

***BOWLES END SUBDIVISION, LOT 5
LITTLE MINDS LEARNING CENTER
PHASE III DRAINAGE REPORT
JEFFERSON COUNTY, COLORADO***
Jefferson County, Colorado

June 3, 2013

PREPARED BY:
PARAGON ENGINEERING CONSULTANTS, INC.
7852 SOUTH ELATI STREET, SUITE 106
LITTLETON, COLORADO 80120
303.794.8604
PROJECT NO. 31-016

PREPARED FOR:
OWNER/DEVELOPER
Wieser Brothers General Contractor, Inc.
200 Twilite Street
La Crescent, MN 55947
507.895.8903
ATTN: Mr. Pat Ries

Case Number _____

Engineer’s Statement:

This report (plan) for the Phase III drainage and water quality design of Bowles End Subdivision, Lot 5 was prepared by me (or under my direct supervision) in accordance with the provisions of Jefferson County Storm Drainage Design and Technical Criteria and was designed to comply with the provisions thereof. I understand that Jefferson County does not and will not assume liability for drainage facilities designed by others.

David P. Theisen
Registered Professional Engineer
Colorado P.E. 41115

Owner’s Statement:

Owner Applicant hereby certifies that the drainage facilities for Bowles End Subdivision, Lot 5 will be constructed according to the design presented in this report. I understand that Jefferson County does not and will not assume liability for drainage facilities designed or reviewed by my engineer. I also understand that Jefferson County relies on the representation of others to establish that drainage facilities are designed and built in compliance with the applicable guidelines, standards or specifications. Review by Jefferson County can therefore in no way limit or diminish any liability which I or any other party may have with respect to the design or construction of such facilities.

(Owner/Applicant)

By:

Date:

Table of Contents

I. GENERAL LOCATION AND DESCRIPTION.....	4
II. DRAINAGE BASINS AND SUB-BASINS.....	4
III. DRAINAGE DESIGN CRITERIA	5
IV. DRAINAGE FACILITY DESIGN	6
V. CONCLUSIONS.....	6
VI. REFERENCES.....	7
VII. APPENDICES	7

I. GENERAL LOCATION AND DESCRIPTION

A. Site Location

The site is generally located at the northeast corner of the intersection of West Bowles Avenue and South Youngfield Court in Jefferson County. The site is located within the Bowles End Subdivision. An existing regional detention/water quality pond is located to the east of the site, which discharges to the east to an existing ditch. A vicinity map is provided in Appendix A for reference.

The legal description for the property is:

Lot 5, Bowles End Subdivision located in the SW ¼, Section 17, T5S, R69W of the 6th P.M., County of Jefferson, State of Colorado.

B. Description of the Property

The Lot 5 project site is approximately 1.44 acres and is located within the Bowles End Subdivision. The Bowles End Subdivision was previously designed by Baseline Engineering Corporation in 2004. Overlot grading and infrastructure for the subdivision was previously completed and the site has been re-seeded. Currently the site is covered with native grasses. A majority of the site generally slopes to the south at approximately 5%, and a portion of the eastern side of the site slopes to the east towards the existing detention pond at approximately 25%.

The soils at the site are predominantly classified as Manzanola clay loam, Englewood clay loam, and Denver clay loam, which are all hydrological group C defined as soils having slow infiltration.

The site is tributary to an unnamed ditch which drains to Coon Creek.

The existing land use designation for the site is commercial. A child daycare, learning center is proposed for the site, which is consistent with the designated land use. Improvements will include a the learning center building generally located near the center of the lot with parking and drive aisles to the west and south of the building. Runoff shall be conveyed via sheet flow and curb and gutter to a proposed inlet and private storm sewer within the site, which shall outfall to existing storm sewer along the south side of the site, which then conveys drainage to the existing regional detention/water quality pond. A portion of the runoff from the site shall be conveyed via sheet flow and shallow concentrated flow directly to the existing detention pond.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Drainage Basins

The site is not located within a known flood hazard area per FIRM maps. There are no known major drainage way studies for the site. Runoff from the site is through the existing regional detention pond, to unnamed ditch which drains to Coon Creek. The major basin is characterized by a mix of single family residential developments,

schools, churches and some commercial areas. There are no irrigation facilities that will influence or be influenced by this development.

B. Sub-Drainage Basins

The historic drainage pattern for the site is overland flow to the existing detention pond. Very minor off-site drainage currently sheet flow across the corner of the site and will not be significantly influenced by this development. Another minor area along the south boundary of the site sheet flows to West Bowles Avenue where it is collected by the existing West Bowles Avenue storm sewer system. This matches the drainage patterns set by the approved drainage report.

III. DRAINAGE DESIGN CRITERIA

A. Regulations

No deviations from the Jefferson County Storm Drainage Design & Technical Criteria are requested for this site.

B. Development Criteria References and Constraints

The site is part of a regional drainage report for a 19.2 acres development as defined by the approved Phase III, Drainage Report for Bowles End Subdivision and Centennial Community Church by Baseline Engineering Corporation – revised March 2004. As part the approved report a regional detention pond and storm sewer collection system was designed and constructed. The drainage information provided in this report was used for the most part as the reference materials in the creation of this report. The site will be developed to conform to the approved Phase III Drainage Report and the final site will maintain an impervious percentage of less than 75% in accordance with the approved detention pond sizing calculations.

C. Hydrological Criteria

The site lies within the Jefferson County Rainfall Zone I. Related rainfall values from the design criteria were used in all runoff calculations. Sub-basins within the site have been delineated on the Drainage Plan to calculate onsite inlet and storm sewer sizing. Runoff calculations were made using the Rational Method as outlined in the Urban Drainage and Flood Control District Drainage Manual. Based on the approved drainage report, the existing regional detention pond was sized to provide require water quality storage volume (WSCV) and 100-yr storm required storage volume.

D. Hydraulic Criteria

Based on the approved drainage report, the existing storm sewer collection system appears to have excess capacity to drain the proposed site development. Existing storm collection system has been checked for adequate capacity to handle the new developed flows from Lot 5.

E. Waivers from Criteria

No waivers are requested for this development at this time.

IV. DRAINAGE FACILITY DESIGN

A. General Concept

The general drainage concept for the site is to convey a portion of the runoff directly to the regional detention pond via sheet flow and a portion of the runoff of the runoff via sheet flow and curb and gutter to a proposed inlet at the southeast corner of the parking area. From the inlet flows will be conveyed through a private storm sewer to the existing storm sewer system that connects to the existing regional detention pond. No alterations to the drainage patterns laid out in the approved Phase III Drainage Report are proposed. The proposed site is 48.5% impervious, which is well below the limits of 75% impervious used to size the detention pond. No changes to the existing detention pond are anticipated or proposed. The existing storm sewer was evaluated for capacity to accept the flows contributed by the site runoff.

B. Specific Details, Storage Facilities, and Water Quality

No drainage problems have been encountered on this site and none are anticipated. The site is currently served by an existing regional detention pond sized for the 100-year storage as well as the Water Quality Control Volume.

V. CONCLUSIONS

A. Compliance with Standards

To my knowledge, all calculations, plans and reports have been prepared according to the Jefferson County and UDFCD storm water drainage design manuals and no variances are requested.

B. Drainage Concept

The hydrologic and hydraulic design for the site conforms to the approved drainage report, and the existing regional detention/water quality system and existing storm sewer system will be used as is with no changes proposed.

VI. REFERENCES

- *Jefferson County Storm Drainage Design & Technical Criteria, County of Jefferson,* latest revision.
- *Urban Drainage and Flood Control District Drainage Criteria Manual (UDFCDCM),* Vol. 1, 2 and 3 prepared by Wright-McLaughlin Engineers, March 1969, with latest revisions.
- *Bowles End Subdivision and Centennial Community Church Phase III Drainage Report,* prepared by Baseline Engineering Corporation, dated March , 2004.

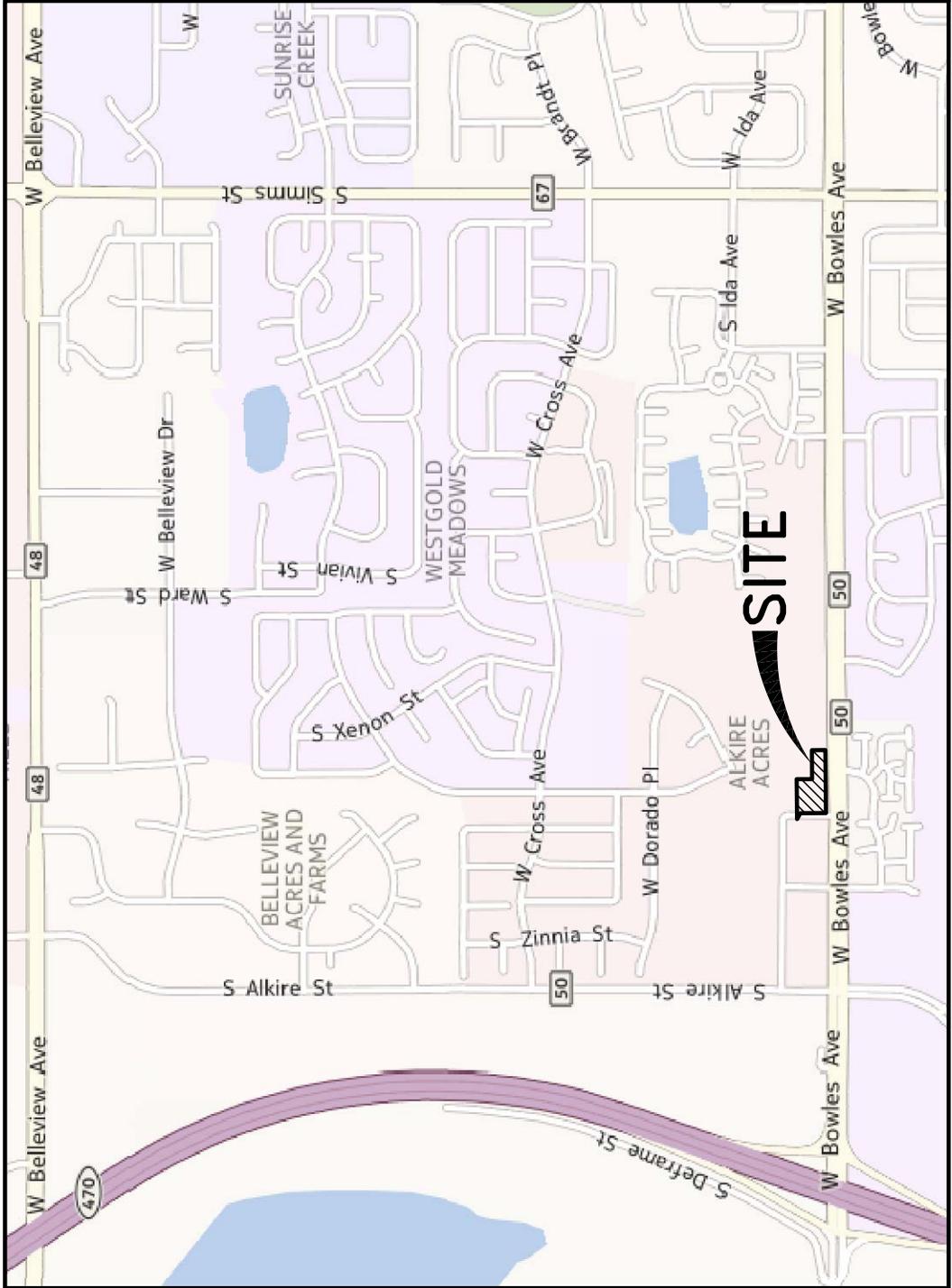
VII. APPENDICES

- A. Vicinity Map
- B. Hydrologic and Hydraulic Calculations
- C. Drainage Map

Appendix A

Vicinity Map

LITTLE MINDS LEARNING CENTER
LOCATED IN THE SW ¼, SECTION 17, T5S, R69W
JEFFERSON COUNTY, COLORADO



VICINITY MAP

Appendix B

Hydrologic and Hydraulic Computations

Little Minds Learning Center
 Site Runoff and Storm Pipe Capacity Calculations

Lot 5 Site Runoff

Type	Area (AC)	% Imp.	Source
Roof	0.2	90	RO-3
Pavement	0.54	90	RO-3
Lawns	0.7	0	RO-3
Total	1.44	46.25	

Note: 0.17 ac of South Youngfield court accounted for in approved drainage report

Lot 5 Site Runoff to proposed inlet

Type	Area (AC)	% Imp.	Source
Roof	0.1	90	RO-3
Pavement	0.37	90	RO-3
Lawns	0.05	0	RO-3
Total	0.52	81.34615	

Basin	Area	C-10yr	c-100yr	Source
LOT 5 TO INLET	0.52	0.68	0.76	RO-5

Time of Concentration 10 Based on Minimum

	10yr	100yr	Source
Intensity	4.20	7.00	RA-15
Flow Q=	1.49	2.77	

Check Capacity of Existing 36" Pipe at Tie in Point
 Based on Information provided in Approved Drainage Report

10- year

Pipe	Existing flow	Existing Capacity	New Flows	Excess capacity
P-1	32.58	68.43	1.49	34.36

100- year

Pipe	Existing flow	Existing Capacity	New Flows	Excess capacity
P-1	52.03	68.43	2.77	13.63

Conclusions

The existing 36" pipe has capacity to handle the Proposed Lot 5 developed flow for both 10 year and 100 year storms

2.0 RATIONAL METHOD

For urban catchments that are not complex and are generally 160 acres or less in size, it is acceptable that the design storm runoff be analyzed by the Rational Method. This method was introduced in 1889 and is still being used in most engineering offices in the United States. Even though this method has frequently come under academic criticism for its simplicity, no other practical drainage design method has evolved to such a level of general acceptance by the practicing engineer. The Rational Method properly understood and applied can produce satisfactory results for urban storm sewer and small on-site detention design.

2.1 Rational Formula

The Rational Method is based on the Rational Formula:

$$Q = CIA \quad (RO-1)$$

in which:

Q = the maximum rate of runoff (cfs)

C = a runoff coefficient that is the ratio between the runoff volume from an area and the average rate of rainfall depth over a given duration for that area

I = average intensity of rainfall in inches per hour for a duration equal to the time of concentration, t_c

A = area (acres)

Actually, Q has units of inches per hour per acre (in/hr/ac); however, since this rate of in/hr/ac differs from cubic feet per second (cfs) by less than one percent, the more common units of cfs are used. The time of concentration is typically defined as the time required for water to flow from the most remote point of the area to the point being investigated. The time of concentration should be based upon a flow length and path that results in a time of concentration for only a portion of the area if that portion of the catchment produces a higher rate of runoff.

The general procedure for Rational Method calculations for a single catchment is as follows:

1. Delineate the catchment boundary. Measure its area.
2. Define the flow path from the upper-most portion of the catchment to the design point. This flow path should be divided into reaches of similar flow type (e.g., overland flow, shallow swale flow, gutter flow, etc.). The length and slope of each reach should be measured.
3. Determine the time of concentration, t_c , for the catchment.

Table RO-3—Recommended Percentage Imperviousness Values

Land Use or Surface Characteristics	Percentage Imperviousness
Business:	
Commercial areas	95
Neighborhood areas	85
Residential:	
Single-family	*
Multi-unit (detached)	60
Multi-unit (attached)	75
Half-acre lot or larger	*
Apartments	80
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	5
Playgrounds	10
Schools	50
Railroad yard areas	15
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	0
Lawns, clayey soil	0

* See [Figures RO-3](#) through [RO-5](#) for percentage imperviousness.

$$C_A = K_A + (1.31i^3 - 1.44i^2 + 1.135i - 0.12) \text{ for } C_A \geq 0, \text{ otherwise } C_A = 0 \quad (\text{RO-6})$$

$$C_{CD} = K_{CD} + (0.858i^3 - 0.786i^2 + 0.774i + 0.04) \quad (\text{RO-7})$$

$$C_B = (C_A + C_{CD})/2$$

Table RO-5— Runoff Coefficients, C

Percentage Imperviousness	Type C and D NRCS Hydrologic Soil Groups					
	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
0%	0.04	0.15	0.25	0.37	0.44	0.50
5%	0.08	0.18	0.28	0.39	0.46	0.52
10%	0.11	0.21	0.30	0.41	0.47	0.53
15%	0.14	0.24	0.32	0.43	0.49	0.54
20%	0.17	0.26	0.34	0.44	0.50	0.55
25%	0.20	0.28	0.36	0.46	0.51	0.56
30%	0.22	0.30	0.38	0.47	0.52	0.57
35%	0.25	0.33	0.40	0.48	0.53	0.57
40%	0.28	0.35	0.42	0.50	0.54	0.58
45%	0.31	0.37	0.44	0.51	0.55	0.59
50%	0.34	0.40	0.46	0.53	0.57	0.60
55%	0.37	0.43	0.48	0.55	0.58	0.62
60%	0.41	0.46	0.51	0.57	0.60	0.63
65%	0.45	0.49	0.54	0.59	0.62	0.65
70%	0.49	0.53	0.57	0.62	0.65	0.68
75%	0.54	0.58	0.62	0.66	0.68	0.71
80%	0.60	0.63	0.66	0.70	0.72	0.74
85%	0.66	0.68	0.71	0.75	0.77	0.79
90%	0.73	0.75	0.77	0.80	0.82	0.83
95%	0.80	0.82	0.84	0.87	0.88	0.89
100%	0.89	0.90	0.92	0.94	0.95	0.96
	TYPE B NRCS HYDROLOGIC SOILS GROUP					
0%	0.02	0.08	0.15	0.25	0.30	0.35
5%	0.04	0.10	0.19	0.28	0.33	0.38
10%	0.06	0.14	0.22	0.31	0.36	0.40
15%	0.08	0.17	0.25	0.33	0.38	0.42
20%	0.12	0.20	0.27	0.35	0.40	0.44
25%	0.15	0.22	0.30	0.37	0.41	0.46
30%	0.18	0.25	0.32	0.39	0.43	0.47
35%	0.20	0.27	0.34	0.41	0.44	0.48
40%	0.23	0.30	0.36	0.42	0.46	0.50
45%	0.26	0.32	0.38	0.44	0.48	0.51
50%	0.29	0.35	0.40	0.46	0.49	0.52
55%	0.33	0.38	0.43	0.48	0.51	0.54
60%	0.37	0.41	0.46	0.51	0.54	0.56
65%	0.41	0.45	0.49	0.54	0.57	0.59
70%	0.45	0.49	0.53	0.58	0.60	0.62
75%	0.51	0.54	0.58	0.62	0.64	0.66
80%	0.57	0.59	0.63	0.66	0.68	0.70
85%	0.63	0.66	0.69	0.72	0.73	0.75
90%	0.71	0.73	0.75	0.78	0.80	0.81
95%	0.79	0.81	0.83	0.85	0.87	0.88
100%	0.89	0.90	0.92	0.94	0.95	0.96

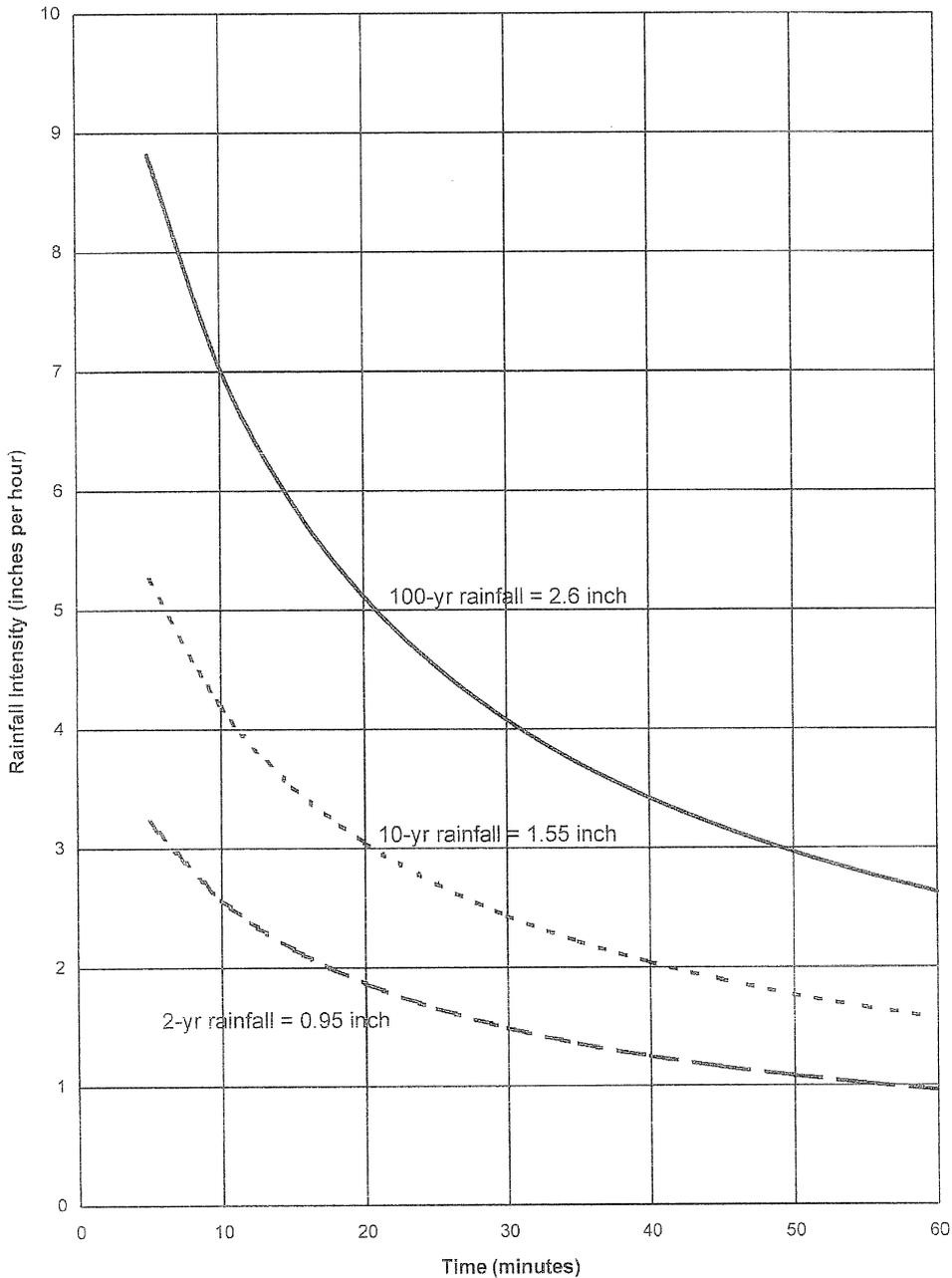


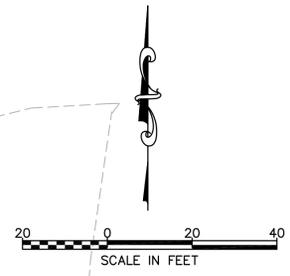
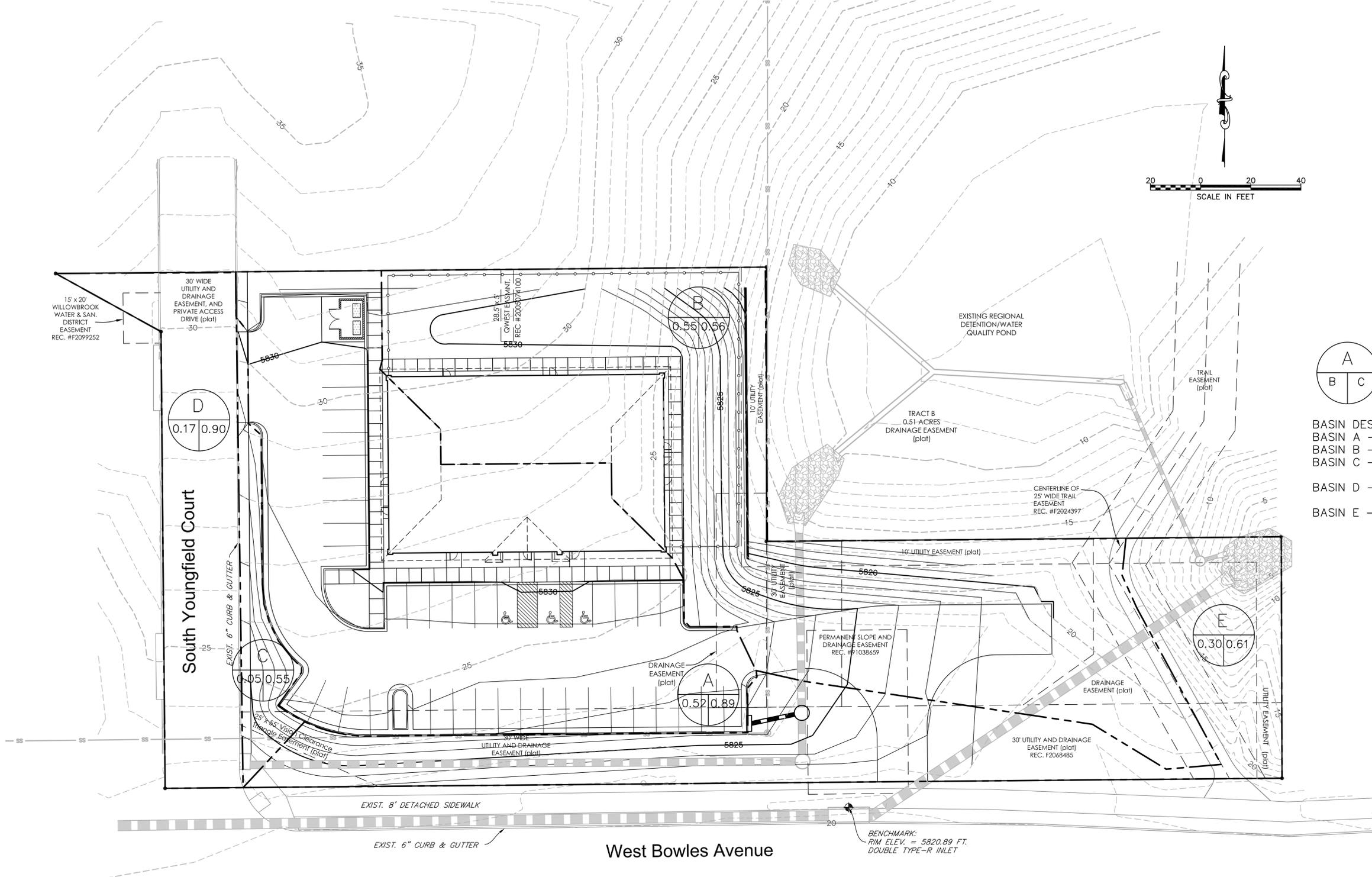
Figure RA-15—Rainfall Intensity-Duration Curves

Appendix C

Drainage Map

LITTLE MINDS LEARNING CENTER EXHIBIT

LOCATED IN THE SW ¼, SECTION 17, T5S, R69W
JEFFERSON COUNTY, COLORADO



- LEGEND:**
- 20- EX. MAJOR CONTOUR
 - - - EX. MINOR CONTOUR
 - 5820— PR. MAJOR CONTOUR
 - PR. MINOR CONTOUR

- Basin Designation Legend:**
- A = DEVELOPED BASIN DESIGNATION
 - B = DEVELOPED BASIN AREA (AC)
 - C = DEVELOPED C100 FACTOR

- BASIN DESCRIPTION**
- BASIN A - DEVELOPED FLOW TO PROPOSED INLET
 - BASIN B - DEVELOPED FLOW TO REGIONAL POND
 - BASIN C - DEVELOPED FLOW TO EXISTING SOUTH YOUNG COURT INLET
 - BASIN D - SOUTH YOUNGFIELD COURT DRAINAGE FROM APPROVED DRAINAGE REPORT
 - BASIN E - FLOW HISTORICALLY DIRECTED OFFSITE

REVISIONS		PARAGON ENGINEERING CONSULTANTS, INC. 7852 SOUTH ELATI STREET, SUITE 106 LITTLETON, CO 80120 303-794-8604	SHEET 1 OF 1
DESIGN:	DATE: 05-10-2013	SCALE: 1" = 20'	
DRAWN:	PROJECT NO: 13-016		

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