

Monitoring Report  
for  
Carteret-Craven Electrical  
Cooperative Wetlands

Morehead City, North Carolina



**S&EC Project No. 4224**

Prepared by

**Soil & Environmental Consultants, PA**

for

**The North Carolina Wetlands Restoration Program**

**January 2, 2003**

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## **Abstract**

The monitoring period for this site began on November 1, 2001 with the installation of groundwater monitoring devices in the west cell. This followed the planting of that cell late in the winter of 2001 (see As-Built Plan dated November 16<sup>th</sup>, 2001 by S&EC). This report covers the period November 1, 2001 through November 1, 2002.

S&EC Biologists visited the site on November 21, 2002 to review vegetative conditions after the first growing season (see detailed report below). The target density, as described in the success criteria, is 320 stems per acre. The average stem density in the wetland cells as of this report is 946 stems per acre. Currently, the vegetative coverage meets the success threshold.

Groundwater monitoring data for the site has been collected since September 28, 2000 in the East Cell and since November 1, 2001 in the West Cell (constructed one year after the East Cell). Saturation to within 12" of the surface for more than 12.5% of the growing season has occurred in both cells since monitoring began (see accompanying data). Both cells met the success threshold for hydrology during the period 11-1-01 through 11-1-02.

## **Site Program**

The goal was to create a palustrine forested wetland ecosystem (with some emergent components) on up to three (3.0) acres of the site that would partially detain and treat storm water flows and base flows prior to leaving the site. The ultimate goal is to reduce peak flow fresh water input to Jumping Run Creek and Bogue Sound, which will improve water quality and facilitate a reduction in closure days for adjacent shellfish waters. Additionally, the design and implementation of this project will further the knowledge of methods intended to improve environmental quality.

### Design Program Elements:

- Quantitative Development of Wetlands in the White Oak River Basin
- Restoration of wetland function and value
- Detention and Treatment of fresh water from the site and the watershed
- Compliment an overall watershed management plan
- Improvement of water quality in Jumping Run Creek and Bogue Sound
- Demonstration of innovative water quality improvement methods

## **Development History**

The site is coastal plain upland, which has been altered for commercial development. The easement for the project is approximately 4.4 acres within an approximate 20.0 acre overall site. There were two cells created as part of site development. The water table was monitored (pre-construction) for a period of time to determine the modal elevation of saturation. Site topography was surveyed to one-foot contours and a grading plan was developed to lower the surface in the areas of the cells to within one foot or less of the expected level of saturation during the growing season. The east cell is a 0.82 acre wetland system and the west cell is a 1.82 acre wetland system, totaling 2.64 acres.

In September of 1999 additional monitoring wells were installed on the site in order to review water levels relative to the existing wastewater system. Additionally, a topographic map of the site was created and groundwater hydrology study was performed during September, 1999. A surface water hydrology study was prepared (HEC-RAS) in January of 2000 relative to proposed flood water elevations.

Based on concept site development plans, bid package documents were sent to four suggested contractors in the project area. One suitable bid was returned. No action was taken on this bid as NCWRP made arrangements with NCDOT to remove material from the first cell (east) for use in their local roadwork. Grading and site development on the eastern cell began the third week of February, 2000 (see attached photographs). Approximately 0.82 acres of the wetland system was graded and the surface was lowered an average of 1.0 foot. Soil was removed from the cell and stored offsite. NCDOT could not grade the west cell during the initial work.

The east cell was seeded with a woody wetland seed mix (which contained annual rye as a nurse crop) and an herbaceous wetland seed mix and mulched with wheat straw during 3/4-3/6, 2000. Bald Cypress (300) and Pond Pine (100) seedlings were added to the site during the first week of March, 2000. Southern Wax Myrtle (200), Buttonbush (200), Cherrybark Oak (100), Swamp Blackgum (150), Water Tupelo (150) Sycamore (150), and Willow Oak (150) were added during the third week of March, 2000. The site was reviewed early in the growing season (5/10/00) and again mid growing season (6/27/00).

During the early growing season, approximately 95% of the woody vegetation was alive and growing. The Water Tupelo and Buttonbush seemed to be thriving. Existing foliage on the Cypress was starting to brown out but there was new foliage sprouting. The Wax Myrtle appeared weakly foliated during the early visit. The one specimen Cypress was doing well.

During the mid season visit, much of the woody vegetation had begun to grow, especially the Wax Myrtle. There appeared to be 90% survival through the mid season visit. Some of the Cypress began to show signs of nutrient deficiencies (yellowing of leaves, etc.). Some of this may be attributed to higher than normal rainfall early in the growing season. Craig Conrad of CCEC indicated that the cell had been under water for two weeks or more due to 14" of rainfall over a short period. In September of 2000 an RDS WL 40

well was installed in the east cell to begin groundwater monitoring. Data from September, 2000 through July, 2001 indicate that the groundwater level was within 12" of the surface every day except one in the 10-month period (typically 2"-6" in winter and 6"-10" in summer months), and that the site was inundated for 55 days during that same time frame.

During August, 2000 the grading plan for the west cell was revised per direction of NCWRP (to reduce total area) and another request for proposals was prepared and sent to four local contractors. A contractor was selected in October, 2000, a pre-construction meeting was held on 11/9/00 and site work began 11/15/00 with the major portions of the work being completed in early December, 2000. Spoil from this portion of the site work was stored on the CCEC site at the request of CCEC management. One grade control weir was installed during February, 2001 in the mid-portion of the western cell.

Tree seedlings had been ordered in July of 2000 from NCFS and were delivered and planted the second week of January, 2001. Additional, larger woody plant material (bald cypress and wax myrtle) was installed during the last week of March, 2001.

Herbaceous plant material was ordered and planted (in both cells) during the last week of March and the first week of April, 2001. Twine fencing was installed as a deterrent to ducks and geese at the same time.

Final inspection of the site indicated that there were minor alterations which were needed to enhance the function of the site. These included; plugging portions of the ditch in the western cell to prevent "short circuiting" of flows, repair of erosion on the west side of the weir as well as below the weir opening, and treatment of over bank flow from the upland site to the western cell. These alterations were completed in late October, 2001.

Two monitoring devices (RDS WL 40') were to be moved from their upland positions to the west cell, however, the WL series monitoring devices have shown difficulty in downloading of water table data. Based on success with a newer EcoTone Series device (also by RDS), S&EC suggested that the RDS devices be replaced with the Ecotone Series. This was authorized and then completed on November 1, 2001. There are presently two EcoTone devices in the west cell and one in the east cell.

An As-Built Report dated November 16, 2001 was prepared and submitted to The North Carolina Wetland Restoration Program (NCWRP) staff.

At the request of NCWRP, S&EC located a reference wetland for the project. The site is along the northern end of Hibbs road in Carteret County, northwest of the project site. The reference site is approximately 0.6 miles south of the intersection of Hibbs Road (SR 1141) and US Highway 70, 275' west of Hibbs Road (see December 9<sup>th</sup>, 2001 S&EC correspondence to Larry Hobbs of NCWRP). In February, 2002 a groundwater monitoring device was located in the reference wetland.

## Success Criteria

### *Vegetation*

The success of the vegetative component will be based on the survival of canopy tree species for a five-year monitoring period. Monitoring will occur for five years or until success criteria are met, whichever is longer. Three 10-meter plots have been established based on groundwater monitoring device locations for vegetative monitoring. All vegetative monitoring will occur within these observation plots throughout the monitoring period as long as they continue to be representative of the community. Any changes to the observation points will require the approval of the NCWRP. Vegetative success will be predicated on a minimum mean density of 260, five-year old stems per acre surviving after five years. By the end of the five-year monitoring period, vegetation in the proposed wetland areas must meet the criteria for hydrophytic vegetation as described in the 1987 Corps of Engineers Wetland Delineation Manual, specifically, more than 50% of the dominant species in all strata are OBL, FACW, or FAC as listed in "National List of Plant Species that Occur in Wetlands" – 1988 USF&W. The status of site vegetation, relative to these criteria, will be included in annual monitoring reports.

### *Hydrology*

Hydrologic success criteria is based on Wetland Hydrology as described in Table 5 in the Corps of Engineers Wetlands Delineation Manual (January 1987). Table 5 in the Manual outlines Hydrologic Zones in Nontidal Areas. The bottom limit for duration of saturation/inundation in wetlands in that table is 5% of the growing season. Generally, any duration of saturation/inundation above 12.5% of the growing season is considered to have wetland hydrology.

The mid-point in the 5% - 12.5% range, or 8.75% of the growing season, is proposed as criteria for hydrologic success at this site. Typical growing season may be estimated from the last frost (5 years in 10) in the Spring to the first frost (5 years in 10) in the Fall. An estimate for Carteret County, based on the climatic data presented in the Soil Survey of Carteret County (USDA, 1987) is 244 days (March 20<sup>th</sup> – November 19<sup>th</sup>). Given that, 8.75% of the growing season is 21.35 or 21 days. Saturation to within 12 inches of the surface for 21 or more contiguous days during the growing season will be considered successful hydrology for that year. The time frame in which this criteria shall be met will extend from the last day in the Spring to the first day in the Fall where temperatures were at or below 32 degrees Fahrenheit. The air temperature data used as a benchmark in this monitoring effort is collected on site by Carteret-Craven Electrical Cooperative staff.

Long-term hydrologic success will be met when individual growing season success criteria (as described above) is achieved for all growing seasons (during the minimum five-year monitoring period) which are preceded by twelve-month periods of average (52.52 inches) or greater rainfall. In years of less than average rainfall, site hydrology data will be considered, case-by-case, relative to rainfall data and reference site hydrology data.

**As-Built Report**

See As-Built Report dated November 16, 2001 by Soil & Environmental Consultants, PA



## **Monitoring Plan**

Initial responsibilities for monitoring and maintenance were described in the Memorandum of Understanding among NCWRP, S&EC and Carteret-Craven Electrical Cooperative (CCEC) but were not comprehensive relative to presently accepted mitigation monitoring requirements. A request was made of S&EC by NCWRP staff to prepare a Monitoring Plan and execute the first year of that plan. S&EC responded with a proposal to NCWRP dated October 17<sup>th</sup>, 2002. NCWRP authorized the work described in the proposal with Task Authorization number - JRC/WO/99/8. The new Monitoring Plan follows:

The project site and reference sites will be monitored for a period of at least five years beginning November 1, 2001 (or until all success criteria are met) following initial construction of the project. This will involve observation of two basic parameters in the wetland areas; 1) vegetation and 2) hydrology.

Vegetative conditions will be evaluated relative to the number and type of living stems of canopy tree species and the wetland occurrence status of all plant community strata at standard sampling points within the restoration.

Site hydrology will be evaluated during site visits as well. Three groundwater monitoring devices have been installed throughout the restoration areas which will continually record data on water levels. Data from the groundwater devices will be downloaded periodically and depths of saturation and inundation will be recorded during each quarterly visit.

Site visits will be conducted quarterly by a Professional Soil Scientist or Biologist. These visits will be made at the end of each season (around March 1, June 1, September 1, and December 1). An annual report of conditions will be made to NCWRP at the end of each calendar year. This report will summarize observations from the quarterly visits. Visits may occur more often as needed (e.g. following severe weather conditions, etc.). Any damage or other site conditions which may jeopardize the long-term success of the project will be addressed as observed during the monitoring period. The conditions will be described, along with proposed solution, in a report to the NCWRP as soon as possible.

### **Existing Monitoring Reports**

There are no previous monitoring reports for this site as of this date. There is a Progress Report dated August 11, 2000 by S&EC which describes site conditions after construction of the first cell (East Cell) and prior to construction of the West Cell. Additionally, the As-Built Report dated November 16, 2001 contains site data.

## Current Monitoring Report

This report summarizes observations and data collected during a site visit by Biologist, Todd Preuninger and Soil Scientist/Site Designer, Mike Ortosky of S&EC on November 21, 2002.

### *Vegetation*

On November 21, 2002, Soil & Environmental Consultants, PA (S&EC) conducted a vegetation survey in the restored wetland areas at Carteret Craven Electric Cooperative. The purpose of this survey was to evaluate the overall effectiveness of the restoration efforts.

### **Sampling Protocol**

Three permanent 100 m<sup>2</sup> (1076 sq. ft) plots were established within the restored wetland areas (cells). Two plots were located within the western cell and one plot was located in the eastern cell. The monitoring well in each of the cells served as one corner of the plot so that plot locations could be replicated each year of the survey. The remaining corners of the plot were orientated in a northerly direction from the well. Only woody plants were included in the stem count, however, the presence and percent cover was also noted for herbaceous species.

### **Results**

Carteret Craven Restoration Project – Vegetation Survey						
S&EC Project #:98-4224						
Species	E. Cell	N.W. Cell	W. Cell	Total	% each spp.	Density (stems/acre)
<i>Chamaecyparis thyoides</i>	0	0	2	2	2.9	27
<i>Myrica cerifera</i>	4	6	5	15	21.4	203
<i>Nyssa aquatica</i>	8	2	3	13	18.6	176
<i>Pinus serotina</i>	10	1	0	11	15.7	149
<i>Quercus nigra</i>	1	7	1	9	12.9	122
<i>Taxodium distichum</i>	9	8	3	20	28.6	270
Total/cell	32	24	14	70		

Average Density (stems/acre)	946
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## Site notes:

E. Cell – Noted the presence of *Juncus* spp., seed box (*Ludwigia spp*), several volunteer wax myrtle seedlings, running grass (crabgrass), and aster. Percent cover was estimated at 80%, with *Juncus* and crabgrass being the dominant plants inside the plot. Portions of the plot were inundated and contained sedges (*Cyperus* spp.), and marsh pennywort (*Hydrocotyle umbellata*).

N.W. Cell – Herbaceous cover comprised approximately 20% of the plot and included the following species; broomsedge (*Andropogon* spp.), aster, seed box, and wax myrtle seedlings. This area appeared much dryer than the rest of the western cell and generally contained fewer plants than the adjacent cell.

W. Cell – Noted the presence of pine saplings (*Pinus taeda*), pennywort, seedling wax myrtles, broomsedge, and dog fennel (in the drier areas of plot). Approximately 2/3 of the plot was inundated during survey. Observed a large cypress (transplant?) with over 100 myrtle seedlings at base of tree. Broomsedge and grasses dominated the dry portion of the plot while herbaceous cover in the wet area was approximately 30%.

## Conclusions

The 2002 vegetation monitoring of the site revealed an average density of 946 stems/acre. This is above the 260 tree/acre requirement according to current success criteria. In addition a number of regenerating target seedlings are present within several sections of the site.

## *Hydrology*

### Sampling Protocol

Three shallow groundwater monitoring devices record daily groundwater levels in the wetland cells. One device is located in the East Cell and two others in the West Cell (see as-built map). A monitoring device was installed on 2/5/02 in the reference wetland (new RDS Series II Ecotone). Attempts to download data from that device were not successful. That device was removed on 11/21/02 and returned to the manufacturer. No data could be retrieved. That device will be replaced with another brand. Data is periodically downloaded from these devices and is summarized in the monitoring report.

### Results

Groundwater level data for the period (measured from the ground surface to free water surface) are attached. The accompanying information indicates daily fluctuations in groundwater levels throughout the one-year reporting period. For purposes of defining the 2002 growing season, the last day in the Spring and the first day in the Fall with temperatures of 32 degrees F, or less, as indicated by on-site instrumentation, were March

23, 2002 and November 23, 2002 respectively. The greatest number of contiguous days during the growing season, per monitoring site, that the groundwater level was within 12" of the surface was:

Site 285 – 37 days      Site 286 – 31 days      Site 287 – 32 days

Refer to the accompanying groundwater monitoring data for additional information. It is noteworthy that drought conditions occurred during late Spring and Summer of 2002. Longer consecutive periods of saturation are anticipated in normal years.

### **Conclusion**

All three groundwater monitoring sites within the wetland restoration areas exceeded the minimum required duration for saturation within 12" of the surface (21 days) therefore, the site meets wetland hydrology criteria for monitoring year 2002.

MARCH 2002

DATE	DAY	HIGH	LOW	DEGREE DAYS	
				H	C
1		54.1	23.4	-26.25	0
2	SATURDAY	64	38.9	-13.55	0
3	SUNDAY	64.4	57.7	-3.95	0
4		57.2	31.4	-20.7	0
5		49.1	25.1	-27.9	0
6		57.9	27.3	-22.4	0
7		66.8	38.7	-12.25	0
8		73.6	45.8	-5.3	0
9	SATURDAY	72.8	57.5	0	0.15
10	SUNDAY	68	40	-11	0
11		57.8	37.5	-17.35	0
12		68.2	50.8	-5.5	0
13		65.3	57.3	-3.7	0
14		66.8	54.4	-4.4	0
15		72.8	52.5	-2.35	0
16	SATURDAY	70.4	61.5	0	0.95
17	SUNDAY	65.6	52.3	-6.05	0
18		69.6	51.2	-4.6	0
19		63	50.8	-8.1	0
20		70.9	53.5	-2.8	0
21		65.7	47	-8.65	0
22		49.4	30.3	-25.15	0
23	SATURDAY	53	27	-25	0
24	SUNDAY	64.4	37.3	-14.15	0
25		73	48.7	-4.15	0
26		73.5	55.6	-0.45	0
27		66.5	47.4	-8.05	0
28		59.2	40.9	-14.95	0
29		68.3	40.1	-10.8	0
30		72.6	63.5	0	3.05
31		75.3	65.3	0	5.3
	TOTAL			-309.5	9.45
AVERAGE	HI / LO =	65.1	45.5		

This site temperature data was collected by Carteret-Craven Electrical Cooperative staff.

November 2002

DATE	DAY	HIGH	LOW	DEGREE DAYS	
				H	C
1		60	34	-18	0
2	SATURDAY	59	36	-17.5	0
3	SUNDAY	62	39	-14.5	0
4		59.1	50.3	-10.3	0
5		70.6	47.4	-6	0
6		73	48	-4.5	0
7		58.6	38.3	-16.55	0
8		65.6	35.9	-14.25	0
9	SATURDAY	74.8	43.3	-5.95	0
10	SUNDAY	74.7	65.3	0	5
11		79	63	0	6
12		73.9	62.2	0	3.05
13		60	40	-15	0
14		62.4	40.5	-13.55	0
15		69	35	-13	0
16	SATURDAY	68	56	-3	0
17	SUNDAY	67	48	-7.5	0
18		54	35	-20.5	0
19		65	34	-15.5	0
20		64	41	-12.5	0
21		64	51	-7.5	0
22		67	42	-10.5	0
23	SATURDAY	54	32	-22	0
24	SUNDAY	65	32	-16.5	0
25		72	34	-12	0
26		62	40	-14	0
27		53.5	35.1	-20.7	0
28		46.2	26.5	-28.65	0
29		54.2	25.9	-24.95	0
30	SATURDAY	60.3	51.2	-9.25	0
	TOTAL =			-374.2	14.1
AVERAGE	HI / LO =	61.9	40.7		

This site temperature data was collected by Carteret-Craven Electrical Cooperative staff.

**MONITORING GUAGE DATA**

**Well Location: CARTERET-CRAVEN**  
**Well ID Number: E00285**

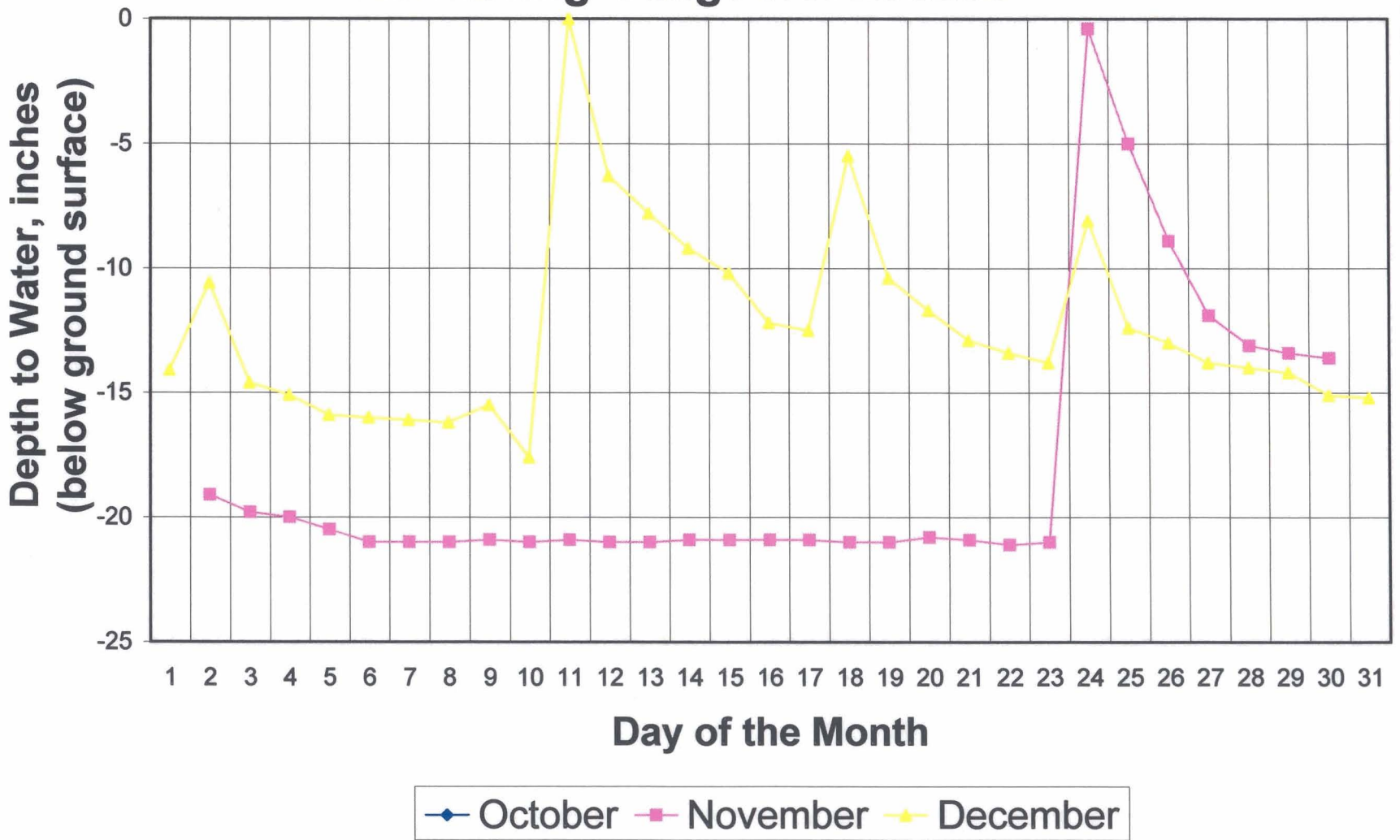
**Project Name: CARTERET-CRAVEN**  
**S&EC Project No.: 4224**

**Monitoring Cycle: Well readings once daily at 7:00 a.m.**

Reading Number Day of the Month	Year 2001											
	January	February	March	April	May	June	July	August	September	October	November	December
1												-14.1
2											-19.1	-10.6
3											-19.8	-14.6
4											-20	-15.1
5											-20.5	-15.9
6											-21	-16
7											-21	-16.1
8											-21	-16.2
9											-20.9	-15.5
10											-21	-17.6
11											-20.9	0
12											-21	-6.3
13											-21	-7.8
14											-20.9	-9.2
15											-20.9	-10.2
16											-20.9	-12.2
17											-20.9	-12.5
18											-21	-5.5
19											-21	-10.4
20											-20.8	-11.7
21											-20.9	-12.9
22											-21.1	-13.4
23											-21	-13.8
24											-0.4	-8.1
25											-5	-12.4
26											-8.9	-13
27											-11.9	-13.8
28											-13.1	-14
29		n/a									-13.4	-14.2
30		n/a									-13.6	-15.1
31		n/a		n/a		n/a		n/a		n/a	n/a	-15.2



# Carteret-Craven Monitoring Gauge No. E00285





**MONITORING GAUGE DATA**

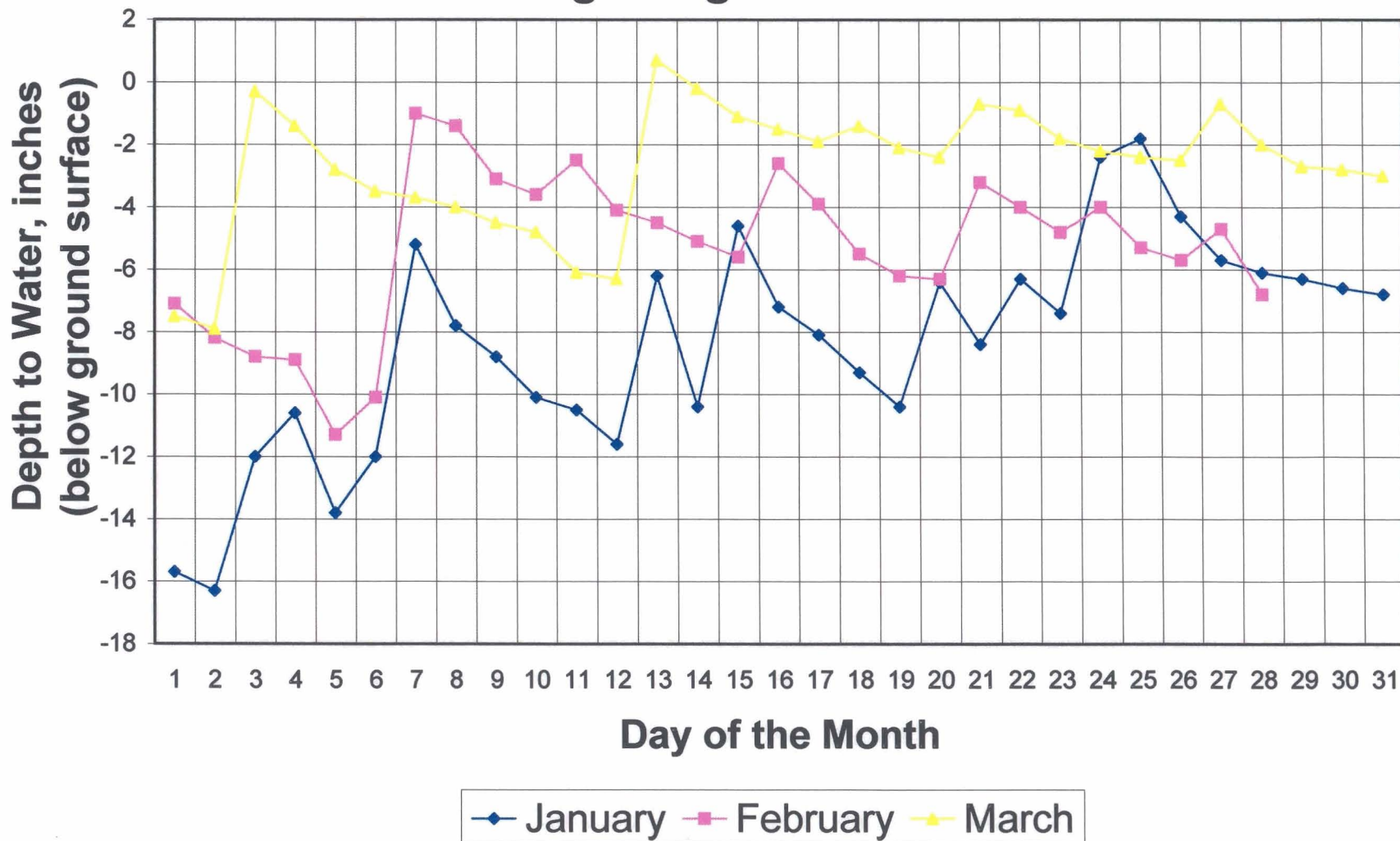
**Well Location: CARTERET-CRAVEN**  
**Well ID Number: E00285**

**Project Name: CARTERET-CRAVEN**  
**S&EC Project No.: 4224**

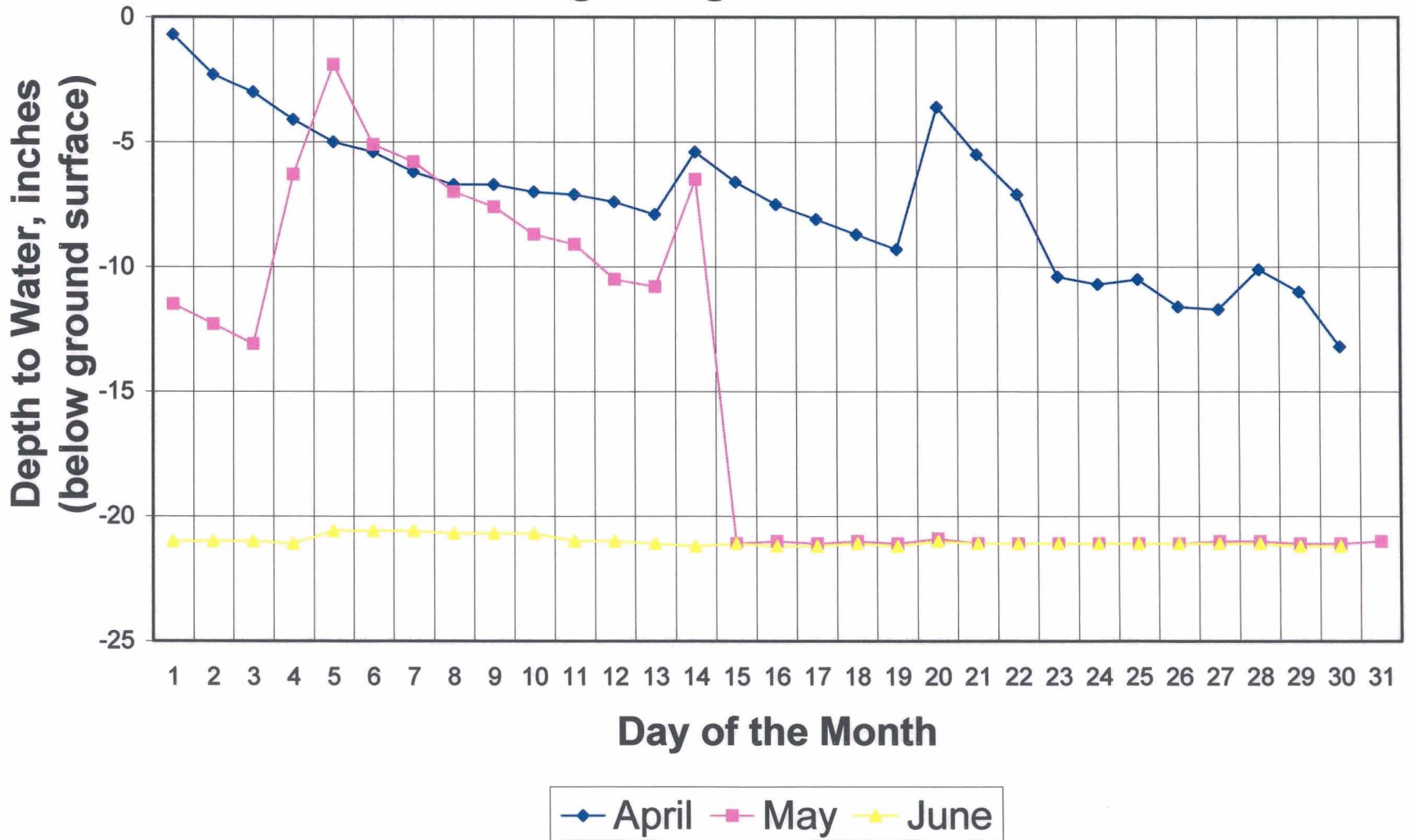
Monitoring Cycle: Well readings once daily at 7:00 a.m.

Reading Number Day of the Month	Year 2002											
	January	February	March	April	May	June	July	August	September	October	November	December
1	-15.7	-7.1	-7.5	-0.7	-11.5	-21	-21.2	-21.2	-21.5	-21.5		
2	-16.3	-8.2	-7.9	-2.3	-12.3	-21	-21.2	-21.2	-21.5	-21.5		
3	-12	-8.8	-0.3	-3	-13.1	-21	-21.2	-21.2	-21.4	-21.5		
4	-10.6	-8.9	-1.4	-4.1	-6.3	-21.1	-21.2	-21.2	-21.4	-21.4		
5	-13.8	-11.3	-2.8	-5	-1.9	-20.6	-21.2	-21.2	-21.5	-21.4		
6	-12	-10.1	-3.5	-5.4	-5.1	-20.6	-21.2	-21.2	-21.5	-21.4		
7	-5.2	-1	-3.7	-6.2	-5.8	-20.6	-21.2	-21.2	-21.5	-21.4		
8	-7.8	-1.4	-4	-6.7	-7	-20.7	-21.2	-21.2	-21.5	-21.4		
9	-8.8	-3.1	-4.5	-6.7	-7.6	-20.7	-21.2	-21.2	-21.5	-21.4		
10	-10.1	-3.6	-4.8	-7	-8.7	-20.7	-21.2	-21.2	-21.5	-21.4		
11	-10.5	-2.5	-6.1	-7.1	-9.1	-21	-21.2	-21.2	-21.5	-21.4		
12	-11.6	-4.1	-6.3	-7.4	-10.5	-21	-21.2	-21.2	-21.5	-21.4		
13	-6.2	-4.5	0.7	-7.9	-10.8	-21.1	-21.2	-21.2	-21.5	-21.4		
14	-10.4	-5.1	-0.2	-5.4	-6.5	-21.2	-21.2	-21.2	-21.5	-21.4		
15	-4.6	-5.6	-1.1	-6.6	-21.1	-21.1	-21.2	-21.2	-21.5	-21.3		
16	-7.2	-2.6	-1.5	-7.5	-21	-21.2	-21.2	-21.3	-21.5	-21.3		
17	-8.1	-3.9	-1.9	-8.1	-21.1	-21.2	-21.2	-21.3	-21.5			
18	-9.3	-5.5	-1.4	-8.7	-21	-21.1	-21.2	-21.3	-21.5			
19	-10.4	-6.2	-2.1	-9.3	-21.1	-21.2	-21.2	-21.3	-21.5			
20	-6.4	-6.3	-2.4	-3.6	-20.9	-21	-21.2	-21.3	-21.5			
21	-8.4	-3.2	-0.7	-5.5	-21.1	-21.1	-21.2	-21.3	-21.5			
22	-6.3	-4	-0.9	-7.1	-21.1	-21.1	-21.2	-21.3	-21.5			
23	-7.4	-4.8	-1.8	-10.4	-21.1	-21.1	-21.2	-21.3	-21.5			
24	-2.4	-4	-2.2	-10.7	-21.1	-21.1	-21.2	-21.3	-21.5			
25	-1.8	-5.3	-2.4	-10.5	-21.1	-21.1	-21.2	-21.3	-21.5			
26	-4.3	-5.7	-2.5	-11.6	-21.1	-21.1	-21.2	-21.3	-21.5			
27	-5.7	-4.7	-0.7	-11.7	-21	-21.1	-21.2	-21.3	-21.5			
28	-6.1	-6.8	-2	-10.1	-21	-21.1	-21.3	-21.3	-21.5			
29	-6.3	n/a	-2.7	-11	-21.1	-21.2	-21.3	-21.3	-21.5			
30	-6.6	n/a	-2.8	-13.2	-21.1	-21.2	-21.2	-21.5	-21.5			
31	-6.8	n/a	-3	n/a	-21	n/a	-21.2	-21.5	n/a		n/a	

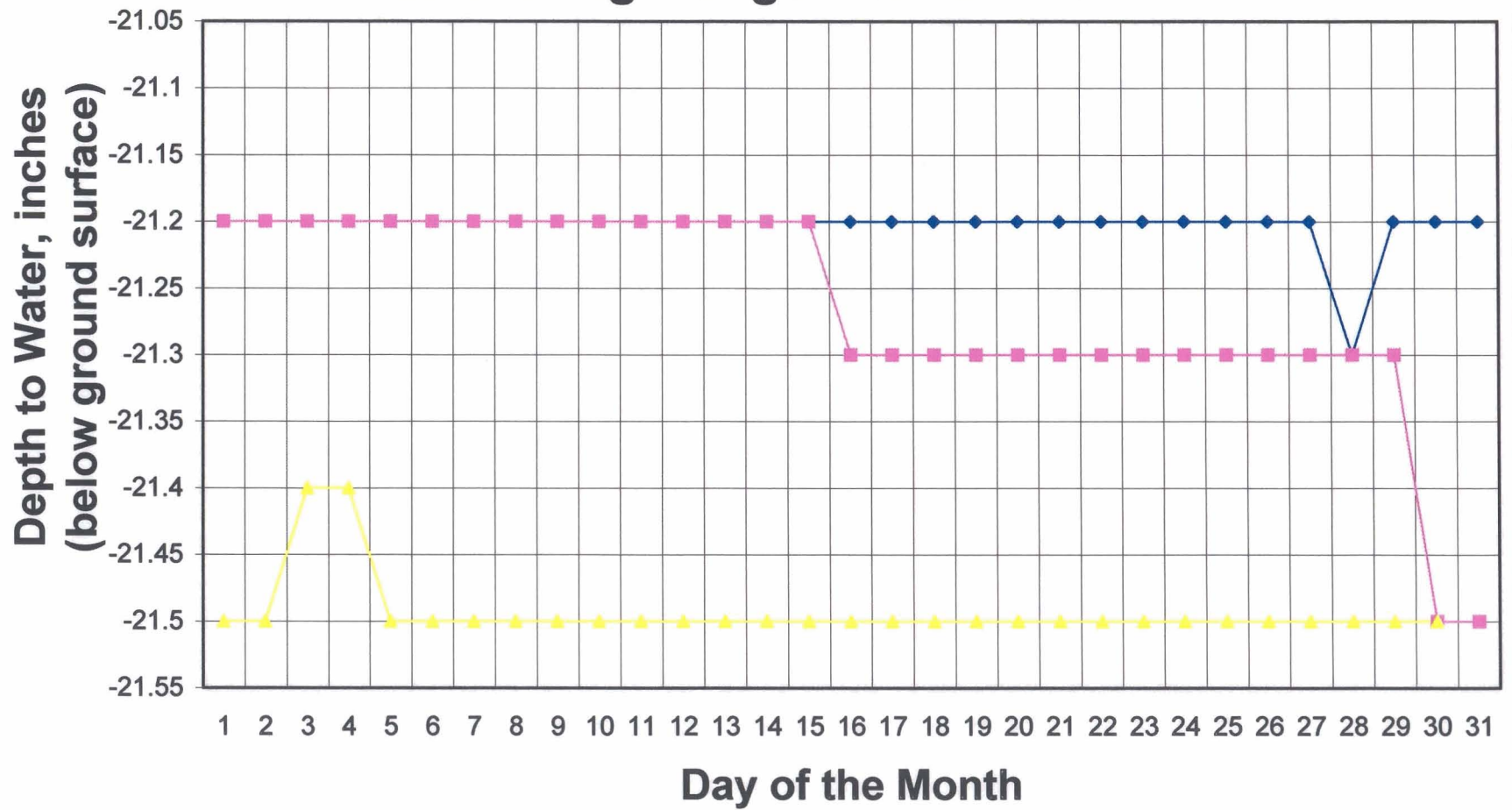
# Carteret-Craven Monitoring Gauge No. E00285



# Carteret-Craven Monitoring Gauge No. E00285

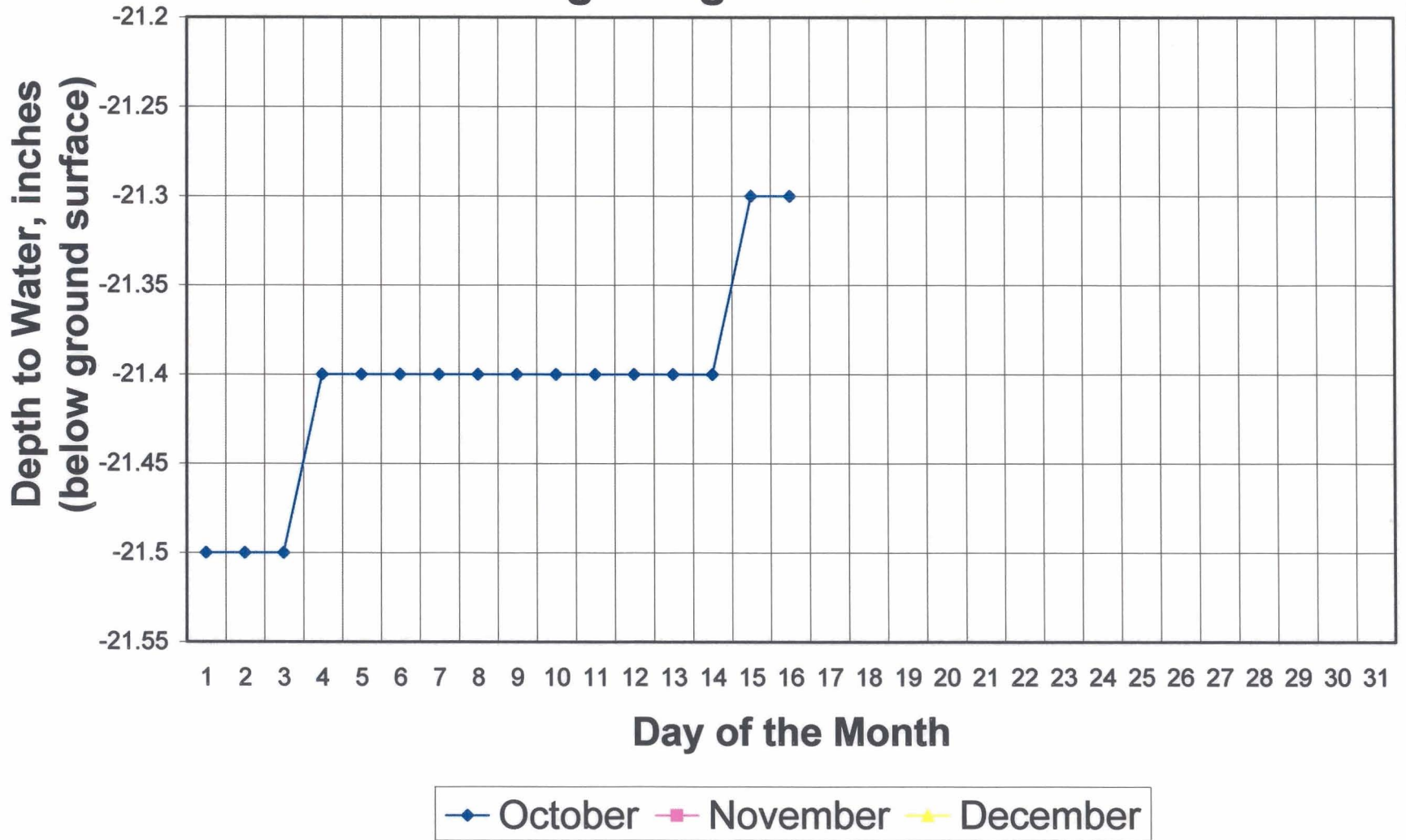


# Carteret-Craven Monitoring Gauge No. E00285



◆ July    ■ August    ▲ September

# Carteret-Craven Monitoring Gauge No. E00285



**MONITORING GAUGE DATA**

Well Location: CARTERET-CRAVEN  
 Well ID Number: E00285

Project Name: CARTERET-CRAVEN  
 S&EC Project No.: 4224

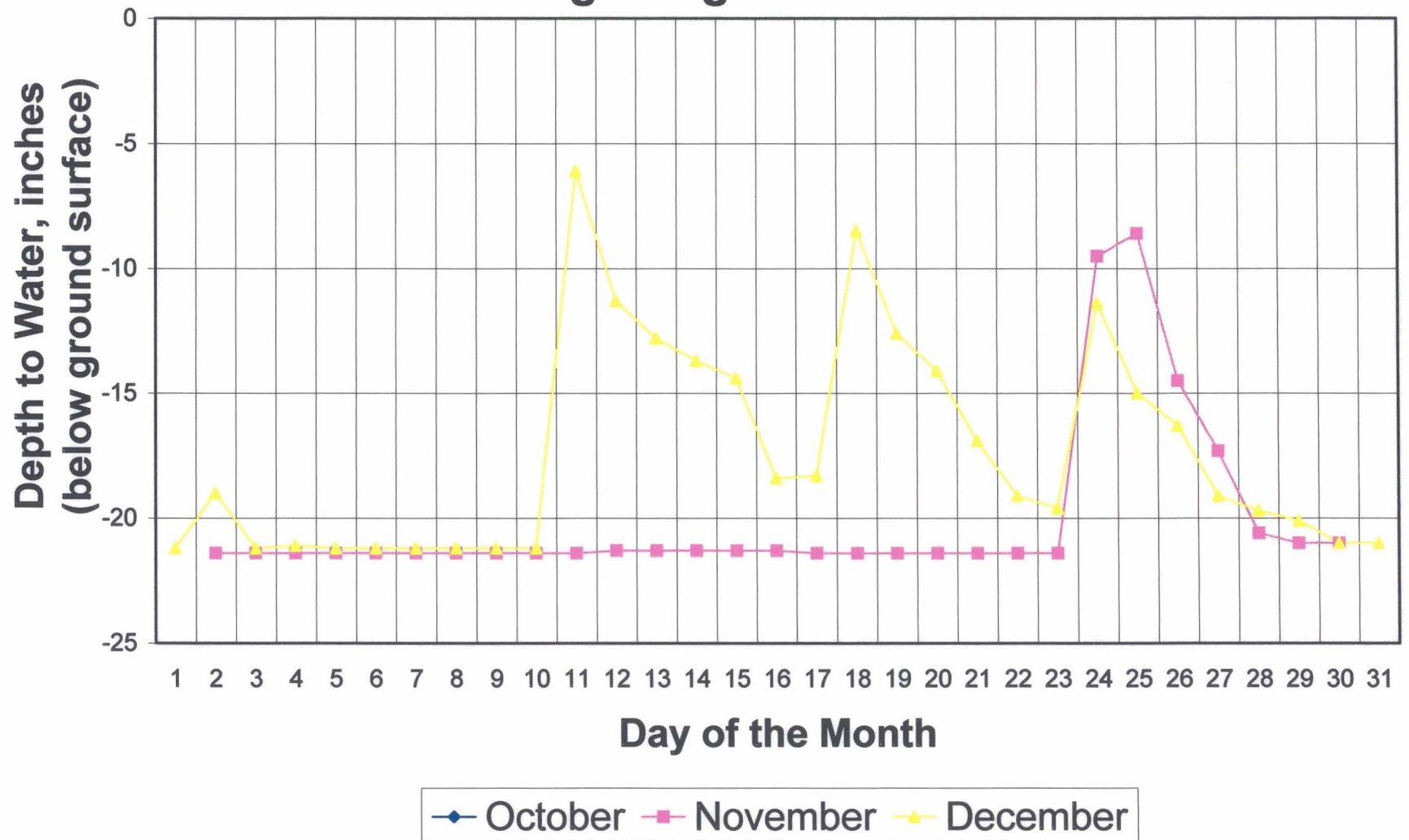
Monitoring Cycle: Well readings once daily at 7:00 a.m.

Statistic	Year 2002												
	January	February	March	April	May	June	July	August	September	October	November	December	ANNUAL
Mean Depth to Water (inches)	-8.36	-5.30	-2.72	-7.35	-15.30	-21.01	-21.20	-21.26	-21.49	-21.41	#DIV/0!	#DIV/0!	-14.54
Median Depth Value (inches)	-7.80	-4.95	-2.40	-7.10	-21.00	-21.10	-21.20	-21.30	-21.50	-21.40	#NUM!	#NUM!	-14.98
Number of Days Water w/in 12 Ground Surface	28	28	31	29	12	0	0	0	0				14.22
Max. Consecutive Days w/in 12 Ground Surface	26	28	31	28	11	0	0	0	0				114
Three Longest Periods w/in 12 of Ground Surface	26 2	28	31	28	11 1	0	0	0	0				114 11 2





# Carteret-Craven Monitoring Gauge No. E00286



**MONITORING GAUGE DATA**

**Well Location:** CARTERET-CRAVEN  
**Well ID Number:** E00286

**Project Name:** CARTERET-CRAVEN  
**S&EC Project No.:** 4224

**Monitoring Cycle:** Well readings once daily at 7:00 a.m.

Statistic	Year 2001												ANNUAL
	January	February	March	April	May	June	July	August	September	October	November	December	
Mean Depth to Water (inches)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	-20.10	-17.39	-18.74
Median Depth Value (inches)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	-21.40	-19.10	-20.25
Number of Days Water w/in 12 Ground Surface											3	4	3.50
Max. Consecutive Days w/in 12 Ground Surface											2	2	2
Three Longest Periods w/in 12 of Ground Surface											2	2 1	2 1 1

## MONITORING GAUGE DATA

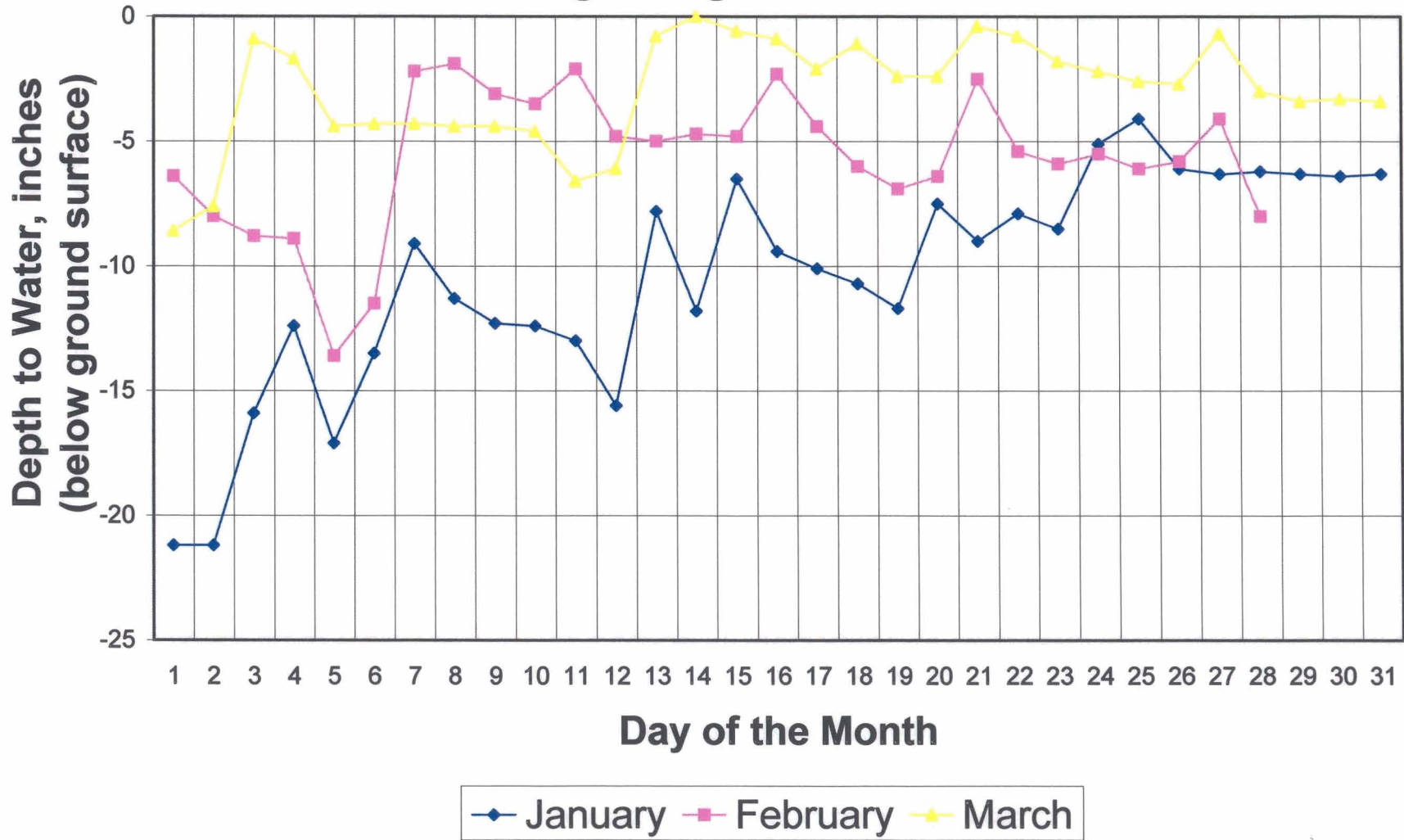
Well Location: CARTERET-CRAVEN  
Well ID Number: E00286

Project Name: CARTERET-CRAVEN  
S&EC Project No.: 4224

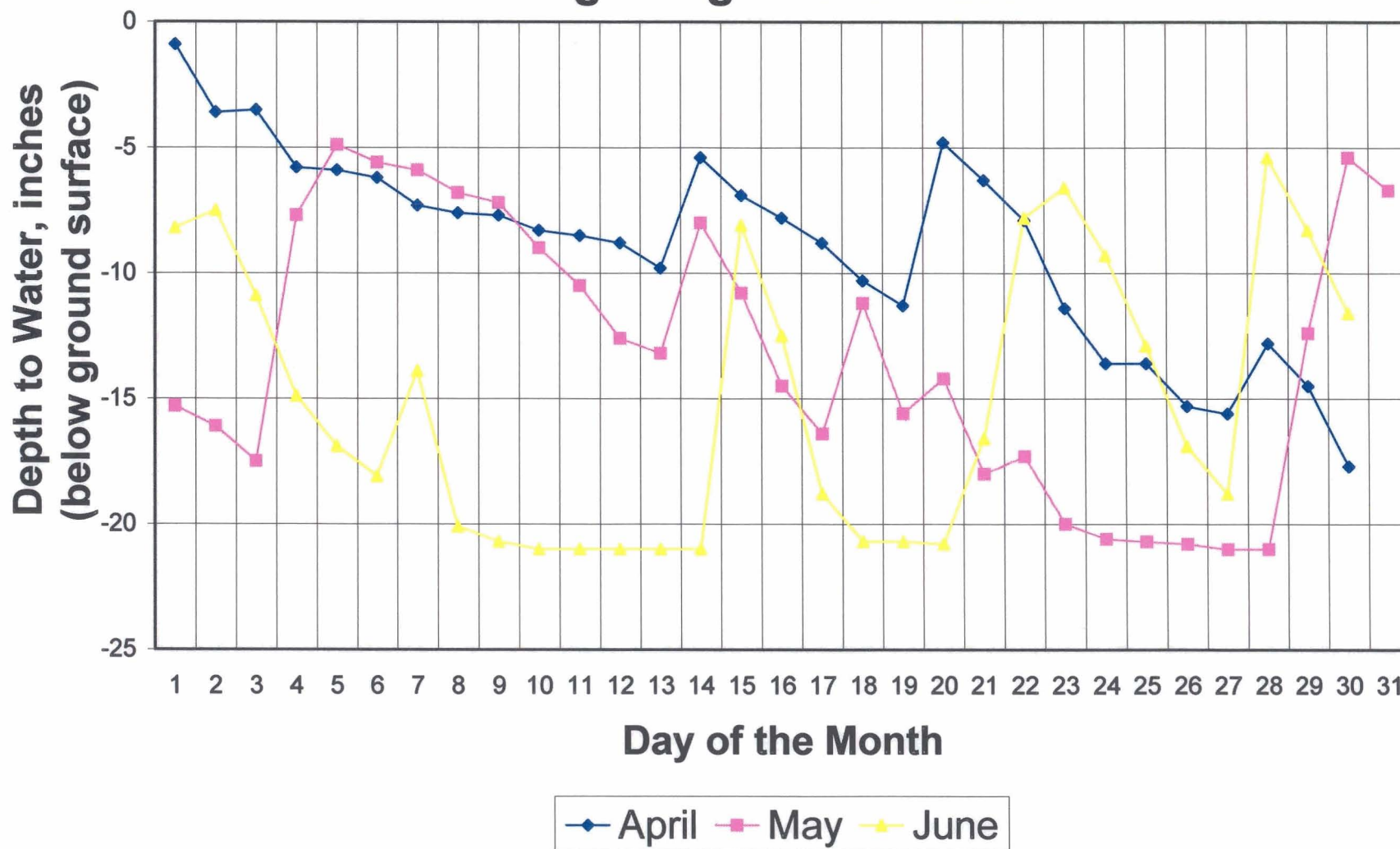
Monitoring Cycle: Well readings once daily at 7:00 a.m.

Reading Number Day of the Month	Year 2002											
	January	February	March	April	May	June	July	August	September	October	November	December
1	-21.2	-6.4	-8.6	-0.9	-15.3	-8.2	-16.7	-4.1	1.5	-0.6	-2.9	
2	-21.2	-8	-7.6	-3.6	-16.1	-7.5	-19.3	-6	0.6	-1.1	-3.5	
3	-15.9	-8.8	-0.9	-3.5	-17.5	-10.9	-20.6	-7.9	0.5	-1.3	-3.9	
4	-12.4	-8.9	-1.7	-5.8	-7.7	-14.9	-20.9	-9.6	0.3	-1.6	-1.9	
5	-17.1	-13.6	-4.4	-5.9	-4.9	-16.9	-20.9	-11.9	0.1	-2.1	-3.5	
6	-13.5	-11.5	-4.3	-6.2	-5.6	-18.1	-20.9	-13.4	-0.5	-2.6	-2.2	
7	-9.1	-2.2	-4.3	-7.3	-5.9	-13.9	-20.9	-14	-1	-2.9	-1.3	
8	-11.3	-1.9	-4.4	-7.6	-6.8	-20.1	-21	-16	-1.1	-3.9	-1.9	
9	-12.3	-3.1	-4.4	-7.7	-7.2	-20.7	-20.9	-17.3	-1.6	-4.5	-2.2	
10	-12.4	-3.5	-4.6	-8.3	-9	-21	-20.9	-18.5	0.5	-3	-1.2	
11	-13	-2.1	-6.6	-8.5	-10.5	-21	-7.4	-19.7	0.5	-1.5	-1	
12	-15.6	-4.8	-6.1	-8.8	-12.6	-21	-13.3	-20.4	0.5	1.2	-0.8	
13	-7.8	-5	-0.8	-9.8	-13.2	-21	-19	-20.4	-0.3	-0.5	-0.7	
14	-11.8	-4.7	0	-5.4	-8	-21	-19.7	-20.4	-0.4	-1.3	-1.5	
15	-6.5	-4.8	-0.6	-6.9	-10.8	-8.1	-16.5	-20.4	0	-0.8	-2	
16	-9.4	-2.3	-0.9	-7.8	-14.5	-12.5	-9.4	-20.4	0.5	0.4	-1.3	
17	-10.1	-4.4	-2.1	-8.8	-16.4	-18.8	-14.5	-20.4	0.4	-0.5	-1.6	
18	-10.7	-6	-1.1	-10.3	-11.2	-20.7	-20.5	-20.5	-0.4	-1.6	-0.4	
19	-11.7	-6.9	-2.4	-11.3	-15.6	-20.7	-20.9	-20.5	-1	-2	-1.1	
20	-7.5	-6.4	-2.4	-4.8	-14.2	-20.8	-21	-20.5	-1.8	-1.9	-1.3	
21	-9	-2.5	-0.4	-6.3	-18	-16.6	-7.6	-20.5	-2.2	-2	-1.3	
22	-7.9	-5.4	-0.8	-7.9	-17.3	-7.8	-6.8	-20.7	-2.5	-1.2		
23	-8.5	-5.9	-1.8	-11.4	-20	-6.6	-9	-20.7	-2.8	-2.2		
24	-5.1	-5.5	-2.2	-13.6	-20.6	-9.3	-5	-20.7	0	-2.6		
25	-4.1	-6.1	-2.6	-13.6	-20.7	-12.9	-2.4	-20.7	-1.3	-2.2		
26	-6.1	-5.8	-2.7	-15.3	-20.8	-16.9	-3.7	-1.9	0.1	-2.3		
27	-6.3	-4.1	-0.7	-15.6	-21	-18.8	-1.4	-2.4	0.6	-3.2		
28	-6.2	-8	-3	-12.8	-21	-5.4	0.4	-1.9	0.2	-3.2		
29	-6.3	n/a	-3.4	-14.5	-12.4	-8.3	-2.2	-1	0.5	-2.3		
30	-6.4	n/a	-3.3	-17.7	-5.4	-11.6	-3.1	1.2	-0.1	-1.4		
31	-6.3	n/a	-3.4	n/a	-6.7	n/a	-4.3	1.3	n/a	-2	n/a	

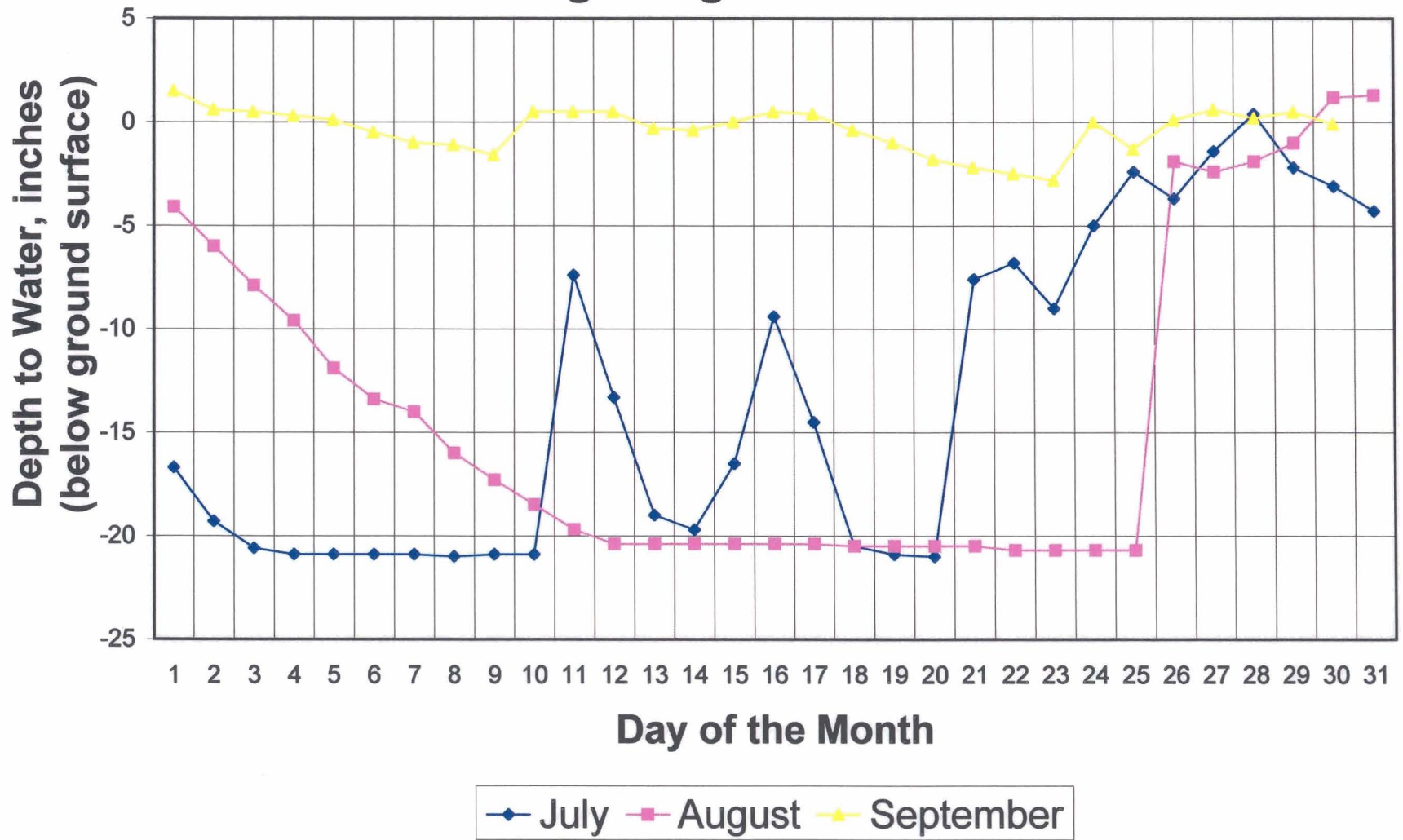
# Carteret-Craven Monitoring Gauge No. E00286



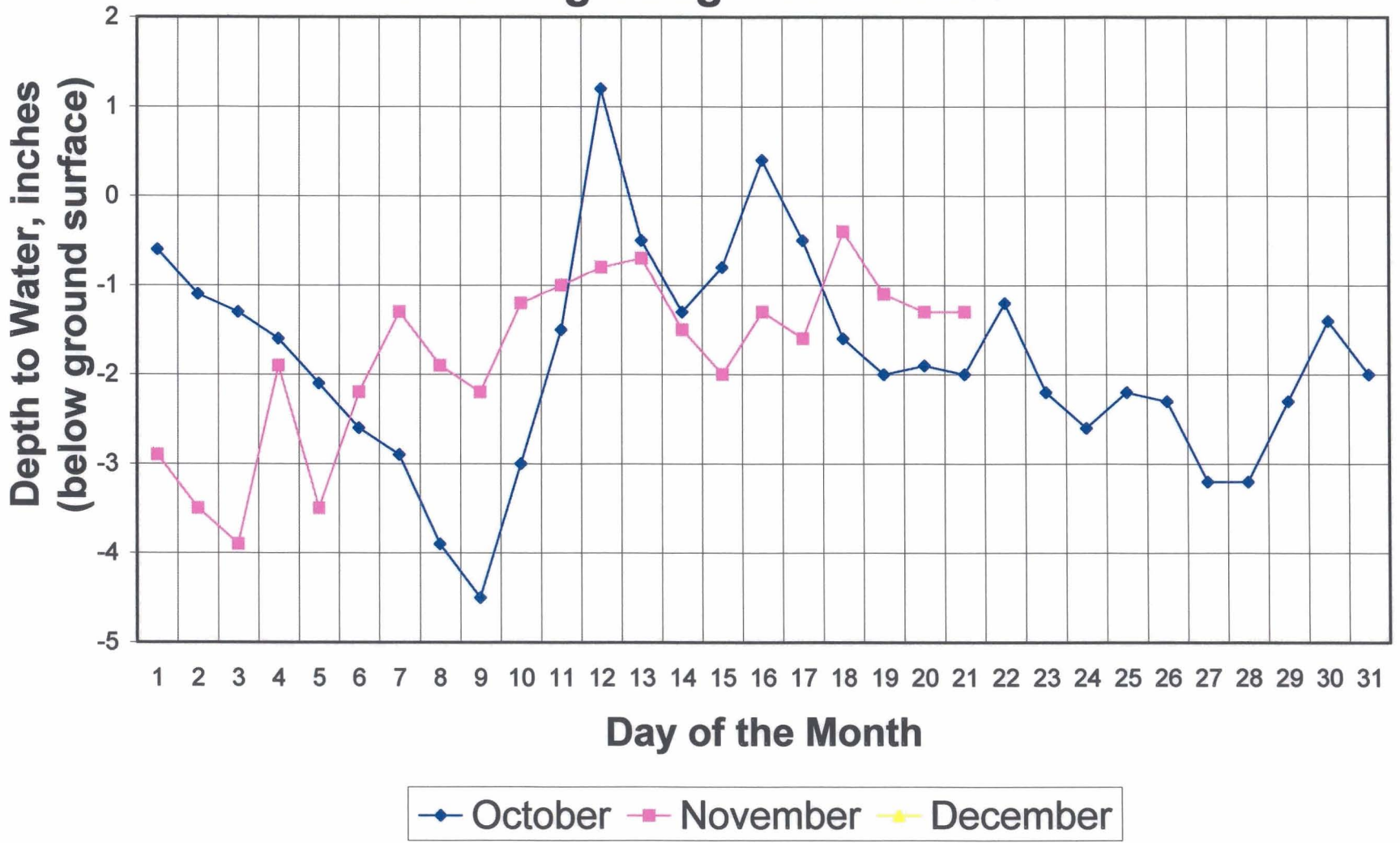
# Carteret-Craven Monitoring Gauge No. E00286



# Carteret-Craven Monitoring Gauge No. E00286



# Carteret-Craven Monitoring Gauge No. E00286





## MONITORING GAUGE DATA

Well Location: CARTERET-CRAVEN  
 Well ID Number: E00286

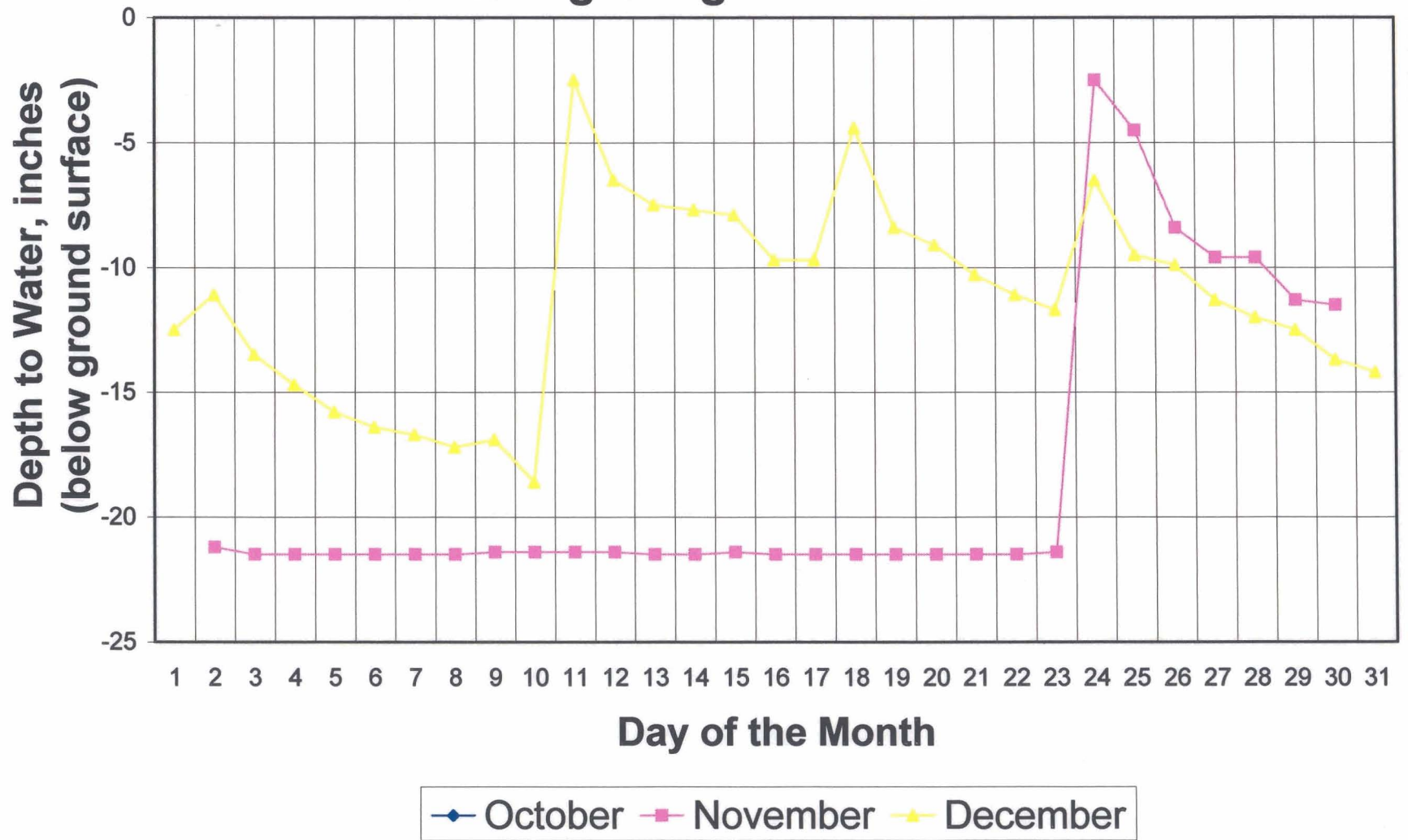
Project Name: CARTERET-CRAVEN  
 S&EC Project No.: 4224

Monitoring Cycle: Well readings once daily at 7:00 a.m.

Statistic	Year 2002												ANNUAL
	January	February	March	April	May	June	July	August	September	October	November	December	
Mean Depth to Water (inches)	-10.41	-5.66	-2.98	-8.93	-13.13	-15.07	-13.24	-13.88	-0.34	-1.83	-1.79	#DIV/0!	-7.93
Median Depth Value (inches)	-9.40	-5.45	-2.60	-8.10	-13.20	-16.75	-16.50	-18.50	0.00	-2.00	-1.50	#NUM!	-8.55
Number of Days Water w/in 12 Ground Surface	21	27	31	23	13	10	13	11	30	31	21		21.00
Max. Consecutive Days w/in 12 Ground Surface	19	23	31	23	8	3	11	6	30	31	21		88
Three Longest Periods w/in 12 of Ground Surface	19 2	23 4	31	23	8 2 2	3 3 3	11 1 1	6 5	30	31	21		88 77 23



# Carteret-Craven Monitoring Gauge No. E00287



**MONITORING GAUGE DATA**

**Well Location:** CARTERET-CRAVEN  
**Well ID Number:** E00287

**Project Name:** CARTERET-CRAVEN  
**S&EC Project No.:** 4224

**Monitoring Cycle:** Well readings once daily at 7:00 a.m.

Statistic	Year 2001												
	January	February	March	April	May	June	July	August	September	October	November	December	ANNUAL
Mean Depth to Water (inches)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	-18.26	-11.27	-14.77
Median Depth Value (inches)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	-21.50	-11.10	-16.30
Number of Days Water w/in 12 Ground Surface											8	19	13.50
Max. Consecutive Days w/in 12 Ground Surface											7	18	18
Three Longest Periods w/in 12 of Ground Surface											7	18 1	18 7 1

## MONITORING GAUGE DATA

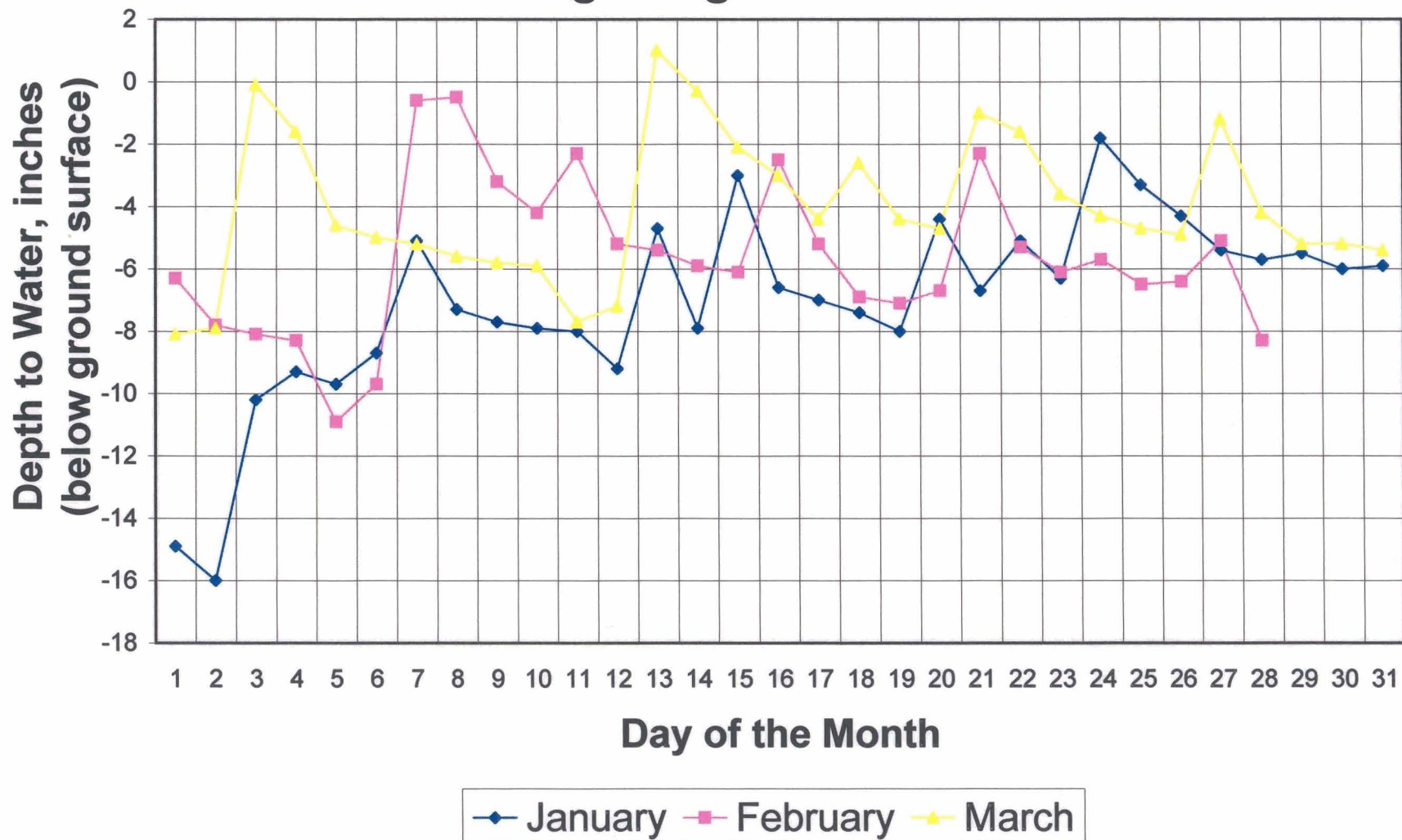
Well Location: **CARTERET-CRAVEN**  
 Well ID Number: **E00287**

Project Name: **CARTERET-CRAVEN**  
 S&EC Project No.: **4224**

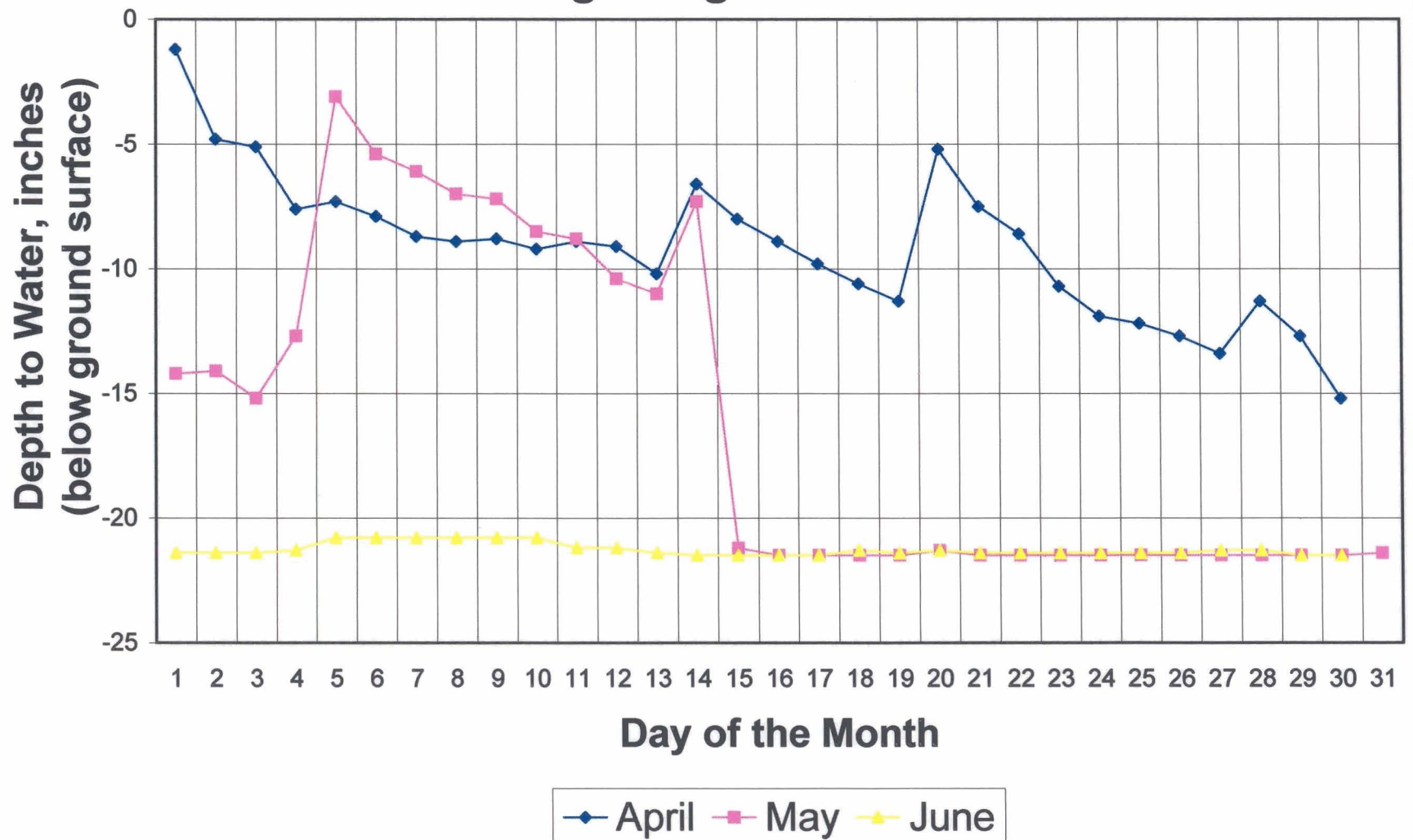
Monitoring Cycle: Well readings once daily at 7:00 a.m.

Reading Number Day of the Month	Year 2002											
	January	February	March	April	May	June	July	August	September	October	November	December
1	-14.9	-6.3	-8.1	-1.2	-14.2	-21.4	-21.5	-21.3	-21.7	-21.6		
2	-16	-7.8	-7.9	-4.8	-14.1	-21.4	-21.5	-21.3	-21.7	-21.6		
3	-10.2	-8.1	-0.1	-5.1	-15.2	-21.4	-21.5	-21.3	-21.6	-21.7		
4	-9.3	-8.3	-1.6	-7.6	-12.7	-21.3	-21.5	-21.3	-21.6	-21.6		
5	-9.7	-10.9	-4.6	-7.3	-3.1	-20.8	-21.4	-21.3	-21.6	-21.6		
6	-8.7	-9.7	-5	-7.9	-5.4	-20.8	-21.4	-21.3	-21.6	-21.6		
7	-5.1	-0.6	-5.2	-8.7	-6.1	-20.8	-21.4	-21.3	-21.6	-21.6		
8	-7.3	-0.5	-5.6	-8.9	-7	-20.8	-21.4	-21.3	-21.6	-21.6		
9	-7.7	-3.2	-5.8	-8.8	-7.2	-20.8	-21.4	-21.3	-21.6	-21.6		
10	-7.9	-4.2	-5.9	-9.2	-8.5	-20.8	-21.4	-21.3	-21.6	-21.6		
11	-8	-2.3	-7.7	-8.9	-8.8	-21.2	-21.4	-21.3	-21.6	-21.6		
12	-9.2	-5.2	-7.2	-9.1	-10.4	-21.2	-21.4	-21.3	-21.6	-21.6		
13	-4.7	-5.4	1	-10.2	-11	-21.4	-21.4	-21.3	-21.6	-21.6		
14	-7.9	-5.9	-0.3	-6.6	-7.3	-21.5	-21.4	-21.3	-21.6	-21.6		
15	-3	-6.1	-2.1	-8	-21.2	-21.5	-21.3	-21.3	-21.6	-21.6		
16	-6.6	-2.5	-3	-8.9	-21.5	-21.5	-21.3	-21.2	-21.7	-21.6		
17	-7	-5.2	-4.4	-9.8	-21.5	-21.5	-21.3	-21.2	-21.7			
18	-7.4	-6.9	-2.6	-10.6	-21.5	-21.3	-21.3	-21.2	-21.6			
19	-8	-7.1	-4.4	-11.3	-21.5	-21.4	-21.3	-21.2	-21.7			
20	-4.4	-6.7	-4.7	-5.2	-21.3	-21.3	-21.3	-21.2	-21.6			
21	-6.7	-2.3	-1	-7.5	-21.5	-21.4	-21.3	-21.2	-21.6			
22	-5.1	-5.3	-1.6	-8.6	-21.5	-21.4	-21.3	-21.2	-21.6			
23	-6.3	-6.1	-3.6	-10.7	-21.5	-21.4	-21.3	-21.2	-21.6			
24	-1.8	-5.7	-4.3	-11.9	-21.5	-21.4	-21.3	-21.2	-21.6			
25	-3.3	-6.5	-4.7	-12.2	-21.5	-21.4	-21.3	-21.2	-21.6			
26	-4.3	-6.4	-4.9	-12.7	-21.5	-21.4	-21.3	-21.2	-21.6			
27	-5.4	-5.1	-1.2	-13.4	-21.5	-21.3	-21.3	-21.2	-21.6			
28	-5.7	-8.3	-4.2	-11.3	-21.5	-21.3	-21.4	-21.2	-21.7			
29	-5.5	n/a	-5.2	-12.7	-21.5	-21.5	-21.3	-21.2	-21.6			
30	-6	n/a	-5.2	-15.2	-21.5	-21.5	-21.4	-21.7	-21.6			
31	-5.9	n/a	-5.4	n/a	-21.4	n/a	-21.3	-21.7	n/a		n/a	

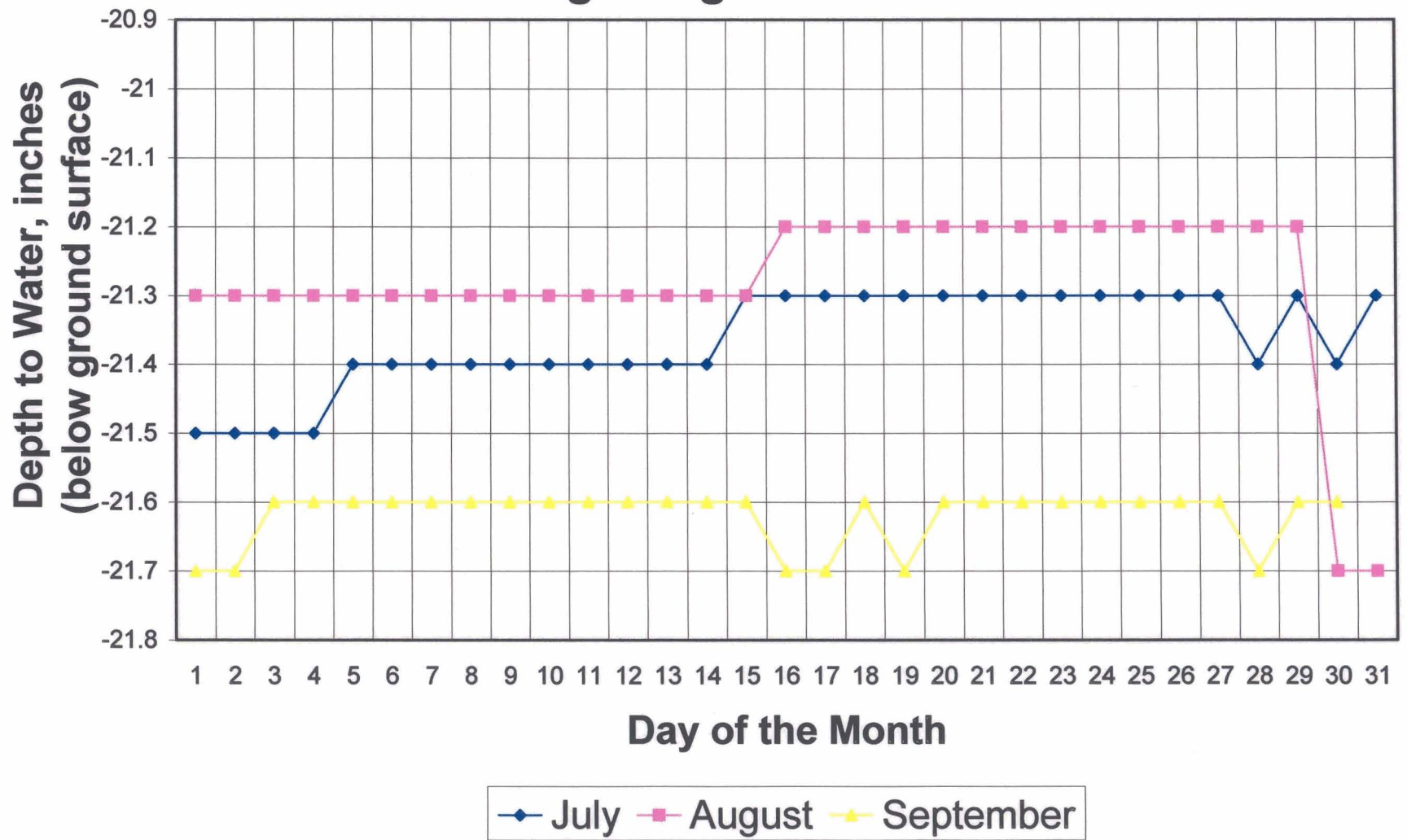
# Carteret-Craven Monitoring Gauge No. E00287



# Carteret-Craven Monitoring Gauge No. E00287



# Carteret-Craven Monitoring Gauge No. E00287





# Carteret-Craven Monitoring Gauge No. E00287

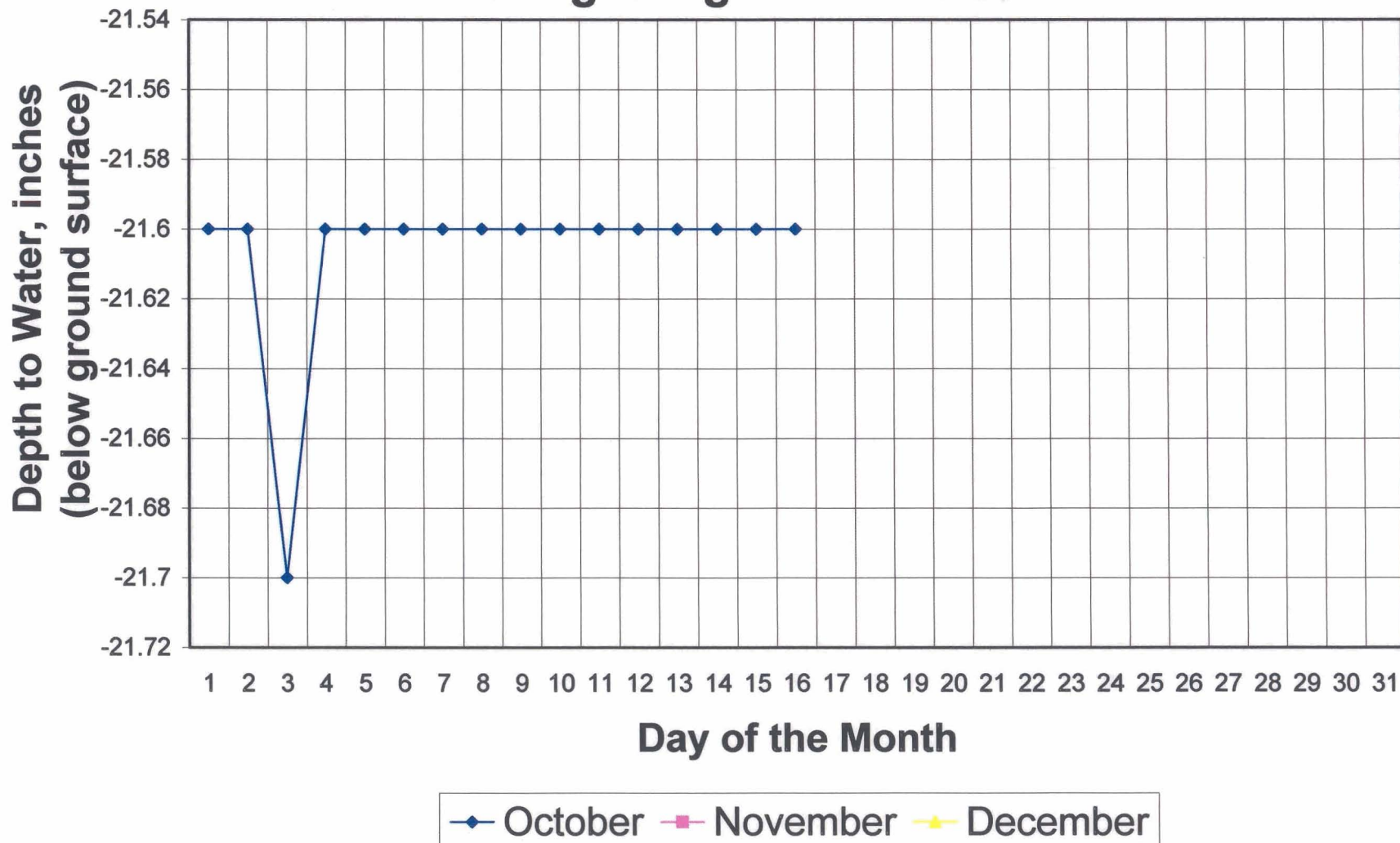






Photo 1 – East Cell Looking East



Photo 2 – East Cell Looking Northeast

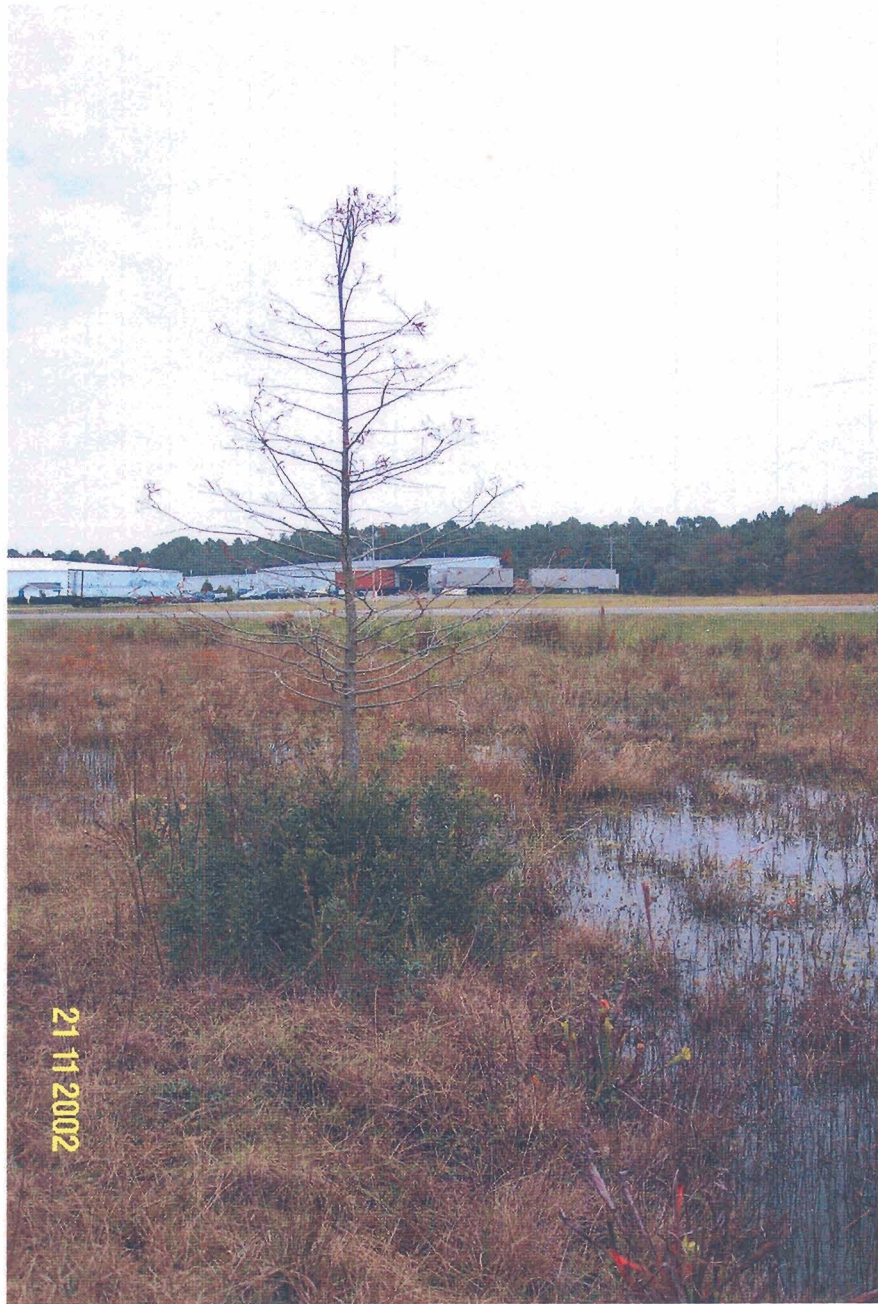


Photo 3 – East Cell Looking Northeast



Photo 4 – East Cell Looking Southeast



Photo 5 – Plant Survivability Plot Layout (Looking North)