96	198.63	198.95	197.91	198.23	199.18	198.99	199.82	200.92	199.60	199.18	199.49	198.26	198.06	198.23	199.55	199.39	198.71
05/31/96	198.63	198.36	197.91	197.41	199.15	198.76	199.43	199.67	199.31	198.78	198.61	197.63	197.90	197.90	197.26	199.39	198.12
06/03/96	198.63	199.21	197.91	198.40	199.54	198.99	199.82	200.39	199.44	198.88	198.81	197.96	198.13	198.13	197.13	199.39	198.32
06/07/96	198.63	199.72	197.91	199.32	201.51	199.74	200.90	200.43	199.63	198.98	198.90	197.99	198.55	198.40	196.96	199.39	198.55
06/17/96	198.63	198.95	197.91	197.61	199.18	199.02	199.66	200.33	199.24	-111.00	198.84	197.53	197.96	198.03	-111.00	199.39	198.87
06/30/96	198.60	198.69	197.47	196.63	198.65	198.79	199.20	200.00	198.88	-111.00	198.54	196.81	197.90	197.61	-111.00	199.39	198.97
07/16/96	196.60	196.85	194.23	195.61	198.13	198.00	198.57	-444.00	198.62	198.98	197.66	196.42	197.96	197.35	-111.00	199.39	197.07
07/29/96	198.63	199.28	197.91	197.64	200.13	199.68	199.92	200.20	199.01	198.65	198.25	197.50	198.03	197.28	197.16	198.97	199.96
08/06/96	198.63	199.02	197.91	198.04	199.77	199.41	199.79	200.16	199.67	199.14	198.90	197.53	198.49	198.43	198.54	199.39	199.96
08/13/96	198.63	198.79	197.91	197.87	199.05	198.73	199.43	199.97	199.27	-111.00	198.67	198.43	198.88	197.94	197.82	198.97	199.66
08/26/96	198.63	196.60	197.91	197.35	198.32	198.04	199.03	198.10	198.81	-111.00	198.42	198.43	198.77	197.57	196.25	198.54	199.37
09/09/96	198.63	196.96	197.91	197.23	198.18	198.36	198.77	199.50	198.63	-111.00	198.34	198.06	198.59	197.42	-111.00	197.83	199.15
09/23/96	198.63	197.78	197.91	198.04	199.57	198.94	198.60	200.13	198.65	-111.00	198.12	197.08	198.18	197.01	195.88	198.29	198.94
10/10/96	198.63	198.79	197.91	197.94	198.60	198.89	199.08	199.83	199.02	-111.00	198.36	196.96	198.37	197.34	-111.00	199.39	199.04
10/21/96	198.63	199.54	197.91	198.93	199.85	199.80	199.88	200.28	199.26	198.78	198.70	197.52	198.22	197.74	-111.00	199.39	199.96
10/25/96	198.63	199.72	197.91	199.33	200.75	199.81	200.60	200.92	200.17	199.90	199.71	198.43	198.96	199.55	201.51	199.39	200.09
11/04/96	198.63	199.58	197.91	199.01	200.62	199.79	200.05	200.73	199.91	199.57	199.40	198.43	198.87	199.19	200.67	199.39	198.54
11/18/96	198.63	199.72	197.91	199.60	201.54	199.87	200.93	200.92	200.08	199.84	199.73	198.43	199.34	199.94	201.41	199.39	199.15
12/08/96	198.63	199.69	197.91	199.17	200.88	199.81	200.22	200.50	200.86	200.44	200.06	198.43	199.56	200.56	203.08	199.39	200.13
12/22/96	198.63	199.72	197.91	199.28	200.79	199.82	200.21	200.92	200.66	200.30	199.95	198.43	199.06	199.66	203.62	199.39	200.01
12/30/96	198.63	199.72	197.91	199.67	201.52	199.87	200.76	200.92	201.31	201.16	200.24	198.43	199.92	200.30	203.80	199.39	200.26
01/13/97	198.63	199.58	197.91	198.89	201.06	199.99	200.15	200.92	200.87	200.47	200.14	198.43	199.18	199.70	203.65	199.39	200.05
01/26/97	198.63	199.72	197.91	199.73	201.54	199.99	201.11	200.92	201.59	202.05	200.24	198.43	199.92	201.00	203.82	199.39	200.26
02/10/97	198.63	199.70	197.91	199.73	201.54	199.97	201.11	200.92	201.68	202.19	200.24	198.43	199.92	200.60	203.82	199.39	200.26
02/24/97	198.63	199.72	197.91	199.73	201.48	199.90	200.99	200.92	202.01	201.76	200.24	198.43	199.92	200.51	203.82	199.39	200.26
03/09/97	198.63	199.72	197.91	199.45	201.18	199.85	200.51	200.71	201.59	201.81	200.24	198.43	199.86	200.02	203.82	199.39	200.26
03/24/97	198.63	199.52	197.91	198.99	200.90	199.64	200.21	200.39	201.03	201.55	200.24	198.43	199.13	199.55	203.46	199.39	199.94
04/08/97	198.63	199.72	197.91	199.73	201.54	199.99	201.11	200.92	202.01	202.40	200.24	198.43	199.92	201.93	203.82	199.39	200.26
04/21/97	198.63	199.14	197.91	198.65	200.35	199.04	200.03	200.30	200.44	199.98	199.54	198.43	198.49	198.62	202.37	199.39	199.87
05/04/97	198.63	199.48	197.91	199.14	200.79	199.48	200.13	200.36	201.07	200.87	200.24	198.43	198.75	198.96	202.59	199.39	200.05
05/23/97	198.63	196.28	197.91	197.79	198.93	199.10	199.55	197.34	199.81	199.22	198.86	198.43	198.09	197.94	199.98	199.39	196.95
06/02/97	198.63	196.67	197.91	198.11	198.95	199.11	199.70	200.27	199.64	199.06	198.73	198.43	198.05	197.84	199.80	199.39	197.41
06/16/97	198.63	198.21	197.91	198.21	198.84	199.08	199.67	200.31	199.51	198.90	198.62	198.24	198.01	197.76	198.88	199.39	197.82
07/01/97	198.63	199.05	197.91	198.21	198.77	199.02	199.54	200.36	199.43	198.80	198.56	197.86	198.08	197.84	199.40	199.39	198.54
07/18/97	198.63	198.48	197.58	196.48	198.02	198.60	199.05	199.79	198.86	198.64	197.91	196.87	197.72	196.95	197.04	199.39	198.04
07/28/97	197.89	198.11	196.16	195.91	-111.00	197.72	198.59	199.31	198.57	-111.00	197.54	196.42	197.65	196.71	196.53	199.13	197.08
08/15/97	198.63	199.12	197.91	196.07	-111.00	197.87	198.28	200.02	198.59	-111.00	197.68	196.37	197.94	196.61	-111.00	198.61	197.67
08/25/97	198.63	198.55	196.83	195.71	-111.00	197.51	197.72	199.60	198.44	-111.00	197.49	196.12	197.71	196.43	-111.00	197.81	196.88
09/08/97	198.05	197.99	196.09	-111.00	-111.00	196.79	-111.00	198.70	198.25	-111.00	197.20	195.69	197.70	196.31	-111.00	197.13	196.27
09/30/97	197.73	197.22	196.64	-111.00	-111.00	196.23	-111.00	198.53	198.36	-111.00	197.35	-111.00	197.72	196.22	-111.00	197.02	-111.00
10/06/97	197.39	197.17	196.23	-111.00	-111.00	-111.00	-111.00	198.31	198.27	-111.00	197.23	-111.00	197.65	196.16	-111.00	-111.00	-111.00
10/19/97	197.66	197.37	196.68	-111.00	-111.00	-111.00	-111.00	199.03	198.35	-111.00	197.47	-111.00	197.72	196.29	-111.00	197.20	-111.00
11/10/97	198.63	199.72	197.91	197.49	199.16	199.85	199.18	200.57	199.12	-111.00	198.38	197.54	198.05	196.90	-111.00	199.39	200.19
11/17/97	198.63	199.59	197.91	198.46	199.20	199.86	199.77	200.29	199.33	198.73	198.61	197.35	198.14	197.17	-111.00	199.39	199.93
12/02/07	198.63	199.56	197.91	198.52	199.24	199.86	199.88	200.34	199.31	198.81	198.68	197.04	198.26	197.33	-111.00	199.39	200.03
12/20/97	198.63	199.20	197.91	198.35	199.98	199.83	199.36	200.17	199.51	198.90	198.72	196.96	198.14	197.57	195.84	199.39	199.43
12/31/97	198.63	199.65	197.91	198.85	200.90	199.88	199.97	200.76	199.89	199.49	199.26	198.30	198.47	198.40	197.88	199.39	200.13

Key: -111.00 = dry well -444.00 = missing data

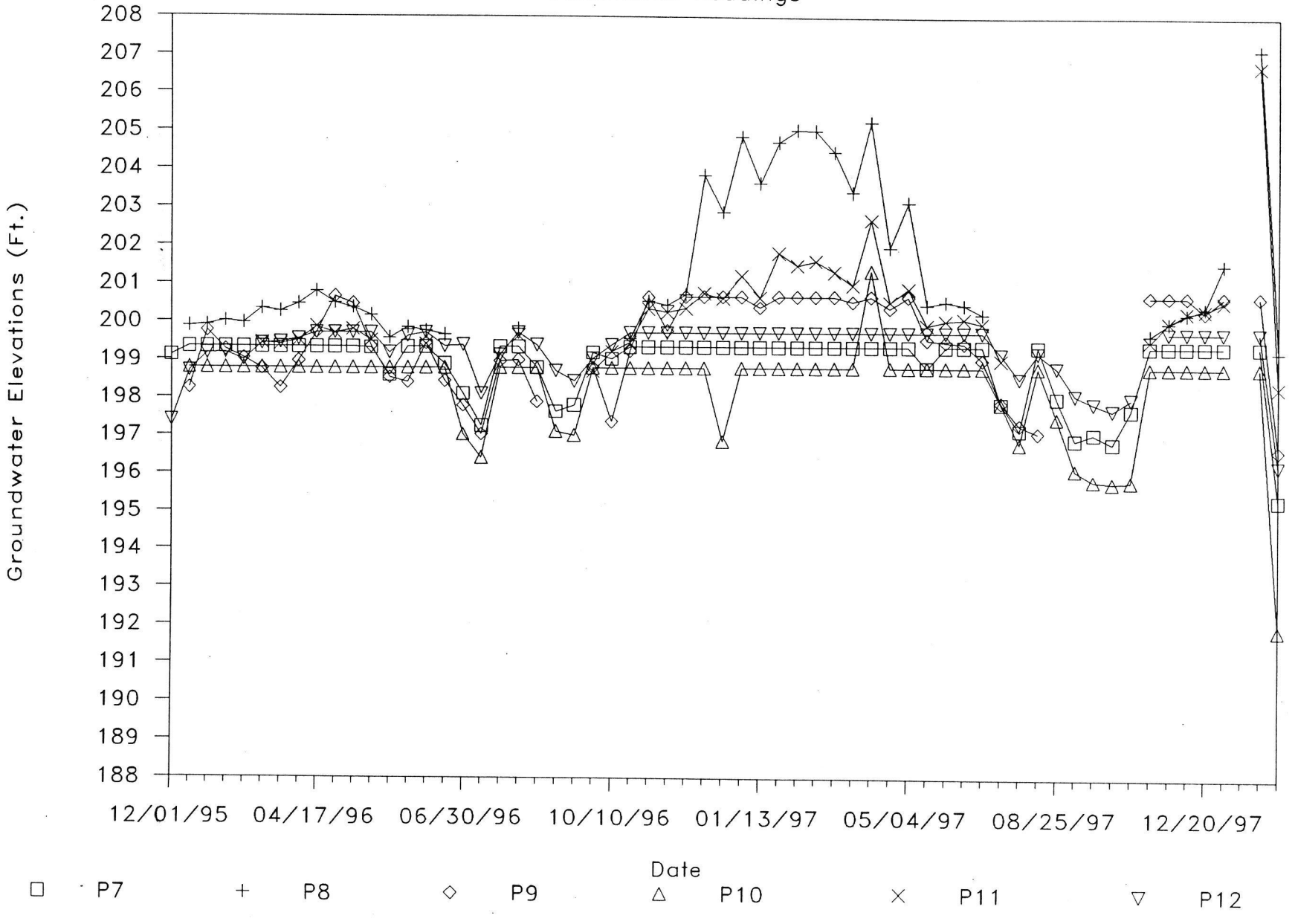
Nevins Creek Mitigation Area

Piezometer Readings



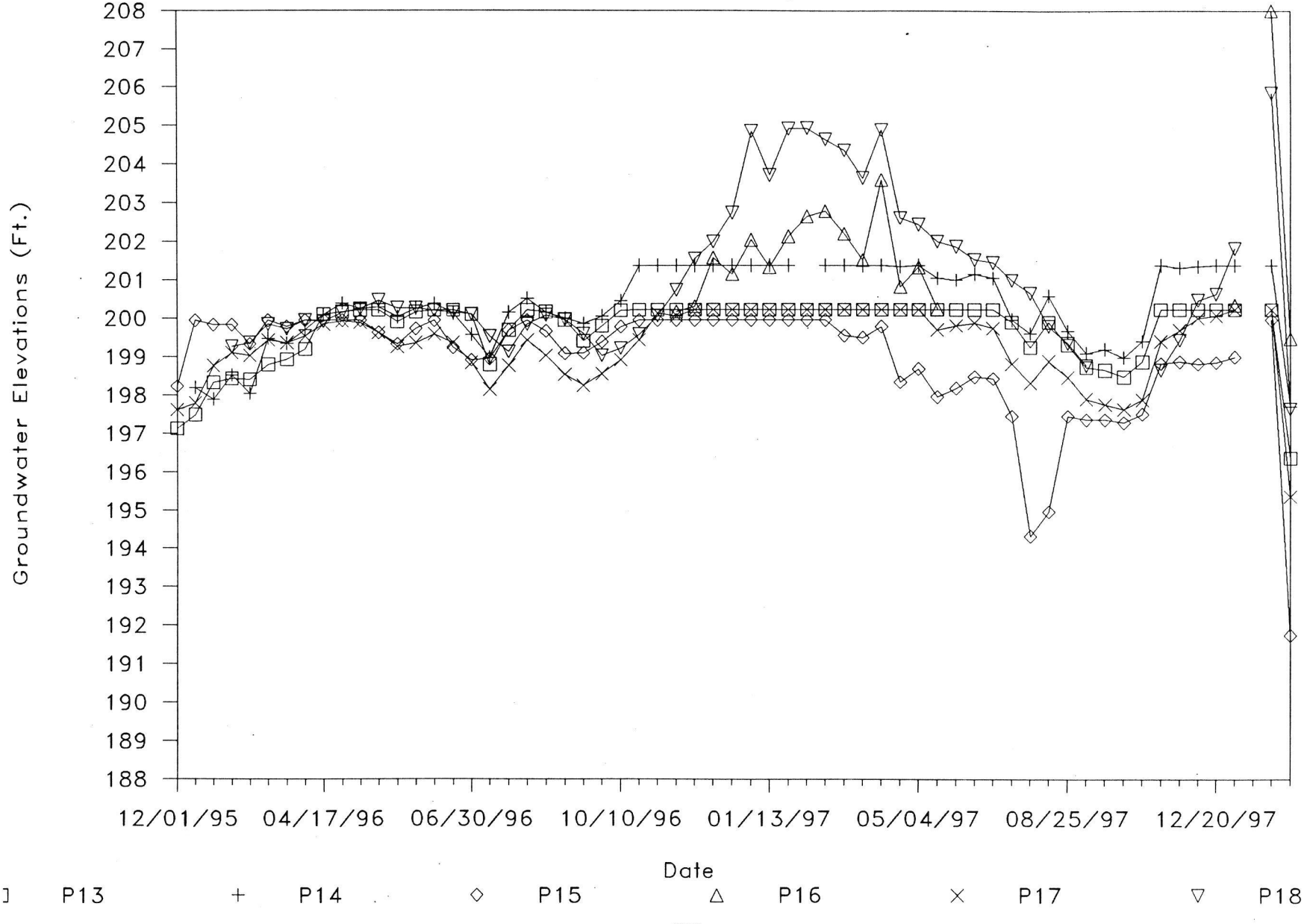
Nevins Creek Mitigation Area

Piezometer Readings



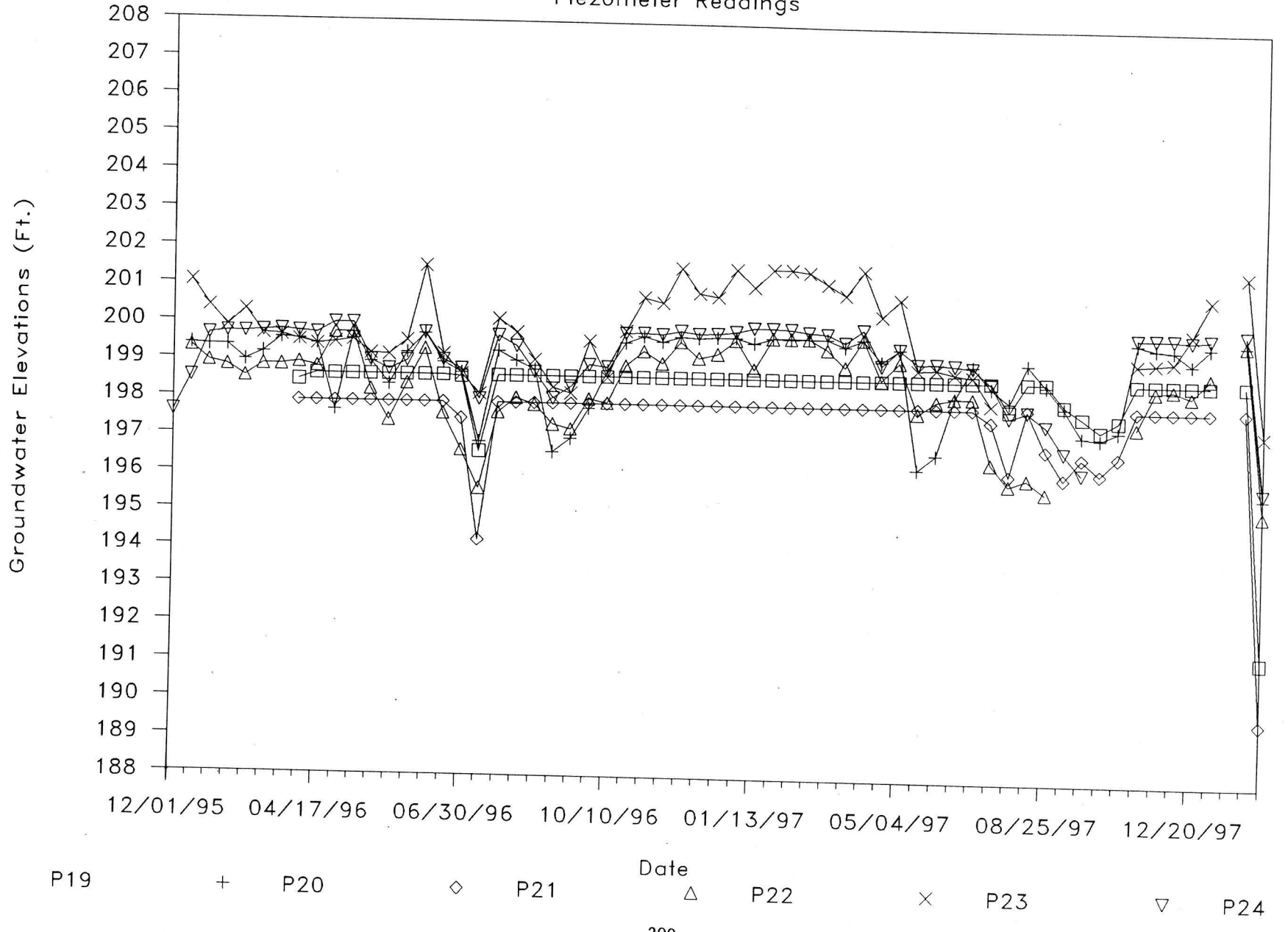
Nevins Creek Mitigation Area

Piezometer Readings

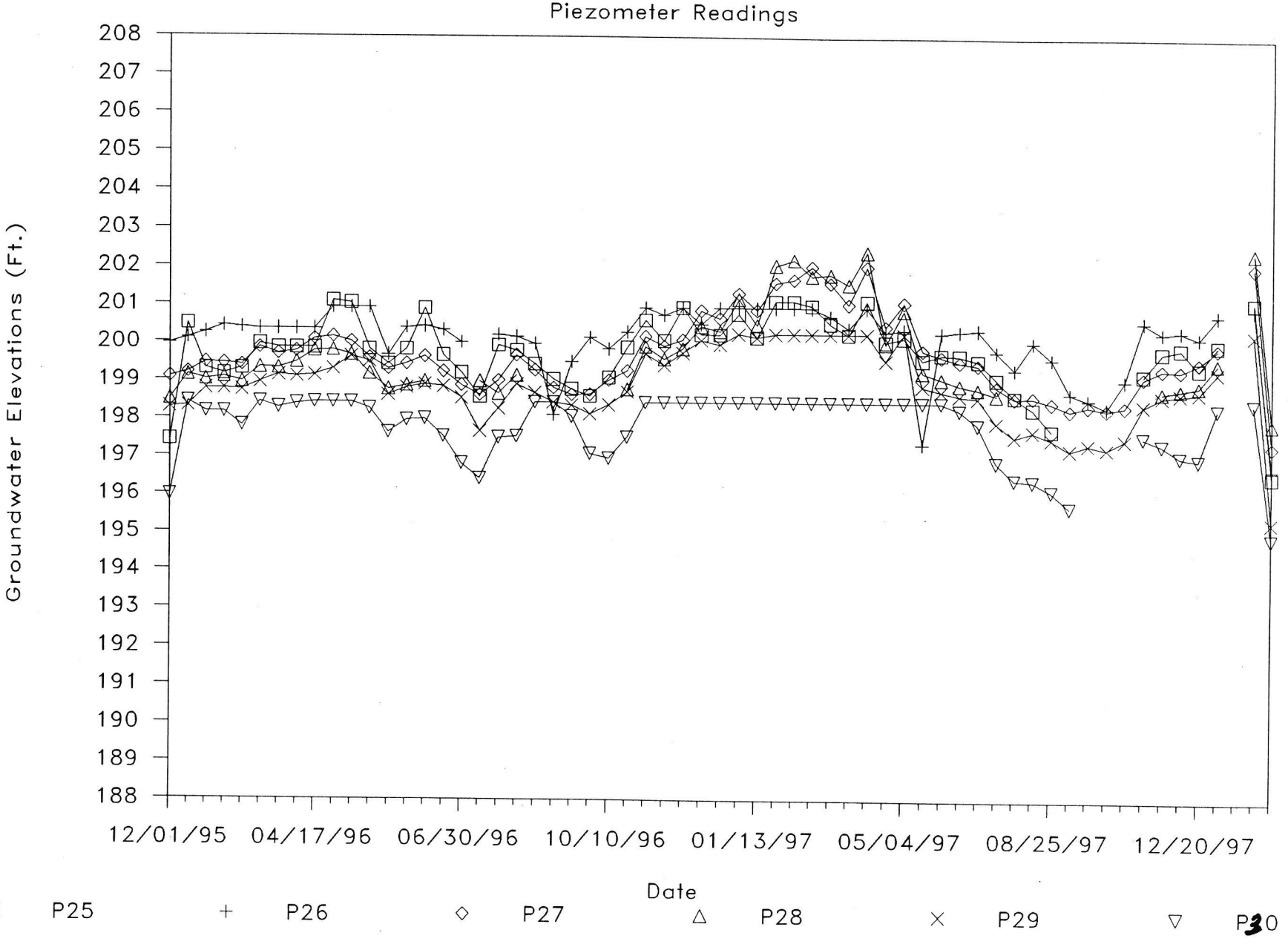


Nevins Creek Mitigation Area

Piezometer Readings

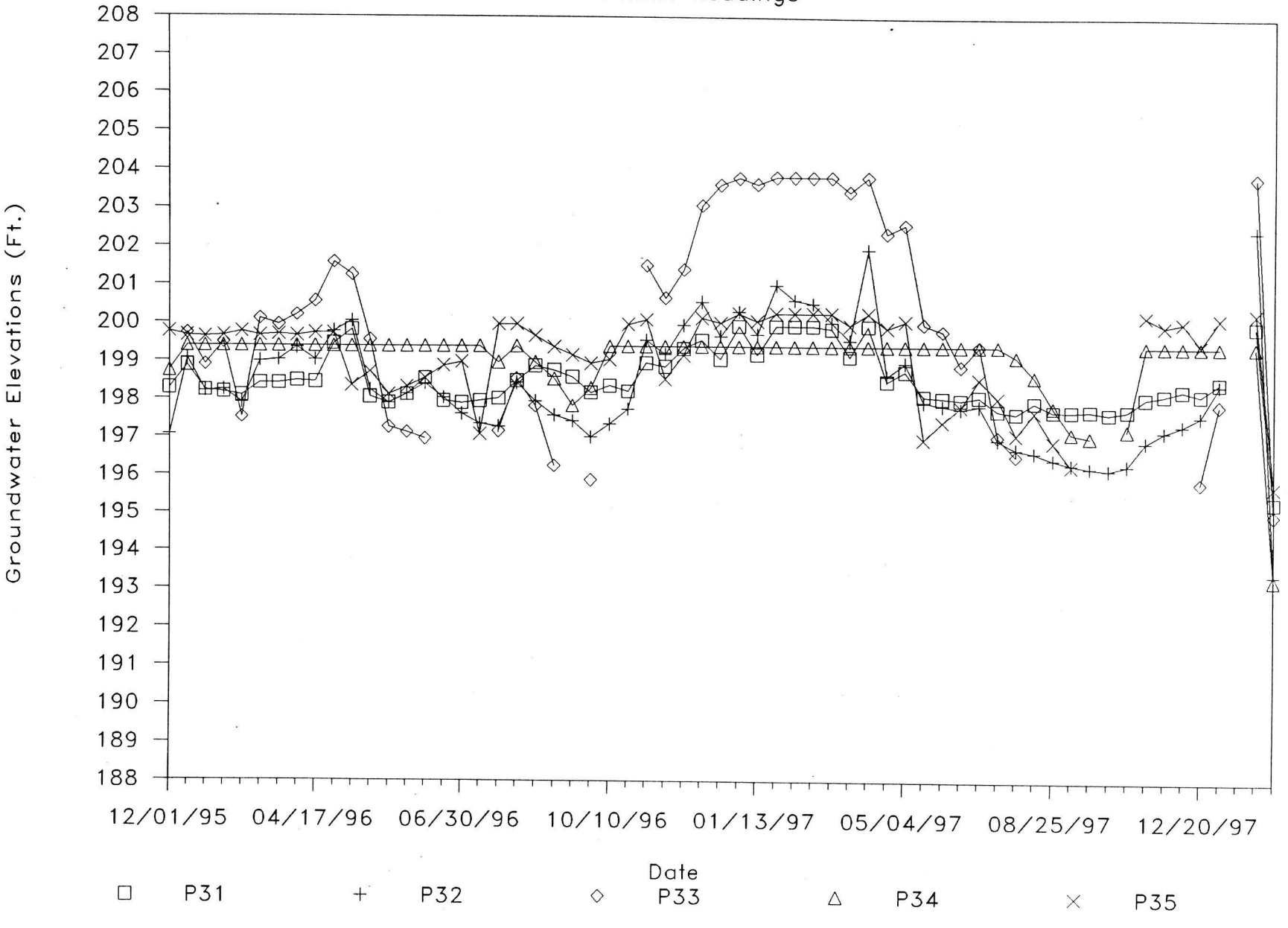


Nevins Creek Mitigation Area



Nevins Creek Mitigation Area

Piezometer Readings



Nevins Creek Mitigation Area
(Piezometer Notes)

(Ft.)	*(cm)	(C)WL#	(Map WL#)
8.92	272	1010	P1
4.07	124	1020	P2
4.04	123	1030	P3
3.81	116	1040	P4
4.20	128	1050	P5
6.76	206	1060	P6
4.04	123	1070	P7
7.94	242	1080	P8
4.04	123	1090	P9
6.89	210	1100	P10
8.43	257	1110	P11
3.51	107	1120	P12
3.87	118	1130	P13
3.67	112	1140	P14
8.20	250	1150	P15
9.42	287	1160	P16
4.86	148	1170	P17
8.20	250	1180	P18
7.32	223	1190	P19
4.07	124	1200	P20
8.24	251	1210	P21
4.53	138	1220	P22
4.23	129	1230	P23
4.20	128	1240	P24
4.59	140	1250	P25
4.20	128	1260	P26
4.69	143	1270	P27
4.49	137	1280	P28
4.92	150	1290	P29
3.54	108	1300	P30
4.59	140	1310	P31
9.02	275	1320	P32
8.83	269	1330	P33
6.10	186	1340	P34
4.53	138	1350	P35

*Well depth measurements(05/13/97)/dw exceptions>WL#1340
(08/06/96)/hl. Readings were taken after modifications
below occured.

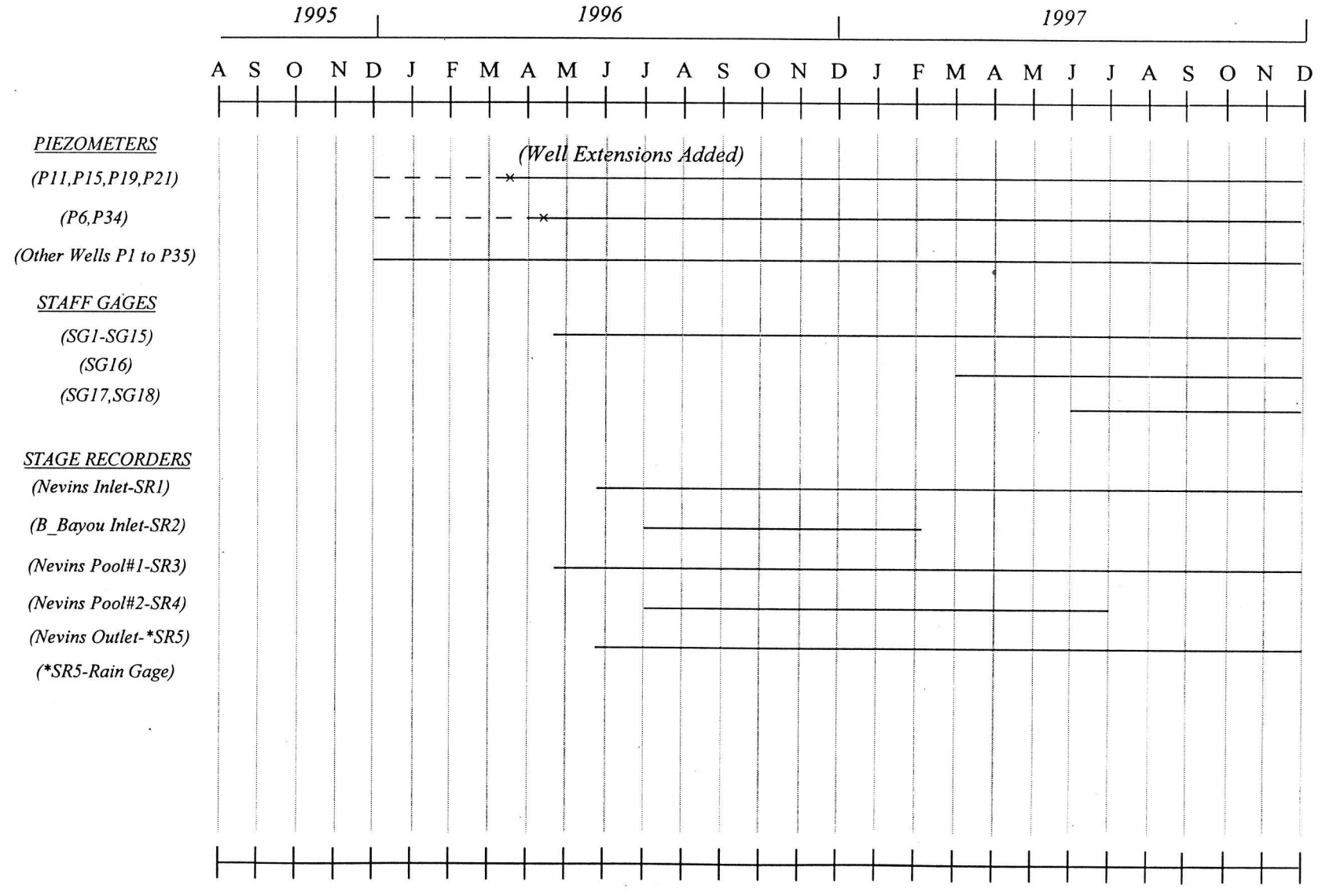
Other Notes:
Well extensions were added after 03/13/1996 to the following wells:
1100,1190,1210
Well extensions were added after 04/17/1996 to the following wells:
1060,1340
Gravel (approx. 2") was added on 10/16/96 to the following wells:
1070,1110,1130,1180,1260,1290

APPENDIX G

Surface Water Monitoring Data

Nevins Creek Mitigation Area

Groundwater & Surfacewater Monitoring



NEVINS CREEK MITIGATION AREA

Staff Gage Readings

Staff Gage#	Date	Time	Stage (Ft.)
1	4 13 1996	1354	1.71
2	4 13 1996	1357	1.52
3	4 13 1996	1408	1.50
4	4 13 1996	1404	0.44
5	4 13 1996	1403	3.27
6	4 13 1996	1401	0.04
7	4 13 1996	1400	1.30
8	4 13 1996	1352	1.21
9	4 13 1996	1348	2.48
10	4 13 1996	1349	1.05
11	4 13 1996	dry	dry
12	4 13 1996	1345	2.62
13	4 13 1996	1347	4.41
14	4 13 1996	1440	2.05
15	4 13 1996	1351	3.47
1	4 15 1996	1606	1.58
2	4 15 1996	1604	1.27
3	4 15 1996	1544	1.20
4	4 15 1996	1548	0.50
5	4 15 1996	1549	3.50
6	4 15 1996	dry	dry
7	4 15 1996	1554	1.02
8	4 15 1996	1602	0.98
9	4 15 1996	1557	2.10
10	4 15 1996	1559	0.68
11	4 15 1996	dry	dry
12	4 15 1996	1609	2.09
13	4 15 1996	1615	3.83
14	4 15 1996	1616	1.52
15	4 15 1996	1619	3.30
1	4 21 1996	1320	1.82
2	4 21 1996	1315	1.76
3	4 21 1996	1312	1.77
4	4 21 1996	1339	0.25
5	4 21 1996	1337	3.24
6	4 21 1996	1435	0.36
7	4 21 1996	1332	1.56
8	4 21 1996	1326	1.51
9	4 21 1996	1344	2.82
10	4 21 1996	1342	1.40
11	4 21 1996	1353	dry
12	4 21 1996	1409	3.00
13	4 21 1996	1350	4.82
14	4 21 1996	1418	2.52
15	4 21 1996	1421	4.00
1	4 25 1996	1444	1.46
2	4 25 1996	1538	1.17
3	4 25 1996	1543	0.97
4	4 25 1996	1532	0.13
5	4 25 1996	1531	2.94
6	4 25 1996	1525	dry
7	4 25 1996	1524	0.81
8	4 25 1996	1518	0.86
9	4 25 1996	1515	1.90
10	4 25 1996	1514	0.52
11	4 25 1996	1505	dry
12	4 25 1996	1454	1.68
13	4 25 1996	1456	3.35
14	4 25 1996	1500	0.79
15	4 25 1996	1502	2.04

Staff Gage#	Date	Time	Stage (Ft.)
1	5 1 1996	1004	1.54
2	5 1 1996	1005	1.19
3	5 1 1996	1011	0.95
4	5 1 1996	1016	0.22
5	5 1 1996	1017	3.16
6	5 1 1996	1019	dry
7	5 1 1996	1027	0.80
8	5 1 1996	1026	0.85
9	5 1 1996	1032	1.89
10	5 1 1996	1030	0.53
11	5 1 1996	1054	dry
12	5 1 1996	1038	1.66
13	5 1 1996	1041	3.33
14	5 1 1996	1051	0.91
15	5 1 1996	1047	2.86
1	5 7 1996	1450	1.77
2	5 7 1996	1447	1.90
3	5 7 1996	1442	1.63
4	5 7 1996	1510	0.32
5	5 7 1996	1508	3.33
6	5 7 1996	1506	0.28
7	5 7 1996	1505	1.56
8	5 7 1996	1500	1.66
9	5 7 1996	1515	2.91
10	5 7 1996	1513	1.50
11	5 7 1996	1518	dry
12	5 7 1996	1526	3.08
13	5 7 1996	1529	4.85
14	5 7 1996	1531	2.56
15	5 7 1996	1535	4.10
1	5 19 1996	1051	1.39
2	5 19 1996	1054	1.05
3	5 19 1996	1057	0.65
4	5 19 1996	1111	-0.07
5	5 19 1996	1112	2.60
6	5 19 1996	1108	dry
7	5 19 1996	1107	0.45
8	5 19 1996	1102	0.59
9	5 19 1996	1117	1.68
10	5 19 1996	1115	0.32
11	5 19 1996	1119	dry
12	5 19 1996	1122	1.22
13	5 19 1996	1138	2.92
14	5 19 1996	1131	0.33
15	5 19 1996	1134	2.20
1	5 31 1996	1246	1.28
2	5 31 1996	1121	0.87
3	5 31 1996	1125	0.51
4	5 31 1996	1154	-0.39
5	5 31 1996	1152	2.54
6	5 31 1996	1146	0.03
7	5 31 1996	1145	0.35
8	5 31 1996	1140	0.40
9	5 31 1996	1202	1.60
10	5 31 1996	1159	dry
11	5 31 1996	1216	dry
12	5 31 1996	1211	1.07
13	5 31 1996	1237	2.72
14	5 31 1996	1229	0.23
15	5 31 1996	1233	2.30

Staff Gage#	Date	Time	Stage (Ft.)
1	6 3 1996	1702	1.35
2	6 3 1996	1704	1.15
3	6 3 1996	1707	0.66
4	6 3 1996	1612	-0.07
5	6 3 1996	1611	2.80
6	6 3 1996	1606	dry
7	6 3 1996	1605	0.54
8	6 3 1996	1601	0.73
9	6 3 1996	1619	1.68
10	6 3 1996	1616	0.48
11	6 3 1996	1622	dry
12	6 3 1996	1625	1.28
13	6 3 1996	1643	2.98
14	6 3 1996	1646	0.50
15	6 3 1996	1649	2.51
1	6 7 1996	1610	1.45
2	6 7 1996	1622	1.21
3	6 7 1996	1617	0.89
4	6 7 1996	1642	0.04
5	6 7 1996	1641	2.98
6	6 7 1996	1636	dry
7	6 7 1996	1635	0.78
8	6 7 1996	1608	0.83
9	6 7 1996	1649	1.86
10	6 7 1996	1646	0.54
11	6 7 1996	1653	dry
12	6 7 1996	1656	1.76
13	6 7 1996	1724	3.40
14	6 7 1996	1716	0.89
15	6 7 1996	1720	2.81
1	6 17 1996	1333	1.25
2	6 17 1996	1346	0.70
3	6 17 1996	1341	0.50
4	6 17 1996	1405	-0.39
5	6 17 1996	1404	2.61
6	6 17 1996	1400	dry
7	6 17 1996	1359	dry
8	6 17 1996	1350	0.36
9	6 17 1996	1412	1.55
10	6 17 1996	1410	dry
11	6 17 1996	1416	dry
12	6 17 1996	1420	2.87
13	6 17 1996	1445	2.60
14	6 17 1996	1434	0.53
15	6 17 1996	1438	2.62
1	6 30 1996	1324	0.94
2	6 30 1996	1220	0.49
3	6 30 1996	1215	0.32
4	6 30 1996	1237	-0.39
5	6 30 1996	1234	2.50
6	6 30 1996	1231	0.02
7	6 30 1996	1229	0.38
8	6 30 1996	1227	0.16
9	6 30 1996	1244	1.28
10	6 30 1996	1241	0.25
11	6 30 1996	1254	dry
12	6 30 1996	1249	0.53
13	6 30 1996	1317	2.40
14	6 30 1996	1309	0.42
15	6 30 1996	1315	2.51

* dry = no water present
* md = missing data

NEVINS CREEK MITIGATION AREA

Staff Gage Readings

Staff Gage#	Date	Time	Stage (Ft.)
1	7 16 1996	1101	0.59
2	7 16 1996	1032	0.18
3	7 16 1996	1045	0.15
4	7 16 1996	1117	-0.39
5	7 16 1996	1116	2.67
6	7 16 1996	1110	dry
7	7 16 1996	1109	0.36
8	7 16 1996	1056	0.15
9	7 16 1996	1126	0.96
10	7 16 1996	1122	0.25
11	7 16 1996	1137	dry
12	7 16 1996	1132	0.40
13	7 16 1996	1205	2.75
14	7 16 1996	1145	0.57
15	7 16 1996	1158	2.60
1	7 29 1996	1940	1.28
2	7 29 1996	1830	1.16
3	7 29 1996	1824	0.47
4	7 29 1996	1851	-0.39
5	7 29 1996	1849	2.51
6	7 29 1996	1845	dry
7	7 29 1996	1843	0.45
8	7 29 1996	1839	0.70
9	7 29 1996	1859	1.54
10	7 29 1996	1856	0.44
11	7 29 1996	1914	dry
12	7 29 1996	1905	1.09
13	7 29 1996	1932	2.85
14	7 29 1996	1925	0.39
15	7 29 1996	1928	2.47
1	7 30 1996	1256	1.80
2	7 30 1996	1259	3.38
3	7 30 1996	1252	2.00
4	7 30 1996	1307	2.87
5	7 30 1996	1306	5.90
6	7 30 1996	1302	1.70
7	7 30 1996	1301	3.02
8	7 30 1996	1315	3.32
9	7 30 1996	1313	4.55
10	7 30 1996	1311	3.14
11	7 30 1996	1320	1.37
12	7 30 1996	1321	4.88
13	7 30 1996	1326	6.77
14	7 30 1996	1328	4.72
15	7 30 1996	1330	6.67
1	7 30 1996	1346	2.04
2	7 30 1996	1348	3.80
3	7 30 1996	1351	2.45
4	7 30 1996	1355	2.92
5	7 30 1996	1356	5.96
6	7 30 1996	1358	2.18
7	7 30 1996	1359	3.45
8	7 30 1996	1420	3.73
9	7 30 1996	1402	4.90
10	7 30 1996	1401	3.48
11	7 30 1996	1404	1.67
12	7 30 1996	1417	5.24
13	7 30 1996	1415	7.07
14	7 30 1996	1409	4.93
15	7 30 1996	1412	6.87

Staff Gage#	Date	Time	Stage (Ft.)
1	7 31 1996	810	4.36
2	7 31 1996	714	5.46
3	7 31 1996	711	4.00
4	7 31 1996	724	4.64
5	7 31 1996	723	7.60
6	7 31 1996	719	3.79
7	7 31 1996	718	5.06
8	7 31 1996	734	5.28
9	7 31 1996	736	6.56
10	7 31 1996	728	5.13
11	7 31 1996	745	3.34
12	7 31 1996	744	6.84
13	7 31 1996	802	8.74
14	7 31 1996	753	6.68
15	7 31 1996	757	8.69
1	8 6 1996	1322	1.24
2	8 6 1996	1337	1.20
3	8 6 1996	1331	0.54
4	8 6 1996	1407	-0.29
5	8 6 1996	1410	2.48
6	8 6 1996	1401	0.04
7	8 6 1996	1358	0.65
8	8 6 1996	1347	0.78
9	8 6 1996	1417	1.65
10	8 6 1996	1414	0.43
11	8 6 1996	1432	dry
12	8 6 1996	1424	1.36
13	8 6 1996	1456	3.10
14	8 6 1996	1449	1.00
15	8 6 1996	1451	2.47
1	8 13 1996	1220	1.06
2	8 13 1996	1236	1.00
3	8 13 1996	1231	0.46
4	8 13 1996	1258	-0.39
5	8 13 1996	1256	2.53
6	8 13 1996	1251	dry
7	8 13 1996	1250	dry
8	8 13 1996	1218	0.31
9	8 13 1996	1304	1.57
10	8 13 1996	1302	0.23
11	8 13 1996	1312	dry
12	8 13 1996	1315	1.66
13	8 13 1996	1343	3.52
14	8 13 1996	1336	1.50
15	8 13 1996	1340	2.44
1	8 26 1996	1214	0.75
2	8 26 1996	1227	dry
3	8 26 1996	1222	dry
4	8 26 1996	1306	-0.93
5	8 26 1996	1252	2.52
6	8 26 1996	1248	dry
7	8 26 1996	1245	dry
8	8 26 1996	1243	dry
9	8 26 1996	1311	1.33
10	8 26 1996	1257	0.24
11	8 26 1996	1325	dry
12	8 26 1996	1355	1.55
13	8 26 1996	1446	3.47
14	8 26 1996	1338	1.39
15	8 26 1996	1341	2.57

Staff Gage#	Date	Time	Stage (Ft.)
1	9 9 1996	1504	1.00
2	9 9 1996	1349	dry
3	9 9 1996	1341	dry
4	9 9 1996	1410	-0.33
5	9 9 1996	1409	2.53
6	9 9 1996	1403	dry
7	9 9 1996	1404	dry
8	9 9 1996	1422	dry
9	9 9 1996	1418	1.22
10	9 9 1996	1416	dry
11	9 9 1996	1427	dry
12	9 9 1996	1428	1.36
13	9 9 1996	1457	3.24
14	9 9 1996	1449	1.21
15	9 9 1996	1453	2.67
1	9 23 1996	1553	1.26
2	9 23 1996	1538	1.12
3	9 23 1996	1432	0.38
4	9 23 1996	1505	-0.39
5	9 23 1996	1503	2.55
6	9 23 1996	1458	dry
7	9 23 1996	1457	0.42
8	9 23 1996	1454	0.66
9	9 23 1996	1512	1.48
10	9 23 1996	1510	0.43
11	9 23 1996	1534	dry
12	9 23 1996	1519	0.91
13	9 23 1996	1546	2.76
14	9 23 1996	1537	0.74
15	9 23 1996	1542	dry
1	9 27 1996	1511	1.64
2	9 27 1996	1514	1.63
3	9 27 1996	1434	0.94
4	9 27 1996	1440	1.07
5	9 27 1996	1439	4.06
6	9 27 1996	1443	0.11
7	9 27 1996	1444	1.36
8	9 27 1996	1451	1.27
9	9 27 1996	1450	2.22
10	9 27 1996	1448	0.81
11	9 27 1996	1454	dry
12	9 27 1996	1455	2.38
13	9 27 1996	1457	4.18
14	9 27 1996	1459	2.16
15	9 27 1996	1502	4.25
1	10 10 1996	1403	1.18
2	10 10 1996	1241	1.07
3	10 10 1996	1228	0.38
4	10 10 1996	1310	-0.28
5	10 10 1996	1309	2.82
6	10 10 1996	1304	dry
7	10 10 1996	1303	0.42
8	10 10 1996	1250	0.32
9	10 10 1996	1318	1.46
10	10 10 1996	1315	0.24
11	10 10 1996	1322	dry
12	10 10 1996	1325	1.04
13	10 10 1996	1254	2.90
14	10 10 1996	1345	0.88
15	10 10 1996	1349	2.24

* dry = no water present
* md = missing data

NEVINS CREEK MITIGATION AREA

Staff Gage Readings

Staff Gage#	Date	Time	Stage (Ft.)
1	10 21 1996	1609	1.42
2	10 21 1996	1435	1.22
3	10 21 1996	1426	0.48
4	10 21 1996	1506	-0.28
5	10 21 1996	1502	2.80
6	10 21 1996	1456	dry
7	10 21 1996	1455	0.65
8	10 21 1996	1442	0.80
9	10 21 1996	1514	1.59
10	10 21 1996	1511	0.50
11	10 21 1996	1530	dry
12	10 21 1996	1523	1.00
13	10 21 1996	1600	2.67
14	10 21 1996	1544	0.55
15	10 21 1996	1548	2.44
1	10 22 1996	1359	4.72
2	10 22 1996	1257	6.01
3	10 22 1996	1652	dry
4	10 22 1996	1311	5.06
5	10 22 1996	1312	8.01
6	10 22 1996	1305	4.31
7	10 22 1996	1304	5.58
8	10 22 1996	1327	5.75
9	10 22 1996	1324	7.01
10	10 22 1996	1319	5.61
11	10 22 1996	1335	3.79
12	10 22 1996	1331	7.27
13	10 22 1996	1343	9.21
14	10 22 1996	1347	7.05
15	10 22 1996	1351	dry
1	10 25 1996	1611	1.40
2	10 25 1996	1449	1.33
3	10 25 1996	1441	0.76
4	10 25 1996	1516	0.06
5	10 25 1996	1515	2.90
6	10 25 1996	1510	0.06
7	10 25 1996	1509	0.96
8	10 25 1996	1456	1.00
9	10 25 1996	1524	1.80
10	10 25 1996	1521	0.55
11	10 25 1996	1537	dry
12	10 25 1996	1540	1.60
13	10 25 1996	1543	3.34
14	10 25 1996	1559	1.20
15	10 25 1996	md	2.68
1	11 4 1996	1523	1.37
2	11 4 1996	1401	1.33
3	11 4 1996	1355	0.76
4	11 4 1996	1430	0.05
5	11 4 1996	1429	2.93
6	11 4 1996	1421	0.07
7	11 4 1996	1320	1.00
8	11 4 1996	1404	1.05
9	11 4 1996	1438	1.85
10	11 4 1996	1436	0.54
11	11 4 1996	md	dry
12	11 4 1996	1445	1.60
13	11 4 1996	1448	3.36
14	11 4 1996	1506	1.26
15	11 4 1996	1509	2.49

Staff Gage#	Date	Time	Stage (Ft.)
1	11 18 1996	1136	1.51
2	11 18 1996	1152	1.78
3	11 18 1996	1145	1.11
4	11 18 1996	1217	0.41
5	11 18 1996	1215	3.42
6	11 18 1996	1210	0.23
7	11 18 1996	md	1.48
8	11 18 1996	md	1.42
9	11 18 1996	1225	2.25
10	11 18 1996	1222	0.84
11	11 18 1996	1229	dry
12	11 18 1996	1239	2.34
13	11 18 1996	1237	4.02
14	11 18 1996	1307	1.74
15	11 18 1996	1312	3.48
1	11 25 1996	1347	5.08
2	11 25 1996	1253	6.30
3	11 25 1996	1250	4.84
4	11 25 1996	1301	5.38
5	11 25 1996	1300	8.28
6	11 25 1996	1256	4.62
7	11 25 1996	1255	5.88
8	11 25 1996	1344	6.06
9	11 25 1996	1315	7.33
10	11 25 1996	1312	5.92
11	11 25 1996	1318	4.12
12	11 25 1996	1341	7.60
13	11 25 1996	1323	9.48
14	11 25 1996	1327	7.44
15	11 25 1996	1332	9.40
1	11 26 1996	1219	3.52
2	11 26 1996	1226	4.70
3	11 26 1996	1234	3.00
4	11 26 1996	1231	3.85
5	11 26 1996	1232	6.80
6	11 26 1996	1234	3.00
7	11 26 1996	1237	4.26
8	11 26 1996	1223	4.49
9	11 26 1996	1245	5.70
10	11 26 1996	1243	4.30
11	11 26 1996	1249	2.47
12	11 26 1996	1320	5.90
13	11 26 1996	1318	7.78
14	11 26 1996	1305	5.76
15	11 26 1996	1308	7.78
1	12 2 1996	1336	1.72
2	12 2 1996	1342	3.11
3	12 2 1996	1348	1.77
4	12 2 1996	1400	2.15
5	12 2 1996	1358	5.20
6	12 2 1996	1356	1.41
7	12 2 1996	1353	2.68
8	12 2 1996	1340	2.90
9	12 2 1996	1408	4.09
10	12 2 1996	1406	2.68
11	12 2 1996	1419	0.85
12	12 2 1996	1420	4.34
13	12 2 1996	1422	6.19
14	12 2 1996	1425	4.13
15	12 2 1996	1428	6.14

Staff Gage#	Date	Time	Stage (Ft.)
1	12 8 1996	1352	1.44
2	12 8 1996	1207	1.64
3	12 8 1996	1155	1.00
4	12 8 1996	1326	0.44
5	12 8 1996	1240	3.22
6	12 8 1996	1231	0.11
7	12 8 1996	1229	1.35
8	12 8 1996	1214	1.31
9	12 8 1996	1252	2.06
10	12 8 1996	1249	0.65
11	12 8 1996	1305	dry
12	12 8 1996	1258	1.95
13	12 8 1996	1331	3.62
14	12 8 1996	1320	1.36
15	12 8 1996	1323	3.05
1	12 17 1996	1213	1.93
2	12 17 1996	1222	3.48
3	12 17 1996	1323	2.08
4	12 17 1996	1236	2.79
5	12 17 1996	1238	5.79
6	12 17 1996	1232	1.81
7	12 17 1996	1227	3.08
8	12 17 1996	1220	3.28
9	12 17 1996	1301	4.48
10	12 17 1996	1242	3.10
11	12 17 1996	1258	1.28
12	12 17 1996	1245	4.77
13	12 17 1996	1247	6.63
14	12 17 1996	1250	4.57
15	12 17 1996	1253	6.56
1	12 22 1996	1308	1.51
2	12 22 1996	1319	1.59
3	12 22 1996	1315	0.94
4	12 22 1996	1342	0.22
5	12 22 1996	1341	3.10
6	12 22 1996	1336	0.10
7	12 22 1996	1335	1.33
8	12 22 1996	1324	1.28
9	12 22 1996	1350	2.03
10	12 22 1996	1348	0.63
11	12 22 1996	1356	dry
12	12 22 1996	1358	1.84
13	12 22 1996	1402	3.52
14	12 22 1996	1420	1.22
15	12 22 1996	1425	2.86
1	12 30 1996	1600	1.44
2	12 30 1996	1639	1.84
3	12 30 1996	1425	1.16
4	12 30 1996	1503	0.54
5	12 30 1996	1502	3.51
6	12 30 1996	1506	0.36
7	12 30 1996	1507	1.63
8	12 30 1996	1443	1.49
9	12 30 1996	1513	2.22
10	12 30 1996	1511	0.81
11	12 30 1996	1517	dry
12	12 30 1996	1520	2.28
13	12 30 1996	1524	3.98
14	12 30 1996	1540	1.68
15	12 30 1996	1545	3.54

* dry = no water present
* md = missing data

NEVINS CREEK MITIGATION AREA

Staff Gage Readings

Staff Gage#	Date	Time	Stage (Ft.)	Staff Gage#	Date	Time	Stage (Ft.)	Staff Gage#	Date	Time	Stage (Ft.)
1	1 13 1997	1214	1.43	1	2 10 1997	1348	1.42	1	3 4 1997	1454	3.27
2	1 13 1997	1228	1.77	2	2 10 1997	1222	1.94	2	3 4 1997	1457	4.48
3	1 13 1997	1221	0.96	3	2 10 1997	1208	1.18	3	3 4 1997	md	md
4	1 13 1997	1301	0.30	4	2 10 1997	1255	0.84	4	3 4 1997	1415	3.49
5	1 13 1997	1259	3.16	5	2 10 1997	md	md	5	3 4 1997	md	md
6	1 13 1997	1254	0.14	6	2 10 1997	1242	0.46	6	3 4 1997	1440	2.83
7	1 13 1997	1252	1.44	7	2 10 1997	1242	1.74	7	3 4 1997	1504	4.05
8	1 13 1997	1236	1.38	8	2 10 1997	1250	1.61	8	3 4 1997	1527	4.21
9	1 13 1997	1308	2.06	9	2 10 1997	1303	2.26	9	3 4 1997	1508	5.48
10	1 13 1997	1306	0.74	10	2 10 1997	1301	0.88	10	3 4 1997	1506	4.09
11	1 13 1997	1312	dry	11	2 10 1997	1308	dry	11	3 4 1997	1511	2.25
12	1 13 1997	1314	1.91	12	2 10 1997	1311	2.57	12	3 4 1997	1510	5.78
13	1 13 1997	1322	3.56	13	2 10 1997	1316	4.24	13	3 4 1997	1513	7.64
14	1 13 1997	1352	1.22	14	2 10 1997	1334	2.02	14	3 4 1997	1516	5.58
15	1 13 1997	1359	2.90	15	2 10 1997	1337	3.98	15	3 4 1997	1519	7.65
1	1 20 1997	1248	1.44	1	2 19 1997	1432	1.66	1	3 9 1997	900	1.38
2	1 20 1997	1122	1.95	2	2 19 1997	1437	1.94	2	3 9 1997	930	1.88
3	1 20 1997	1108	1.23	3	2 19 1997	1441	1.30	3	3 9 1997	920	1.16
4	1 20 1997	1152	1.05	4	2 19 1997	1351	0.73	4	3 9 1997	958	0.48
5	1 20 1997	1151	4.04	5	2 19 1997	md	md	5	3 9 1997	md	md
6	1 20 1997	1144	0.49	6	2 19 1997	1355	0.38	6	3 9 1997	951	0.38
7	1 20 1997	1142	1.75	7	2 19 1997	1358	1.66	7	3 9 1997	949	1.66
8	1 20 1997	1126	1.58	8	2 19 1997	1415	1.54	8	3 9 1997	935	1.57
9	1 20 1997	1201	2.54	9	2 19 1997	1403	2.18	9	3 9 1997	1012	2.12
10	1 20 1997	1158	1.15	10	2 19 1997	1401	0.80	10	3 9 1997	1010	0.73
11	1 20 1997	1206	dry	11	2 19 1997	1419	dry	11	3 9 1997	1011	dry
12	1 20 1997	1211	2.82	12	2 19 1997	1418	2.38	12	3 9 1997	1020	2.01
13	1 20 1997	1216	4.62	13	2 19 1997	1421	4.18	13	3 9 1997	1025	3.70
14	1 20 1997	1234	2.50	14	2 19 1997	1422	2.11	14	3 9 1997	1045	1.40
15	1 20 1997	1237	4.45	15	2 19 1997	1423	4.18	15	3 9 1997	1050	3.30
1	2 4 1997	1323	7.67	1	2 24 1997	1356	1.43	1	3 24 1997	1140	1.36
2	2 4 1997	1304	8.80	2	2 24 1997	1220	1.86	2	3 24 1997	1156	1.85
3	2 4 1997	md	md	3	2 24 1997	1213	1.14	3	3 24 1997	1147	1.02
4	2 4 1997	1242	md	4	2 24 1997	1302	0.71	4	3 24 1997	1216	0.25
5	2 4 1997	1231	md	5	2 24 1997	md	md	5	3 24 1997	md	md
6	2 4 1997	1244	6.98	6	2 24 1997	1248	0.43	6	3 24 1997	1212	dry
7	2 4 1997	1225	md	7	2 24 1997	1245	1.71	7	3 24 1997	1211	1.63
8	2 4 1997	1300	8.52	8	2 24 1997	1226	1.53	8	3 24 1997	1200	1.61
9	2 4 1997	1159	9.63	9	2 24 1997	1311	2.18	9	3 24 1997	1224	2.11
10	2 4 1997	1214	uw	10	2 24 1997	1308	0.80	10	3 24 1997	1221	0.71
11	2 4 1997	1151	6.39	11	2 24 1997	1317	dry	11	3 24 1997	1230	dry
12	2 4 1997	1117	9.82	12	2 24 1997	1320	2.31	12	3 24 1997	1233	2.04
13	2 4 1997	1119	uw	13	2 24 1997	1325	4.06	13	3 24 1997	1231	3.71
14	2 4 1997	1129	9.67	14	2 24 1997	1342	1.85	14	3 24 1997	1257	1.25
15	2 4 1997	1137	uw	15	2 24 1997	1346	3.83	15	3 24 1997	1301	2.89
1	2 6 1997	1413	1.53	1	3 3 1997	1359	5.93	1	4 18 1997	1027	1.50
2	2 6 1997	1418	2.78	2	3 3 1997	1404	7.01	2	4 18 1997	1049	2.56
3	2 6 1997	1402	1.48	3	3 3 1997	md	md	3	4 18 1997	1048	0.88
4	2 6 1997	1451	1.91	4	3 3 1997	md	md	4	4 18 1997	1130	1.43
5	2 6 1997	md	md	5	3 3 1997	md	md	5	4 18 1997	md	md
6	2 6 1997	1427	1.10	6	3 3 1997	1415	5.40	6	4 18 1997	1116	0.89
7	2 6 1997	1425	2.38	7	3 3 1997	md	md	7	4 18 1997	1112	2.16
8	2 6 1997	1456	2.52	8	3 3 1997	1428	6.86	8	4 18 1997	1054	2.33
9	2 6 1997	1500	3.74	9	3 3 1997	1430	8.07	9	4 18 1997	1139	3.52
10	2 6 1997	1506	2.34	10	3 3 1997	md	md	10	4 18 1997	1137	2.14
11	2 6 1997	1508	0.50	11	3 3 1997	1432	4.84	11	4 18 1997	1147	0.26
12	2 6 1997	1510	4.03	12	3 3 1997	1446	8.36	12	4 18 1997	1150	3.82
13	2 6 1997	1513	5.89	13	3 3 1997	md	md	13	4 18 1997	1159	5.70
14	2 6 1997	1516	3.84	14	3 3 1997	1435	8.20	14	4 18 1997	1218	3.64
15	2 6 1997	1519	5.88	15	3 3 1997	1437	md	15	4 18 1997	1222	5.70

* dry = no water present
* md = missing data

NEVINS CREEK MITIGATION AREA

Staff Gage Readings

Staff Gage#	Date	Time	Stage (Ft.)
1	4 21 1997	1424	1.28
2	4 21 1997	1438	1.68
3	4 21 1997	1432	0.37
4	4 21 1997	md	-0.06
5	4 21 1997	md	md
6	4 21 1997	1456	dry
7	4 21 1997	1455	1.49
8	4 21 1997	1443	1.35
9	4 21 1997	1511	1.57
10	4 21 1997	1509	dry
11	4 21 1997	1517	dry
12	4 21 1997	1520	1.43
13	4 21 1997	1525	3.14
14	4 21 1997	1543	0.61
15	4 21 1997	1547	2.15
18	4 21 1997	1502	0.82
1	5 5 1997	1459	1.37
2	5 5 1997	1348	1.81
3	5 5 1997	md	md
4	5 5 1997	1409	0.04
5	5 5 1997	md	md
6	5 5 1997	1402	dry
7	5 5 1997	1401	1.57
8	5 5 1997	1351	dry
9	5 5 1997	1415	2.01
10	5 5 1997	1413	0.67
11	5 5 1997	1419	dry
12	5 5 1997	1421	1.55
13	5 5 1997	1425	3.26
14	5 5 1997	1441	0.67
15	5 5 1997	1444	2.34
18	5 5 1997	md	0.90
1	5 23 1997	1613	1.14
2	5 23 1997	1450	dry
3	5 23 1997	md	md
4	5 23 1997	1515	-0.18
5	5 23 1997	md	md
6	5 23 1997	1517	dry
7	5 23 1997	1506	dry
8	5 23 1997	1453	dry
9	5 23 1997	1527	1.68
10	5 23 1997	1522	dry
11	5 23 1997	1527	dry
12	5 23 1997	1534	1.06
13	5 23 1997	1539	2.70
14	5 23 1997	1557	0.20
15	5 23 1997	1601	1.89
16	5 23 1997	1446	1.58
18	5 23 1997	1517	0.84
1	6 2 1997	1544	1.20
2	6 2 1997	1428	1.29
3	6 2 1997	md	md
4	6 2 1997	md	-0.21
5	6 2 1997	md	md
6	6 2 1997	1443	dry
7	6 2 1997	1441	dry
8	6 2 1997	1431	dry
9	6 2 1997	1500	1.84
10	6 2 1997	1456	dry
11	6 2 1997	md	dry
12	6 2 1997	1505	dry
13	6 2 1997	1510	2.70
14	6 2 1997	1527	0.18
15	6 2 1997	1532	1.90
16	6 2 1997	1443	1.56
18	6 2 1997	1445	0.74

Staff Gage#	Date	Time	Stage (Ft.)
1	6 16 1997	1654	1.22
2	6 16 1997	1525	1.70
3	6 16 1997	1518	md
4	6 16 1997	1554	-0.19
5	6 16 1997	md	md
6	6 16 1997	1548	dry
7	6 16 1997	1548	1.24
8	6 16 1997	1529	dry
9	6 16 1997	1609	dry
10	6 16 1997	1604	0.51
11	6 16 1997	1612	dry
12	6 16 1997	1614	1.03
13	6 16 1997	1620	2.72
14	6 16 1997	1638	0.15
15	6 16 1997	1645	1.06
16	6 16 1997	1518	1.56
17	6 16 1997	1711	3.46
18	6 16 1997	md	0.69
1	7 1 1997	1315	1.27
2	7 1 1997	1129	1.54
3	7 1 1997	md	md
4	7 1 1997	1200	0.02
5	7 1 1997	md	md
6	7 1 1997	1152	dry
7	7 1 1997	1151	dry
8	7 1 1997	1132	1.38
9	7 1 1997	1216	1.93
10	7 1 1997	1211	0.46
11	7 1 1997	1220	dry
12	7 1 1997	1223	1.18
13	7 1 1997	1233	2.98
14	7 1 1997	1252	0.24
15	7 1 1997	1303	2.28
16	7 1 1997	1123	1.59
17	7 1 1997	1158	3.71
18	7 1 1997	1157	0.90
1	7 18 1997	1635	0.86
2	7 18 1997	1516	1.13
3	7 18 1997	md	md
4	7 18 1997	1540	-0.18
5	7 18 1997	md	md
6	7 18 1997	1532	dry
7	7 18 1997	1531	dry
8	7 18 1997	1519	dry
9	7 18 1997	1548	dry
10	7 18 1997	1546	dry
11	7 18 1997	1552	dry
12	7 18 1997	1555	dry
13	7 18 1997	1603	2.00
14	7 18 1997	1621	dry
15	7 18 1997	1625	dry
16	7 18 1997	1511	1.36
17	7 18 1997	1538	3.52
18	7 18 1997	1538	0.76

Staff Gage#	Date	Time	Stage (Ft.)
1	7 28 1997	1302	dry
2	7 28 1997	1314	dry
3	7 28 1997	1309	md
4	7 28 1997	1347	-0.20
5	7 28 1997	md	md
6	7 28 1997	1338	dry
7	7 28 1997	1337	dry
8	7 28 1997	1316	dry
9	7 28 1997	1407	dry
10	7 28 1997	1405	dry
11	7 28 1997	1408	dry
12	7 28 1997	1413	dry
13	7 28 1997	1430	1.89
14	7 28 1997	1448	dry
15	7 28 1997	1451	dry
16	7 28 1997	1309	1.04
17	7 28 1997	1345	3.63
18	7 28 1997	1343	0.87
1	8 15 1997	1709	dry
2	8 15 1997	1535	1.25
3	8 15 1997	md	md
4	8 15 1997	md	-0.21
5	8 15 1997	md	md
6	8 15 1997	1603	dry
7	8 15 1997	1602	dry
8	8 15 1997	1538	dry
9	8 15 1997	1620	1.81
10	8 15 1997	1618	dry
11	8 15 1997	1624	dry
12	8 15 1997	1626	1.11
13	8 15 1997	1637	2.92
14	8 15 1997	1655	0.29
15	8 15 1997	1659	1.82
16	8 15 1997	1530	1.49
17	8 15 1997	1609	3.52
18	8 15 1997	1608	0.76
1	8 25 1997	1402	dry
2	8 25 1997	1414	dry
3	8 25 1997	md	md
4	8 25 1997	1442	-0.16
5	8 25 1997	md	md
6	8 25 1997	1434	dry
7	8 25 1997	1431	dry
8	8 25 1997	1417	dry
9	8 25 1997	1449	1.58
10	8 25 1997	1441	dry
11	8 25 1997	1454	dry
12	8 25 1997	1456	0.95
13	8 25 1997	1505	2.36
14	8 25 1997	1522	dry
15	8 25 1997	1526	1.80
16	8 25 1997	1409	1.26
17	8 25 1997	1441	3.88
18	8 25 1997	1440	1.14

* dry = no water present
* md = missing data

NEVINS CREEK MITIGATION AREA

Staff Gage Readings

Staff Gage#	Date	Time	Stage (Ft.)
1	9 8 1997	1445	dry
2	9 8 1997	1511	dry
3	9 8 1997	md	md
4	9 8 1997	1534	-0.06
5	9 8 1997	md	md
6	9 8 1997	1527	dry
7	9 8 1997	1523	dry
8	9 8 1997	1514	dry
9	9 8 1997	1542	dry
10	9 8 1997	1539	dry
11	9 8 1997	1545	dry
12	9 8 1997	1547	dry
13	9 8 1997	1551	1.97
14	9 8 1997	1607	0.05
15	9 8 1997	1611	1.90
16	9 8 1997	1506	0.70
17	9 8 1997	1531	3.96
18	9 8 1997	1531	1.20
1	9 30 1997	1351	dry
2	9 30 1997	1404	dry
3	9 30 1997	md	md
4	9 30 1997	1428	dry
5	9 30 1997	md	md
6	9 30 1997	1419	dry
7	9 30 1997	1417	dry
8	9 30 1997	1406	dry
9	9 30 1997	1442	dry
10	9 30 1997	1439	dry
11	9 30 1997	1445	dry
12	9 30 1997	1447	dry
13	9 30 1997	1451	2.30
14	9 30 1997	1508	0.05
15	9 30 1997	1512	1.43
16	9 30 1997	1358	1.20
17	9 30 1997	1426	3.66
18	9 30 1997	1425	0.91

Staff Gage#	Date	Time	Stage (Ft.)
1	10 6 1997	1416	dry
2	10 6 1997	1310	dry
3	10 6 1997	md	md
4	10 6 1997	1457	dry
5	10 6 1997	md	md
6	10 6 1997	1451	dry
7	10 6 1997	1448	dry
8	10 6 1997	1437	dry
9	10 6 1997	1512	dry
10	10 6 1997	1505	dry
11	10 6 1997	1515	dry
12	10 6 1997	1517	dry
13	10 6 1997	2521	2.16
14	10 6 1997	1538	0.05
15	10 6 1997	1542	1.90
16	10 6 1997	1428	1.01
17	10 6 1997	1508	3.73
18	10 6 1997	1454	0.99
1	10 19 1997	1246	0.88
2	10 19 1997	1137	dry
3	10 19 1997	md	md
4	10 19 1997	1401	dry
5	10 19 1997	md	md
6	10 19 1997	1152	dry
7	10 19 1997	1151	dry
8	10 19 1997	1141	dry
9	10 19 1997	1209	dry
10	10 19 1997	1207	dry
11	10 19 1997	1209	dry
12	10 19 1997	1215	dry
13	10 19 1997	1219	2.22
14	10 19 1997	1233	0.06
15	10 19 1997	1237	2.02
16	10 19 1997	1132	1.25
17	10 19 1997	1159	3.61
18	10 19 1997	1157	0.85

Staff Gage#	Date	Time	Stage (Ft.)
1	11 10 1997	1215	1.30
2	11 10 1997	1238	1.76
3	11 10 1997	md	md
4	11 10 1997	1326	dry
5	11 10 1997	md	md
6	11 10 1997	1305	0.43
7	11 10 1997	1310	1.52
8	11 10 1997	1249	1.36
9	11 10 1997	1333	1.92
10	11 10 1997	1331	0.69
11	11 10 1997	1340	1.04
12	11 10 1997	1338	dry
13	11 10 1997	1354	2.72
14	11 10 1997	1415	0.36
15	11 10 1997	1419	2.28
16	11 10 1997	1230	1.48
17	11 10 1997	1324	3.80
18	11 10 1997	1322	1.04
1	11 17 1997	1204	1.28
2	11 17 1997	1416	1.77
3	11 17 1997	md	md
4	11 17 1997	1452	0.17
5	11 17 1997	md	md
6	11 17 1997	1440	0.34
7	11 17 1997	1434	1.52
8	11 17 1997	1419	1.36
9	11 17 1997	1500	1.91
10	11 17 1997	1458	0.66
11	11 17 1997	1505	dry
12	11 17 1997	1509	1.06
13	11 17 1997	1514	2.74
14	11 17 1997	1531	0.46
15	11 17 1997	1536	2.29
16	11 17 1997	1411	1.51
17	11 17 1997	1450	3.84
18	11 17 1997	1448	1.08

* dry = no water present
* md = missing data

NEVINS CREEK

(Staff Gage Elevations from Caice data set 04/97)

Staff Gage#	Uncorrected Elevation	Staff Gage Reference Pt.	Ground Elevation	diff	diff (corr)
1	202.887	3.00	199.825	202.825	0.062
2	200.685	2.00	198.668	200.668	0.017
3	203.130	3.00	200.391	203.391	-0.261
4	200.958	1.00	199.573	200.573	0.385
5	200.876	4.00	196.990	200.990	-0.114
6	201.361	1.00	200.258	201.258	0.103
7	201.109	2.00	198.968	200.968	0.141
8	201.118	2.20	198.762	200.962	0.156
9	200.603	3.00	197.120	200.120	0.483
10	201.023	2.00	198.996	200.996	0.027
11	201.896	1.00	200.790	201.790	0.106
12	200.370	3.00	197.428	200.428	-0.058
13	200.488	5.00	195.589	200.589	-0.101
14	199.462	2.00	197.385	199.385	0.077
15	200.469	5.00	195.320	200.320	0.149
16	201.056	2.00	201.046	203.046	-1.990
17	199.957	4.00	199.947	203.947	-3.990
18	200.692	2.00	200.682	202.682	-1.990

	Coordinates (Ft.)	
Staff Gage#	(X)	(Y)
1	1298252.500	1864846.375
2	1297992.750	1865035.000
3	1297509.375	1864876.625
4	1297826.375	1865705.750
5	1297901.500	1865597.375
6	1297971.875	1865286.750
7	1298061.750	1865223.375
8	1298238.375	1865024.750
9	1298457.375	1865229.125
10	1298265.125	1865357.750
11	1298678.500	1865346.250
12	1298723.625	1865199.250
13	1298964.125	1865270.625
14	1299266.375	1865570.750
15	1299705.625	1865513.750
16	1297668.750	1865088.750
17	1297874.500	1865576.500
18	1297882.000	1865551.250

Henry's later notes may show "3", "5A", and "5B".
In case the gages were operational the new numbers were added to avoid confusion.

(New gage name "3" = #16, readings start 05/23/97)
Staff gage #5 missing. Installed two new ones.
(New gage name "5A"= #17, readings start 06/16/97)
(New gage name "5B"= #18, readings start 04/21/97)

Daily Rainfall Measured at the Nevins Creek Site 1996

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	in.											
1	-	-	-	-	-	0.92	0.00	0.02	0.00	0.00	0.87	0.00
2	-	-	-	-	-	0.00	0.00	0.01	0.14	0.01	0.01	0.00
3	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.01
5	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.35
6	-	-	-	-	-	0.01	0.02	0.00	0.00	0.00	0.00	0.00
7	-	-	-	-	-	1.41	0.00	0.00	0.00	0.00	1.14	0.00
8	-	-	-	-	-	0.02	0.00	0.00	0.14	0.00	0.01	0.00
9	-	-	-	-	-	0.00	0.01	0.00	0.00	0.00	0.00	0.00
10	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	-	-	-	-	-	0.00	0.00	0.09	0.00	0.00	0.00	0.00
12	-	-	-	-	-	0.36	0.00	0.02	0.00	0.00	0.01	0.00
13	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	-	-	-	-	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00
15	-	-	-	-	0.00	0.00	0.05	0.00	1.18	0.00	0.00	0.37
16	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53
17	-	-	-	-	0.00	0.00	0.00	0.00	0.01	1.73	0.86	0.15
18	-	-	-	-	0.00	0.23	0.00	0.00	0.00	0.00	0.01	0.00
19	-	-	-	-	0.00	0.01	0.00	0.00	0.00	0.00	0.08	0.00
20	-	-	-	-	0.00	0.00	0.00	0.04	0.04	0.00	0.13	0.00
21	-	-	-	-	0.00	0.00	0.00	0.01	0.48	2.32	0.00	0.00
22	-	-	-	-	0.00	0.00	0.53	0.00	0.00	0.95	0.00	0.00
23	-	-	-	-	0.00	0.00	0.16	0.00	0.00	0.00	0.02	1.46
24	-	-	-	-	0.00	0.00	0.08	0.00	0.93	0.00	1.46	0.00
25	-	-	-	-	0.00	0.00	0.01	0.00	0.00	0.03	0.58	0.00
26	-	-	-	-	0.00	0.02	1.14	0.56	1.32	0.27	0.00	0.81
27	-	-	-	-	0.66	0.00	0.18	0.02	0.93	0.04	0.00	0.00
28	-	-	-	-	0.00	0.00	0.00	0.00	0.01	0.18	0.00	0.00
29	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.02	1.03	0.00
30	-		-	-	0.00	0.00	1.96	0.00	0.00	0.00	1.29	0.00
31	-		-		0.00		1.76	0.00		0.00		0.01
Total	-	-	-	-	0.66	2.98	6.10	0.77	5.18	5.55	7.50	3.69

Daily Rainfall Measured at the Nevins Creek Site 1997

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	in.											
1	0.00	0.00	1.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	1.20	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	1.75	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45
4	0.09	0.25	0.00	2.60	0.00	0.00	0.07	0.03	0.00	0.00	0.00	0.00
5	0.00	0.00	0.07	2.61	0.00	0.00	0.00	0.00	0.00	0.00	1.47	0.00
6	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.13	0.52	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.33
8	0.83	0.00	0.00	0.00	0.00	0.00	0.09	0.23	0.00	0.21	0.00	0.46
9	0.03	0.00	0.34	0.35	0.23	0.75	0.00	0.04	0.00	0.10	0.02	0.00
10	0.00	0.00	0.01	0.02	0.00	0.09	0.05	0.00	0.00	0.00	0.27	-
11	0.00	0.00	0.00	0.27	0.00	0.00	0.14	0.00	0.00	0.00	0.06	-
12	0.00	0.03	0.18	0.01	0.02	0.37	0.00	0.12	0.00	0.00	0.20	-
13	0.00	0.62	0.70	0.00	0.00	0.00	0.00	0.60	0.00	1.09	0.73	-
14	0.00	0.00	0.02	0.00	0.04	0.00	0.00	0.01	0.00	0.00	0.03	-
15	0.50	0.00	0.00	0.00	0.00	0.07	0.13	0.00	0.01	0.00	0.02	-
16	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	-
17	0.00	0.00	0.25	0.00	0.00	1.22	0.00	0.00	0.00	0.00	0.00	-
18	0.00	0.00	0.54	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.00	-
19	0.00	1.18	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
20	0.01	0.26	0.00	0.00	0.06	0.00	0.00	0.12	0.00	0.00	0.00	-
21	0.10	0.68	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.17	0.00	-
22	0.04	0.00	0.00	0.65	0.00	0.00	0.00	0.01	0.00	0.00	0.00	-
23	0.77	0.00	0.00	0.18	0.00	0.00	0.00	0.00	1.12	1.23	0.00	-
24	0.18	0.05	0.00	0.00	0.28	0.00	0.00	0.00	0.06	0.02	0.01	-
25	0.00	0.32	0.24	0.48	0.00	0.00	0.00	0.00	0.05	0.67	0.00	-
26	0.00	0.76	0.00	1.31	0.00	0.01	0.00	0.00	0.00	0.00	0.00	-
27	0.46	0.00	0.00	0.84	0.31	0.00	0.00	0.00	0.00	0.00	0.00	-
28	0.01	0.02	0.00	2.87	0.46	0.67	0.00	0.00	0.00	0.00	0.70	-
29	0.00		0.00	0.00	0.00	0.16	0.55	0.00	0.00	0.00	0.05	-
30	0.00		0.11	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	-
31	0.00		0.00		0.02		0.00	0.00		0.35		-
Total	3.18	6.44	5.62	12.19	1.57	3.43	1.03	1.47	1.52	3.84	3.56	1.24

Daily Stage Measured at the Nevins Creek Inlet 1996

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
						Ft.						
1	-	-	-	-	-	0.46	0.00	1.52	0.00	0.29	0.73	5.08
2	-	-	-	-	-	0.69	0.00	0.58	0.04	0.26	1.02	2.23
3	-	-	-	-	-	0.43	0.00	0.45	0.11	0.23	0.75	1.19
4	-	-	-	-	-	0.33	0.00	0.39	0.05	0.21	0.64	1.08
5	-	-	-	-	-	0.28	0.00	0.32	0.00	0.19	0.58	1.19
6	-	-	-	-	-	0.26	0.00	0.28	0.00	0.19	0.56	1.15
7	-	-	-	-	-	0.67	0.00	0.26	0.00	0.18	1.32	0.98
8	-	-	-	-	-	0.73	0.00	0.23	0.04	0.18	1.33	0.87
9	-	-	-	-	-	0.55	0.00	0.22	0.06	0.16	0.82	0.84
10	-	-	-	-	-	0.44	0.00	0.21	0.00	0.14	0.72	0.80
11	-	-	-	-	-	0.35	0.00	0.21	0.00	0.08	0.67	0.77
12	-	-	-	-	-	0.31	0.00	0.20	0.00	0.02	0.68	0.74
13	-	-	-	-	-	0.28	0.00	0.19	0.00	0.00	0.58	0.72
14	-	-	-	-	-	0.26	0.00	0.20	0.00	0.00	0.57	0.71
15	-	-	-	-	-	0.24	0.00	0.19	0.04	0.00	0.53	0.72
16	-	-	-	-	-	0.21	0.00	0.17	0.51	0.00	0.50	1.31
17	-	-	-	-	-	0.19	0.00	0.16	0.29	0.16	0.71	2.07
18	-	-	-	-	-	0.18	0.00	0.15	0.22	0.99	1.03	1.23
19	-	-	-	-	-	0.19	0.00	0.14	0.19	0.47	0.80	1.00
20	-	-	-	-	-	0.17	0.00	0.13	0.17	0.39	0.70	0.87
21	-	-	-	-	-	0.16	0.00	0.14	0.19	0.56	0.70	0.83
22	-	-	-	-	0.30	0.15	0.00	0.08	0.16	4.28	0.63	0.79
23	-	-	-	-	0.31	0.14	0.11	0.03	0.13	1.88	0.63	1.07
24	-	-	-	-	0.30	0.14	0.06	0.00	0.30	0.86	0.71	4.17
25	-	-	-	-	0.27	0.13	0.08	0.00	0.34	0.70	4.40	1.90
26	-	-	-	-	0.25	0.13	0.28	0.06	0.33	0.64	3.26	1.90
27	-	-	-	-	0.30	0.13	0.85	0.13	0.98	0.61	1.10	3.21
28	-	-	-	-	0.31	0.12	0.33	0.12	0.83	0.64	0.90	1.67
29	-	-	-	-	0.30	0.07	0.21	0.10	0.43	0.72	1.27	1.23
30	-		-	-	0.27	0.02	1.48	0.05	0.33	0.57	3.85	1.10
31	-		-		0.25		3.72	0.00		0.55		1.08

Daily Stage Measured at the Nevins Creek Outlet 1996

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
						Ft.						
1	-	-	-	-	-	0.45	0.18	3.72	1.16	0.71	1.28	7.54
2	-	-	-	-	-	0.83	0.19	1.15	1.15	0.74	1.57	4.51
3	-	-	-	-	-	0.35	0.24	0.42	1.15	0.76	1.24	2.40
4	-	-	-	-	-	0.21	0.27	0.29	1.13	0.75	1.11	1.62
5	-	-	-	-	-	0.14	0.32	0.58	1.10	0.74	1.10	1.66
6	-	-	-	-	-	0.12	0.33	0.77	1.07	0.73	1.09	1.82
7	-	-	-	-	-	0.93	0.34	0.95	1.04	0.73	2.47	1.44
8	-	-	-	-	-	0.72	0.35	1.04	1.02	0.73	3.31	1.23
9	-	-	-	-	-	0.42	0.32	1.08	1.01	0.73	1.60	1.17
10	-	-	-	-	-	0.27	0.30	1.13	0.99	0.71	1.27	1.12
11	-	-	-	-	-	0.16	md	1.19	0.96	0.69	1.21	1.07
12	-	-	-	-	-	0.13	md	1.26	0.93	0.67	1.21	1.02
13	-	-	-	-	-	0.29	md	1.30	0.91	0.65	1.11	0.99
14	-	-	-	-	-	0.34	md	1.32	0.89	0.64	1.09	0.98
15	-	-	-	-	-	0.29	md	1.37	1.00	0.63	1.07	0.99
16	-	-	-	-	-	0.30	md	1.40	1.49	0.62	1.04	2.01
17	-	-	-	-	-	0.29	md	1.39	0.34	0.95	1.30	4.30
18	-	-	-	-	-	0.31	0.29	1.38	0.23	2.10	1.63	2.70
19	-	-	-	-	-	0.32	0.29	1.36	0.19	1.19	1.30	1.61
20	-	-	-	-	-	0.23	0.29	1.34	0.35	0.69	1.14	1.23
21	-	-	-	-	-	0.21	0.30	1.33	0.62	0.83	1.13	1.14
22	-	-	-	-	0.10	0.20	0.31	1.29	0.61	6.64	1.06	1.10
23	-	-	-	-	0.09	0.18	0.48	1.27	0.55	4.11	1.06	1.60
24	-	-	-	-	0.10	0.20	0.30	1.24	0.91	1.61	1.29	6.48
25	-	-	-	-	0.07	0.21	0.28	1.21	0.90	1.09	6.69	3.99
26	-	-	-	-	0.06	0.21	0.88	1.21	0.73	1.03	5.72	3.27
27	-	-	-	-	0.18	0.21	2.20	1.25	2.11	0.99	2.68	5.61
28	-	-	-	-	0.11	0.19	0.43	1.23	1.72	0.96	1.47	3.66
29	-	-	-	-	0.09	0.24	0.20	1.22	0.69	1.18	2.02	2.20
30	-		-	-	0.08	0.20	2.82	1.20	0.64	1.02	6.14	1.59
31	-		-		0.07		6.18	1.17		1.03		1.43

md=missing data

Daily Stage Measured at the Nevins Creek Inlet 1997

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Ft.											
1	0.98	0.87	1.88	0.69	1.24	0.56	0.51	0.33	0.00	0.00	0.32	0.52
2	0.92	0.82	7.99	0.68	1.06	0.50	0.44	0.30	0.00	0.00	0.30	0.53
3	0.88	1.80	5.90	0.66	0.97	0.48	0.39	0.27	0.00	0.00	0.30	0.57
4	0.86	6.39	3.56	1.65	0.95	0.48	0.37	0.25	0.00	0.00	0.30	0.59
5	1.00	4.77	1.82	9.22	0.85	0.48	0.35	0.23	0.00	0.00	0.55	0.52
6	0.88	1.84	1.60	5.48	0.81	0.47	0.34	0.20	0.00	0.00	0.93	0.51
7	0.86	1.51	1.23	2.43	0.78	0.46	0.32	0.19	0.00	0.00	0.50	0.50
8	1.14	2.47	1.11	1.29	0.83	0.45	0.31	0.27	0.00	0.00	0.43	0.92
9	2.27	1.42	1.06	1.07	0.79	0.47	0.30	0.26	0.00	0.01	0.40	0.88
10	1.54	1.14	1.74	1.00	0.75	0.58	0.30	0.24	0.00	0.00	0.38	-
11	1.12	1.03	1.23	0.96	0.71	0.51	0.29	0.21	0.00	0.00	0.37	-
12	0.96	0.96	0.96	1.00	0.69	0.62	0.27	0.21	0.00	0.00	0.38	-
13	0.87	1.36	2.55	0.93	0.67	0.69	0.26	0.25	0.00	0.21	0.73	-
14	0.82	2.00	3.62	0.88	0.68	0.54	0.24	0.34	0.00	0.26	0.84	-
15	1.21	1.44	1.41	0.82	0.68	0.51	0.26	0.40	0.00	0.16	0.53	-
16	1.54	1.09	1.05	0.84	0.67	0.48	0.25	0.32	0.00	0.04	0.45	-
17	1.07	0.99	1.05	0.82	0.66	1.32	0.24	0.30	0.00	0.00	0.42	-
18	0.94	0.93	1.26	0.76	0.64	1.00	0.23	0.30	0.00	0.00	0.40	-
19	0.89	1.68	2.06	0.77	0.61	0.72	0.21	0.28	0.00	0.00	0.39	-
20	0.84	4.01	1.31	0.72	0.61	0.62	0.20	0.25	0.00	0.00	0.38	-
21	0.82	5.08	1.10	0.70	0.61	0.53	0.19	0.23	0.00	0.00	0.38	-
22	0.89	3.30	0.94	0.83	0.58	0.48	0.17	0.24	0.00	0.01	0.37	-
23	0.90	1.34	0.84	0.98	0.58	0.46	0.12	0.23	0.11	0.08	0.38	-
24	3.35	1.09	0.85	0.87	0.59	0.44	0.06	0.14	0.27	0.56	0.39	-
25	2.84	1.29	0.75	0.80	0.61	0.41	0.03	0.05	0.24	0.52	0.38	-
26	1.16	1.71	0.84	1.32	0.60	0.39	0.01	0.02	0.14	0.45	0.37	-
27	1.07	4.27	0.78	5.08	0.61	0.36	0.00	0.00	0.03	0.40	0.37	-
28	1.70	2.12	0.71	7.38	0.68	0.39	0.00	0.00	0.00	0.36	0.37	-
29	1.17		0.71	5.59	0.70	0.62	0.26	0.00	0.00	0.35	0.58	-
30	1.01		0.72	2.40	0.63	0.61	0.70	0.00	0.00	0.33	0.57	-
31	0.93		0.72		0.61		0.40	0.00		0.34		-

Daily Stage Measured at the Nevins Creek Outlet 1997

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Ft.											
1	1.28	1.12	3.36	0.73	3.31	0.12	0.00	0.00	0.00	0.00	0.01	0.31
2	1.17	1.03	10.41	0.71	2.21	0.11	0.00	0.00	0.00	0.00	0.01	0.34
3	1.11	3.01	8.48	0.67	1.31	0.08	0.08	0.00	0.00	0.00	0.02	0.39
4	1.07	8.83	6.06	2.42	0.86	0.08	0.15	0.00	0.00	0.00	0.02	0.38
5	1.33	7.28	4.05	11.28	0.64	0.07	0.02	0.00	0.00	0.00	0.71	0.34
6	1.16	4.16	3.80	8.28	0.56	0.05	0.00	0.00	0.00	0.00	0.95	0.32
7	1.08	3.18	2.36	4.97	0.51	0.04	0.00	0.00	0.00	0.00	0.28	0.31
8	1.56	4.83	1.56	3.54	0.57	0.03	0.00	0.00	0.00	0.00	0.14	0.81
9	4.40	3.27	1.40	2.51	0.53	0.17	0.00	0.00	0.00	0.00	0.08	0.67
10	3.40	2.00	3.78	1.61	0.45	0.17	0.00	0.00	0.00	0.00	0.07	-
11	1.97	1.50	3.14	1.09	0.40	0.10	0.03	0.00	0.00	0.00	0.07	-
12	1.31	1.24	1.64	1.00	0.36	0.28	0.00	0.00	0.00	0.00	0.07	-
13	1.12	2.03	4.05	0.86	0.33	0.36	0.00	0.16	0.00	0.13	0.74	-
14	1.06	4.10	6.16	0.77	0.31	0.12	0.00	0.02	0.00	0.01	0.70	-
15	1.74	3.51	3.30	0.71	0.30	0.10	0.00	0.10	0.00	0.01	0.31	-
16	3.44	2.20	1.68	0.74	0.28	0.06	0.00	0.00	0.00	0.01	0.22	-
17	2.02	1.51	1.38	0.70	0.25	1.83	0.00	0.00	0.00	0.01	0.18	-
18	1.28	1.22	2.00	0.60	0.22	1.25	0.00	0.00	0.00	0.02	0.14	-
19	1.15	2.49	4.31	0.62	0.19	0.28	0.00	0.00	0.00	0.01	0.12	-
20	1.10	6.42	2.84	0.53	0.19	0.04	0.00	0.00	0.00	0.01	0.11	-
21	1.06	7.52	1.73	0.48	0.18	0.00	0.00	0.00	0.00	0.01	0.10	-
22	1.15	5.77	1.26	0.71	0.15	0.00	0.00	0.00	0.00	0.02	0.10	-
23	1.22	3.05	1.05	0.95	0.14	0.00	0.00	0.00	0.26	0.13	0.10	-
24	5.44	1.83	1.03	0.75	0.15	0.00	0.00	0.00	0.01	0.50	0.13	-
25	5.30	2.00	0.92	0.59	0.15	0.00	0.00	0.00	0.00	0.71	0.13	-
26	2.57	3.12	1.03	1.70	0.13	0.00	0.00	0.00	0.00	0.59	0.11	-
27	1.69	6.65	0.96	7.56	0.14	0.02	0.00	0.00	0.00	0.20	0.11	-
28	3.37	4.41	0.88	9.92	0.28	0.13	0.00	0.00	0.00	0.02	0.16	-
29	2.45		0.83	8.16	0.27	0.33	0.09	0.00	0.00	0.02	0.44	-
30	1.51		0.77	4.94	0.16	0.19	0.67	0.00	0.00	0.01	0.38	-
31	1.24		0.77		0.14		0.08	0.00		0.02		-

Daily Stage Measured at the Bartholomew Bayou Inlet 1996

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
						Ft.						
1	-	-	-	-	-	-	-	1.40	0.00	0.00	0.15	4.74
2	-	-	-	-	-	-	-	0.05	0.00	0.00	0.09	2.05
3	-	-	-	-	-	-	-	0.01	0.00	0.00	0.07	0.38
4	-	-	-	-	-	-	-	0.00	0.00	0.00	0.06	0.19
5	-	-	-	-	-	-	-	0.00	0.00	0.00	0.08	0.17
6	-	-	-	-	-	-	-	0.00	0.00	0.00	0.07	0.26
7	-	-	-	-	-	-	-	0.00	0.00	0.00	0.67	0.15
8	-	-	-	-	-	-	-	0.00	0.00	0.00	1.41	0.15
9	-	-	-	-	-	-	-	0.00	0.00	0.00	0.16	0.15
10	-	-	-	-	-	-	-	0.00	0.00	0.00	0.04	0.15
11	-	-	-	-	-	-	-	0.00	0.00	0.00	0.03	0.18
12	-	-	-	-	-	-	-	0.00	0.00	0.00	0.02	0.22
13	-	-	-	-	-	-	-	0.00	0.00	0.00	0.03	0.20
14	-	-	-	-	-	-	-	0.00	0.00	0.00	0.04	0.22
15	-	-	-	-	-	-	-	0.00	0.05	0.00	0.05	0.20
16	-	-	-	-	-	-	-	0.00	0.00	0.00	0.05	0.57
17	-	-	-	-	-	-	-	0.00	0.00	0.25	0.09	2.05
18	-	-	-	-	-	-	-	0.00	0.00	0.23	0.05	0.85
19	-	-	-	-	-	-	-	0.00	0.00	0.00	0.07	0.20
20	-	-	-	-	-	-	-	0.00	0.00	0.00	0.08	0.17
21	-	-	-	-	-	-	-	0.00	0.00	0.34	0.08	0.17
22	-	-	-	-	-	-	-	0.00	0.00	4.07	0.06	0.17
23	-	-	-	-	-	-	-	0.00	0.00	1.73	0.07	0.54
24	-	-	-	-	-	-	-	0.00	0.00	0.09	0.28	3.85
25	-	-	-	-	-	-	-	0.00	0.00	0.08	4.10	1.67
26	-	-	-	-	-	-	-	0.00	0.07	0.13	3.19	1.12
27	-	-	-	-	-	-	-	0.00	0.49	0.13	0.70	3.07
28	-	-	-	-	-	-	-	0.00	0.25	0.13	0.33	1.46
29	-	-	-	-	-	-	-	0.00	0.00	0.13	0.67	0.41
30	-		-	-	-	-	-	0.00	0.00	0.13	3.61	0.11
31	-		-		-		-	0.00		0.12		0.10

Daily Stage Measured at the Bartholomew Bayou Inlet 1997

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
						Ft.						
1	0.10	0.10	-	-	-	-	-	-	-	-	-	-
2	0.09	0.10	-	-	-	-	-	-	-	-	-	-
3	0.09	0.78	-	-	-	-	-	-	-	-	-	-
4	0.10	4.85	-	-	-	-	-	-	-	-	-	-
5	0.10	1.19	-	-	-	-	-	-	-	-	-	-
6	0.10	0.00	-	-	-	-	-	-	-	-	-	-
7	0.10	0.00	-	-	-	-	-	-	-	-	-	-
8	0.17	0.00	-	-	-	-	-	-	-	-	-	-
9	1.93	0.00	-	-	-	-	-	-	-	-	-	-
10	1.33	0.01	-	-	-	-	-	-	-	-	-	-
11	0.33	-	-	-	-	-	-	-	-	-	-	-
12	0.08	-	-	-	-	-	-	-	-	-	-	-
13	0.08	-	-	-	-	-	-	-	-	-	-	-
14	0.08	-	-	-	-	-	-	-	-	-	-	-
15	0.18	-	-	-	-	-	-	-	-	-	-	-
16	1.43	-	-	-	-	-	-	-	-	-	-	-
17	0.38	-	-	-	-	-	-	-	-	-	-	-
18	0.08	-	-	-	-	-	-	-	-	-	-	-
19	0.08	-	-	-	-	-	-	-	-	-	-	-
20	0.08	-	-	-	-	-	-	-	-	-	-	-
21	0.09	-	-	-	-	-	-	-	-	-	-	-
22	0.09	-	-	-	-	-	-	-	-	-	-	-
23	0.12	-	-	-	-	-	-	-	-	-	-	-
24	2.95	-	-	-	-	-	-	-	-	-	-	-
25	2.80	-	-	-	-	-	-	-	-	-	-	-
26	0.65	-	-	-	-	-	-	-	-	-	-	-
27	0.19	-	-	-	-	-	-	-	-	-	-	-
28	1.17	-	-	-	-	-	-	-	-	-	-	-
29	0.65	-	-	-	-	-	-	-	-	-	-	-
30	0.11		-	-	-	-	-	-	-	-	-	-
31	0.11		-		-		-	-		-		-

Daily Stage Measured at Nevins Creek Pool #2 1996

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
						Ft.						
1	-	-	-	-	-	-	-	-	-	-	2.59	8.59
2	-	-	-	-	-	-	-	-	-	-	3.07	5.72
3	-	-	-	-	-	-	-	-	-	-	2.63	3.70
4	-	-	-	-	-	-	-	-	-	-	2.47	3.04
5	-	-	-	-	-	-	-	-	-	-	2.45	3.14
6	-	-	-	-	-	-	-	-	-	-	2.45	3.25
7	-	-	-	-	-	-	-	-	-	-	3.76	2.90
8	-	-	-	-	-	-	-	-	-	-	4.62	2.68
9	-	-	-	-	-	-	-	-	-	-	3.01	2.61
10	-	-	-	-	-	-	-	-	-	-	2.67	2.58
11	-	-	-	-	-	-	-	-	-	-	2.57	2.53
12	-	-	-	-	-	-	-	-	-	-	2.57	2.48
13	-	-	-	-	-	-	-	-	-	-	2.46	2.43
14	-	-	-	-	-	-	-	-	-	-	2.42	2.40
15	-	-	-	-	-	-	-	-	-	1.99	2.40	2.42
16	-	-	-	-	-	-	-	-	-	1.97	2.38	3.36
17	-	-	-	-	-	-	-	-	-	2.06	2.67	5.52
18	-	-	-	-	-	-	-	-	-	2.28	3.19	3.96
19	-	-	-	-	-	-	-	-	-	2.30	2.88	2.99
20	-	-	-	-	-	-	-	-	-	2.18	2.69	2.67
21	-	-	-	-	-	-	-	-	-	1.97	2.58	2.61
22	-	-	-	-	-	-	-	-	-	3.81	2.47	2.58
23	-	-	-	-	-	-	-	-	-	3.97	2.42	3.04
24	-	-	-	-	-	-	-	-	-	3.08	2.57	7.67
25	-	-	-	-	-	-	-	-	-	2.57	7.84	5.21
26	-	-	-	-	-	-	-	-	-	2.54	6.92	4.53
27	-	-	-	-	-	-	-	-	-	2.50	3.95	6.81
28	-	-	-	-	-	-	-	-	-	2.39	2.86	4.93
29	-	-	-	-	-	-	-	-	-	2.63	3.39	3.58
30	-		-	-	-	-	-	-	-	2.42	7.37	3.08
31	-		-		-		-	-		2.35		2.97

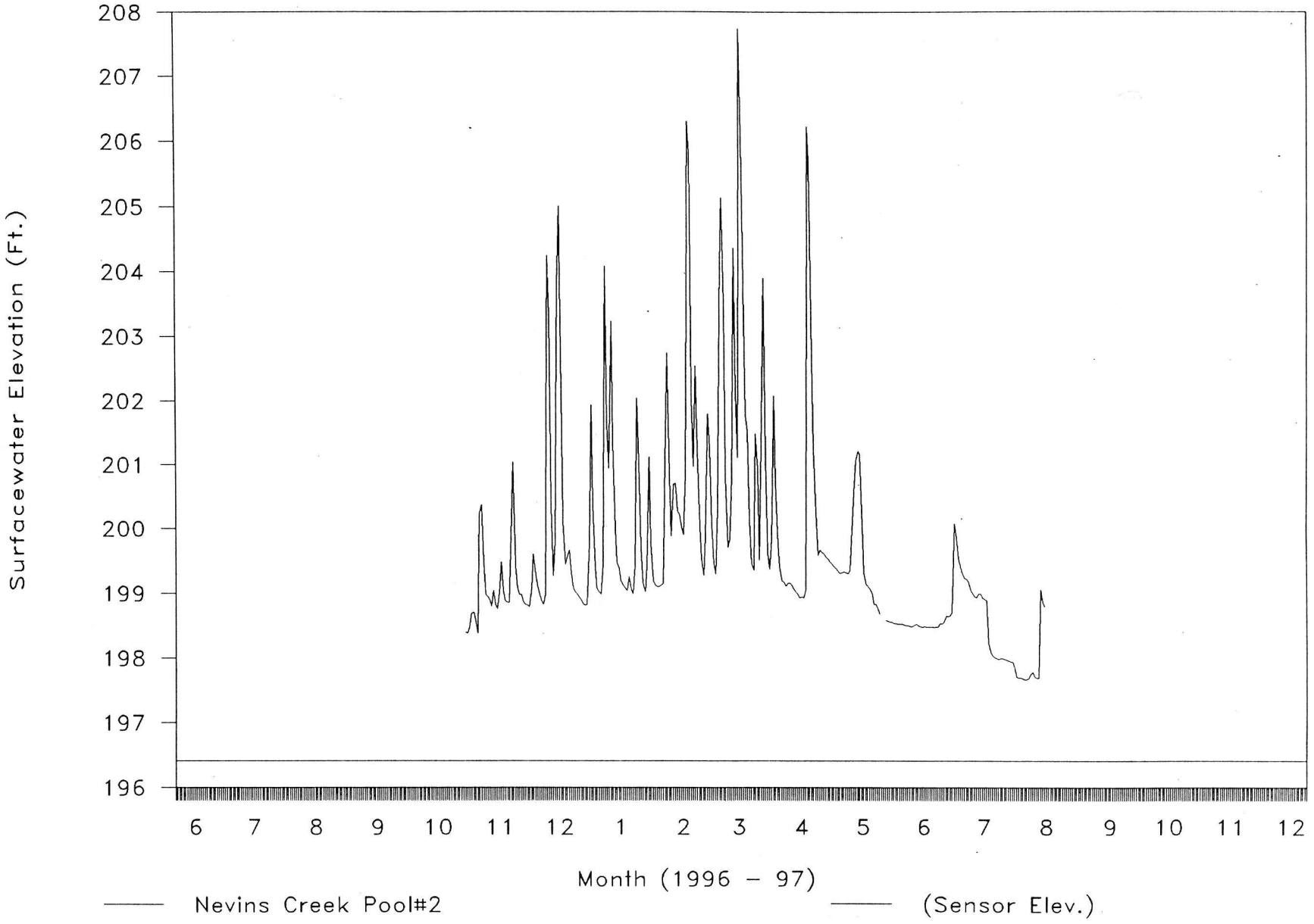
Daily Stage Measured at Nevins Creek Pool #2 1997

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
						Ft.						
1	2.79	3.50	11.32	2.53	3.63	2.08	2.50	-	-	-	-	-
2	2.71	4.44	9.64	2.52	2.90	2.07	2.47	-	-	-	-	-
3	2.67	9.89	7.32	2.63	2.73	2.07	1.82	-	-	-	-	-
4	2.63	9.41	5.35	9.81	2.70	2.07	1.69	-	-	-	-	-
5	2.85	5.64	5.10	9.28	2.66	2.07	1.63	-	-	-	-	-
6	2.66	4.55	3.72	6.24	2.60	2.06	1.60	-	-	-	-	-
7	2.58	6.12	3.05	4.82	2.42	2.07	1.58	-	-	-	-	-
8	3.00	4.80	2.94	3.83	2.42	2.07	1.57	-	-	-	-	-
9	5.62	3.61	5.06	3.17	2.35	2.12	1.58	-	-	-	-	-
10	4.62	3.12	4.51	3.25	2.27	2.11	1.58	-	-	-	-	-
11	3.29	2.86	3.10	3.22	md	2.15	1.57	-	-	-	-	-
12	2.75	3.46	5.29	3.19	md	2.24	1.56	-	-	-	-	-
13	2.61	5.37	7.48	3.15	2.17	2.23	1.55	-	-	-	-	-
14	3.00	4.84	4.67	3.11	2.16	2.25	1.53	-	-	-	-	-
15	4.70	3.65	3.19	3.07	2.15	2.30	1.53	-	-	-	-	-
16	3.36	3.05	2.96	3.04	2.15	3.66	1.44	-	-	-	-	-
17	2.79	2.88	3.42	3.00	2.13	3.44	1.30	-	-	-	-	-
18	2.72	3.88	5.65	2.97	2.12	3.12	1.29	-	-	-	-	-
19	2.69	7.71	4.30	2.93	2.11	2.99	1.29	-	-	-	-	-
20	2.69	8.71	3.34	2.90	2.11	2.89	1.27	-	-	-	-	-
21	2.71	7.08	2.99	2.91	2.11	2.82	1.26	-	-	-	-	-
22	2.74	4.39	2.78	2.92	2.10	2.80	1.26	-	-	-	-	-
23	5.07	3.29	2.76	2.91	2.09	2.77	1.28	-	-	-	-	-
24	6.32	3.42	2.70	2.89	2.09	2.63	1.34	-	-	-	-	-
25	4.41	4.38	2.75	2.94	2.08	2.59	1.37	-	-	-	-	-
26	3.47	7.94	2.75	3.56	2.08	2.53	1.30	-	-	-	-	-
27	4.28	5.70	2.71	4.14	2.09	2.52	1.28	-	-	-	-	-
28	4.29	4.69	2.66	4.64	2.11	2.58	1.28	-	-	-	-	-
29	3.86		2.61	4.78	2.09	2.58	2.64	-	-	-	-	-
30	3.81		2.58	4.73	2.08	2.51	2.45	-	-	-	-	-
31	3.60		2.52		2.06		2.38	-		-		-

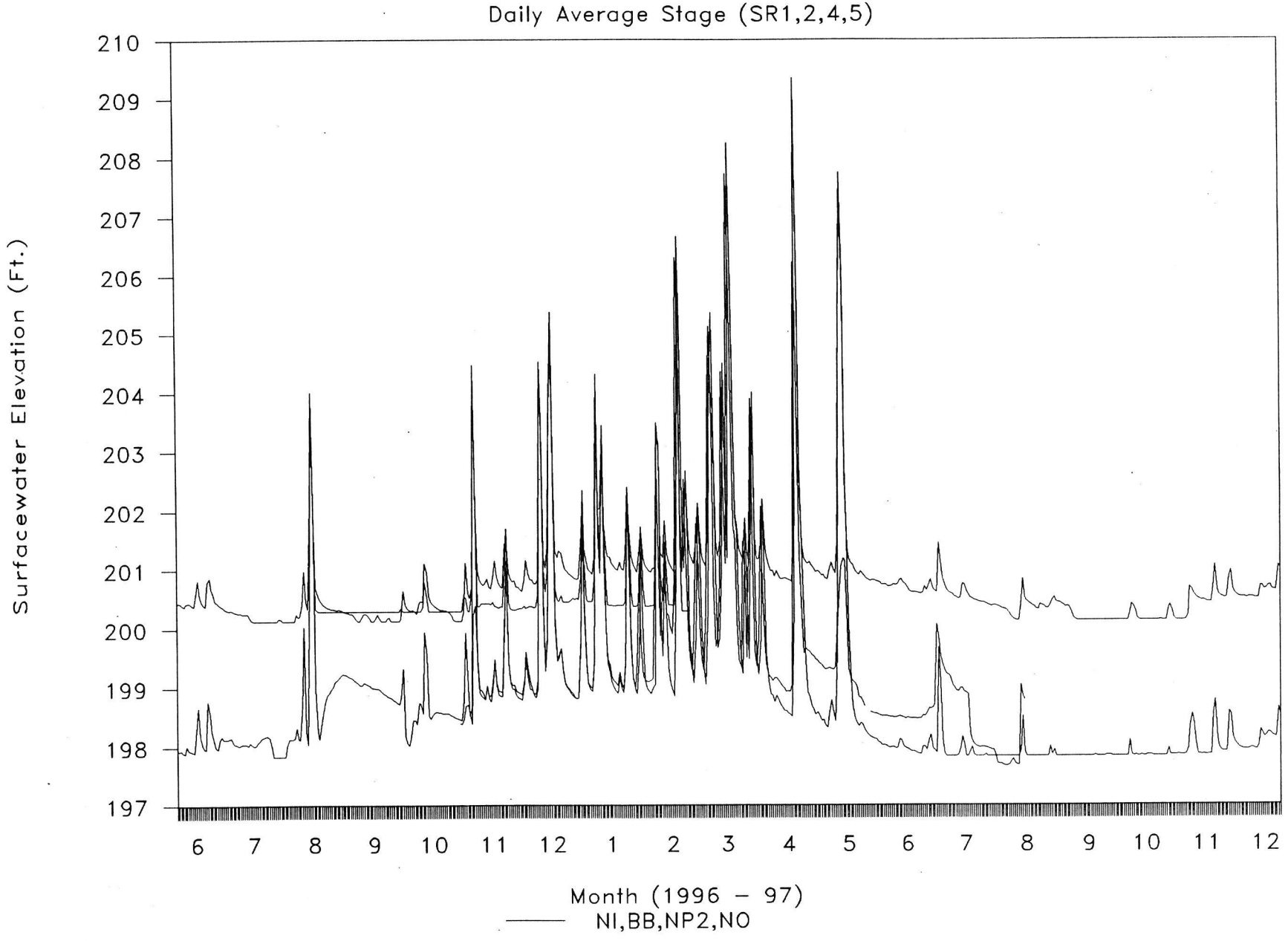
md = missing data

Nevins Creek Mitigation Area

Daily Average Stage (SR4)

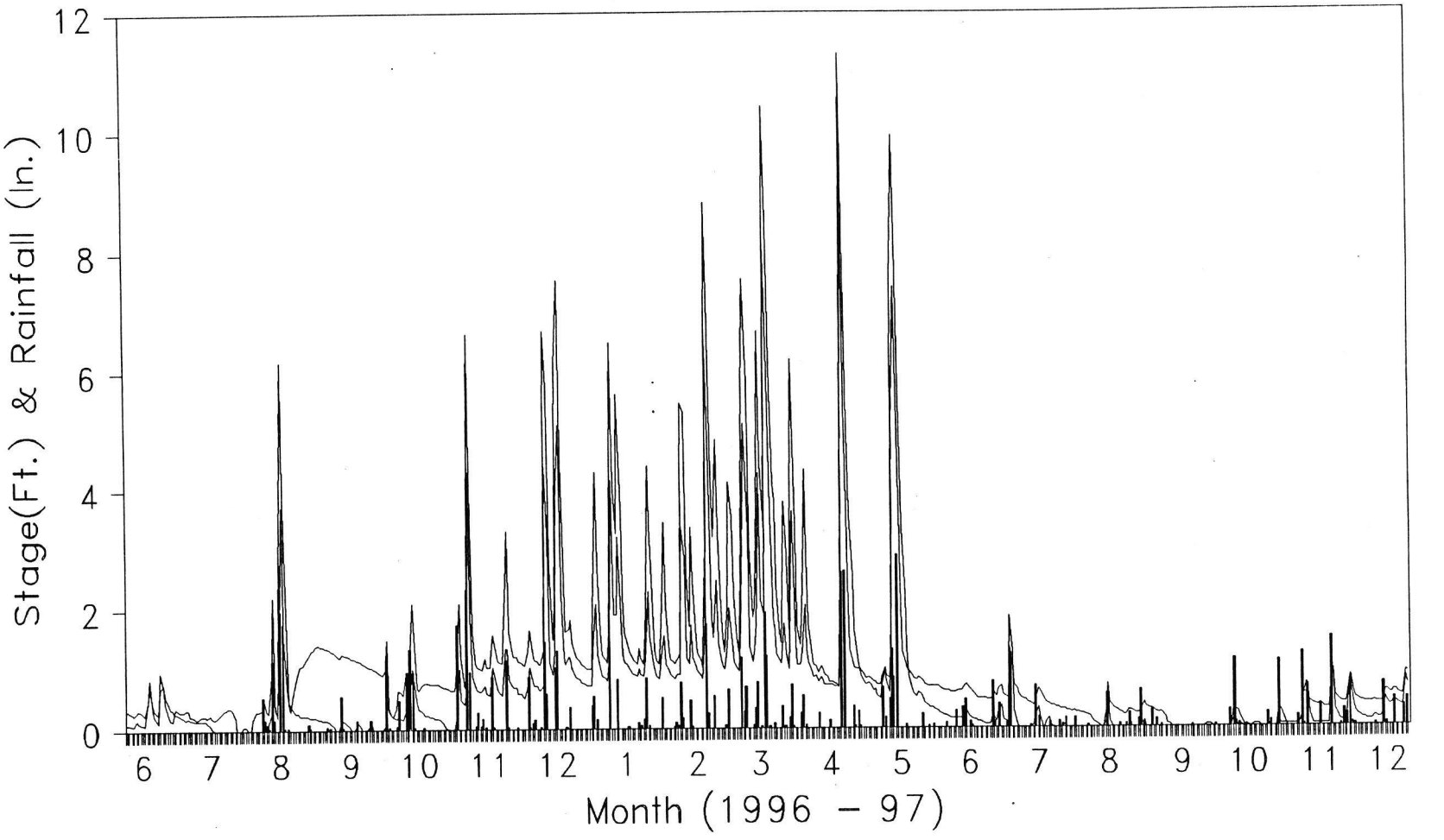


Nevins Creek Mitigation Area



Nevins Creek Mitigation Area

Daily Average Stage & Rainfall



APPENDIX H

Preliminary Groundwater Modeling of the Nevins Creek Wetland Area

PRELIMINARY GROUNDWATER MODELING OF THE NEVINS CREEK CONSTRUCTED WETLANDS PROJECT JEFFERSON COUNTY, ARKANSAS

By

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April 21, 1996

ABSTRACT

The Nevins Creek Constructed Wetland Project is a mitigation site managed by the Arkansas State Highway and Transportation Department. The site is located in east-central Arkansas, south of the City of Pine Bluff, and immediately adjacent to the U. S. Highway 65 Bypass (under construction). The groundwater conditions were simulated using MODFLOW EXT, a finite difference software package.

Using water level measurements from observations wells, and hydraulic conductivity values calculated from drawdown tests, a model was developed that appeaser to approximate the groundwater conditions at the study site.

While a qualitative calibration was achieved for the model, a lack of precise vertical and horizontal control introduced a low level of confidence into any attempt to reach a quantitative calibration. Acquisition of additional water level data, a control survey, and refinement of recharge and evapotranspiration rates should result in a model that could simulate conditions at Nevins Creek, and allow prediction of long-term groundwater conditions in the wetlands.

1.0 INTRODUCTION

1.1 Scope and Purpose

The scope of this project was one, which if successful, would reasonably result in a model depicting the configuration and movement of the groundwater within the project site. . The scope essentially consists of three major components; accumulation of data, simulation by a computer software model, and an analysis of the model.

Data was accumulated from several sources, the primary source being information collected in conjunction with a project funded by the Arkansas State Highway and Transportation Department. This project is intended to monitor and describe the conditions associated with a constructed wetlands adjacent to the U. S. Highway 65 Bypass around the City of Pine Bluff, Arkansas. The Nevins Creek site was constructed to mitigate wetlands destruction caused by the construction of the highway along Bayou Bartholomew.

Key to the monitoring of the site was the development of an understanding of the surface hydrology and geohydrologic conditions created during the construction of the wetlands. Inasmuch as fill was removed from the site for the highway grade, the groundwater regime was modified from that originally present. The regime was additionally modified by channelization and the construction of berms and islands within the site.

The second phase of the project consisted of constructing a model that would simulate the groundwater conditions at the site. This phase included data reduction, and selection of hydrogeologic and climatologic parameters that would closely resemble those that exist at the surface. These parameters were utilized on subsequent runs of the model to simulate site conditions.

The final phase was that of analyzing the model created by multiple simulations. This included calibration of the model and sensitivity analysis.

1.2 Standards

No applicable standards exist for the simulation and modeling of groundwater.

1.3 Objectives

The objective of this study was acquire base data, and select hydrogeologic and climatologic parameters that would allow the construction of a software model that would best simulate the groundwater regime at the project site. The design of a successful model will allow the simulation of hydrogeologic conditions on a long term basis.

1.4 Previous Work

No previous attempts to model the site are known, nor any site or sites within the proximity of the wetlands project. Some base flow data exists for the surface waters (Bayou Bartholomew), as well as ongoing data collection within the monitoring project.

2.0 SITE DESCRIPTION

2.1 Location and Legal Description

The site for the model is a tract of land that is approximately three thousand feet in length and fifteen hundred feet in width (slightly in excess of one hundred acres). The project site lies within Sections 19 and 20, Township 6 South, Range 9 West, Jefferson County, Arkansas. Plate 1 (Appendix A) is a site map prepared by the Arkansas State Highway and Transportation Department of the Nevins Creek site.

2.2 Site Characteristics

The project site is located on the southwest side of the City of Pine Bluff, Arkansas. The newly constructed grade for the U. S. Highway 65 Bypass lies to the south of the site, and the St. Louis-Southwestern Railroad right-of-way borders the site on the west. Bayou Bartholomew borders the site to the north and northeast. The site is bordered on the south and southeast by Nevins Creek.

The topography of the site is typical of that encountered in the Mississippi Gulf Embayment, and may be typified as low-lying wetlands, alluvial plains, and gently rolling hills. The site has been farmed in the past, and is predominantly within the alluvial plain of the two nearby streams. Much of the original vegetation has been removed during the removal of fill. Bayou Bartholomew has been channelized in the past (by a private landowner) and Nevins Creek has been rerouted during the construction of the highway grade.

Accurate vertical control is lacking at the site, but an examination of the topographic map indicates that probably less than 20 feet of relative relief ever existed at the site. Current site elevations are estimated to range from approximately 195 to 205 feet MSL.

Portions of the site are flood-prone, and a significant portion of the wetlands lies within the 100 year floodplain as designated by the Federal Emergency Management Act.

2.3 General Geology

The site lies within the Mississippi Gulf Embayment. The bedrock underlying this portion of the embayment is a sequence of sedimentary rocks deposited during the Cenozoic and Mesozoic Eras (Cretaceous and Tertiary Systems). These units are primarily interbedded sandstone and shales, and do not outcrop at the project site.

2.4 Soils

The soil survey map of Jefferson County (Gill, Larance, and Fortner, 1980) indicates that the Nevins Creek site soils are mainly alluvial plain soils covered by Ouachita soils. These soils are an undifferentiated series of soils that are found predominantly along streams and rivers of the region. The soils vary in texture, but are mainly described as silty loams.

The soil profile is described as usually beginning with a surface layer of dark-brown silt loam, overlying a subsoil of yellowish-brown silt loam or loam. The base of the sequence is usually a yellowish-brown fine sandy loam.

Gill, Larance, and Fortner (1980, p. 97-100) provide the following physical properties for this soils series, along with classifications that cover the majority of the soil exposures at the site:

SOIL CHARACTERISTIC/CLASSIFICATION	VALUE OR DESCRIPTION
Permeability	0.6-6.0 inch/hour
Salinity	<2 mmhos/cm
pH	4.5-6.0
Shrink/Swell Potential	Low
Liquid Limit	25-40
Plasticity Index	5-20
Unified System	ML, CL, SM-SL
AASHTO System	A-4, A-6, A-2

Table 1--Physical characteristics and classifications of Ouachita soils found at the Nevins Creek site (from Gill, Larance, and Fortner, 1980).

2.5 Hydrogeologic Setting

The aquifer at the site may be characterized as a shallow unconfined one with a water table that is generally quite shallow. There is some evidence to suggest that locally the aquifer may exhibit signs of confinement resulting in perched water tables.

There is an abundance of hydrogeologic data available at the site. This data is in the form of regular water level measurements, and drawdown tests. This data comes from a series of thirty-five shallow observations wells drilled at the site. The observations wells were drilled to depths ranging from four feet to forty-eight feet in depth. The approximate locations of most of these wells are plotted on Plate 1. Because of a lack of accurate vertical and horizontal control, the locations and wellhead elevations of the wells have been estimated from field notes and aerial photography.

The observation wells were constructed by drilling a hole with an auger, placing an appropriate length of 2" diameter Schedule 40 PVC depth to total depth, and then backfilling the annulus with 3/8" nominal diameter pea gravel. After setting the casing, the wellhead was fitted with a plug, and portland cement grout placed around the surface. Each well was also fitted with a piezometer.

The cutting from each well were examined, and a summary of the lithology prepared. the lithologic descriptions of the soils encountered at each wellsite are contained in Appendix B.

Four series of water level measurements were made available for the use during this study. Those measurements were collected between December 1, 1995 and January 29, 1996, and are contained within Appendix C.

2.51 Hydraulic Conductivity

Hydraulic conductivity values were calculated for twelve of the observation wells. The calculations were performed using the Bouer-Rice Method, and utilized data collected from drawdown tests conducted on January 31, 1996. The field notes and summary of calculations for each of the twelve wells are presented in Appendix D.

The hydraulic conductivity values for the wells are summarized below in Table 2.

WELL NUMBER	HYDRAULIC CONDUCTIVITY (ft/min)	AQUIFER THICKNESS (ft)	CASING DIAMETER (ft)	BOREHOLE DIAMETER (ft)
1050A	3.476E-05	25	0.1667	0.5729
1050B	2.644E-04	25	0.1667	0.5729
1060	3.273E-02	25	0.1667	0.5729
1070	4.076E-01	*50*	0.1667	0.5729
1150	1.668E-03	25	0.1667	0.5729
1170	5.685E-04	25	0.1667	0.5729
1180A	2.171E-03	25	0.1667	0.5729
1180B	7.627E-03	25	0.1667	0.5729
1200	4.644E-05	25	0.1667	0.5729
1240	4.193E-05	*50*	0.1667	*0.5000*
1300	7.372E-04	25	0.1667	0.5729
1320	1.352E-03	25	0.1667	0.5729
1330	1.034E-03	25	0.1667	0.5729
1340	9.002E-01	*50*	0.1667	0.5729

(Values in italics have had aquifer thickness or borehole diameter modified from actual values so that the software could generate a curve that did not result in an impressed groundwater level. Field data reduced using AQTESOLV software and Bouer-Rice Method.)

Table 2--Summary of calculated hydraulic conductivities at Nevins Creek

The calculations were performed based on an estimated soil profile of 25 feet. This value is a reasonable estimate, and is judged to be a conservative one based on the soil thickness of more than 48 feet described in borehole 1010. The values where the aquifer thickness of borehole diameter were adjusted most likely have mechanical problems. At least one of the wells (1340) was noted have loose casing during water level measurements.

The hydraulic conductivities calculated ranged over four orders of magnitude. The lowest value was 4.644E-05 while the highest was 9.002E-01 feet per minute. When the locations of the calculated values are considered with the well locations, there is an apparent east to west trend at the site. The trend generally coincides with the axis of the excavated fill, and the lower conductivity values appear to lie closest to those area where the site was excavated the deepest. There is also a correlation of generally higher conductivity values with soils having coarser grain fractions.

Because of experimental error and other sources of inaccuracy, the values of hydraulic conductivity used as input for the simulations were mathematically rounded. The conductivity values were also converted from feet per minute to feet per day. Table 3 below shows the actual conductivity values used for simulation input.

ORDER OF MAGNITUDE OF CALCULATED HYDRAULIC CONDUCTIVITY (feet/minute)	HYDRAULIC CONDUCTIVITY USED FOR SIMULATION (feet/day)
10^{-1}	144.00
10^{-2}	14.400
10^{-3}	1.4400
10^{-4}	0.1440
10^{-5}	0.0144

Table 3--Comparison of calculated hydraulic conductivity values and actual input values.

2.52 Aquifer Recharge

No actual precipitation records are available for the site, nor were any values for recharge of the aquifer. For simulation purposes recharge to this shallow aquifer was estimated to be twenty percent of the mean annual precipitation. Annual precipitation was estimated at 45 inches, thus recharge was estimated to be 0.75 feet per year, or 0.002055 feet per day.

2.53 Evapotranspiration

No evapotranspiration (ET) data exists for the site. However, based on a mean annual lake evaporation of 42 inches (Kohler, 1959), two values of ET were estimated. Since significant portions of the site have been disturbed by excavation, relatively low permeability soils have been exposed. These soils with low permeability were estimated to have ET rates of five inches annually, or 0.001142 feet per day. The portions of the site with less disturbance and more vegetation were assigned an estimated ET rate of 30 inches annually, or 0.006849 feet per day.

2.54 Saturated Thickness

Lacking good subsurface well control, no reliable values are available for the saturated thickness of this shallow aquifer. However, based on the thickness of the soil in well 1010, the aquifer is estimated to have a saturated thickness of at least 25 feet on an areal basis.

2.55 Boundary Conditions

The project site is bound on three sides by physical boundaries. Bayou Bartholomew and Nevins Creek represent physical boundaries to the groundwater regime, and for the purposes of simulation were considered to be specified head boundaries. Using the stream gradient and estimated elevations, the head at each node of the model was assigned a constant value.

The western end of the site lacked any obvious physical or hydrologic boundary. Therefore, for purposes of modeling, it was decided to leave that end of the model open to flow. In order to provide groundwater to move through the aquifer, it was necessary to deal with the nature of this western end. Alternatives that were considered were to place a series of phantom injection wells at regular intervals, or otherwise use a constant flux to move water into the system.

A simple approach was chosen to design this constant flux boundary.. This approach involved increasing the recharge rate over selected cell sites to mimic the actual groundwater flow. The recharge rate was increased by a value that was calculated using Darcy's Law. The steps in this calculation were as follows:

(1) Darcy's Law was used to calculate the flow through an individual cell face. The formula used is

$$Q = K A i$$

Where K = hydraulic conductivity in feet/day
A = area of the cell face based a width of 150 feet and a depth of 25 feet.
i = hydraulic gradient of 1/900

(2) The flow rate Q obtained above was then used to calculate a recharge value as follows:

Recharge = Q/A Where A = surface area of cell with dimensions of 100' X 100'

(3) The values used to simulate flow at the western cells are:

Recharge of 0.004 ft/day with hydraulic conductivity of 14.40 ft/day
Recharge of 0.0004 ft/day with hydraulic conductivity of 1.44 ft/day

2.56 Recharge & Discharge Zones

Recharge was assumed to take place throughout the project site. No recharge was assigned to inactive cells, or those beyond the model boundaries. Otherwise recharge was assumed to be constant over all the cells excepting those on the western side where recharge was increased to mimic flow, and at one other site. Recharge was reduced at one site where the hydraulic conductivity was extremely low on the basis that the clays exposed at that site would be unlikely to accept recharge values as high as the surrounding portions of the aquifer with higher conductivities.

No discharge zones as such were utilized during the modeling process at this site, although Nevins Creek and Bayou Bartholomew are both assumed to be gaining streams.

3.0 MODEL DEVELOPMENT

3.1 Modeling Concept & Strategy

Because of the simplicity of the site, it was decided that a steady state model of the groundwater regime would provide the best simulation. Additionally, the model was assumed to be a two dimensional one of an unconfined aquifer. Although there is most likely vertical and horizontal variations in hydraulic conductivity, these were ignored and the system was assumed to be isotropic. Finally, lithologic variations in the aquifer were ignored and the aquifer was modeled as being homogeneous.

The model was also developed on the assumption that groundwater flowed in an easterly direction, and that flow would be such that both Bayou Bartholomew and Nevins Creek would be classified as gaining streams (sites of discharge from the aquifer to the stream).

It was further assumed that the model would reach steady state during a period of one year or less. Finally, water level measurements from the January 29, 1996 observations were used as hydraulic head values at the observation wells.

3.2 Model Selection

The software package used for simulation was MODFLOW, and it was originally developed by the United States Geological Survey. MODFLOW is a three-dimensional type of finite difference program that utilizes both strongly implicit procedure and slice successive over-relaxation solution techniques. The specifications of the software package used are below:

Program Name: MODFLOW EXT
Title: Extended Memory Version for the Modular Three-Dimensional Finite Difference Groundwater Flow Model
Date: March, 1993
Version: 1.31
Language: ANSI Fortran 77
Compiler: Lahey F77LEM/32 Version 5.0
Linker: Pharlap 386| DOS-Extended Version 4.1
Status: MODFLOW-Public Domain
PREMOD and POSTMOD-IGWMC non-copyrighted, proprietary
Authors: Michael G. McDonald
Arlen W. Harbaugh
Address: U. S. Geological Survey
Ground Water Branch, WRD
WGS-Mail Stop 433
Reston, VA 22042
Distributor: International Ground Water Modeling Center
Colorado School of Mines
Golden, CO 80401-1887 USA

The model was used as supplied and the code was not modified in any manner.

3.3 Grid Design

MODFLOW uses a block-centered approach to its solution technique. This approach requires that a grid be superimposed on the area of investigation. The grid is generally required to be of such dimensions that the parameters governing groundwater flow can be accurately depicted, but of not such a small scale that an inordinate amount of data is required to be input.

In the block-centered approach, the calculations for defining the aquifer characteristics are performed as if they occur at the center of each cell, even though the data for the calculations may have come from any of the four surrounding nodal points.

For the purposes of modeling at the Nevins Creek site, it was determined that a grid consisting of square cells each 150 feet to a side would be adequate. To provide coverage for all of the site, a grid consisting of 10 rows and 20 columns (200 cells) was utilized. The grid configuration is indicated on Plate 1.

The spatial distribution of hydraulic conductivity, hydraulic head, recharge and evapotranspiration are shown as matrices in Appendix E.

As previously note the model was configured as a steady state simulation, and was run for 365 days in twelve time steps with no time step multiplier.

In view of the many estimations and assumptions made during development of the model, there exists a wide range of confidence in the input parameters. Those parameters and a subjective determination of a confidence level for that parameter are shown below in Table 4.

INPUT PARAMETER	CONFIDENCE LEVEL	COMMENTS
Observation well locations	Moderate	Lack of vertical/horizontal control results in estimation of location of wells within approximately 75 feet, and estimation of wellhead elevations within approximately 5 feet.
Hydraulic Conductivity	High	Excellent curve fits from drawdown data. Suspect well data ignored.
Recharge	Low	No firm value for recharge into aquifer exists.
Evapotranspiration	Low	No firm values for ET are available.
Boundaries	High	Streams easily modeled as constant head boundaries within grid system.
Hydraulic Head	Low to moderate	Lack of good well control prevents accurate determination of water levels.

Table 4--Confidence limit for various input parameters.

3.4 Model Calibration

Lacking any flow values for Bayou Bartholomew and Nevins Creek, it was apparent that calibration would best be accomplished by utilizing hydraulic heads. Although the model was configured to iterate until a closure on heads of 0.001 feet was reached, the lack of accurate vertical control makes this precision somewhat superfluous. Therefore a quantitative approach to calibration was impossible.

Using the pre-construction site map (Plate 1) it was possible to determine head values at each node of the streams with some reliability (within 1 foot). Also by using Plate 1 and the topographic map for the area, it was possible to determine the low and high values for elevations with the project site. Knowing these limits, and considering the reliability of the stream heads, the head values generated by the model were examined.

The first simulation generated some heads that were very obviously above the maximum ground level elevation of the area. This coincided with an original conductivity configuration that in retrospect distributed the lowest conductivity values over too wide an area. The spatial distribution of the conductivities was re-interpreted and a new conductivity distribution prepared and input.

The second simulation provided heads that appear to be a better portrayal of the conceptual model. The generated heads indicated the assumed gradient from west to east, and in general were evenly spaced and oriented properly. However, an elongate dome-shaped groundwater high was still present along the trend of the excavation. Only one head appeared to be above the maximum assumed elevation in the site. This excessive head coincided with the location of the observation well with the lowest conductivity value. Since a high degree of reliability had been assigned to the conductivity values, the excessive head was most likely due to an excessively high recharge value.

A reconsideration of the lithology and the conductivity suggested that the low permeability of the soil at that site could reduce recharge. This interpretation resulted in reducing the recharge into that cell by a factor of 50%.

A final simulation of the site produced a groundwater level map of the site (Figure 1). There remains a noticeable elongate bulge in the head values along the trend of the excavations at the site. However, the heads generated at these cells appears to be well below the estimated ground level elevations. Any readjustment of recharge values in this area to reduce the magnitude of this bulge would be speculative given the lack of vertical and horizontal control.

The input and output files for the final simulation of the site are attached as Appendix F.

3.5 Sensitivity Analysis

A rigorous sensitivity analysis was not conducted on this model given the low confidence level assigned to the well locations and elevations. However, as the site was simulated and input parameters modified, it was generally observed that:

(1) The model is extremely sensitive to changes in recharge. A decrease in recharge of 50% resulted in a change in head at one cell of nearly six feet.
(2) Evapotranspiration rates in the disturbed areas may be significantly greater than the original estimate of 0.001142 feet per day, and might be as much as three times that value.
(3) Small changes in head along the constant head boundaries (streams) do not significantly affect the head distribution.

3.6 Predictions

Although four sets of water level measurements are available, all four are within a 60 day interval and are representative of one season. This absence of temporally spaced data prevented any attempt to verify the accuracy of the model.

Additionally, although the model does appear to roughly calibrate, any attempt to predict future groundwater configurations given the low confidence ascribed to the input parameters would be extremely questionable.

3.7 Limitations

The simulation of groundwater flow using this model is obviously limited by the low confidence levels, most particularly the wellhead elevations and locations. The assumptions concerning recharge rates and evapotranspiration also limit the reliability of the model.

The uncertainty of these input parameters into the simulation efforts effectively limit the use of this model to a crude approximation of the heads that could be anticipated at the Nevins Creek site. The depiction of groundwater flow from west to east supports the original assumption, as does the estimation of the hydraulic gradient. There is insufficient reliability in the model at this point in time to make any important decisions or long-term predictions.

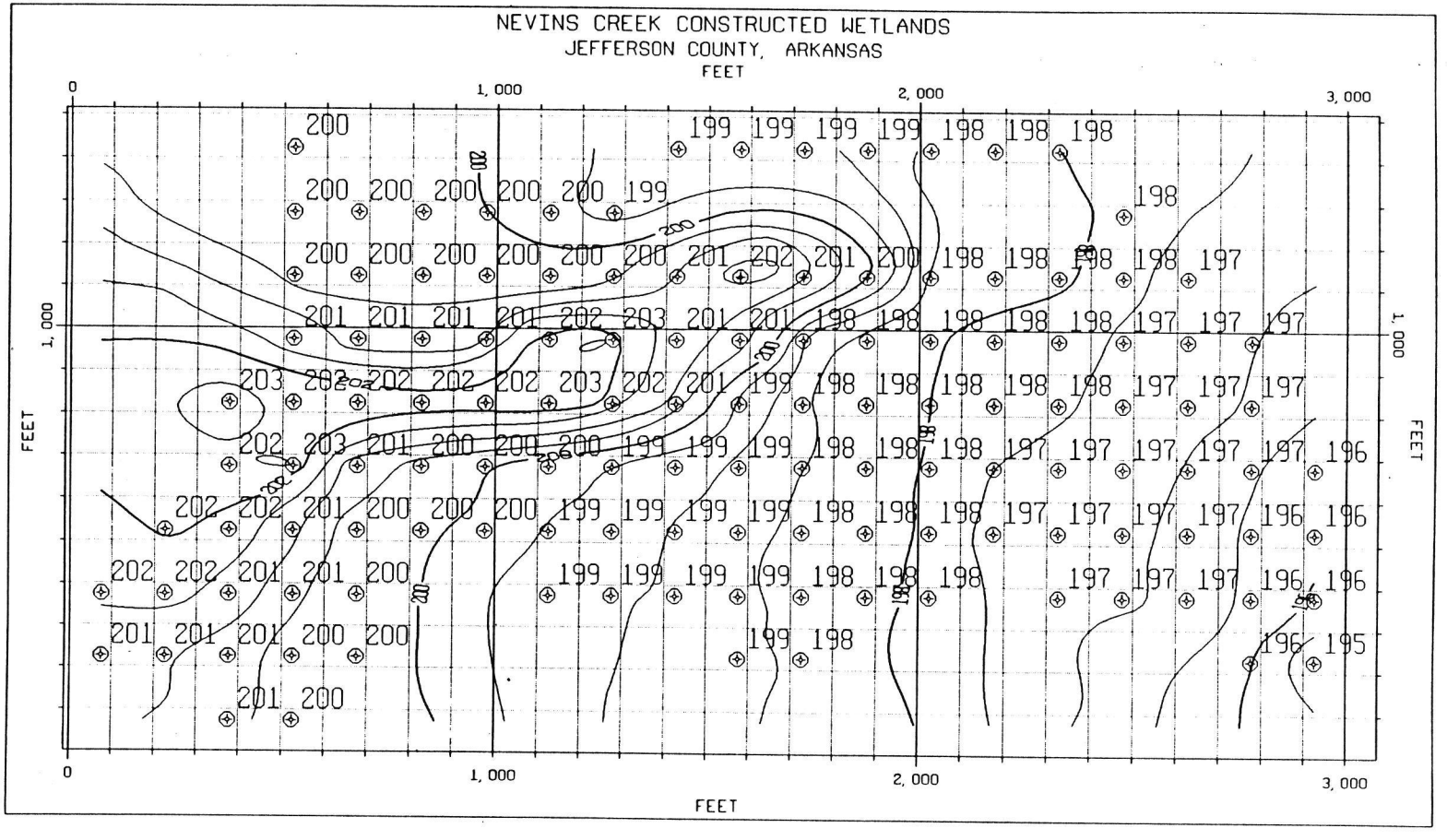


Figure 1--Groundwater level map for Nevins Creek site generated by MODFLOW.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The modeling efforts generally succeeded in a rough approximation of the groundwater flow and direction at Nevins Creek. While there is much data available data to date, much of that data possesses a low confidence limit because of a lack of control. The model obviously is constrained by the limitations of the data, and a refined simulation would require the following:

(1) A controlled survey showing the location and wellhead elevations for each of the observation wells. The survey should also provide vertical control on selected points along the streams.
(2) An examination of the mechanical integrity of the observation wells in light of the impressed head conditions that were calculated.
(3) A re-interpretation of the distribution of hydraulic conductivity based on exact well locations.
(4) Construction of a series of East-West and North-South geological cross-sections to determine potential variations in vertical conductivity.
(5) Evaluation of climatologic and agricultural data to more accurately estimate recharge and evapotranspiration rates.
(6) Accumulation of additional water levels and stream stages for predictive attempts.
(7) Consideration of re-gridding the site with smaller grids to better reflect apparent abrupt changes in hydraulic conductivity.

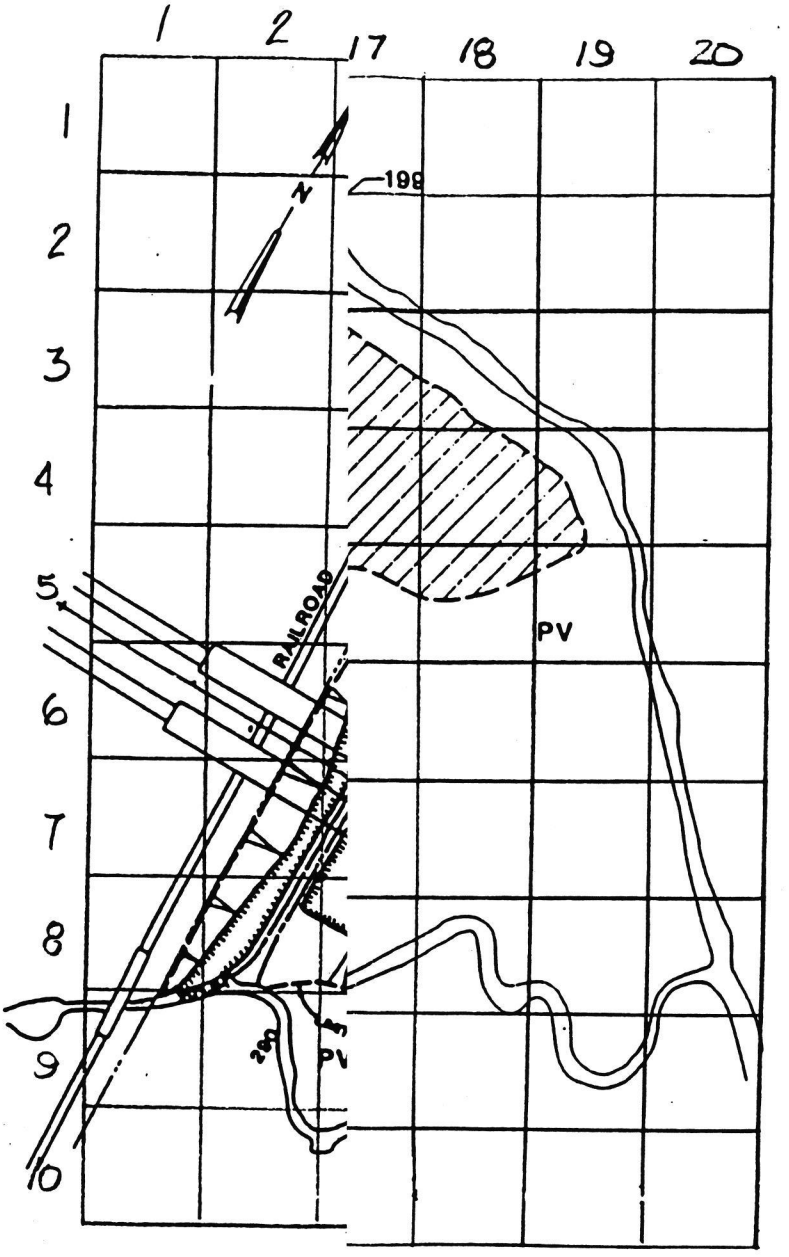
REFERENCES CITED

Gill, Hiram V., Larance, Fred C., and Fortner, Thomas W., 1980, Soil Survey of Jefferson and Lincoln Counties, Arkansas: U. S. Department of Agriculture, Soil Conservation Service, 107 p. + plates.

Kohler, M. A., et al, 1959, Evaporation Maps for the United States: U. S. Weather Bureau, Technical Paper No. 37.

APPENDIX A

PLATE 1--Nevins Creek site map showing configuration of constructed wetlands, approximate locations of observation wells, and model grid positioning.



NEVINS CREI

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Nodal Spacing = 15(

APPENDIX B

Lithologic Descriptions of Water Well Borings for Nevins Creek

Lithologic descriptions of water well borings for TRC-9603
"Bottomland Wetland Reforestation"
Logged by: H. Langston and D. Lumbert

Well #	Depth	Description
NC1010	0-20"	Clay, brown to gray
	20-28"	Sand, medium to large grain-well rounded and sorted-w/ some pea gravel
	28-32"	Sand, large grain w/ well rounded pea gravel
	32-48"	Clay, brown to gray-silty-modeled
NC1020	0-5'	Clay, brown to gray w/ some silt
NC1030	0-5'	Clay, gray w/ fine to medium grain sand
NC1040	0-5'	Fine to medium grain sandy clay, gray
NC1050	0-5'	Fine to medium grain sandy clay, gray
NC1060	0-5'	Sand, medium grain w/ some gray clay. Water flow at 4.5'
NC1070	0-5'	Sandy clay, gray w/ medium to large grain quartz sand near bottom
NC1080	0-10'	Clay, brown w/ fine to medium grain sand
NC1090	0-5'	Clay, brown w/ very fine sand
NC1100	0-3'	Sand, fine to medium grain, gray
	3-5'	Clay, gray w/ silt
NC1110		CORED
NC1120	0-1'	Clay w/ silt, gray
	1-4'	Sand, fine to medium grain-wet at 4.5'
NC1130	0-5'	Sand, medium grain, gray-wet at 5'
NC1140	0-3'	Sand, fine to medium grain, gray
	3-4'	Clay, silty-brown
	4-5'	Sand, medium grain-wet
NC1150	0-2'	Sand, fine to medium grain
	2-5'	Sand, medium grain holding water-clay at bottom
NC1160		CORED
NC1170	0-3'	Clay, gray to brown, silty
	3-4'	Same as above but wet
	4-5'	Clay, w/ fine grain sand, brown to purple
NC1180		CORED
NC1190	0-4'	Clay, silty-brown to light brown
	4-5'	Clay, silty-red
NC1200	0-3'	Clay, silty-red
	3-5'	Clay, silty-brown to light brown (modeled)
NC1210	0-3'	Clay, silty-brown-wet
	3-4'	Clay, red
	4-5'	Clay, sandy-white
NC1220	0-5'	Sand, fine to medium grain-very wet
NC1230	0-3'	Sand, medium grain
	3-4'	Clay, gray w/seams of fine grain sand

NC1240	0-1'	Sand, medium grain
	1-5'	Clay, silty-red
NC1250	0-3'	Sand, very fine grain
	3-5'	Clay, silty-red
NC1260	0-1'	Sand, very fine grain
	1-5'	Clay, silty-red
NC1270	0-1'	Sand, very fine grain
	1-4'	Sand, very fine grain w/ thin layers of gray clay
	4-5'	Sand and pea gravel
NC1280	0-1'	Sand, fine to medium grain w/ layers of yellow to brown clay
	1-4'	Sand, fine to medium grain-gray
	4-5'	Same as above w/ increase in moisture
NC1290	0-4'	Sand, very fine to medium grain w/ clay lenses, white to gray
	4-5'	Pea gravel-very wet
NC1300	0-1'	Silty loam
	1-3'	Clay, gray w/ some silt
	3-4'	Clay, red w/ very fine sand or silt
	4-5'	Clay, gray w/ very fine sand and wet at bottom of hole
NC1310	0-1'	Clay, brown w/ very fine sand
	1-4'	Sand, medium to fine grain-gray in color
	4-5'	Same as above but wet
NC1320	0-4'	Silty loam, w/ interbedded clay, gray
	4-5'	Clay, gray-silty, w/ some fine to medium grain sand
	5-9'	Clay, gray-brown, w/ layers of very fine sand
	9-10'	Sand, fine grain w/ clay layers very wet
NC1330	0-5'	Compacted tan silty loam
	5-7'	Clay, tan-brown
	7-10'	Clay, gray w/ very fine sand
NC1340	0-4'	Sand, fine to medium grain-tan in color
	4-5'	Sand, medium grain, wet
NC1350		CORED
	0-3'	Sandy clay, brown to gray mixed w/ humid material
	3-4'	Clay, brown, w/ fine to medium grain sand
	4-5'	Clay, red to brown

APPENDIX C

Water Level Measurements at Nevins Creek Observation Wells

WATER WELL MEASUREMENTS FOR TRC-9603 "BOTTOMLAND WETLANDS RESTORATION"

WELL NUMBER	DEPTH (cm)	CONDITION	COMMENTS
1010			
1020	49	Water	
1030	139	Dry	
1040	135	Dry	
1050	142	Water	
1060	70	Water	
1070	20	Water	
1080	240	Dry	
1090	139	Dry	
1100	7	Water	
1110	240	Dry	
1120	86	Water	
1130	100	Water	
1140	133	Dry	
1150	168	Water	
1160	240	Dry	
1170	88	Water	
1180	240	Dry	
1190	70	Water	
1200	138	Dry	
1210	49	Water	
1220	137	Dry	
1230	135	Dry	
1240	83	Water	
1250	126	Water	
1260	44	Water	
1270	101	Water	
1280	140	Water	
1290	71	Water	
1300	93	Water	
1310	60	Water	
1320	178	Water	
1330	240	Dry	
1340	122	Water	
1350	25	Water	

DATE: 12/01/95

WATER WELL MEASUREMENTS FOR
TRC-9603 "BOTTOMLAND WETLANDS RESTORATION"

WELL NUMBER	DEPTH (cm)	CONDITION	COMMENTS
1010	55	Water	
1020	135	Dry	
1030	96	Water	
1040	135	Dry	
1050	24	Water	
1060	26	Water	
1070	0	Water	At top of pipe
1080	229	Water	
1090	86	Water	
1100	-		Under water
1110	240	Dry	
1120	46	Water	
1130	89	Water	
1140	107	Water	
1150	103	Water	
1160	240	Dry	
1170	83	Water	
1180	240	Dry	
1190	-		Under water
1200	19	Water	
1210	-		Under water
1220	26	Water	
1230	25	Water	
1240	55	Water	
1250	33	Water	
1260	40	Water	
1270	97	Water	
1280	120	Water	
1290	70	Water	
1300	5	Water	
1310	42	Water	
1320	117	Water	
1330	150	Water	
1340	8	Water	
1350	28	Water	

DATE: 12/18/96

WATER WELL MEASUREMENTS FOR TRC-9603 "BOTTOMLAND WETLANDS RESTORATION"

WELL NUMBER	DEPTH (cm)	CONDITION	COMMENTS
1010	56	Water	
1020	96	Water	
1030	82	Water	
1040	136	Dry	
1050	56	Water	
1060	10	Water	
1070	0	Water at top	
1080	228	Water	
1090	40	Water	
1100	-		Under water
1110	240	Dry	
1120	32	Wet	Well loose
1130	63	Water	
1140	116	Water	
1150	119	Water	
1160	240	Dry	
1170	53	Water	
1180	240	Dry	
1190	-		Under Water
1200	20	Water	
1210	-		Under Water
1220	38	Water	
1230	45	Water	
1240	20	Water	
1250	69	Water	
1260	35	Water	
1270	89	Water	
1280	124	Water	
1290	56	Water	
1300	26	Water	
1310	62	Water	
1320	143	Water	
1330	175	Water	
1340	15	Water	Well loose
1350	29	Water	

DATE: 01/14/96

WATER WELL MEASUREMENTS FOR TRC-9603 "BOTTOMLAND WETLANDS RESTORATION"

WELL NUMBER	DEPTH (cm)	CONDITION	COMMENTS
1010	57	Water	
1020	114	Water	
1030	83	Water	
1040	137	Dry	
1050	58	Water	
1060	8	Water	
1070	0	Water	At top of pipe
1080	225	Water	
1090	55	Water	
1100	-		Under Water
1110	240	Dry	
1120	31	Water	Well loose
1130	60	Water	
1140	97	Water	
1150	119	Water	
1160	240	Dry	
1170	43	Water	
1180	216	Water	
1190	-		Under water
1200	20	Water	
1210	-		Under water
1220	41	Water	
1230	61	Water	
1240	18	Water	
1250	73	Water	
1260	30	Water	
1270	90	Water	
1280	122	Water	
1290	56	Water	
1300	26	Water	
1310	63	Water	
1320	142	Water	
1330	157	Water	
1340	13	Water	Well loose
1350	28	Water	

DATE: 01/29/96

APPENDIX D

Drawdown Test Data and Hydraulic Conductivity Calculations

Highway Mitigation US-65 Bypass
Nevins Creek Project
Pine Bluff, Arkansas
Drawdown Test of Monitoring Wells

Date	31 Jan 1996	Comments
Well#	1050	Did this one twice
Total Well Depth (ft)		
Depth TO Static Water Table (ft)	1.81	
Screen Length (ft)		
Well Diameter (in)		
Casing Diameter (in)	2	

Time (sec)	Depth (ft)
0	3.00
14	2.94
29	2.92
47	2.90
75	2.89
90	2.88
120	2.88
150	2.86
180	2.86
215	2.85
240	2.85
270	2.85
300	2.85

(Second try)

Time (sec)	Depth (ft)
0	3.18
11	Missed reading
23	3.10
29	2.98
36	2.96
41	2.95
49	2.94
68	2.93
115	2.93

AQTESOLV RESULTS
Version 1.10

03/07/96 08:37:05

TEST DESCRIPTION

Data set..... nev1050a.dat
Data set title..... NEVINS CREEK 1050A

Knowns and Constants:
No. of data points..... 8
Radius of well casing..... 0.1667
Radius of well..... 0.5729
Aquifer saturated thickness..... 25
Well screen length..... 4
Static height of water in well..... 1.81
Log(Re/Rw)..... 0.7428
A, B, C..... 1.813, 0.246, 0.000

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	3.4757E-005
y0 =	1.0466E-001

TYPE CURVE DATA

K = 3.47574E-005
y0 = 1.05290E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	1.053E-001	1.800E+002	9.318E-003		

AQTESOLV RESULTS
Version 1.10

03/07/96 08:52:17

TEST DESCRIPTION

Data set..... nev1050b.dat
Data set title..... NEVINS CREEK 1050B

Knowns and Constants:
No. of data points..... 5
Radius of well casing..... 0.1667
Radius of well..... 0.5729
Aquifer saturated thickness..... 25
Well screen length..... 4
Static height of water in well..... 1.81
Log(Re/Rw)..... 0.7428
A, B, C..... 1.813, 0.246, 0.000

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	2.6441E-004
y0 =	û.óUùE-š83

TYPE CURVE DATA

K = 2.64408E-004
y0 = 1.33626E+000

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	1.336E+000	4.900E+001	8.813E-003		

Highway Mitigation US-65 Bypass
Nevins Creek Project
Pine Bluff, Arkansas
Drawdown Test of Monitoring Wells

Date	31 Jan 1996	Comments
Well#	1060	Gravel in first
Total Well Depth (ft)		few bail outs.
Depth TO Static Water Table (ft)	0.03	(8cm)
Screen Length (ft)		
Well Diameter (in)		
Casing Diameter (in)	2	

Time (sec)	Depth (ft)
0	4.32
9	4.30
45	4.28
60	4.26
90	4.24
120	4.22
180	4.20
210	4.18
240	4.16
270	4.15
300	4.13
330	4.11
360	4.10
390	4.08
420	4.07
450	4.05
480	4.02
510	4.01
540	4.00
570	3.99
600	3.98

AQTESOLV RESULTS
Version 1.10

03/07/96 09:09:48

TEST DESCRIPTION

Data set..... nev1060.dat
Data set title..... NEVINS CREEK 1060

Knowns and Constants:
No. of data points..... 19
Radius of well casing..... 0.1667
Radius of well..... 0.5729
Aquifer saturated thickness..... 25
Well screen length..... 4
Static height of water in well..... 0.03
Log(Re/Rw)..... 50.73
A, B, C..... 1.813, 0.246, 0.000

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	3.2731E-002
y0 =	0.0000E+000

TYPE CURVE DATA

K = 3.27312E-002
y0 = 3.40816E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	3.408E-001	1.000E+001	5.319E-002		

Highway Mitigation US-65 Bypass
Nevins Creek Project
Pine Bluff, Arkansas
Drawdown Test of Monitoring Wells

Date	31 Jan 1996	Comments
Well#	1070	first well
Total Well Depth (ft)		(note sure about time 0 sec)
Depth TO Static Water Table (ft)	0.04	(13cm)
Screen Length (ft)		
Well Diameter (in)		
Casing Diameter (in)	2	

Time (sec)	Depth (ft)
10	3.10
23	2.70
31	2.50
44	2.25
60	2.00
100	1.78
130	1.60
139	1.50
147	1.43
154	1.38
202	1.30
210	1.25
223	1.20
232	1.12
237	1.10
246	1.05
256	1.00
311	0.95
326	0.90
344	0.85
497	0.80
439	0.75
511	0.70

AQTESOLV RESULTS
Version 1.10

03/07/96 20:06:26

TEST DESCRIPTION

Data set..... nev1070.dat
Data set title..... NEVINS CREEK 1070

Knowns and Constants:
No. of data points..... 22
Radius of well casing..... 0.1667
Radius of well..... 0.5729
Aquifer saturated thickness..... 50
Well screen length..... 4
Static height of water in well..... 0.04
Log(Re/Rw)..... 261
A, B, C..... 1.813, 0.246, 0.000

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	4.0756E-001
y0 =	2.7822E-308

TYPE CURVE DATA

K = 4.07555E-001
y0 = 2.32374E+000

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	2.324E+000	9.000E+000	4.067E-002		

Highway Mitigation US-65 Bypass
Nevins Creek Project
Pine Bluff, Arkansas
Drawdown Test of Monitoring Wells

Date	31 Jan 1996	Comments
Well#	1150	Well top 3.58'
Total Well Depth (ft)		above ground.
Depth TO Static Water Table (ft)	3.54	Gravel in first
Screen Length (ft)		few bail outs.
Well Diameter (in)		
Casing Diameter (in)	2	

Time (sec)	Depth (ft)
0	5.44
6	5.18
10	5.04
20	4.78
25	4.64
31	4.54
38	4.45
45	4.36
50	4.31
53	4.29
57	4.25
61	4.22
67	4.18
71	4.15
76	4.11
81	4.09
87	4.05
92	4.03
102	4
115	3.95
132	3.90
162	3.85
206	3.80
240	3.76
270	3.73
300	3.71
330	3.71
360	3.70

AQTESOLV RESULTS
Version 1.10

03/07/96 10:26:31

TEST DESCRIPTION

Data set..... nev1150.dat
Data set title..... NEVINS CREEK 1150

Knowns and Constants:
No. of data points..... 25
Radius of well casing..... 0.1667
Radius of well..... 0.5729
Aquifer saturated thickness..... 25
Well screen length..... 9
Static height of water in well..... 3.54
Log(Re/Rw)..... 1.243
A, B, C..... 2.038, 0.306, 0.000

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	1.6678E-003
y0 =	4.8384E+113

TYPE CURVE DATA

K = 1.66781E-003
y0 = 1.34539E+000

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	1.345E+000	5.000E+000	1.745E-002		

Highway Mitigation US-65 Bypass
Nevins Creek Project
Pine Bluff, Arkansas
Drawdown Test of Monitoring Wells

Date	31 Jan 1996	Comments
Well#	1170	
Total Well Depth (ft)		
Depth TO Static Water Table (ft)	1.38	
Screen Length (ft)		
Well Diameter (in)		
Casing Diameter (in)	2	

Time (sec)	Depth (ft)
0	4.20
9	4.16
17	4.13
26	4.10
31	4.08
37	4.06
44	4.04
50	4.02
57	4.00
63	3.98
69	3.96
77	3.94
84	3.92
92	3.90
99	3.88
106	3.86
113	3.84
122	3.82
130	3.80
137	3.78
145	3.76
153	3.74
159	3.72
169	3.70
174	3.68
182	3.66
190	3.64
199	3.62
207	3.60
215	3.58
224	3.56
231	3.54
241	3.52
250	3.50
260	3.48
269	3.46
277	3.44

286	3.42
293	3.40
304	3.38
314	3.36
324	3.34
334	3.32
345	3.30
355	3.28
366	3.26
376	3.24
387	3.22
397	3.20
407	3.18
420	3.16
431	3.14
445	3.12
455	3.10
468	3.08
480	3.06
497	3.04
508	3.02
521	3.00
540	2.95
549	2.95
570	2.91
600	2.87

AQTESOLV RESULTS
Version 1.10

03/07/96 10:49:24

TEST DESCRIPTION

Data set..... nev1170.dat
Data set title..... NEVINS CREEK 1170

Knowns and Constants:
No. of data points..... 60
Radius of well casing..... 0.1667
Radius of well..... 0.5729
Aquifer saturated thickness..... 25
Well screen length..... 4
Static height of water in well..... 1.38
Log(Re/Rw)..... 0.609
A, B, C..... 1.813, 0.246, 0.000

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	5.6847E-004
y0 =	3.7247E-280

TYPE CURVE DATA

K = 5.68469E-004
y0 = 1.67025E+000

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	1.670E+000	1.000E+001	1.137E-001		

TYPE CURVE DATA

K = 3.76732E-004
y0 = 1.28405E+000

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	1.284E+000	1.000E+001	2.164E-001		

Highway Mitigation US-65 Bypass
Nevins Creek Project
Pine Bluff, Arkansas
Drawdown Test of Monitoring Wells

Date	31 Jan 1996	Comments
Well#	1180	2 attempts
Total Well Depth (ft)		"pretty white sand"
Depth TO Static Water Table (ft)	7.18	when hole bas bored
Screen Length (ft)		(Henry)
Well Diameter (in)		
Casing Diameter (in)	2	

Time (sec)	Depth (ft)
0	7.70
10	7.65
16	7.64
30	7.62
60	7.62
90	7.61
120	7.61
180	7.60

(Second attempt)

Time (sec)	Depth (ft)
0	7.72
5	7.68
12	7.66
17	7.65
36	7.64
53	7.63
120	7.63

AQTESOLV RESULTS
Version 1.10

03/07/96 10:54:47

TEST DESCRIPTION

Data set..... nev11801.dat
Data set title..... NEVINS CREEK 1180A

Knowns and Constants:
No. of data points..... 6
Radius of well casing..... 0.1667
Radius of well..... 0.5279
Aquifer saturated thickness..... 25
Well screen length..... 9
Static height of water in well..... 7.18
Log(Re/Rw)..... 1.644
A, B, C..... 2.072, 0.316, 0.000

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	2.1706E-003
y0 =	3.7247E-280

TYPE CURVE DATA

K = 2.17056E-003
y0 = 4.50350E-002

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	4.504E-002	2.000E+000	8.142E-003		

AQTESOLV RESULTS
Version 1.10

03/07/96 10:56:34

TEST DESCRIPTION

Data set..... nev1180b.dat
Data set title..... NEVINS CREEK 1180B

Knowns and Constants:
No. of data points..... 4
Radius of well casing..... 0.1667
Radius of well..... 0.5279
Aquifer saturated thickness..... 25
Well screen length..... 9
Static height of water in well..... 7.18
Log(Re/Rw)..... 1.644
A, B, C..... 2.072, 0.316, 0.000

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	7.6266E-003
y0 =	3.7247E-280

TYPE CURVE DATA

K = 7.62664E-003
y0 = 5.61936E-002

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	5.619E-002	1.000E+000	2.784E-003		

Highway Mitigation US-65 Bypass
Nevins Creek Project
Pine Bluff, Arkansas
Drawdown Test of Monitoring Wells

Date	31 Jan 1996	Comments
Well#	1200	
Total Well Depth (ft)		
Depth TO Static Water Table (ft)	0.55	
Screen Length (ft)		
Well Diameter (in)		
Casing Diameter (in)	2	

Time (sec)	Depth (ft)
0	3.20
3	3.15
8	3.14
20	3.12
40	3.10
60	3.09
90	3.08
120	3.07
150	3.06
180	3.05
210	3.04
240	3.03
270	3.03
300	3.02
330	3.02
360	3.01
390	3.00
420	3.00
450	3.00
480	2.99

AQTESOLV RESULTS
Version 1.10

03/07/96 10:59:01

TEST DESCRIPTION

Data set..... nev1200.dat
Data set title..... NEVINS CREEK 1200

Knowns and Constants:
No. of data points..... 18
Radius of well casing..... 0.1667
Radius of well..... 0.5279
Aquifer saturated thickness..... 25
Well screen length..... 4
Static height of water in well..... 0.55
Log(Re/Rw)..... 0.03678
A, B, C..... 1.833, 0.248, 0.000

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	4.6443E-005
y0 =	3.7247E-280

TYPE CURVE DATA

K = 4.64431E-005
y0 = 1.61654E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	1.617E-001	8.000E+000	8.822E-003		

Highway Mitigation US-65 Bypass
Nevins Creek Project
Pine Bluff, Arkansas
Drawdown Test of Monitoring Wells

Date	31 Jan 1996	Comments
Well#	1240	Water level
Total Well Depth (ft)		oscillations
Depth TO Static Water Table (ft)	0.51	when cap removed
Screen Length (ft)		
Well Diameter (in)		
Casing Diameter (in)	2	

Time (sec)	Depth (ft)
0	3.00
6	2.85
10	2.75
13	2.70
17	2.65
19	2.60
21	2.55
23	2.50
26	2.45
30	2.40
33	2.35
36	2.30
39	2.25
42	2.20
46	2.15
50	2.10
54	2.05
58	2.00
62	1.95
66	1.90
71	1.85
75	1.80
80	1.75
85	1.70
90	1.65
95	1.60
101	1.55
108	1.50
114	1.45
120	1.40
121	1.35
135	1.30
143	1.25
151	1.20
160	1.15
170	1.10
180	1.05

191	1.00
204	0.95
218	0.90
233	0.85
249	0.80
268	0.75
293	0.70
322	0.65

AQTESOLV RESULTS
Version 1.10

03/07/96 20:46:31

TEST DESCRIPTION

Data set..... nev1240.dat
Data set title..... NEVINS CREEK 1240

Knowns and Constants:
No. of data points..... 43
Radius of well casing..... 0.1667
Radius of well..... 0.5
Aquifer saturated thickness..... 50
Well screen length..... 4
Static height of water in well..... 0.51
Log(Re/Rw)..... 0.01788
A, B, C..... 1.846, 0.250, 0.000

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	4.1931E-005
y0 =	1.0000E-004

TYPE CURVE DATA

K = 3.63264E-005
y0 = 2.34658E+000

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	2.347E+000	5.000E+000	1.260E-001		

Highway Mitigation US-65 Bypass
Nevins Creek Project
Pine Bluff, Arkansas
Drawdown Test of Monitoring Wells

Date	31 Jan 1996	Comments
Well#	1300	
Total Well Depth (ft)		
Depth TO Static Water Table (ft)	0.83	
Screen Length (ft)		
Well Diameter (in)		
Casing Diameter (in)	2	

Time (sec)	Depth (ft)
0	2.50
6	2.48
25	2.46
49	2.45
60	2.45
90	2.44
120	2.44
150	2.43
180	2.42
240	2.42

AQTESOLV RESULTS
Version 1.10

03/07/96 19:44:43

TEST DESCRIPTION

Data set..... nev1300.dat
Data set title..... NEVINS CREEK 1300

Knowns and Constants:
No. of data points..... 5
Radius of well casing..... 0.1667
Radius of well..... 0.5729
Aquifer saturated thickness..... 25
Well screen length..... 4
Static height of water in well..... 0.83
Log(Re/Rw)..... 0.2977
A, B, C..... 1.813, 0.246, 0.000

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	7.3717E-004
y0 =	-1.3965E+001

TYPE CURVE DATA

K = 7.37173E-004
y0 = 5.78478E-002

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	5.785E-002	3.000E+000	6.817E-003		

Highway Mitigation US-65 Bypass
Nevins Creek Project
Pine Bluff, Arkansas
Drawdown Test of Monitoring Wells

Date	31 Jan 1996	Comments
Well#	1320	
Total Well Depth (ft)		
Depth TO Static Water Table (ft)	4.62	
Screen Length (ft)		
Well Diameter (in)		
Casing Diameter (in)	2	

Time (sec)	Depth (ft)
0	8.12
28	8.05
60	8.03
90	8.03
120	8.02
180	8.01
240	7.99
300	7.97

AQTESOLV RESULTS
Version 1.10

03/07/96 19:46:23

TEST DESCRIPTION

Data set..... nev1320.dat
Data set title..... NEVINS CREEK 1320

Knowns and Constants:
No. of data points..... 6
Radius of well casing..... 0.1667
Radius of well..... 0.5729
Aquifer saturated thickness..... 25
Well screen length..... 4
Static height of water in well..... 4.62
Log(Re/Rw)..... 1.096
A, B, C..... 1.813, 0.246, 0.000

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	1.3515E-003
y0 =	-1.3965E+001

TYPE CURVE DATA

K = 1.35148E-003
y0 = 9.64937E-002

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	9.649E-002	4.000E+000	2.332E-002		

TYPE CURVE DATA

K = 1.35148E-003
y0 = 9.64937E-002

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	9.649E-002	4.000E+000	2.332E-002		

Highway Mitigation US-65 Bypass
Nevins Creek Project
Pine Bluff, Arkansas
Drawdown Test of Monitoring Wells

Date	31 Jan 1996	Comments
Well#	1330	Edge of tree line
Total Well Depth (ft)		
Depth TO Static Water Table (ft)	5.38	
Screen Length (ft)		
Well Diameter (in)		
Casing Diameter (in)	2	

Time (sec)	Depth (ft)
0	7.71
13	7.68
33	7.67
69	7.66
90	7.66
120	7.65
180	7.64
240	7.64
300	7.63

AQTESOLV RESULTS
Version 1.10

03/07/96 19:48:07

TEST DESCRIPTION

Data set..... nev1330.dat
Data set title..... NEVINS CREEK 1330

Knowns and Constants:
No. of data points..... 7
Radius of well casing..... 0.1667
Radius of well..... 0.5729
Aquifer saturated thickness..... 25
Well screen length..... 9
Static height of water in well..... 5.38
Log(Re/Rw)..... 1.45
A, B, C..... 2.038, 0.306, 0.000

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	1.0340E-003
y0 =	-1.3965E+001

TYPE CURVE DATA

K = 1.03396E-003
y0 = 5.26224E-002

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	5.262E-002	4.000E+000	8.291E-003		

Highway Mitigation US-65 Bypass
Nevins Creek Project
Pine Bluff, Arkansas
Drawdown Test of Monitoring Wells

Date	31 Jan 1996	Comments
Well#	1340	Edge of tree line
Total Well Depth (ft)		
Depth TO Static Water Table (ft)	0.04 (11cm)	
Screen Length (ft)		
Well Diameter (in)		
Casing Diameter (in)	2	

Time (sec)	Depth (ft)
0	2.20
9	1.95
14	1.82
30	1.69
37	1.57
34	1.49
40	1.40
44	1.35
51	1.30
55	1.25
58	1.20
64	1.15
70	1.10
78	1.05
85	1.00
96	0.95
105	0.90
117	0.85
132	0.80
149	0.75
172	0.70
198	0.65
240	0.60

AQTESOLV RESULTS
Version 1.10

03/07/96 20:01:35

TEST DESCRIPTION

Data set..... nev1340.dat
Data set title..... NEVINS CREEK 1340

Knowns and Constants:
No. of data points..... 21
Radius of well casing..... 0.1667
Radius of well..... 0.5729
Aquifer saturated thickness..... 50
Well screen length..... 4
Static height of water in well..... 0.04
Log(Re/Rw)..... 261
A, B, C..... 1.813, 0.246, 0.000

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	9.0024E-001
y0 =	2.7822E-308

TYPE CURVE DATA

K = 9.00244E-001
y0 = 1.63334E+000

Time	Drawdown	Time	Drawdown	Time	Drawdown
0,000E+000	1.633E+000	4.000E+000	3.078E-002		

APPENDIX E

Matrices of Input Parameters

MODFLOW INPUT PARAMETER MATRIX OF NEVINS CREEK SIMULATION

INPUT PARAMETER: CELL STATUS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	-1	0	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	0	0	0	0
2	0	0	0	1	-1	-1	-1	-1	-1	1	1	1	1	1	1	1	-1	0	0	0
3	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-1	0	0
4	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-1	0
5	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-1	0
6	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-1
7	0	1	1	1	1	-1	-1	1	1	1	1	1	1	-1	-1	1	1	1	1	-1
8	1	1	1	1	-1	0	0	-1	-1	-1	1	-1	-1	-1	0	-1	-1	-1	1	-1
9	-1	1	1	1	-1	0	0	0	0	0	-1	-1	0	0	0	0	0	0	-1	-1
10	0	0	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

(-1 = Specified Head Boundary, 0 = Inactive Cell, 1 = Active Cell)

INPUT PARAMETER: HYDRAULIC CONDUCTIVITY

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
2	999	999	999	14.4	999	999	999	999	999	14.4	1.44	1.44	1.44	1.44	1.44	1.44	999	999	999	999
3	999	999	999	14.4	14.4	14.4	14.4	14.4	1.44	1.44	0.144	0.144	0.144	1.44	1.44	1.44	1.44	999	999	999
4	999	999	999	1.44	1.44	1.44	1.44	0.144	0.144	0.0144	0.144	14.4	14.4	14.4	14.4	14.4	14.4	14.4	999	999
5	999	999	14.4	1.44	0.144	0.144	0.144	0.144	0.144	0.144	1.44	14.4	14.4	14.4	14.4	14.4	14.4	14.4	999	999
6	999	999	14.4	0.144	1.44	1.44	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	999
7	999	14.4	14.4	14.4	14.4	999	999	144	14.4	14.4	14.4	14.4	14.4	999	999	14.4	14.4	14.4	14.4	999
8	1.44	1.44	1.44	1.44	999	999	999	999	999	999	14.4	999	999	999	999	999	999	999	999	999
9	999	999	14.4	14.4	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
10	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999

(999 = Inactive Cell; Values in ft/day)

MODFLOW INPUT PARAMETER MATRIX OF NEVINS CREEK SIMULATION

INPUT PARAMETER: HYDRAULIC HEADS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	999	999	999	200	999	999	999	999	999	199	199	199	199	198	198	198	999	999	999	999
2	999	999	999	201	200	200	200	200	199	199.1	198	199	199	197.9	198	199	198	999	999	999
3	999	999	999	202	200	200	200	200	198.6	199.4	198.2	199	200.2	200	199	199	198	197	999	999
4	999	999	999	202	199	201	200.6	200	200	200	199	198.7	200	200	200	199	199	198	197	999
5	999	999	200.5	201	201	201	201	201	201.3	200	199.9	200	200	200	200	199	199	198	197	999
6	999	999	202	202	200.1	201.7	201	201	201.2	201	202	201	200	199	199	199	199	198	197	196
7	999	202	202	201.3	200.3	200	200	200	200	200	202	199	198	198	197	198	198	197	197	196
8	201	201	201	201	200	999	999	199	199	199	199.6	198	198	198	999	197	197	197	197	196
9	201	201	201	201	200	999	999	999	999	999	199	198	999	999	999	999	999	999	196	195
10	999	999	201	200	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999

(Values are elevations in feet MSL)

INPUT PARAMETER: EVAPOTRANSPIRATION SURFACE ELEVATIONS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
2	999	999	999	203	999	999	999	999	999	202	202	200	201	200	201	200	999	999	999	999
3	999	999	999	203	201	202	201	201	201	200	200	200	201	202	202	202	202	999	999	999
4	999	999	999	204	201	202	202	204	204	202	201	200	201	202	202	202	202	202	999	999
5	999	999	205	203	203	202	204	204	202	202	205	205	203	203	203	203	202	202	999	999
6	999	999	204	204	202	202	202	202	203	202	204	205	204	203	203	203	203	202	201	999
7	999	204	204	204	204	999	999	203	203	203	204	204	203	999	999	203	203	203	201	999
8	203	203	202	202	999	999	999	999	999	999	200	999	999	999	999	999	999	999	200	999
9	999	999	202	203	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
10	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999

(Values are elevation in feet MSL)

MODFLOW INPUT PARAMETER MATRIX OF NEVINS CREEK SIMULATION

INPUT PARAMETER: EVAPOTRANSPIRATION RATE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
2	999	999	999	0.001142	999	999	999	999	999	0.001142	0.001142	0.001142	0.001142	0.001142	0.001142	0.001142	999	999	999	999
3	999	999	999	0.001142	0.001142	0.001142	0.001142	0.001142	0.001142	0.001142	0.001142	0.001142	0.001142	0.006849	0.001142	0.001142	0.001142	999	999	999
4	999	999	999	0.001142	0.001142	0.001142	0.001142	0.001142	0.001142	0.001142	0.001142	0.001142	0.006849	0.006849	0.006849	0.006849	0.001142	0.001142	999	999
5	999	999	0.001142	0.001142	0.001142	0.001142	0.001142	0.001142	0.001142	0.001142	0.006849	0.006849	0.006849	0.006849	0.006849	0.006849	0.006849	0.006849	999	999
6	999	999	0.001142	0.001142	0.001142	0.001142	0.001142	0.001142	0.001142	0.006849	0.006849	0.006849	0.006849	0.006849	0.006849	0.006849	0.006849	0.006849	0.006849	999
7	999	0.001142	0.001142	0.001142	0.001142	999	999	0.006849	0.006849	0.006849	0.006849	0.006849	0.006849	999	999	0.006849	0.006849	0.006849	0.006849	999
8	0.001142	0.001142	0.001142	0.001142	999	999	999	999	999	999	0.006849	999	999	999	999	999	999	999	999	999
9	999	999	0.001142	0.001142	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
10	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999

(Values are in feet/day; Extinction depth set at 6 feet for entire grid)

INPUT PARAMETER: RECHARGE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
2	999	999	999	0.006055	999	999	999	999	999	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	999	999	999	999
3	999	999	999	0.006055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	999	999	999
4	999	999	999	0.002455	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	999	999
5	999	999	0.002455	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	999	999
6	999	999	0.002455	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	999
7	999	0.006055	0.002055	0.002055	0.002055	999	999	0.002055	0.002055	0.002055	0.002055	0.002055	0.002055	999	999	0.002055	0.002055	0.002055	0.002055	999
8	0.002455	0.002055	0.002055	0.002055	999	999	999	999	999	999		999	999	999	999	999	999	999	999	999
9	999	999	0.002055	0.002055	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
10	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999

(Values are in feet/day)

APPENDIX F

MODFLOW Input/Output Files

```
1                  U.S. GEOLOGICAL SURVEY MODULAR FINITE-DIFFERENCE GROUND-WATER MODEL
ONEVINS CREEK                                                                DOUG MELTON
    1 LAYERS        10 ROWS        20 COLUMNS
   1 STRESS PERIOD(S) IN SIMULATION
 MODEL TIME UNIT IS DAYS
OI/O UNITS:
 ELEMENT OF IUNIT:  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
         I/O UNIT: 11  0  0  0 15  0  0 18 19  0  0 22  0  0  0  0  0  0  0  0  0  0  0  0
OBAS1 -- BASIC MODEL PACKAGE, VERSION 1, 9/1/87 INPUT READ FROM UNIT  1
 ARRAYS RHS AND BUFF WILL SHARE MEMORY.
 START HEAD WILL BE SAVED
     1834 ELEMENTS IN X ARRAY ARE USED BY BAS
     1834 ELEMENTS OF X ARRAY USED OUT OF  517000
OBCF2 -- BLOCK-CENTERED FLOW PACKAGE, VERSION 2, 7/1/91 INPUT READ FROM UNIT 11
 STEADY-STATE SIMULATION
 CONSTANT HEAD CELL-BY-CELL FLOWS WILL BE PRINTED
 HEAD AT CELLS THAT CONVERT TO DRY=  0.00000
 WETTING CAPABILITY IS NOT ACTIVE
      LAYER  AQUIFER TYPE
      ------------------
         1         1
      401 ELEMENTS IN X ARRAY ARE USED BY BCF
     2235 ELEMENTS OF X ARRAY USED OUT OF  517000
ORCH1 -- RECHARGE PACKAGE, VERSION 1, 9/1/87 INPUT READ FROM UNIT 18
 OPTION 1 -- RECHARGE TO TOP LAYER
 CELL-BY-CELL FLOW TERMS WILL BE RECORDED ON UNIT 28
      200 ELEMENTS OF X ARRAY USED FOR RECHARGE
     2435 ELEMENTS OF X ARRAY USED OUT OF  517000
OEVT1 -- EVAPOTRANSPIRATION PACKAGE, VERSION 1, 9/1/87 INPUT READ FROM UNIT 15
 OPTION 1 -- EVAPOTRANSPIRATION FROM TOP LAYER
 CELL-BY-CELL FLOW TERMS WILL BE SAVED ON UNIT 27
      600 ELEMENTS OF X ARRAY USED FOR EVAPOTRANSPIRATION
     3035 ELEMENTS OF X ARRAY USED OUT OF  517000
OSIP1 -- STRONGLY IMPLICIT PROCEDURE SOLUTION PACKAGE, VERSION 1, 9/1/87 INPUT READ FROM UNIT 19
 MAXIMUM OF  50 ITERATIONS ALLOWED FOR CLOSURE
  5 ITERATION PARAMETERS
     1005 ELEMENTS IN X ARRAY ARE USED BY SIP
     4040 ELEMENTS OF X ARRAY USED OUT OF  517000
1NEVINS CREEK                                                                DOUG MELTON
0
```

BOUNDARY ARRAY FOR LAYER 1 WILL BE READ ON UNIT 1 USING FORMAT: (4012)

```
       1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20
 ------------------------------------------------------------
0  1   0  0  0 -1  0  0  0  0  0 -1 -1 -1 -1 -1 -1 -1  0  0  0  0
0  2   0  0  0  1 -1 -1 -1 -1 -1 -1  0  0  0  0  0  0  0 -1  0  0  0
0  3   0  0  0  1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1  0  0
0  4   0  0  0  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1  0
0  5   0  0  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1  0
0  6   0  0  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1 -1
0  7   0  1  1  1  1 -1 -1  1  1  1  1  1  1 -1 -1  1  1  1  1 -1
0  8   1  1  1  1 -1  0  0 -1 -1 -1  1 -1 -1 -1 -1  0 -1 -1 -1  1 -1
0  9  -1 -1  1  1 -1  0  0  0  0  0 -1 -1  0  0  0  0  0  0 -1 -1
0 10   0  0 -1 -1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
OAQUIFER HEAD WILL BE SET TO  999.00     AT ALL NO-FLOW NODES (IBOUND=0).
0
```

INITIAL HEAD FOR LAYER 1 WILL BE READ ON UNIT 1 USING FORMAT: (7G11.4)

```
          1           2           3           4           5           6           7           8           9          10
         11          12          13          14          15          16          17          18          19          20
```

0 1	999.0	999.0	999.0	200.0	999.0	999.0	999.0	999.0	999.0	199.0
	199.0	199.0	199.0	198.0	198.0	198.0	999.0	999.0	999.0	999.0
0 2	999.0	999.0	999.0	201.0	200.0	200.0	200.0	200.0	199.0	199.1
	198.0	199.0	199.0	197.9	198.0	199.0	198.0	999.0	999.0	999.0
0 3	999.0	999.0	999.0	202.0	200.0	200.0	200.0	200.0	198.6	199.4
	198.2	199.0	200.2	200.0	199.0	199.0	198.0	197.0	999.0	999.0
0 4	999.0	999.0	999.0	202.0	199.0	201.0	200.6	200.0	200.0	200.0
	199.0	198.7	200.0	200.0	200.0	199.0	199.0	198.0	197.0	999.0
0 5	999.0	999.0	200.5	201.0	201.0	201.0	201.0	201.0	201.3	200.0
	199.9	200.0	200.0	200.0	200.0	199.0	199.0	198.0	197.0	999.0
0 6	999.0	999.0	202.0	202.0	200.1	201.7	201.0	201.0	201.2	201.0
	202.0	201.0	200.0	199.0	199.0	199.0	199.0	198.0	197.0	196.0
0 7	999.0	202.0	202.0	201.3	200.3	200.0	200.0	200.0	200.0	200.0
	202.0	199.0	198.0	198.0	197.0	198.0	198.0	197.0	197.0	196.0
0 8	201.0	201.0	201.0	201.0	200.0	999.0	999.0	199.0	199.0	199.0
	199.6	198.0	198.0	198.0	999.0	197.0	197.0	197.0	197.0	196.0
0 9	201.0	201.0	201.0	201.0	200.0	999.0	999.0	999.0	999.0	999.0
	199.0	198.0	999.0	999.0	999.0	999.0	999.0	999.0	196.0	195.0
0 10	999.0	999.0	201.0	200.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0

OHEAD PRINT FORMAT IS FORMAT NUMBER 2 DRAWDOWN PRINT FORMAT IS FORMAT NUMBER 2
OHEADS WILL BE SAVED ON UNIT 24 DRAWDOWNS WILL BE SAVED ON UNIT 25
OOUTPUT CONTROL IS SPECIFIED EVERY TIME STEP
0 COLUMN TO ROW ANISOTROPY = 1.000000
0 DELR = 150.0000
0 DELC = 150.0000
0

HYD. COND. ALONG ROWS FOR LAYER 1 WILL BE READ ON UNIT 11 USING FORMAT: (7G11.4)

	1 11	2 12	3 13	4 14	5 15	6 16	7 17	8 18	9 19	10 20
0 1	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
0 2	999.0	999.0	999.0	14.40	999.0	999.0	999.0	999.0	999.0	14.40
	1.440	1.440	1.440	1.440	1.440	1.440	999.0	999.0	999.0	999.0
0 3	999.0	999.0	999.0	14.40	14.40	14.40	14.40	14.40	1.440	1.440
	0.1440	0.1440	0.1440	1.440	1.440	1.440	1.440	999.0	999.0	999.0
0 4	999.0	999.0	999.0	1.440	1.440	1.440	1.440	0.1440	0.1440	1.4400E-02
	0.1440	14.40	14.40	14.40	14.40	14.40	14.40	14.40	999.0	999.0
0 5	999.0	999.0	14.40	1.440	0.1440	0.1440	0.1440	0.1440	0.1440	0.1440
	1.440	14.40	14.40	14.40	14.40	14.40	14.40	14.40	999.0	999.0
0 6	999.0	999.0	14.40	0.1440	1.440	1.440	14.40	14.40	14.40	14.40
	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	14.40	999.0
0 7	999.0	14.40	14.40	14.40	14.40	999.0	999.0	144.0	14.40	14.40
	14.40	14.40	14.40	999.0	999.0	14.40	14.40	14.40	14.40	999.0
0 8	1.440	1.440	1.440	1.440	999.0	999.0	999.0	999.0	999.0	999.0
	14.40	999.0	999.0	999.0	999.0	999.0	999.0	999.0	14.40	999.0
0 9	999.0	999.0	14.40	14.40	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
0 10	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0

0 BOTTOM = 175.0000 FOR LAYER 1
0

SOLUTION BY THE STRONGLY IMPLICIT PROCEDURE

0 MAXIMUM ITERATIONS ALLOWED FOR CLOSURE = 50
ACCELERATION PARAMETER = 1.0000
HEAD CHANGE CRITERION FOR CLOSURE = 0.10000E-02
SIP HEAD CHANGE PRINTOUT INTERVAL = 1

0
5 ITERATION PARAMETERS CALCULATED FROM SPECIFIED WSEED = 0.00100000 :

0.0000000E+00 0.8221720E+00 0.9683772E+00 0.9943766E+00 0.9990000E+00

1 STRESS PERIOD NO. 1, LENGTH = 365.0000

NUMBER OF TIME STEPS = 12

MULTIPLIER FOR DELT = 1.000

INITIAL TIME STEP SIZE = 30.41667

0

RECHARGE WILL BE READ ON UNIT 18 USING FORMAT: (7G11.4)

	1	2	3	4	5	6	7	8	9	10
	11	12	13	14	15	16	17	18	19	20
0 1	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
0 2	999.0	999.0	999.0	6.0550E-03	999.0	999.0	999.0	999.0	999.0	2.0550E-03
	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	999.0	999.0	999.0	999.0
0 3	999.0	999.0	999.0	6.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03
	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	999.0	999.0	999.0
0 4	999.0	999.0	999.0	2.4550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	1.0280E-03
	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	999.0	999.0
0 5	999.0	999.0	6.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03
	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	999.0	999.0
0 6	999.0	999.0	6.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03
	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	999.0
0 7	999.0	6.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	999.0	999.0	2.0550E-03	2.0550E-03	2.0550E-03
	2.0550E-03	2.0550E-03	2.0550E-03	999.0	999.0	2.0550E-03	2.0550E-03	2.0550E-03	2.0550E-03	999.0
0 8	2.4550E-03	2.0550E-03	2.0550E-03	2.0550E-03	999.0	999.0	999.0	999.0	999.0	999.0
	2.0550E-03	999.0	999.0	999.0	999.0	999.0	999.0	999.0	2.0550E-03	999.0
0 9	999.0	999.0	2.0550E-03	2.0550E-03	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
0 10	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0

0

ET SURFACE WILL BE READ ON UNIT 15 USING FORMAT: (7G11.4)

	1	2	3	4	5	6	7	8	9	10
	11	12	13	14	15	16	17	18	19	20
0 1	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
0 2	999.0	999.0	999.0	203.0	999.0	999.0	999.0	999.0	999.0	202.0
	202.0	200.0	201.0	200.0	201.0	200.0	999.0	999.0	999.0	999.0
0 3	999.0	999.0	999.0	203.0	201.0	202.0	201.0	201.0	201.0	200.0
	200.0	200.0	201.0	202.0	202.0	202.0	202.0	999.0	999.0	999.0
0 4	999.0	999.0	999.0	204.0	201.0	202.0	202.0	204.0	204.0	202.0
	201.0	200.0	201.0	202.0	202.0	202.0	202.0	202.0	999.0	999.0
0 5	999.0	999.0	205.0	203.0	203.0	203.0	204.0	204.0	202.0	202.0
	205.0	205.0	203.0	203.0	203.0	203.0	203.0	202.0	999.0	999.0
0 6	999.0	999.0	204.0	204.0	202.0	202.0	202.0	202.0	203.0	202.0
	205.0	205.0	204.0	203.0	203.0	203.0	203.0	202.0	201.0	999.0
0 7	999.0	204.0	204.0	204.0	204.0	999.0	999.0	203.0	203.0	203.0
	204.0	204.0	203.0	999.0	999.0	203.0	203.0	203.0	201.0	999.0
0 8	203.0	203.0	202.0	202.0	999.0	999.0	999.0	999.0	999.0	999.0
	200.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	200.0	999.0

0 9	999.0	999.0	202.0	202.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
0 10	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0

0

EVAPOTRANSPIRATION RATE WILL BE READ ON UNIT 15 USING FORMAT: (7G11.4)

	1	2	3	4	5	6	7	8	9	10
	11	12	13	14	15	16	17	18	19	20
0 1	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
0 2	999.0	999.0	999.0	1.1420E-03	999.0	999.0	999.0	999.0	999.0	1.1420E-03
	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	999.0	999.0	999.0	999.0
0 3	999.0	999.0	999.0	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03
	1.1420E-03	1.1420E-03	1.1420E-03	6.8490E-03	1.1420E-03	1.1420E-03	1.1420E-03	999.0	999.0	999.0
0 4	999.0	999.0	999.0	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03
	1.1420E-03	1.1420E-03	6.8490E-03	6.8490E-03	6.8490E-03	6.8490E-03	1.1420E-03	1.1420E-03	999.0	999.0
0 5	999.0	999.0	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03
	6.8490E-03	6.8490E-03	6.8490E-03	6.8490E-03	6.8490E-03	6.8490E-03	6.8490E-03	6.8490E-03	999.0	999.0
0 6	999.0	999.0	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	6.8490E-03
	6.8490E-03	6.8490E-03	6.8490E-03	6.8490E-03	6.8490E-03	6.8490E-03	6.8490E-03	6.8490E-03	6.8490E-03	999.0
0 7	999.0	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	999.0	999.0	6.8490E-03	6.8490E-03	6.8490E-03
	6.8490E-03	6.8490E-03	6.8490E-03	999.0	999.0	6.8490E-03	6.8490E-03	6.8490E-03	6.8490E-03	999.0
0 8	1.1420E-03	1.1420E-03	1.1420E-03	1.1420E-03	999.0	999.0	999.0	999.0	999.0	999.0
	6.8490E-03	999.0	999.0	999.0	999.0	999.0	999.0	999.0	6.8490E-03	999.0
0 9	999.0	999.0	1.1420E-03	1.1420E-03	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
0 10	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0

0

EXTINCTION DEPTH WILL BE READ ON UNIT 15 USING FORMAT: (7G11.4)

	1	2	3	4	5	6	7	8	9	10
	11	12	13	14	15	16	17	18	19	20
0 1	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
0 2	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
0 3	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
0 4	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
0 5	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
0 6	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
0 7	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
0 8	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
0 9	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
0 10	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000

0

8 ITERATIONS FOR TIME STEP 1 IN STRESS PERIOD 1

0MAXIMUM HEAD CHANGE FOR EACH ITERATION:

0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,CO

```
   3.781     (  1,  3, 11)  -1.213     (  1,  5, 12) -0.3388     (  1,  3, 16)  0.5480E-01 (  1,  4, 17) -0.2291E-01 (  1,  5,  3
  0.8182E-02 (  1,  5,  4)  0.1707E-02 (  1,  3, 12)  0.3425E-03 (  1,  5, 12)
0
OHEAD/DRAWDOWN PRINTOUT FLAG = 1     TOTAL BUDGET PRINTOUT FLAG = 1     CELL-BY-CELL FLOW TERM FLAG = 1
OOUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:
   HEAD     DRAWDOWN  HEAD  DRAWDOWN
 PRINTOUT  PRINTOUT  SAVE     SAVE
 ---------------------------------
     1         1       1       1
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   1   COL   4   RATE   -110.8069
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   1   COL  10   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   1   COL  11   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   1   COL  12   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   1   COL  13   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   1   COL  14   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   1   COL  15   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   1   COL  16   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   2   COL   5   RATE   -244.5992
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   2   COL   6   RATE   -86.52573
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   2   COL   7   RATE   -69.93730
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   2   COL   8   RATE   -51.35868
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   2   COL   9   RATE   -76.44451
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   2   COL  17   RATE    16.76054
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   3   COL  18   RATE   -117.3062
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   4   COL  19   RATE   -68.66121
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   5   COL  19   RATE    208.6175
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   6   COL  20   RATE   -343.1398
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   7   COL   6   RATE   -220.6989
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   7   COL   7   RATE    3186.212
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   7   COL  14   RATE   -21.89178
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   7   COL  15   RATE   -329.5172
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   7   COL  20   RATE   -225.6071
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   8   COL   5   RATE   -244.1237
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   8   COL   8   RATE   -3020.778
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   8   COL   9   RATE   -140.6309
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   8   COL  10   RATE    252.5831
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   8   COL  12   RATE   -614.4191
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   8   COL  13   RATE   -60.83220
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   8   COL  14   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   8   COL  16   RATE   -58.88734
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   8   COL  17   RATE   -45.53798
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   8   COL  18   RATE    459.0896
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   8   COL  20   RATE   -201.3971
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   9   COL   1   RATE   -39.98970
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   9   COL   2   RATE    42.27792
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   9   COL   5   RATE   -152.1568
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   9   COL  11   RATE    241.3961
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   9   COL  12   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   9   COL  19   RATE   -201.3971
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW   9   COL  20   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW  10   COL   3   RATE    90.68905
0   CONSTANT HEAD   PERIOD  1   STEP  1   LAYER  1   ROW  10   COL   4   RATE   -152.1568
 "        RECHARGE" BUDGET VALUES WILL BE SAVED ON UNIT 28 AT END OF TIME STEP  1, STRESS PERIOD  1
 "              ET" BUDGET VALUES WILL BE SAVED ON UNIT 27 AT END OF TIME STEP  1, STRESS PERIOD  1
1                    HEAD IN LAYER  1 AT END OF TIME STEP  1 IN STRESS PERIOD  1
            -------------------------------------------------------------

                1           2           3           4           5           6           7           8           9
               10          11          12          13          14          15          16          17          18
               19          20

 ------------------------------------------------------------------------------------------------------------------------
0  1    999.000     999.000     999.000     200.000     999.000     999.000     999.000     999.000     999.000
        199.000     199.000     199.000     199.000     198.000     198.000     198.000     999.000     999.000
        999.000     999.000
0  2    999.000     999.000     999.000     200.155     200.000     200.000     200.000     200.000     199.000
```

```
        999.000     999.000     999.000     999.000     999.000     999.000     999.000     198.000     999.000
        999.000     999.000
  0  3  999.000     999.000     999.000     200.427     200.187     200.121     200.098     200.072     200.061
        200.910     202.347     201.238     200.200     198.144     198.262     198.116     197.744     197.000
        999.000     999.000
  0  4  999.000     999.000     999.000     201.366     200.872     200.753     200.789     202.403     202.830
        201.398     200.771     198.432     198.200     198.002     197.807     197.622     197.421     197.109
        197.000     999.000
  0  5  999.000     999.000     202.722     202.460     202.422     202.275     202.288     202.562     202.103
        201.094     199.159     198.468     198.230     197.987     197.710     197.532     197.346     197.096
        197.000     999.000
  0  6  999.000     999.000     202.467     202.596     200.790     200.376     199.941     199.609     199.336
        199.026     198.802     198.477     198.216     197.940     197.425     197.346     197.215     196.964
        196.561     196.000
  0  7  999.000     202.123     201.906     201.121     200.269     200.000     200.000     199.491     199.205
        198.984     198.699     198.280     198.093     198.000     197.000     197.094     197.073     196.912
        196.372     196.000
  0  8  201.524     201.632     201.419     200.688     200.000     999.000     999.000     199.000     199.000
        199.000     198.640     198.000     198.000     198.000     999.000     197.000     197.000     197.000
        196.333     196.000
  0  9  201.000     201.000     200.877     200.213     200.000     999.000     999.000     999.000     999.000
        999.000     199.000     198.000     999.000     999.000     999.000     999.000     999.000     999.000
        196.000     195.000
  0 10  999.000     999.000     201.000     200.000     999.000     999.000     999.000     999.000     999.000
        999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000
        999.000     999.000
OHEAD WILL BE SAVED ON UNIT 24 AT END OF TIME STEP  1, STRESS PERIOD  1
1                 DRAWDOWN IN LAYER  1 AT END OF TIME STEP  1 IN STRESS PERIOD  1
                 ---------------------------------------------------------------

                    1           2           3           4           5           6           7           8           9
                   10          11          12          13          14          15          16          17          18
                   19          20
 ..........................................................................................................................
  0  1  999.000     999.000     999.000     0.000000    999.000     999.000     999.000     999.000     999.000
        0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    999.000     999.000
        999.000     999.000
  0  2  999.000     999.000     999.000     0.844833    0.000000    0.000000    0.000000    0.000000    0.000000
        999.000     999.000     999.000     999.000     999.000     999.000     999.000     0.000000    999.000
        999.000     999.000
  0  3  999.000     999.000     999.000     1.57329     -0.187119   -0.121323   -9.815979E-02 -7.215881E-02 -1.46074
       -1.50981    -4.14735    -2.23849    1.525879E-05 1.85612    0.737701    0.884308    0.256241    0.000000
        999.000     999.000
  0  4  999.000     999.000     999.000     0.633835    -1.87222    0.247177    -0.189209   -2.40309    -2.83044
       -1.39769    -1.77075    0.268173    1.79974     1.99800     2.19325     1.37755     1.57851     0.890610
        0.000000    999.000
  0  5  999.000     999.000     -2.22218    -1.46042    -1.42184    -1.27475    -1.28825    -1.56224    -0.803131
       -1.09384    0.741226    1.53162     1.77046     2.01299     2.28981     1.46819     1.65427     0.903839
        0.000000    999.000
  0  6  999.000     999.000     -0.466949   -0.595795   -0.689911   1.32448     1.05913     1.39075     1.86395
        1.97400     3.19815     2.52318     1.78387     1.05978     1.57481     1.65392     1.78532     1.03571
        0.439224    0.000000
  0  7  999.000     -0.122772   9.396362E-02 0.179001    3.053284E-02 0.000000    0.000000    0.508743    0.795334
        1.01643     3.30147     0.720398    -9.278870E-02 0.000000    0.000000    0.906113    0.927322    8.793640E-(
        0.628082    0.000000
  0  8 -0.524261    -0.632111   -0.419205   0.311935    0.000000    999.000     999.000     0.000000    0.000000
        0.000000    0.959595    0.000000    0.000000    0.000000    999.000     0.000000    0.000000    0.000000
        0.667389    0.000000
  0  9  0.000000    0.000000    0.123444    0.787399    0.000000    999.000     999.000     999.000     999.000
        999.000     0.000000    0.000000    999.000     999.000     999.000     999.000     999.000     999.000
        0.000000    0.000000
  0 10  999.000     999.000     0.000000    0.000000    999.000     999.000     999.000     999.000     999.000
        999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000
        999.000     999.000
ODRAWDOWN WILL BE SAVED ON UNIT 25 AT END OF TIME STEP  1, STRESS PERIOD  1
0
```

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 1 IN STRESS PERIOD 1

	CUMULATIVE VOLUMES	L**3	RATES FOR THIS TIME STEP	L**3/T
	IN:		IN:	
	STORAGE =	0.00000	STORAGE =	0.00000
	CONSTANT HEAD =	0.14129E+06	CONSTANT HEAD =	4645.3
	RECHARGE =	0.13308E+06	RECHARGE =	4375.1
	ET =	0.00000	ET =	0.00000
0	TOTAL IN =	0.27437E+06	TOTAL IN =	9020.4
0	OUT:		OUT:	
	STORAGE =	0.00000	STORAGE =	0.00000
	CONSTANT HEAD =	0.21433E+06	CONSTANT HEAD =	7046.5
	RECHARGE =	0.00000	RECHARGE =	0.00000
	ET =	60040.	ET =	1973.9
0	TOTAL OUT =	0.27437E+06	TOTAL OUT =	9020.4
0	IN - OUT =	-0.81250	IN - OUT =	-0.25391E-01
0	PERCENT DISCREPANCY =	0.00	PERCENT DISCREPANCY =	0.00

0

TIME SUMMARY AT END OF TIME STEP 1 IN STRESS PERIOD 1

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	0.262800E+07	43800.0	730.000	30.4167	0.832763E-01
STRESS PERIOD TIME	0.262800E+07	43800.0	730.000	30.4167	0.832763E-01
TOTAL SIMULATION TIME	0.262800E+07	43800.0	730.000	30.4167	0.832763E-01

1
1 ITERATIONS FOR TIME STEP 2 IN STRESS PERIOD 1
0MAXIMUM HEAD CHANGE FOR EACH ITERATION:
0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL

0.1153E-03 (1, 5, 3)
0
0HEAD/DRAWDOWN PRINTOUT FLAG = 1 TOTAL BUDGET PRINTOUT FLAG = 1 CELL-BY-CELL FLOW TERM FLAG = 1
0OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:

	HEAD PRINTOUT	DRAWDOWN PRINTOUT	HEAD SAVE	DRAWDOWN SAVE
	1	1	1	1

0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	1	COL	4	RATE	-110.8077
0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	1	COL	10	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	1	COL	11	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	1	COL	12	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	1	COL	13	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	1	COL	14	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	1	COL	15	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	1	COL	16	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	2	COL	5	RATE	-244.6004
0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	2	COL	6	RATE	-86.52441
0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	2	COL	7	RATE	-69.93559
0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	2	COL	8	RATE	-51.35725
0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	2	COL	9	RATE	-76.44463
0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	2	COL	17	RATE	16.76008
0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	3	COL	18	RATE	-117.3130
0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	4	COL	19	RATE	-68.66748
0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	5	COL	19	RATE	208.6079
0	CONSTANT HEAD	PERIOD	1	STEP	2	LAYER	1	ROW	6	COL	20	RATE	-343.1419

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0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   7   COL   6   RATE    -220.6908
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   7   COL   7   RATE     3186.214
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   7   COL  14   RATE    -21.88462
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   7   COL  15   RATE    -329.5195
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   7   COL  20   RATE    -225.6070
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   8   COL   5   RATE    -244.1141
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   8   COL   8   RATE    -3020.777
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   8   COL   9   RATE    -140.6302
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   8   COL  10   RATE     252.5861
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   8   COL  12   RATE    -614.4132
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   8   COL  13   RATE    -60.83028
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   8   COL  14   RATE    0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   8   COL  16   RATE    -58.88793
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   8   COL  17   RATE    -45.53860
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   8   COL  18   RATE     459.0888
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   8   COL  20   RATE    -201.3971
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   9   COL   1   RATE    -39.98977
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   9   COL   2   RATE     42.27700
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   9   COL   5   RATE    -152.1571
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   9   COL  11   RATE     241.3969
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   9   COL  12   RATE    0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   9   COL  19   RATE    -201.3971
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW   9   COL  20   RATE    0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW  10   COL   3   RATE     90.68848
0   CONSTANT HEAD   PERIOD  1   STEP  2   LAYER  1   ROW  10   COL   4   RATE    -152.1571
 "        RECHARGE" BUDGET VALUES WILL BE SAVED ON UNIT 28 AT END OF TIME STEP  2, STRESS PERIOD  1
 "              ET" BUDGET VALUES WILL BE SAVED ON UNIT 27 AT END OF TIME STEP  2, STRESS PERIOD  1
1                    HEAD IN LAYER  1 AT END OF TIME STEP  2 IN STRESS PERIOD  1
           ----------------------------------------------------------------

                1           2           3           4           5           6           7           8           9
               10          11          12          13          14          15          16          17          18
               19          20
 ------------------------------------------------------------------------------------------------------------------------
0  1    999.000     999.000     999.000     200.000     999.000     999.000     999.000     999.000     999.000
        199.000     199.000     199.000     199.000     198.000     198.000     198.000     999.000     999.000
        999.000     999.000
0  2    999.000     999.000     999.000     200.155     200.000     200.000     200.000     200.000     199.000
        999.000     999.000     999.000     999.000     999.000     999.000     999.000     198.000     999.000
        999.000     999.000
0  3    999.000     999.000     999.000     200.427     200.187     200.121     200.098     200.072     200.061
        200.910     202.347     201.238     200.200     198.144     198.262     198.116     197.744     197.000
        999.000     999.000
0  4    999.000     999.000     999.000     201.366     200.872     200.753     200.789     202.403     202.830
        201.398     200.771     198.432     198.200     198.002     197.807     197.622     197.422     197.109
        197.000     999.000
0  5    999.000     999.000     202.722     202.460     202.422     202.275     202.288     202.562     202.103
        201.094     199.159     198.468     198.230     197.987     197.710     197.532     197.346     197.096
        197.000     999.000
0  6    999.000     999.000     202.467     202.596     200.790     200.376     199.941     199.609     199.336
        199.026     198.802     198.477     198.216     197.940     197.425     197.346     197.215     196.964
        196.561     196.000
0  7    999.000     202.123     201.906     201.121     200.269     200.000     200.000     199.491     199.205
        198.984     198.699     198.280     198.093     198.000     197.000     197.094     197.073     196.912
        196.372     196.000
0  8    201.524     201.632     201.419     200.688     200.000     999.000     999.000     199.000     199.000
        199.000     198.640     198.000     198.000     198.000     999.000     197.000     197.000     197.000
        196.333     196.000
0  9    201.000     201.000     200.877     200.213     200.000     999.000     999.000     999.000     999.000
        999.000     199.000     198.000     999.000     999.000     999.000     999.000     999.000     999.000
        196.000     195.000
0 10    999.000     999.000     201.000     200.000     999.000     999.000     999.000     999.000     999.000
        999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000
        999.000     999.000
OHEAD WILL BE SAVED ON UNIT 24 AT END OF TIME STEP  2, STRESS PERIOD  1
1                  DRAWDOWN IN LAYER  1 AT END OF TIME STEP  2 IN STRESS PERIOD  1
```

```
                                                                    1             2             3             4             5             6             7             8             9
                                                                   10            11            12            13            14            15            16            17            18
                                                                   19            20
 ------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
0  1   999.000       999.000       999.000      0.000000       999.000       999.000       999.000       999.000       999.000
       0.000000      0.000000      0.000000      0.000000      0.000000      0.000000      0.000000       999.000       999.000
        999.000       999.000
0  2   999.000       999.000       999.000      0.844833      0.000000      0.000000      0.000000      0.000000      0.000000
       999.000       999.000       999.000       999.000       999.000       999.000       999.000      0.000000       999.000
        999.000       999.000
0  3   999.000       999.000       999.000       1.57329      -0.187119      -0.121323  -9.815979E-02 -7.215881E-02      -1.46074
      -1.50983      -4.14738      -2.23846  9.155273E-05       1.85616      0.737686      0.884293      0.256241      0.000000
        999.000       999.000
0  4   999.000       999.000       999.000      0.633804      -1.87224      0.247177      -0.189209      -2.40309      -2.83044
      -1.39769      -1.77072      0.268204       1.79977       1.99802       2.19325       1.37753       1.57849      0.890594
       0.000000       999.000
0  5   999.000       999.000      -2.22231      -1.46048      -1.42191      -1.27477      -1.28825      -1.56224      -0.803131
      -1.09383      0.741257       1.53165       1.77049       2.01300       2.28981       1.46817       1.65425      0.903839
       0.000000       999.000
0  6   999.000       999.000      -0.466965      -0.595825      -0.689896       1.32448       1.05913       1.39075       1.86395
       1.97401       3.19817       2.52319       1.78389       1.05980       1.57481       1.65390       1.78531       1.03571
      0.439209      0.000000
0  7   999.000      -0.122772  9.396362E-02      0.179047  3.054810E-02      0.000000      0.000000      0.508743      0.795334
       1.01643       3.30148      0.720398  -9.278870E-02      0.000000      0.000000      0.906113      0.927322  8.793640E-02
      0.628082      0.000000
0  8  -0.524261      -0.632111      -0.419220      0.311966      0.000000       999.000       999.000      0.000000      0.000000
      0.000000      0.959595      0.000000      0.000000      0.000000       999.000      0.000000      0.000000      0.000000
      0.667389      0.000000
0  9   0.000000      0.000000      0.123428      0.787399      0.000000       999.000       999.000       999.000       999.000
       999.000      0.000000      0.000000       999.000       999.000       999.000       999.000       999.000       999.000
      0.000000      0.000000
0 10   999.000       999.000      0.000000      0.000000       999.000       999.000       999.000       999.000       999.000
       999.000       999.000       999.000       999.000       999.000       999.000       999.000       999.000       999.000
       999.000       999.000
ODRAWDOWN WILL BE SAVED ON UNIT 25 AT END OF TIME STEP  2, STRESS PERIOD  1
0


                                VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP  2 IN STRESS PERIOD  1
                                ---------------------------------------------------------------------------
0                    CUMULATIVE VOLUMES      L**3                                RATES FOR THIS TIME STEP      L**3/T
                     ------------------                                          ------------------------

                          IN:                                                         IN:
                          ---                                                         ---
                            STORAGE =   0.00000                                         STORAGE =   0.00000
                     CONSTANT HEAD =   0.28259E+06                               CONSTANT HEAD =   4645.3
                          RECHARGE =   0.26615E+06                                    RECHARGE =   4375.1
                                ET =   0.00000                                          ET =   0.00000
0                           TOTAL IN =   0.54874E+06                                 TOTAL IN =   9020.4
0                         OUT:                                                        OUT:
                          ----                                                        ----
                            STORAGE =   0.00000                                         STORAGE =   0.00000
                     CONSTANT HEAD =   0.42866E+06                               CONSTANT HEAD =   7046.5
                          RECHARGE =   0.00000                                    RECHARGE =   0.00000
                                ET =   0.12008E+06                                      ET =   1973.9
0                           TOTAL OUT =   0.54874E+06                                TOTAL OUT =   9020.4
0                           IN - OUT =   -1.2500                                     IN - OUT =  -0.13672E-01
0                 PERCENT DISCREPANCY =        0.00                          PERCENT DISCREPANCY =        0.00


0
```

```
         TIME SUMMARY AT END OF TIME STEP  2 IN STRESS PERIOD  1
                              SECONDS         MINUTES         HOURS          DAYS          YEARS
                         ------------------------------------------------------------------------
      TIME STEP LENGTH       0.262800E+07    43800.0         730.000        30.4167       0.832763E-01
    STRESS PERIOD TIME       0.525600E+07    87600.0         1460.00        60.8333       0.166553
 TOTAL SIMULATION TIME       0.525600E+07    87600.0         1460.00        60.8333       0.166553
1
     1 ITERATIONS FOR TIME STEP   3 IN STRESS PERIOD  1
0MAXIMUM HEAD CHANGE FOR EACH ITERATION:
0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,CO
 ------------------------------------------------------------------------------------------------------------------------------------
   0.1541E-04 (  1,  6,  3)
0
0HEAD/DRAWDOWN PRINTOUT FLAG = 1     TOTAL BUDGET PRINTOUT FLAG = 1     CELL-BY-CELL FLOW TERM FLAG = 1
0OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:
    HEAD     DRAWDOWN  HEAD  DRAWDOWN
 PRINTOUT  PRINTOUT  SAVE     SAVE
 ---------------------------------
     1         1       1       1
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   1   COL   4   RATE   -110.8079
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   1   COL  10   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   1   COL  11   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   1   COL  12   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   1   COL  13   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   1   COL  14   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   1   COL  15   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   1   COL  16   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   2   COL   5   RATE   -244.6015
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   2   COL   6   RATE   -86.52474
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   2   COL   7   RATE   -69.93562
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   2   COL   8   RATE   -51.35719
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   2   COL   9   RATE   -76.44462
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   2   COL  17   RATE    16.75999
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   3   COL  18   RATE   -117.3140
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   4   COL  19   RATE   -68.66836
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   5   COL  19   RATE    208.6070
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   6   COL  20   RATE   -343.1423
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   7   COL   6   RATE   -220.6910
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   7   COL   7   RATE    3186.215
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   7   COL  14   RATE   -21.88198
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   7   COL  15   RATE   -329.5201
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   7   COL  20   RATE   -225.6072
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   8   COL   5   RATE   -244.1142
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   8   COL   8   RATE   -3020.777
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   8   COL   9   RATE   -140.6294
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   8   COL  10   RATE    252.5885
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   8   COL  12   RATE   -614.4108
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   8   COL  13   RATE   -60.82907
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   8   COL  14   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   8   COL  16   RATE   -58.88847
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   8   COL  17   RATE   -45.53952
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   8   COL  18   RATE    459.0883
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   8   COL  20   RATE   -201.3971
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   9   COL   1   RATE   -39.98968
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   9   COL   2   RATE    42.27760
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   9   COL   5   RATE   -152.1570
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   9   COL  11   RATE    241.3975
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   9   COL  12   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   9   COL  19   RATE   -201.3971
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW   9   COL  20   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW  10   COL   3   RATE    90.68880
0   CONSTANT HEAD   PERIOD  1   STEP  3   LAYER  1   ROW  10   COL   4   RATE   -152.1570
 "        RECHARGE" BUDGET VALUES WILL BE SAVED ON UNIT 28 AT END OF TIME STEP  3, STRESS PERIOD  1
 "              ET" BUDGET VALUES WILL BE SAVED ON UNIT 27 AT END OF TIME STEP  3, STRESS PERIOD  1
1                    HEAD IN LAYER  1 AT END OF TIME STEP  3 IN STRESS PERIOD  1
```

```
                                                                    1           2           3           4           5           6           7           8           9
                                                                   10          11          12          13          14          15          16          17          18
                                                                   19          20
 ------------------------------------------------------------------------------------------------------------------------------------------------------------------------
  0  1   999.000     999.000     999.000     200.000     999.000     999.000     999.000     999.000     999.000
           199.000     199.000     199.000     199.000     198.000     198.000     198.000     999.000     999.000
           999.000     999.000
  0  2   999.000     999.000     999.000     200.155     200.000     200.000     200.000     200.000     199.000
           999.000     999.000     999.000     999.000     999.000     999.000     999.000     198.000     999.000
           999.000     999.000
  0  3   999.000     999.000     999.000     200.427     200.187     200.121     200.098     200.072     200.061
           200.910     202.347     201.238     200.200     198.144     198.262     198.116     197.744     197.000
           999.000     999.000
  0  4   999.000     999.000     999.000     201.366     200.872     200.753     200.789     202.403     202.830
           201.398     200.771     198.432     198.200     198.002     197.807     197.622     197.422     197.109
           197.000     999.000
  0  5   999.000     999.000     202.722     202.460     202.422     202.275     202.288     202.562     202.103
           201.094     199.159     198.468     198.230     197.987     197.710     197.532     197.346     197.096
           197.000     999.000
  0  6   999.000     999.000     202.467     202.596     200.790     200.376     199.941     199.609     199.336
           199.026     198.802     198.477     198.216     197.940     197.425     197.346     197.215     196.964
           196.561     196.000
  0  7   999.000     202.123     201.906     201.121     200.269     200.000     200.000     199.491     199.205
           198.984     198.699     198.280     198.093     198.000     197.000     197.094     197.073     196.912
           196.372     196.000
  0  8   201.524     201.632     201.419     200.688     200.000     999.000     999.000     199.000     199.000
           199.000     198.640     198.000     198.000     198.000     999.000     197.000     197.000     197.000
           196.333     196.000
  0  9   201.000     201.000     200.877     200.213     200.000     999.000     999.000     999.000     999.000
           999.000     199.000     198.000     999.000     999.000     999.000     999.000     999.000     999.000
           196.000     195.000
  0 10   999.000     999.000     201.000     200.000     999.000     999.000     999.000     999.000     999.000
           999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000
           999.000     999.000

OHEAD WILL BE SAVED ON UNIT 24 AT END OF TIME STEP  3, STRESS PERIOD  1
1                DRAWDOWN IN LAYER  1 AT END OF TIME STEP  3 IN STRESS PERIOD  1
                 ------------------------------------------------------------------

                                                                    1           2           3           4           5           6           7           8           9
                                                                   10          11          12          13          14          15          16          17          18
                                                                   19          20
 ------------------------------------------------------------------------------------------------------------------------------------------------------------------------
  0  1   999.000     999.000     999.000     0.000000    999.000     999.000     999.000     999.000     999.000
          0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    999.000     999.000
           999.000     999.000
  0  2   999.000     999.000     999.000     0.844833    0.000000    0.000000    0.000000    0.000000    0.000000
           999.000     999.000     999.000     999.000     999.000     999.000     999.000     0.000000    999.000
           999.000     999.000
  0  3   999.000     999.000     999.000     1.57329     -0.187119   -0.121323   -9.815979E-02 -7.215881E-02 -1.46074
          -1.50983    -4.14737    -2.23846    9.155273E-05 1.85616    0.737686    0.884293    0.256241    0.000000
           999.000     999.000
  0  4   999.000     999.000     999.000     0.633804    -1.87224    0.247177    -0.189209   -2.40309    -2.83044
          -1.39769    -1.77072    0.268219    1.79979     1.99802     2.19325     1.37753     1.57849     0.890594
          0.000000    999.000
  0  5   999.000     999.000     -2.22232    -1.46049    -1.42191    -1.27477    -1.28825    -1.56224    -0.803131
          -1.09381    0.741257    1.53166     1.77049     2.01300     2.28981     1.46817     1.65425     0.903839
          0.000000    999.000
  0  6   999.000     999.000     -0.466980   -0.595840   -0.689896   1.32448     1.05913     1.39075     1.86395
           1.97401    3.19818     2.52321     1.78389     1.05980     1.57481     1.65390     1.78531     1.03569
          0.439209    0.000000
  0  7   999.000     -0.122772   9.396362E-02 0.179031    3.054810E-02 0.000000    0.000000    0.508743    0.795334
           1.01643    3.30148     0.720413    -9.278870E-02 0.000000    0.000000    0.906113    0.927322    8.793640E-0
          0.628082    0.000000
  0  8  -0.524261    -0.632111   -0.419220    0.311966    0.000000    999.000     999.000     0.000000    0.000000
```

```
      0.000000      0.959595      0.000000      0.000000      0.000000      999.000      0.000000      0.000000      0.000000
      0.667389      0.000000
0 9   0.000000      0.000000      0.123428      0.787399      0.000000      999.000      999.000       999.000       999.000
       999.000      0.000000      0.000000       999.000       999.000      999.000      999.000       999.000       999.000
      0.000000      0.000000
0 10   999.000       999.000      0.000000      0.000000      999.000      999.000      999.000       999.000       999.000
       999.000       999.000       999.000       999.000      999.000      999.000      999.000       999.000       999.000
       999.000       999.000
ODRAWDOWN WILL BE SAVED ON UNIT 25 AT END OF TIME STEP  3, STRESS PERIOD  1
0


                          VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP  3 IN STRESS PERIOD  1
                          ------------------------------------------------------------------------------
0                   CUMULATIVE VOLUMES      L**3                          RATES FOR THIS TIME STEP      L**3/T
                    ------------------                                    ------------------------

                         IN:                                                   IN:
                         ---                                                   ---
                           STORAGE =   0.00000                                   STORAGE =   0.00000
                      CONSTANT HEAD =  0.42388E+06                          CONSTANT HEAD =   4645.3
                          RECHARGE =   0.39923E+06                              RECHARGE =   4375.1
                                ET =   0.00000                                        ET =   0.00000
0                       TOTAL IN =     0.82311E+06                          TOTAL IN =      9020.4
0                       OUT:                                                  OUT:
                        ----                                                  ----
                           STORAGE =   0.00000                                   STORAGE =   0.00000
                      CONSTANT HEAD =  0.64299E+06                          CONSTANT HEAD =   7046.5
                          RECHARGE =   0.00000                                  RECHARGE =   0.00000
                                ET =   0.18012E+06                                    ET =   1973.9
0                       TOTAL OUT =    0.82311E+06                          TOTAL OUT =     9020.4
0                       IN - OUT =     -1.3750                              IN - OUT =     -0.78125E-02
0                 PERCENT DISCREPANCY =          0.00                    PERCENT DISCREPANCY =          0.00



0

          TIME SUMMARY AT END OF TIME STEP  3 IN STRESS PERIOD  1
                              SECONDS         MINUTES         HOURS          DAYS          YEARS
                          ------------------------------------------------------------------------
       TIME STEP LENGTH     0.262800E+07    43800.0         730.000        30.4167       0.832763E-01
     STRESS PERIOD TIME     0.788400E+07    131400.         2190.00        91.2500       0.249829
  TOTAL SIMULATION TIME     0.788400E+07    131400.         2190.00        91.2500       0.249829
1
     1 ITERATIONS FOR TIME STEP   4 IN STRESS PERIOD  1
OMAXIMUM HEAD CHANGE FOR EACH ITERATION:
0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL
 ------------------------------------------------------------------------------------------------------------------------------------
   0.9600E-05 (  1,  5,  4)
0
OHEAD/DRAWDOWN PRINTOUT FLAG = 1     TOTAL BUDGET PRINTOUT FLAG = 1     CELL-BY-CELL FLOW TERM FLAG = 1
OOUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:
    HEAD     DRAWDOWN  HEAD  DRAWDOWN
 PRINTOUT  PRINTOUT  SAVE    SAVE
 ---------------------------------
     1         1       1       1
0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   1   COL   4   RATE   -110.8080
0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   1   COL  10   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   1   COL  11   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   1   COL  12   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   1   COL  13   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   1   COL  14   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   1   COL  15   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   1   COL  16   RATE   0.0000000
```

```
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   2   COL   5   RATE    -244.6017
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   2   COL   6   RATE    -86.52484
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   2   COL   7   RATE    -69.93567
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   2   COL   8   RATE    -51.35720
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   2   COL   9   RATE    -76.44461
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   2   COL  17   RATE     16.75999
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   3   COL  18   RATE    -117.3142
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   4   COL  19   RATE    -68.66854
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   5   COL  19   RATE     208.6067
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   6   COL  20   RATE    -343.1424
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   7   COL   6   RATE    -220.6910
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   7   COL   7   RATE     3186.215
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   7   COL  14   RATE    -21.88054
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   7   COL  15   RATE    -329.5200
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   7   COL  20   RATE    -225.6072
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   8   COL   5   RATE    -244.1142
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   8   COL   8   RATE    -3020.776
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   8   COL   9   RATE    -140.6291
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   8   COL  10   RATE     252.5894
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   8   COL  12   RATE    -614.4095
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   8   COL  13   RATE    -60.82854
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   8   COL  14   RATE    0.0000000
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   8   COL  16   RATE    -58.88858
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   8   COL  17   RATE    -45.53963
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   8   COL  18   RATE     459.0882
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   8   COL  20   RATE    -201.3971
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   9   COL   1   RATE    -39.98975
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   9   COL   2   RATE     42.27732
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   9   COL   5   RATE    -152.1570
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   9   COL  11   RATE     241.3977
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   9   COL  12   RATE    0.0000000
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   9   COL  19   RATE    -201.3971
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW   9   COL  20   RATE    0.0000000
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW  10   COL   3   RATE     90.68875
 0   CONSTANT HEAD   PERIOD  1   STEP  4   LAYER  1   ROW  10   COL   4   RATE    -152.1570
 "        RECHARGE" BUDGET VALUES WILL BE SAVED ON UNIT 28 AT END OF TIME STEP  4, STRESS PERIOD  1
 "              ET" BUDGET VALUES WILL BE SAVED ON UNIT 27 AT END OF TIME STEP  4, STRESS PERIOD  1
1                   HEAD IN LAYER  1 AT END OF TIME STEP  4 IN STRESS PERIOD  1
                    ------------------------------------------------------------
```

	1	2	3	4	5	6	7	8	9
	10	11	12	13	14	15	16	17	18
	19	20							
0 1	999.000	999.000	999.000	200.000	999.000	999.000	999.000	999.000	999.000
	199.000	199.000	199.000	199.000	198.000	198.000	198.000	999.000	999.000
	999.000	999.000							
0 2	999.000	999.000	999.000	200.155	200.000	200.000	200.000	200.000	199.000
	999.000	999.000	999.000	999.000	999.000	999.000	999.000	198.000	999.000
	999.000	999.000							
0 3	999.000	999.000	999.000	200.427	200.187	200.121	200.098	200.072	200.061
	200.910	202.347	201.238	200.200	198.144	198.262	198.116	197.744	197.000
	999.000	999.000							
0 4	999.000	999.000	999.000	201.366	200.872	200.753	200.789	202.403	202.830
	201.398	200.771	198.432	198.200	198.002	197.807	197.622	197.422	197.109
	197.000	999.000							
0 5	999.000	999.000	202.722	202.461	202.422	202.275	202.288	202.562	202.103
	201.094	199.159	198.468	198.229	197.987	197.710	197.532	197.346	197.096
	197.000	999.000							
0 6	999.000	999.000	202.467	202.596	200.790	200.376	199.941	199.609	199.336
	199.026	198.802	198.477	198.216	197.940	197.425	197.346	197.215	196.964
	196.561	196.000							
0 7	999.000	202.123	201.906	201.121	200.269	200.000	200.000	199.491	199.205
	198.984	198.699	198.280	198.093	198.000	197.000	197.094	197.073	196.912
	196.372	196.000							
0 8	201.524	201.632	201.419	200.688	200.000	999.000	999.000	199.000	199.000

```
         199.000     198.640     198.000     198.000     198.000     999.000     197.000     197.000     197.000
         196.333     196.000
 0  9    201.000     201.000     200.877     200.213     200.000     999.000     999.000     999.000     999.000
         999.000     199.000     198.000     999.000     999.000     999.000     999.000     999.000     999.000
         196.000     195.000
 0 10    999.000     999.000     201.000     200.000     999.000     999.000     999.000     999.000     999.000
         999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000
         999.000     999.000
OHEAD WILL BE SAVED ON UNIT 24 AT END OF TIME STEP  4, STRESS PERIOD  1
1                DRAWDOWN IN LAYER  1 AT END OF TIME STEP  4 IN STRESS PERIOD  1
                 ---------------------------------------------------------------

                     1           2           3           4           5           6           7           8           9
                    10          11          12          13          14          15          16          17          18
                    19          20
 ------------------------------------------------------------------------------------------------------------------------
 0  1    999.000     999.000     999.000     0.000000    999.000     999.000     999.000     999.000     999.000
         0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    999.000     999.000
         999.000     999.000
 0  2    999.000     999.000     999.000     0.844833    0.000000    0.000000    0.000000    0.000000    0.000000
         999.000     999.000     999.000     999.000     999.000     999.000     999.000     0.000000    999.000
         999.000     999.000
 0  3    999.000     999.000     999.000     1.57329     -0.187119   -0.121323   -9.815979E-02 -7.215881E-02 -1.46074
        -1.50983    -4.14737    -2.23845    9.155273E-05 1.85617    0.737701    0.884293    0.256241    0.000000
         999.000     999.000
 0  4    999.000     999.000     999.000     0.633804    -1.87224    0.247177    -0.189209   -2.40309    -2.83044
        -1.39769    -1.77071    0.268219    1.79979     1.99802     2.19325     1.37753     1.57849     0.890594
         0.000000    999.000
 0  5    999.000     999.000     -2.22232    -1.46051    -1.42192    -1.27477    -1.28825    -1.56224    -0.803131
        -1.09381    0.741272    1.53166     1.77051     2.01300     2.28981     1.46817     1.65425     0.903839
         0.000000    999.000
 0  6    999.000     999.000     -0.466980   -0.595840   -0.689896   1.32448     1.05913     1.39075     1.86395
         1.97401     3.19818     2.52321     1.78391     1.05980     1.57481     1.65390     1.78531     1.03569
         0.439209    0.000000
 0  7    999.000     -0.122787   9.396362E-02 0.179031    3.054810E-02 0.000000    0.000000    0.508743    0.795334
         1.01643     3.30148     0.720413    -9.278870E-02 0.000000    0.000000    0.906113    0.927322    8.793640E-0
         0.628082    0.000000
 0  8   -0.524261   -0.632111   -0.419220   0.311966    0.000000    999.000     999.000     0.000000    0.000000
         0.000000    0.959595    0.000000    0.000000    0.000000    999.000     0.000000    0.000000    0.000000
         0.667389    0.000000
 0  9    0.000000    0.000000    0.123428    0.787399    0.000000    999.000     999.000     999.000     999.000
         999.000     0.000000    0.000000    999.000     999.000     999.000     999.000     999.000     999.000
         0.000000    0.000000
 0 10    999.000     999.000     0.000000    0.000000    999.000     999.000     999.000     999.000     999.000
         999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000
         999.000     999.000
ODRAWDOWN WILL BE SAVED ON UNIT 25 AT END OF TIME STEP  4, STRESS PERIOD  1
0


                    VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP  4 IN STRESS PERIOD  1
                    ---------------------------------------------------------------------------
0                CUMULATIVE VOLUMES      L**3                    RATES FOR THIS TIME STEP      L**3/T
                 ------------------                              ------------------------

                      IN:                                             IN:
                      ---                                             ---
                        STORAGE =   0.00000                             STORAGE =   0.00000
                CONSTANT HEAD =   0.56518E+06                   CONSTANT HEAD =   4645.3
                     RECHARGE =   0.53230E+06                        RECHARGE =   4375.1
                           ET =   0.00000                                  ET =   0.00000
0                     TOTAL IN =   0.10975E+07                    TOTAL IN =   9020.4
0                    OUT:                                        OUT:
                     ----                                        ----
                        STORAGE =   0.00000                             STORAGE =   0.00000
                CONSTANT HEAD =   0.85732E+06                   CONSTANT HEAD =   7046.5
```

```
        199.000     198.640     198.000     198.000     198.000     999.000     197.000     197.000     197.000
        196.333     196.000
0  9    201.000     201.000     200.877     200.213     200.000     999.000     999.000     999.000     999.000
        999.000     199.000     198.000     999.000     999.000     999.000     999.000     999.000     999.000
        196.000     195.000
0 10    999.000     999.000     201.000     200.000     999.000     999.000     999.000     999.000     999.000
        999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000
        999.000     999.000
OHEAD WILL BE SAVED ON UNIT 24 AT END OF TIME STEP  4, STRESS PERIOD  1
1                DRAWDOWN IN LAYER  1 AT END OF TIME STEP  4 IN STRESS PERIOD  1
                 ---------------------------------------------------------------

                  1           2           3           4           5           6           7           8           9
                 10          11          12          13          14          15          16          17          18
                 19          20
 ..........................................................................................................................
0  1    999.000     999.000     999.000     0.000000    999.000     999.000     999.000     999.000     999.000
        0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    999.000     999.000
        999.000     999.000
0  2    999.000     999.000     999.000     0.844833    0.000000    0.000000    0.000000    0.000000    0.000000
        999.000     999.000     999.000     999.000     999.000     999.000     999.000     0.000000    999.000
        999.000     999.000
0  3    999.000     999.000     999.000     1.57329     -0.187119   -0.121323   -9.815979E-02 -7.215881E-02 -1.46074
        -1.50983    -4.14737    -2.23845    9.155273E-05 1.85617    0.737701    0.884293    0.256241    0.000000
        999.000     999.000
0  4    999.000     999.000     999.000     0.633804    -1.87224    0.247177    -0.189209   -2.40309    -2.83044
        -1.39769    -1.77071    0.268219    1.79979     1.99802     2.19325     1.37753     1.57849     0.890594
        0.000000    999.000
0  5    999.000     999.000     -2.22232    -1.46051    -1.42192    -1.27477    -1.28825    -1.56224    -0.803131
        -1.09381    0.741272    1.53166     1.77051     2.01300     2.28981     1.46817     1.65425     0.903839
        0.000000    999.000
0  6    999.000     999.000     -0.466980   -0.595840   -0.689896   1.32448     1.05913     1.39075     1.86395
        1.97401     3.19818     2.52321     1.78391     1.05980     1.57481     1.65390     1.78531     1.03569
        0.439209    0.000000
0  7    999.000     -0.122787   9.396362E-02 0.179031    3.054810E-02 0.000000    0.000000    0.508743    0.795334
        1.01643     3.30148     0.720413    -9.278870E-02 0.000000    0.000000    0.906113    0.927322    8.793640E-(
        0.628082    0.000000
0  8   -0.524261   -0.632111   -0.419220   0.311966    0.000000    999.000     999.000     0.000000    0.000000
        0.000000    0.959595    0.000000    0.000000    0.000000    999.000     0.000000    0.000000    0.000000
        0.667389    0.000000
0  9    0.000000    0.000000    0.123428    0.787399    0.000000    999.000     999.000     999.000     999.000
        999.000     0.000000    0.000000    999.000     999.000     999.000     999.000     999.000     999.000
        0.000000    0.000000
0 10    999.000     999.000     0.000000    0.000000    999.000     999.000     999.000     999.000     999.000
        999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000
        999.000     999.000
ODRAWDOWN WILL BE SAVED ON UNIT 25 AT END OF TIME STEP  4, STRESS PERIOD  1
0


                    VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP  4 IN STRESS PERIOD  1
                    ---------------------------------------------------------------------------
0                CUMULATIVE VOLUMES      L**3                    RATES FOR THIS TIME STEP      L**3/T
                 ------------------                              ------------------------

                      IN:                                             IN:
                      ---                                             ---
                        STORAGE =   0.00000                             STORAGE =   0.00000
                CONSTANT HEAD =   0.56518E+06                   CONSTANT HEAD =   4645.3
                     RECHARGE =   0.53230E+06                        RECHARGE =   4375.1
                           ET =   0.00000                                  ET =   0.00000
0                     TOTAL IN =   0.10975E+07                    TOTAL IN =   9020.4
0                    OUT:                                            OUT:
                     ----                                            ----
                        STORAGE =   0.00000                             STORAGE =   0.00000
                CONSTANT HEAD =   0.85732E+06                   CONSTANT HEAD =   7046.5
```

```
        199.000     198.640     198.000     198.000     198.000     999.000     197.000     197.000     197.000
        196.333     196.000
0  9    201.000     201.000     200.877     200.213     200.000     999.000     999.000     999.000     999.000
        999.000     199.000     198.000     999.000     999.000     999.000     999.000     999.000     999.000
        196.000     195.000
0 10    999.000     999.000     201.000     200.000     999.000     999.000     999.000     999.000     999.000
        999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000
        999.000     999.000
OHEAD WILL BE SAVED ON UNIT 24 AT END OF TIME STEP  4, STRESS PERIOD  1
1                DRAWDOWN IN LAYER  1 AT END OF TIME STEP  4 IN STRESS PERIOD  1
                 ---------------------------------------------------------------

                    1           2           3           4           5           6           7           8           9
                   10          11          12          13          14          15          16          17          18
                   19          20
 ------------------------------------------------------------------------------------------------------------------------
0  1    999.000     999.000     999.000     0.000000    999.000     999.000     999.000     999.000     999.000
        0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    999.000     999.000
        999.000     999.000
0  2    999.000     999.000     999.000     0.844833    0.000000    0.000000    0.000000    0.000000    0.000000
        999.000     999.000     999.000     999.000     999.000     999.000     999.000     0.000000    999.000
        999.000     999.000
0  3    999.000     999.000     999.000     1.57329     -0.187119   -0.121323   -9.815979E-02 -7.215881E-02 -1.46074
       -1.50983    -4.14737    -2.23845    9.155273E-05 1.85617    0.737701    0.884293    0.256241    0.000000
        999.000     999.000
0  4    999.000     999.000     999.000     0.633804    -1.87224    0.247177    -0.189209   -2.40309    -2.83044
       -1.39769    -1.77071    0.268219    1.79979     1.99802     2.19325     1.37753     1.57849     0.890594
        0.000000    999.000
0  5    999.000     999.000     -2.22232    -1.46051    -1.42192    -1.27477    -1.28825    -1.56224    -0.803131
       -1.09381    0.741272    1.53166     1.77051     2.01300     2.28981     1.46817     1.65425     0.903839
        0.000000    999.000
0  6    999.000     999.000     -0.466980   -0.595840   -0.689896   1.32448     1.05913     1.39075     1.86395
        1.97401     3.19818     2.52321     1.78391     1.05980     1.57481     1.65390     1.78531     1.03569
        0.439209    0.000000
0  7    999.000     -0.122787   9.396362E-02 0.179031    3.054810E-02 0.000000    0.000000    0.508743    0.795334
        1.01643     3.30148     0.720413    -9.278870E-02 0.000000    0.000000    0.906113    0.927322    8.793640E-
        0.628082    0.000000
0  8   -0.524261    -0.632111   -0.419220   0.311966    0.000000    999.000     999.000     0.000000    0.000000
        0.000000    0.959595    0.000000    0.000000    0.000000    999.000     0.000000    0.000000    0.000000
        0.667389    0.000000
0  9    0.000000    0.000000    0.123428    0.787399    0.000000    999.000     999.000     999.000     999.000
        999.000     0.000000    0.000000    999.000     999.000     999.000     999.000     999.000     999.000
        0.000000    0.000000
0 10    999.000     999.000     0.000000    0.000000    999.000     999.000     999.000     999.000     999.000
        999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000
        999.000     999.000
ODRAWDOWN WILL BE SAVED ON UNIT 25 AT END OF TIME STEP  4, STRESS PERIOD  1
0


                        VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP  4 IN STRESS PERIOD  1
                        ---------------------------------------------------------------------------
0                   CUMULATIVE VOLUMES      L**3                    RATES FOR THIS TIME STEP      L**3/T
                    ------------------                              ------------------------

                          IN:                                             IN:
                          ---                                             ---
                            STORAGE =   0.00000                             STORAGE =   0.00000
                    CONSTANT HEAD =   0.56518E+06                   CONSTANT HEAD =   4645.3
                            RECHARGE =   0.53230E+06                        RECHARGE =   4375.1
                                  ET =   0.00000                                  ET =   0.00000
0                           TOTAL IN =   0.10975E+07                        TOTAL IN =   9020.4
0                         OUT:                                            OUT:
                          ----                                            ----
                            STORAGE =   0.00000                             STORAGE =   0.00000
                    CONSTANT HEAD =   0.85732E+06                   CONSTANT HEAD =   7046.5
```

```
                    RECHARGE =    0.00000                                    RECHARGE =    0.00000
                          ET =    0.24016E+06                                      ET =     1973.9
0                  TOTAL OUT =    0.10975E+07                           TOTAL OUT =     9020.4
0                   IN - OUT =   -1.6250                                  IN - OUT =   -0.29297E-02
0          PERCENT DISCREPANCY =          0.00                  PERCENT DISCREPANCY =          0.00


0


        TIME SUMMARY AT END OF TIME STEP  4 IN STRESS PERIOD  1
                            SECONDS         MINUTES         HOURS          DAYS          YEARS
                        ------------------------------------------------------------------------
     TIME STEP LENGTH     0.262800E+07    43800.0         730.000        30.4167       0.832763E-01
   STRESS PERIOD TIME     0.105120E+08    175200.         2920.00        121.667       0.333105
 TOTAL SIMULATION TIME    0.105120E+08    175200.         2920.00        121.667       0.333105
1
     1 ITERATIONS FOR TIME STEP   5 IN STRESS PERIOD  1
0MAXIMUM HEAD CHANGE FOR EACH ITERATION:
0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL
 ------------------------------------------------------------------------------------------------------------------------------------------------------------
  -0.3162E-05 (  1,  4, 13)
0
0HEAD/DRAWDOWN PRINTOUT FLAG = 1     TOTAL BUDGET PRINTOUT FLAG = 1     CELL-BY-CELL FLOW TERM FLAG = 1
0OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:
   HEAD     DRAWDOWN  HEAD  DRAWDOWN
 PRINTOUT   PRINTOUT  SAVE    SAVE
 ---------------------------------
     1         1       1       1
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   1   COL   4   RATE   -110.8080
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   1   COL  10   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   1   COL  11   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   1   COL  12   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   1   COL  13   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   1   COL  14   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   1   COL  15   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   1   COL  16   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   2   COL   5   RATE   -244.6018
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   2   COL   6   RATE   -86.52489
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   2   COL   7   RATE   -69.93569
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   2   COL   8   RATE   -51.35721
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   2   COL   9   RATE   -76.44461
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   2   COL  17   RATE    16.76000
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   3   COL  18   RATE   -117.3142
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   4   COL  19   RATE   -68.66853
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   5   COL  19   RATE    208.6067
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   6   COL  20   RATE   -343.1424
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   7   COL   6   RATE   -220.6912
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   7   COL   7   RATE    3186.215
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   7   COL  14   RATE   -21.87970
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   7   COL  15   RATE   -329.5197
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   7   COL  20   RATE   -225.6072
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   8   COL   5   RATE   -244.1144
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   8   COL   8   RATE   -3020.776
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   8   COL   9   RATE   -140.6290
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   8   COL  10   RATE    252.5898
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   8   COL  12   RATE   -614.4089
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   8   COL  13   RATE   -60.82826
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   8   COL  14   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   8   COL  16   RATE   -58.88857
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   8   COL  17   RATE   -45.53964
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   8   COL  18   RATE    459.0882
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   8   COL  20   RATE   -201.3971
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   9   COL   1   RATE   -39.98976
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   9   COL   2   RATE    42.27728
```

```
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   9   COL   5   RATE   -152.1570
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   9   COL  11   RATE    241.3978
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   9   COL  12   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   9   COL  19   RATE   -201.3971
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW   9   COL  20   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW  10   COL   3   RATE    90.68874
0   CONSTANT HEAD   PERIOD  1   STEP  5   LAYER  1   ROW  10   COL   4   RATE   -152.1570
 "       RECHARGE" BUDGET VALUES WILL BE SAVED ON UNIT 28 AT END OF TIME STEP  5, STRESS PERIOD  1
 "             ET" BUDGET VALUES WILL BE SAVED ON UNIT 27 AT END OF TIME STEP  5, STRESS PERIOD  1
1                    HEAD IN LAYER  1 AT END OF TIME STEP  5 IN STRESS PERIOD  1
            --------------------------------------------------------------------

                  1           2           3           4           5           6           7           8           9
                 10          11          12          13          14          15          16          17          18
                 19          20

 ------------------------------------------------------------------------------------------------------------------------
0  1    999.000     999.000     999.000     200.000     999.000     999.000     999.000     999.000     999.000
        199.000     199.000     199.000     199.000     198.000     198.000     198.000     999.000     999.000
        999.000     999.000
0  2    999.000     999.000     999.000     200.155     200.000     200.000     200.000     200.000     199.000
        999.000     999.000     999.000     999.000     999.000     999.000     999.000     198.000     999.000
        999.000     999.000
0  3    999.000     999.000     999.000     200.427     200.187     200.121     200.098     200.072     200.061
        200.910     202.347     201.238     200.200     198.144     198.262     198.116     197.744     197.000
        999.000     999.000
0  4    999.000     999.000     999.000     201.366     200.872     200.753     200.789     202.403     202.830
        201.398     200.771     198.432     198.200     198.002     197.807     197.622     197.422     197.109
        197.000     999.000
0  5    999.000     999.000     202.722     202.461     202.422     202.275     202.288     202.562     202.103
        201.094     199.159     198.468     198.229     197.987     197.710     197.532     197.346     197.096
        197.000     999.000
0  6    999.000     999.000     202.467     202.596     200.790     200.376     199.941     199.609     199.336
        199.026     198.802     198.477     198.216     197.940     197.425     197.346     197.215     196.964
        196.561     196.000
0  7    999.000     202.123     201.906     201.121     200.269     200.000     200.000     199.491     199.205
        198.984     198.699     198.280     198.093     198.000     197.000     197.094     197.073     196.912
        196.372     196.000
0  8    201.524     201.632     201.419     200.688     200.000     999.000     999.000     199.000     199.000
        199.000     198.640     198.000     198.000     198.000     999.000     197.000     197.000     197.000
        196.333     196.000
0  9    201.000     201.000     200.877     200.213     200.000     999.000     999.000     999.000     999.000
        999.000     199.000     198.000     999.000     999.000     999.000     999.000     999.000     999.000
        196.000     195.000
0 10    999.000     999.000     201.000     200.000     999.000     999.000     999.000     999.000     999.000
        999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000
        999.000     999.000
OHEAD WILL BE SAVED ON UNIT 24 AT END OF TIME STEP  5, STRESS PERIOD  1
1                  DRAWDOWN IN LAYER  1 AT END OF TIME STEP  5 IN STRESS PERIOD  1
            --------------------------------------------------------------------

                  1           2           3           4           5           6           7           8           9
                 10          11          12          13          14          15          16          17          18
                 19          20

 ------------------------------------------------------------------------------------------------------------------------
0  1    999.000     999.000     999.000     0.000000    999.000     999.000     999.000     999.000     999.000
       0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    999.000     999.000
        999.000     999.000
0  2    999.000     999.000     999.000     0.844833    0.000000    0.000000    0.000000    0.000000    0.000000
        999.000     999.000     999.000     999.000     999.000     999.000     999.000     0.000000    999.000
        999.000     999.000
0  3    999.000     999.000     999.000     1.57329     -0.187119   -0.121323   -9.815979E-02 -7.215881E-02 -1.46074
       -1.50983    -4.14737    -2.23845    1.068115E-04 1.85617    0.737701    0.884293    0.256241    0.000000
        999.000     999.000
0  4    999.000     999.000     999.000     0.633804    -1.87224    0.247177    -0.189209   -2.40309    -2.83044
       -1.39769    -1.77071    0.268219    1.79979     1.99803     2.19325     1.37753     1.57849     0.890594
       0.000000    999.000
```

```
0  5   999.000      999.000     -2.22232     -1.46051     -1.42192     -1.27477     -1.28825     -1.56224     -0.803116
       -1.09381     0.741272      1.53166      1.77051      2.01302      2.28981      1.46817      1.65425      0.903839
       0.000000     999.000
0  6   999.000      999.000     -0.466995    -0.595840    -0.689896     1.32448      1.05913      1.39075      1.86395
       1.97401      3.19818      2.52321      1.78391      1.05980      1.57481      1.65390      1.78531      1.03569
       0.439209     0.000000
0  7   999.000     -0.122787     9.396362E-02 0.179031     3.054810E-02 0.000000     0.000000     0.508743     0.795334
       1.01643      3.30148      0.720413    -9.278870E-02 0.000000     0.000000     0.906113     0.927322     8.793640E-02
       0.628082     0.000000
0  8  -0.524261    -0.632111    -0.419220     0.311966     0.000000     999.000      999.000      0.000000     0.000000
       0.000000     0.959595     0.000000     0.000000     0.000000     999.000      0.000000     0.000000     0.000000
       0.667389     0.000000
0  9   0.000000     0.000000     0.123428     0.787399     0.000000     999.000      999.000      999.000      999.000
       999.000      0.000000     0.000000     999.000      999.000      999.000      999.000      999.000      999.000
       0.000000     0.000000
0 10   999.000      999.000      0.000000     0.000000     999.000      999.000      999.000      999.000      999.000
       999.000      999.000      999.000      999.000      999.000      999.000      999.000      999.000      999.000
       999.000      999.000
ODRAWDOWN WILL BE SAVED ON UNIT 25 AT END OF TIME STEP  5, STRESS PERIOD  1
0


                              VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP  5 IN STRESS PERIOD  1
                              ---------------------------------------------------------------------------
0                    CUMULATIVE VOLUMES      L**3                          RATES FOR THIS TIME STEP      L**3/T
                     ------------------                                    ----------------------

                          IN:                                                   IN:
                          ---                                                   ---
                            STORAGE =   0.00000                                   STORAGE =   0.00000
                     CONSTANT HEAD =   0.70647E+06                         CONSTANT HEAD =    4645.3
                            RECHARGE =   0.66538E+06                              RECHARGE =    4375.1
                                  ET =   0.00000                                        ET =   0.00000
0                           TOTAL IN =   0.13718E+07                              TOTAL IN =    9020.4
0                         OUT:                                                  OUT:
                          ----                                                  ----
                            STORAGE =   0.00000                                   STORAGE =   0.00000
                     CONSTANT HEAD =   0.10716E+07                         CONSTANT HEAD =    7046.5
                            RECHARGE =   0.00000                                  RECHARGE =   0.00000
                                  ET =   0.30020E+06                                    ET =    1973.9
0                          TOTAL OUT =   0.13719E+07                             TOTAL OUT =    9020.4
0                           IN - OUT =   -1.6250                                  IN - OUT =   0.00000
0                 PERCENT DISCREPANCY =          0.00                   PERCENT DISCREPANCY =          0.00


0

            TIME SUMMARY AT END OF TIME STEP  5 IN STRESS PERIOD  1
                                  SECONDS         MINUTES         HOURS           DAYS            YEARS
                                 ------------------------------------------------------------------------
          TIME STEP LENGTH       0.262800E+07    43800.0         730.000         30.4167         0.832763E-01
        STRESS PERIOD TIME       0.131400E+08    219000.         3650.00         152.083         0.416382
     TOTAL SIMULATION TIME       0.131400E+08    219000.         3650.00         152.083         0.416382
1
    1 ITERATIONS FOR TIME STEP   6 IN STRESS PERIOD  1
OMAXIMUM HEAD CHANGE FOR EACH ITERATION:
O HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL
 ----------------------------------------------------------------------------------------------------------------------------------------------------------
   0.1793E-05 (  1,  5,  4)
0
OHEAD/DRAWDOWN PRINTOUT FLAG = 1     TOTAL BUDGET PRINTOUT FLAG = 1     CELL-BY-CELL FLOW TERM FLAG = 1
OOUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:
    HEAD     DRAWDOWN  HEAD  DRAWDOWN
 PRINTOUT  PRINTOUT  SAVE    SAVE
```

```
 ---------------------------------
     1         1         1         1
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   1   COL   4   RATE    -110.8080
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   1   COL  10   RATE    0.0000000
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   1   COL  11   RATE    0.0000000
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   1   COL  12   RATE    0.0000000
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   1   COL  13   RATE    0.0000000
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   1   COL  14   RATE    0.0000000
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   1   COL  15   RATE    0.0000000
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   1   COL  16   RATE    0.0000000
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   2   COL   5   RATE    -244.6019
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   2   COL   6   RATE    -86.52490
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   2   COL   7   RATE    -69.93570
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   2   COL   8   RATE    -51.35721
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   2   COL   9   RATE    -76.44461
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   2   COL  17   RATE     16.76001
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   3   COL  18   RATE    -117.3141
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   4   COL  19   RATE    -68.66850
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   5   COL  19   RATE     208.6068
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   6   COL  20   RATE    -343.1424
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   7   COL   6   RATE    -220.6912
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   7   COL   7   RATE     3186.215
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   7   COL  14   RATE    -21.87923
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   7   COL  15   RATE    -329.5195
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   7   COL  20   RATE    -225.6072
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   8   COL   5   RATE    -244.1145
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   8   COL   8   RATE    -3020.776
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   8   COL   9   RATE    -140.6289
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   8   COL  10   RATE     252.5900
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   8   COL  12   RATE    -614.4086
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   8   COL  13   RATE    -60.82811
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   8   COL  14   RATE    0.0000000
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   8   COL  16   RATE    -58.88855
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   8   COL  17   RATE    -45.53962
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   8   COL  18   RATE     459.0882
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   8   COL  20   RATE    -201.3971
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   9   COL   1   RATE    -39.98978
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   9   COL   2   RATE     42.27721
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   9   COL   5   RATE    -152.1570
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   9   COL  11   RATE     241.3978
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   9   COL  12   RATE    0.0000000
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   9   COL  19   RATE    -201.3971
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW   9   COL  20   RATE    0.0000000
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW  10   COL   3   RATE     90.68872
 0   CONSTANT HEAD   PERIOD  1   STEP  6   LAYER  1   ROW  10   COL   4   RATE    -152.1570
  "        RECHARGE" BUDGET VALUES WILL BE SAVED ON UNIT 28 AT END OF TIME STEP  6, STRESS PERIOD  1
  "             ET" BUDGET VALUES WILL BE SAVED ON UNIT 27 AT END OF TIME STEP  6, STRESS PERIOD  1
 1                   HEAD IN LAYER  1 AT END OF TIME STEP  6 IN STRESS PERIOD  1
            ------------------------------------------------------------------

                    1           2           3           4           5           6           7           8           9
                   10          11          12          13          14          15          16          17          18
                   19          20

 ------------------------------------------------------------------------------------------------------------------------
 0  1    999.000     999.000     999.000     200.000     999.000     999.000     999.000     999.000     999.000
          199.000     199.000     199.000     199.000     198.000     198.000     198.000     999.000     999.000
          999.000     999.000
 0  2    999.000     999.000     999.000     200.155     200.000     200.000     200.000     200.000     199.000
          999.000     999.000     999.000     999.000     999.000     999.000     999.000     198.000     999.000
          999.000     999.000
 0  3    999.000     999.000     999.000     200.427     200.187     200.121     200.098     200.072     200.061
          200.910     202.347     201.238     200.200     198.144     198.262     198.116     197.744     197.000
          999.000     999.000
 0  4    999.000     999.000     999.000     201.366     200.872     200.753     200.789     202.403     202.830
          201.398     200.771     198.432     198.200     198.002     197.807     197.622     197.422     197.109
          197.000     999.000
```

```
0  5   999.000     999.000     202.722     202.461     202.422     202.275     202.288     202.562     202.103
       201.094     199.159     198.468     198.229     197.987     197.710     197.532     197.346     197.096
       197.000     999.000
0  6   999.000     999.000     202.467     202.596     200.790     200.376     199.941     199.609     199.336
       199.026     198.802     198.477     198.216     197.940     197.425     197.346     197.215     196.964
       196.561     196.000
0  7   999.000     202.123     201.906     201.121     200.269     200.000     200.000     199.491     199.205
       198.984     198.699     198.280     198.093     198.000     197.000     197.094     197.073     196.912
       196.372     196.000
0  8   201.524     201.632     201.419     200.688     200.000     999.000     999.000     199.000     199.000
       199.000     198.640     198.000     198.000     198.000     999.000     197.000     197.000     197.000
       196.333     196.000
0  9   201.000     201.000     200.877     200.213     200.000     999.000     999.000     999.000     999.000
       999.000     199.000     198.000     999.000     999.000     999.000     999.000     999.000     999.000
       196.000     195.000
0 10   999.000     999.000     201.000     200.000     999.000     999.000     999.000     999.000     999.000
       999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000
       999.000     999.000
OHEAD WILL BE SAVED ON UNIT 24 AT END OF TIME STEP  6, STRESS PERIOD  1
1                DRAWDOWN IN LAYER  1 AT END OF TIME STEP  6 IN STRESS PERIOD  1
                 ---------------------------------------------------------------

                    1           2           3           4           5           6           7           8           9
                   10          11          12          13          14          15          16          17          18
                   19          20
 ---------------------------------------------------------------------------------------------------------------------
0  1   999.000     999.000     999.000     0.000000    999.000     999.000     999.000     999.000     999.000
       0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    999.000     999.000
       999.000     999.000
0  2   999.000     999.000     999.000     0.844833    0.000000    0.000000    0.000000    0.000000    0.000000
       999.000     999.000     999.000     999.000     999.000     999.000     999.000     0.000000    999.000
       999.000     999.000
0  3   999.000     999.000     999.000     1.57329     -0.187119   -0.121323   -9.815979E-02 -7.215881E-02 -1.46074
       -1.50983    -4.14737    -2.23845    1.068115E-04 1.85617    0.737701    0.884293    0.256241    0.000000
       999.000     999.000
0  4   999.000     999.000     999.000     0.633804    -1.87224    0.247177    -0.189209   -2.40309    -2.83044
       -1.39769    -1.77071    0.268219    1.79980     1.99803     2.19325     1.37753     1.57849     0.890594
       0.000000    999.000
0  5   999.000     999.000     -2.22232    -1.46051    -1.42192    -1.27477    -1.28825    -1.56224    -0.803131
       -1.09381    0.741272    1.53166     1.77051     2.01302     2.28981     1.46817     1.65425     0.903839
       0.000000    999.000
0  6   999.000     999.000     -0.466995   -0.595840   -0.689896   1.32448     1.05913     1.39075     1.86395
       1.97401     3.19818     2.52321     1.78391     1.05980     1.57481     1.65390     1.78531     1.03569
       0.439209    0.000000
0  7   999.000     -0.122787   9.396362E-02 0.179031    3.054810E-02 0.000000    0.000000    0.508743    0.795334
       1.01643     3.30148     0.720413    -9.278870E-02 0.000000    0.000000    0.906113    0.927322    8.793640E-0
       0.628082    0.000000
0  8  -0.524261    -0.632111   -0.419220   0.311966    0.000000    999.000     999.000     0.000000    0.000000
       0.000000    0.959595    0.000000    0.000000    0.000000    999.000     0.000000    0.000000    0.000000
       0.667389    0.000000
0  9   0.000000    0.000000    0.123428    0.787399    0.000000    999.000     999.000     999.000     999.000
       999.000     0.000000    0.000000    999.000     999.000     999.000     999.000     999.000     999.000
       0.000000    0.000000
0 10   999.000     999.000     0.000000    0.000000    999.000     999.000     999.000     999.000     999.000
       999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000
       999.000     999.000
ODRAWDOWN WILL BE SAVED ON UNIT 25 AT END OF TIME STEP  6, STRESS PERIOD  1
0


                        VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP  6 IN STRESS PERIOD  1
                        ---------------------------------------------------------------------------

0                  CUMULATIVE VOLUMES      L**3                        RATES FOR THIS TIME STEP      L**3/T
                   ------------------                                  ------------------------

                        IN:                                                 IN:
```

```
                  ---                                                              ---
              STORAGE =    0.00000                                             STORAGE =    0.00000
        CONSTANT HEAD =    0.84777E+06                                   CONSTANT HEAD =     4645.3
             RECHARGE =    0.79845E+06                                        RECHARGE =     4375.1
                   ET =    0.00000                                                  ET =    0.00000
0            TOTAL IN =    0.16462E+07                                        TOTAL IN =     9020.4
0                OUT:                                                             OUT:
                 ----                                                             ----
              STORAGE =    0.00000                                             STORAGE =    0.00000
        CONSTANT HEAD =    0.12860E+07                                   CONSTANT HEAD =     7046.5
             RECHARGE =    0.00000                                            RECHARGE =    0.00000
                   ET =    0.36024E+06                                              ET =     1973.9
0           TOTAL OUT =    0.16462E+07                                       TOTAL OUT =     9020.4
0            IN - OUT =    -1.5000                                            IN - OUT =    0.97656E-03
0 PERCENT DISCREPANCY =              0.00                          PERCENT DISCREPANCY =              0.00



0


         TIME SUMMARY AT END OF TIME STEP  6 IN STRESS PERIOD  1
                              SECONDS        MINUTES        HOURS          DAYS          YEARS
                         -----------------------------------------------------------------------
     TIME STEP LENGTH      0.262800E+07    43800.0        730.000        30.4167       0.832763E-01
   STRESS PERIOD TIME      0.157680E+08    262800.        4380.00        182.500       0.499658
 TOTAL SIMULATION TIME     0.157680E+08    262800.        4380.00        182.500       0.499658
1
     1 ITERATIONS FOR TIME STEP   7 IN STRESS PERIOD  1
0MAXIMUM HEAD CHANGE FOR EACH ITERATION:
0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,CC
 ------------------------------------------------------------------------------------------------------------------------------------
  -0.9247E-06 (  1,  4, 13)
0
0HEAD/DRAWDOWN PRINTOUT FLAG = 1     TOTAL BUDGET PRINTOUT FLAG = 1     CELL-BY-CELL FLOW TERM FLAG = 1
0OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:
   HEAD    DRAWDOWN  HEAD  DRAWDOWN
 PRINTOUT  PRINTOUT  SAVE    SAVE
 ----------------------------------
     1        1        1       1
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   1   COL   4   RATE   -110.8080
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   1   COL  10   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   1   COL  11   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   1   COL  12   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   1   COL  13   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   1   COL  14   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   1   COL  15   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   1   COL  16   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   2   COL   5   RATE   -244.6019
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   2   COL   6   RATE   -86.52491
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   2   COL   7   RATE   -69.93570
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   2   COL   8   RATE   -51.35721
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   2   COL   9   RATE   -76.44461
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   2   COL  17   RATE    16.76002
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   3   COL  18   RATE   -117.3141
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   4   COL  19   RATE   -68.66846
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   5   COL  19   RATE    208.6068
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   6   COL  20   RATE   -343.1424
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   7   COL   6   RATE   -220.6913
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   7   COL   7   RATE    3186.215
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   7   COL  14   RATE   -21.87897
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   7   COL  15   RATE   -329.5193
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   7   COL  20   RATE   -225.6072
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   8   COL   5   RATE   -244.1145
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   8   COL   8   RATE   -3020.776
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   8   COL   9   RATE   -140.6289
```

```
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   8   COL  10   RATE    252.5901
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   8   COL  12   RATE   -614.4084
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   8   COL  13   RATE   -60.82803
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   8   COL  14   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   8   COL  16   RATE   -58.88853
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   8   COL  17   RATE   -45.53960
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   8   COL  18   RATE    459.0882
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   8   COL  20   RATE   -201.3971
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   9   COL   1   RATE   -39.98978
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   9   COL   2   RATE    42.27719
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   9   COL   5   RATE   -152.1570
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   9   COL  11   RATE    241.3979
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   9   COL  12   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   9   COL  19   RATE   -201.3971
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW   9   COL  20   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW  10   COL   3   RATE    90.68871
0   CONSTANT HEAD   PERIOD  1   STEP  7   LAYER  1   ROW  10   COL   4   RATE   -152.1570
 "       RECHARGE" BUDGET VALUES WILL BE SAVED ON UNIT 28 AT END OF TIME STEP  7, STRESS PERIOD  1
 "             ET" BUDGET VALUES WILL BE SAVED ON UNIT 27 AT END OF TIME STEP  7, STRESS PERIOD  1
1                   HEAD IN LAYER  1 AT END OF TIME STEP  7 IN STRESS PERIOD  1
                   ------------------------------------------------------------------

                     1           2           3           4           5           6           7           8           9
                    10          11          12          13          14          15          16          17          18
                    19          20
 ------------------------------------------------------------------------------------------------------------------------
0  1    999.000     999.000     999.000     200.000     999.000     999.000     999.000     999.000     999.000
         199.000     199.000     199.000     199.000     198.000     198.000     198.000     999.000     999.000
         999.000     999.000
0  2    999.000     999.000     999.000     200.155     200.000     200.000     200.000     200.000     199.000
         999.000     999.000     999.000     999.000     999.000     999.000     999.000     198.000     999.000
         999.000     999.000
0  3    999.000     999.000     999.000     200.427     200.187     200.121     200.098     200.072     200.061
         200.910     202.347     201.238     200.200     198.144     198.262     198.116     197.744     197.000
         999.000     999.000
0  4    999.000     999.000     999.000     201.366     200.872     200.753     200.789     202.403     202.830
         201.398     200.771     198.432     198.200     198.002     197.807     197.622     197.422     197.109
         197.000     999.000
0  5    999.000     999.000     202.722     202.461     202.422     202.275     202.288     202.562     202.103
         201.094     199.159     198.468     198.229     197.987     197.710     197.532     197.346     197.096
         197.000     999.000
0  6    999.000     999.000     202.467     202.596     200.790     200.376     199.941     199.609     199.336
         199.026     198.802     198.477     198.216     197.940     197.425     197.346     197.215     196.964
         196.561     196.000
0  7    999.000     202.123     201.906     201.121     200.269     200.000     200.000     199.491     199.205
         198.984     198.699     198.280     198.093     198.000     197.000     197.094     197.073     196.912
         196.372     196.000
0  8    201.524     201.632     201.419     200.688     200.000     999.000     999.000     199.000     199.000
         199.000     198.640     198.000     198.000     198.000     999.000     197.000     197.000     197.000
         196.333     196.000
0  9    201.000     201.000     200.877     200.213     200.000     999.000     999.000     999.000     999.000
         999.000     199.000     198.000     999.000     999.000     999.000     999.000     999.000     999.000
         196.000     195.000
0 10    999.000     999.000     201.000     200.000     999.000     999.000     999.000     999.000     999.000
         999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000
         999.000     999.000
OHEAD WILL BE SAVED ON UNIT 24 AT END OF TIME STEP  7, STRESS PERIOD  1
1                DRAWDOWN IN LAYER  1 AT END OF TIME STEP  7 IN STRESS PERIOD  1
                   ------------------------------------------------------------------

                     1           2           3           4           5           6           7           8           9
                    10          11          12          13          14          15          16          17          18
                    19          20
 ------------------------------------------------------------------------------------------------------------------------
0  1    999.000     999.000     999.000     0.000000    999.000     999.000     999.000     999.000     999.000
       0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    999.000     999.000
```

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         999.000      999.000
0  2     999.000      999.000      999.000     0.844833     0.000000     0.000000     0.000000     0.000000     0.000000
         999.000      999.000      999.000      999.000      999.000      999.000      999.000     0.000000      999.000
         999.000      999.000
0  3     999.000      999.000      999.000      1.57329     -0.187119    -0.121323   -9.815979E-02 -7.215881E-02  -1.46074
        -1.50983     -4.14737     -2.23845    1.068115E-04  1.85617     0.737701     0.884293     0.256241     0.000000
         999.000      999.000
0  4     999.000      999.000      999.000     0.633804     -1.87224     0.247177    -0.189209     -2.40309     -2.83044
        -1.39769     -1.77071     0.268219     1.79980      1.99803      2.19325      1.37753      1.57849     0.890594
        0.000000      999.000
0  5     999.000      999.000     -2.22232     -1.46051     -1.42192     -1.27477     -1.28825     -1.56224     -0.803116
        -1.09381     0.741272      1.53166      1.77051      2.01302      2.28981      1.46817      1.65425     0.903839
        0.000000      999.000
0  6     999.000      999.000     -0.466995    -0.595840    -0.689896     1.32448      1.05913      1.39075      1.86395
         1.97401      3.19818      2.52322      1.78391      1.05980      1.57481      1.65390      1.78531      1.03569
        0.439209     0.000000
0  7     999.000     -0.122787    9.396362E-02  0.179031    3.054810E-02  0.000000     0.000000     0.508743     0.795334
         1.01643      3.30150     0.720413    -9.278870E-02  0.000000     0.000000     0.906113     0.927322    8.793640E-02
        0.628082     0.000000
0  8    -0.524261    -0.632111    -0.419220     0.311966     0.000000      999.000      999.000     0.000000     0.000000
        0.000000     0.959595     0.000000     0.000000     0.000000      999.000     0.000000     0.000000     0.000000
        0.667389     0.000000
0  9    0.000000     0.000000     0.123428     0.787399     0.000000      999.000      999.000      999.000      999.000
         999.000     0.000000     0.000000      999.000      999.000      999.000      999.000      999.000      999.000
        0.000000     0.000000
0 10     999.000      999.000     0.000000     0.000000      999.000      999.000      999.000      999.000      999.000
         999.000      999.000      999.000      999.000      999.000      999.000      999.000      999.000      999.000
         999.000      999.000
ODRAWDOWN WILL BE SAVED ON UNIT 25 AT END OF TIME STEP  7, STRESS PERIOD  1
0


                                VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP  7 IN STRESS PERIOD  1
                                ------------------------------------------------------------------------------
0                    CUMULATIVE VOLUMES      L**3                                RATES FOR THIS TIME STEP      L**3/T
                     ------------------                                          ------------------------

                          IN:                                                         IN:
                          ---                                                         ---
                            STORAGE =  0.00000                                          STORAGE =  0.00000
                      CONSTANT HEAD =  0.98906E+06                                CONSTANT HEAD =  4645.3
                           RECHARGE =  0.93153E+06                                     RECHARGE =  4375.1
                                 ET =  0.00000                                           ET =  0.00000
0                         TOTAL IN =  0.19206E+07                                   TOTAL IN =  9020.4
0                        OUT:                                                       OUT:
                         ----                                                       ----
                            STORAGE =  0.00000                                          STORAGE =  0.00000
                      CONSTANT HEAD =  0.15003E+07                                CONSTANT HEAD =  7046.5
                           RECHARGE =  0.00000                                         RECHARGE =  0.00000
                                 ET =  0.42028E+06                                       ET =  1973.9
0                        TOTAL OUT =  0.19206E+07                                  TOTAL OUT =  9020.4
0                         IN - OUT =  -1.5000                                       IN - OUT =  0.97656E-03
0                PERCENT DISCREPANCY =          0.00                        PERCENT DISCREPANCY =          0.00


0

          TIME SUMMARY AT END OF TIME STEP  7 IN STRESS PERIOD  1
                              SECONDS      MINUTES      HOURS        DAYS         YEARS
                          ------------------------------------------------------------
       TIME STEP LENGTH    0.262800E+07  43800.0      730.000      30.4167     0.832763E-01
     STRESS PERIOD TIME    0.183960E+08  306600.      5110.00      212.917     0.582934
  TOTAL SIMULATION TIME    0.183960E+08  306600.      5110.00      212.917     0.582934
1
```

```
     1 ITERATIONS FOR TIME STEP   8 IN STRESS PERIOD  1
0MAXIMUM HEAD CHANGE FOR EACH ITERATION:
0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL
 ---------------------------------------------------------------------------------------------------------------------------------
   0.6238E-06 (  1,  5,  9)
0
0HEAD/DRAWDOWN PRINTOUT FLAG = 1     TOTAL BUDGET PRINTOUT FLAG = 1     CELL-BY-CELL FLOW TERM FLAG = 1
0OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:
    HEAD     DRAWDOWN  HEAD  DRAWDOWN
 PRINTOUT   PRINTOUT  SAVE    SAVE
 ---------------------------------
     1          1       1       1
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   1   COL   4   RATE   -110.8080
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   1   COL  10   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   1   COL  11   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   1   COL  12   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   1   COL  13   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   1   COL  14   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   1   COL  15   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   1   COL  16   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   2   COL   5   RATE   -244.6019
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   2   COL   6   RATE   -86.52492
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   2   COL   7   RATE   -69.93570
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   2   COL   8   RATE   -51.35721
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   2   COL   9   RATE   -76.44461
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   2   COL  17   RATE    16.76003
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   3   COL  18   RATE   -117.3141
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   4   COL  19   RATE   -68.66844
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   5   COL  19   RATE    208.6068
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   6   COL  20   RATE   -343.1424
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   7   COL   6   RATE   -220.6913
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   7   COL   7   RATE    3186.215
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   7   COL  14   RATE   -21.87880
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   7   COL  15   RATE   -329.5193
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   7   COL  20   RATE   -225.6072
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   8   COL   5   RATE   -244.1145
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   8   COL   8   RATE   -3020.776
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   8   COL   9   RATE   -140.6289
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   8   COL  10   RATE    252.5901
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   8   COL  12   RATE   -614.4083
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   8   COL  13   RATE   -60.82798
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   8   COL  14   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   8   COL  16   RATE   -58.88852
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   8   COL  17   RATE   -45.53959
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   8   COL  18   RATE    459.0882
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   8   COL  20   RATE   -201.3971
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   9   COL   1   RATE   -39.98978
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   9   COL   2   RATE    42.27718
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   9   COL   5   RATE   -152.1570
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   9   COL  11   RATE    241.3979
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   9   COL  12   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   9   COL  19   RATE   -201.3971
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW   9   COL  20   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW  10   COL   3   RATE    90.68871
0   CONSTANT HEAD   PERIOD  1   STEP  8   LAYER  1   ROW  10   COL   4   RATE   -152.1570
 "        RECHARGE" BUDGET VALUES WILL BE SAVED ON UNIT 28 AT END OF TIME STEP  8, STRESS PERIOD  1
 "              ET" BUDGET VALUES WILL BE SAVED ON UNIT 27 AT END OF TIME STEP  8, STRESS PERIOD  1
1                   HEAD IN LAYER  1 AT END OF TIME STEP  8 IN STRESS PERIOD  1
                   ------------------------------------------------------------

                1           2           3           4           5           6           7           8           9
               10          11          12          13          14          15          16          17          18
               19          20

 ---------------------------------------------------------------------------------------------------------------------------------
0 1    999.000     999.000     999.000     200.000     999.000     999.000     999.000     999.000     999.000
       199.000     199.000     199.000     199.000     198.000     198.000     198.000     999.000     999.000
```

	999.000	999.000							
0 2	999.000	999.000	999.000	200.155	200.000	200.000	200.000	200.000	199.000
	999.000	999.000	999.000	999.000	999.000	999.000	999.000	198.000	999.000
	999.000	999.000							
0 3	999.000	999.000	999.000	200.427	200.187	200.121	200.098	200.072	200.061
	200.910	202.347	201.238	200.200	198.144	198.262	198.116	197.744	197.000
	999.000	999.000							
0 4	999.000	999.000	999.000	201.366	200.872	200.753	200.789	202.403	202.830
	201.398	200.771	198.432	198.200	198.002	197.807	197.622	197.422	197.109
	197.000	999.000							
0 5	999.000	999.000	202.722	202.461	202.422	202.275	202.288	202.562	202.103
	201.094	199.159	198.468	198.229	197.987	197.710	197.532	197.346	197.096
	197.000	999.000							
0 6	999.000	999.000	202.467	202.596	200.790	200.376	199.941	199.609	199.336
	199.026	198.802	198.477	198.216	197.940	197.425	197.346	197.215	196.964
	196.561	196.000							
0 7	999.000	202.123	201.906	201.121	200.269	200.000	200.000	199.491	199.205
	198.984	198.699	198.280	198.093	198.000	197.000	197.094	197.073	196.912
	196.372	196.000							
0 8	201.524	201.632	201.419	200.688	200.000	999.000	999.000	199.000	199.000
	199.000	198.640	198.000	198.000	198.000	999.000	197.000	197.000	197.000
	196.333	196.000							
0 9	201.000	201.000	200.877	200.213	200.000	999.000	999.000	999.000	999.000
	999.000	199.000	198.000	999.000	999.000	999.000	999.000	999.000	999.000
	196.000	195.000							
0 10	999.000	999.000	201.000	200.000	999.000	999.000	999.000	999.000	999.000
	999.000	999.000	999.000	999.000	999.000	999.000	999.000	999.000	999.000
	999.000	999.000							

OHEAD WILL BE SAVED ON UNIT 24 AT END OF TIME STEP 8, STRESS PERIOD 1

1 DRAWDOWN IN LAYER 1 AT END OF TIME STEP 8 IN STRESS PERIOD 1

	1	2	3	4	5	6	7	8	9
	10	11	12	13	14	15	16	17	18
	19	20							
0 1	999.000	999.000	999.000	0.000000	999.000	999.000	999.000	999.000	999.000
	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	999.000	999.000
	999.000	999.000							
0 2	999.000	999.000	999.000	0.844833	0.000000	0.000000	0.000000	0.000000	0.000000
	999.000	999.000	999.000	999.000	999.000	999.000	999.000	0.000000	999.000
	999.000	999.000							
0 3	999.000	999.000	999.000	1.57329	-0.187119	-0.121323	-9.815979E-02	-7.215881E-02	-1.46074
	-1.50983	-4.14737	-2.23845	1.068115E-04	1.85617	0.737701	0.884293	0.256241	0.000000
	999.000	999.000							
0 4	999.000	999.000	999.000	0.633804	-1.87224	0.247177	-0.189209	-2.40309	-2.83044
	-1.39769	-1.77071	0.268219	1.79980	1.99803	2.19325	1.37753	1.57849	0.890594
	0.000000	999.000							
0 5	999.000	999.000	-2.22232	-1.46051	-1.42192	-1.27477	-1.28825	-1.56224	-0.803131
	-1.09381	0.741272	1.53166	1.77051	2.01302	2.28981	1.46817	1.65425	0.903839
	0.000000	999.000							
0 6	999.000	999.000	-0.466995	-0.595840	-0.689896	1.32448	1.05913	1.39075	1.86395
	1.97401	3.19818	2.52322	1.78391	1.05980	1.57481	1.65390	1.78531	1.03569
	0.439209	0.000000							
0 7	999.000	-0.122787	9.396362E-02	0.179031	3.054810E-02	0.000000	0.000000	0.508743	0.795334
	1.01643	3.30150	0.720413	-9.278870E-02	0.000000	0.000000	0.906113	0.927322	8.793640E-02
	0.628082	0.000000							
0 8	-0.524261	-0.632111	-0.419220	0.311966	0.000000	999.000	999.000	0.000000	0.000000
	0.000000	0.959595	0.000000	0.000000	0.000000	999.000	0.000000	0.000000	0.000000
	0.667389	0.000000							
0 9	0.000000	0.000000	0.123428	0.787399	0.000000	999.000	999.000	999.000	999.000
	999.000	0.000000	0.000000	999.000	999.000	999.000	999.000	999.000	999.000
	0.000000	0.000000							
0 10	999.000	999.000	0.000000	0.000000	999.000	999.000	999.000	999.000	999.000
	999.000	999.000	999.000	999.000	999.000	999.000	999.000	999.000	999.000
	999.000	999.000							

0DRAWDOWN WILL BE SAVED ON UNIT 25 AT END OF TIME STEP 8, STRESS PERIOD 1
0

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 8 IN STRESS PERIOD 1

	CUMULATIVE VOLUMES L**3		RATES FOR THIS TIME STEP L**3/T	
	IN:		IN:	
	STORAGE =	0.00000	STORAGE =	0.00000
	CONSTANT HEAD =	0.11304E+07	CONSTANT HEAD =	4645.3
	RECHARGE =	0.10646E+07	RECHARGE =	4375.1
	ET =	0.00000	ET =	0.00000
0	TOTAL IN =	0.21950E+07	TOTAL IN =	9020.4
0	OUT:		OUT:	
	STORAGE =	0.00000	STORAGE =	0.00000
	CONSTANT HEAD =	0.17146E+07	CONSTANT HEAD =	7046.5
	RECHARGE =	0.00000	RECHARGE =	0.00000
	ET =	0.48032E+06	ET =	1973.9
0	TOTAL OUT =	0.21950E+07	TOTAL OUT =	9020.4
0	IN - OUT =	-1.5000	IN - OUT =	0.19531E-02
0	PERCENT DISCREPANCY =	0.00	PERCENT DISCREPANCY =	0.00

0

TIME SUMMARY AT END OF TIME STEP 8 IN STRESS PERIOD 1

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	0.262800E+07	43800.0	730.000	30.4167	0.832763E-01
STRESS PERIOD TIME	0.210240E+08	350400.	5840.00	243.333	0.666210
TOTAL SIMULATION TIME	0.210240E+08	350400.	5840.00	243.333	0.666210

1
1 ITERATIONS FOR TIME STEP 9 IN STRESS PERIOD 1
0MAXIMUM HEAD CHANGE FOR EACH ITERATION:
0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,CO

-0.6923E-06 (1, 5, 9)
0
0HEAD/DRAWDOWN PRINTOUT FLAG = 1 TOTAL BUDGET PRINTOUT FLAG = 1 CELL-BY-CELL FLOW TERM FLAG = 1
0OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:

HEAD PRINTOUT	DRAWDOWN PRINTOUT	HEAD SAVE	DRAWDOWN SAVE
1	1	1	1

0	CONSTANT HEAD	PERIOD	1	STEP	9	LAYER	1	ROW	1	COL	4	RATE	-110.8080
0	CONSTANT HEAD	PERIOD	1	STEP	9	LAYER	1	ROW	1	COL	10	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	9	LAYER	1	ROW	1	COL	11	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	9	LAYER	1	ROW	1	COL	12	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	9	LAYER	1	ROW	1	COL	13	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	9	LAYER	1	ROW	1	COL	14	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	9	LAYER	1	ROW	1	COL	15	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	9	LAYER	1	ROW	1	COL	16	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	9	LAYER	1	ROW	2	COL	5	RATE	-244.6019
0	CONSTANT HEAD	PERIOD	1	STEP	9	LAYER	1	ROW	2	COL	6	RATE	-86.52492
0	CONSTANT HEAD	PERIOD	1	STEP	9	LAYER	1	ROW	2	COL	7	RATE	-69.93570
0	CONSTANT HEAD	PERIOD	1	STEP	9	LAYER	1	ROW	2	COL	8	RATE	-51.35721
0	CONSTANT HEAD	PERIOD	1	STEP	9	LAYER	1	ROW	2	COL	9	RATE	-76.44461
0	CONSTANT HEAD	PERIOD	1	STEP	9	LAYER	1	ROW	2	COL	17	RATE	16.76003
0	CONSTANT HEAD	PERIOD	1	STEP	9	LAYER	1	ROW	3	COL	18	RATE	-117.3141
0	CONSTANT HEAD	PERIOD	1	STEP	9	LAYER	1	ROW	4	COL	19	RATE	-68.66843

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0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   5   COL  19   RATE    208.6069
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   6   COL  20   RATE   -343.1424
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   7   COL   6   RATE   -220.6913
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   7   COL   7   RATE    3186.215
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   7   COL  14   RATE   -21.87872
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   7   COL  15   RATE   -329.5192
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   7   COL  20   RATE   -225.6072
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   8   COL   5   RATE   -244.1146
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   8   COL   8   RATE   -3020.776
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   8   COL   9   RATE   -140.6289
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   8   COL  10   RATE    252.5902
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   8   COL  12   RATE   -614.4083
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   8   COL  13   RATE   -60.82795
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   8   COL  14   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   8   COL  16   RATE   -58.88850
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   8   COL  17   RATE   -45.53958
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   8   COL  18   RATE    459.0882
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   8   COL  20   RATE   -201.3971
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   9   COL   1   RATE   -39.98979
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   9   COL   2   RATE    42.27718
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   9   COL   5   RATE   -152.1570
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   9   COL  11   RATE    241.3979
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   9   COL  12   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   9   COL  19   RATE   -201.3971
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW   9   COL  20   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW  10   COL   3   RATE    90.68871
0   CONSTANT HEAD   PERIOD  1   STEP  9   LAYER  1   ROW  10   COL   4   RATE   -152.1570
 "        RECHARGE" BUDGET VALUES WILL BE SAVED ON UNIT 28 AT END OF TIME STEP  9, STRESS PERIOD  1
 "             ET" BUDGET VALUES WILL BE SAVED ON UNIT 27 AT END OF TIME STEP  9, STRESS PERIOD  1
1                   HEAD IN LAYER  1 AT END OF TIME STEP  9 IN STRESS PERIOD  1
                   ---------------------------------------------------------------------
```

	1	2	3	4	5	6	7	8	9
	10	11	12	13	14	15	16	17	18
	19	20							
0 1	999.000	999.000	999.000	200.000	999.000	999.000	999.000	999.000	999.000
	199.000	199.000	199.000	199.000	198.000	198.000	198.000	999.000	999.000
	999.000	999.000							
0 2	999.000	999.000	999.000	200.155	200.000	200.000	200.000	200.000	199.000
	999.000	999.000	999.000	999.000	999.000	999.000	999.000	198.000	999.000
	999.000	999.000							
0 3	999.000	999.000	999.000	200.427	200.187	200.121	200.098	200.072	200.061
	200.910	202.347	201.238	200.200	198.144	198.262	198.116	197.744	197.000
	999.000	999.000							
0 4	999.000	999.000	999.000	201.366	200.872	200.753	200.789	202.403	202.830
	201.398	200.771	198.432	198.200	198.002	197.807	197.622	197.422	197.109
	197.000	999.000							
0 5	999.000	999.000	202.722	202.461	202.422	202.275	202.288	202.562	202.103
	201.094	199.159	198.468	198.229	197.987	197.710	197.532	197.346	197.096
	197.000	999.000							
0 6	999.000	999.000	202.467	202.596	200.790	200.376	199.941	199.609	199.336
	199.026	198.802	198.477	198.216	197.940	197.425	197.346	197.215	196.964
	196.561	196.000							
0 7	999.000	202.123	201.906	201.121	200.269	200.000	200.000	199.491	199.205
	198.984	198.699	198.280	198.093	198.000	197.000	197.094	197.073	196.912
	196.372	196.000							
0 8	201.524	201.632	201.419	200.688	200.000	999.000	999.000	199.000	199.000
	199.000	198.640	198.000	198.000	198.000	999.000	197.000	197.000	197.000
	196.333	196.000							
0 9	201.000	201.000	200.877	200.213	200.000	999.000	999.000	999.000	999.000
	999.000	199.000	198.000	999.000	999.000	999.000	999.000	999.000	999.000
	196.000	195.000							
0 10	999.000	999.000	201.000	200.000	999.000	999.000	999.000	999.000	999.000
	999.000	999.000	999.000	999.000	999.000	999.000	999.000	999.000	999.000
	999.000	999.000							

OHEAD WILL BE SAVED ON UNIT 24 AT END OF TIME STEP 9, STRESS PERIOD 1
1 DRAWDOWN IN LAYER 1 AT END OF TIME STEP 9 IN STRESS PERIOD 1

	1	2	3	4	5	6	7	8	9
	10	11	12	13	14	15	16	17	18
	19	20							
0 1	999.000	999.000	999.000	0.000000	999.000	999.000	999.000	999.000	999.000
	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	999.000	999.000
	999.000	999.000							
0 2	999.000	999.000	999.000	0.844833	0.000000	0.000000	0.000000	0.000000	0.000000
	999.000	999.000	999.000	999.000	999.000	999.000	999.000	0.000000	999.000
	999.000	999.000							
0 3	999.000	999.000	999.000	1.57329	-0.187119	-0.121323	-9.815979E-02	-7.215881E-02	-1.46074
	-1.50983	-4.14737	-2.23845	1.068115E-04	1.85617	0.737701	0.884293	0.256241	0.000000
	999.000	999.000							
0 4	999.000	999.000	999.000	0.633804	-1.87224	0.247177	-0.189209	-2.40309	-2.83044
	-1.39769	-1.77071	0.268219	1.79980	1.99803	2.19325	1.37753	1.57849	0.890594
	0.000000	999.000							
0 5	999.000	999.000	-2.22232	-1.46051	-1.42192	-1.27477	-1.28825	-1.56224	-0.803116
	-1.09381	0.741272	1.53168	1.77051	2.01302	2.28981	1.46817	1.65425	0.903839
	0.000000	999.000							
0 6	999.000	999.000	-0.466995	-0.595840	-0.689896	1.32448	1.05913	1.39075	1.86395
	1.97401	3.19818	2.52322	1.78391	1.05980	1.57481	1.65390	1.78531	1.03569
	0.439209	0.000000							
0 7	999.000	-0.122787	9.396362E-02	0.179031	3.054810E-02	0.000000	0.000000	0.508743	0.795334
	1.01643	3.30150	0.720413	-9.278870E-02	0.000000	0.000000	0.906113	0.927322	8.793640E-02
	0.628082	0.000000							
0 8	-0.524261	-0.632111	-0.419220	0.311966	0.000000	999.000	999.000	0.000000	0.000000
	0.000000	0.959595	0.000000	0.000000	0.000000	999.000	0.000000	0.000000	0.000000
	0.667389	0.000000							
0 9	0.000000	0.000000	0.123428	0.787399	0.000000	999.000	999.000	999.000	999.000
	999.000	0.000000	0.000000	999.000	999.000	999.000	999.000	999.000	999.000
	0.000000	0.000000							
0 10	999.000	999.000	0.000000	0.000000	999.000	999.000	999.000	999.000	999.000
	999.000	999.000	999.000	999.000	999.000	999.000	999.000	999.000	999.000
	999.000	999.000							

ODRAWDOWN WILL BE SAVED ON UNIT 25 AT END OF TIME STEP 9, STRESS PERIOD 1
0

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 9 IN STRESS PERIOD 1

0	CUMULATIVE VOLUMES L**3		RATES FOR THIS TIME STEP L**3/T	
	IN:		IN:	
	STORAGE =	0.00000	STORAGE =	0.00000
	CONSTANT HEAD =	0.12717E+07	CONSTANT HEAD =	4645.3
	RECHARGE =	0.11977E+07	RECHARGE =	4375.1
	ET =	0.00000	ET =	0.00000
0	TOTAL IN =	0.24693E+07	TOTAL IN =	9020.4
0	OUT:		OUT:	
	STORAGE =	0.00000	STORAGE =	0.00000
	CONSTANT HEAD =	0.19290E+07	CONSTANT HEAD =	7046.5
	RECHARGE =	0.00000	RECHARGE =	0.00000
	ET =	0.54036E+06	ET =	1973.9
0	TOTAL OUT =	0.24693E+07	TOTAL OUT =	9020.4
0	IN - OUT =	-1.2500	IN - OUT =	0.19531E-02
0	PERCENT DISCREPANCY =	0.00	PERCENT DISCREPANCY =	0.00

0

TIME SUMMARY AT END OF TIME STEP 9 IN STRESS PERIOD 1

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	0.262800E+07	43800.0	730.000	30.4167	0.832763E-01
STRESS PERIOD TIME	0.236520E+08	394200.	6570.00	273.750	0.749487
TOTAL SIMULATION TIME	0.236520E+08	394200.	6570.00	273.750	0.749487

1
1 ITERATIONS FOR TIME STEP 10 IN STRESS PERIOD 1
0MAXIMUM HEAD CHANGE FOR EACH ITERATION:
0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL

0.6536E-06 (1, 5, 9)
0
0HEAD/DRAWDOWN PRINTOUT FLAG = 1 TOTAL BUDGET PRINTOUT FLAG = 1 CELL-BY-CELL FLOW TERM FLAG = 1
0OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:

HEAD PRINTOUT	DRAWDOWN PRINTOUT	HEAD SAVE	DRAWDOWN SAVE
1	1	1	1

0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	1	COL	4	RATE	-110.8080
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	1	COL	10	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	1	COL	11	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	1	COL	12	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	1	COL	13	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	1	COL	14	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	1	COL	15	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	1	COL	16	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	2	COL	5	RATE	-244.6019
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	2	COL	6	RATE	-86.52492
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	2	COL	7	RATE	-69.93570
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	2	COL	8	RATE	-51.35721
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	2	COL	9	RATE	-76.44461
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	2	COL	17	RATE	16.76003
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	3	COL	18	RATE	-117.3140
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	4	COL	19	RATE	-68.66843
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	5	COL	19	RATE	208.6069
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	6	COL	20	RATE	-343.1424
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	7	COL	6	RATE	-220.6913
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	7	COL	7	RATE	3186.215
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	7	COL	14	RATE	-21.87867
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	7	COL	15	RATE	-329.5192
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	7	COL	20	RATE	-225.6072
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	8	COL	5	RATE	-244.1146
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	8	COL	8	RATE	-3020.776
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	8	COL	9	RATE	-140.6289
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	8	COL	10	RATE	252.5902
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	8	COL	12	RATE	-614.4082
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	8	COL	13	RATE	-60.82794
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	8	COL	14	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	8	COL	16	RATE	-58.88850
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	8	COL	17	RATE	-45.53958
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	8	COL	18	RATE	459.0882
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	8	COL	20	RATE	-201.3971
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	9	COL	1	RATE	-39.98979
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	9	COL	2	RATE	42.27717
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	9	COL	5	RATE	-152.1570
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	9	COL	11	RATE	241.3979
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	9	COL	12	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	9	COL	19	RATE	-201.3971
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	9	COL	20	RATE	0.0000000
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	10	COL	3	RATE	90.68871
0	CONSTANT HEAD	PERIOD	1	STEP	10	LAYER	1	ROW	10	COL	4	RATE	-152.1570

" RECHARGE" BUDGET VALUES WILL BE SAVED ON UNIT 28 AT END OF TIME STEP 10, STRESS PERIOD 1

" ET" BUDGET VALUES WILL BE SAVED ON UNIT 27 AT END OF TIME STEP 10, STRESS PERIOD 1

1 HEAD IN LAYER 1 AT END OF TIME STEP 10 IN STRESS PERIOD 1

	1	2	3	4	5	6	7	8	9
	10	11	12	13	14	15	16	17	18
	19	20							
0 1	999.000	999.000	999.000	200.000	999.000	999.000	999.000	999.000	999.000
	199.000	199.000	199.000	199.000	198.000	198.000	198.000	999.000	999.000
	999.000	999.000							
0 2	999.000	999.000	999.000	200.155	200.000	200.000	200.000	200.000	199.000
	999.000	999.000	999.000	999.000	999.000	999.000	999.000	198.000	999.000
	999.000	999.000							
0 3	999.000	999.000	999.000	200.427	200.187	200.121	200.098	200.072	200.061
	200.910	202.347	201.238	200.200	198.144	198.262	198.116	197.744	197.000
	999.000	999.000							
0 4	999.000	999.000	999.000	201.366	200.872	200.753	200.789	202.403	202.830
	201.398	200.771	198.432	198.200	198.002	197.807	197.622	197.422	197.109
	197.000	999.000							
0 5	999.000	999.000	202.722	202.461	202.422	202.275	202.288	202.562	202.103
	201.094	199.159	198.468	198.229	197.987	197.710	197.532	197.346	197.096
	197.000	999.000							
0 6	999.000	999.000	202.467	202.596	200.790	200.376	199.941	199.609	199.336
	199.026	198.802	198.477	198.216	197.940	197.425	197.346	197.215	196.964
	196.561	196.000							
0 7	999.000	202.123	201.906	201.121	200.269	200.000	200.000	199.491	199.205
	198.984	198.699	198.280	198.093	198.000	197.000	197.094	197.073	196.912
	196.372	196.000							
0 8	201.524	201.632	201.419	200.688	200.000	999.000	999.000	199.000	199.000
	199.000	198.640	198.000	198.000	198.000	999.000	197.000	197.000	197.000
	196.333	196.000							
0 9	201.000	201.000	200.877	200.213	200.000	999.000	999.000	999.000	999.000
	999.000	199.000	198.000	999.000	999.000	999.000	999.000	999.000	999.000
	196.000	195.000							
0 10	999.000	999.000	201.000	200.000	999.000	999.000	999.000	999.000	999.000
	999.000	999.000	999.000	999.000	999.000	999.000	999.000	999.000	999.000
	999.000	999.000							

OHEAD WILL BE SAVED ON UNIT 24 AT END OF TIME STEP 10, STRESS PERIOD 1

1 DRAWDOWN IN LAYER 1 AT END OF TIME STEP 10 IN STRESS PERIOD 1

	1	2	3	4	5	6	7	8	9
	10	11	12	13	14	15	16	17	18
	19	20							
0 1	999.000	999.000	999.000	0.000000	999.000	999.000	999.000	999.000	999.000
	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	999.000	999.000
	999.000	999.000							
0 2	999.000	999.000	999.000	0.844833	0.000000	0.000000	0.000000	0.000000	0.000000
	999.000	999.000	999.000	999.000	999.000	999.000	999.000	0.000000	999.000
	999.000	999.000							
0 3	999.000	999.000	999.000	1.57329	-0.187119	-0.121323	-9.815979E-02	-7.215881E-02	-1.46074
	-1.50983	-4.14737	-2.23845	1.068115E-04	1.85617	0.737701	0.884308	0.256241	0.000000
	999.000	999.000							
0 4	999.000	999.000	999.000	0.633804	-1.87224	0.247177	-0.189209	-2.40309	-2.83044
	-1.39769	-1.77071	0.268219	1.79980	1.99803	2.19325	1.37753	1.57849	0.890594
	0.000000	999.000							
0 5	999.000	999.000	-2.22232	-1.46051	-1.42192	-1.27477	-1.28825	-1.56224	-0.803131
	-1.09381	0.741272	1.53168	1.77051	2.01302	2.28981	1.46817	1.65425	0.903839
	0.000000	999.000							
0 6	999.000	999.000	-0.466995	-0.595840	-0.689896	1.32448	1.05913	1.39075	1.86395
	1.97401	3.19818	2.52322	1.78391	1.05980	1.57481	1.65390	1.78531	1.03569
	0.439209	0.000000							
0 7	999.000	-0.122787	9.396362E-02	0.179031	3.054810E-02	0.000000	0.000000	0.508743	0.795334
	1.01643	3.30150	0.720413	-9.278870E-02	0.000000	0.000000	0.906113	0.927322	8.793640E-0

```
          196.372     196.000
0  8      201.524     201.632     201.419     200.688     200.000     999.000     999.000     199.000     199.000
          199.000     198.640     198.000     198.000     198.000     999.000     197.000     197.000     197.000
          196.333     196.000
0  9      201.000     201.000     200.877     200.213     200.000     999.000     999.000     999.000     999.000
          999.000     199.000     198.000     999.000     999.000     999.000     999.000     999.000     999.000
          196.000     195.000
0 10      999.000     999.000     201.000     200.000     999.000     999.000     999.000     999.000     999.000
          999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000
          999.000     999.000
OHEAD WILL BE SAVED ON UNIT 24 AT END OF TIME STEP 11, STRESS PERIOD  1
1                 DRAWDOWN IN LAYER  1 AT END OF TIME STEP 11 IN STRESS PERIOD  1
                  ------------------------------------------------------------

                    1           2           3           4           5           6           7           8           9
                   10          11          12          13          14          15          16          17          18
                   19          20
 ..........................................................................................................................
0  1      999.000     999.000     999.000     0.000000    999.000     999.000     999.000     999.000     999.000
          0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    999.000     999.000
          999.000     999.000
0  2      999.000     999.000     999.000     0.844833    0.000000    0.000000    0.000000    0.000000    0.000000
          999.000     999.000     999.000     999.000     999.000     999.000     999.000     0.000000    999.000
          999.000     999.000
0  3      999.000     999.000     999.000     1.57329     -0.187119   -0.121323   -9.815979E-02 -7.215881E-02 -1.46074
          -1.50983    -4.14737    -2.23845    1.068115E-04 1.85617    0.737701    0.884293    0.256241    0.000000
          999.000     999.000
0  4      999.000     999.000     999.000     0.633804    -1.87224    0.247177    -0.189209   -2.40309    -2.83044
          -1.39769    -1.77071    0.268219    1.79980     1.99803     2.19325     1.37753     1.57849     0.890594
          0.000000    999.000
0  5      999.000     999.000     -2.22232    -1.46051    -1.42192    -1.27477    -1.28825    -1.56224    -0.803116
          -1.09381    0.741272    1.53168     1.77051     2.01302     2.28981     1.46817     1.65425     0.903839
          0.000000    999.000
0  6      999.000     999.000     -0.466995   -0.595840   -0.689896   1.32448     1.05913     1.39075     1.86395
          1.97401     3.19818     2.52322     1.78391     1.05980     1.57481     1.65390     1.78531     1.03569
          0.439209    0.000000
0  7      999.000     -0.122787   9.396362E-02 0.179031    3.054810E-02 0.000000    0.000000    0.508743    0.795334
          1.01643     3.30150     0.720413    -9.278870E-02 0.000000    0.000000    0.906113    0.927322    8.793640E-02
          0.628082    0.000000
0  8      -0.524261   -0.632111   -0.419220   0.311966    0.000000    999.000     999.000     0.000000    0.000000
          0.000000    0.959595    0.000000    0.000000    0.000000    999.000     0.000000    0.000000    0.000000
          0.667389    0.000000
0  9      0.000000    0.000000    0.123428    0.787399    0.000000    999.000     999.000     999.000     999.000
          999.000     0.000000    0.000000    999.000     999.000     999.000     999.000     999.000     999.000
          0.000000    0.000000
0 10      999.000     999.000     0.000000    0.000000    999.000     999.000     999.000     999.000     999.000
          999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000
          999.000     999.000
ODRAWDOWN WILL BE SAVED ON UNIT 25 AT END OF TIME STEP 11, STRESS PERIOD  1
0


                        VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 11 IN STRESS PERIOD  1
                        ---------------------------------------------------------------------------
0                     CUMULATIVE VOLUMES      L**3                    RATES FOR THIS TIME STEP      L**3/T
                      ------------------                              ------------------------

                           IN:                                             IN:
                           ---                                             ---
                             STORAGE =   0.00000                             STORAGE =   0.00000
                      CONSTANT HEAD =   0.15542E+07                   CONSTANT HEAD =    4645.3
                            RECHARGE =   0.14638E+07                        RECHARGE =    4375.1
                                  ET =   0.00000                                ET =   0.00000
0                           TOTAL IN =   0.30181E+07                      TOTAL IN =    9020.4
0                          OUT:                                            OUT:
                           ----                                            ----
```

```
                    STORAGE =   0.00000                                   STORAGE =   0.00000
                CONSTANT HEAD =   0.23576E+07                         CONSTANT HEAD =   7046.5
                    RECHARGE =   0.00000                              RECHARGE =   0.00000
                          ET =   0.66044E+06                                ET =   1973.9
0                   TOTAL OUT =   0.30181E+07                         TOTAL OUT =   9020.4
0                    IN - OUT =  -0.75000                             IN - OUT =   0.29297E-02
0           PERCENT DISCREPANCY =              0.00                 PERCENT DISCREPANCY =              0.00


0


        TIME SUMMARY AT END OF TIME STEP 11 IN STRESS PERIOD  1
                            SECONDS         MINUTES         HOURS          DAYS            YEARS
                        ------------------------------------------------------------------------
     TIME STEP LENGTH       0.262800E+07    43800.0         730.000        30.4167         0.832763E-01
   STRESS PERIOD TIME       0.289080E+08    481800.         8030.00        334.583         0.916039
 TOTAL SIMULATION TIME      0.289080E+08    481800.         8030.00        334.583         0.916039
1
     1 ITERATIONS FOR TIME STEP  12 IN STRESS PERIOD  1
0MAXIMUM HEAD CHANGE FOR EACH ITERATION:
0 HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL HEAD CHANGE LAYER,ROW,COL
 ---------------------------------------------------------------------------------------------------------------------------------
   0.6615E-06 (  1,  5,  9)
0
0HEAD/DRAWDOWN PRINTOUT FLAG = 1     TOTAL BUDGET PRINTOUT FLAG = 1     CELL-BY-CELL FLOW TERM FLAG = 1
0OUTPUT FLAGS FOR ALL LAYERS ARE THE SAME:
    HEAD     DRAWDOWN  HEAD  DRAWDOWN
 PRINTOUT   PRINTOUT  SAVE    SAVE
 ---------------------------------
     1         1       1       1
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  1   COL   4   RATE   -110.8080
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  1   COL  10   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  1   COL  11   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  1   COL  12   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  1   COL  13   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  1   COL  14   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  1   COL  15   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  1   COL  16   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  2   COL   5   RATE   -244.6019
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  2   COL   6   RATE   -86.52492
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  2   COL   7   RATE   -69.93570
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  2   COL   8   RATE   -51.35721
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  2   COL   9   RATE   -76.44461
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  2   COL  17   RATE    16.76003
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  3   COL  18   RATE   -117.3140
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  4   COL  19   RATE   -68.66842
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  5   COL  19   RATE    208.6069
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  6   COL  20   RATE   -343.1424
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  7   COL   6   RATE   -220.6913
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  7   COL   7   RATE    3186.215
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  7   COL  14   RATE   -21.87862
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  7   COL  15   RATE   -329.5192
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  7   COL  20   RATE   -225.6072
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  8   COL   5   RATE   -244.1146
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  8   COL   8   RATE   -3020.776
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  8   COL   9   RATE   -140.6289
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  8   COL  10   RATE    252.5902
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  8   COL  12   RATE   -614.4082
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  8   COL  13   RATE   -60.82792
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  8   COL  14   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  8   COL  16   RATE   -58.88850
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  8   COL  17   RATE   -45.53957
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  8   COL  18   RATE    459.0882
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  8   COL  20   RATE   -201.3971
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0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW   9   COL   1   RATE   -39.98979
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW   9   COL   2   RATE    42.27717
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW   9   COL   5   RATE   -152.1570
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW   9   COL  11   RATE    241.3979
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW   9   COL  12   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW   9   COL  19   RATE   -201.3971
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW   9   COL  20   RATE   0.0000000
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  10   COL   3   RATE    90.68871
0   CONSTANT HEAD   PERIOD  1   STEP 12   LAYER  1   ROW  10   COL   4   RATE   -152.1570
 "        RECHARGE" BUDGET VALUES WILL BE SAVED ON UNIT 28 AT END OF TIME STEP 12, STRESS PERIOD  1
 "              ET" BUDGET VALUES WILL BE SAVED ON UNIT 27 AT END OF TIME STEP 12, STRESS PERIOD  1
1                    HEAD IN LAYER  1 AT END OF TIME STEP 12 IN STRESS PERIOD  1
             ------------------------------------------------------------------

                    1           2           3           4           5           6           7           8           9
                   10          11          12          13          14          15          16          17          18
                   19          20
 ..........................................................................................................................
0  1   999.000     999.000     999.000     200.000     999.000     999.000     999.000     999.000     999.000
         199.000     199.000     199.000     199.000     198.000     198.000     198.000     999.000     999.000
         999.000     999.000
0  2   999.000     999.000     999.000     200.155     200.000     200.000     200.000     200.000     199.000
         999.000     999.000     999.000     999.000     999.000     999.000     999.000     198.000     999.000
         999.000     999.000
0  3   999.000     999.000     999.000     200.427     200.187     200.121     200.098     200.072     200.061
         200.910     202.347     201.238     200.200     198.144     198.262     198.116     197.744     197.000
         999.000     999.000
0  4   999.000     999.000     999.000     201.366     200.872     200.753     200.789     202.403     202.830
         201.398     200.771     198.432     198.200     198.002     197.807     197.622     197.422     197.109
         197.000     999.000
0  5   999.000     999.000     202.722     202.461     202.422     202.275     202.288     202.562     202.103
         201.094     199.159     198.468     198.229     197.987     197.710     197.532     197.346     197.096
         197.000     999.000
0  6   999.000     999.000     202.467     202.596     200.790     200.376     199.941     199.609     199.336
         199.026     198.802     198.477     198.216     197.940     197.425     197.346     197.215     196.964
         196.561     196.000
0  7   999.000     202.123     201.906     201.121     200.269     200.000     200.000     199.491     199.205
         198.984     198.699     198.280     198.093     198.000     197.000     197.094     197.073     196.912
         196.372     196.000
0  8   201.524     201.632     201.419     200.688     200.000     999.000     999.000     199.000     199.000
         199.000     198.640     198.000     198.000     198.000     999.000     197.000     197.000     197.000
         196.333     196.000
0  9   201.000     201.000     200.877     200.213     200.000     999.000     999.000     999.000     999.000
         999.000     199.000     198.000     999.000     999.000     999.000     999.000     999.000     999.000
         196.000     195.000
0 10   999.000     999.000     201.000     200.000     999.000     999.000     999.000     999.000     999.000
         999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000     999.000
         999.000     999.000
OHEAD WILL BE SAVED ON UNIT 24 AT END OF TIME STEP 12, STRESS PERIOD  1
1                 DRAWDOWN IN LAYER  1 AT END OF TIME STEP 12 IN STRESS PERIOD  1
             ------------------------------------------------------------------

                    1           2           3           4           5           6           7           8           9
                   10          11          12          13          14          15          16          17          18
                   19          20
 ..........................................................................................................................
0  1   999.000     999.000     999.000     0.000000    999.000     999.000     999.000     999.000     999.000
       0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000    999.000     999.000
         999.000     999.000
0  2   999.000     999.000     999.000     0.844833    0.000000    0.000000    0.000000    0.000000    0.000000
         999.000     999.000     999.000     999.000     999.000     999.000     999.000     0.000000    999.000
         999.000     999.000
0  3   999.000     999.000     999.000     1.57329     -0.187119   -0.121323   -9.815979E-02 -7.215881E-02 -1.46074
        -1.50983    -4.14737    -2.23845    1.068115E-04 1.85617    0.737701    0.884308    0.256241    0.000000
         999.000     999.000
0  4   999.000     999.000     999.000     0.633804    -1.87224    0.247177    -0.189209   -2.40309    -2.83044
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      -1.39769      -1.77071      0.268219       1.79980       1.99803       2.19325       1.37753       1.57849      0.890594
       0.000000      999.000
0  5   999.000       999.000      -2.22232      -1.46051      -1.42192      -1.27477      -1.28825      -1.56224     -0.803131
      -1.09381      0.741272       1.53168       1.77051       2.01302       2.28981       1.46817       1.65425      0.903839
       0.000000      999.000
0  6   999.000       999.000     -0.466995     -0.595840     -0.689896       1.32448       1.05913       1.39075       1.86395
       1.97401       3.19818       2.52322       1.78391       1.05980       1.57481       1.65390       1.78531       1.03569
       0.439209      0.000000
0  7   999.000     -0.122787   9.396362E-02      0.179031   3.054810E-02      0.000000      0.000000      0.508743      0.795334
       1.01643       3.30150      0.720413   -9.278870E-02      0.000000      0.000000      0.906113      0.927322   8.793640E-02
       0.628082      0.000000
0  8 -0.524261     -0.632111     -0.419220      0.311966      0.000000      999.000       999.000       0.000000      0.000000
       0.000000      0.959595      0.000000      0.000000      0.000000      999.000       0.000000      0.000000      0.000000
       0.667389      0.000000
0  9   0.000000      0.000000      0.123428      0.787399      0.000000      999.000       999.000       999.000       999.000
       999.000       0.000000      0.000000       999.000       999.000       999.000       999.000       999.000       999.000
       0.000000      0.000000
0 10   999.000       999.000       0.000000      0.000000      999.000       999.000       999.000       999.000       999.000
       999.000       999.000       999.000       999.000       999.000       999.000       999.000       999.000       999.000
       999.000       999.000
ODRAWDOWN WILL BE SAVED ON UNIT 25 AT END OF TIME STEP 12, STRESS PERIOD  1
0


                          VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 12 IN STRESS PERIOD  1
                          ------------------------------------------------------------------------------
0                   CUMULATIVE VOLUMES      L**3                          RATES FOR THIS TIME STEP      L**3/T
                    ------------------                                    ------------------------

                         IN:                                                   IN:
                         ---                                                   ---
                           STORAGE =   0.00000                                   STORAGE =   0.00000
                    CONSTANT HEAD =   0.16955E+07                         CONSTANT HEAD =    4645.3
                         RECHARGE =   0.15969E+07                              RECHARGE =    4375.1
                               ET =   0.00000                                        ET =   0.00000
0                       TOTAL IN =   0.32924E+07                              TOTAL IN =    9020.4
0                       OUT:                                                  OUT:
                        ----                                                  ----
                           STORAGE =   0.00000                                   STORAGE =   0.00000
                    CONSTANT HEAD =   0.25720E+07                         CONSTANT HEAD =    7046.5
                         RECHARGE =   0.00000                                  RECHARGE =   0.00000
                               ET =   0.72048E+06                                    ET =    1973.9
0                       TOTAL OUT =   0.32924E+07                             TOTAL OUT =    9020.4
0                        IN - OUT =  -0.75000                                  IN - OUT =   0.29297E-02
0                PERCENT DISCREPANCY =          0.00                  PERCENT DISCREPANCY =          0.00



0

            TIME SUMMARY AT END OF TIME STEP 12 IN STRESS PERIOD  1
                                SECONDS         MINUTES         HOURS          DAYS          YEARS
                               ------------------------------------------------------------------------
         TIME STEP LENGTH     0.262800E+07    43800.0         730.000        30.4167     0.832763E-01
       STRESS PERIOD TIME     0.315360E+08    525600.         8760.00        365.000     0.999316
     TOTAL SIMULATION TIME    0.315360E+08    525600.         8760.00        365.000     0.999316
1
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APPENDIX I

Chemical Analysis of Ground and Surface Water Samples

Chemical analysis of water samples collected from 9 piezometers and outlet surface water. Samples were collected 10 July 1996.

Sample ID	NH3-N mg/L 7/23/96	TKN mg/L 8/12/96	Cl mg/L 7/11-16/96	SO4 mg/L 7/11-16/96	NO3-N mg/L 7/11/96	PO4-P mg/L 7/11/96	Total P mg/L 7/19/96	Total Solids mg/L 7/16/96	TOC mg/L 7/17/96
NC1010	0.522	1.47	19.22	92.98	<0.01	0.152	0.23	497.5	5.67
NC1070	<0.003	0.39	8.76	11.95	0.15	0.334	0.27	425.5	3.40
NC1130	<0.003	1.17	10.05	14.33	0.01	0.425	1.41	1869.8	3.04
NC1150	0.056	0.47	16.53	23.55	<0.01	0.038	0.08	164.3	6.86
NC1170	<0.003	0.71	6.82	29.37	0.01	0.836	0.91	960.0	3.31
NC1190	0.058	0.67	94.73	268.19	<0.01	0.147	0.19	905.0	11.25
NC1210	1.076	1.61	84.63	270.60	<0.01	0.037	0.06	813.3	12.96
NC1310	<0.003	0.44	10.27	9.12	<0.01	0.348	0.39	277.8	4.98
NC1320	<0.003	0.34	4.74	14.12	<0.01	0.224	0.28	182.8	4.89
Outlet Surface Water	0.036	0.83	5.68	2.72	<0.01	0.039	0.14	119.8	7.69
Field Blank	0.005	<0.05	0.10	<0.01	0.01	<0.005	<0.02	<0.2	2.39

Sample ID Date Analyzed:	Al mg/L 10/4/96	Cu mg/L 10/4/96	Fe mg/L 10/4-11/96	Mn mg/L 10/4-11/96	Zn mg/L 10/4/96	Ca mg/L 10/4-11/96	Na mg/L 10/4-11/96	Mg mg/L 10/4-11/96	K mg/L 10/4-11/96
NC1010	0.062	0.0131	2.375	0.1691	<0.0002	9.290	34.770	3.495	3.617
NC1070	1.977	0.0092	0.880	0.0253	<0.0002	2.021	12.430	0.544	0.992
NC1130	2.408	0.0092	1.479	0.0717	0.0061	3.404	17.190	0.974	1.687
NC1150	0.056	0.0143	0.276	0.3835	0.0082	3.718	16.520	1.271	3.230
NC1170	1.160	0.0145	1.460	0.0616	0.0029	1.718	19.660	0.482	1.983
NC1190	<0.005	0.0060	4.542	1.4210	<0.0002	49.240	113.700	17.990	5.350
NC1210	0.333	0.0247	0.049	0.0046	<0.0002	114.500	120.000	0.069	7.440
NC1310	0.624	0.0077	3.501	0.1755	<0.0002	10.710	5.960	0.739	0.954
NC1320	0.220	0.0224	1.917	0.2346	<0.0002	2.118	9.610	0.484	0.739
Outlet Surface Water	0.318	0.0011	0.771	0.2806	<0.0002	3.410	16.600	1.422	4.168
Field Blank	<0.005	<0.0014	0.003	0.0012	<0.0002	0.017	0.334	<0.003	0.013

Chemical analysis of water samples collected from 20 piezometers and inlet and outlet surface water. Samples were collected 30 October 1996.

Sample ID	NH3-N mg/L	TKN mg/L	Cl mg/L	SO4 mg/L	NO3-N mg/L	PO4-P mg/L	Total P mg/L	Total Solids mg/L	TOC mg/L
Date Analyzed:	10/31/96	11/7-12/5/96	10/31-11/2/96	10/31-11/2/96	10/31/96	10/31/96	10/31-11/5/96	11/1/96	11/2/96
NC1300	0.053	0.22	8.75	31.89	0.14	0.031	0.07	215.0	3.85
NC INLET	<0.003	0.52	5.50	11.77	0.01	0.030	0.14	154.0	15.18
NC OUTLET	<0.003	0.62	5.37	11.87	<0.01	0.075	0.10	141.3	14.74
NC1330	<0.003	0.52	1.24	10.16	0.13	0.385	0.28	600.8	2.60
NC1320	0.023	<0.05	4.35	8.61	0.02	0.078	0.08	94.0	3.16
NC1310	<0.003	0.05	4.17	7.18	<0.01	0.087	0.07	104.3	8.78
NC1260	<0.003	0.44	29.14	20.08	0.06	0.196	0.23	346.8	8.17
NC1250	0.026	0.26	3.99	41.19	0.02	0.070	0.08	294.3	3.98
NC1240	0.032	0.22	13.15	59.44	0.02	0.105	0.10	437.3	5.28
NC1220	0.139	0.22	142.43	61.70	0.03	<0.005	<0.02	1012.8	5.42
NC1210	0.613	0.56	74.70	276.00	<0.01	<0.005	<0.02	686.7	7.68
NC1200	0.048	0.19	41.20	118.41	0.18	0.092	0.03	361.5	5.69
NC1190	0.048	0.15	72.60	244.00	0.08	0.009	<0.02	638.8	5.75
NC1170	<0.003	0.12	5.09	21.48	0.01	0.127	0.17	229.5	1.46
NC1150	0.013	<0.05	6.49	22.71	0.01	0.016	0.02	112.5	2.19
NC1130	0.007	<0.05	6.63	12.73	0.13	0.010	0.03	92.8	0.48
NC1120	0.007	<0.05	11.46	13.64	0.28	0.021	0.04	105.0	1.27
NC1110	0.206	0.43	5.64	7.49	1.76	0.026	0.05	105.3	4.16
NC1100	0.022	0.19	9.40	232.70	0.04	0.009	0.02	435.5	2.43
NC1080	<0.003	0.11	43.36	19.00	0.10	0.074	0.09	268.3	1.62
NC1070	<0.003	0.12	7.90	13.59	0.10	0.058	0.09	239.3	0.70
NC1010	0.219	1.12	14.46	134.98	<0.01	0.023	0.03	362.3	3.52

Chemical analysis of water samples collected from 20 piezometers and inlet and outlet surface water. Samples were collected 30 October 1996.

Sample ID	Al	Cu	Fe	Mn	Zn	Ca	Na	Mg	K
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Date Analyzed:	3/28/97	3/28/97	3/28/96	3/28/97	3/28/97	3/28/97	3/28/97	3/28/97	3/28/97
NC1300	0.817	0.0440	0.421	0.1329	0.0226	6.238	2.974	0.933	3.287
NC INLET	7.576	<0.0014	4.512	0.1504	0.0154	6.121	7.154	2.524	5.718
NC OUTLET	4.609	<0.0014	3.108	0.0685	0.0204	5.307	6.687	2.044	4.800
NC1330	6.558	<0.0014	26.640	0.1045	0.0652	16.911	4.561	4.874	4.211
NC1320	0.375	0.0163	1.595	0.2288	0.0102	1.364	9.175	0.405	0.594
NC1310	3.673	<0.0014	4.517	0.1304	0.0038	7.016	8.345	0.631	1.108
NC1260	13.909	0.0047	6.233	0.0266	0.0171	32.003	46.144	3.124	0.454
NC1250	1.182	0.0091	0.680	0.0311	0.0038	50.387	23.568	11.768	5.329
NC1240	1.099	0.0071	0.694	0.1252	0.0046	73.539	45.359	24.316	4.859
NC1220	0.704	0.0136	0.016	0.0009	<0.0002	326.812	146.062	0.024	7.804
NC1210	0.217	0.0235	0.018	0.0013	0.0074	94.016	136.190	0.026	0.573
NC1200	0.304	0.0078	0.184	0.0039	0.0064	42.272	59.156	1.840	6.084
NC1190	0.024	0.0076	5.967	0.9170	0.0109	45.511	122.595	17.523	4.994
NC1170	11.959	<0.0014	4.186	0.0539	0.0294	1.087	15.083	1.003	2.340
NC1150	0.214	0.0017	0.788	0.4785	0.0106	4.394	13.050	1.195	2.701
NC1130	0.393	<0.0014	0.180	0.0096	0.0042	0.368	11.505	0.179	0.858
NC1120	0.898	0.0285	0.440	0.2260	0.0102	1.066	13.171	0.500	2.568
NC1110	0.319	0.0462	0.683	0.5204	0.0101	7.902	5.115	0.844	8.004
NC1100	3.060	0.0265	0.180	1.5170	0.0623	34.040	40.382	14.599	8.342
NC1080	1.133	0.0130	0.675	0.1577	0.0145	3.138	34.845	0.517	0.647
NC1070	10.447	<0.0014	3.763	0.0281	0.0102	3.796	12.998	0.943	1.263
NC1010	0.095	0.0140	2.577	0.1773	0.0371	13.539	47.531	6.098	4.764

Chemical analysis of water samples collected from 28 piezometers and inlet and outlet surface water. Samples were collected 14 May 1997.

Sample ID Date Analyzed:	NH3-N mg/L 5/31/97	TKN mg/L 5/15-29/97	Cl mg/L 5/15/97	SO4 mg/L 5/15-21/97	NO3-N mg/L 5/15/97	PO4-P mg/L 5/15/97	Total P mg/L 5/16,19,27/97	Total Solids mg/L 5/15/97	TOC mg/L 5/19/97	Conductivity uS/cm 5/15/97
NC1010	0.077	0.20	15.62	106.14	0.006	0.157	<0.021	241.2	2.32	300
NC1020	0.956	1.68	6.94	11.22	0.007	0.030	0.043	250.5	13.26	390
NC1030	0.130	0.34	2.90	47.74	0.005	0.060	0.070	207.0	4.56	230
NC1040	0.025	0.09	15.98	50.26	0.317	0.074	0.023	172.5	0.94	200
NC1050	<0.009	0.42	21.84	360.45	<0.004	0.049	0.023	642.8	6.98	865
NC1060	0.620	1.76	18.82	9.46	<0.004	0.230	0.157	582.5	14.64	365
NC1080	<0.009	0.61	6.17	2.35	<0.004	0.066	0.067	170.8	19.69	135
NC1090	0.016	0.20	16.58	50.63	<0.004	0.089	0.027	227.5	2.61	200
NC1100	0.030	0.14	7.28	28.66	0.109	0.045	<0.021	115.7	1.30	120
NC1110	0.135	0.39	1.11	5.81	0.007	0.069	0.053	80.7	4.59	79
NC1130	0.026	0.04	3.66	76.08	0.534	0.039	<0.021	152.7	1.02	215
NC1140	0.029	0.31	3.42	128.56	0.884	0.300	0.176	417.5	1.04	330
NC1160	0.022	0.17	3.57	11.10	0.260	0.082	0.063	83.5	1.05	66
NC1170	0.050	0.22	6.34	25.62	0.018	0.205	0.113	257.3	0.58	107
NC1190	0.090	0.23	80.08	229.08	<0.004	0.066	0.027	585.0	4.15	860
NC1200	0.055	0.12	64.59	215.33	0.017	0.048	0.037	532.0	4.05	820
NC1210	0.375	0.55	18.72	100.81	0.006	0.037	<0.021	290.0	6.37	430
NC1220	0.524	0.69	155.60	113.42	0.017	0.011	<0.021	814.5	4.69	2500
NC1230	0.117	0.99	41.91	42.31	0.013	0.614	0.370	1135.5	6.00	740
NC1240	0.278	0.36	82.13	59.58	<0.004	0.494	0.436	519.8	3.74	790
NC1250	0.069	0.21	18.53	35.89	0.040	0.108	0.070	360.2	3.43	525
NC1260	0.075	0.36	103.91	35.73	0.005	0.236	0.165	415.5	5.10	620
NC1270	0.118	0.67	4.60	10.54	0.098	0.176	0.130	380.5	3.56	150
NC1300	0.048	0.11	5.39	12.34	0.004	0.066	0.023	117.5	0.92	72
NC1310	0.033	0.15	2.21	7.08	0.286	0.112	0.090	110.3	0.79	76
NC1320	0.059	0.10	3.25	9.09	0.004	0.087	0.067	82.5	0.49	60
NC1330	0.050	0.40	6.34	27.96	0.078	0.332	0.210	459.0	1.67	310
NC1400	0.043	0.08	0.31	0.05	0.003	<0.006	<0.021	4.7	0.31	5
NC Inlet surface	0.074	0.62	5.78	11.61	0.116	0.079	0.087	98.7	5.75	86
NC outlet surface	0.067	0.93	5.87	11.60	0.096	0.090	0.117	113.0	6.01	86

Chemical analysis of water samples collected from 28 piezometers and inlet and outlet surface water. Samples were collected 14 May 1997.

Sample ID Date Analyzed:	NH3-N mg/L 5/31/97	TKN mg/L 5/15-29/97	Cl mg/L 5/15/97	SO4 mg/L 5/15-21/97	NO3-N mg/L 5/15/97	PO4-P mg/L 5/16/97	Total P mg/L 5/16,19,27/97	Total Solids mg/L 5/15/97	TOC mg/L 5/19/97	Conductivity uS/cm 5/15/97
NC1010	0.077	0.20	15.62	106.14	0.006	0.157	<0.021	241.2	2.32	300
NC1020	0.956	1.68	6.94	11.22	0.007	0.030	0.043	250.5	13.26	390
NC1030	0.130	0.34	2.90	47.74	0.005	0.060	0.070	207.0	4.56	230
NC1040	0.025	0.09	15.98	50.26	0.317	0.074	0.023	172.5	0.94	200
NC1050	<0.009	0.42	21.84	360.45	<0.004	0.049	0.023	642.8	6.98	865
NC1060	0.620	1.76	18.82	9.46	<0.004	0.230	0.157	582.5	14.64	365
NC1080	<0.009	0.61	6.17	2.35	<0.004	0.066	0.067	170.8	19.69	135
NC1090	0.016	0.20	16.58	50.63	<0.004	0.089	0.027	227.5	2.61	200
NC1100	0.030	0.14	7.28	28.66	0.109	0.045	<0.021	115.7	1.30	120
NC1110	0.135	0.39	1.11	5.81	0.007	0.069	0.053	80.7	4.59	79
NC1130	0.026	0.04	3.66	76.08	0.534	0.039	<0.021	152.7	1.02	215
NC1140	0.029	0.31	3.42	128.56	0.884	0.300	0.176	417.5	1.04	330
NC1160	0.022	0.17	3.57	11.10	0.260	0.082	0.063	83.5	1.05	66
NC1170	0.050	0.22	6.34	25.62	0.018	0.205	0.113	257.3	0.58	107
NC1190	0.090	0.23	80.08	229.08	<0.004	0.066	0.027	585.0	4.15	860
NC1200	0.055	0.12	64.59	215.33	0.017	0.048	0.037	532.0	4.05	820
NC1210	0.375	0.55	18.72	100.81	0.006	0.037	<0.021	290.0	6.37	430
NC1220	0.524	0.69	155.60	113.42	0.017	0.011	<0.021	814.5	4.69	2500
NC1230	0.117	0.99	41.91	42.31	0.013	0.614	0.370	1135.5	6.00	740
NC1240	0.278	0.36	82.13	59.58	<0.004	0.494	0.436	519.8	3.74	790
NC1250	0.069	0.21	18.53	35.89	0.040	0.108	0.070	360.2	3.43	525
NC1260	0.075	0.36	103.91	35.73	0.005	0.236	0.165	415.5	5.10	620
NC1270	0.118	0.67	4.60	10.54	0.098	0.176	0.130	380.5	3.56	150
NC1300	0.048	0.11	5.39	12.34	0.004	0.066	0.023	117.5	0.92	72
NC1310	0.033	0.15	2.21	7.08	0.286	0.112	0.090	110.3	0.79	76
NC1320	0.059	0.10	3.25	9.09	0.004	0.087	0.067	82.5	0.49	60
NC1330	0.050	0.40	6.34	27.96	0.078	0.332	0.210	459.0	1.67	310
NC1400	0.043	0.08	0.31	0.05	0.003	<0.006	<0.021	4.7	0.31	5
NC Inlet surface	0.074	0.62	5.78	11.61	0.116	0.079	0.087	98.7	5.75	86
NC outlet surface	0.067	0.93	5.87	11.60	0.096	0.090	0.117	113.0	6.01	86

Chemical analysis of water samples collected from 28 piezometers and inlet and outlet surface water. Samples were collected 14 May 1997.

Sample ID	Zn mg/L	Mn mg/L	Fe mg/L	Mg mg/L	Al mg/L	Ca mg/L	Cu mg/L	Na mg/L	K mg/L
Date Analyzed:	6/6-13/97	6/6-13/97	6/6-13/97	6/6-13/97	6/6-13/97	6/6-13/97	6/6-13/97	6/6-13/97	6/6-13/97
NC1010	0.007	0.1088	2.860	3.493	0.018	8.403	<0.007	36.358	3.319
NC1020	0.014	5.1090	27.740	8.717	0.033	28.043	<0.007	21.944	6.911
NC1030	0.014	2.2720	0.604	4.882	0.370	20.212	0.008	9.045	10.038
NC1040	0.009	0.0796	0.205	2.000	0.571	1.447	<0.007	29.183	1.858
NC1050	0.062	4.0140	27.910	17.482	0.118	47.987	<0.007	85.041	2.898
NC1060	0.026	1.1200	29.950	6.695	39.122	18.581	<0.007	56.315	6.009
NC1080	<0.006	0.2883	19.430	0.323	1.341	1.614	<0.007	14.854	2.484
NC1090	<0.006	0.0487	0.275	0.471	0.269	1.650	0.029	33.108	1.316
NC1100	<0.006	0.1966	0.373	1.204	0.235	4.306	0.008	10.900	2.551
NC1110	0.009	0.4727	2.685	1.499	0.289	7.284	<0.007	1.982	3.716
NC1130	0.020	0.0814	0.052	3.007	0.227	5.389	<0.007	25.208	2.322
NC1140	0.050	0.1450	2.737	12.491	5.379	14.259	<0.007	22.250	3.540
NC1160	<0.006	0.0909	0.583	0.424	1.331	1.941	<0.007	7.705	0.512
NC1170	0.014	0.0117	4.482	0.849	11.821	0.518	<0.007	18.497	1.072
NC1190	0.008	0.7491	4.796	15.578	0.058	44.719	0.026	111.831	3.903
NC1200	<0.006	0.0041	0.039	8.077	0.037	76.307	<0.007	83.007	5.924
NC1210	<0.006	0.0089	0.226	0.790	0.328	39.371	<0.007	48.015	4.089
NC1220	<0.006	0.0020	0.022	0.030	0.888	205.012	0.007	145.543	5.625
NC1230	0.061	0.3033	25.240	6.975	56.910	40.031	<0.007	142.826	5.452
NC1240	<0.006	0.5702	1.235	18.205	0.195	74.9800	0.012	59.818	3.024
NC1250	<0.006	0.0878	0.521	17.281	0.734	60.3780	0.016	27.978	5.152
NC1260	0.011	0.0102	1.800	6.210	2.596	37.7030	0.022	89.550	3.939
NC1270	0.030	0.2721	9.278	3.493	28.517	14.9411	0.017	5.577	4.296
NC1300	0.005	<0.0006	0.626	0.240	0.816	0.3755	<0.007	10.725	0.376
NC1310	0.006	0.0719	0.923	0.861	2.554	8.8639	0.017	3.189	0.796
NC1320	0.006	0.2735	0.273	0.623	0.462	1.4904	0.016	8.064	0.471
NC1330	0.020	1.3016	5.767	2.567	13.884	18.3181	0.009	43.901	2.113
NC1400	0.001	<0.0006	0.010	<0.016	0.027	0.0000	<0.007	<0.046	<0.037
NC Inlet surface	<0.006	0.2060	1.975	1.611	1.224	4.9406	<0.007	7.304	1.827
NC outlet surface	<0.006	0.2214	2.244	1.651	1.613	4.8224	<0.007	7.260	1.806

I. Soil: Unconsolidated sediment; NC 1010

II. County: Jefferson

III. Location: Nevins Creek Mitigation Wetland

IV. Described by: Phillip R. Owens and S. Curtis Osier 2/96

V. Sampled by: Dr. Duane C. Wolf and AHTD personnel

VII. Pedon Description:

C 0-20 cm; Brown (10YR 5/3) fine sandy loam; structureless massive; friable; few fine pores; few fine distinct yellowish brown (10YR 5/8) masses of iron accumulation; clear boundary.

Cg1 20-52 cm; Gray (10YR 5/1) loamy fine sand; structureless massive; friable; few fine and few very fine pores; few fine distinct brownish yellow (10YR 6/8) masses of iron accumulation; abrupt boundary.

Cg2 52-74 cm; Light gray (10YR 7/2) fine sand; structureless single grain; loose; 2% rounded quartz and chert gravels; abrupt boundary.

2Cg 74-150+ cm; Grayish brown (10YR 5/2) loam; no pedogenic structure present, but soil platy due to compaction and bedding planes; firm; common medium distinct yellowish brown (10YR 5/6) and common medium distinct strong brown (7.5YR 4/6) masses of iron accumulation; dark brown (7.5YR 3/3) partially decayed leaves and other organic material arranged on bedding planes; boundary not observed.

APPENDIX K

Extractable Soil Nutrient Levels

Extractable Nutrient Levels from Nevins Creek Wetland Site Soil Samples Collected October 1995.

Sample[2]	Depth[3]	pH	EC	Mehlich III Extractable[1]										
				P	K	Ca	Mg	Na	S	Fe	Mn	Zn	Cu	B
			μS	lbs/A										
NC1010	A	4.38	124.9	55	110	243	133	54	34	111	26	0.2	1.1	2.5
NC1010	B	5.03	41.5	8	71	747	333	138	15	117	4	0.1	1.5	1.3
NC1020	A	4.00	246.0	25	130	927	408	146	157	359	90	0.3	1.1	1.1
NC1020	B	4.86	70.7	25	97	370	149	83	30	710	187	1.1	1.5	1.5
NC1030	A	4.57	146.0	19	169	776	180	50	35	541	606	1.9	1.3	1.3
NC1030	B	4.97	108.8	22	154	755	206	54	36	828	648	1.4	1.4	1.7
NC1040	A	4.99	80.0	29	179	928	189	22	32	500	511	3.1	1.1	1.3
NC1040	B	5.37	67.3	32	182	614	152	32	24	753	777	1.9	1.4	1.5
NC1050	A	4.19	166.7	22	60	486	163	85	86	457	53	1.2	1.5	0.9
NC1050	B	4.54	144.3	24	73	460	174	139	88	640	45	2.1	1.5	1.2
NC1060	A	4.82	108.9	38	138	680	307	222	51	1219	185	2.7	2.1	1.9
NC1060	B	5.04	56.7	19	86	172	138	262	23	461	136	0.9	2.2	0.9
NC1070	A	4.57	78.1	34	103	277	171	107	23	461	132	1.4	4.1	0.9
NC1070	B	4.95	32.3	31	74	329	189	96	19	349	35	1.5	4.6	2.0
NC1080	A	4.48	145.2	33	250	710	178	27	51	373	305	5.5	1.3	1.2
NC1080	B	4.45	70.0	23	110	240	65	17	32	371	86	1.4	1.2	0.9
NC1090	A	4.28	87.0	31	139	170	173	188	41	435	96	1.7	2.3	0.8
NC1090	B	4.39	61.5	13	50	183	226	254	32	405	33	1.4	1.6	0.6
NC1100	A	4.63	35.5	14	68	106	60	49	23	225	9	0.1	2.7	0.7
NC1100	B	4.67	25.8	16	64	98	55	41	8	216	3	0.1	2.4	0.5
NC1110	A	4.36	251.0	37	194	606	192	88	41	381	640	1.1	1.0	0.9
NC1110	B	4.35	128.3	52	178	484	165	30	35	337	572	0.8	1.3	0.7
NC1120	A	4.57	202.0	41	178	509	201	202	48	554	578	2.5	1.7	1.0
NC1120	B	4.64	174.1	38	180	467	204	266	43	507	519	3.2	1.8	1.0
NC1130	A	5.00	127.0	60	84	220	310	670	43	352	26	2.3	2.0	0.6
NC1130	B	4.97	106.2	71	110	174	454	913	31	402	11	4.5	3.0	0.7

Extractable Nutrient Levels from Nevins Creek Wetland Site Soil Samples Collected October 1995.

Sample[2]	Depth[3]	pH	EC	Mehlich III Extractable[1]										
				P	K	Ca	Mg	Na	S	Fe	Mn	Zn	Cu	B
			μS	lbs/A										
NC1140	A	4.70	32.8	28	72	67	73	24	28	311	60	0.1	1.1	0.6
NC1140	B	4.65	30.6	21	54	33	66	15	22	236	17	0.1	0.9	0.4
NC1150	A	4.79	63.0	23	135	680	266	63	41	580	234	2.7	2.7	2.2
NC1150	B	4.90	46.0	21	146	759	291	39	29	574	203	1.6	2.8	1.3
NC1160	A	4.75	297.0	85	316	675	163	51	42	626	724	1.2	1.0	1.2
NC1160	B	4.79	179.5	43	201	781	179	54	39	920	1001	1.5	1.9	1.4
NC1170	A	4.30	357.0	118	247	661	449	713	170	390	87	4.0	4.0	0.8
NC1170	B	4.19	309.0	88	166	801	545	911	183	477	27	5.2	4.9	0.8
NC1180	A	4.39	153.2	43	156	468	183	61	39	379	209	1.0	1.3	0.8
NC1180	B	4.64	90.4	13	153	378	423	279	40	439	169	2.4	2.4	0.8
NC1190	A	4.70	177.9	23	326	2609	1041	296	96	351	264	2.7	2.3	1.0
NC1190	B	4.34	298.0	16	359	3702	1522	458	135	345	185	1.7	2.0	0.9
NC1200	A	4.72	324.0	98	701	5533	2013	394	145	326	225	9.9	2.3	1.2
NC1200	B	4.85	451.0	113	858	7120	2632	572	193	285	147	11.4	2.7	1.1
NC1210	A	4.62	218.0	51	285	1918	688	89	111	1297	399	6.5	2.8	1.7
NC1210	B	4.52	165.0	27	187	1638	626	99	187	532	500	2.4	3.5	0.9
NC1220	A	4.60	463.0	48	175	1635	608	293	181	897	117	5.9	2.1	1.3
NC1220	B	4.42	403.0	32	208	1800	710	452	180	327	103	1.9	2.3	2.1
NC1230	A	5.37	238.0	52	174	2066	643	674	81	428	54	3.3	1.7	1.2
NC1230	B	4.67	175.5	16	129	782	476	714	60	270	21	1.3	1.7	0.7
NC1240	A	4.92	160.2	39	146	1501	485	174	81	1014	157	5.1	1.8	1.5
NC1240	B	4.85	154.0	54	370	3378	1420	697	73	416	54	3.4	2.7	1.0
NC1250	A	5.31	95.3	24	84	823	253	48	39	583	145	2.1	1.0	1.0
NC1250	B	5.21	99.3	46	216	1953	724	68	49	595	86	2.9	1.4	1.0
NC1260	A	5.13	63.7	15	119	674	160	28	25	473	270	1.1	0.8	0.9
NC1260	B	5.43	58.1	31	194	1404	527	81	32	454	247	1.5	1.1	0.9

Extractable Nutrient Levels from Nevins Creek Wetland Site Soil Samples Collected October 1995.

Sample[2]	Depth[3]	pH	EC	Mehlich III Extractable[1]										
				P	K	Ca	Mg	Na	S	Fe	Mn	Zn	Cu	B
			μS	lbs/A										
NC1270	A	5.34	85.3	12	102	604	204	221	29	351	226	0.7	1.0	0.7
NC1270	B	5.45	86.7	12	130	632	298	460	33	359	196	0.8	1.1	0.7
NC1280	A	5.14	70.7	16	105	597	194	109	29	298	319	0.7	1.0	0.5
NC1280	B	5.14	78.2	19	112	625	287	255	34	307	231	0.9	1.1	0.5
NC1290	A	4.83	94.9	20	85	528	244	130	39	895	62	8.3	1.5	1.0
NC1290	B	5.30	39.5	12	85	428	259	197	13	409	50	0.4	1.0	0.7
NC1300	A	4.21	46.6	49	106	101	84	66	18	348	51	2.1	2.1	1.9
NC1300	B	4.34	31.9	41	97	69	81	61	12	358	34	1.2	2.0	0.9
NC1310	A	4.66	69.3	28	126	725	274	87	34	1040	150	11.0	2.2	1.4
NC1310	B	4.79	40.1	23	51	232	106	33	11	593	52	0.7	1.6	0.9
NC1320	A	4.61	62.9	20	61	640	158	21	45	354	274	6.0	0.9	0.7
NC1320	B	4.68	49.1	15	55	531	138	19	39	301	244	2.8	1.0	0.6
NC1330	A	4.35	67.3	21	46	245	66	21	51	512	88	2.6	1.7	0.8
NC1330	B	4.40	72.2	18	49	363	58	27	61	387	140	2.2	1.9	0.6
NC1340	A	4.46	49.4	16	71	200	80	26	23	392	57	0.1	0.8	0.6
NC1340	B	4.44	40.6	14	46	69	33	19	15	288	24	0.1	0.6	0.5
NC1350	A	5.79	161.8	146	350	4035	1013	104	99	407	146	1.8	1.5	1.2
NC1350	B	5.71	146.7	258	615	6550	1738	172	95	296	300	1.9	1.7	1.5

[1] Samples were subjected to Mehlich III extraction and analysis by ICP. The analytical procedures were performed by Agricultural Diagnostic Services Laboratory at the University of Arkansas.

[2] Sample numbers correspond to piezometer locations.

[3] A = 0 to 6 inches; B = 6 to 12 inches.

Extractable Nutrient Levels from Nevins Creek Wetland Site Soil Samples Collected July 1996

Sample[2]	pH	EC	Mehlich III Extractable[1]										
			P	K	Ca	Mg	Na	S	Fe	Mn	Zn	Cu	B
		μS	lbs/A										
NC1010	4.80	97.8	55	92	486	240	90	32	171	79	1.1	0.7	<.09
NC1020	4.60	124.1	19	117	682	326	93	78	321	144	2.4	0.9	<.09
NC1030	4.43	52.1	23	264	806	223	56	38	343	938	2.7	0.8	<.09
NC1040	4.92	93.6	37	253	707	171	18	31	335	362	3.3	0.9	<.09
NC1050	4.87	23.9	27	61	711	255	43	130	430	43	2.6	0.6	<.09
NC1060	5.18	74.5	18	73	603	296	225	40	552	91	3.7	0.9	<.09
NC1070	4.68	58.0	39	84	316	146	61	26	468	63	2.9	1.2	<.09
NC1080	4.60	96.6	34	167	564	134	10	42	273	327	4.0	1.0	<.09
NC1090	4.65	66.1	87	127	226	190	122	30	261	192	2.4	0.8	<.09
NC1100	4.14	221.0	34	63	421	138	21	144	599	72	3.6	0.9	<.09
NC1110	4.33	495.0	38	182	374	212	32	60	181	371	1.4	0.7	<.09
NC1120	4.92	112.0	55	159	736	250	77	67	402	465	5.0	0.7	<.09
NC1130	5.13	141.6	61	88	466	328	497	47	437	60	3.8	0.5	<.09
NC1140	4.78	75.6	37	101	450	200	51	30	496	115	2.7	0.6	<.09
NC1150	4.90	70.5	18	120	573	200	25	45	295	259	2.0	0.9	<.09
NC1160	4.79	39.3	28	144	330	129	7	46	181	393	1.0	1.1	<.09
NC1170	4.33	390.0	77	92	832	537	981	231	317	57	5.9	1.4	<.09
NC1180	5.09	52.1	24	152	618	172	6	27	404	181	2.7	0.7	<.09
NC1190	4.94	127.8	23	225	2603	1042	259	83	374	489	3.8	1.2	<.09
NC1200	4.96	150.5	55	423	4331	1632	263	84	318	199	5.0	1.7	<.09
NC1210	4.90	121.6	21	199	1478	528	48	86	550	436	5.3	1.0	<.09
NC1220	4.89	496.0	35	144	2328	885	687	205	441	103	6.3	1.2	<.09
NC1230	5.17	128.4	22	83	952	501	581	53	324	43	4.0	1.4	<.09
NC1240	5.23	67.8	24	74	978	308	46	42	509	68	5.8	0.8	<.09
NC1250	5.26	40.3	15	135	649	179	7	21	315	203	2.5	1.1	<.09

Extractable Nutrient Levels from Nevins Creek Wetland Site Soil Samples Collected July 1996

Sample[2]	pH	EC	Mehlich III Extractable[1]										
			P	K	Ca	Mg	Na	S	Fe	Mn	Zn	Cu	B
		μS	lbs/A										
NC1260	5.08	99.0	25	152	676	199	66	37	332	289	2.1	0.9	<.09
NC1270	5.41	54.9	13	126	459	183	90	30	206	131	1.8	1.0	0.5
NC1280	4.98	45.0	18	133	582	173	42	28	228	207	2.0	1.0	0.3
NC1290	5.23	50.2	12	46	396	202	95	16	490	53	3.2	0.9	0.4
NC1300	4.65	71.0	73	140	303	197	180	33	341	203	4.4	1.1	0.2
NC1310	4.97	59.6	22	79	618	281	139	26	363	139	5.8	1.2	0.2
NC1320	4.80	48.1	24	109	716	186	13	34	258	217	5.9	1.5	0.2
NC1330	4.43	56.9	23	78	284	59	19	38	327	103	3.3	1.8	0.2
NC1340	no sample collected												
NC1350	5.14	126.1	48	299	3322	998	101	76	324	132	3.4	1.5	0.6

[1] Samples were subjected to Mehlich III extraction and analysis by ICP. The analytical procedures were performed by Agricultural Diagnostic Services Laboratory at the University of Arkansas. All samples were collected at a depth of 0 to 6 inches.

[2] Sample numbers correspond to piezometer locations.

Extractable nutrient levels from Nevins Creek Wetland site soil samples collected May 1997.

Sample[2]	pH	EC	Mehlich III Extractable[1]										
			P	K	Ca	Mg	Na	S	Fe	Mn	Zn	Cu	B
		μS	lbs/A										
NC1010	5.06	38.1	72	104	281	128	28	12	128	39	0.9	0.4	0.1
NC1020	4.59	93.9	15	114	726	313	69	48	264	121	2.0	0.8	1.0
NC1030	4.89	70.8	19	81	490	136	11	28	405	95	2.7	0.4	0.5
NC1040	5.00	52.6	27	163	717	171	15	28	298	164	3.2	0.7	0.6
NC1050	4.76	166.8	28	89	749	229	16	80	513	45	4.1	0.4	1.8
NC1060	5.10	116.5	40	121	1126	294	28	39	523	198	9.1	0.4	0.8
NC1070	5.03	126.7	39	172	1048	295	46	56	520	275	12.7	0.6	1.3
NC1080	4.79	49.6	22	133	479	124	10	32	227	184	2.4	0.8	0.7
NC1090	4.62	102.0	27	113	473	238	122	43	291	231	4.3	0.7	0.9
NC1100	4.86	101.3	24	50	567	156	17	39	507	77	3.7	0.4	0.8
NC1110	4.94	62.6	21	119	581	143	25	31	246	323	2.1	0.7	0.6
NC1120	4.99	140.5	37	107	921	243	27	57	652	246	8.9	0.4	1.3
NC1130	5.37	61.6	25	56	484	118	37	27	554	118	4.1	0.3	0.5
NC1140	5.01	49.0	26	71	370	135	31	29	464	122	2.9	0.7	0.6
NC1150	5.04	57.5	13	86	604	213	32	37	248	237	2.6	0.8	0.7
NC1160	4.93	33.7	22	126	298	114	23	37	141	276	1.1	0.6	0.8
NC1170	4.53	247.0	40	111	820	411	485	128	315	150	7.1	0.8	3.1
NC1180	5.28	42.2	12	130	685	184	16	17	322	151	2.0	0.6	0.3
NC1190	5.27	98.7	21	182	1244	400	116	43	342	730	3.5	0.8	0.9
NC1200	4.84	154.3	45	223	2003	668	114	80	309	190	4.6	1.0	1.7
NC1210	5.03	142.9	24	142	1294	366	35	68	553	432	9.3	0.6	1.5
NC1220	5.05	191.3	31	124	1524	452	158	70	407	80	8.9	0.8	1.5
NC1230	5.36	101.9	22	79	1052	444	363	32	320	58	4.9	0.9	0.5
NC1240	5.09	76.4	22	73	989	264	44	36	462	67	6.9	0.5	0.7
NC1250	5.28	39.4	12	123	809	202	17	19	256	147	3.1	0.8	0.3

Extractable nutrient levels from Nevins Creek Wetland site soil samples collected May 1997.

Sample[2]	pH	EC	Mehlich III Extractable[1]										
			P	K	Ca	Mg	Na	S	Fe	Mn	Zn	Cu	B
		μS	lbs/A										
NC1260	5.29	64.1	11	94	598	138	42	25	267	215	2.1	0.7	0.4
NC1270	5.48	37.3	11	106	649	156	36	15	215	179	1.9	0.8	0.2
NC1280	5.23	40.2	13	90	542	147	35	20	203	178	1.7	0.7	0.3
NC1290	5.41	32.9	10	69	661	279	70	17	413	72	5.9	0.6	0.2
NC1300	4.69	89.3	43	100	526	186	82	43	393	195	7.1	0.7	0.9
NC1310	4.86	73.7	25	108	765	249	73	26	330	144	8.3	0.9	0.4
NC1320	4.88	55.6	15	70	682	160	26	40	252	233	7.3	1.1	0.8
NC1330	4.65	64.8	25	73	437	97	16	26	319	111	3.9	1.0	0.5
NC1340	no sample collected												
NC1350	5.06	128.4	46	214	2530	735	64	50	336	88	3.3	1.0	0.8

[1] Samples were subjected to Mehlich III extraction and analysis by ICP. The analytical procedures were performed by Agricultural Diagnostic Services Laboratory at the University of Arkansas. All samples were collected at a depth of 0 to 6 inches.

[2] Sample numbers correspond to piezometer locations.

APPENDIX L

Hydric Soil Development in the Nevins Creek Wetland Area

HYDRIC SOIL DEVELOPMENT IN THE NEVINS CREEK PROJECT

E. Moye Rutledge, Ph.D., P.S.C.*

Introduction

A Hydric Soil is "a soil formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part." (NRCS, 1996)

This report is the result of field studies of soil morphology in order to evaluate the amount of saturation and reduction as well as subsequent oxidation that has occurred in the Nevins Creek Project. It is based entirely on observations of soil morphology in the southwestern one-fourth to one-third of the study area. Morphological properties of soils are essentially those that can be evaluated in the field such as color, texture, structure, root channels, etc.

The Nevins Creek project is an attempt to build a wetland by the Arkansas State Highway and Transportation Department in order to mitigate areas of wetlands destroyed in construction of a highway bypass for Pine Bluff, Jefferson County, Arkansas. Details as to the location and nature of this project are contained in other chapters of this report.

The classic factors which control soil formation are: 1) the parent material, 2)climate, 3) biota (usually only vegetation is considered), 4) topography and 5) time.

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Recently we have become more aware that man (or at least his activities) can be a significant soil forming factor. Man certainly has been a significant soil forming factor in the Nevins Creek Project.

The parent materials of the Nevins Creek Project are primarily loamy sediments from the Jackson Group of the Gulf Coastal Plain (David Lumbert personal communication and AGS field sheet), which are normally gray. These Jackson materials have followed several modes of transportation to become soil parent materials in the Nevins Creek Project. A few soils which originally formed in the Jackson sediments are still in place. Other parent materials were deposited recently by water and include a few reddish sediments. The most common situation seems to be 8 to 18 inches of loamy "stock" material over Jackson materials from which the original soil has been removed. These "stock" materials are soils and parent materials, which were stock piled (A horizon?) and returned to the surface of the site after fill removal was completed (about 2 ½ to 3 years ago). They consist of former soils and soil parent materials. Apparently many of the trees on the site and other wood scraps were pushed into piles and burned. Therefore, the stock also contains ashes, charcoal and various woody parts. These woody materials comprise about 8% of the stock by volume.

The climate on this site is humid subtropical. It is not a variable across the site, except for variable additions of water. Water from Nevins Creek enters the site in a controlled manner. This additional water should enhance the formation of Hydric soils. The topography at the project site was created mainly by man's actions and has already been a factor in soil formation. The topography varies from a fairly level plain with areas of depression, to side slopes of 0 to about 30%. Also some of the original soils remain on uncut areas which are essentially ridges. The depressions within the plain retain water and thus have more development related to saturation and reduction.

The time for soil development in the project has, in most cases, been very short (2 ½ to 3 years). However, significant and quite obvious soil development has occurred. The visible soil properties are mainly structure, root channels and changes in color due to reduction and subsequent oxidation. Man's activities as a factor in soil formation are a major, major factor at this site. They have influenced much of the parent materials, shaped the land surface and strongly compacted the soil parent materials.

The concept of the processes of reduction and subsequent oxidation being reflected in soil color properties is as old as the U.S. soil survey program which started about 99 years ago. Likely it goes back to the 1850s and 1860s and perhaps to earlier periods. Vepraskas (1992) has recently organized our knowledge of soil morphological features which reflect previous occurrence of saturation and reduction with or without subsequent oxidation. He refers to these properties as redoximorphic features. Most redoximorphic features are due to changes in valence of iron and manganese to a lesser extent. Simply put, Vepraskas (1992) refers to area of the soil that are more gray than the matrix or assumed matrix as depletions (primarily depletion of iron). He refers to browner or black areas as concentrations (of iron or iron and/or manganese). The terms concentration and depletion are to be used only when one interprets them to be due to redoximorphic processes.

The Natural Resource Conservation Service, in conjunction with others, primarily Federal agencies, has developed a set of field indicators of Hydric soils. They are primarily depletion. Concentrations are used to a lesser extent. In some areas of the country, the indicators are supported by data on saturation and reduction. In most cases they seem to be a matter of opinion unsupported by scientific information. Recognition of Hydric soils is not simply identification of these indicators, but is based on recognition of these indicators and an interpretation of the soil development

processes that formed them. Field identification of Hydric soils is an interpretation of soil genesis.

Results and Discussion

In order to determine the area of Hydric and non-Hydric soils in the project area, the Field Indicators of Hydric Soils in the United States (NRCS, 1996) was used. The indicator F3 (p 10 & 11 of 24) seemed the most applicable:

> **F3 Depleted Matrix.** ***For use in all Land Resource Regions (LRRs) except W, X, and Y (see NRSC, 1996).*** **A layer at least 15 cm (6 in.) thick with a depleted matrix that has 60% or more chroma 2 or less starting within 25 cm (10 in.) of the surface.**

Depleted Matrix User Notes: redox concentrations include iron and manganese masses (reddish mottles) and/or pore linings. The low chroma matrix must be due to wetness and not a relict or parent material feature.

After applying this indicator for a few hours it seemed obvious that there was a problem. Hydric soils were being identified on essentially all landscape positions. Dave Lumbert, a geologist with the Arkansas State Highway and Transportation Department, pointed out that most of the parent materials in the Jackson formation, were gray and would most likely meet the requirements of F3. A little checking showed this to be correct. Parent material colors frequently had hues of 10YR, 2.5Y, and 5Y with values of mostly 5 and 6 and chromas of <1, 1, and 2. All of these colors meet the definition of F3. However, these colors are not the result of soil genesis, but rather are parent material colors. The User Notes for F3 state "The low

chroma matrix must be due to wetness and not a relict or parent material feature". At this point it became apparent that the job of identifying Hydric soils in this project area was not to be taken lightly and some serious field work needed to be done.

Attachment No. 1 is the field notes that were taken on this project. From these observations, a set of potential field indicators were proposed specifically for this project.

Proposed Field Indicators for Hydric Soils in the Nevins Creek Project

Hydric soils have:

1. **Six inches (cumulative) or more of glayed matrix colors within 10 inches of the surface <u>or</u>**
2. **Six inches (cumulative) or more of chroma <1.0 within 10 inches of the soil surface <u>or</u>**
3. **The presence of a hydrogen sulfide odor within the upper 10 inches of the soil surface.**

These proposed field indicators are just that, proposed. They should be tested during the wetter part of the growing season with α,α-dipyridyl which is a field indicator for ferrous iron (Fe^{++}). One often encounters the opinion that soils which are frequently ponded or flooded for long durations are Hydric. They are Hydric only if they are saturated in the upper part.

It is apparent that some saturation and reduction with subsequent reoxidation has occurred over most of the Nevins Creek Project, even on the side slopes. Many soils

are on their way to becoming Hydric if they are not already there. Compaction by equipment seems to have had a pronounced effect on water movement. In most places, including the side slopes, water has been trapped between the plates of the platy structure which is assumed to have been caused by compaction from heavy equipment. Redoximorphic features related to the platy structure are primarily redox concentrations (bright colors). Concentrations are not as reliable to use as indicators as are depletions. Concentrations can move with the water before they precipitate and depletions remain where they were formed. However, some argument could be made that the concentrations are the result of reduction and saturation in the upper part of the soil on the side slopes and thus, these are Hydric soils. The definition of Hydric soils does not say where the upper part of the soil is or the duration of saturation and reduction that is required. Since Hydric soils normally do not occur on side slopes, except in seep areas, I proposed indicators that would exclude most of the side slopes from the Hydric classification.

The platy structure and compaction which evidently retards water movement throughout the project area presents an interesting situation. With time, freezing and thawing, root biological actions should reduce the compaction (bulk density) of activities, and other the soil and thus increase the hydraulic conductivity. Will this convert Hydric soils to non-Hydric and result in relic redoximorphic features? I don't think anyone knows the answer.

Considering the southwest portion of the project area, the potential indicators proposed above would indicate:

1. The slopes and remnants of the ridge are non-Hydric soils with a few exceptions.

2. The plain at about 205 foot elevation is non-Hydric with several exceptions. The plain is moving toward Hydric and could become Hydric in a few years.
3. Depressions within the plain occurring at about 205 feet are mainly Hydric. This includes the depressions in the southwest corner, south of the bridge. Also some very shallow depressions under and near the bridge are Hydric. Some of the deeper equipment tracks are Hydric and some are non-Hydric.

Please remember the proposed Hydric indicators are untested and should be tested with α,ὰ-dipyridyl before being taken too seriously.

If a map of proposed Hydric soils is desired, it should be made on a aerial photograph background. Due to the rough and rutted surface, a topographic map would require a 1 or 2 inch contour interval and still would not be as helpful as an aerial photograph. I suggest a 1:8,000 to 1:12,000 scale color I.R. photograph.

Summary

A lot of saturation and reduction is occurring in the upper part of the soils of the Nevins Creek Project. How much is enough to call them Hydric soils is unclear. The gray parent materials make the identification of the redox depletions quite difficult. It appears that a significant part of the saturation and reduction has been caused from compaction by heavy equipment. Perhaps the compaction will be reduced with time and the hydraulic conductivity increased with time thus improving the drainage, with time, of some of these soils.

Using some of the herein proposed Hydric indicators, which need verification, it appears that most of the low spots in the 205 foot elevation - plain are Hydric including some of the vehicle tracks. Most other areas are non-Hydric.

If a map is to be made of Hydric soils, it is recommended that the proposed indicators be verified and a color I.R. photograph be used as a base map.

References

Arkansas Geologic Commission. Field Sheet showing geologic mapping in the project area. Arkansas Geologic Commission, Little Rock.

Lumbert, David. 1997. Personal Onsite Communication. Geologist, Arkansas State Highway and Transportation Department, Little Rock.

NRCS, 1996. Field Indicators of Hydric Soils in the United States, Version 3.1. http://159.189.24.10/fieldin.htm.

Vepraskas, Michael J. 1992. Redoximorphic Features for Identifying Aquic Conditions. Tech. Bul.301. Department of Soil Science, North Carolina State University, Raleigh.

Attachment No. 1

Field Notes on Soil Morphology in the Nevins Project Area

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Stop #1 - Near middle of bridge.

Grays and pale brown - seems to be mainly a parent material effect; some oranges which also turned out to be chunks of parent material - INCONCLUSIVE - probably redoximorphic features; little or no organic material at the site.

Stop #2 - Six paces NW of Stop #1.

Same as Stop #1; many parent materials; no oxidized root channels.

Stop #3 - South of water depth gauge and 3 paces south of water pool approximately 1 foot above water level.

Oxidized root channels of yellowish red (5YR 5/8) and common (15%) yellowish red (5YR 5/8) iron concentrations.

Stop #4a - Ten paces ENE of Stop #3 and ESE of depth gauge.

Similar to Stop #3 - oxidized root channels and redoximorphic concentrations; also approximately 1 cm of dark gray (10YR 4/1); anaerobic by smell; surface material (?); oxidized root channels extend to 10+ inches; lower part loamy sand could also have concentrations - not clear because of variable parent material.

Stop #4b - Just north of Stop #3 at approximately 207 feet elevation.

0-8+ inches; physical mixture of light brownish gray (2.5YR 6/2) (70%), pale brown (10YR 6/3) (20%), and strong brown (7.5YR 5/6 and 5/8) (10%) loam; weak medium subangular blocky structure; common fine roots matted on fracture and structure faces; (no redoximorphic features; assumed to be moved into this location).

Stop #4c - North side of water body about 4 inches under water.

0-10 inches; greenish gray (10G 6/1) [between greenish gray (10G 6/1) and gray (5Y 6/1)]; many fine and medium roots all of which are associated with approximately 3 mm diameter concentrations of strong brown (7.5YR 5/8); too wet to determine structure; little or no change with depth except roots are more common in the upper inch.

Stop #5 - Three feet south of the water's edge and 3 inches higher than the water level.

0-7 inches; essentially the same as Stop #4; extensive oxidized root channels; perhaps a few concentrations other than those associated with roots.

Stop #6 - Three feet south and 2 inches higher than Stop #5.

0-2 inches; gray (5Y 6/1) loam; weak medium granular structure; very friable; many very fine, many fine, and few medium roots all haloed with strong brown (7.5YR 5/8) iron concentrations; few strong brown (7.5YR 5/6) concentrations on what was old platy structure.

2-14 inches; greenish gray (10G 5/1) loam; structureless massive; common fine and medium roots, all with some strong brown (7.5YR 5/8) concentrations; approximately 2% yellowish brown (10YR 5/6) parent material volumes.

NOTES:
1. Lower part smells of hydrogen sulfide gas.
2. Water is within 11 inches of the soil surface and rising.

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Stop #7 - Ten feet south and 7 inches higher than Stop #6.

0-3 inches; light olive brown (2.5Y 5/3) loam; moderate medium fine and medium subangular blocky structure; approximately 3% inclusions of 2-4 mm yellowish brown (10YR 5/8) and strong brown (7.5YR 5/8) materials; many very fine, many fine and few medium roots (no redoximorphic features or oxidized root channels); clear smooth boundary.

3-11 inches; brown (10YR 5/3) loam; weak medium subangular blocky structure; 3% inclusions of wood chunks approximately 4-10 mm in diameter; few very fine and common fine roots; approximately 2% inclusions of yellowish brown (10YR 5/8) and strong brown (7.5YR 5/8) material as above; few fine gray (2.5Y 5/1) depletions on ped faces; no oxidized root channels observed.

11-16+ inches; grayish brown (2.5Y 5/2) clay loam; weak coarse subangular blocky structure; few fine faint dark reddish gray (2.5YR 5/1) depletions; 3% inclusions of yellowish brown (10YR 5/6) parent material.

NOTES:
1. Visual differences between this soil and the previous soil with greenish gray (10G 5/1) are quite striking.

Stop #8 - Half way between Stops #6 & #7. Flag estimated to be 10 feet from the edge of the water and 8 inches above the water level.

0-16+ inches; no gley colors; no oxidized root channels; no hydrogen sulfide gas odor.

Stop #9 - At water's edge; zero inches to water level.

0-6+ inches; gray (5Y 6/1); essentially all roots have oxidized root channels.

Stop #10 - Ten feet south of Stop #9 and 4 inches higher.

0-3 inches; gray (5YR 5/1); no oxidized root channels.

3-11 inches; gray (5YR 5/1); most root channels oxidized.

11-16 inches; more yellow brown (10YR 5/6) parent material; gray (5Y 6/1) still present with oxidized root channels.

Stop #11 - Flag is located approximately 11 feet from the water's edge and 4-6 inches above it.

0-13 inches; light brownish gray (10YR 6/2) with occasional oxidized root channels.

13+ inches; gray(10YR 6/1) with oxidized root channels.

Stop #12 - Creek bank at deer crossing approximately 30 m south of the bridge.

0-14 inches (fill); 60% gray (2.5Y 5/1) parent material chunks, 40% light olive brown (2.5Y 5/3) areas of parent material; both material are loam; the light olive brown (2.5Y 5/3) is very friable and the gray (2.5Y 5/1) is noticeably firm; the gray (2.5Y 5/1) material has oxidized root channels and yellowish brown (10YR 5/6) and strong brown (7.5YR 5/8) concretions on the faces of some peds; the light olive brown (2.5Y 5/3) material shows no oxidized root channels and extends from the surface to the contact; [the gray (2.5Y 5/1) and light olive brown (2.5Y 5/3) are both parent material colors].

14-20+ inches; stratified loamy fine sand, the grayest of which is light brownish gray (2.5Y 6/2); the iron concentration probably was liberated outside (here) and some iron was liberated from the sands; [non-Hydric gray (2.5Y 5/1) is the parent material color].

Stop #13 - Across the creek from Stop #11.

Jackson sediments 97% gray (5Y 6/1) and 3% brown; outside one inch oxidized a little; mostly loams.

Stop #14 - Two meters west of Stop #13; creek overbank.

Sands; no redoximorphic features at 16+ inches

Stop #15a - Five meters west of Stop #14; low area behind deposits.

0-6+ inches; light brownish gray (2.5Y 6/2) and pale brown (10YR 6/3); few redoximorphic features, mostly oxidized root channels.

Stop #15b- Downstream at gauging station; water level approximately 2 inches below rod.

Few narrow (1-5 cm) bands of very dark gray (2.5Y 3/1) silty clay loam observed.

Stop #16 - Parent material; south of bridge about 30 meters on west bank of eastern stream.

0-6 inches (fill); grayish brown (10YR 5/2) loamy; no oxidized root channels, few spots of concretions.

6-12+ inches; light brownish gray (10YR 6/2); no oxidized root channels; occasional strong brown (7.5YR 6/2) and occasional light yellowish brown (10YR 6/4) on fracture face; massive.

LUNCH

Stop #17a - Ten meters west of Stop #16.

0-5 inches; brown (10YR 4/3) with some dark grayish brown (10YR 4/2); loamy; no oxidized root channels; occasional strong brown (7.5YR 5/8) concretions.

5-14+ inches; loamy; gray (2.5Y 5/1) with common yellow brown (10YR 5/6) concretions on weak ped faces and old platy faces.

Stop #17b - Three meters west of Stop #17a.

0-1 inch; loamy sand.

1-5 inches; brown (10YR 4/3) with dark grayish brown (10YR 4/2) redox concentrations.

6-12+ inches; light brownish gray (2.5Y 6/2) loamy; common (12%) redoximorphic concretions of yellowish brown (10YR 5/6), strong brown (7.5YR 5/6), and brown (10YR 4/3); (some concretions probably due to compaction with equipment and may improve with time).

Stop #18 - Ten meters east of water body.

0-4 inches; brown (10YR 4/3) with few dark grayish brown (10YR 4/2) redox concentrations.

4-8+ inches; dark grayish brown (10YR 4/2); common redox concentrations.

Stop #19a - 1.5 meters east of water body.

0-2 inches; gray (2.5Y 5/1) to greenish gray (10G 5/1).

2-12+ inches; gray (5Y5/1); common (10%) redoximorphic concentrations; picture of iron and matted roots on compaction fracture face.

Stop #19b - Greenish gray (10G 5/1) from under water.

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Parent Material Observations

Stop #1 - Below the bridge east side: light brownish gray (10YR 6/2).

Stop #2 - South side of 2-tree island: gray (10YR 6/1).

Stop #3 - About 1/3 to 1/2 the way up the slope.

01- inch; light brownish gray (10YR 6/2) loamy dine sand; structureless massive; no redoximorphic features.

1-3 inches; gray (10YR 6/1) very fine sandy loam; structureless massive; many medium and common coarse yellow brown (10YR 5/6) relic concentrations; common fine and common medium roots; no oxidized root channels or other current redoximorphic features.

3-16+ inches; same as above except no roots.

NOTES:
1. No redoximorphic features related to roots or other current features. No change in concentrations with depth.
2. At rain gauge station: few narrow band of very dark gray (2.5Y 3/1) silty clay loam.
3. Water level approximately 2 inches below rod.

Stop #4 - 48 inches from Stop #3 to north side of bridge. Pedon 4, upland, south of bridge approximately 211 feet in elevation.

0-4 inches; brown (10YR 4/3) loam with small volumes (<5% total) of brown (10YR 5/3), yellowish brown (10YR 5/6) , and strong brown (7.5YR 5/8) loamy material; 1% charcoal; many very fine and many fine roots matted on structural faces; structure assumed to be due to compaction; no redoximorphic features; abrupt boundary.

4-6 inches; yellowish brown (10YR 5/8) loam; many medium plus large pale red (2.5 YR 7/3) materials with fracture plains, some of which have common fine and common very fine roots on surfaces (not sure if moved or compacted in place); <1% charcoal <4 mm in diameter; abrupt wavy boundary.

11-16+ inches; strong brown (7.5YR 5/6) with common, medium pale brown (10YR 6/3) relic depletions; weak medium platy structure; no roots; observed few faint clay films.

NOTES:
1. Assume compacted in place; hard to dig.
2. Probably former Savanah soil.

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NOTES: - Testing proposed indicators

Stop #1 - Under bridge.

Stop #2 - Backup 10 paces to small stream; where stream is 6 inches wide, lots of redoximorphic features.

Stop #3 - Under south bridge, between 3rd and 4th pillars from east end. Standing water 0-6 inches deep; all Hydric; irregular slope, topographical map not help, need 1 or 2 inch interval.

Stop #4 - South side of south bridge between posts 3 and 4 from the east. 1/4 to 3/4 inch water - non-Hydric; 3/4 to 2 inches - Hydric.

Stop #3 and #4 are both standing , not flowing.

Stop #5a - Ten paces south of bridge; level surface; close but non-Hydric.

Stop #5b - Two paces south; under 1/4 inch of water; even closer but non-Hydric.

Apparently many of the lows in this landscape that hold ponded water (non-flowing) will be Hydric.

These soils are noticeably hard to dig, contain platy rock structure in places and evidently are still compacted from equipment. They are not saturated beneath the surface 2 cm.

These soils show noticeable depletions (reduction) around old sticks 1/4 to 3+ inches in diameter; depletions extend 1/4 to 3/4 inches outward.

Stop #6 - One-third the way up the south hill. Close, some depletions, but not duplicated enough; non-Hydric.

Stop #7 - Mid-slope; shows some depletions, non-Hydric; not saturated.

Stop #8 - Top of slope in old tractor ruts; Hydric; water 0-2 inches, mostly 1 inch deep; not saturated.

Stop #9 - Top of slope - 3 observations in old cut and fill area; almost Hydric but non-Hydric.

Stop #10 - Side slope to west; 1/2 way up close but non-Hydric, fill.

Combination of compaction and some buried carbon (charcoal) have made strange fellows; likely to get better with time.

Stop #11 - Top of south hill; around old tree roots; top 10 inches show no redoximorphic features; apparently was Savanah.

Stop #12 - Between bridges, nearest north bridge; standing water 0-4 inches deep; Hydric a little beyond the waters edge between 4th and 5th support from east 6-8 m in diameter.

Work out the low spots (micro lows) with ponded water. Check more side slopes and equipment tracks.

APPENDIX M

Biological Analysis of Aquatic Organisms at the Nevins Creek Wetland Area

Nevins Creek Report

Arkansas Department of Highways and Transportation

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September, 1997

Introduction:

The ponds created in the borrow pit during the construction of the highway represents a unique habitat. The ponds are new communities where none previously existed. In addition these depressions initially lack organic bottom deposits and diverse marginal vegetation. Within a brief period, one or two pioneering vascular vegetation species dominate the margin and littoral zone. In time additional species are expected to appear. Thus, diversity increases as the ponds mature.

With the development of the marginal vegetation wave action is suppressed, filtration of erosional components increases and with the deposition of organic litter a true littoral zone begins. This littoral zone or subcommunity is a major source of algal species and is a refuge for zooplankton and other animals (Round, 1981). Until the littoral zone develops only a limnetic zone (open water) exists. This latter zone is anticipated to have limited algal diversity and production and thus limit the diversity of herbivorous zooplankton. These limitations are expressed throughout other levels of the food web.

The ponds in the borrow pits are now at an early stage of development. They have margins dominated by a single species of vascular plant with only minimal representation by a second species. In time additional species may occur naturally and be introduced by transplantation.

Algal species are introduced by periodic flooding. Those associated with the stream system may exist temporarily and are unimportant to the system. Those organisms transported from upstream ponds will serve as an innoculum and probably survive. Additional species may be introduced on the feathers and feet of water fowl.

The ponds are young and at an early stage of developmnet. It is anticipated that they will continue to receive introductions of a wide diversity of organisms. Those adapted to tolerate the existing conditions will populate the ponds. They, in turn, will modify the standing crop or food supply and lead to further maturation of the system. The ponds are unique in that the systems can be disturbed by flooding or drought.

The information presented in this report establishes a baseline upon which future collections can be compared. It is assumed that through time habitat modification will continue, new species will be introduced, some will survive to become important and certain present species will be lost. This is to be expected during early maturation of new communities. It is during the time when succession progresses rapidly and the systems are changing at their maximum dynamic rate. This study, therefore, is important by providing the present status of the system as well as a reference for future comparisons.

Site Description:

The general site consisted of one major pond and several wet areas. Along the southwestern region a ephemeral creek channel contained shallow water. Other depressions were dry during late summer. These ephemeral pools and depression were not collected since their populations are dependent on introduced organisms via flooding, random windborne transport or translocation by waterfowl and aquatic mammals. These ephemeral pools and depressions are not dependable for typifying the site or characterizing trends. Therefore, they are not included in this study.

The standard collection sites were selected from the large pond located within the south-central/southeastern region of the area. These sites were populated by the Water Primroses (*Ludwigia peploides (H.B.K.) Raven* and *L. alternafolia L.*,) and a small island of Cattails (*Typha latifolia L.*.). Water Primrose was the predominant emergent vascular vegetation. These plants are perennial with the ability to survive rising and falling water levels. At the time of collection the water level had decreased greater than one-half meter. The vegetation was dense and flowering. These plants stabilize the pond margins thereby reducing erosion and associated turbidity. Also, there was evidence of organic matter accumulation within the littoral zone. The dissolved organic matter was present in great enough concentration to tinge the water slightly brown.

The algae and associated organisms were present in two zones. The littoral zone vegetation contained well established surficial growths of filamentous and other attached algae. The open water, limnetic zone, contained a surface film of the remains of an *Anabaena flos-aquae* (a filamentous bluegreen alga) bloom. The floating remnants of this population produced an intense light green layer on the surface. Other planktonic species were present is reduced numbers.

Samples were collected in August so that the summer populations and subcommunities would be at their maximum development. During development in spring and early summer the emergent vascular vegetation secrete an exudate which diminished colonization by epiphytic (attached) algae and protozoans. As the plants mature during the summer a harder epidermal layer develops and their surface supports the maximum quantity and quality of epiphytic organisms. During fall and winter the stem surfaces undergoes sloughing and decomposition. The epiphytic subcommunity is dramatically diminished and biased. Since the open water subcommunity of ponds and pools is strongly influenced by the rich biological source from the littoral zone it is best to sample in mid-to-late summer. Also the most favorable expression of trophic condition in the true planktonic subcommunity (euplanktonic) is determined during this period. Therefore the August collection provide an adequate representation of the present biological conditions.

Material and Methods:

Samples were collected with a 15cm diameter 25 mesh conical plankton net. An integrated net sample was collected from 5 m into the water body to shore. The net was maneuvered to collect surface, subsurface, intermediate and suprabottom populations. Samples were stored submerged in ice water (2-4°C) and returned to the laboratory for analysis. The samples were maintained in a 24 hour illuminated culture chamber at 8°C.

The samples were analyzed with an Olympus BH2 light microscope containing brightfield, phase-contrast and differential interference optics. Identifications of living organisms were made to the species level where possible. In certain instances special preparations or culturing to produce additional life history stages would be required for complete identification. In these cases the number of probable species was enumerated and assigned a number value, i.e., 1, 2, 3,...

Results:

The table given below is a qualitative list all of the organisms identified in the samples collected from the major pond at the Nevins Creek borrow pit site.

Biological Analysis of Aquatic Organisms Samples

TAXON	Sample 1	Sample 2
Algae		
Chlorophyceae (Greens)		
Bulbochaete sp. 1	X	
Ankistrodesmus falcatus	X	X
Chlamydomonas sp. 1		X
Coesastrum cambricum	X	X
Coelastrum heteracanthum	X	X
Crucigenia tetrapedia	X	X
Crucigenia sp. 1		X
Eudorina elegans		X
Kirchneriella lunaris		X
Microglena sp. 1		X
Oedogonium sp. 1	X	X
Pediastrum boryanum	X	
Pediastrum duplex	X	X
Pediastrum simplex	X	
Scenedesmus bijuga	X	X
Scenedesmus quadracauda	X	X

Scenedesmus serratus		X
Selenastrum palustre		X
Tetraedron minimum		X
Ulothrix sp. 1	X	X
Ulothrix sp. 2		X
Conjugatophyceae (Desmids, etc.)		
Closterium setosum	X	X
Cosmarium angulosum	X	
Cosmarium bioculatum	X	X
Cosmarium granulatum	X	
Cosmarium lundeii	X	X
Cosmarium regnellii	X	
Cosmarium sexangulare	X	X
Cosmarium subcucumis	X	
Cosmarium transiforum	X	X
Euastrum binale	X	
Euastrum kriegeri	X	
Gonatozygon kinihana	X	
Hyalotheca mucosa	X	
Mougeotia sp. 1	X	X
Pleurotaenium ehrenbergii	X	
Spirogyra sp. 1	X	X
Staurastrum paradoxum	X	
Staurodesmus alternans	X	X
Staurodesmus claviferus	X	X
Staurodesmus dickii	X	X
Staurodesmus disputatus		X
Staurodesmus laponicus		X
Zygnema sp. 1	X	
Euglenophyceae (Euglenoids)		
Euglena charkowiense	X	X
Euglena gracilis	X	X
Euglena mutabilis		X
Euglena pisciformis		X
Euglena spirogyra		X
Euglena splendida	X	
Lepocinclis ovum	X	X
Lepocinclis texta	X	X
Phacus brevicaudus	X	X
Phacus longicaudus	X	X
Phacus pulcherrima		X
Phacus suecicus		X
Phacus swirenkoi		X
Trachelomonas armata	X	

Trachelomonas cylindricus		X
Trachelomonas hispida	X	X
Trachelomonas volvocina	X	X
Tribophyceae (Yellow-greens)		
Centritractus belongiformis		X
Pyrrhophyceae (Dinoflagellates)		
Peridiniopsis palustre	X	X
Bacillariophyceae (Diatoms)		
Cyclotella menegihana	X	X
Cyclotella stellata	X	
Cymbella sp. 1	X	X
Eunotia sp. 1	X	
Melosira islandica	X	
Navicula sp. 1	X	X
Navicula sp. 2	X	X
Nitzschia sp. 1	X	X
Nitzschia sp. 2	X	
Ophephora sp. 1	X	
Pinnularia sp. 1	X	
Cryptophyceae (Cryptomonads)		
Cryptomonas ovalis	X	
Cyanophyceae (Bluegreen)		
Anabaena flos-aquae	X	X
Anabaena plancktonica	X	
Aphanizomenon flos-aquae	X	
Merismopedia trollerii	X	
Microcystis incerta	X	X
Oscillatoria principes	X	X
Oscillatoria sp. 1	X	X
Oscillatoria sp. 2	X	X
Animalia		
Amoebidae		
Amoeba sp. 1	X	X
Difflugia sp. 1	X	X
Mastogophora		
Euplotes sp. 1	X	X
Paramecium sp. 1	X	X
Vorticella sp. 1	X	X

Trachelomonas cylindricus		X
Trachelomonas hispida	X	X
Trachelomonas volvocina	X	X
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Centritractus belongiformis		X
Pyrrhophyceae (Dinoflagellates)		
Peridiniopsis palustre	X	X
Bacillariophyceae (Diatoms)		
Cyclotella menegihana	X	X
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Melosira islandica	X	
Navicula sp. 1	X	X
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Nitzschia sp. 1	X	X
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Animalia		
Amoebidae		
Amoeba sp. 1	X	X
Difflugia sp. 1	X	X
Mastogophora		
Euplotes sp. 1	X	X
Paramecium sp. 1	X	X
Vorticella sp. 1	X	X

Rotifers		
Keratella sp. 1	X	X
Polyarthra sp. 1	X	X
Copepods		
Aplanchna sp. 1	X	X
Nematodes		
Species 1	X	X
Species 2	X	X

The algae and animals collected from the two sites have a diversity (number of species) of 74 and 67, respectively. Fourty-eight species are common in both samples. A comparison of the similarity between the two samples shows that they have a Sorensen (1948) Similarity Index value of 68%. This high similarity from random net tows indicates minimal patchiness and a high degree of homogeniety. The reduced patchiness is related to the open fetch of the pond surface, i.e., the exposure to wind action, and the ponds shallow depth. Thus the wind has a strong influence on the distribution of the planktonic organisms and the movement of littoral zone floating species into and throughout the pond. The organisms are more-or-less evenly distributed through the community. This suggests that a simple, reduced sampling program can be used for future tracking of ecosystem succession and maturation.

The presence of a large diversity of desmids and euglenoid algae strongly indicate the presence of dissolved organic matter, thus the influence of the marginal vegetation is clearly expressed. Almost all of the diatoms present were epiphytic taxa dislodged from the vegetation. Many of the bluegreen algae were associated with the vegetation or mud-water interface (epipelic zone).

The open water (euplanktonic) zone contained a reduced diversity of algae but was populated with a dense bloom of the bluegreen alga *Anabaena flos-aquae* and an developing population of *Aphanizomenon flos-aquae*. These organisms typify moderately-to-highly enriched waters. Each of these organisms are capable of fixing atmospheric nitrogen. The green algae present in the plankton are typical of mesotrophic-to-moderately eutrophic conditions.

The animals present are those commonly found in permanent ponds. They were actively reproducing. Numerous eggs and juvenile stages were observed. Those observed were herbivores grazing on the algal primary producers. They was supported by gut content analysis . The gut contents of the zooplankters included numerous planktonic algae. This interaction between the algae and animals probably results in a reduction of the standing crop of algae. These animals are capable of filtering large quantities of phytoplankton and reducing the diversity and quantity of algae present at any point in time. Thus

the limited number of phytoplanktors present may be the result of intense grazing by the zooplankton. These observations suggest that a healthy food web is becoming established between these two trophic levels, i.e., the primary producers and herbivores. No carnivorous zooplankters were observed. This would suggest that only the base levels an immature food web has been established. In time additional levels may become established. The development of upper levels of the food web is dependent upon stability in the systems, i.e., the reduction of disturbance by the stream or drought and the introduction of appropriate species. The reduced diversity of animal species suggest that this trophic level lacks adequate redundancy and can be easily disturbed or destroyed.

The growth, development and maturation of the primary producers, the algae, are described in detail in the compendia by Round (1981) and Sandgren (1988). These general references provide a window into the extensive literature base for understanding probable future development of the pond community and its several subcommunities. The Nevins Creek ponds, however, may be unusual since they are periodically flooded. Flooding will certainly dilute the existing populations. Also the change from stand to flowing water may eliminate certain species not tolerant to current. In addition a new innoculum will be introduced with each flood. Several taxa may survive and populate the pond. Alternatively, drought conditions apply strong selective pressure and only those organisms which can quickly produce resistant spores or cysts may survive. Certain species are tolerant of the increasing salinity and temperature associated with drying. These latter organisms will dominate the ponds as they are refilled via ground water inflow. Ground water seldom contains organisms and it represents a filtered water recharge of the pond. Therefore the drought resistant organisms have an initial advantage in repopulating the re-established pond community.

After the dramatic impacts of flooding or of drought the patterns of succession of the flora and fauna may be dramatically altered. These two conditions, flood and drought, may result in unstability. If these disturbances occur frequently the pond will not achieve stability and succeed into a mature system. Only regular periodic sampling can assess the impacts of these events and the recovery towards nominal conditions.

Conclusions and Recommendations:

- The pond has a diversity of species with representatives from all major groups of freshwater algae.
- The algae present are typical of mesotrophic-to-slightly eutrophic conditions.
- The algal species present will probably remain however their concentration and importance will vary as the pond matures and/or the zooplankton quantity and quality changes.
- The diversity of algae in the littoral zone are limited by the species of present

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- The diversity of algae in the littoral zone are limited by the species of present

vascular vegetation and the predominance of water primrose.

- The animal diversity is limited by method of introduction and will probably increase through time unless the system is disturbed.
- It is recommended that additional marginal vegetation be introduced to increase it diversity as well as the diversity of algae and zooplankton. This will reduce the fragile nature of the present aquatic ecosystem. Locally adapted species of pond weed (*Potomogeton*), water willow (*Justicia*), rushes (*Scirpus*), and sedges (*Carex*) should be considered.
- Future sampling can be limited to two open water sites and tows through representative beds of marginal vegetation. The two open water sites should be taken away from but near the vegetation on the windward shore and perpendicularly (90°) from the wind direction. All samples are best collected in mid-spring and early fall.
- Chlorophyll concentrations should be determined from the open water samples as an estimate of the trophic status (richness) of the pond. This is an excellent method to determine long-term trends.

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