ANNUAL REPORT FOR 2000

Little Sugar Creek Mitigation Site

Mecklenburg County

Project No. 8.U670122

TIP No. R-211 DA

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SUMMARY

The Little Sugar Creek Mitigation Site, located in Mecklenburg County, is in its fourth year of monitoring. Approximately 21 acres in size, the site was to serve as mitigation for a section of the Charlotte Outer Loop. The site was originally constructed in the winter of 1996-97; it must demonstrate jurisdictional success for a minimum of three years. The Little Sugar Creek site is monitored for both wetland hydrology and vegetation survival.

Five of the groundwater gauges (W2, W4, W5, W6 and W8) and two of the surface water gauges (S1 and S10) on site lost data during a portion of the growing season due to battery failure. With the exception of one surface water gauge, which was problematic throughout the summer, most of the data gaps were not long in duration. An unreliable rainfall gauge on-site was replaced with more reliable equipment prior to the start of the 2000 growing season. Battery failure caused a gap in the rainfall data, which was supplemented with local weather station data.

The 2000 monitoring has shown no improvement in site hydrology. The site typically had groundwater 15 to 18 inches below the surface, even though rainfall for the site was fairly average for the year. The hydrologic data indicates that once water reaches the site, it quickly drains from the central uplands into the channels prior to entering Little Sugar Creek.

Vegetation survival is high. The average tree density for bottomland hardwood species is 601 trees per acre after four years. Planted shrub species have survived at 227 trees per acre, and plantings are becoming very well established in the bottom and side slopes of the channels.

Alternatives are being assessed to address the lack of water on site. Work will be done to adjust two water control structures before the start of the growing season, in an effort to increase the length of time that stormwater remains on the site.

1.0 Introduction

1.1 Project Description

The Little Sugar Creek Mitigation Site is located in Mecklenburg County. The site, which encompasses approximately 21 acres, is situated at the intersection of Highway 51 and Leitner Drive (Figure 1). It was designed as mitigation for a portion of the Charlotte Outer Loop project that extends from NC 51 to Rea Road (TIP No. R-211 DA, USACE Action ID 199200013).

The project provides for the restoration/creation of bottomland forest, shrub-scrub wetland, and emergent marsh. The site was originally constructed in the winter 1996-97; NCDOT performed supplemental planting work in 1998. The site is in its fourth year of hydrologic and vegetation monitoring.

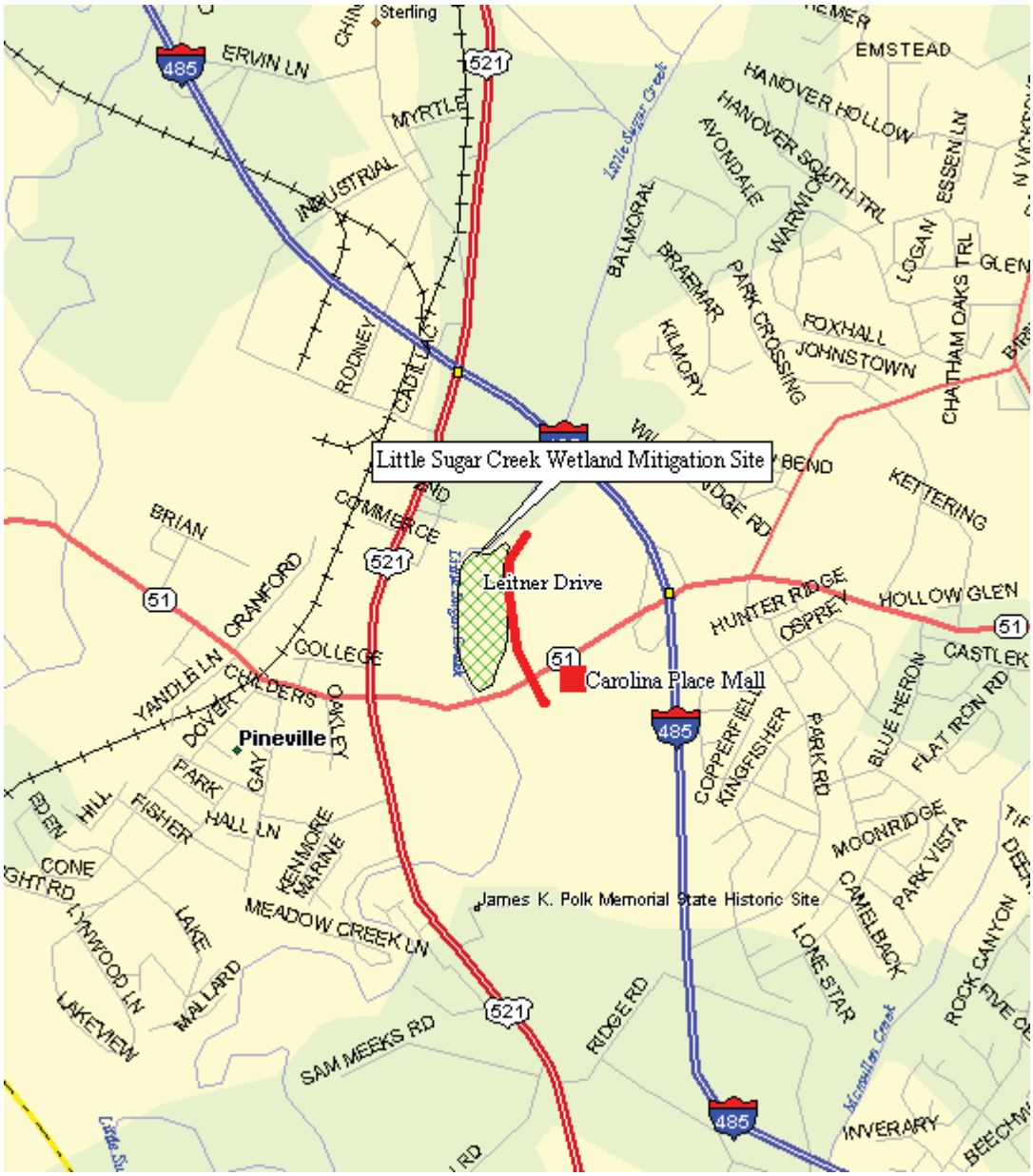
1.2 Purpose

In order to demonstrate successful mitigation, Little Sugar Creek is monitored for both hydrology and vegetation. Success criteria are based on federal guidelines for wetland mitigation. These guidelines stipulate criteria for both hydrologic conditions and vegetation survival. The following report describes the results of the hydrologic and vegetative monitoring during 2000 at the Little Sugar Creek Mitigation Site. Included in this report are the hydrologic and vegetation monitoring results as well as an analysis of local climate conditions throughout the growing season.

1.3 Project History

March 1997	Site planted
March-November 1997	Hydrologic Monitoring (1 yr.)
September 1997	Vegetation Monitoring (1 yr.)
March 1998	Shrub Area Replanted
March-November 1998	Hydrologic Monitoring (2 yr.)
September 1998	Vegetation Monitoring (2 yr.)
March-November 1999	Hydrologic Monitoring (3 yr.)
September 1999	Vegetation Monitoring (3 yr.)
March-November 2000	Hydrologic Monitoring (4 yr.)
September 2000	Vegetation Monitoring (4 yr.)

Figure 1
Site Location Map



2.0 Hydrology

2.1 Success Criteria

Federal guidelines for wetland mitigation state that the area must be inundated or saturated (within 12" of the surface) by surface or ground water for at least 12.5% of the growing season for hydrologic success. The permit conditions for this mitigation site, however, state that the 1987 Wetland Manual criterion for hydrology must be exceeded: "saturated within 10 inches of the surface, ponded or flooded for at least 26 consecutive days of the growing season." Neither the federal requirement nor the permit condition for hydrology has been met.

The growing season in Mecklenburg County begins March 22 and ends November 11. These dates correspond to a 50% probability that air temperatures will drop to 28° or lower after March 22 and before November 11.[1] Thus the growing season is 235 days; minimum wetland hydrology requires 12.5% of this season, or 29 days, under average climatic conditions.

2.2 Hydrologic Description

Nine groundwater gauges, one rain gauge, and three surface water gauges were installed in 1997 (Figure 2). The automatic monitoring gauges record daily readings of the groundwater depth. The year 2000 is the fourth season for hydrologic monitoring.

Three sluice gates are being used to control the water levels within the channels. During 1997, the gates were intentionally left open to allow hardwood trees and scrub-shrub vegetation an opportunity to initially grow in upland conditions. The gates were closed to trap water in the site during the winter of 1997-1998. The top pipe on each gate was later opened; however, too much water was leaving the site. The gates were closed again in July 1999. The gates remained closed in 2000.

Runoff from the surrounding area is the primary hydrologic input to the Little Sugar Creek site. A stormwater pipe, running underneath Leitner Drive, releases water collected from adjacent shopping centers near gauge 9. The monitoring gauges on the site are to show the effects of the stormwater collected in the channels as well as the effects of specific rainfall events on the groundwater table.

[1] Soil Conservation Service, Soil Survey of Mecklenburg County, North Carolina, p. 61.

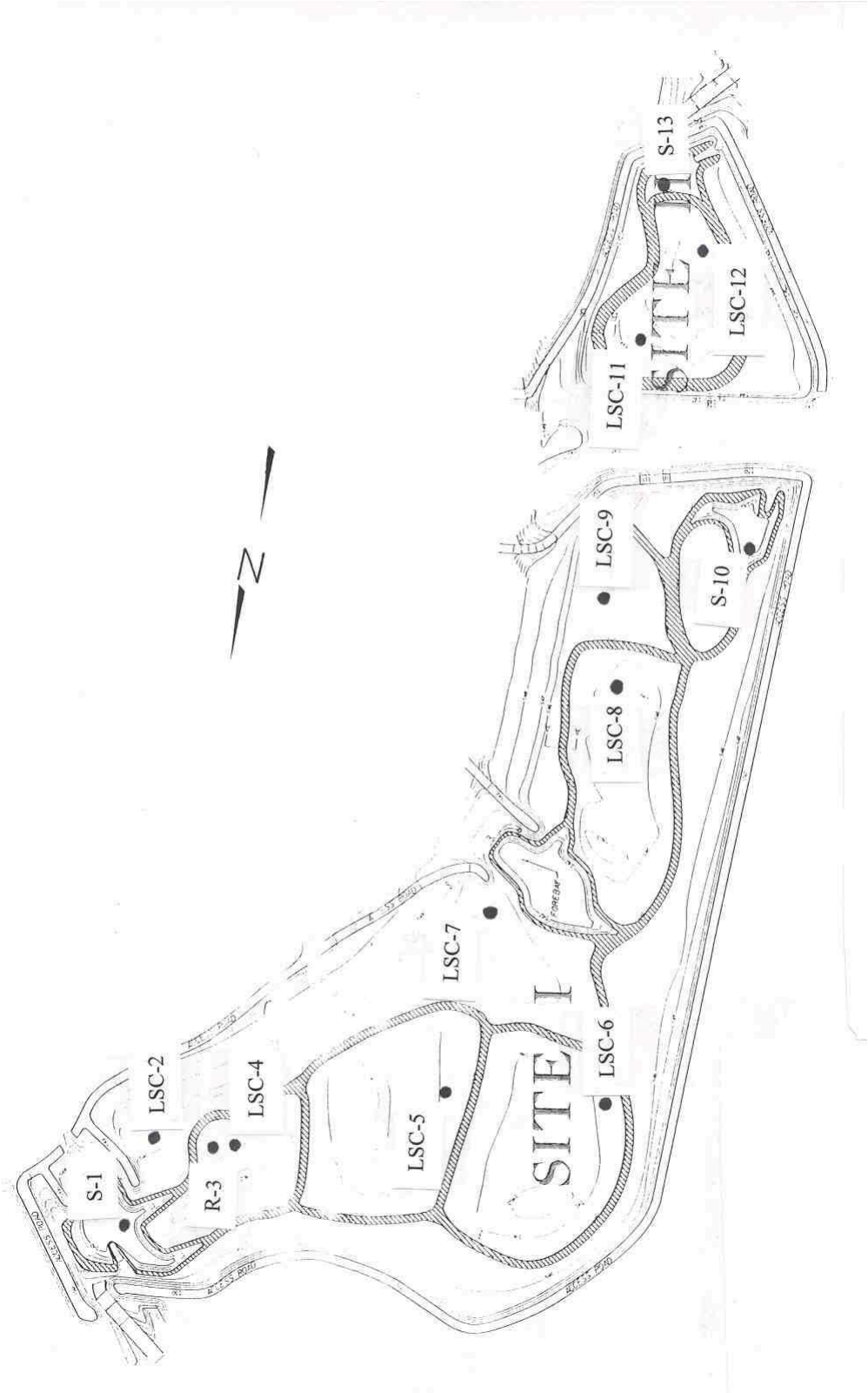


Figure 2
Gauge Location Map

2.3 Results of Hydrologic Monitoring

2.3.1 Site Data

The maximum number of consecutive days that the groundwater was within twelve inches of the surface was determined for each gauge. This number was converted into a percentage of the 235-day growing season. The results are presented in Table 1. Appendix A contains a plot of the groundwater and surface water depth for each groundwater and surface gauge, respectively.

The individual precipitation events, shown on the monitoring gauge graphs as bars, represent data collected from the on-site rain gauge or from a Charlotte weather station (provided by the NC State Climate Office). The rain gauge on the site was replaced with a more accurate measuring device prior to the beginning of the 2000 monitoring season; however, a battery failure caused a gap in the data, which was supplemented with official rainfall information in the monitoring gauge graphs. A comparison of the new on-site rain gauge with the Charlotte weather station indicates that the two sets of rainfall data are fairly similar in both dates and amounts of rainfall.

Table 1
2000 Hydrologic Monitoring Results

Monitoring Gauge	< 5%	5% - 8%	8% - 12.5%	> 12.5%	Actual %	Dates of Success
LSC-2	✔				2.1	September 23-27
LSC-4	✔				3.0	September 23-29
LSC-5	✔				2.1	Aug. 29-Oct. 2
LSC-6	✔				0.4	July 13
LSC-7	✔				0.4	September 26
LSC-8	✔				2.6	September 20-25
LSC-9	✔				2.6	September 23-28
LSC-11		✔			6.8	March 22-April 6 Sept. 19-Oct. 3
LSC-12	✔				3.4	September 23-30

The surface water gauges have indicated consistent surface water in the channels throughout the growing season. None of the groundwater gauges registered success for a consecutive 12.5% of the growing season, although the gauges registered above –12 inches slightly more often than during the summer drought of 1999. Each monitoring gauge showed a groundwater level of 15-18 inches below the surface throughout most of the season. These results are similar to those of last year.

It should be noted that in addition to the rain gauge, five of the groundwater gauges (W2, W4, W5, W6 and W8) and two of the surface water gauges (S1 and S10) lost data during the a portion of the growing season due to battery failure. Surface gauge S10 was problematic throughout the summer, such that the chart of S10 data is not included in this report. What data that was gathered from S10 was similar to the data from 1999 and comparable to the other on-site surface water gauges from 2000.

2.3.2 Climatic Data

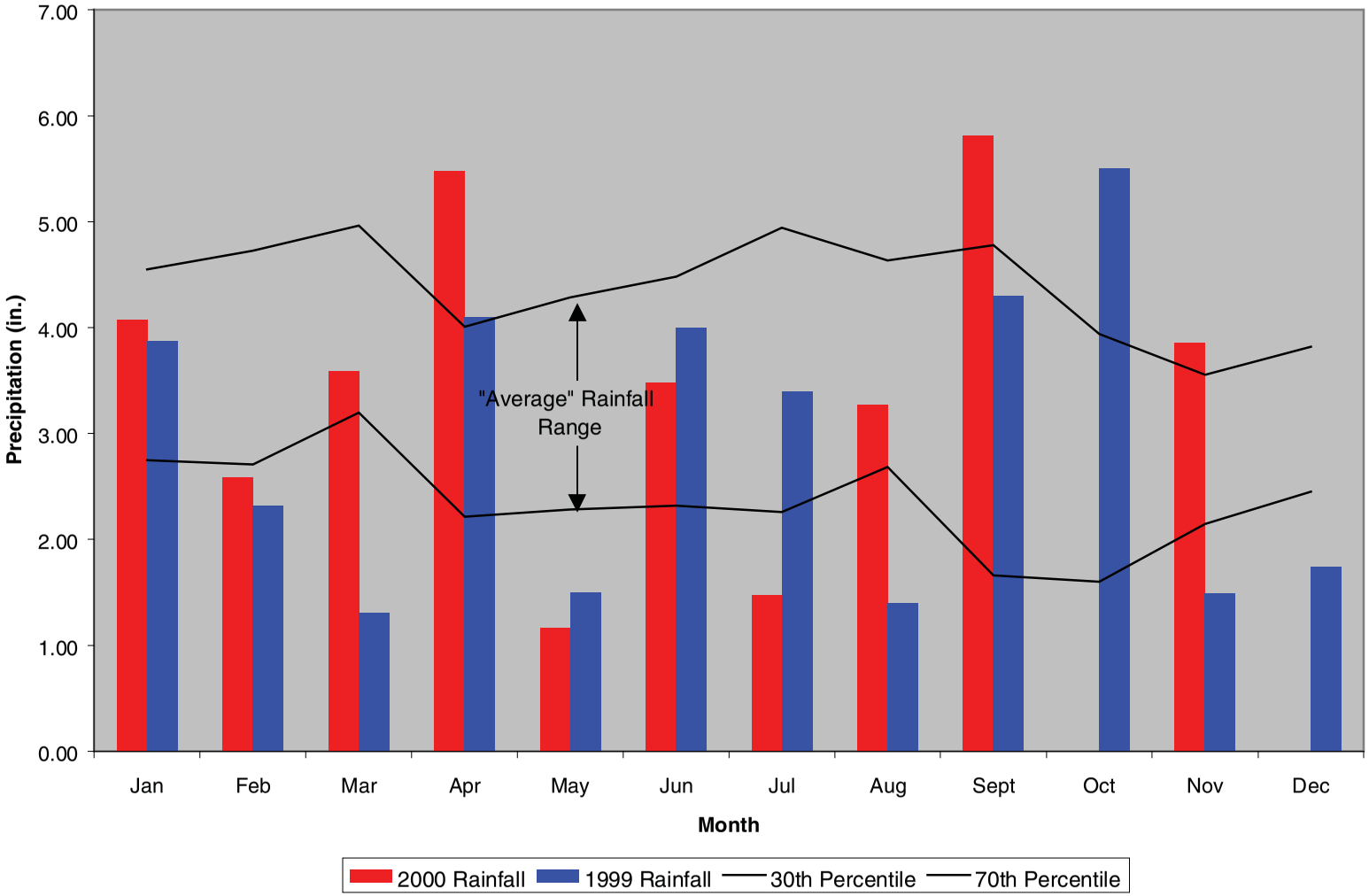
Figure 3 is a comparison of 1999 and 2000 monthly rainfall to historical precipitation for the area. This comparison indicates if 2000 was "average" in terms of climate conditions by comparing the rainfall to that of historical rainfall (data collected between 1948 and 1997). Historic data was provided by the NC State Climate Office.

Above average rainfall occurred in April and September, briefly elevating the groundwater level on the site. No rainfall occurred in October. Based on the data collected from the Charlotte rain gauge, the region received roughly average monthly rainfall totals during most of the growing season.

2.4 Conclusions

Despite average rainfall, the Little Sugar Creek site was rather dry for the majority of the growing season. Gauges indicate that the groundwater level averages 15-18 inches below the surface. Above average rainfall for the months of April and September temporarily raised the groundwater levels on the site. The data indicates that most of the water received by the site remains in the channels, and does not migrate into the central pods of the site.

Figure 3
Little Sugar Creek 30-70 Percentile Graph
Charlotte, NC



3.0 Vegetation

3.1 Success Criteria

Success criteria in the permit conditions state that there must be a minimum mean density of 320 planted tree species/acre surviving for three consecutive years in the bottomland forest area of the site. Mast-producing oaks must comprise at least 50% of the trees. No quantitative sampling requirements were developed for the herb and shrub assemblages as part of the vegetation success criteria.

3.2 Description of Species

The following shrub species were re-planted in the Wetland Shrub Restoration Area (1998):

Cornus amomum, Silky Dogwood
Leucothoe axillaris, Dog Hobble
Rhododendron arborescens, Smooth Azalea
Sambucus canadensis, Elderberry
Viburnum nudum, Possum Haw
Aesculus sylvatico, Painted Buckeye
Lindera benzoin, Spicebush

The following herbaceous species were planted in the Channel Areas:

Juncus effusus, Soft Rush
Scirpus validus, Bulrush

The following tree species were planted in the Wetland Restoration Area:

Quercus michauxii, Swamp Chestnut Oak
Quercus pagoda, Cherrybark Oak
Quercus phellos, Willow Oak
Fraxinus pennsylvanica, Green Ash
Betula nigra, River Birch
Quercus lyrata, Overcup Oak
Quercus nigra, Water Oak

3.3 Results of Vegetation Monitoring (4th year)

Plot # (Type)	Silky Dogwood	Dog Hobble	Painted Buckeye	Green Ash	Water Oak	Cherrybark Oak	Overcup Oak	Swp Chestnut Oak	River Birch	Willow Oak	Total	Total (at planting)	Density (Tree/Acre)
1(Shrub)	5	2	3								10	30	227
2(BLH)				10	1	1		6	2	3	23	30	521
3(BLH)				12	1	4		5	1	7	30	30	680
				AVERAGE TREE (BLH) DENSITY									601

To determine tree density, 50' x 50' plots are installed following planting. Planted trees that occur within the plot are counted. This number is equated to the number of trees per plot that would represent 680 trees per acre (average). The survival number is compared to the planted number to obtain survival percentage. This percentage is applied to the 680 trees per acre to estimate trees per acre for the site.

Density = (monitoring count/planted trees) x 680 (trees per acre)

Observations from site: other species found were *Juncus* sp., switch grass (*Panicum* sp.), goldenrod (*Solidago* sp.), volunteer sycamore (*Liquidambar styraciflua*), and foxtail (*Setaria* sp.). One inch of surface water was in Plot 1. Four to six inches of water were in Plot 3. Evidence of beaver was seen in Plot 2.

3.4 Conclusions

Approximately 9.8 acres of the site were planted in bottomland hardwoods in March, 1997. There are two vegetation monitoring plots located in this bottomland hardwood area, Plot #2 and Plot #3. The results of the monitoring are an average density of 601 trees per acre, well above the 320 tree/acre minimum requirement. The density has increased from 555 trees/acre last year because the trees have grown in size and are easier to spot during surveys. The density of oaks is 385 trees/acre, comprising 64% of the trees. Approximately 3.2 acres of this site were re-planted with scrub-shrub species in 1998. Plot #1 shows a density of 227 shrubs/acre; the density last year was 68. The remaining 3.7 acres were planted with herbaceous plants. From visual observation (see photos in Appendix B), this plant material is becoming established in the bottom and side slopes of the channels on the site.

4.0 Overall Conclusions/ Recommendations

After four years of hydrologic and vegetation monitoring, the site does not meet success criteria for wetland mitigation. The site does provide water quality protection for Little Sugar Creek by acting as a storm water detention basin, however remediation is necessary to meet hydrologic requirements.

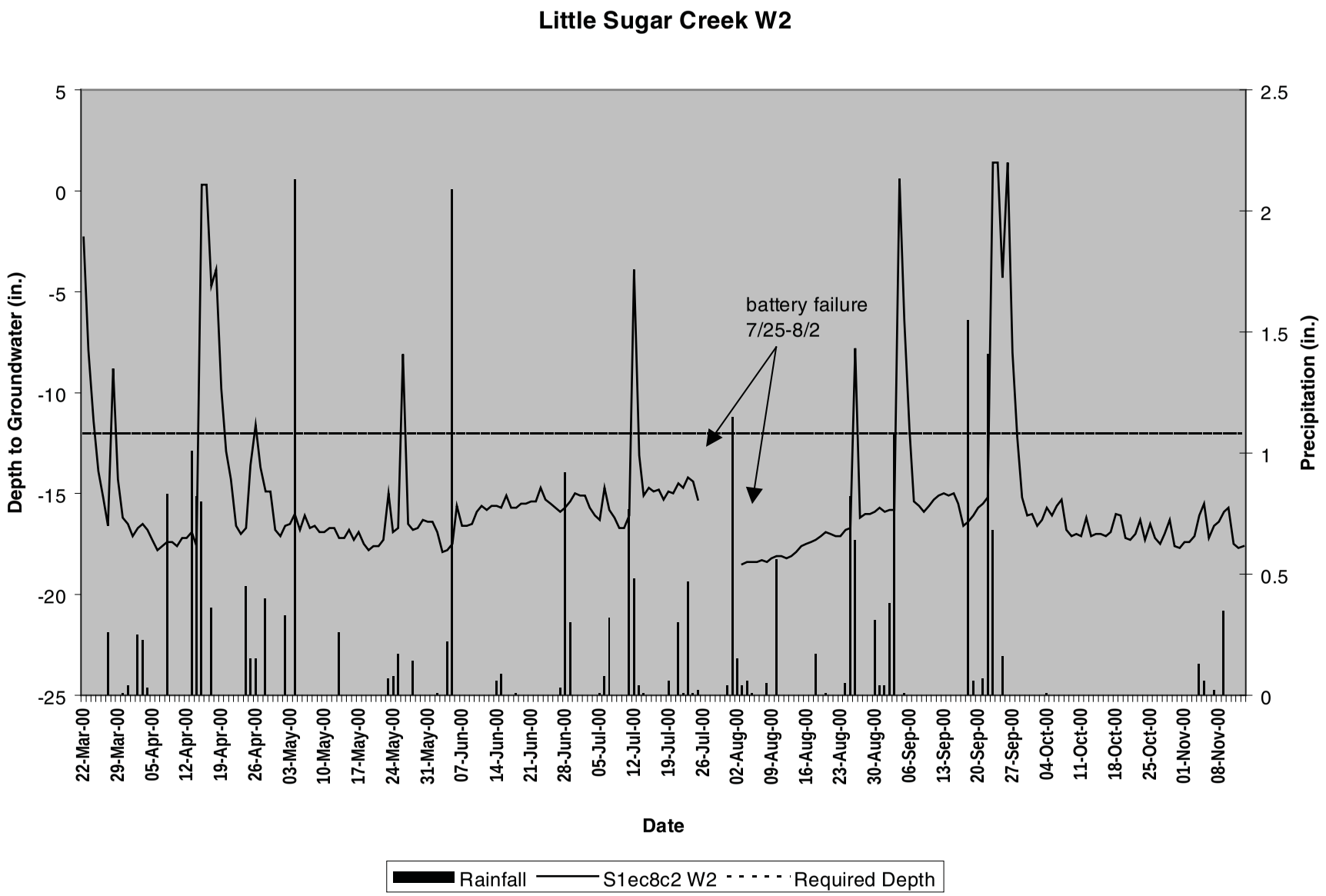
The NCDOT Hydraulics Unit has been consulted about the lack of water on site and alternatives are being assessed to address this issue. Short-circuiting of storm water may occur near one of the outlets for the site.

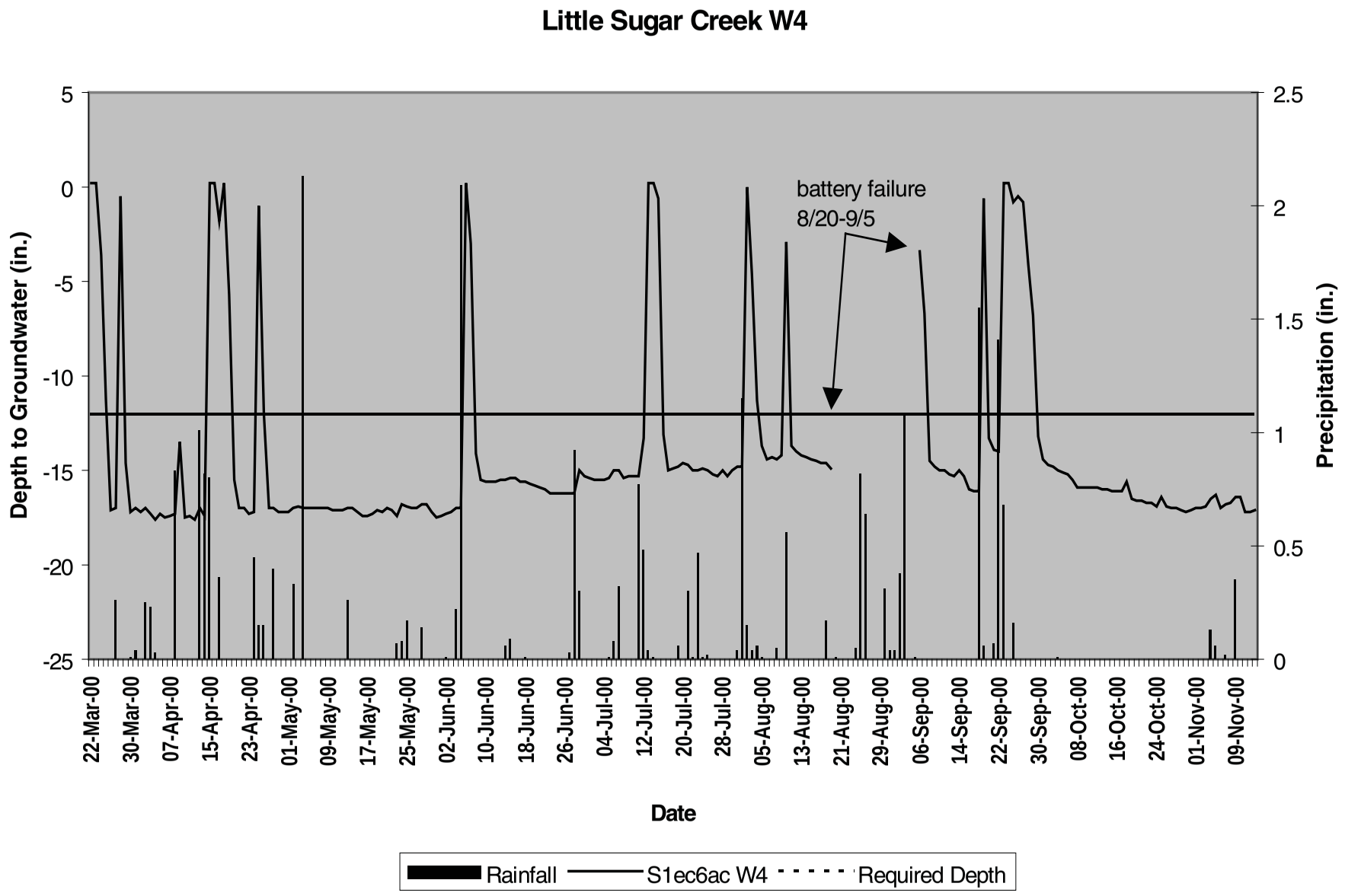
NCDOT has the following recommendations:

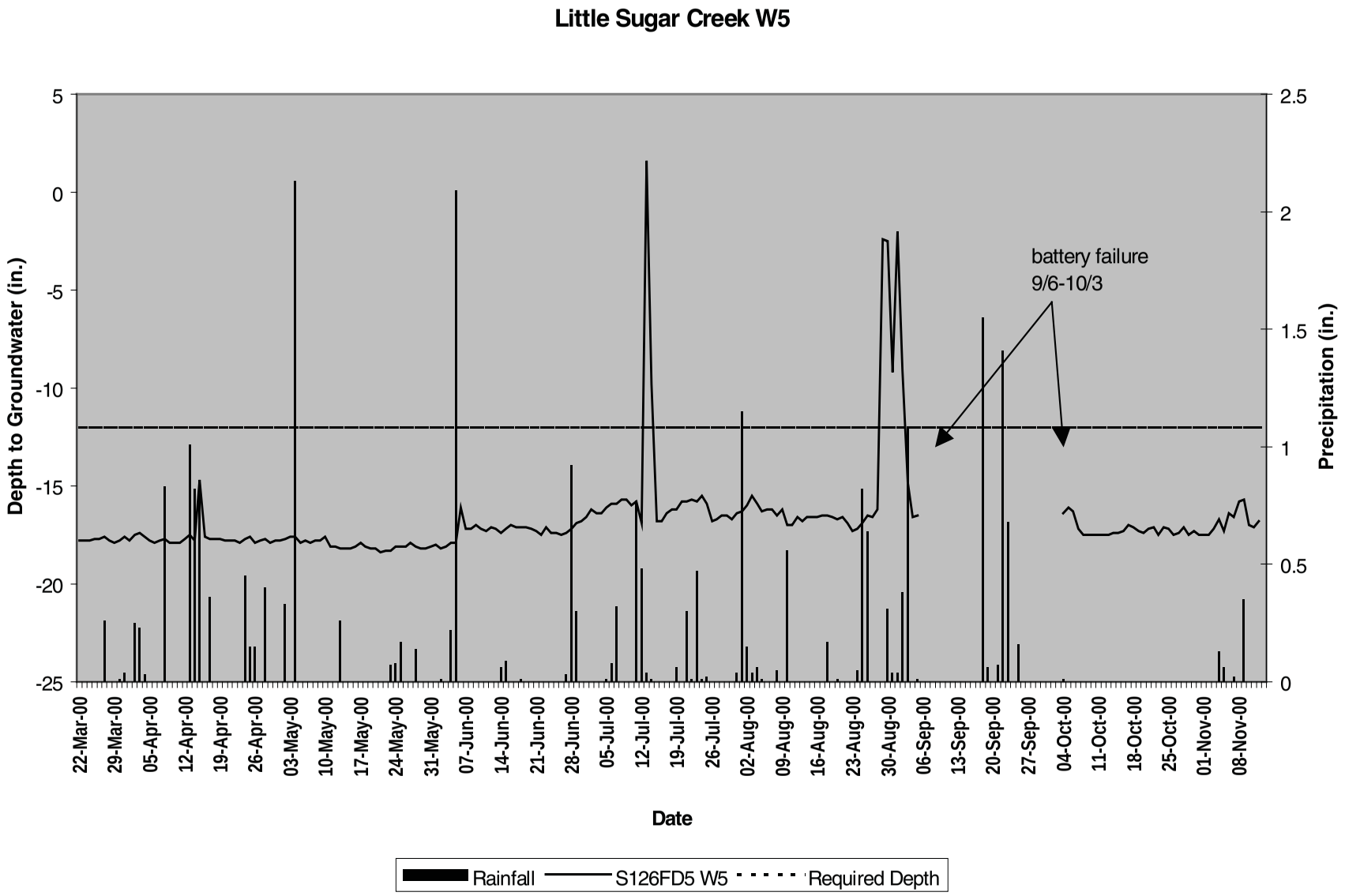
- Adjust a water control structure on the northern part of the site and another on the southern to increase the amount of time that storm water remains on the site. This work will be conducted before the start of the growing season. Any disturbed areas will be stabilized with permanent groundcover.
- Continue monitoring the site.

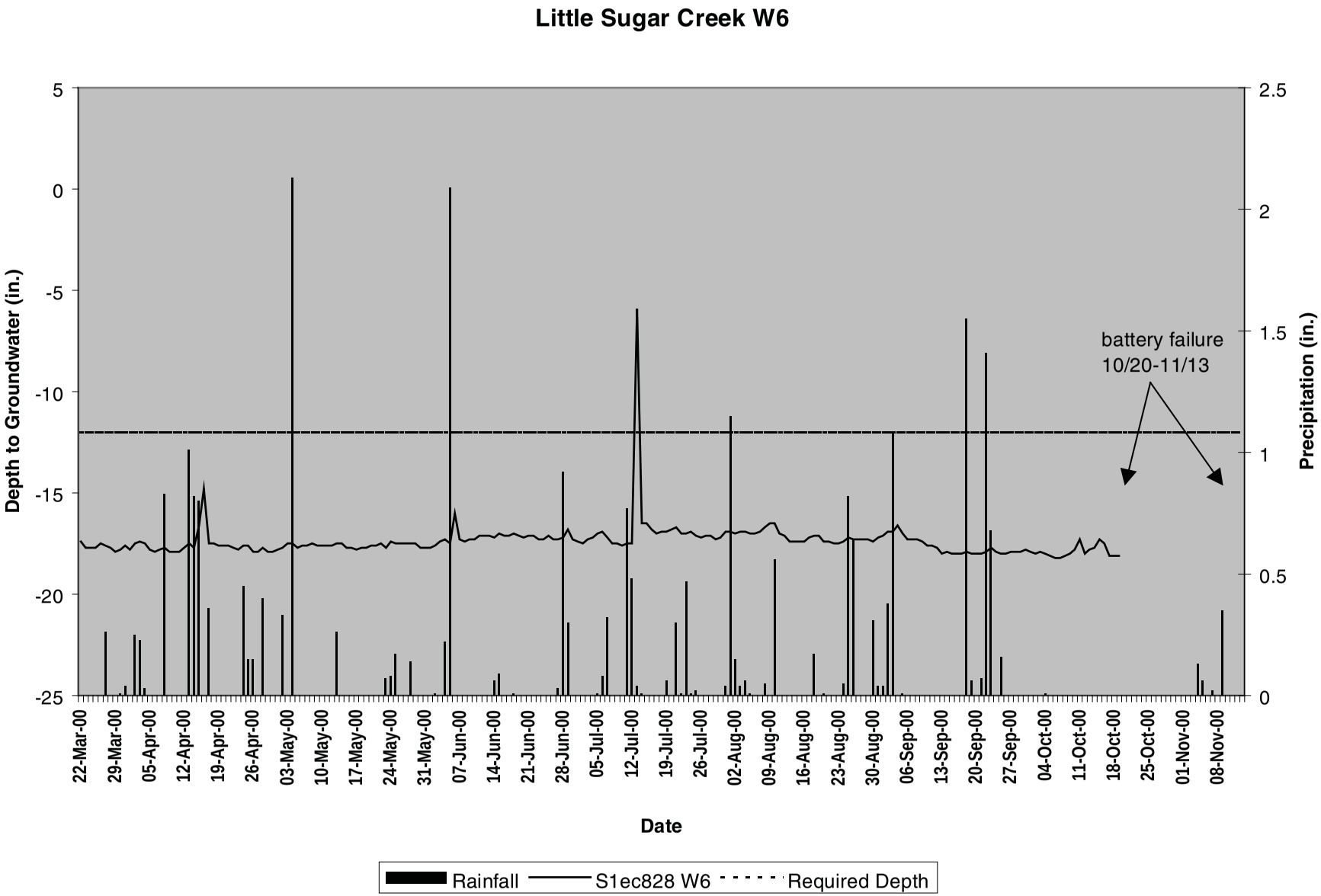
Appendix A

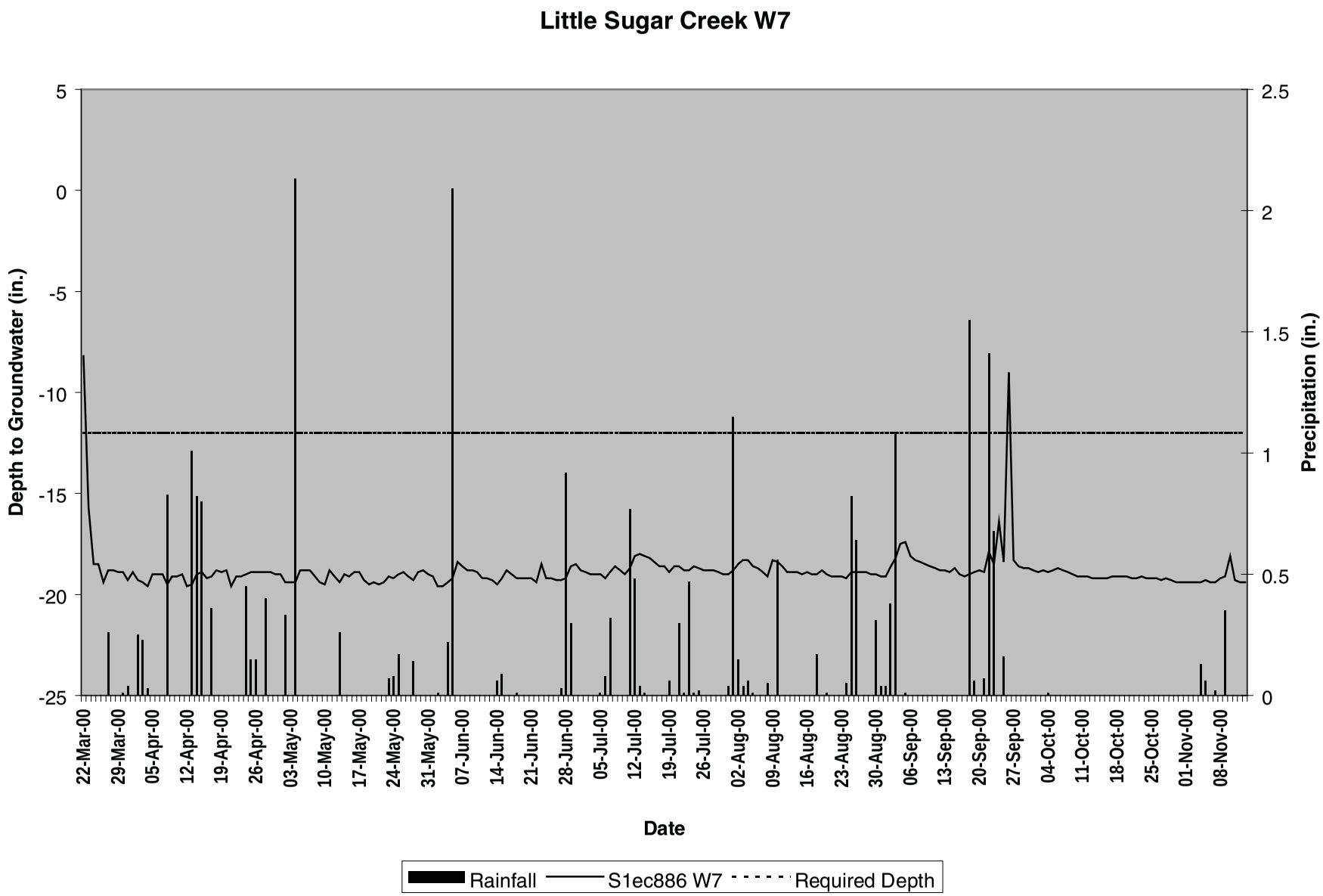
Depth to Groundwater Plots

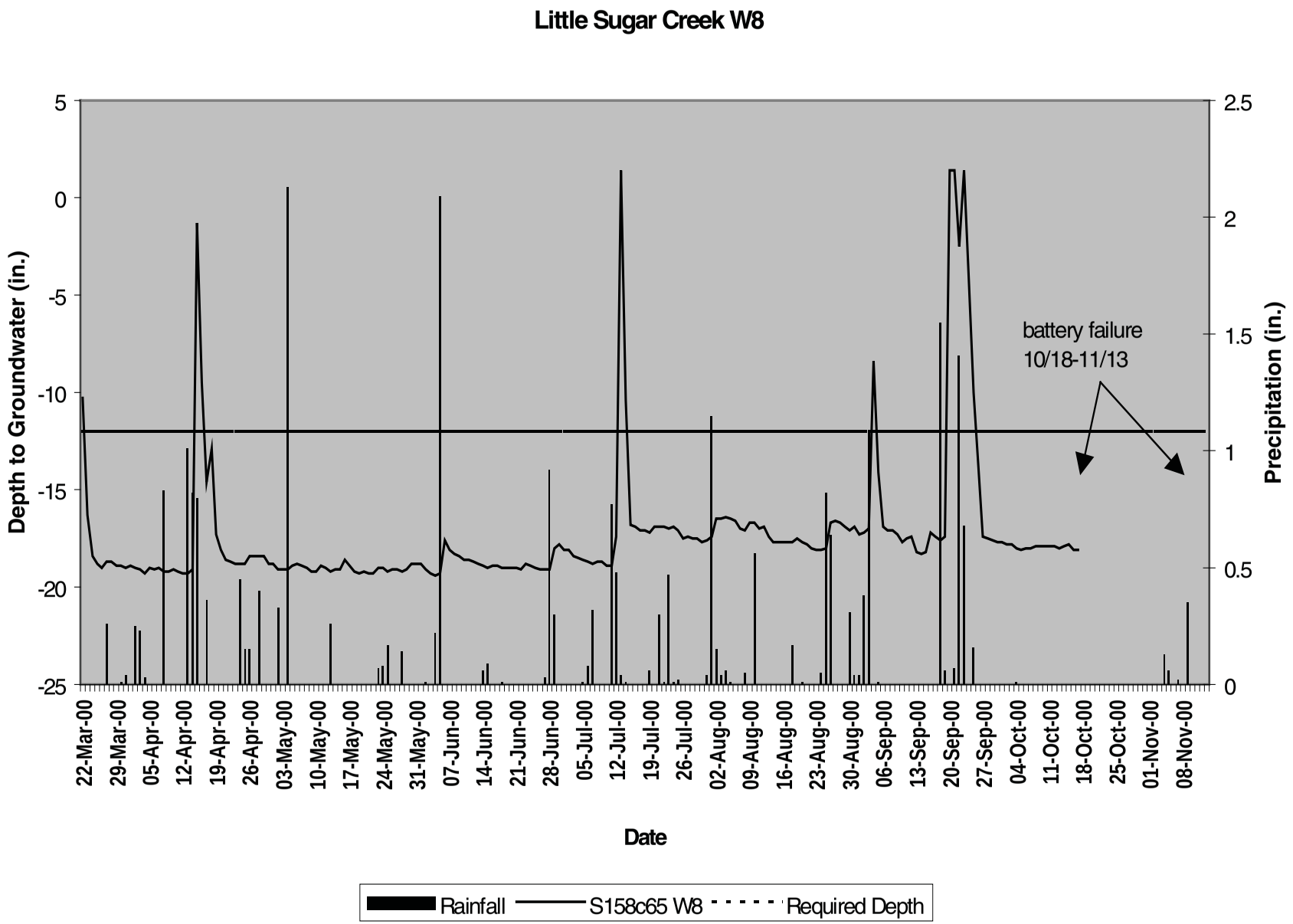

Little Sugar Creek W2
Depth to Groundwater (in.)
Precipitation (in.)
Date
battery failure
7/25-8/2
5
0
-5
-10
-15
-20
-25
2.5
2
1.5
1
0.5
0
22-Mar-00
29-Mar-00
05-Apr-00
12-Apr-00
19-Apr-00
26-Apr-00
03-May-00
10-May-00
17-May-00
24-May-00
31-May-00
07-Jun-00
14-Jun-00
21-Jun-00
28-Jun-00
05-Jul-00
12-Jul-00
19-Jul-00
26-Jul-00
02-Aug-00
09-Aug-00
16-Aug-00
23-Aug-00
30-Aug-00
06-Sep-00
13-Sep-00
20-Sep-00
27-Sep-00
04-Oct-00
11-Oct-00
18-Oct-00
25-Oct-00
01-Nov-00
08-Nov-00
Rainfall
S1ec8c2 W2
Required Depth

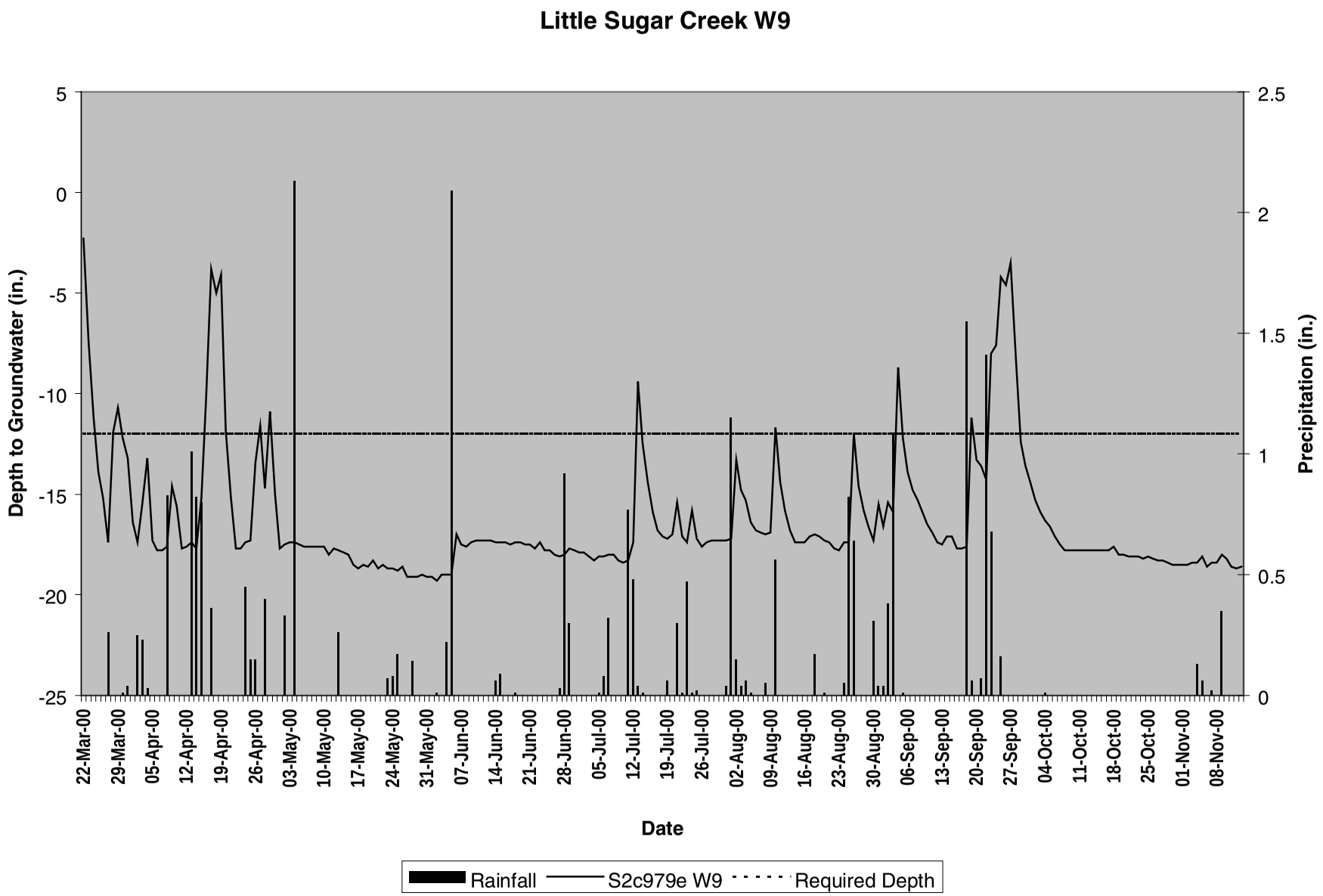

Little Sugar Creek W4
Depth to Groundwater (in.)
Precipitation (in.)
Date
battery failure
8/20-9/5
5
0
-5
-10
-15
-20
-25
2.5
2
1.5
1
0.5
0
22-Mar-00
30-Mar-00
07-Apr-00
15-Apr-00
23-Apr-00
01-May-00
09-May-00
17-May-00
25-May-00
02-Jun-00
10-Jun-00
18-Jun-00
26-Jun-00
04-Jul-00
12-Jul-00
20-Jul-00
28-Jul-00
05-Aug-00
13-Aug-00
21-Aug-00
29-Aug-00
06-Sep-00
14-Sep-00
22-Sep-00
30-Sep-00
08-Oct-00
16-Oct-00
24-Oct-00
01-Nov-00
09-Nov-00
Rainfall
S1ec6ac W4
Required Depth


Little Sugar Creek W5
Depth to Groundwater (in.)
Precipitation (in.)
5
0
-5
-10
-15
-20
-25
2.5
2
1.5
1
0.5
0
battery failure
9/6-10/3
22-Mar-00
29-Mar-00
05-Apr-00
12-Apr-00
19-Apr-00
26-Apr-00
03-May-00
10-May-00
17-May-00
24-May-00
31-May-00
07-Jun-00
14-Jun-00
21-Jun-00
28-Jun-00
05-Jul-00
12-Jul-00
19-Jul-00
26-Jul-00
02-Aug-00
09-Aug-00
16-Aug-00
23-Aug-00
30-Aug-00
06-Sep-00
13-Sep-00
20-Sep-00
27-Sep-00
04-Oct-00
11-Oct-00
18-Oct-00
25-Oct-00
01-Nov-00
08-Nov-00
Date
Rainfall
S126FD5 W5
Required Depth


Little Sugar Creek W6
Depth to Groundwater (in.)
Precipitation (in.)
Date
battery failure
10/20-11/13
5
0
-5
-10
-15
-20
-25
2.5
2
1.5
1
0.5
0
22-Mar-00
29-Mar-00
05-Apr-00
12-Apr-00
19-Apr-00
26-Apr-00
03-May-00
10-May-00
17-May-00
24-May-00
31-May-00
07-Jun-00
14-Jun-00
21-Jun-00
28-Jun-00
05-Jul-00
12-Jul-00
19-Jul-00
26-Jul-00
02-Aug-00
09-Aug-00
16-Aug-00
23-Aug-00
30-Aug-00
06-Sep-00
13-Sep-00
20-Sep-00
27-Sep-00
04-Oct-00
11-Oct-00
18-Oct-00
25-Oct-00
01-Nov-00
08-Nov-00
Rainfall
S1ec828 W6
Required Depth


Little Sugar Creek W7
Depth to Groundwater (in.)
Precipitation (in.)
5
0
-5
-10
-15
-20
-25
2.5
2
1.5
1
0.5
0
22-Mar-00
29-Mar-00
05-Apr-00
12-Apr-00
19-Apr-00
26-Apr-00
03-May-00
10-May-00
17-May-00
24-May-00
31-May-00
07-Jun-00
14-Jun-00
21-Jun-00
28-Jun-00
05-Jul-00
12-Jul-00
19-Jul-00
26-Jul-00
02-Aug-00
09-Aug-00
16-Aug-00
23-Aug-00
30-Aug-00
06-Sep-00
13-Sep-00
20-Sep-00
27-Sep-00
04-Oct-00
11-Oct-00
18-Oct-00
25-Oct-00
01-Nov-00
08-Nov-00
Date
Rainfall
S1ec886 W7
Required Depth


Little Sugar Creek W8
Depth to Groundwater (in.)
Precipitation (in.)
5
0
-5
-10
-15
-20
-25
2.5
2
1.5
1
0.5
0
battery failure
10/18-11/13
22-Mar-00
29-Mar-00
05-Apr-00
12-Apr-00
19-Apr-00
26-Apr-00
03-May-00
10-May-00
17-May-00
24-May-00
31-May-00
07-Jun-00
14-Jun-00
21-Jun-00
28-Jun-00
05-Jul-00
12-Jul-00
19-Jul-00
26-Jul-00
02-Aug-00
09-Aug-00
16-Aug-00
23-Aug-00
30-Aug-00
06-Sep-00
13-Sep-00
20-Sep-00
27-Sep-00
04-Oct-00
11-Oct-00
18-Oct-00
25-Oct-00
01-Nov-00
08-Nov-00
Date
Rainfall
S158c65 W8
Required Depth


Little Sugar Creek W9
Depth to Groundwater (in.)
Precipitation (in.)
5
0
-5
-10
-15
-20
-25
2.5
2
1.5
1
0.5
0
22-Mar-00
29-Mar-00
05-Apr-00
12-Apr-00
19-Apr-00
26-Apr-00
03-May-00
10-May-00
17-May-00
24-May-00
31-May-00
07-Jun-00
14-Jun-00
21-Jun-00
28-Jun-00
05-Jul-00
12-Jul-00
19-Jul-00
26-Jul-00
02-Aug-00
09-Aug-00
16-Aug-00
23-Aug-00
30-Aug-00
06-Sep-00
13-Sep-00
20-Sep-00
27-Sep-00
04-Oct-00
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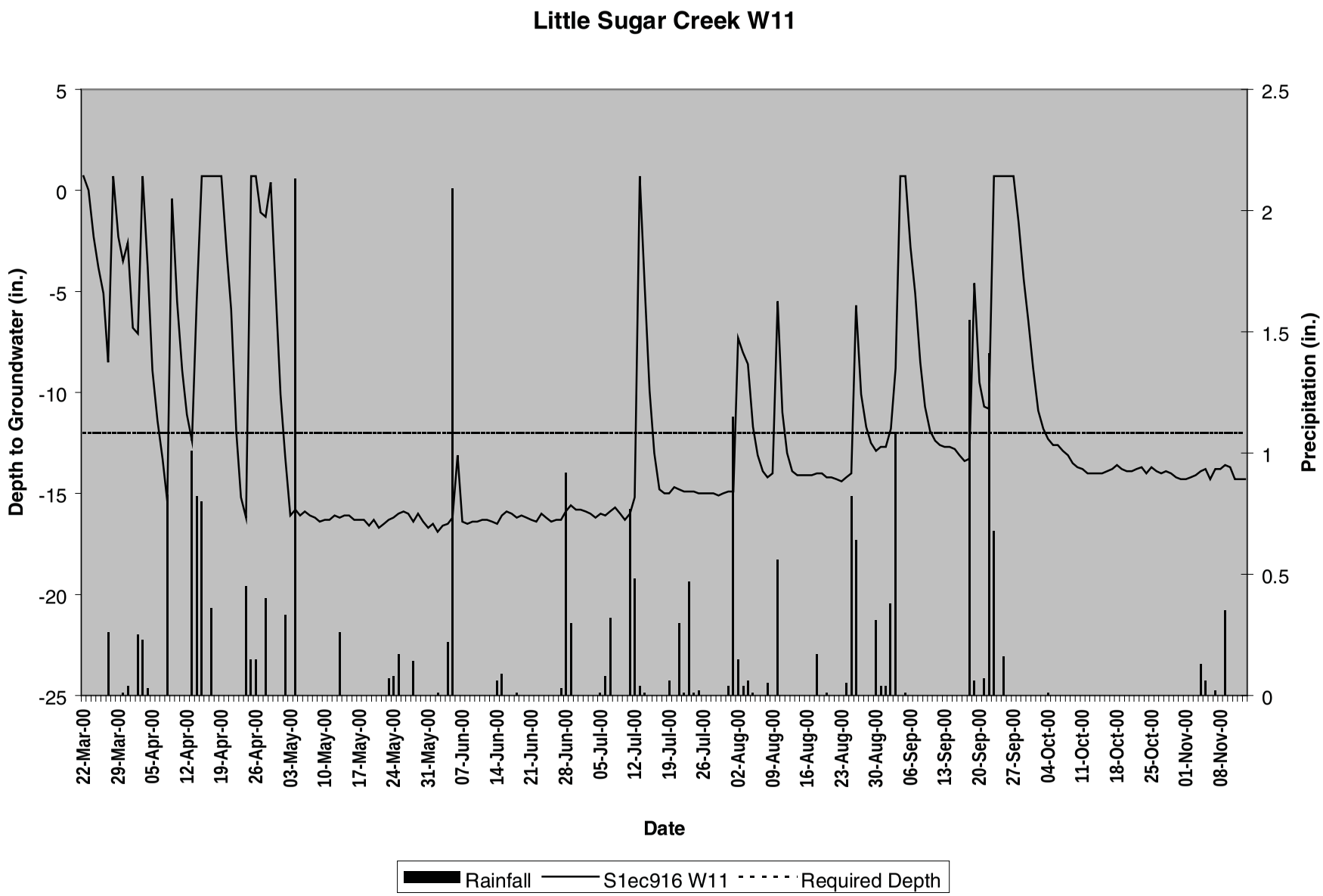
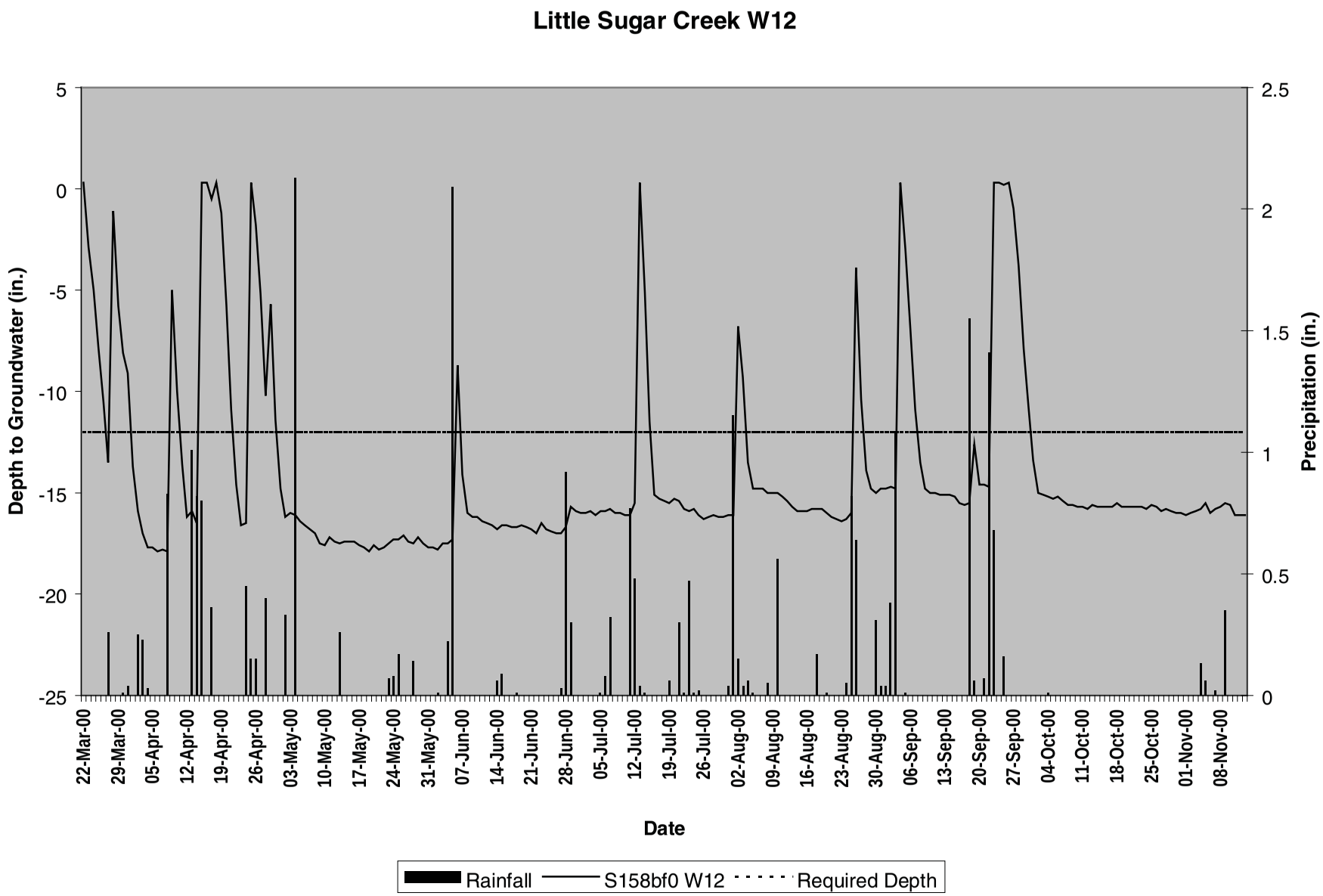
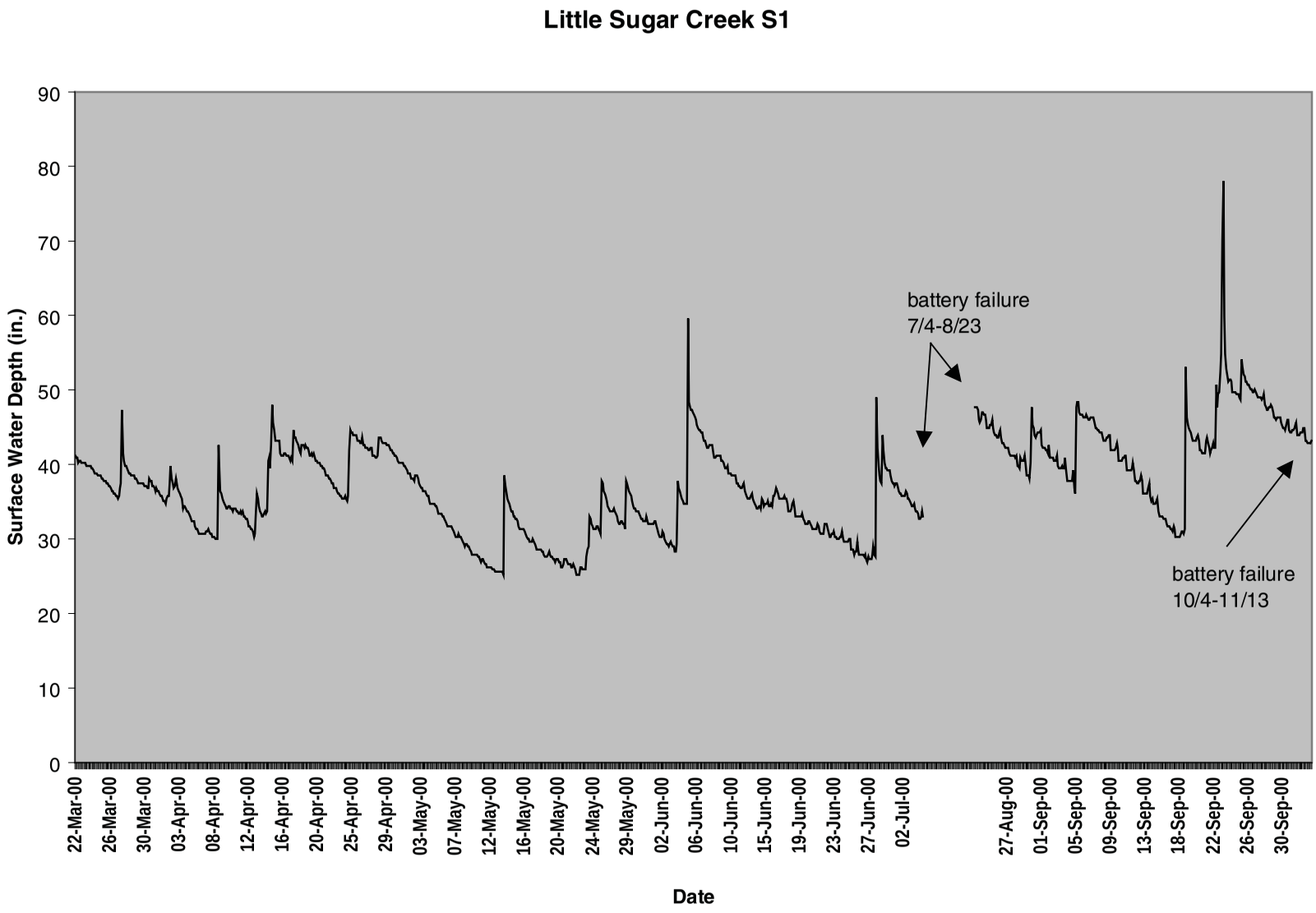
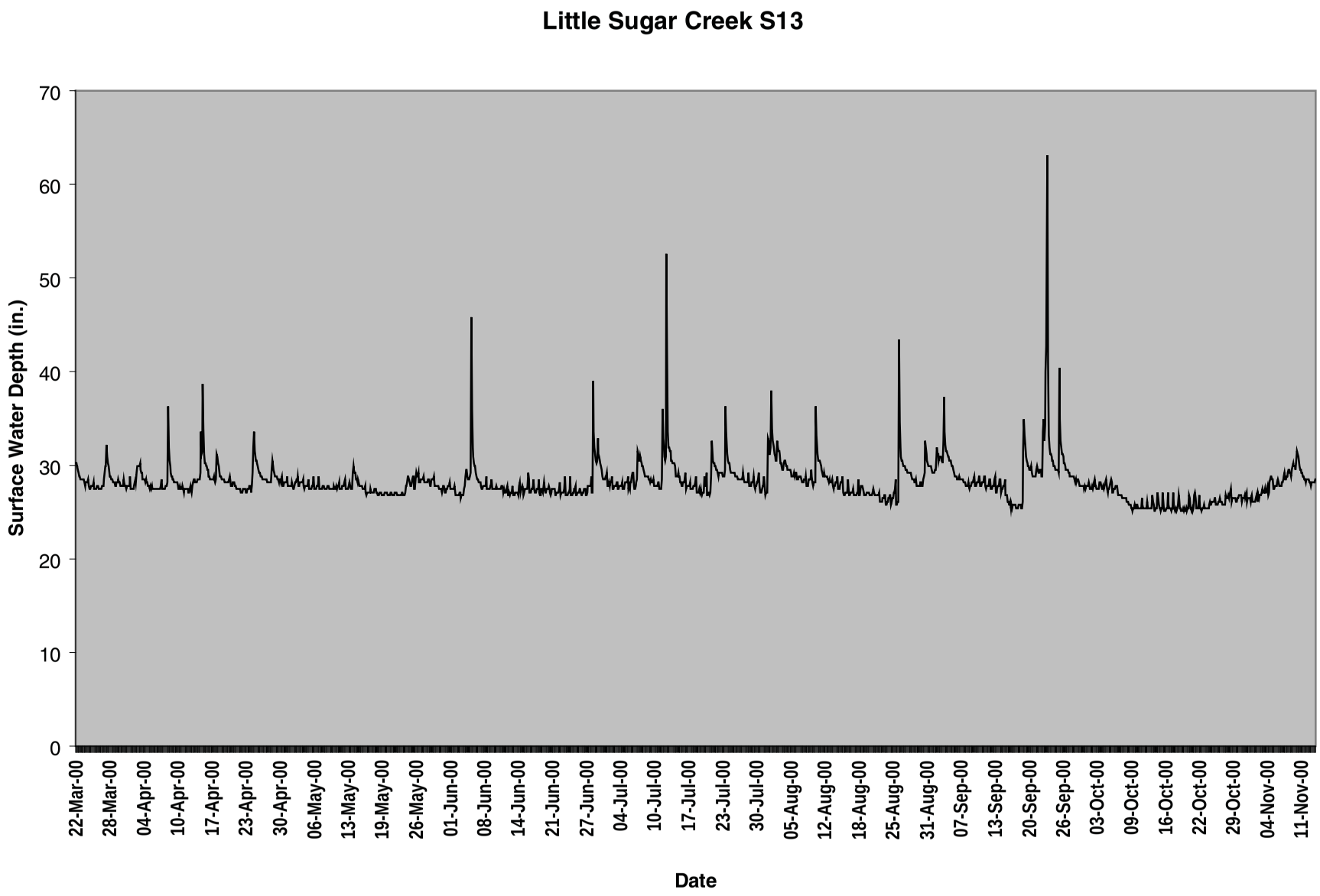
25-Oct-00
01-Nov-00
08-Nov-00
Date
Rainfall
S2c979e W9
Required Depth


Little Sugar Creek W11
Depth to Groundwater (in.)
Precipitation (in.)
5
0
-5
-10
-15
-20
-25
2.5
2
1.5
1
0.5
0
22-Mar-00
29-Mar-00
05-Apr-00
12-Apr-00
19-Apr-00
26-Apr-00
03-May-00
10-May-00
17-May-00
24-May-00
31-May-00
07-Jun-00
14-Jun-00
21-Jun-00
28-Jun-00
05-Jul-00
12-Jul-00
19-Jul-00
26-Jul-00
02-Aug-00
09-Aug-00
16-Aug-00
23-Aug-00
30-Aug-00
06-Sep-00
13-Sep-00
20-Sep-00
27-Sep-00
04-Oct-00
11-Oct-00
18-Oct-00
25-Oct-00
01-Nov-00
08-Nov-00
Date
Rainfall
S1ec916 W11
Required Depth


Little Sugar Creek W12
Depth to Groundwater (in.)
Precipitation (in.)
5
0
-5
-10
-15
-20
-25
2.5
2
1.5
1
0.5
0
22-Mar-00
29-Mar-00
05-Apr-00
12-Apr-00
19-Apr-00
26-Apr-00
03-May-00
10-May-00
17-May-00
24-May-00
31-May-00
07-Jun-00
14-Jun-00
21-Jun-00
28-Jun-00
05-Jul-00
12-Jul-00
19-Jul-00
26-Jul-00
02-Aug-00
09-Aug-00
16-Aug-00
23-Aug-00
30-Aug-00
06-Sep-00
13-Sep-00
20-Sep-00
27-Sep-00
04-Oct-00
11-Oct-00
18-Oct-00
25-Oct-00
01-Nov-00
08-Nov-00
Date
Rainfall
S158bf0 W12
Required Depth


Little Sugar Creek S1
Surface Water Depth (in.)
90
80
70
60
50
40
30
20
10
0
battery failure
7/4-8/23
battery failure
10/4-11/13
22-Mar-00
26-Mar-00
30-Mar-00
03-Apr-00
08-Apr-00
12-Apr-00
16-Apr-00
20-Apr-00
25-Apr-00
29-Apr-00
03-May-00
07-May-00
12-May-00
16-May-00
20-May-00
24-May-00
29-May-00
02-Jun-00
06-Jun-00
10-Jun-00
15-Jun-00
19-Jun-00
23-Jun-00
27-Jun-00
02-Jul-00
27-Aug-00
01-Sep-00
05-Sep-00
09-Sep-00
13-Sep-00
18-Sep-00
22-Sep-00
26-Sep-00
30-Sep-00
Date


Little Sugar Creek S13
Surface Water Depth (in.)
70
60
50
40
30
20
10
0
22-Mar-00
28-Mar-00
04-Apr-00
10-Apr-00
17-Apr-00
23-Apr-00
30-Apr-00
06-May-00
13-May-00
19-May-00
26-May-00
01-Jun-00
08-Jun-00
14-Jun-00
21-Jun-00
27-Jun-00
04-Jul-00
10-Jul-00
17-Jul-00
23-Jul-00
30-Jul-00
05-Aug-00
12-Aug-00
18-Aug-00
25-Aug-00
31-Aug-00
07-Sep-00
13-Sep-00
20-Sep-00
26-Sep-00
03-Oct-00
09-Oct-00
16-Oct-00
22-Oct-00
29-Oct-00
04-Nov-00
11-Nov-00
Date

Appendix B

Site Photos

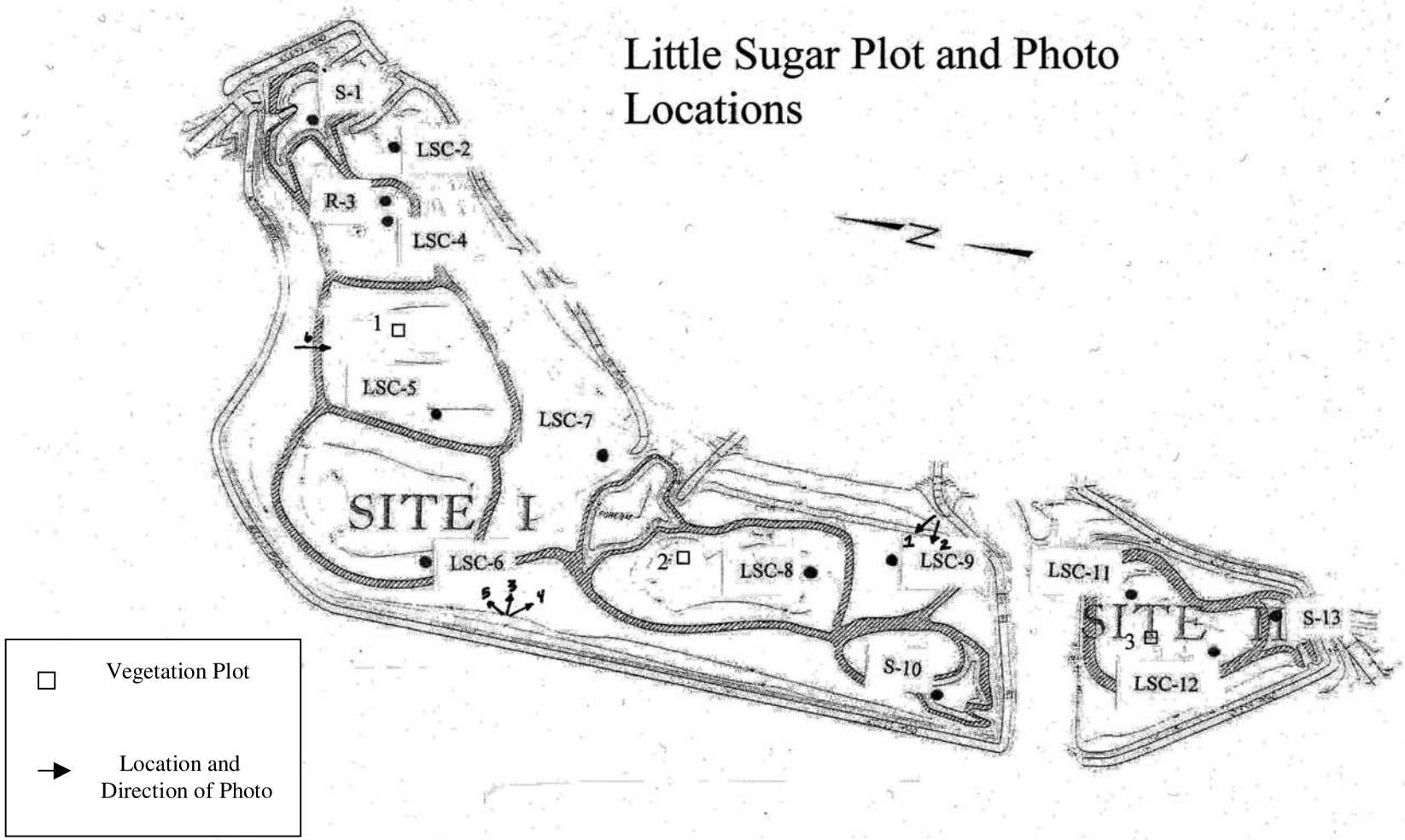
Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Little Sugar Plot and Photo Locations