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THE JOHN R. McADAMS COMPANY, INC.

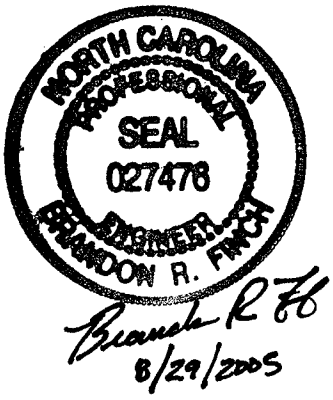
WILLIAMS CORNER

CHATHAM COUNTY, NORTH CAROLINA

PRELIMINARY STORMWATER IMPACT ANALYSIS

FOR-05190

August 2005



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WILLIAMS CORNER

Preliminary Stormwater Management Plan

Project Description and Summary

Williams Corner is located at the northeast quadrant of the intersection of US 15-501 and Lystra Road in Chatham County, North Carolina. The proposed project is a mixed-use development with associated building and parking areas. The project area consists of approximately 98.5 acres with approximately 23.6 acres of the site to be covered with impervious surfaces under the proposed plan. This site is currently undeveloped.

Currently the site must comply with two sets of stormwater management requirements. The site is located within the water-supply watershed protected area for B. Everett Jordan Lake and therefore must comply with the Chatham County Watershed Protection ordinance. Also, per discussions with County staff, this project must comply with the high-density option post-construction stormwater management requirements of the upcoming National Pollutant Discharge Elimination System (NPDES) Phase II program. The site will remain under 24% impervious; therefore the water-supply watershed regulations will be satisfied for low-density development.

Stormwater management is an important facet to the overall development of this project and of Chatham County as a whole. Stormwater runoff from this site ultimately discharges into B. Everett Jordan Lake, which is the drinking water source for several municipalities in the region. Due to this concern and a variety of others, the stormwater management plan for Williams Corner meets the high-density NPDES Phase II requirements for stormwater management, while also meeting the low-density impervious surface thresholds.

The calculations contained within this report are based on a preliminary analysis of the site. Further analysis of the site and downstream systems based on more detailed information (once site design is started and field survey information becomes available) may indicate the need for actions other than those recommended within this report.

Stormwater Management Regulations

As mentioned previously, the stormwater management regulations for this site stem from both compliance with the water-supply watershed regulations and the upcoming NPDES Phase II post-construction runoff stormwater management controls. For compliance with the water-supply watershed regulations (WS-IV PA), the site is to be developed at less than 24% impervious surface.

The project also complies with the high-density option of the NPDES Phase II regulations for stormwater management control. These regulations include:

- That measures be in place to control and treat the difference in stormwater runoff volume leaving the project site between pre- and post-development conditions for the one-year, 24-hour storm event.

- That all structural stormwater management facilities meet the requirement for a minimum 85% average annual removal for Total Suspended Solids (TSS).

Discussion of Low-Impact Development Techniques

As development of Williams Corner progresses, it is expected that low-impact development (LID) techniques may be incorporated. LID techniques are sited and designed to control stormwater runoff close to the point of generation, in an attempt to better match pre-development hydrology in the post-development condition. However, it is not possible at this point in the design process to determine to what extent LID practices may be used for this development. The developer of this project has committed to the use of LID where the use of such is feasible and practical. LID techniques may be used in combination with the stormwater devices presented in this report to further reduce pollutants in stormwater runoff before discharge from the site.

It is important to note that the hydrologic effects of low-impact development devices are heavily dependent upon their maintenance, location, and type of practice chosen. All of these factors will be considered when deciding the type and extent of LID to be used within this particular project.

Sediment and Erosion Control during construction

Control of sediment in runoff during construction is a major concern with any development project. A sedimentation and erosion control plan will be developed for this site, and approved by the appropriate authority. The erosion control measures provided for in this plan will be in place and operational at the onset of construction. As the sedimentation and erosion control plan is developed, a more "regional" approach to erosion control will be taken where possible. The plan will, to the extent practicable, place the sedimentation control facilities along the outskirts of land disturbance. This will allow the usage of riser sediment basins, which are more efficient than many other erosion control methods. This also allows the contractor to work within the site without disturbance of the more localized erosion control methods, such as inlet control protections. Maintenance of sedimentation and erosion control measures is imperative to the efficient capture of sediment in stormwater runoff. Proper maintenance and inspection is arguably the most important consideration for erosion control measures. The erosion control measures provided for in the approved plan will be installed and maintained per the requirements of the plan.

Calculation Methodology

The proposed stormwater management facilities have been preliminarily sized for illustration on the preliminary plans for the project. Included with this report are the preliminary sizing computations for each of the facilities depicted on the plans.

- Drainage areas to each facility were estimated as to total area to the facility and the proposed impervious area that is planned to drain to each facility.

- Surface area requirements for each of the facilities was computed based on requirements found in *Stormwater Best Management Practices*, April 1999, published by the NC Division of Water Quality.

- For preliminary purposed, the facilities were designed to completely store the runoff for the post-development 1-year, 24-hour storm event. This is conservative, since the requirement will be only to store the *difference* in volume between the pre- and post-development 1-year, 24-hour storm events.

- The stormwater runoff volume for the 1-year, 24-hour storm event was computed by taking the drainage area to the pond and multiplying that area by the rainfall depth for the 1-year, 24-hour storm event (3.0 inches). This is conservative, as the actual stormwater runoff amount will be dependent on site soil types and land uses within the drainage basin to the facility. This will be revised to actual computed runoff numbers as the design process progresses.

- A preliminary grading plan is presented for each of the facilities that meets both the surface area *and* volume storage requirements as computed within this report. The areas should be conservative, based upon the assumptions stated earlier.

SUMMARY OF RESULTS

B.R. FINCH, PE
8/29/2005

==> *Wet Pond #1*

Required surface area at normal pool =	12456	sq. ft.
Provided surface area at normal pool =	22773	sq. ft.
3-inch rainfall volume =	164330	cu. ft.
Total provided detention volume =	246449	cu. ft.

==> *Wet Pond #2*

Required surface area at normal pool =	7288	sq. ft.
Provided surface area at normal pool =	25003	sq. ft.
3-inch rainfall volume =	118701	cu. ft.
Total provided detention volume =	185794	cu. ft.

==> *Wetland #3*

Required surface area at normal pool =	8590	sq. ft.
Provided surface area at normal pool =	16326	sq. ft.
3-inch rainfall volume =	121480	cu. ft.
Total provided detention volume =	160200	cu. ft.

==> *Wetland #4*

Required surface area at normal pool =	9911	sq. ft.
Provided surface area at normal pool =	11973	sq. ft.
3-inch rainfall volume =	103237	cu. ft.
Total provided detention volume =	140959	cu. ft.

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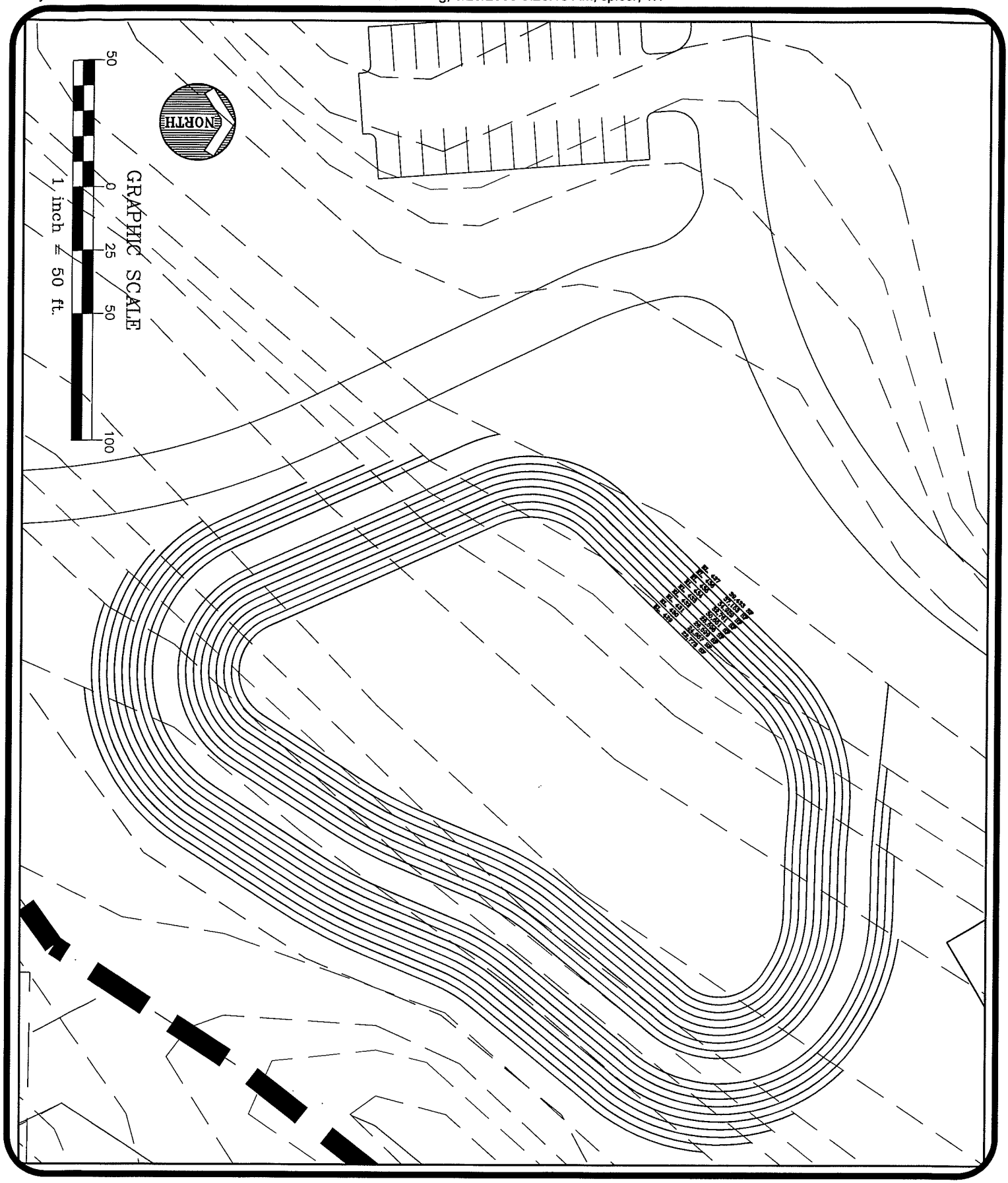

McADAMS

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DATE:	08-29-2005

WILLIAMS CORNER

DURHAM, NORTH CAROLINA

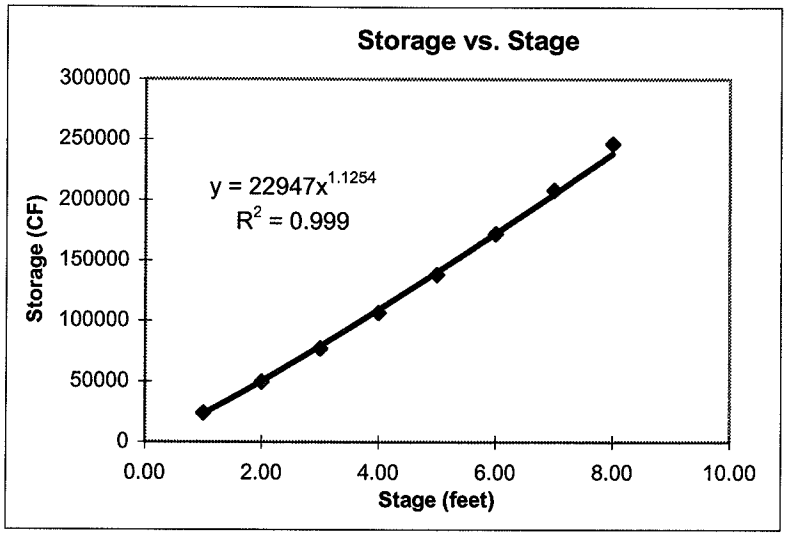
POND #1 EXHIBIT

THE JOHN R. McADAMS COMPANY, INC.
ENGINEERS/PLANNERS/SURVEYORS
RESEARCH TRIANGLE PARK, NC
P.O. BOX 14005 ZIP 27709-4005
(919) 361-5000

Stage-Storage Function

Project Name: Lystra Road - Pond #1
Designer: B.R. Finch, PE
Job Number: FOR-05190
Date: 8/29/2005

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
429.00	0.00	22773				
430.00	1.00	24657	23715	23715	23715	1.03
431.00	2.00	26599	25628	25628	49343	1.97
432.00	3.00	28596	27598	27598	76941	2.93
433.00	4.00	30651	29624	29624	106564	3.91
434.00	5.00	32761	31706	31706	138270	4.93
435.00	6.00	34929	33845	33845	172115	5.99
436.00	7.00	37153	36041	36041	208156	7.10
437.00	8.00	39433	38293	38293	246449	8.24



K_S =	**22947**
b =	**1.1254**

==> Stage - Storage Function

Ks = 22947
b = 1.1254
Zo = 429.00

Elevation	Storage	
[feet]	[cf]	[acre-feet]
429.00	0	0.000
429.20	3751	0.086
429.40	8182	0.188
429.60	12914	0.296
429.80	17851	0.410
430.00	22947	0.527
430.20	28173	0.647
430.40	33510	0.769
430.60	38944	0.894
430.80	44464	1.021
431.00	50062	1.149
431.20	55730	1.279
431.40	61463	1.411
431.60	67257	1.544
431.80	73107	1.678
432.00	79009	1.814
432.20	84961	1.950
432.40	90960	2.088
432.60	97004	2.227
432.80	103089	2.367
433.00	109215	2.507
433.20	115380	2.649
433.40	121582	2.791
433.60	127818	2.934
433.80	134090	3.078
434.00	140393	3.223
434.20	146729	3.368
434.40	153095	3.515
434.60	159491	3.661
434.80	165916	3.809
435.00	172368	3.957
435.20	178848	4.106
435.40	185354	4.255
435.60	191885	4.405
435.80	198441	4.556
436.00	205021	4.707

Preliminary Wet Pond Sizing

Source: ***Stormwater Best Management Practices***. NCDENR: Division of Water Quality - Water Quality Section. April 1999.

Enter the drainage area characteristics ==>

Total drainage area to pond =	15.09	acres
Total impervious area to pond =	6.19	acres

Note The pond must be sized to treat all impervious surface runoff draining into the pond, not just the impervious surface from on-site development.

Drainage area = **15.09** acres @ **41.0%** impervious
Use a conservative assumed impervious of 45%

Estimate the surface area required at pond normal pool elevation ==>

Assume a minimum (worst case) average depth of = 3.0 feet (Per NCDENR Handbook)

From the DWQ BMP Handbook (4/99), the required SA/DA ratio ==>

		3.0	3.0	4.0
Lower Boundary =>	40.0	1.73		1.43
Site % impervious =>	45.0	1.90	***1.90***	1.58
Upper Boundary =>	50.0	2.06		1.73

Therefore, SA/DA required =	***1.90***

Surface area required at normal pool =	12456	ft^2
=	0.29	acres
Surface area provided at normal pool =	22773	ft^2

WATER QUALITY VOLUME CALCULATIONS

J.C. SPICER, EI
8/29/2005

==> *Determination of Water Quality Volume (WQ_V) - To Pond #1*

$WQ_V = (DA)(R)/12$

where,

WQ_V = water quality volume (in acre-ft)
DA = Drainage area to the pond (in acres)
R = Rainfall depth (in inches)

Input data:

Total area, A =	15.09	acres
Rainfall, R =	3.0	inches

Calculated values:

WQ_V =	3.77	acre-ft
=	164330	cf.

==> *Associated Wet Pond Depth*

Ks =	22947	
b =	1.1254	
V =	164330	
Normal Pool Elevation =	429.00	cf.
WQ Elevation =	434.75	feet
Top of Berm Elevation =	437.00	feet

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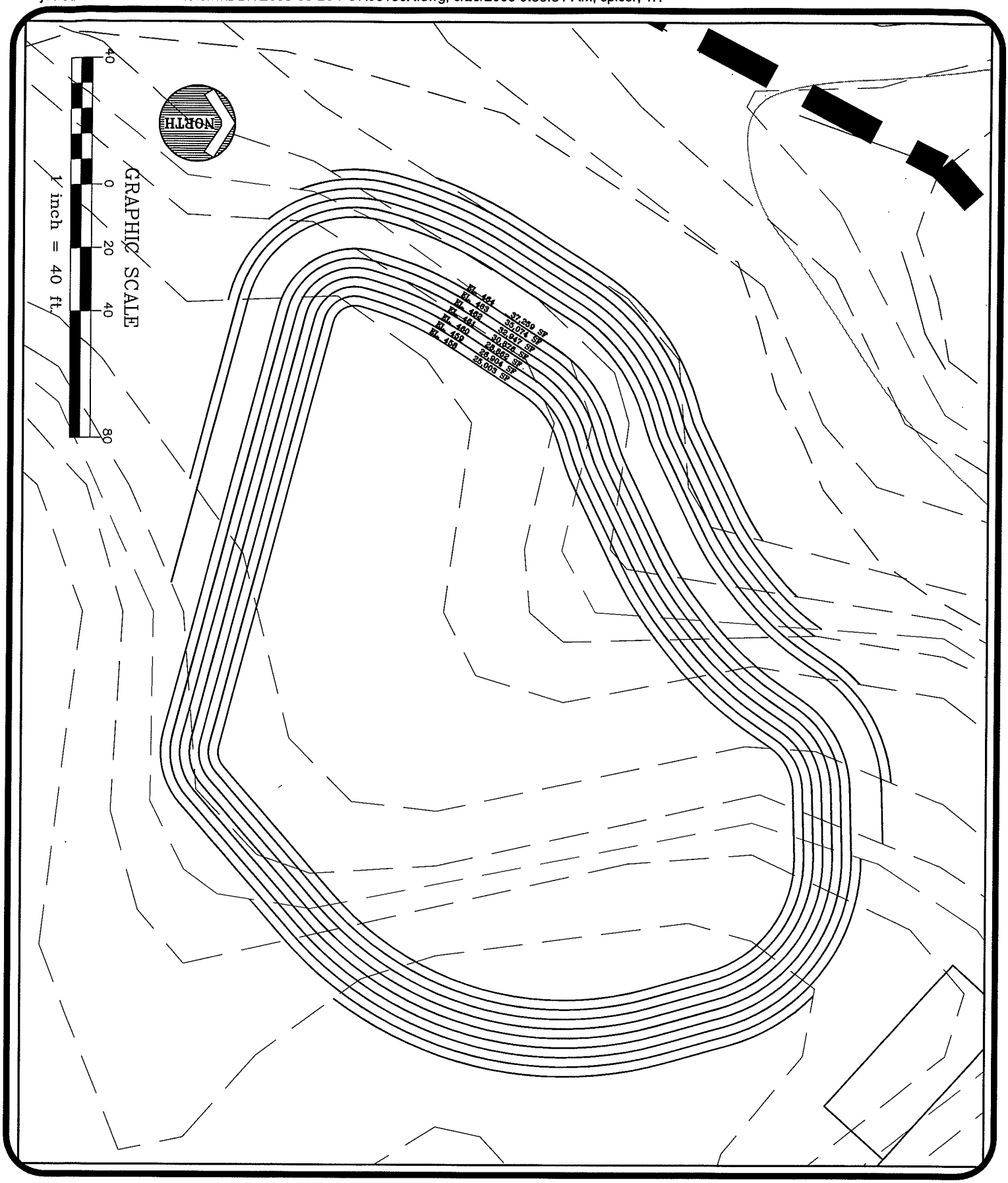

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DATE:	08-29-2005

WILLIAMS CORNER

DURHAM, NORTH CAROLINA

POND #2 EXHIBIT

THE JOHN R. McADAMS COMPANY, INC.

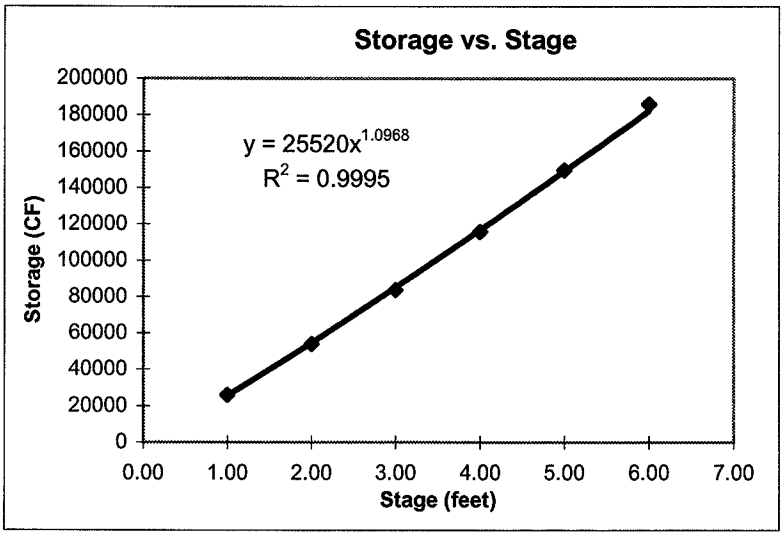
ENGINEERS/PLANNERS/SURVEYORS

RESEARCH TRIANGLE PARK, NC
P.O. BOX 14005 ZIP 27709-4005
(919) 361-5000

Stage-Storage Function

Project Name: Lystra Road - Pond #2
Designer: B.R. Finch, PE
Job Number: FOR-05190
Date: 8/29/2005

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
458.00	0.00	25003				
459.00	1.00	26904	25954	25954	25954	1.02
460.00	2.00	28862	27883	27883	53837	1.98
461.00	3.00	30876	29869	29869	83706	2.95
462.00	4.00	32947	31912	31912	115617	3.96
463.00	5.00	35074	34011	34011	149628	5.02
464.00	6.00	37258	36166	36166	185794	6.11



K_S =	**25520**
b =	**1.0968**

==> ***Stage - Storage Function***

Ks = 25520
b = 1.0968
Zo = 458.00

Elevation	Storage	
[feet]	[cf]	[acre-feet]
458.00	0	0.000
458.20	4368	0.100
458.40	9342	0.214
458.60	14573	0.335
458.80	19980	0.459
459.00	25520	0.586
459.20	31169	0.716
459.40	36911	0.847
459.60	42733	0.981
459.80	48625	1.116
460.00	54582	1.253
460.20	60597	1.391
460.40	66665	1.530
460.60	72782	1.671
460.80	78945	1.812
461.00	85151	1.955
461.20	91396	2.098
461.40	97680	2.242
461.60	104000	2.388
461.80	110354	2.533
462.00	116740	2.680
462.20	123157	2.827
462.40	129604	2.975
462.60	136080	3.124
462.80	142582	3.273
463.00	149111	3.423
463.20	155666	3.574
463.40	162245	3.725
463.60	168847	3.876
463.80	175472	4.028
464.00	182120	4.181

Preliminary Wet Pond Sizing

Source: ***Stormwater Best Management Practices***. NCDENR: Division of Water Quality - Water Quality Section. April 1999.

Enter the drainage area characteristics ==>

Total drainage area to pond =	10.90	acres
Total impervious area to pond =	3.53	acres

Note The pond must be sized to treat all impervious surface runoff draining into the pond, not just the impervious surface from on-site development.

Drainage area = **10.90** acres @ **32.4%** impervious
Use a conservative assumed impervious of 35%

Estimate the surface area required at pond normal pool elevation ==>

Assume a minimum (worst case) average depth of = 3.0 feet (Per NCDENR Handbook)

From the DWQ BMP Handbook (4/99), the required SA/DA ratio ==>

		3.0	3.0	4.0
Lower Boundary =>	30.0	1.34		1.08
Site % impervious =>	35.0	1.54	***1.54***	1.26
Upper Boundary =>	40.0	1.73		1.43

Therefore, SA/DA required =	***1.54***

Surface area required at normal pool =	7288	ft^2
=	0.17	acres
Surface area provided at normal pool =	25003	ft^2

WATER QUALITY VOLUME CALCULATIONS

==> *Determination of Water Quality Volume (WQ_V) - To Pond #2*

$WQ_V = (DA)(R)/12$

where,

WQ_V = water quality volume (in acre-ft)
DA = Drainage area to the pond (in acres)
R = Rainfall depth (in inches)

Input data:

Total area, A =	10.90	acres
Rainfall, R =	3.0	inches

Calculated values:

WQ_V =	2.73	acre-ft
=	118701	cf.

==> *Associated Wet Pond Depth*

Ks =	25520	
b =	1.0968	
V =	118701	
Normal Pool Elevation =	458.00	cf.
WQ Elevation =	462.06	feet
Top of Berm Elevation =	464.00	feet

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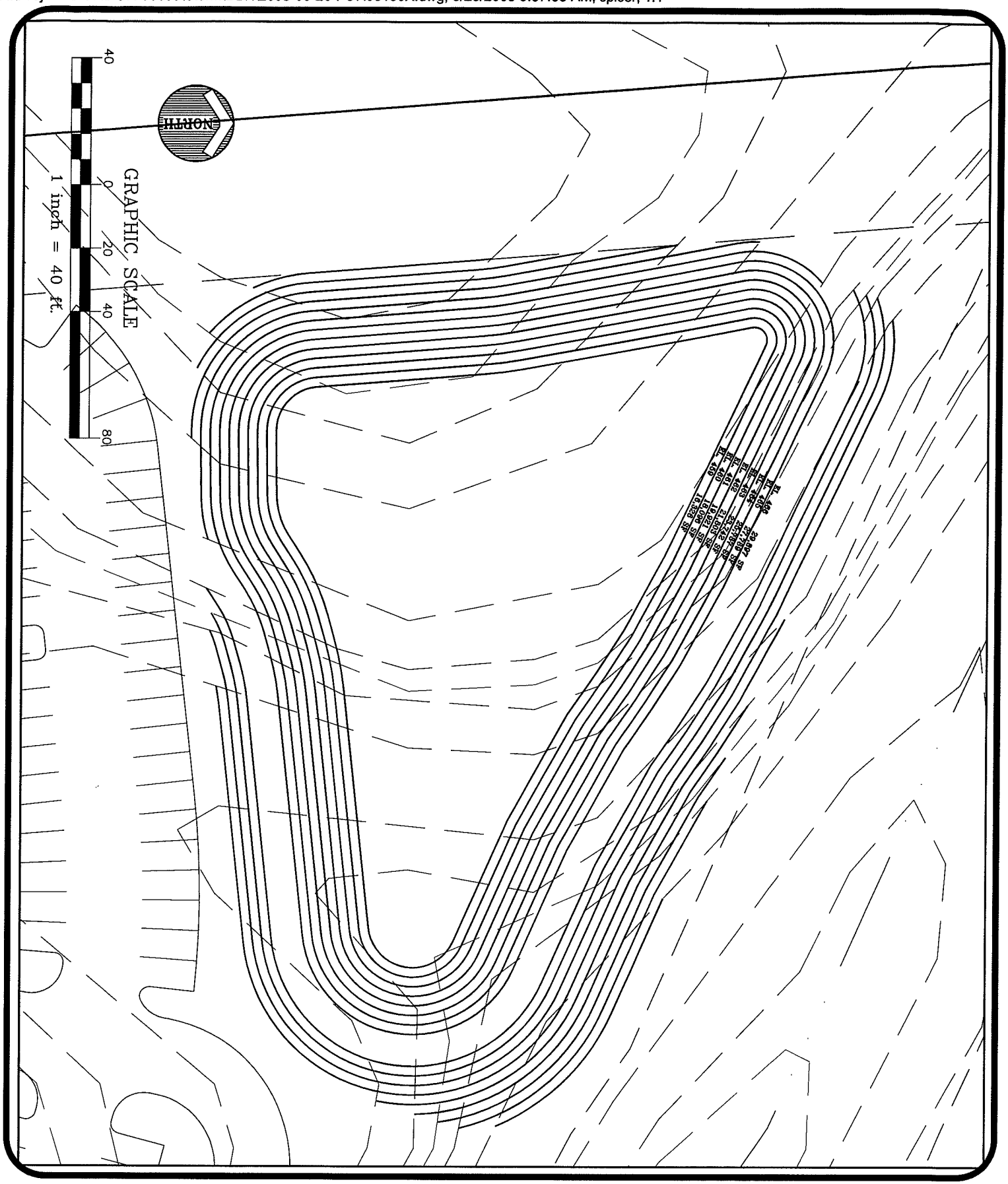

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DATE:	08-29-2005

WILLIAMS CORNER

DURHAM, NORTH CAROLINA

POND #3 EXHIBIT

THE JOHN R. McADAMS COMPANY, INC.

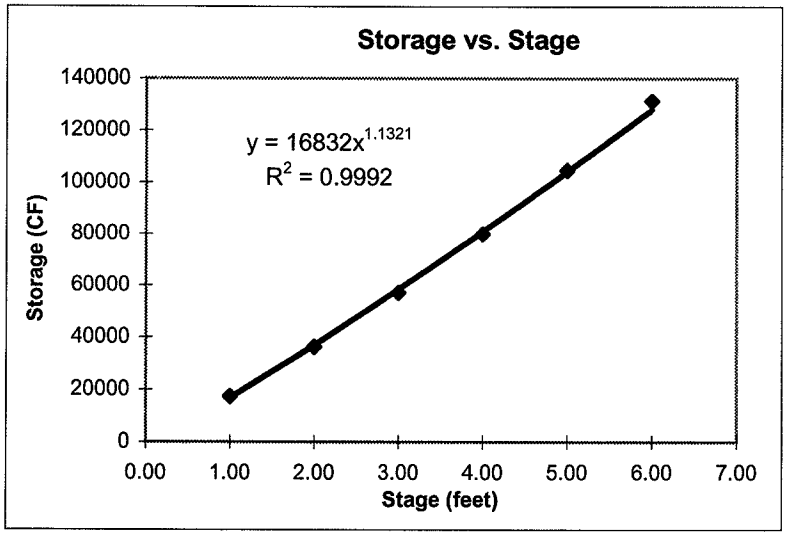
ENGINEERS/PLANNERS/SURVEYORS

RESEARCH TRIANGLE PARK, NC
P.O. BOX 14005 ZIP 27709-4005
(919) 361-5000

Stage-Storage Function

Project Name: Lystra Road - Pond #3
Designer: B.R. Finch, PE
Job Number: FOR-05190
Date: 8/29/2005

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
459.00	0.00	16326				
460.00	1.00	18096	17211	17211	17211	1.02
461.00	2.00	19921	19009	19009	36220	1.97
462.00	3.00	21803	20862	20862	57082	2.94
463.00	4.00	23742	22773	22773	79854	3.96
464.00	5.00	25737	24740	24740	104594	5.02
465.00	6.00	27789	26763	26763	131357	6.14
466.00	7.00	29897	28843	28843	160200	7.32



K_S =	**16832**
b =	**1.1321**

==> Stage - Storage Function

Ks = 16832
b = 1.1321
Zo = 459.00

Elevation	Storage	
[feet]	[cf]	[acre-feet]
459.00	0	0.000
459.20	2722	0.062
459.40	5965	0.137
459.60	9440	0.217
459.80	13074	0.300
460.00	16832	0.386
460.20	20691	0.475
460.40	24636	0.566
460.60	28656	0.658
460.80	32744	0.752
461.00	36892	0.847
461.20	41095	0.943
461.40	45350	1.041
461.60	49651	1.140
461.80	53996	1.240
462.00	58383	1.340
462.20	62808	1.442
462.40	67270	1.544
462.60	71767	1.648
462.80	76297	1.752
463.00	80859	1.856

Preliminary Wetland Sizing

Source: ***Stormwater Best Management Practices***. NCDENR: Division of Water Quality - Water Quality Section. April 1999.

Enter the drainage area characteristics ==>

Total drainage area to pond =	7.47	acres
Total impervious area to pond =	4.48	acres

Note The pond must be sized to treat all impervious surface runoff draining into the pond, not just the impervious surface from on-site development.

Drainage area = **7.47** acres @ **60.0%** impervious

Use a conservative assumed impervious of 65%

Estimate the surface area required at pond normal pool elevation ==>

Assume a minimum (worst case) average depth of = 3.0 feet (Per NCDENR Handbook)

From the DWQ BMP Handbook (4/99), the required SA/DA ratio ==>

		3.0	3.0	4.0
Lower Boundary =>	60.0	2.40		2.03
Site % impervious =>	65.0	2.64	***2.64***	2.22
Upper Boundary =>	70.0	2.88		2.40

Therefore, SA/DA required =	***2.64***

Surface area required at normal pool =	8590	ft^2
=	0.20	acres
Surface area provided at normal pool =	16326	ft^2

WATER QUALITY VOLUME CALCULATIONS

J.C. SPICER, EI
8/29/2005

==> *Determination of Water Quality Volume (WQ_V) - To Pond #3*

$WQ_V = (DA)(R)(1")/12$

where,

WQ_V = water quality volume (in acre-ft)
DA = Drainage area to the pond (in acres)
R = Rainfall depth (in inches)

Input data:

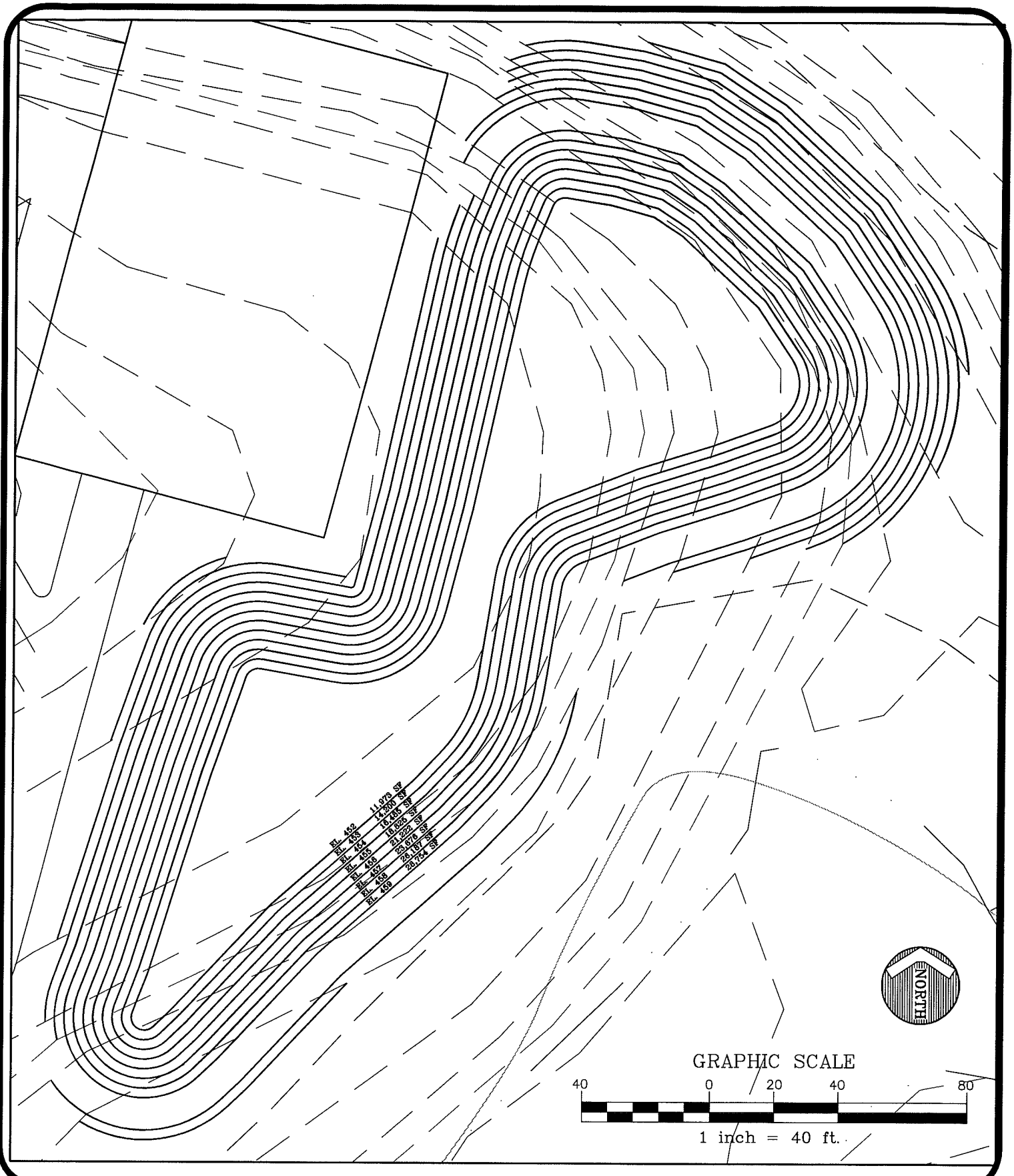
Total area, A =	7.47	acres
Rainfall, R =	4.48	inches

Calculated values:

WQ_V =	2.79	acre-ft
=	121480	cf.

==> *Associated Wet Pond Depth*

Ks =	16832	
b =	1.1321	
V =	121480	
Normal Pool Elevation =	459.00	cf.
WQ Elevation =	464.73	feet
Top of Berm Elevation =	466.00	feet



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SCALE:	1"=40'
DATE:	08-29-2005

WILLIAMS CORNER

DURHAM, NORTH CAROLINA

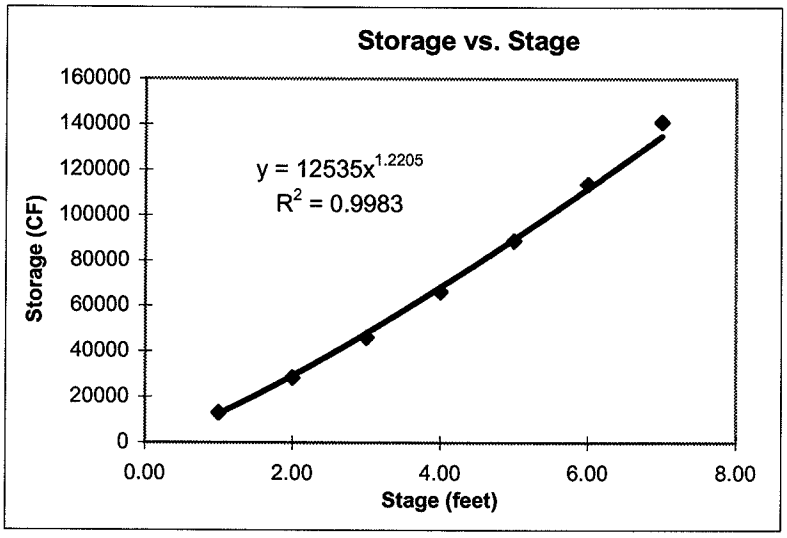
POND #4 EXHIBIT

THE JOHN R. McADAMS COMPANY, INC.
ENGINEERS/PLANNERS/SURVEYORS
RESEARCH TRIANGLE PARK, NC
P.O. BOX 14005 ZIP 27709-4005
(919) 361-5000

Stage-Storage Function

Project Name: Lystra Road - Pond #4
Designer: B.R. Finch, PE
Job Number: FOR-05190
Date: 8/29/2005

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
452.00	0.00	11973				
453.00	1.00	14200	13087	13087	13087	1.04
454.00	2.00	16485	15343	15343	28429	1.96
455.00	3.00	18825	17655	17655	46084	2.91
456.00	4.00	21222	20024	20024	66108	3.91
457.00	5.00	23676	22449	22449	88557	4.96
458.00	6.00	26187	24932	24932	113488	6.08
459.00	7.00	28754	27471	27471	140959	7.26



K_S =	**12535**
b =	**1.2205**

==> ***Stage - Storage Function***

Ks = 16832
b = 1.1321
Zo = 459.00

Elevation	Storage	
[feet]	[cf]	[acre-feet]
459.00	0	0.000
459.20	2722	0.062
459.40	5965	0.137
459.60	9440	0.217
459.80	13074	0.300
460.00	16832	0.386
460.20	20691	0.475
460.40	24636	0.566
460.60	28656	0.658
460.80	32744	0.752
461.00	36892	0.847
461.20	41095	0.943
461.40	45350	1.041
461.60	49651	1.140
461.80	53996	1.240
462.00	58383	1.340
462.20	62808	1.442
462.40	67270	1.544
462.60	71767	1.648
462.80	76297	1.752
463.00	80859	1.856

Preliminary Wetland Sizing

Source: ***Stormwater Best Management Practices***. NCDENR: Division of Water Quality - Water Quality Section. April 1999.

Enter the drainage area characteristics ==>

Total drainage area to pond =	9.48	acres
Total impervious area to pond =	5.48	acres

Note The pond must be sized to treat all impervious surface runoff draining into the pond, not just the impervious surface from on-site development.

Drainage area = **9.48** acres @ **57.8%** impervious

Use a conservative assumed impervious of 60%

Estimate the surface area required at pond normal pool elevation ==>

Assume a minimum (worst case) average depth of = 3.0 feet (Per NCDENR Handbook)

From the DWQ BMP Handbook (4/99), the required SA/DA ratio ==>

		3.0	3.0	4.0
Lower Boundary =>	50.0	2.06		1.73
Site % impervious =>	60.0	2.40	***2.40***	2.03
Upper Boundary =>	60.0	2.40		2.03

Therefore, SA/DA required =	***2.40***

Surface area required at normal pool =	9911	ft^2
=	0.23	acres
Surface area provided at normal pool =	11973	ft^2

WATER QUALITY VOLUME CALCULATIONS

J.C. SPICER, EI
8/29/2005

==> *Determination of Water Quality Volume (WQ_V) - To Pond #4*

$WQ_V = (DA)(R)(1")/12$

where,

WQ_V = water quality volume (in acre-ft)
DA = Drainage area to the pond (in acres)
R = Rainfall depth (in inches)

Input data:

Total area, A =	9.48	acres
Rainfall, R =	3.0	inches

Calculated values:

WQ_V =	2.37	acre-ft
=	103237	cf.

==> *Associated Wet Pond Depth*

Ks =	12535	
b =	1.2205	
V =	103237	
Normal Pool Elevation =	452.00	cf.
WQ Elevation =	457.63	feet
Top of Berm Elevation =	459.00	feet