ANNUAL REPORT FOR 2005

Dowd Dairy Farm Mitigation Site
Bladen County
Project No. 8.1241802
TIP No. R-2204WM

Prepared By:
Ecosystem Enhancement Program
Raleigh, North Carolina
November 2005

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

EXECUTIVE SUMMARY

The following report summarizes the monitoring activities that have occurred in the past year at the Dowd Dairy Farm Mitigation Site. Phase I of this site was constructed in 1998 and Phase II was completed in 2000. Monitoring of the site began in 1999 following Phase I site construction. The monitoring activities in 2005 represent the fifth official year of monitoring following completion of the entire site. The site must demonstrate hydrologic and vegetation success for a minimum of five years or until the project is deemed successful.

The site is being monitored with 39 groundwater-monitoring gauges, two rain gauges, and 38 vegetation plots.

Rainfall data has been acquired from onsite rain gauges. Also, monthly rainfall data recorded from a rain gauge maintained by the North Carolina State Climate Office in Elizabethtown was used for the historical data.

Hydrological monitoring for year 2005 found 51% of the all gauges met jurisdictional hydrologic success of continuous soil saturation of flooding for at least 12.5% during the growing season; conversely, 18% did not meet jurisdictional hydrologic success. Approximately 31% of monitoring gauges were either faulty or failed after July 2005, resulting in missing data and preventing an accurate description of the hydrological conditions of the entire site. These gauges are noted in Table 1.

The 2005 vegetation monitoring of the 619 acres of planted areas revealed an average density of 462 trees per acre, which is above the minimum requirement of 320 trees per acre.

As per the letter dated August 25, 2004 to the NCDOT, Ecosystem Enhancement Program (EEP) has accepted the transfer of all offsite mitigation projects. As a result, EEP is responsible for fulfilling the remaining monitoring requirements and any future remediation for this project. This report summarizes the sampling activities for the fifth and final year of monitoring.

1.0 INTRODUCTION

1.1 Project Description

The Dowd Dairy Farm Wetland Mitigation Site is located 7 miles north of Elizabethtown and 2 miles east of White Oak in Bladen County (Figure 1). It is bounded by SR 1324 (Dowd Dairy Farm Road) to the north, SR 1332 (Oak Grove Church Road) to the west, and dense forest to the south and east. The site represents a Coastal Plain interstream divide converted for agricultural use. The site receives drainage from elevated sandy terraces and discharges into Ellis Creek and Panther Branch, tributaries of the Cape Fear River.

The site encompasses approximately 658 acres and is designed as a mitigation site for the Cape Fear River Basin (HUC#: 03030005).

1.2 Purpose

In order to demonstrate successful mitigation, hydrologic and vegetative monitoring must be conducted for a minimum of five years or until success criteria are fulfilled. Success criteria are based on federal guidelines for wetland mitigation. These guidelines stipulate criteria for both hydrologic conditions and vegetation survival. The following report details the results of hydrologic and vegetative monitoring during 2005 on the Dowd Dairy Farm Mitigation Site.

Activities in 2005 reflect the fifth year of monitoring following the construction of Phase II at the site. Included in this report are analyses of both hydrologic and vegetative monitoring results, as well as local climate conditions throughout the growing season.

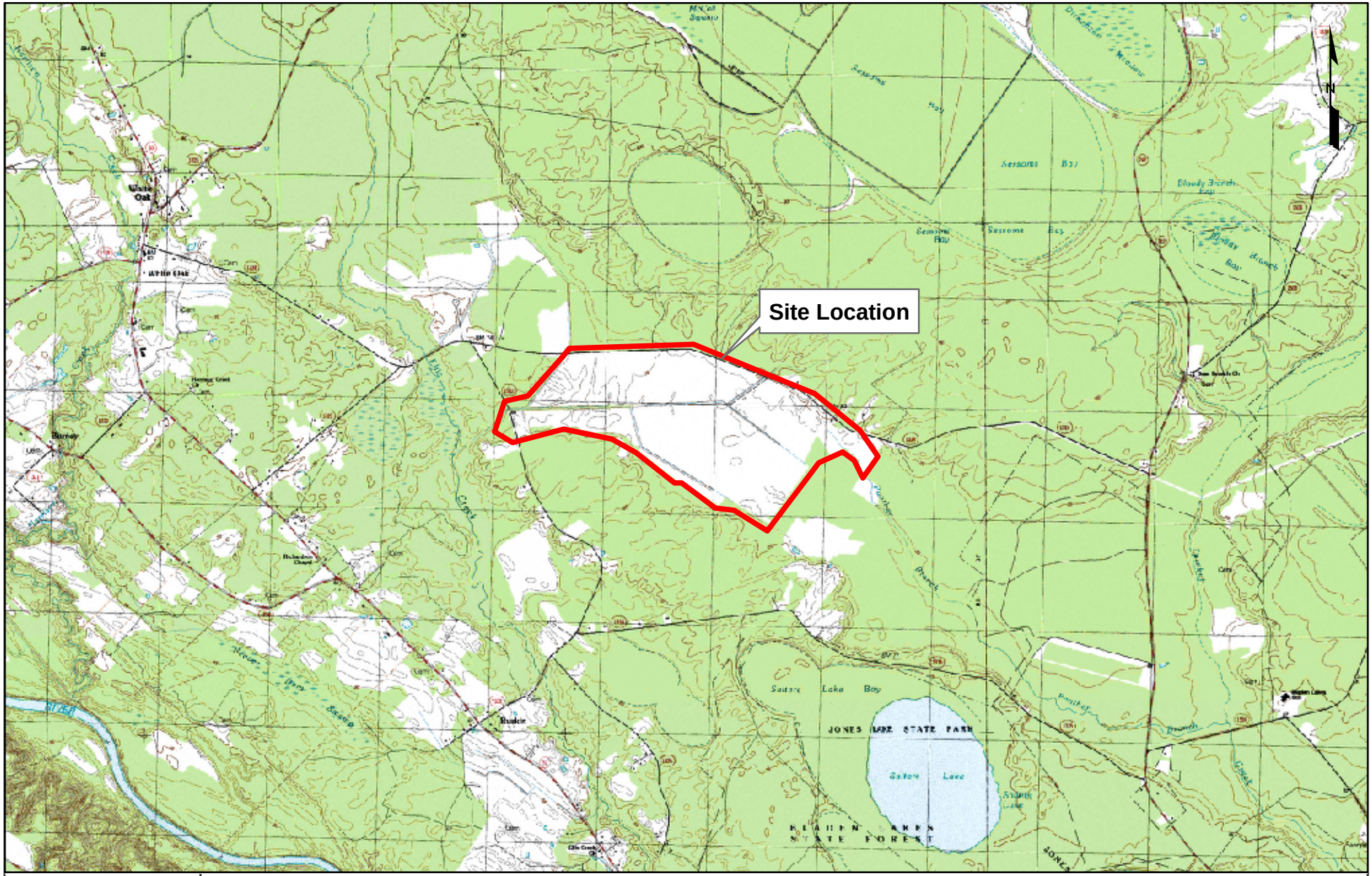


Figure 1. Site Location Map

Dowd Dairy Farm Mitigation Site (Year 5 of 5)
Bladen County, NC
Project No. 8.1241802
TIP No. R-2204WM

SCALE
4,000 2,000 0
Feet

The Louis Berger Group, Inc.
DECEMBER 2005

1.3 Project History

Summer 1998	Construction – Phase I
Spring 1999	Tree Planting – Phase I
February – April 1999	Installation of Monitoring Gauges
March – November 1999	Hydrologic Monitoring (Year 1)
September 1999	Construction Begins – Phase II
November 1999	Vegetation Monitoring (Year 1)
March – November 2000	Hydrologic Monitoring (Year 2)
June 2000	Construction Completed – Phase II
November 2000	Vegetation Monitoring (Year 2)
February 2001	Tree Planting – Phase II
March – November 2001	Hydrologic Monitoring (Restart Year 1)
October 2001	Vegetation Monitoring (Restart Year 1)
August 2002	Vegetation Monitoring (Year 2)
March – November 2002	Hydrologic Monitoring (Year 2)
May 2003	Onsite Agency Meeting
August 2003	Vegetation Monitoring (Year 3)
March – November 2003	Hydrologic Monitoring (Year 3)
July 2004	Vegetation Monitoring (Year 4)
March – November 2004	Hydrologic Monitoring (Year 4)
October 2005	Vegetation Monitoring (Year 5)
March – November 2005	Hydrologic Monitoring (Year 5)

Phase I construction consisted of clearing, grubbing, ripping, filling lateral ditches, and adding ditch plugs. Phase II construction consisted of filling in the central canal. Completion of the site was delayed to June 2000 due to the saturated conditions from the hurricane activity in the fall of 1999.

2.0 HYDROLOGY

2.1 Success Criteria

In accordance with federal guidelines for wetland mitigation, the success criteria for hydrology state that the area must be inundated or saturated (within 12" of the surface) by surface or groundwater for at least 12.5% of the growing season. Areas inundated less than 5% of the growing season are always classified as non-wetlands. Areas inundated between 5% - 12.5% of the growing season can be classified as wetlands depending upon other factors, such as the presence of hydrophytic vegetation and hydric soils.

The growing season in Bladen County begins March 16 and ends November 14. The dates correspond to a 50% probability that temperatures will drop to 28^{o} F or lower after March 16 and before November 14.[1] The growing season is 244 days; therefore the optimum duration for wetland hydrology is 31 days. Also, local climate must represent average conditions for the area.

2.2 Hydrologic Description

Historically, wetlands on the tract were created by a combination of radial groundwater and surface water flow from adjacent terraces, as well as precipitation and vertical groundwater fluctuations maintained within the site. After an extensive study of the site's hydrology, it was concluded that blocking and filling the drainage ditches within the site would elevate the groundwater to a level that would saturate the soil stratum within the required twelve inches. It was predicted that this, in addition to surface water and runoff, would be sufficient to restore wetland hydrology.

Thirty-one groundwater-monitoring gauges and 2 rain gauges were installed in 1999 (Figure 2). Five additional gauges were installed in transects along the main channel in 2001 to examine potential drainage effects of the large remaining canal. In June 2003, two additional groundwater gauges were installed. The rain gauges and groundwater monitoring gauges record daily readings of rainfall and depth to groundwater, respectively.

[1] Natural Resources Conversation Service, Soil Survey of Bladen County, North Carolina, p. 123.

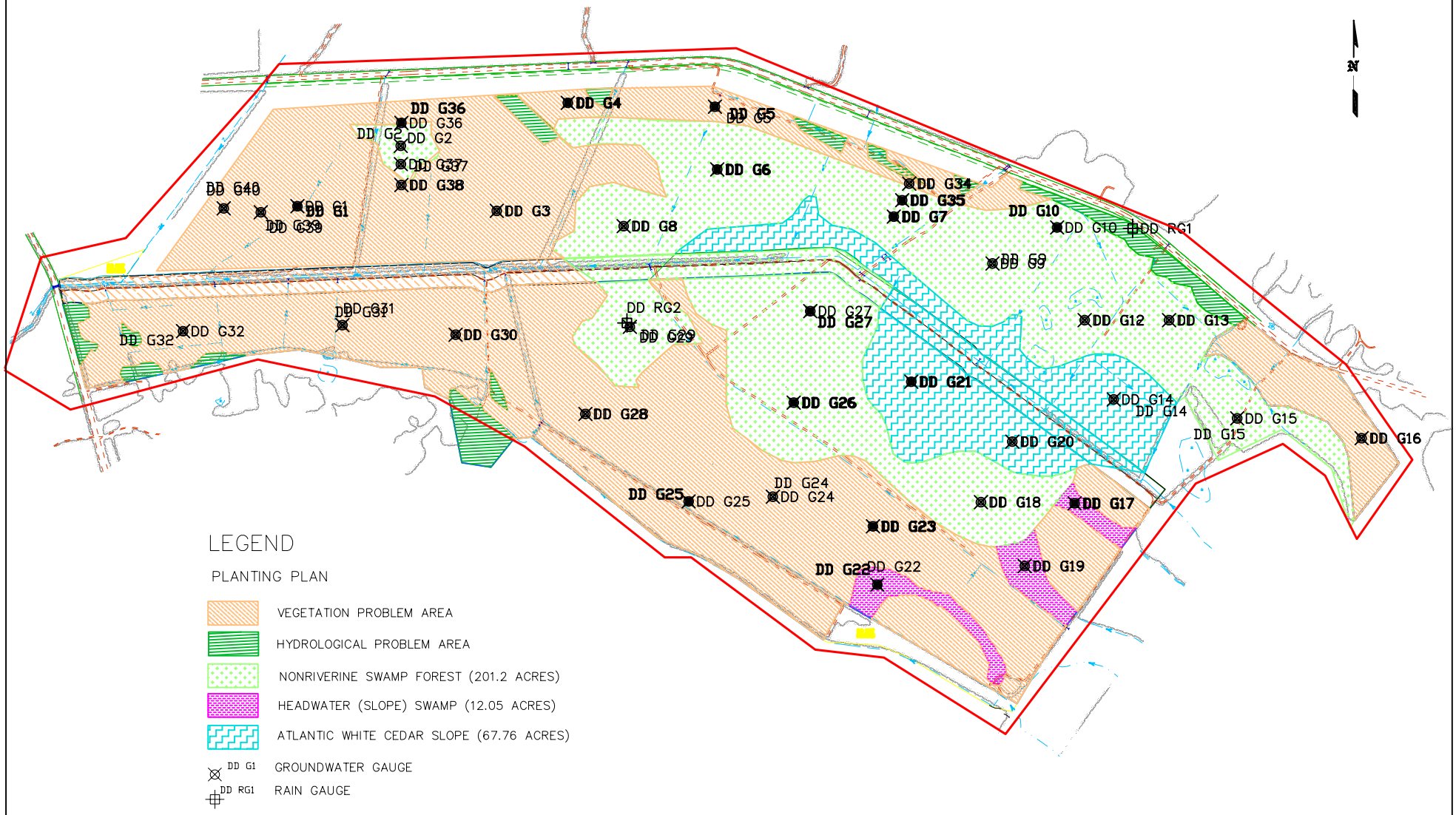


Figure 2. Gauge Location Map

Dowd Dairy Farm Mitigation Site
Bladen County, NC
Project No. 8.1241802
TIP No. R-2204WM

SCALE (ft.)
0 575 1150

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 groundwater gauge. This number was converted into a percentage of the 244-day growing season. Table 1 presents the hydrologic monitoring results for 2005.

Figure 3 provides a graphical representation of the hydrologic results. Gauges highlighted in blue indicate wetland hydrology for more than 12.5% of the growing season. Gauges highlighted in red show hydrology between 8% and 12.5% of the growing season, while those in green indicate hydrology between 5% and 8%. Gauges highlighted in black indicate no wetland hydrology (less than 5% of the growing season).

Appendix A contains a plot of the groundwater depth for each monitoring gauge. Daily rainfall is included on each graph as bars (recorded by rain gauges located on the site). The maximum number of consecutive days that the groundwater was within 12 inches of the surface is noted on each graph.

Eight faulty gauges (1, 10, 17, 21, 22, 23, 26, and 35) were determined to be non-functional in July 2005. In addition, four more gauges (4, 5, 6, and 27) failed after July 2005, resulting in missing data. These gauges were presented in Table 1. Gauges 12, 16, 18, 29, 30, 31, and 39 met jurisdictional hydrologic success of at least 12.5% during the growing season despite partially incomplete readings during the growing season.

Table 1. Hydrological monitoring results for year 2005.

Monitoring Gauge	Percentage of Growing Season at Saturation (< 12" below surface)					Dates Meeting Success
	< 5%	5 - 8%	8 - 12.5%	> 12.5%	Actual	
DD1*	X				0.0	UNDETERMINED
DD2	X				3.7	
DD3				X	16.0	March 16 – April 23
DD4+	X				0.0	UNDETERMINED
DD5+	X				0.0	UNDETERMINED
DD6+	X				0.0	UNDETERMINED
DD7~	X				2.9	UNDETERMINED
DD8				X	26.2	March 16 – May 18
DD9				X	29.1	March 16 – May 25
DD10*	X				0.0	UNDETERMINED
DD12				X	28.7	March 16 – May 24
DD13	X				2.0	
DD14				X	26.6	March 16 – May 19
DD15				X	63.5	March 16 – June 21, June 26 – August 21
DD16				X	29.5	March 16 – May 26
DD17*	X				0.0	UNDETERMINED
DD18				X	39.3	March 16 – June 19
DD19				X	29.5	March 16 – May 26
DD20				X	70.1	March 16 – June 24, June 26 - September 3
DD21*	X				0.0	UNDETERMINED
DD22*	X				0.0	UNDETERMINED
DD23*	X				0.0	UNDETERMINED
DD24				X	29.5	March 16 – May 26
DD25~	X				4.1	UNDETERMINED
DD26*	X				0.0	UNDETERMINED
DD27+	X				0.0	UNDETERMINED
DD28				X	45.5	March 16 – May 29, July 14 – August 18
DD29				X	39.3	March 16 – June 19
DD30				X	36.5	March 16 – May 9, May 23 – June 25
DD31				X	29.1	March 16 – May 25, July 14 – August 19
DD32				X	26.2	March 16 – May 18
DD33	X				0.0	UNDETERMINED
DD34	X				2.5	
DD35*	X				0.0	UNDETERMINED
DD36	X				0.8	UNDETERMINED
DD37				X	17.6	March 16 – April 27
DD38				X	25.8	March 16 – May 17
DD39				X	16.0	March 16 – April 23
DD40				X	20.1	March 16 – May 3

* Gauges have been determined to be non-functional as of July 2005.

+ Gauge data for growing season absent due to gauge failure after July 2005.

~ Gauge data for growing season absent due to gauge failure prior July 2005.

Note: Gauges DD11, and DDRG-2 located near DD29, are rain gauges.

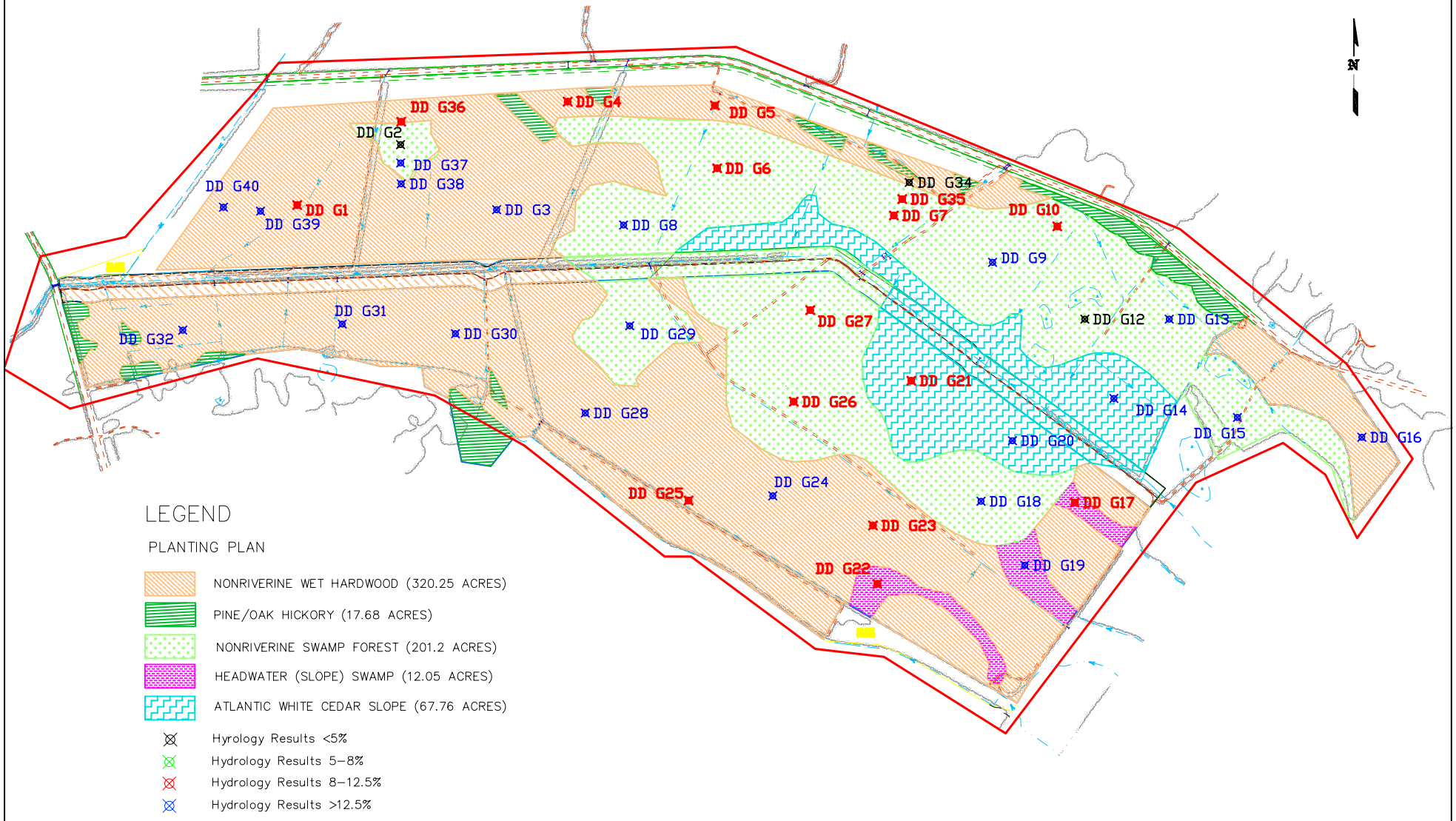


Figure 3. Hydrologic Monitoring Results

Dowd Dairy Farm Mitigation Site
Bladen County, NC
Project No. 8.1241802
TIP No. R-2204WM

SCALE (ft.)
0 400 800

2.3.2 Climatic Data

Figure 4 represents an evaluation of the local climate in comparison with historical data in order to determine whether 2005 was "average" in terms of climate conditions. The two lines represent the 30th and 70th percentiles of monthly precipitation for Elizabethtown, NC. The bars are monthly rainfall totals for 2004 and 2005. The historical data was collected from the State Climate Office of North Carolina.

For year 2005, May, June, and July experienced above average rainfall. The months of November (04'), February, April, August, and September recorded average rainfall for the site. February and April experienced average rainfall. Below average rainfall was observed for December (04'), January, March, and October. Overall, 2005 experienced an average to above average rainfall year.

2.4 Conclusions

Hydrological monitoring for year 2005 found 51% of the all gauges met jurisdictional hydrologic success of at least 12.5% during the growing season; conversely, 18% did not meet jurisdictional hydrologic success. Approximately 31% of monitoring gauges were either faulty or failed after July 2005, resulting in missing data and preventing an overall accurate description of the hydrological conditions of the site. Certain gauges met jurisdictional hydrologic success of at least 12.5% during the growing season despite partially incomplete readings during the growing season.

Based on a comparison of gauge records from previous years, it is likely that the majority of gauges which had insufficient data in 2005 would have met the jurisdictional hydrologic success.

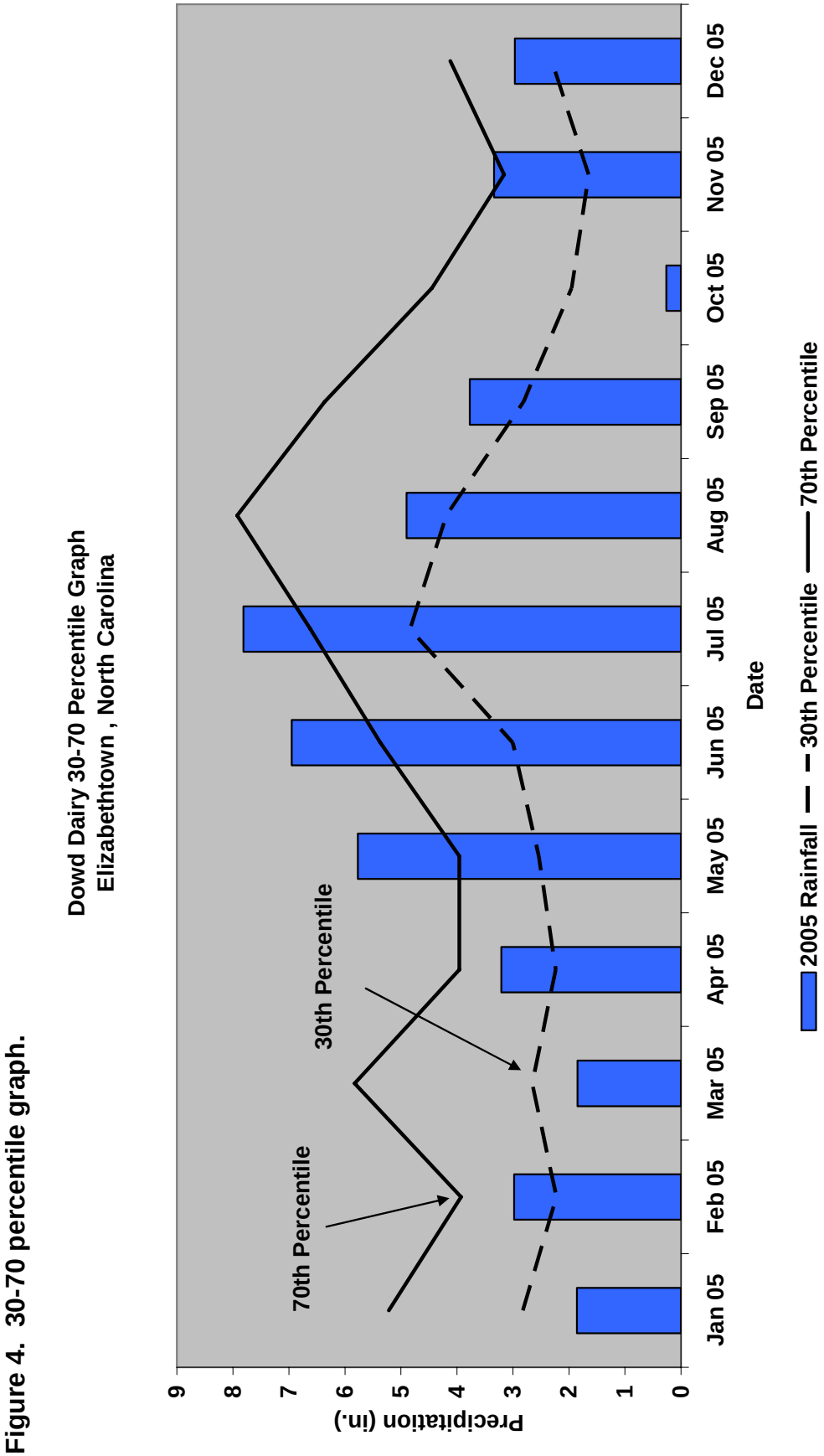


Figure 4. 30-70 percentile graph.

3.0 VEGETATION

3.1 Success Criteria

Success criteria state that there must be a minimum of 320 trees per acre for at least three consecutive years. A minimum of five character tree species must be present, with no more than 20% of any one species present, with the exception of Atlantic White Cedar, which may comprise up to 75% of the swamp forest restoration. Loblolly Pine cannot comprise more than 10% of the 320 trees per acre requirement.

3.2 Description of Species

The following tree species were planted in the Wetland Planting Areas:

Zone 1: Non-Riverine Wet Hardwood Forest (320.25 acres)

Quercus falcata var. *pagodaefolia*, Cherrybark Oak

Fraxinus pennsylvanica, Green Ash

Quercus laurifolia, Laurel Oak

Quercus lyrata, Overcup Oak

Quercus michauxii, Swamp Chestnut Oak

Nyssa aquatica, Water Tupelo

Quercus nigra, Water Oak

Quercus phellos, Willow Oak

Zone 2: Pine/Oak/Hickory (17.68 acres)

Juglans nigra, Black Walnut

Nyssa sylvatica var*. sylvatica*, Blackgum

Pinus palustris, Longleaf Pine

Quercus falcata var*. falcata*, Southern Red Oak

Quercus nigra, Water Oak

Quercus alba, White Oak

Quercus phellos, Willow Oak

Liriodendron tulipifera, Tulip Poplar

Quercus lyrata, Overcup Oak

Zone 3: Non-Riverine Swamp Forest (201.2 acres)

Chamaecyparis thyoides, Atlantic White Cedar

Taxodium distichum, Bald cypress

Quercus falcata var. *pagodaefolia*, Cherrybark Oak

Fraxinus pennsylvanica, Green Ash

Quercus laurifolia, Laurel Oak

Quercus lyrata, Overcup Oak

Quercus nigra, Water Oak

Quercus phellos, Willow Oak

Nyssa aquatica, Water Tupelo

Zone 4: Headwater (Slope) Swamp (12.05 acres)

Taxodium distichum, Bald cypress

Quercus falcata var. *pagodaefolia*, Cherrybark Oak

Quercus laurifolia, Laurel Oak

Quercus lyrata, Overcup Oak

Quercus michauxii, Swamp Chestnut Oak

Quercus nigra, Water Oak

Quercus phellos, Willow Oak

Liriodendron tulipifera, Tulip Poplar

Zone 5: Atlantic White Cedar Slope (67.76 acres)

Chamaecyparis thyoides, Atlantic White Cedar

Taxodium Distichum, Bald cypress

Pinus serotina, Pond Pine

Quercus michauxii, Swamp Chestnut Oak

Nyssa aquatica, Water Tupelo

Quercus phellos, Willow Oak

Liriodendron tulipifera, Tulip Poplar

Quercus falcata var. *pagodaefolia*, Cherrybark Oak

Fraxinus pennsylvanica, Green Ash

Quercus laurifolia, Laurel Oak

Quercus lyrata, Overcup Oak

3.3 Results of Vegetation Monitoring

Thirty-eight plots measuring 0.05-acres in size were established in year 2000 to represent a 0.3% sample of the planting area (Figure 5). Overall plot and zone densities, tree counts for individual plots and zones, and species counts are all presented in Table 2. Overall average tree density for all Zones was 462 trees/acre. Densities exceeding the minimum requirement of 320 trees/acre were reported for all five zones, including the lowest value of 360 trees/acre in Zone 2 (Pine/Oak/Hickory).

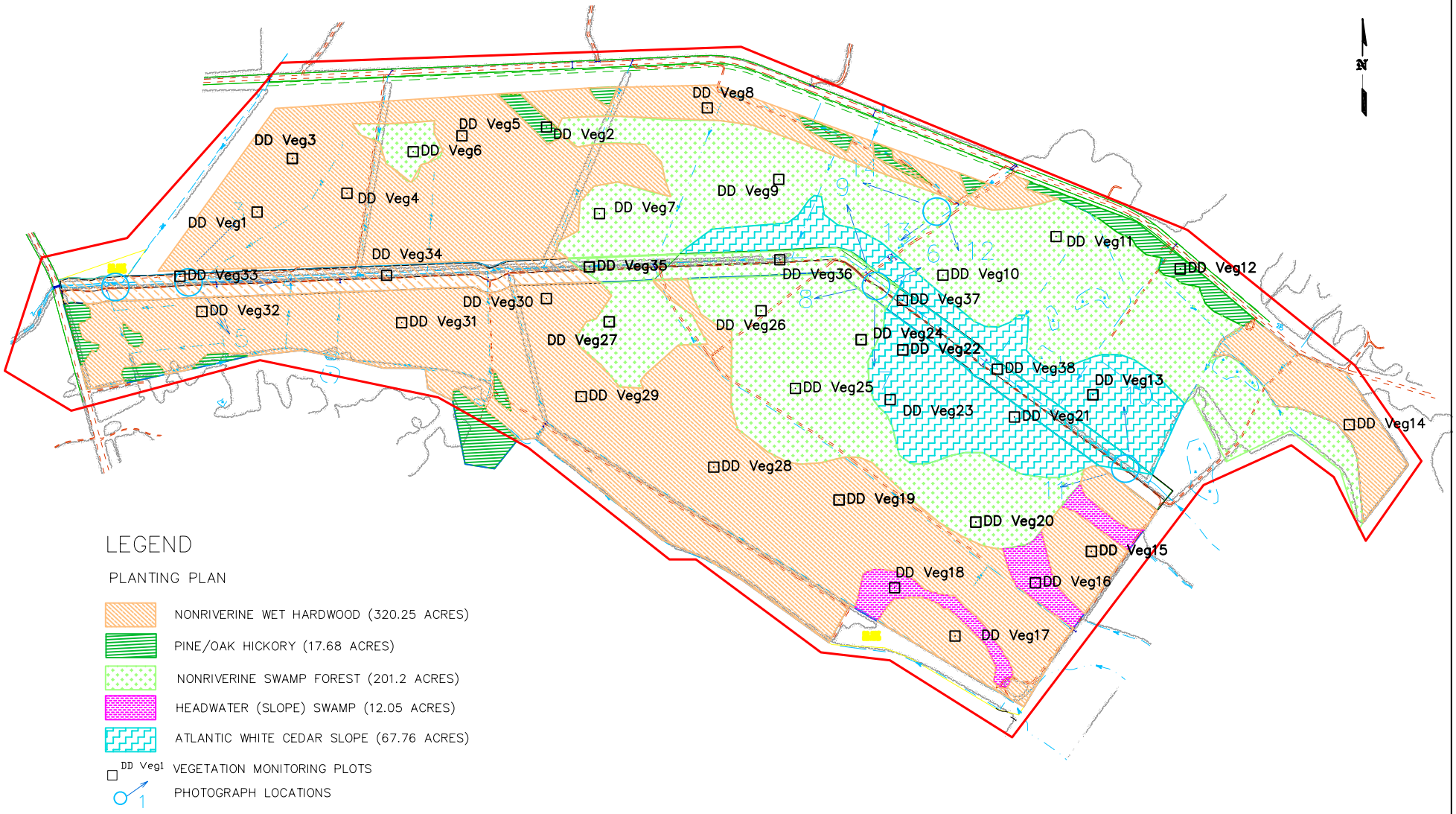


Figure 5. Planting Zones, Vegetation Plots, Photo Locations

Dowd Dairy Farm Mitigation Site
Bladen County, NC
Project No. 8.1241802
TIP No. R-2204WM

SCALE (ft.)
0 575 1150

Table 2. Vegetation monitoring results.

ZONE	PLOT	SPECIES [1]												TOTALS		DENSITY
		swamp chestnut oak	laurel oak	willow oak	cherrybark oak	water tupelo	water oak	green ash	overcup oak	pond pine	black gum	bald cypress	Atlantic white cedar	Year 5	Initial Planting	(trees/acre)
1	1			8	1			6	11					26	37	520
	3	4		6		1			3					14	40	280
	4	3	3	1				1	19					27	28	540
	5		7	3	2	2	1	12	10					37	39	740
	8	4	1	3		3		9						20	38	400
	14	5	2	7	9									23	39	460
	15	1	3	9										13	32	260
	17	13	1	1	6		1		1					23	41	460
	19	4	1	1		1			2					9	35	180
	28	2		10		3		7	4					26	37	520
	29	4	2	1				5	18					30	41	600
	30		5					18	2					25	39	500
	31	15		8	1	1		6	5					36	37	720
	32	5		3	1	1		14	2					26	38	520
	33		1	2	9	4		25	3					44	44	880
	34	4	1			2		5	10					22	39	440
															Zone Average	501
2	2			1	1				21					23	25	460
	12		1	2	9		1							13	26	260
															Zone Average	360
3	6		2	2	6		2	2	2			8	7	31	30	620
	7							9	2			18		29	40	580
	9		2	2								10	4	18	34	360
	10		6	2	3		2		9			10	1	33	44	660
	11		1	12	1				4			7	1	26	28	520
	20			3				10						13	37	260
	24		1	4				2				4		11	34	220
	25			3	4			6	4			1	4	22	31	440
	26			2				20	1			6	2	31	35	620
	27		2	3				1	10			4		20	36	400
	35				2	3		6	1					12	37	240
	36		4	5	1			4				2		16	36	320
															Zone Average	437

ZONE	PLOT	SPECIES [1]												TOTALS		DENSITY
		swamp chestnut oak	laurel oak	willow oak	cherrybark oak	water tupelo	water oak	green ash	overcup oak	pond pine	black gum	bald cypress	Atlantic white cedar	Year 5	Initial Planting	(trees/acre)
4	16	4							6			12		22	31	440
	18	7	3	1					2			9		22	35	440
															Zone Average	440
5	13		1		3			4	3					11	24	220
	21			4						4		16		24	29	480
	22	2		2		3						8		15	27	300
	23	1		9		4				5		13		32	38	640
	37	23		4						2	2	8		39	47	780
	38 [2]	21		12					4	2	8	3		50	50	1000
															Zone Average	570
															Total Average for all Zones	462

[1] white oak, longleaf pine, black walnut, and tulip poplar were not observed during year 2005 monitoring activities and are not included in this table

[2] vegetation plot 38 could not be located; data presented reflects year 4 values.

3.4 Site Notes of Observed Herbaceous Cover and Volunteer Woody Stems

Zone 1: Herbaceous cover ranged between 60 and 100% and consisted of the following observed species: blackberry (*Rubus*), goldenrod (*Solidago*), sedges (*Carex*), broad-leaved cattails (*Typha latifolia*), trumpet creeper (*Campsis radicans*), smartweed (*Polygonum*), fennel grass (*Foeniculum*), rush (*Juncus*), marsh fleabane (*Pluchea*), cane (*Arundinaria gigantea*), aster (*Aster*), and bluestem (*Andropogon virginicus*). Volunteer woody species observed included: black willow (*Salix nigra*), red maple (*Acer rubrum*), loblolly pine (*Pinus taeda*), sweetgum (*Liquidambar styraciflua*), and groundsel bush (*Baccharis halimifolia*).

Zone 2: Herbaceous cover averaged 90% and consisted of the following observed species: broomsedge, bluestem, goldenrod, and blackberry.

Zone 3: Herbaceous cover ranged between 25 and 100% and consisted of the following observed species: blackberry, goldenrod, sedges, inkberry (*Ilex glabra*), cattails, rush, aster, southern bayberry (*Myrica heterophylla*), cane, marsh fleabane, bluestem, peashrub (*Caragana*), broomsedge bluestem, and woolgrass (*Scirpus cyperinus*). Volunteer woody species observed included: black willow, red maple, baccharis, groundsel bush, and sweetgum.

Zone 4: Herbaceous cover averaged 90% and consisted of the following observed species: trumpet creeper, blackberry, goldenrod, and rush. Volunteer woody species observed included red maple and loblolly pine.

Zone 5: Herbaceous cover ranged between 90 and 100% and consisted of the following observed species: blackberry, goldenrod, trumpet creeper, cattail, rush, woolgrass, sedges, marsh fleabane, and smartweed. Volunteer woody species consisted of black willow.

3.5 Conclusions

Of the 658 acres on this site, approximately 619 acres involved tree planting. Thirty-eight test plots were established throughout the planting areas, covering all plant communities. Vegetation monitoring of the planted areas for year 5 revealed an average density of 462 trees per acre, which is above the minimum requirement of 320 trees per acre. It should be noted that since this was a phased project, the majority of the plots contain 5-year old trees. The site was wet at the time of monitoring.

Field observations noted that natural recruitment of pioneer species such as red maple, sweetgum, and loblolly pine has occurred around the periphery of the site that border existing forest and in the cut-over area. Stem densities of these species varied, but in at least three locations, sweetgum and loblolly pine formed dense,

pole-stage stands. These areas are not particularly extensive within the site. Natural succession patterns will, in time, result in a more diverse stand of tree species in these areas. No additional management activities are recommended in these areas.

4.0 OVERALL CONCLUSIONS/ RECOMMENDATIONS

Hydrological monitoring for year 2005 found 51% of the all gauges met jurisdictional hydrologic success of at least 12.5% during the growing season; conversely, 18% did not meet jurisdictional hydrologic success of at least than 12.5% of the growing season. Approximately 31% of monitoring gauges were either faulty or failed after July 2005, resulting in missing data and preventing an overall accurate description of the hydrological conditions of the site. Certain gauges met jurisdictional hydrologic success of at least 12.5% during the growing season despite partially incomplete readings during the growing season.

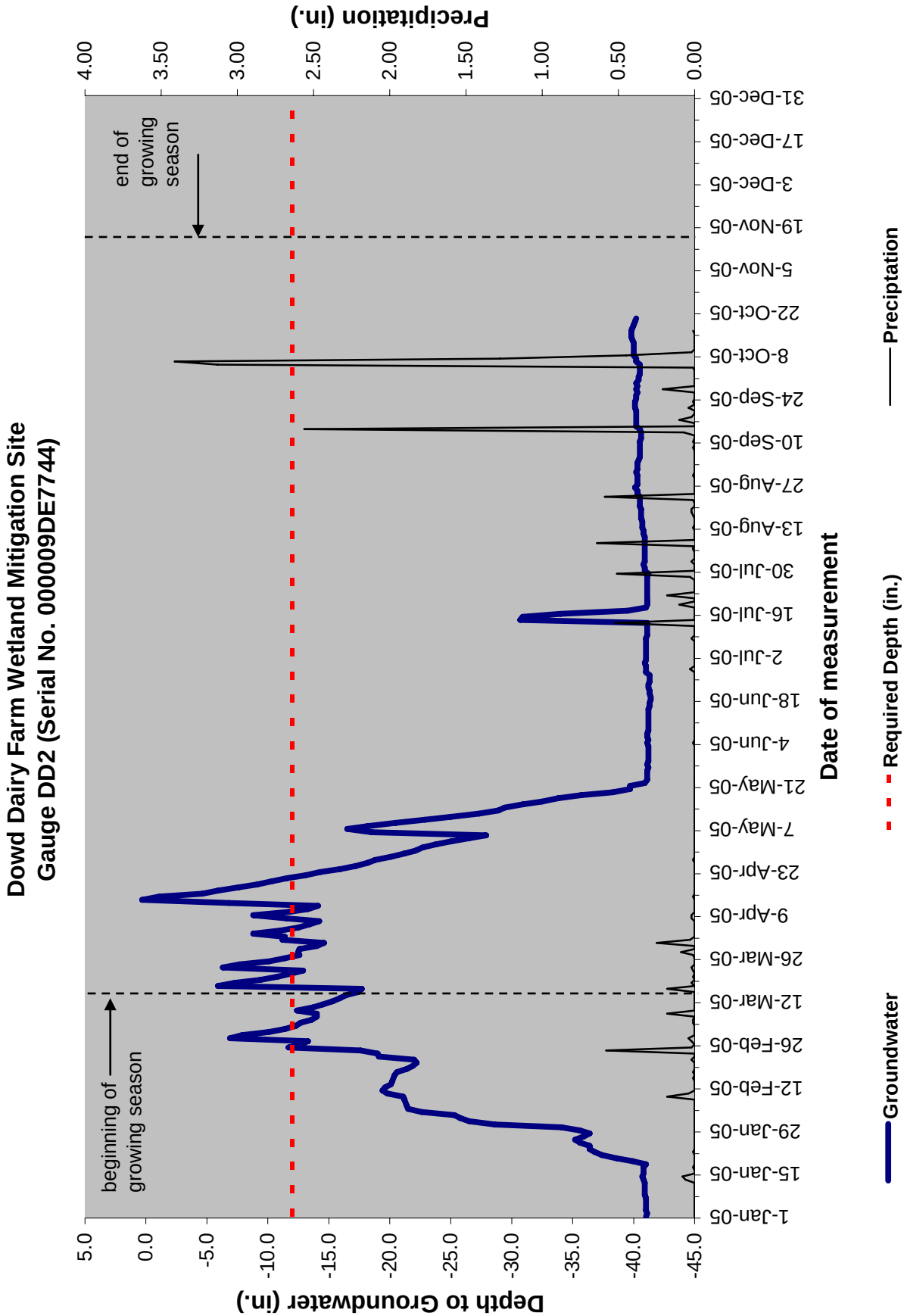
Based on a comparison of gauge records from previous years, it is likely that the majority of gauges which had insufficient data in 2005 would have met the jurisdictional hydrologic success.

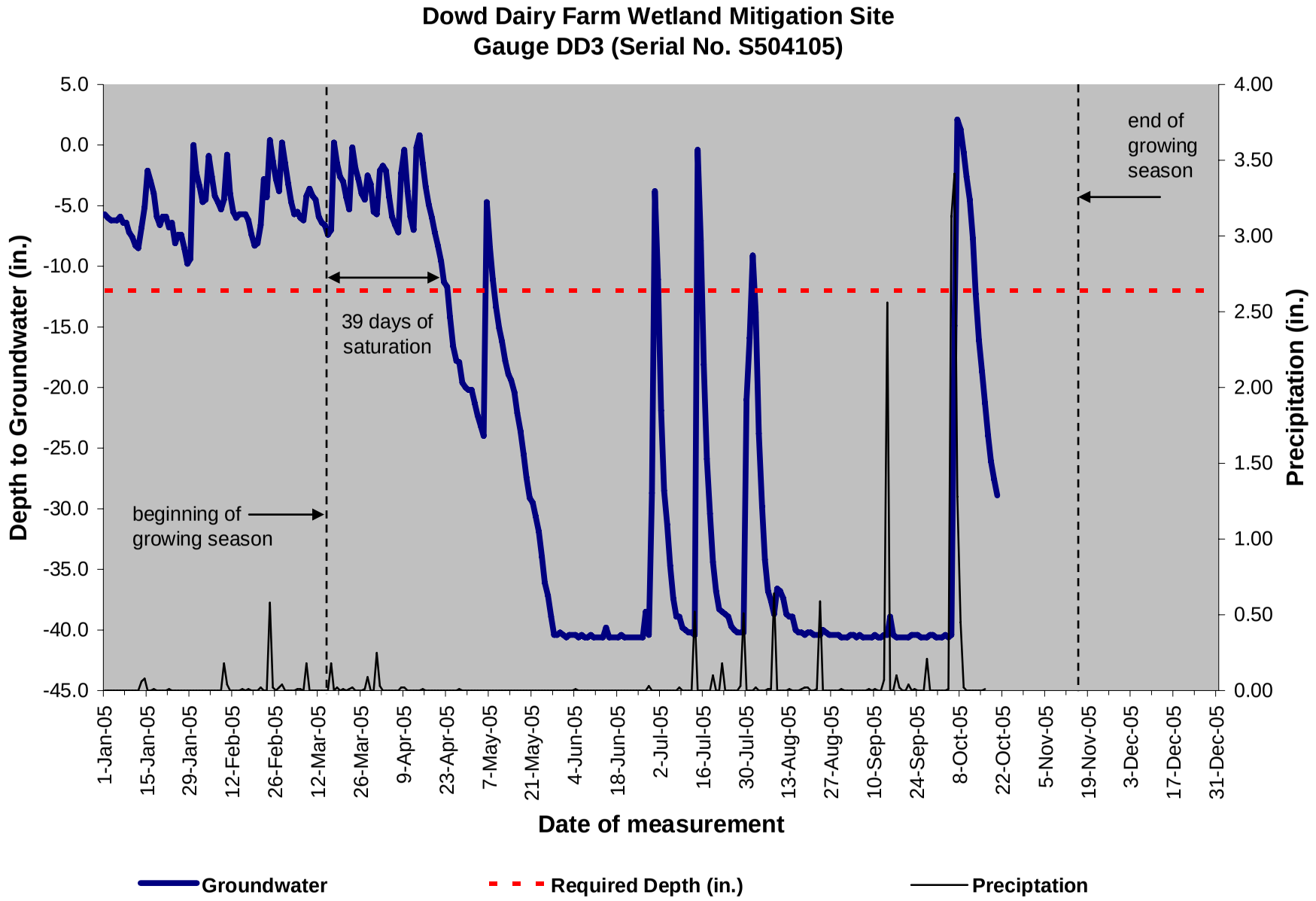
Thirty-eight test plots were established throughout the planting areas, covering all plant communities. Vegetation monitoring of the planted areas for year 5 revealed an average density of 462 trees per acre, and tree densities exceeded the minimum requirement of 320 trees/acre for all five zones. It should be noted that since this was a phased project, the majority of the plots contain 5-year old trees.

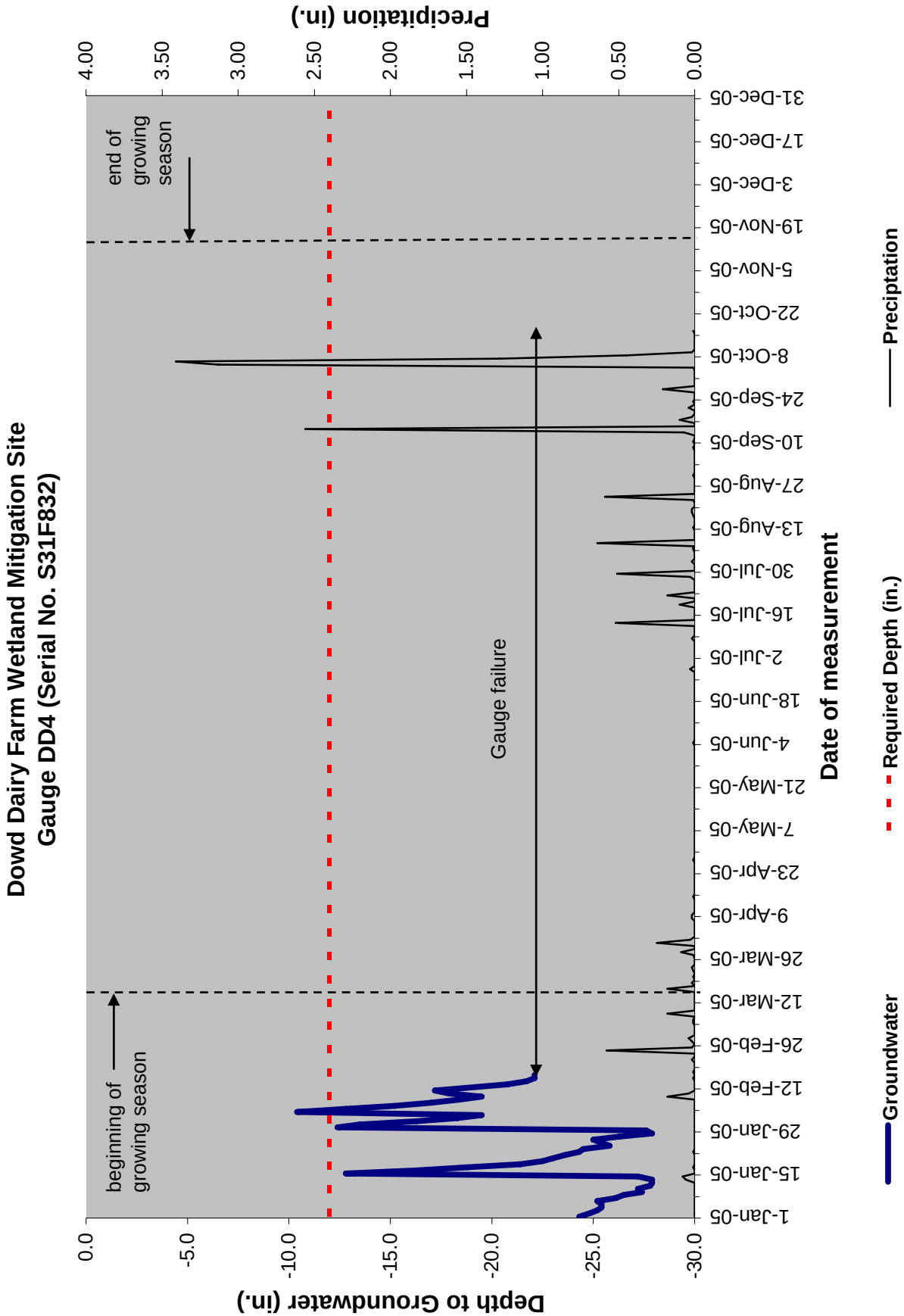
Field observations noted that natural recruitment of pioneer species such as red maple, sweetgum, and loblolly pine has occurred around the periphery of the site that border existing forest and in the cut-over area. Stem densities of these species varied, but in at least three locations, sweetgum and loblolly pine formed dense, pole-stage stands. However, as the areas where these species were noted are not extensive in size, it is probable that natural succession patterns will, in time, result in a more diverse stand of the species in these areas. No additional management activities are recommended in these areas.

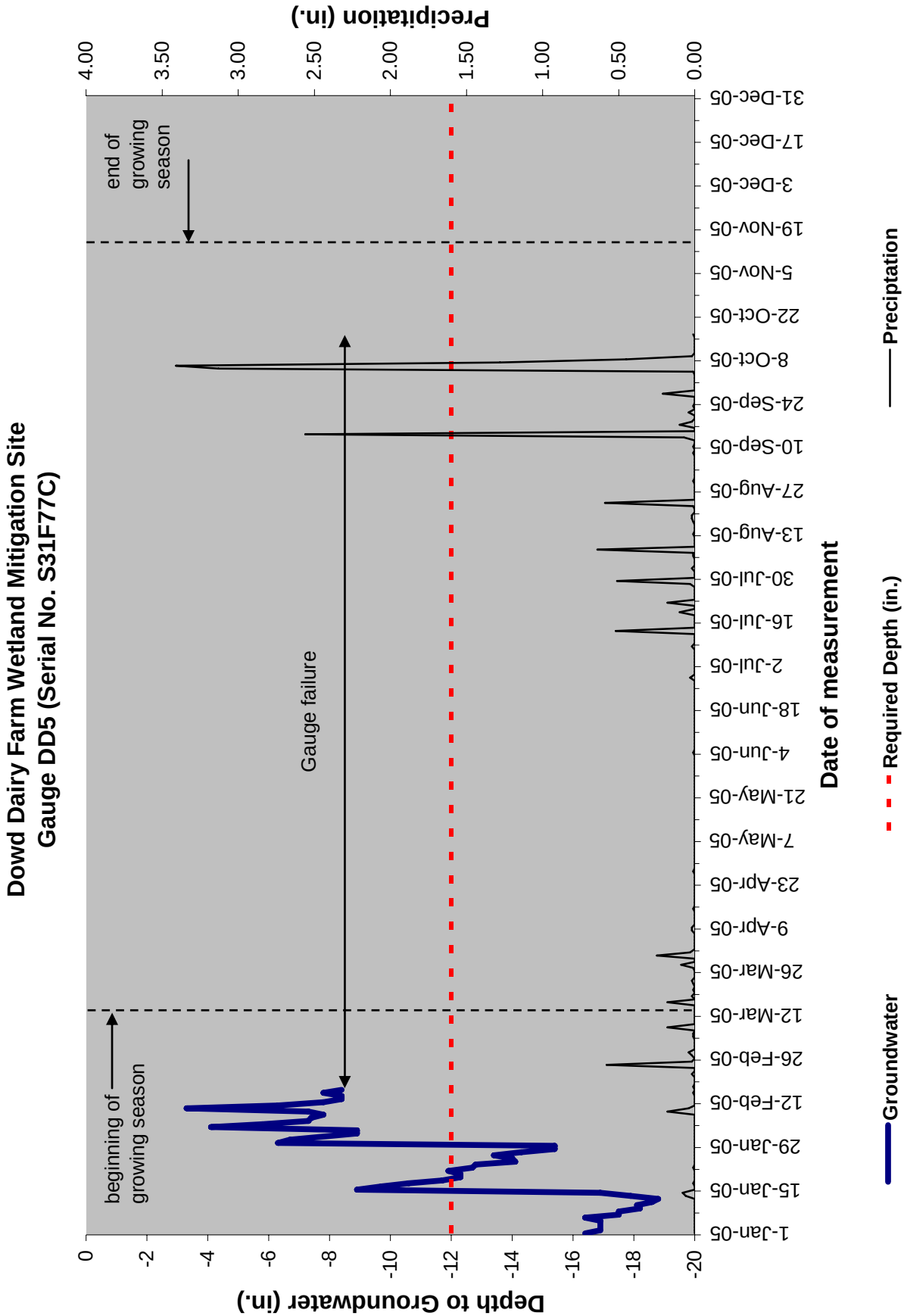
APPENDIX A

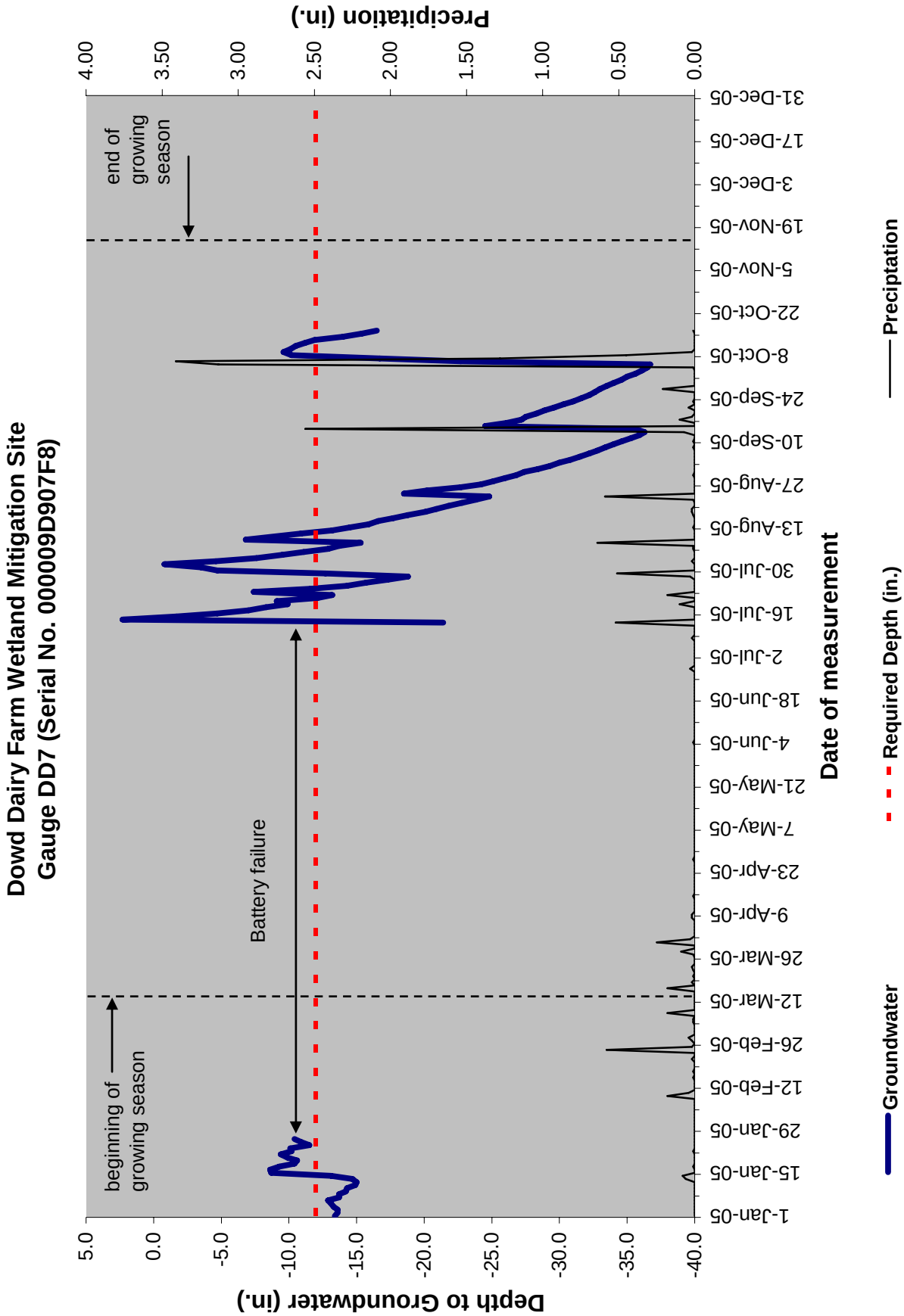
GAUGE DATA GRAPHS

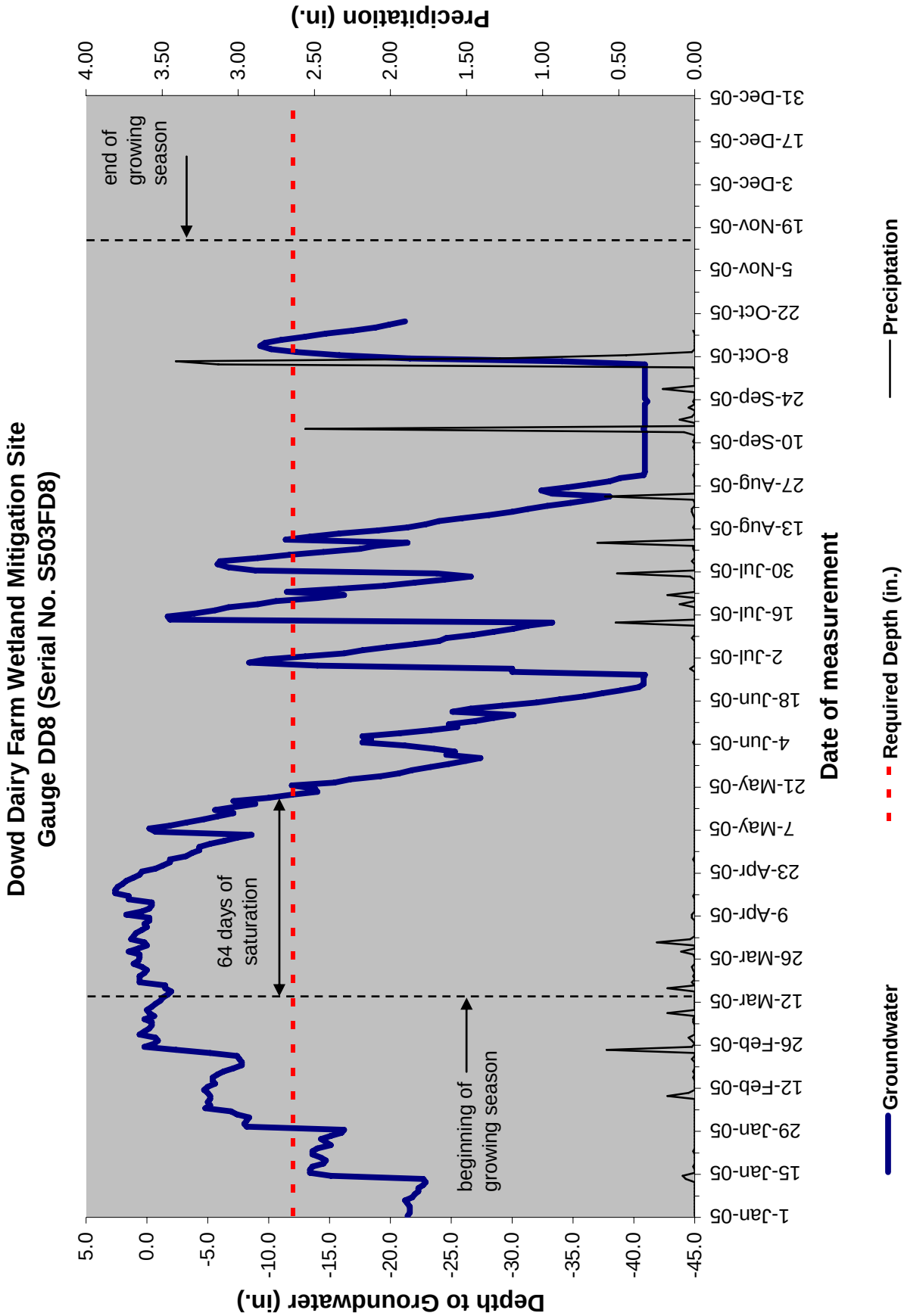

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD2 (Serial No. 000009DE7744)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
beginning of growing season
end of growing season
Groundwater
Required Depth (in.)
Preciptation
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05

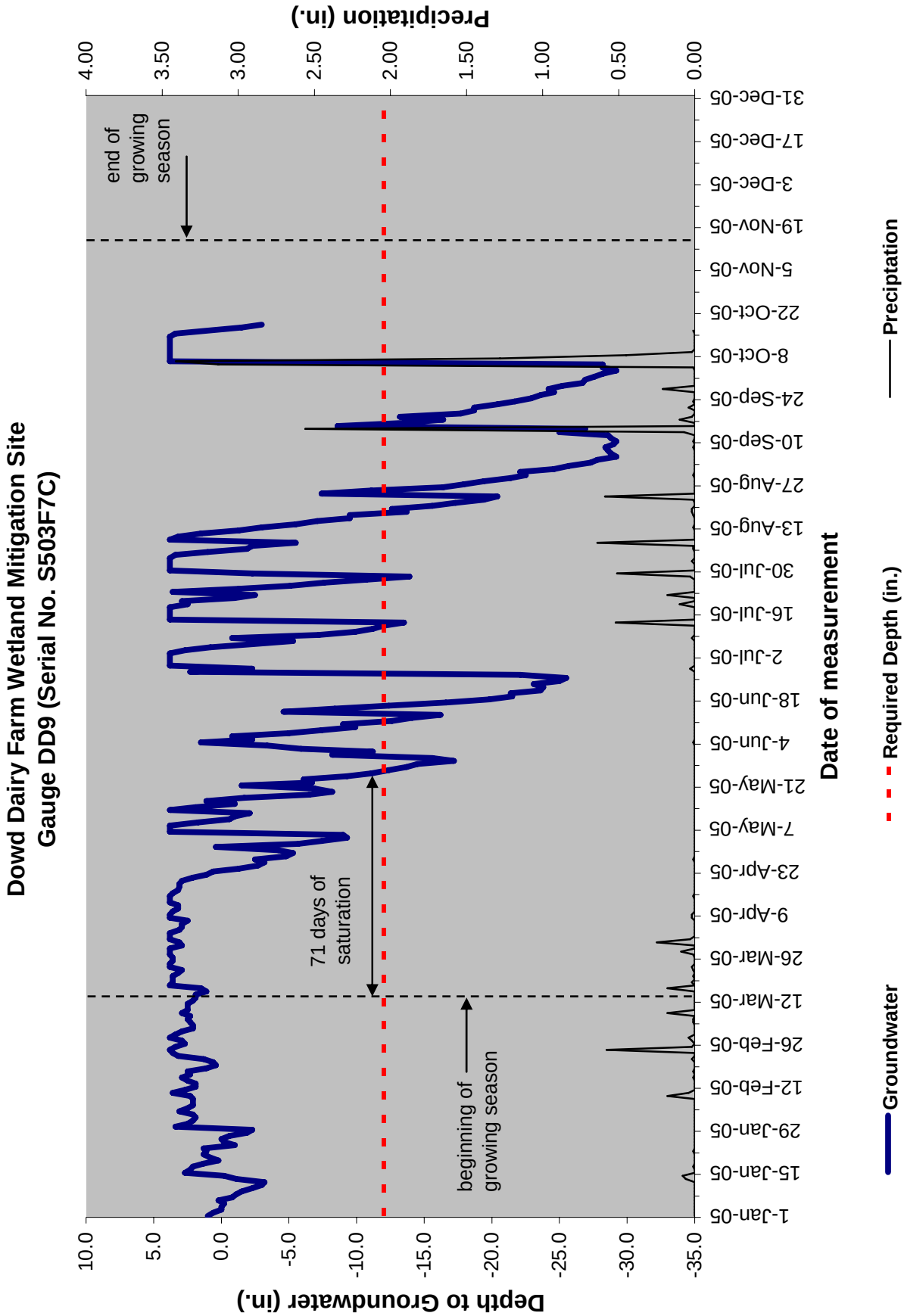

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD3 (Serial No. S504105)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05
beginning of growing season
39 days of saturation
end of growing season
Groundwater
Required Depth (in.)
Preciptation

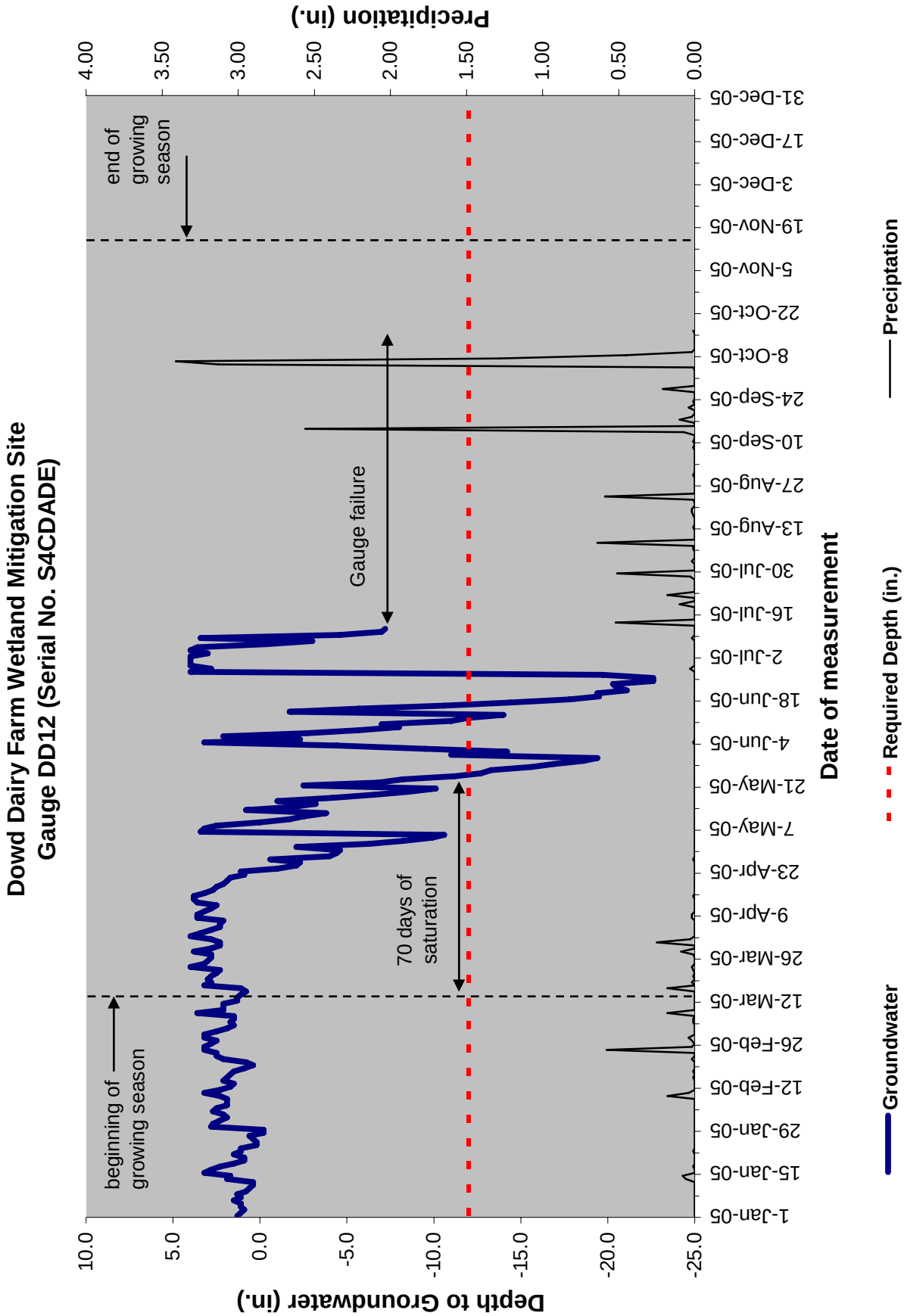

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD4 (Serial No. S31F832)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation
beginning of growing season
end of growing season
Gauge failure
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05

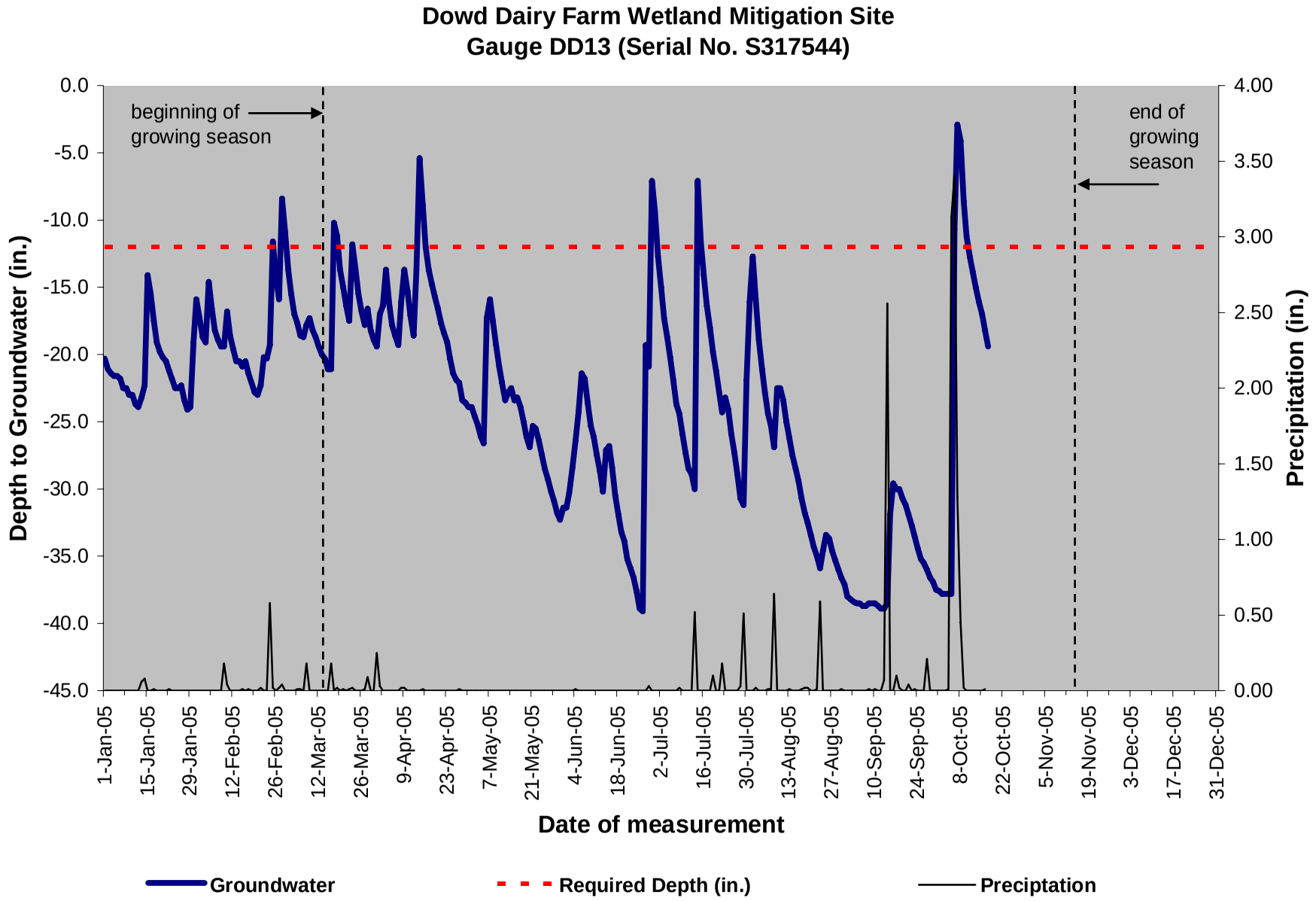

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD5 (Serial No. S31F77C)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation
beginning of growing season
end of growing season
Gauge failure
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05

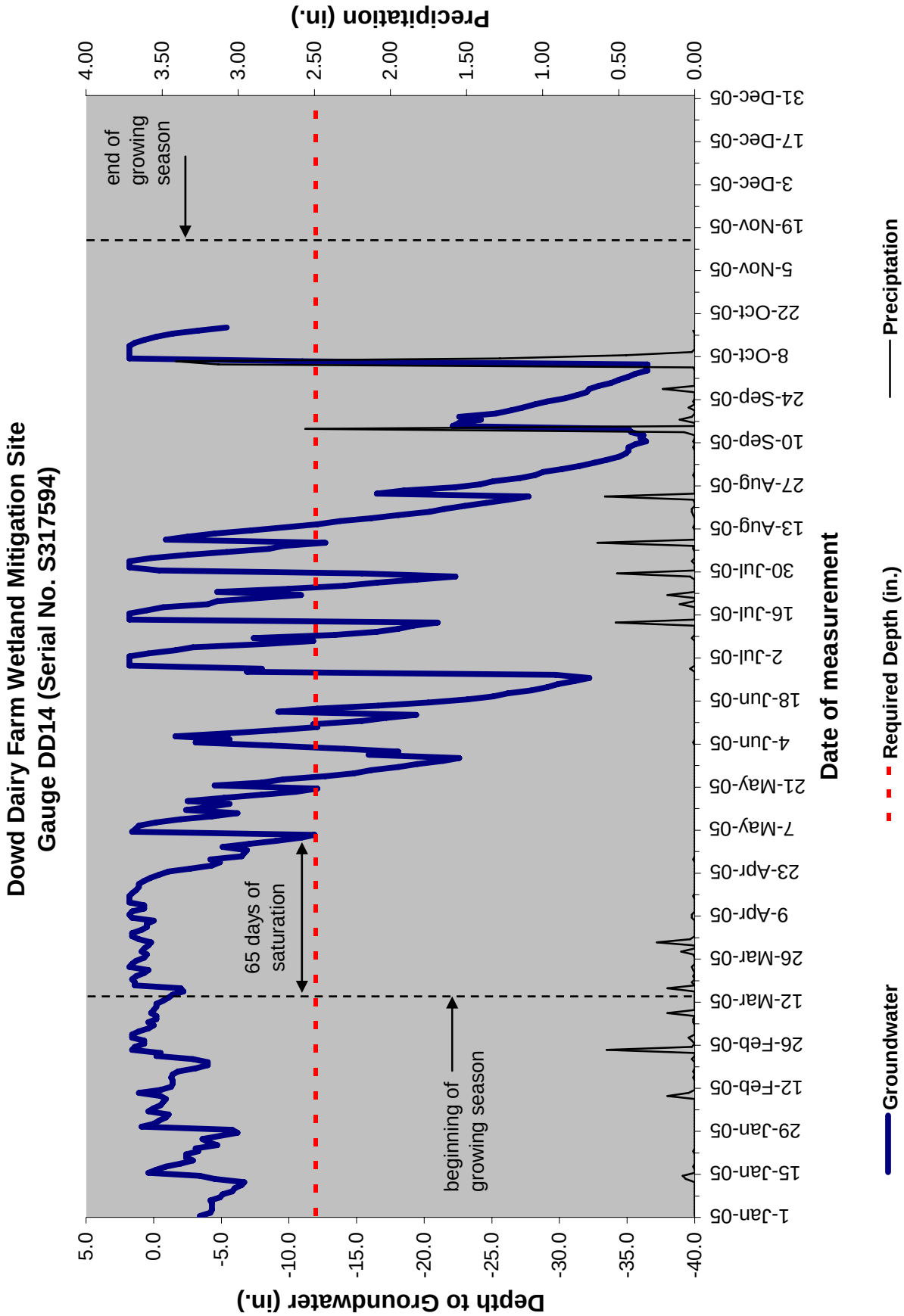

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD7 (Serial No. 000009D907F8)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation
beginning of growing season
Battery failure
end of growing season
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05

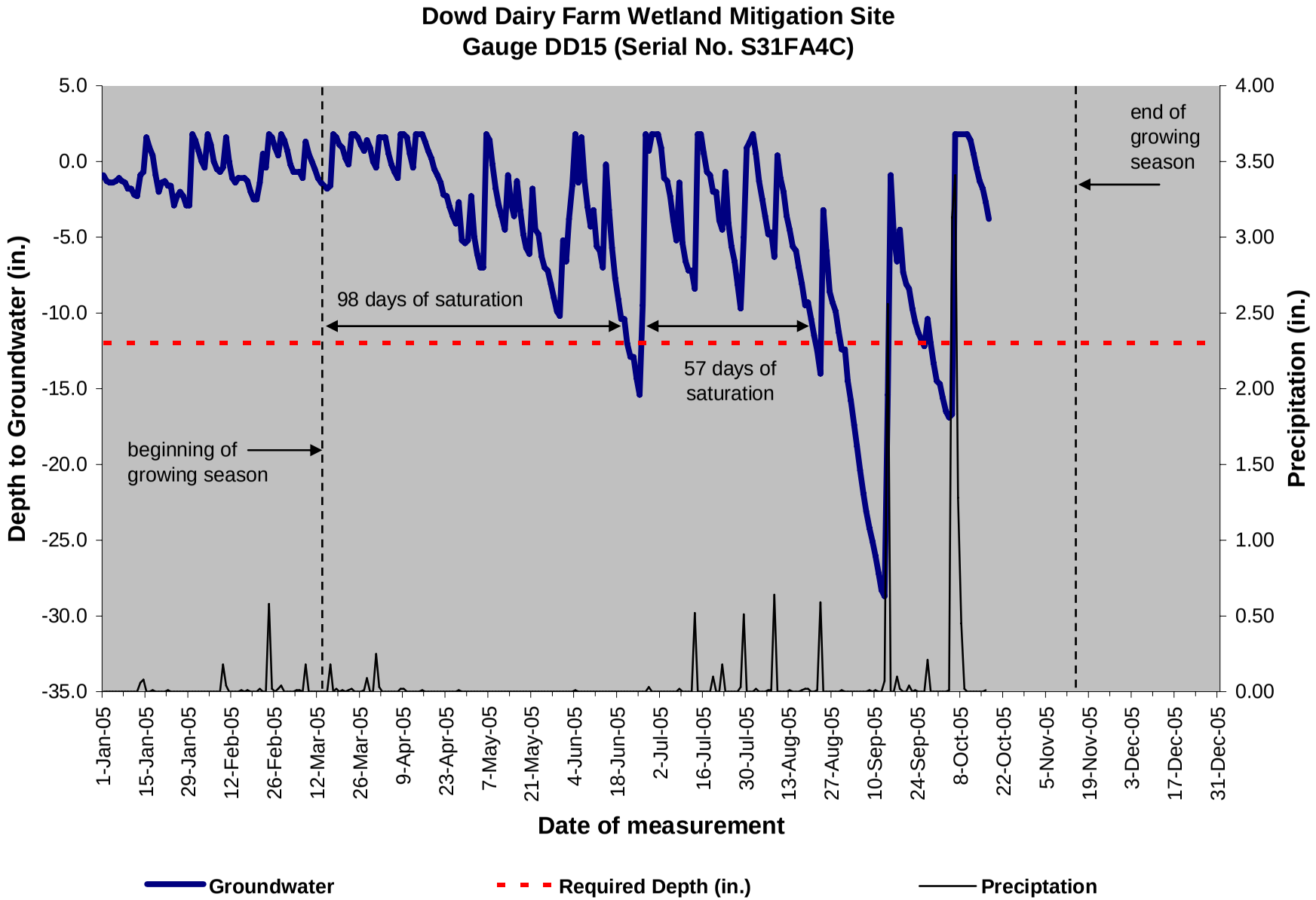

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD8 (Serial No. S503FD8)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation
64 days of saturation
beginning of growing season
end of growing season
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05

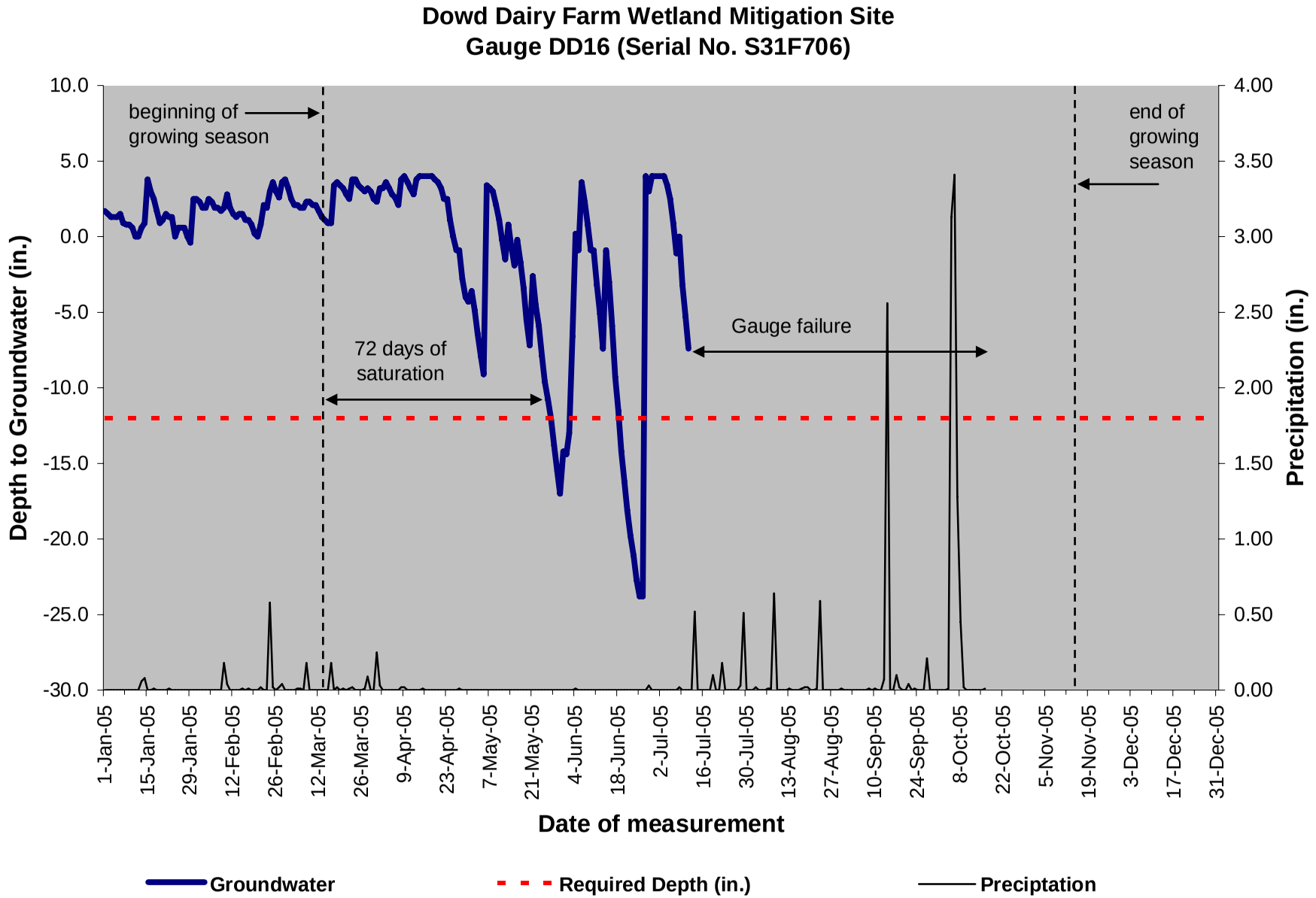

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD9 (Serial No. S503F7C)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation
end of growing season
71 days of saturation
beginning of growing season
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05

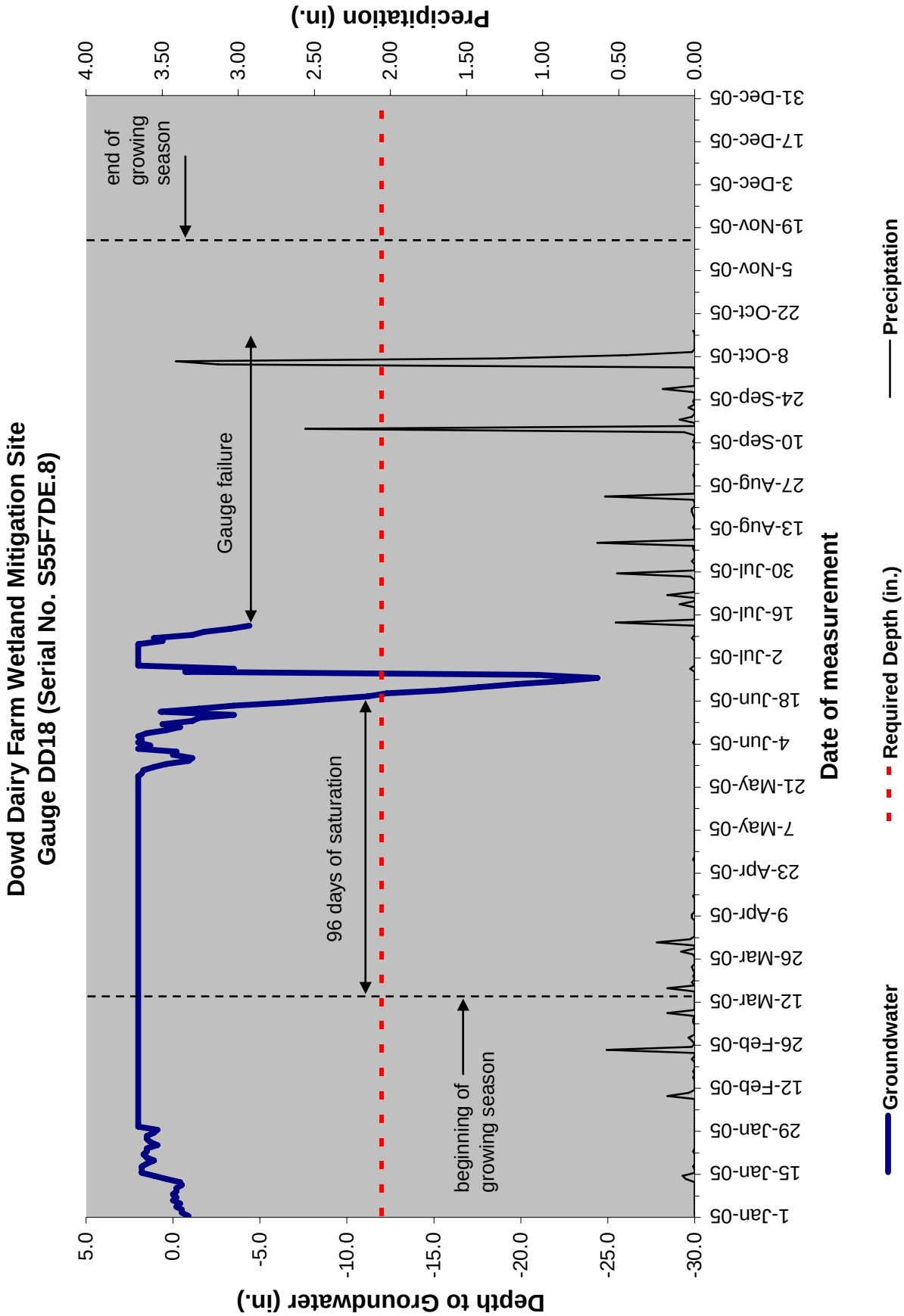

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD12 (Serial No. S4CDADE)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation
beginning of growing season
70 days of saturation
Gauge failure
end of growing season
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05

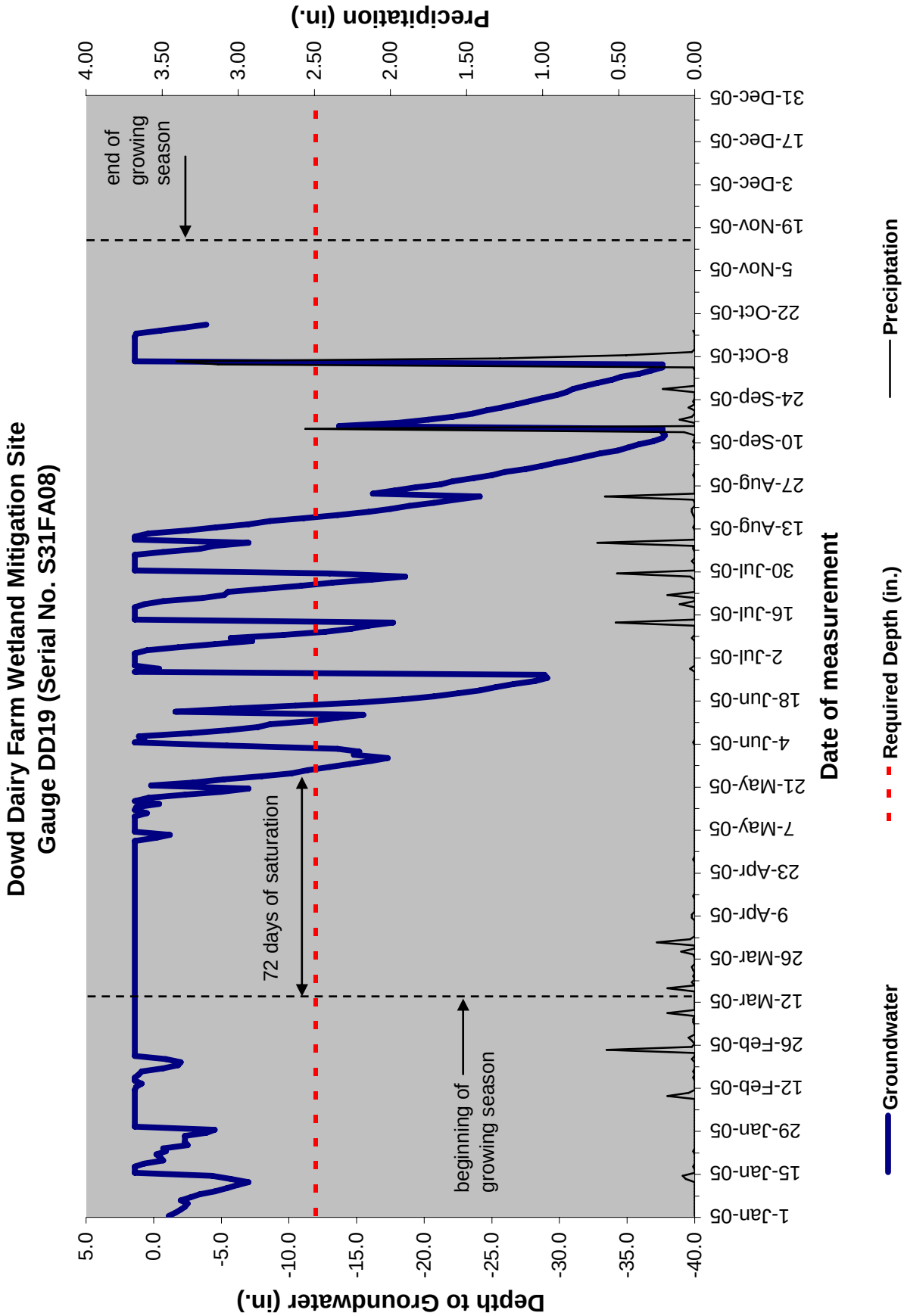

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD13 (Serial No. S317544)
beginning of growing season
end of growing season
Depth to Groundwater (in.)
Precipitation (in.)
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05
Date of measurement
Groundwater
Required Depth (in.)
Preciptation

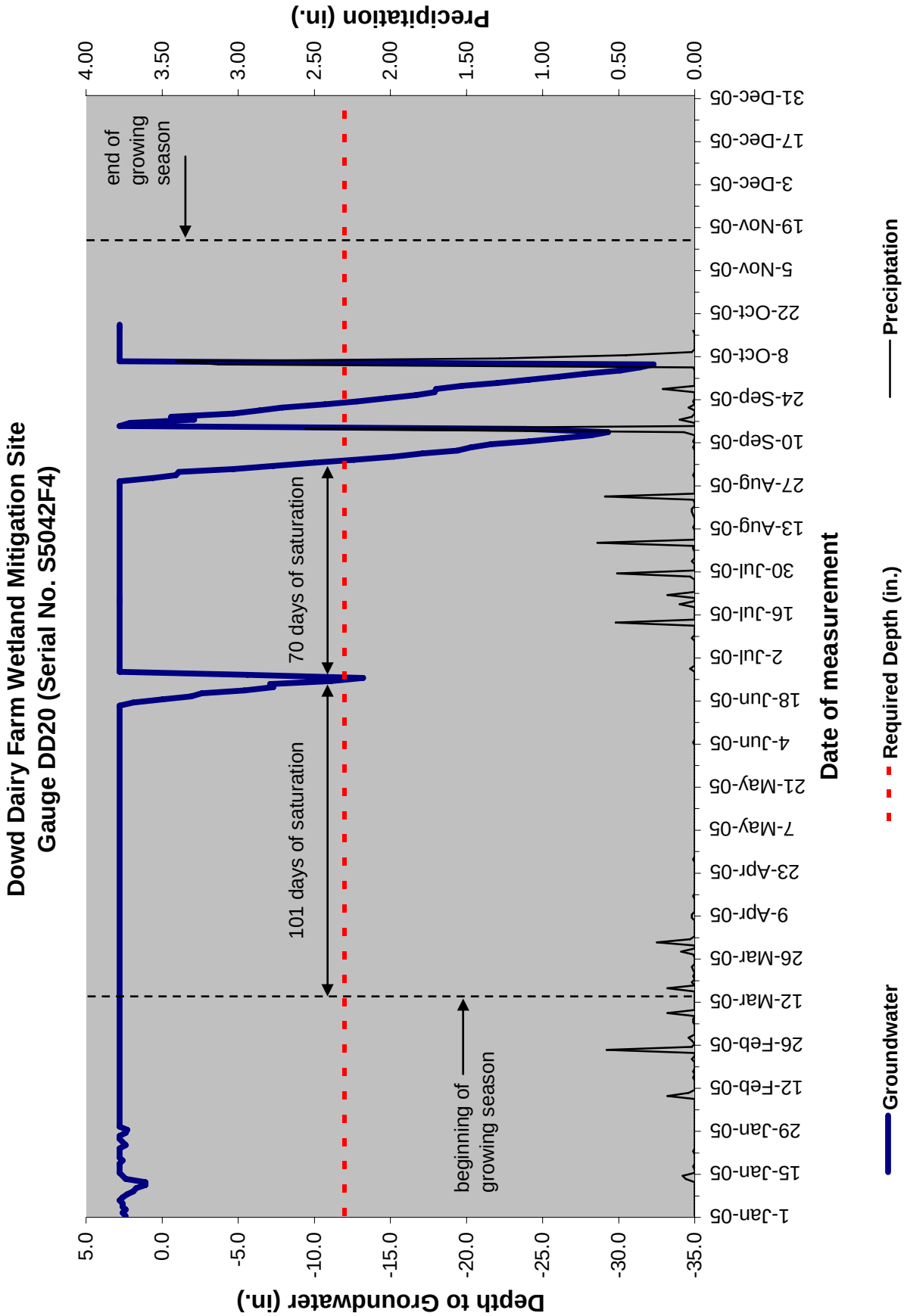

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD14 (Serial No. S317594)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation
65 days of saturation
beginning of growing season
end of growing season
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05

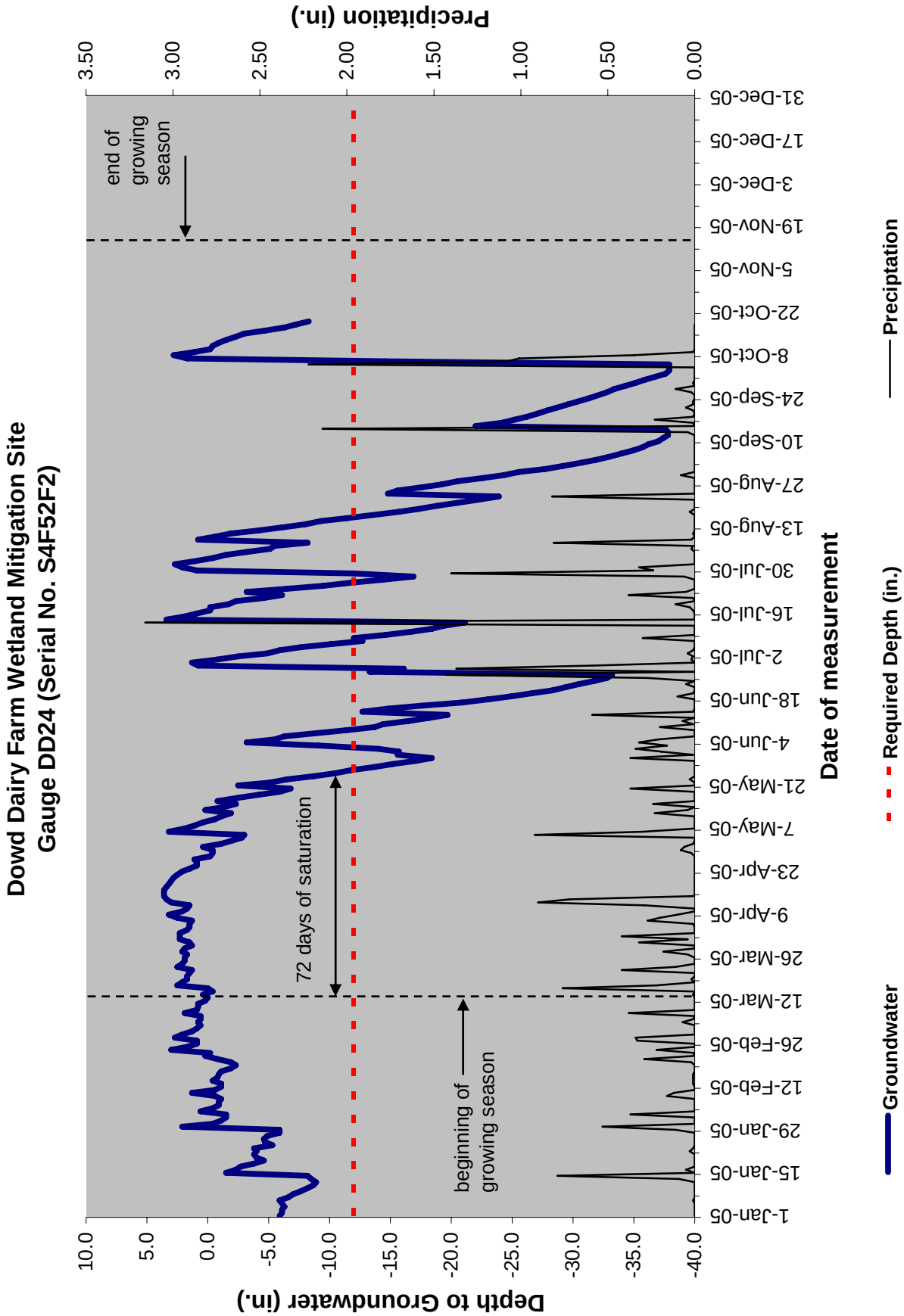

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD15 (Serial No. S31FA4C)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
98 days of saturation
57 days of saturation
beginning of growing season
end of growing season
Groundwater
Required Depth (in.)
Preciptation

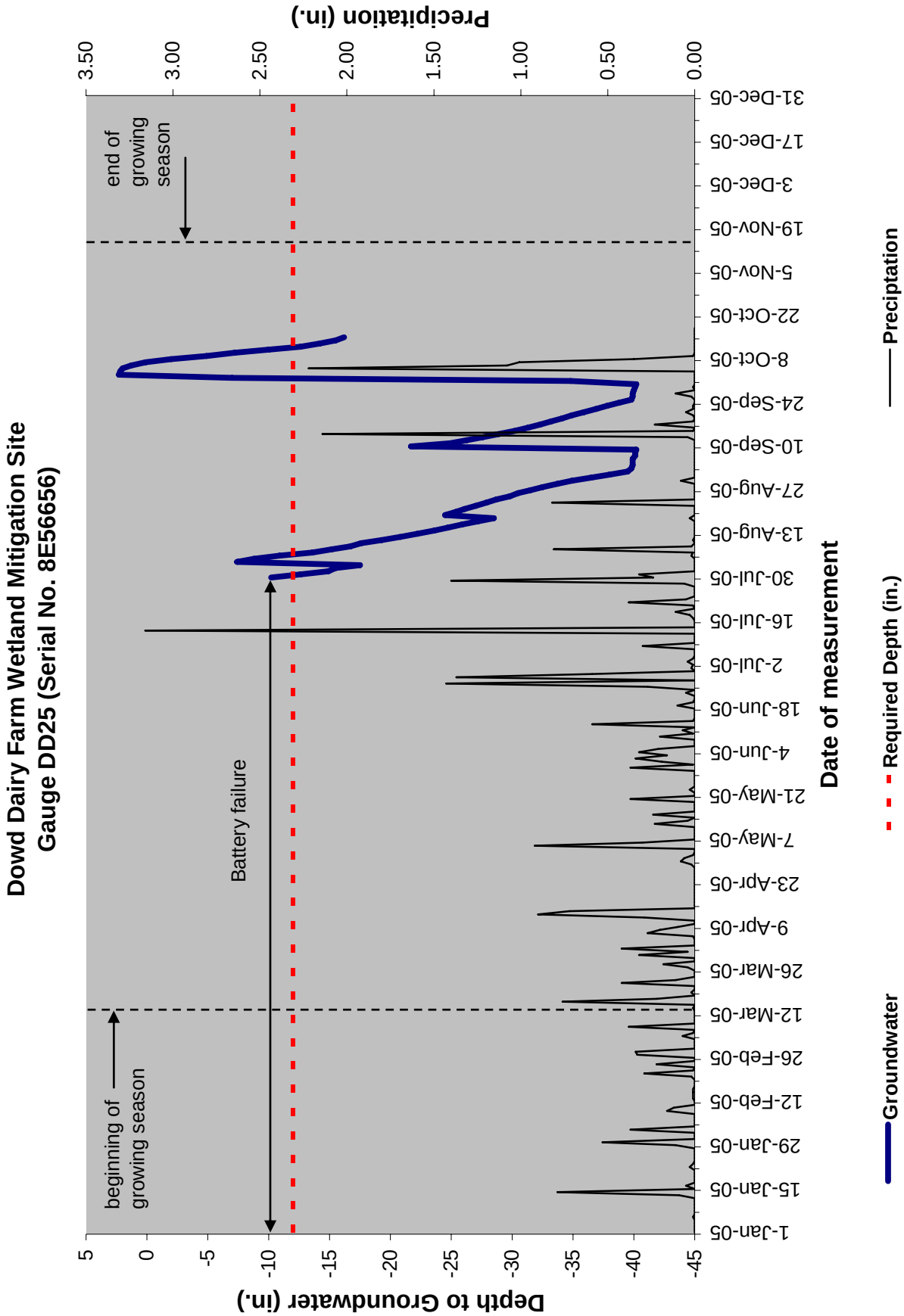

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD16 (Serial No. S31F706)
beginning of growing season
end of growing season
72 days of saturation
Gauge failure
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05
Groundwater
Required Depth (in.)
Preciptation

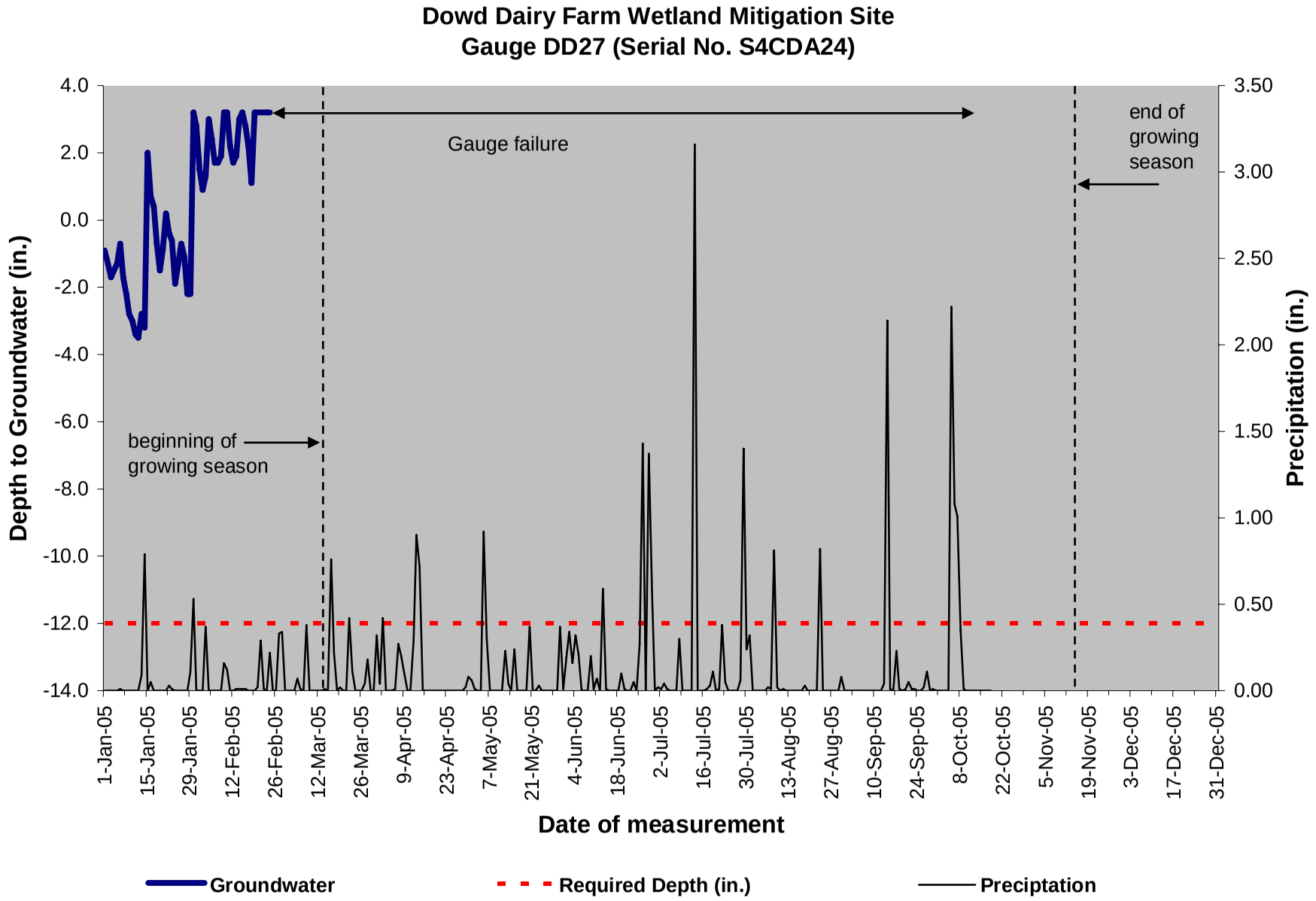

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD18 (Serial No. S55F7DE.8)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation
end of growing season
Gauge failure
96 days of saturation
beginning of growing season
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05

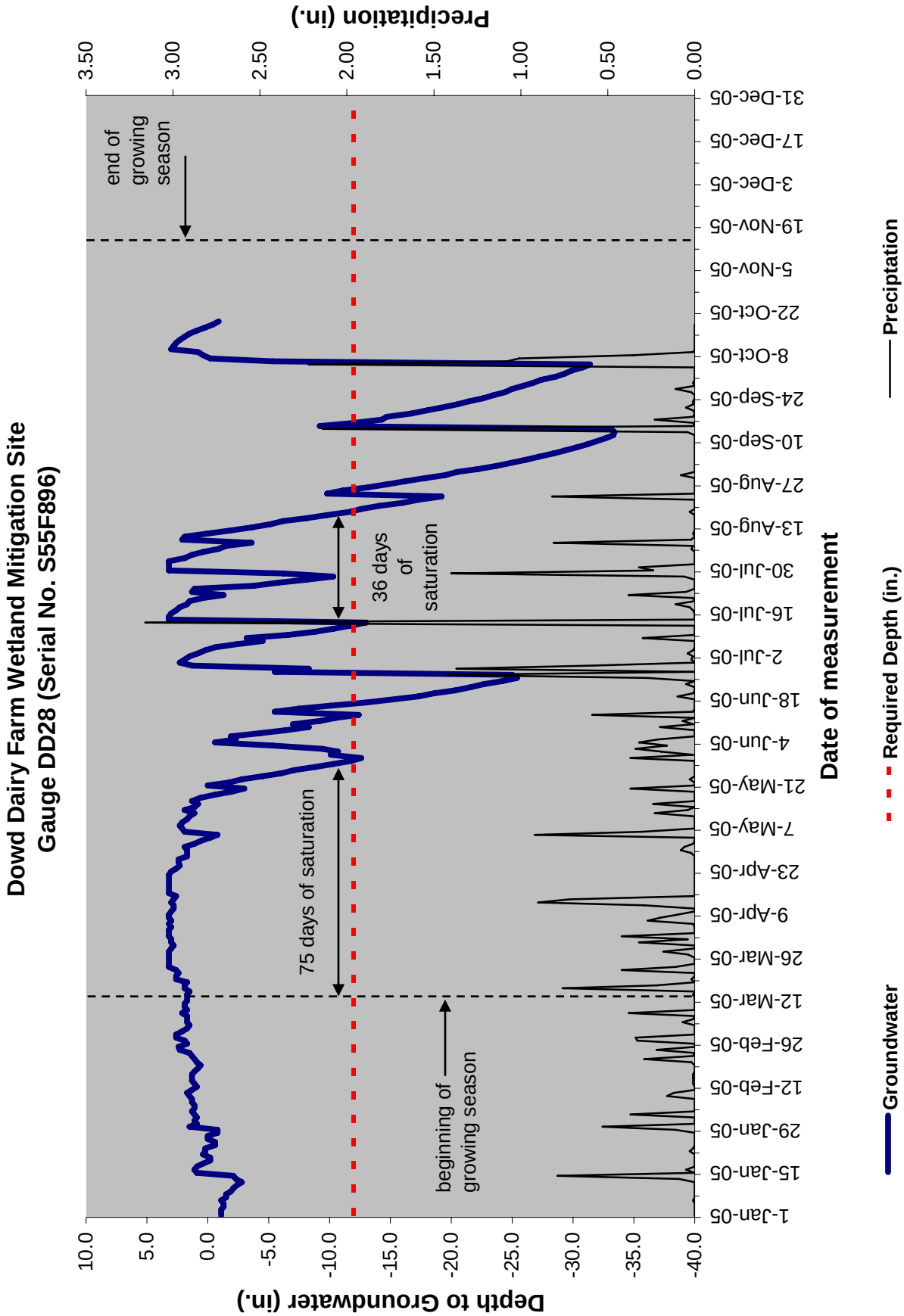

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD19 (Serial No. S31FA08)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation
72 days of saturation
beginning of growing season
end of growing season
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05

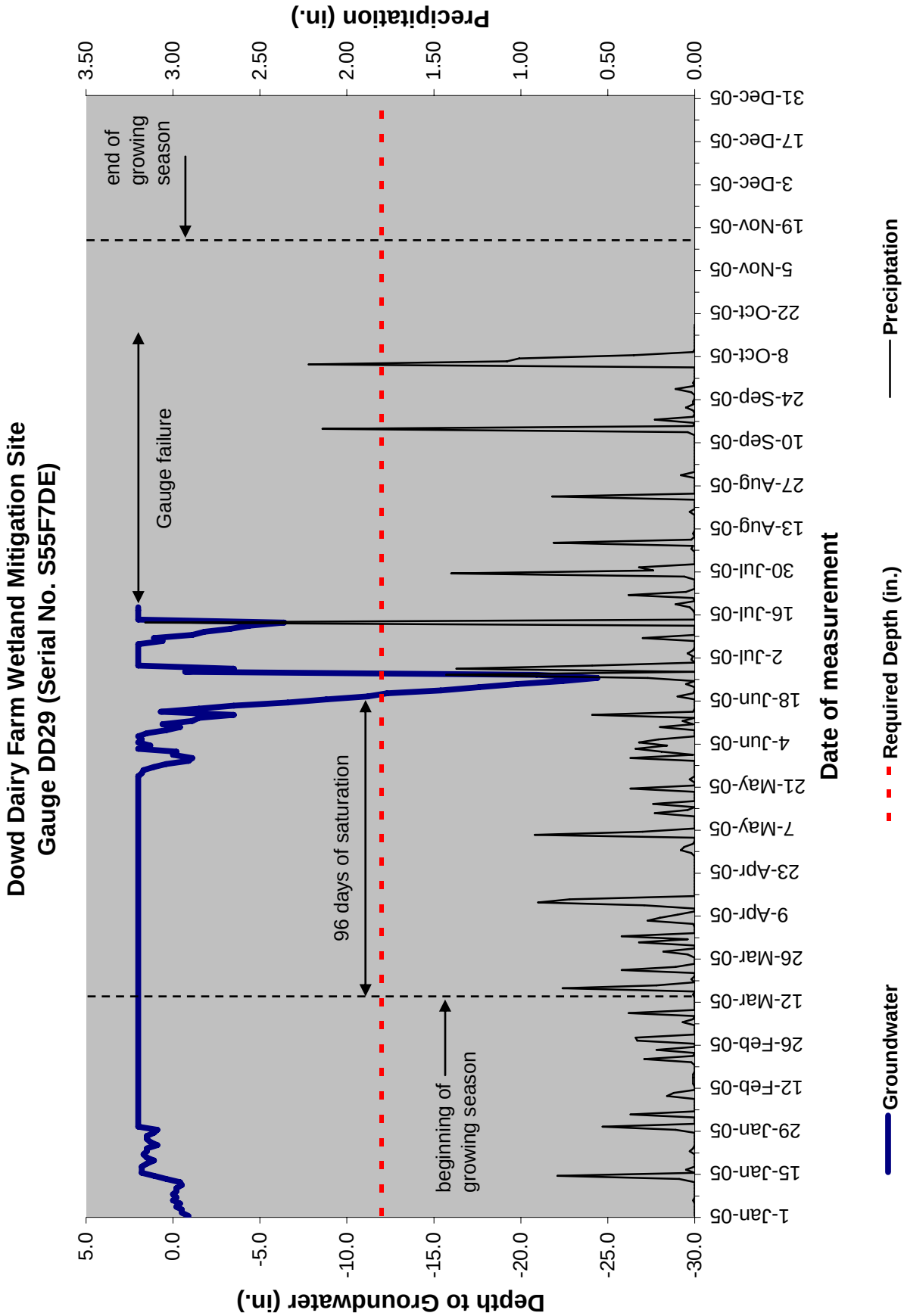

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD20 (Serial No. S5042F4)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation
end of growing season
beginning of growing season
70 days of saturation
101 days of saturation
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05

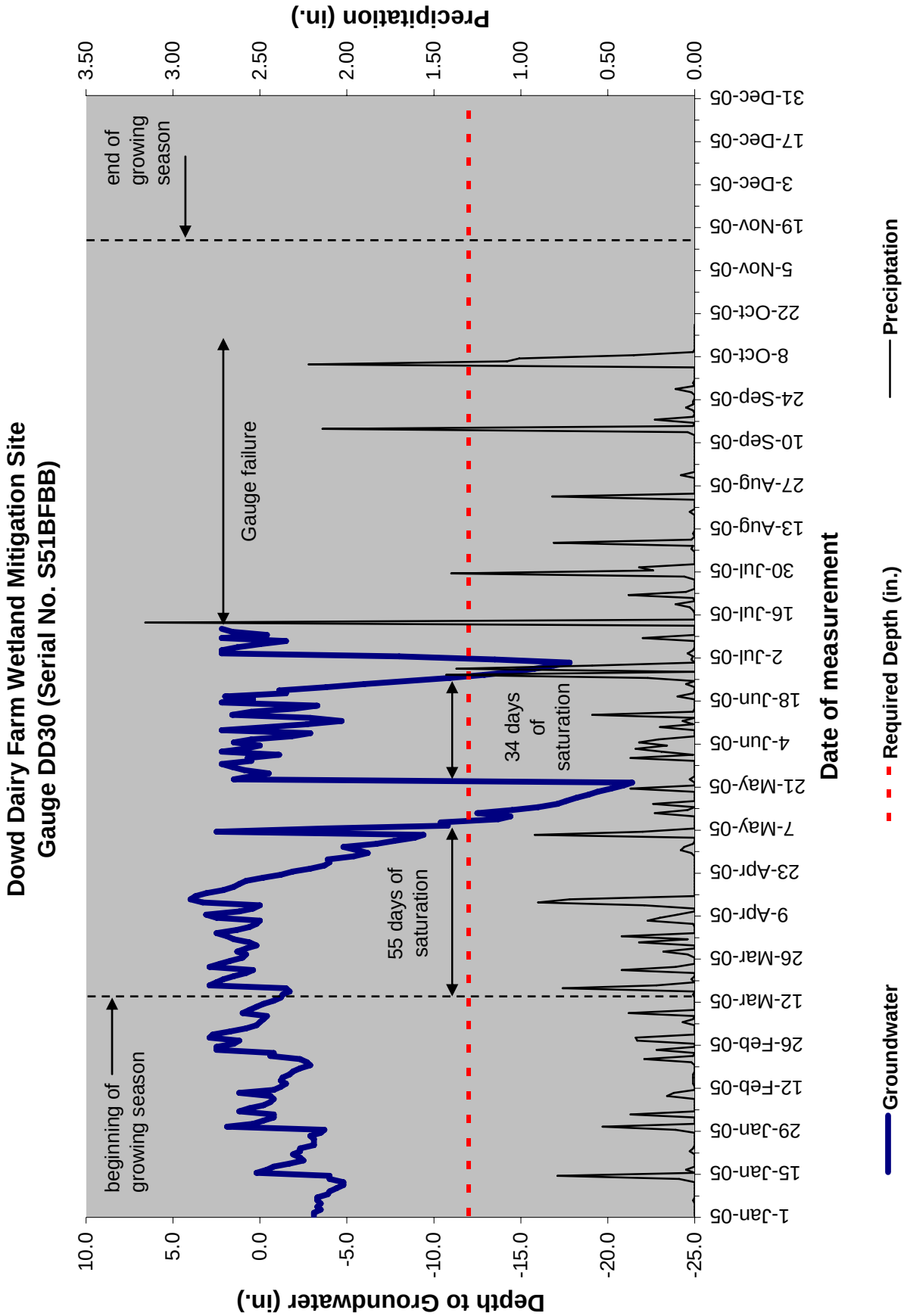

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD24 (Serial No. S4F52F2)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation
72 days of saturation
beginning of growing season
end of growing season
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05

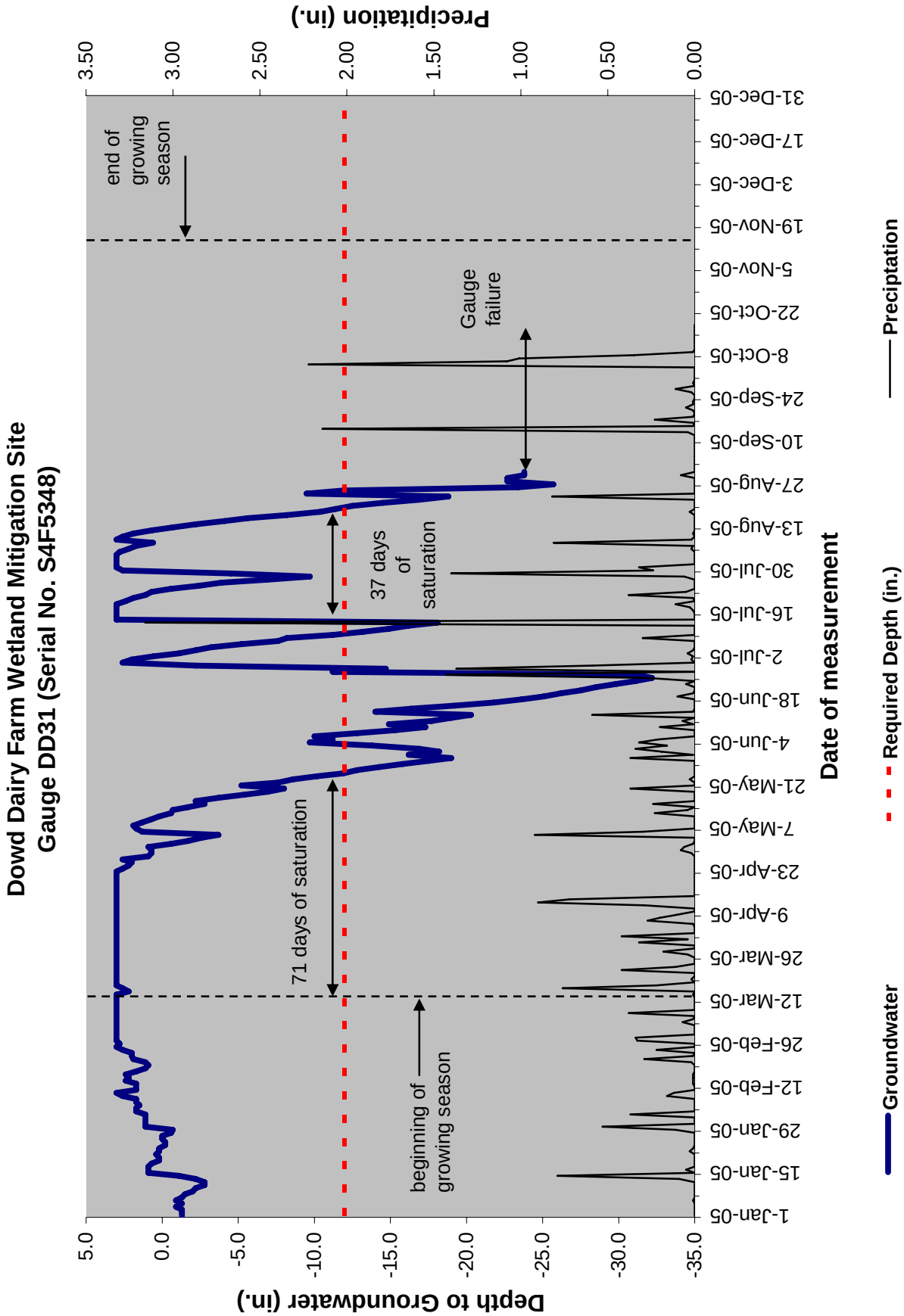

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD25 (Serial No. 8E56656)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation
beginning of growing season
Battery failure
end of growing season
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05

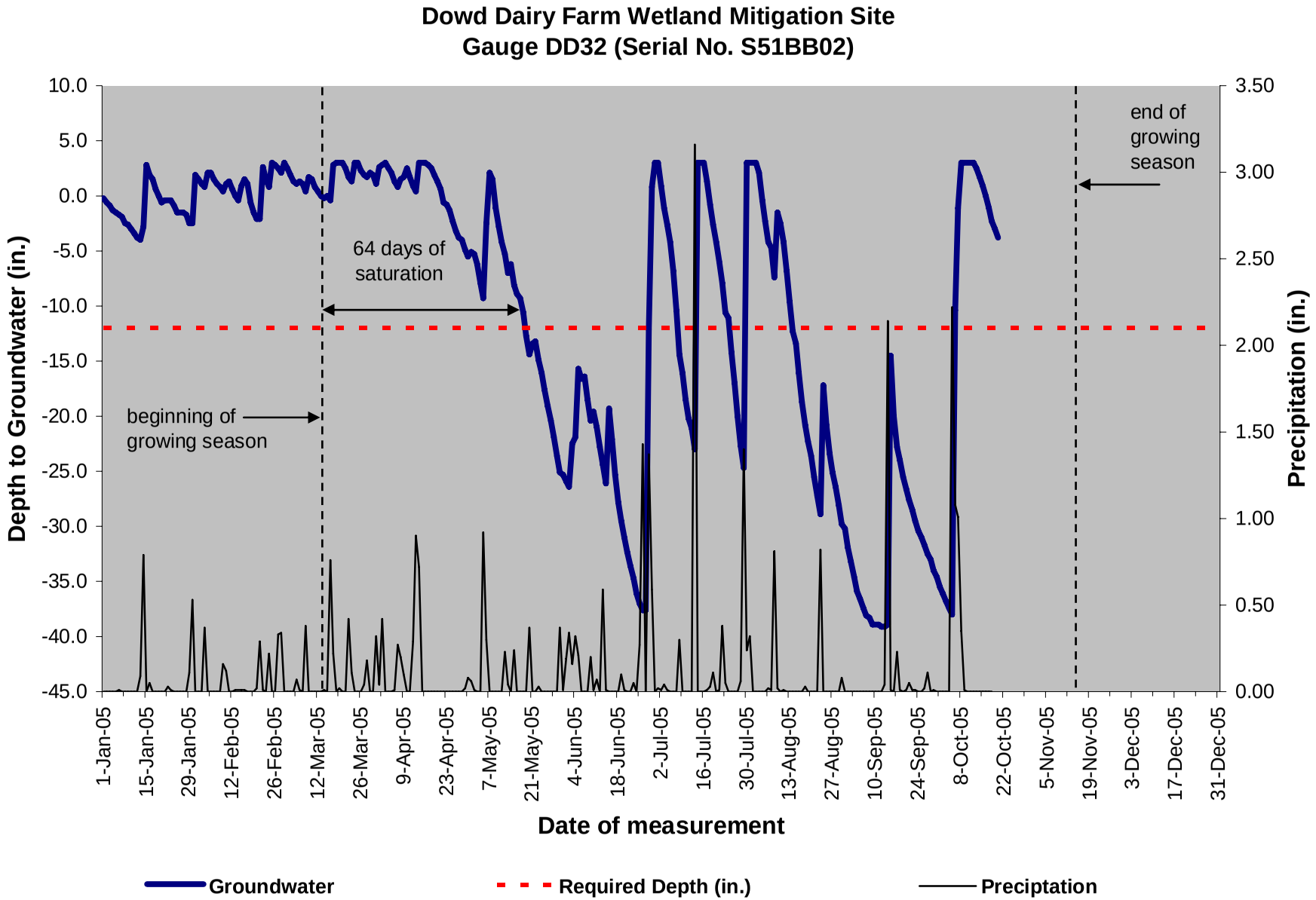

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD27 (Serial No. S4CDA24)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Gauge failure
beginning of growing season
end of growing season
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
-14.0
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05
Groundwater
Required Depth (in.)
Preciptation

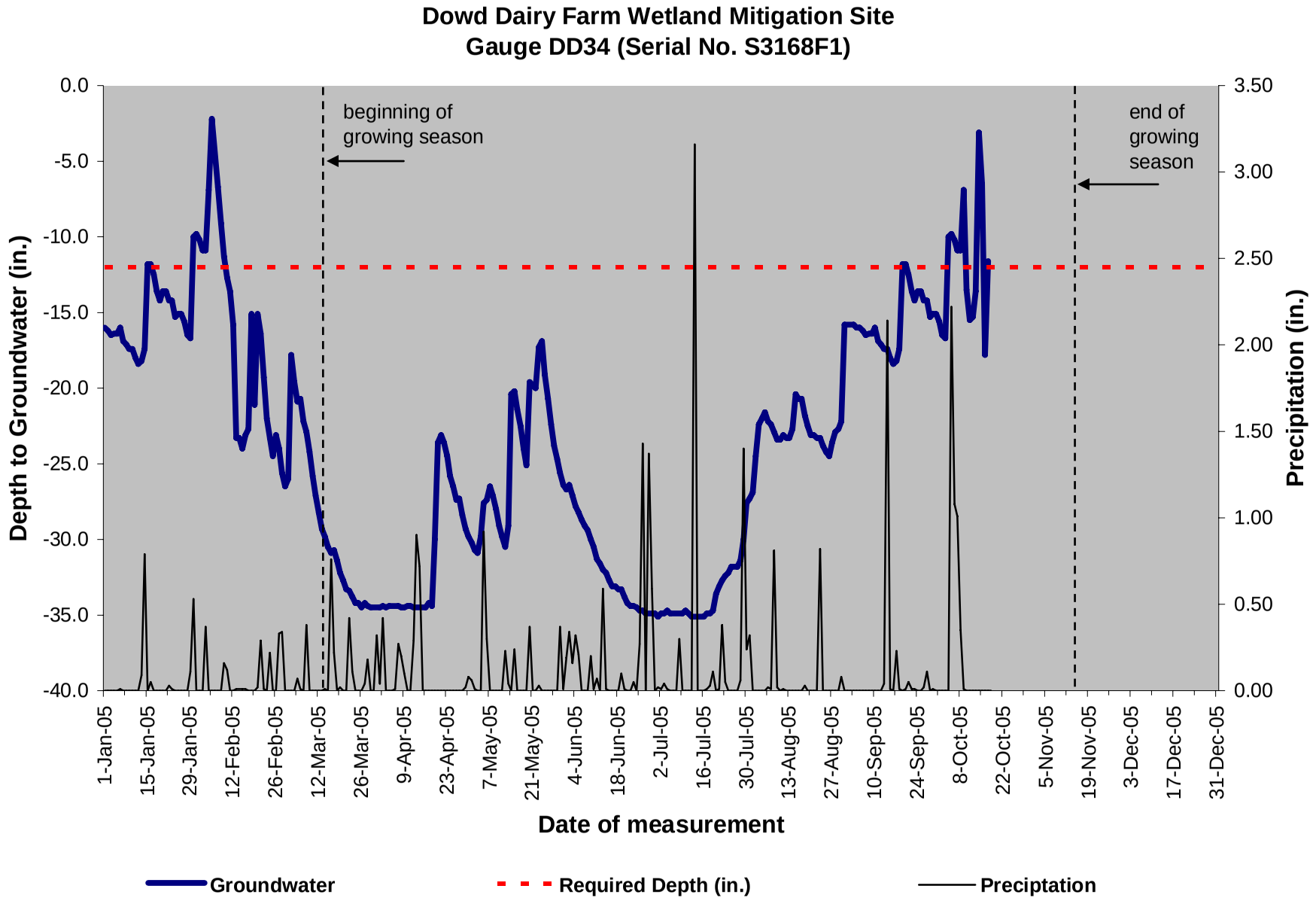

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD28 (Serial No. S55F896)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation
end of growing season
36 days of saturation
75 days of saturation
beginning of growing season
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05

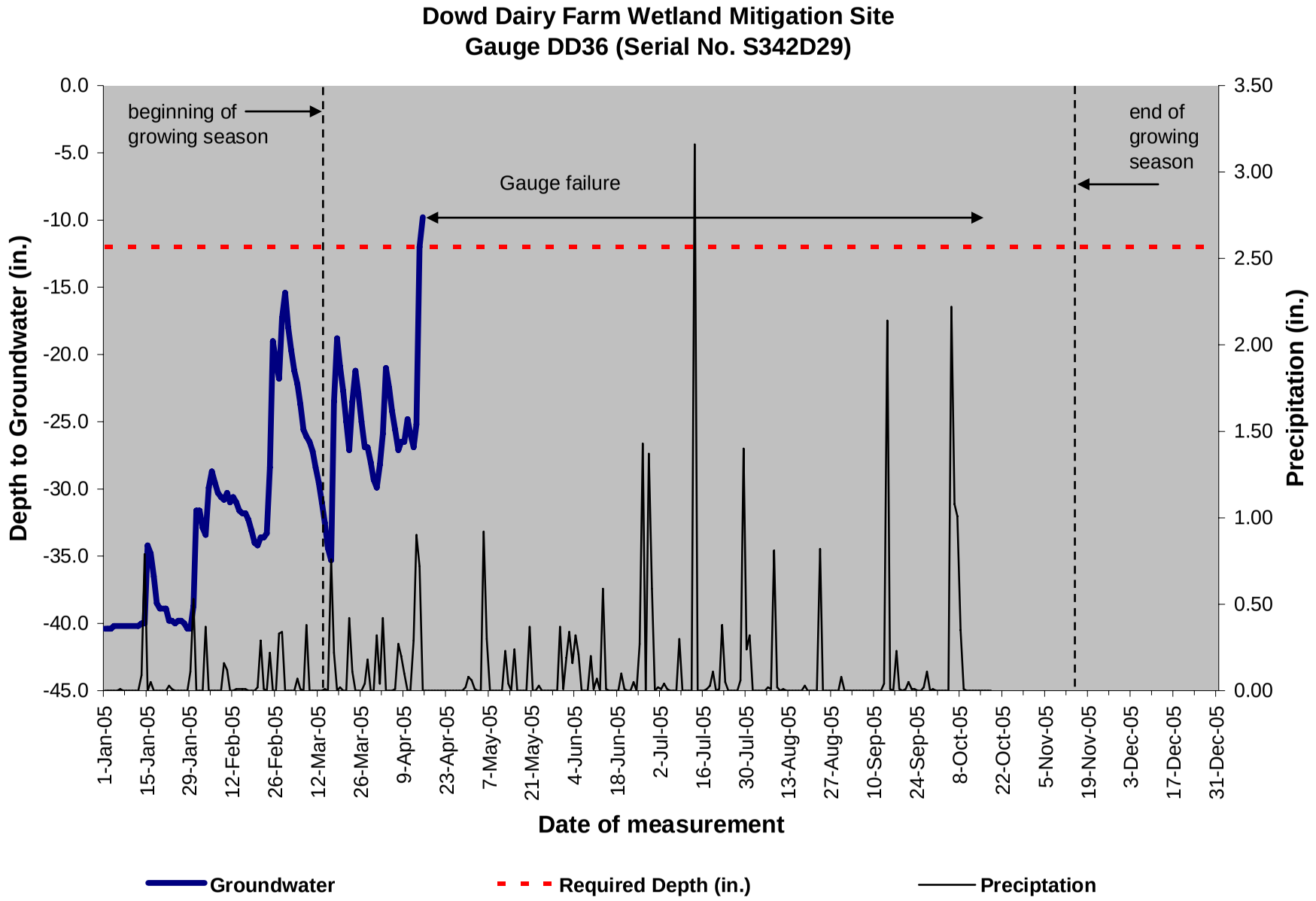

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD29 (Serial No. S55F7DE)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation
Gauge failure
96 days of saturation
beginning of growing season
end of growing season
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05

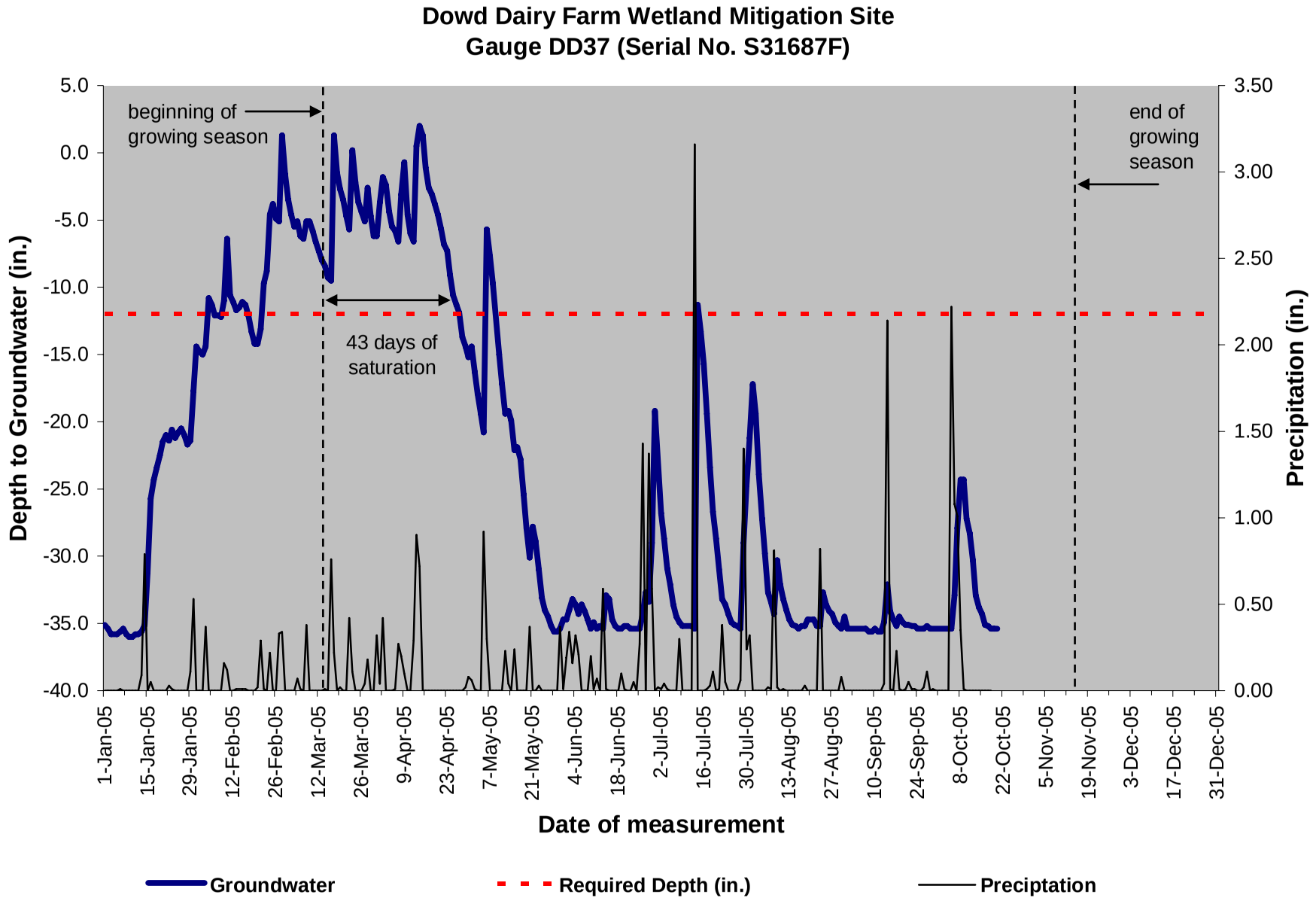

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD30 (Serial No. S51BFBB)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation
beginning of growing season
end of growing season
Gauge failure
55 days of saturation
34 days of saturation
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05

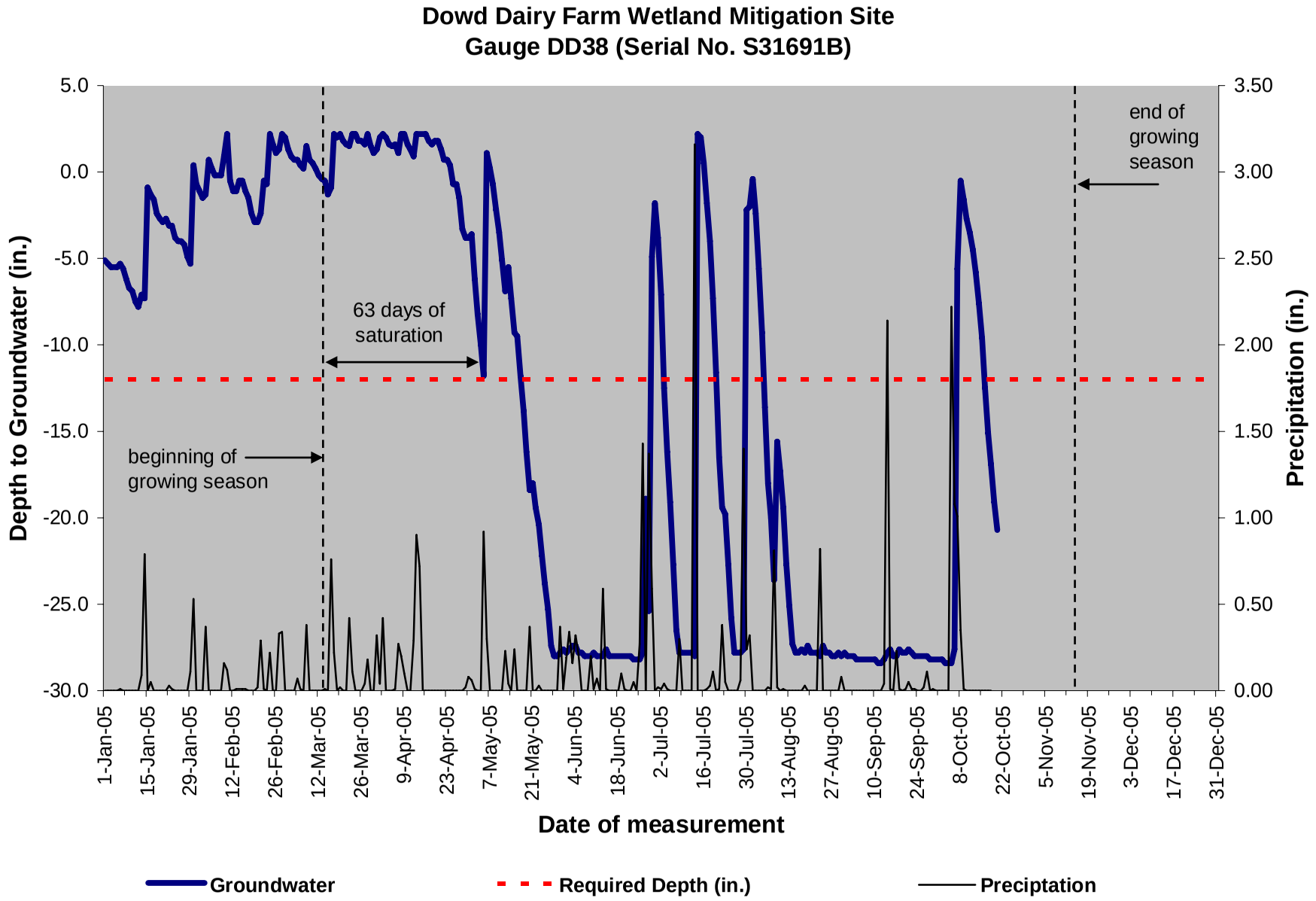

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD31 (Serial No. S4F5348)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation
71 days of saturation
37 days of saturation
Gauge failure
beginning of growing season
end of growing season
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05

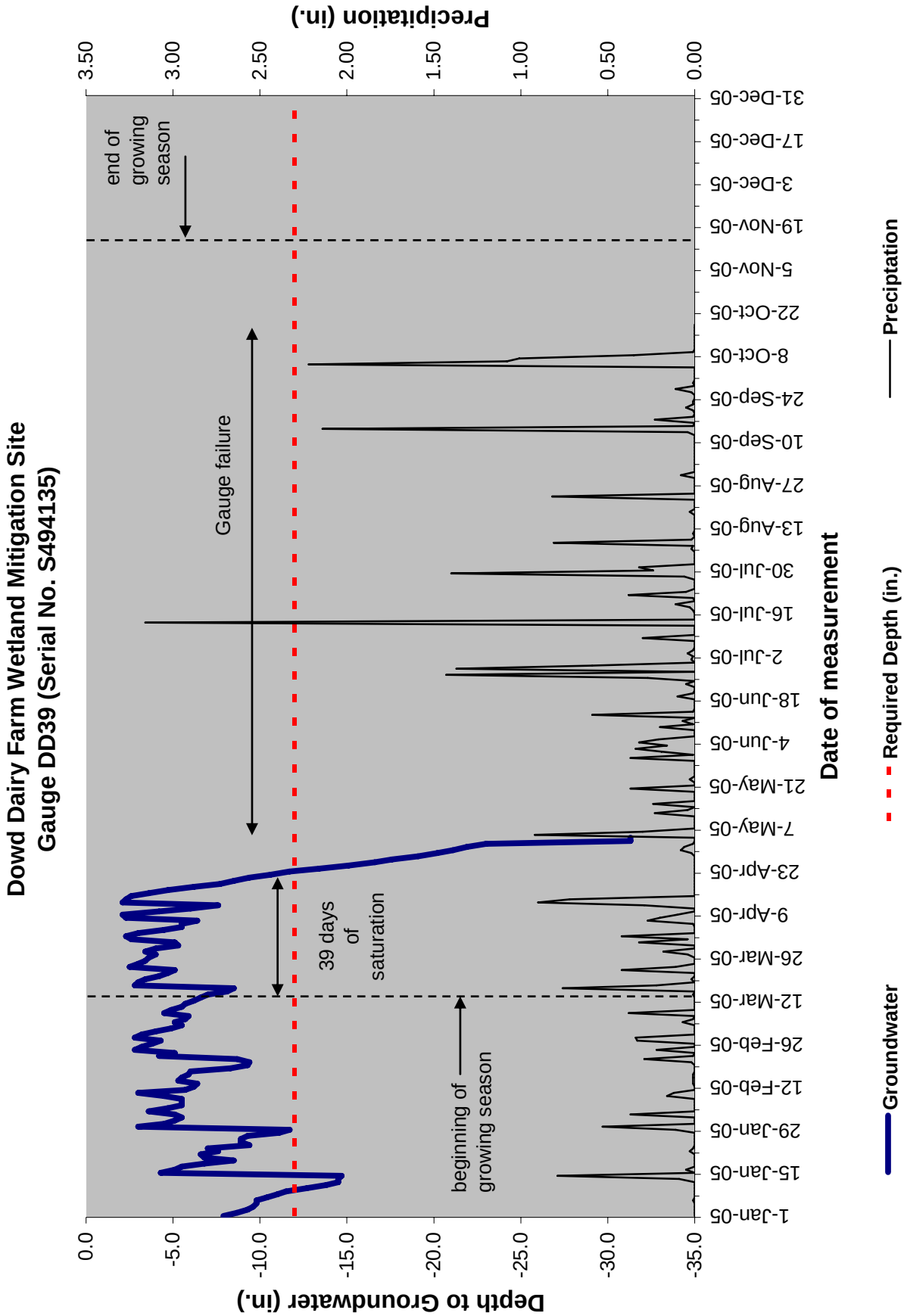

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD32 (Serial No. S51BB02)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
64 days of saturation
beginning of growing season
end of growing season
Groundwater
Required Depth (in.)
Preciptation

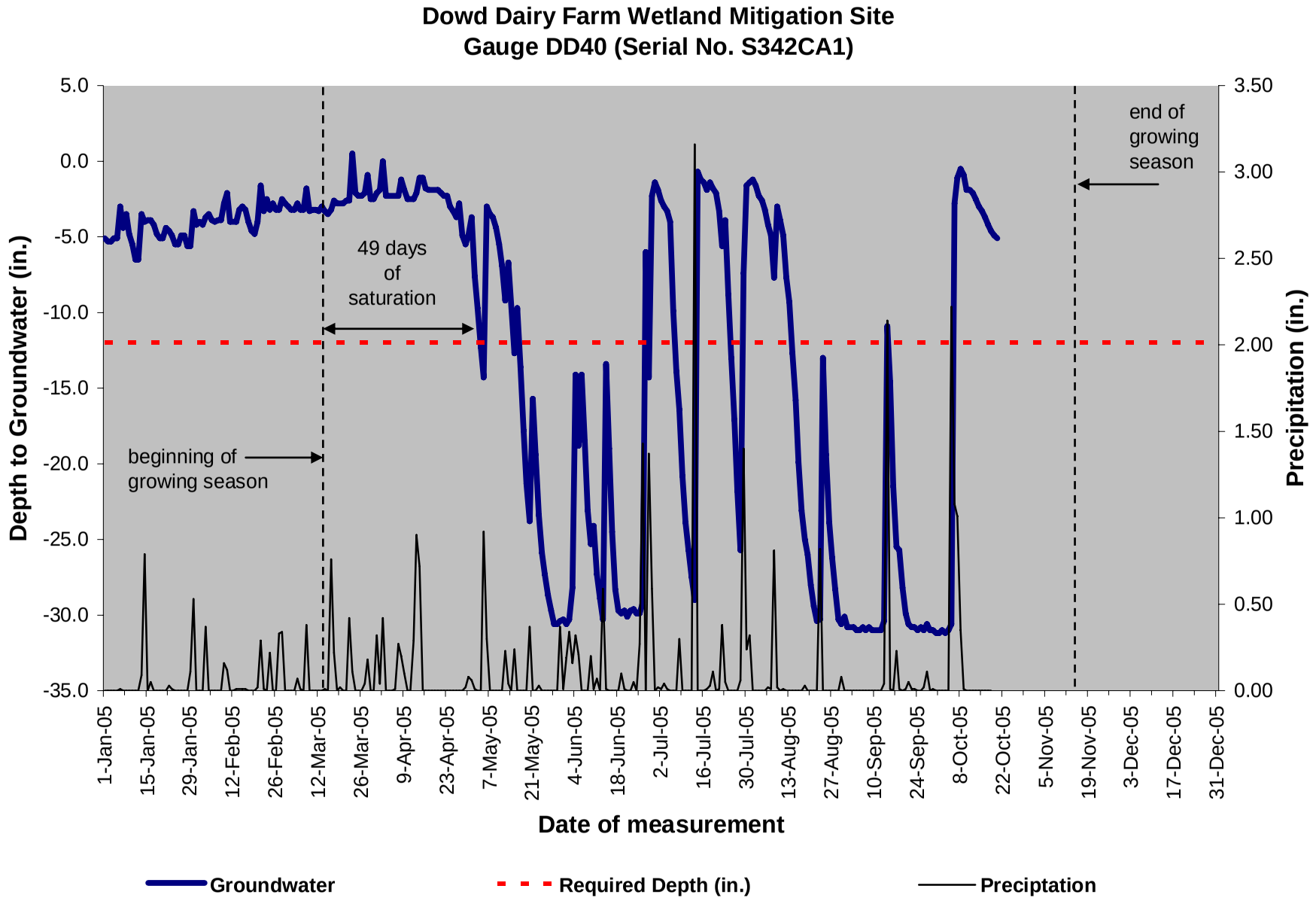

Dowd Dairy Farm Wetland Mitigation Site
Gauge DD34 (Serial No. S3168F1)
beginning of growing season
end of growing season
Depth to Groundwater (in.)
Precipitation (in.)
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05
Date of measurement
Groundwater
Required Depth (in.)
Preciptation


Dowd Dairy Farm Wetland Mitigation Site
Gauge DD36 (Serial No. S342D29)
beginning of growing season
end of growing season
Gauge failure
Depth to Groundwater (in.)
Precipitation (in.)
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05
Date of measurement
Groundwater
Required Depth (in.)
Preciptation


Dowd Dairy Farm Wetland Mitigation Site
Gauge DD37 (Serial No. S31687F)
beginning of growing season
end of growing season
43 days of saturation
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation


Dowd Dairy Farm Wetland Mitigation Site
Gauge DD38 (Serial No. S31691B)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
63 days of saturation
beginning of growing season
end of growing season
Groundwater
Required Depth (in.)
Preciptation


Dowd Dairy Farm Wetland Mitigation Site
Gauge DD39 (Serial No. S494135)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
Groundwater
Required Depth (in.)
Preciptation
beginning of growing season
39 days of saturation
Gauge failure
end of growing season
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1-Jan-05
15-Jan-05
29-Jan-05
12-Feb-05
26-Feb-05
12-Mar-05
26-Mar-05
9-Apr-05
23-Apr-05
7-May-05
21-May-05
4-Jun-05
18-Jun-05
2-Jul-05
16-Jul-05
30-Jul-05
13-Aug-05
27-Aug-05
10-Sep-05
24-Sep-05
8-Oct-05
22-Oct-05
5-Nov-05
19-Nov-05
3-Dec-05
17-Dec-05
31-Dec-05


Dowd Dairy Farm Wetland Mitigation Site
Gauge DD40 (Serial No. S342CA1)
Depth to Groundwater (in.)
Precipitation (in.)
Date of measurement
49 days of saturation
beginning of growing season
end of growing season
Groundwater
Required Depth (in.)
Preciptation

APPENDIX B

SITE PHOTOS
PHOTO AND VEGETATION PLOT LOCATION

DOWD DAIRY

Photo Locations 1 and 2.

Photo Location 3.

Photo Location 4.

Photo Location 5.

Photo Location 6.

Photo Location 7.

DOWD DAIRY

Photo Location 8.

Photo Location 9.

Photo Locations 1-10 (a).

Photo Locations 1-10 (b).

Photo Locations 1-10 (c).

Photo Locations 1-10 (d).

DOWD DAIRY

Photo Location 1-10 (e).

Vegetation Plot 1.

Vegetation Plot 2.

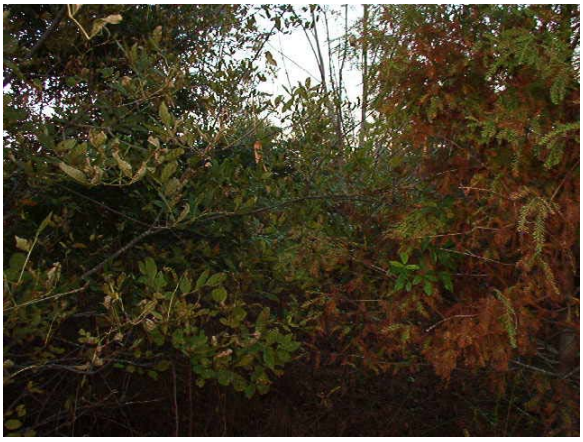
Vegetation Plot 3.

Vegetation Plot 4.

Vegetation Plot 5.

DOWD DAIRY

Vegetation Plot 6.



Vegetation Plot 7.

Vegetation Plot 8.

Vegetation Plot 9.

Vegetation Plot 11.

Vegetation Plot 12.

DOWD DAIRY

Vegetation Plot 13.

Vegetation Plot 14.

Vegetation Plot 15.

Vegetation Plot 16.

Vegetation Plot 17.

Vegetation Plot 18.

DOWD DAIRY

Vegetation Plot 19.

Vegetation Plot 20.

Vegetation Plot 21.

Vegetation Plot 22.

Vegetation Plot 23.

Vegetation Plot 24.

DOWD DAIRY

Vegetation Plot 25.

Vegetation Plot 26.

Vegetation Plot 27.

Vegetation Plot 28.

Vegetation Plot 29.

Vegetation Plot 30.

DOWD DAIRY

Vegetation Plot 31.

Vegetation Plot 32.

Vegetation Plot 33.

Vegetation Plot 34.

Vegetation Plot 35.

Vegetation Plot 36.

DOWD DAIRY

Vegetation Plot 38.