



Drainage Reports



**PRELIMINARY DRAINAGE REPORT
FOR
RAINTREE PHASE III RESIDENTIAL BUILDING**

March 4, 2020
WP# 195063



EXPIRES 06-30-22

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EXPIRES 06-30-22

1.0 INTRODUCTION

The proposed Raintree Phase III Residential Building (Site) consists of a 5-story, 190,000 square-foot multifamily residential building with associated parking, landscape and hardscape open space. The approximate 3-acre Site is located near the southeast corner of Northsight Boulevard and Raintree Drive in Scottsdale, Arizona within Section 12, Township 3 North, Range 4 East of the Gila and Salt River Base and Meridian, Maricopa County, Arizona. The Site is bound by Raintree Drive to the north, private drive to the east, a parking garage to the south and soon to be developed Raintree Phase II Office building and parking garage to the east. Refer to Exhibit 1 – *Vicinity Map* for the location.

This Preliminary Drainage Report is prepared for Trammell Crow Company and submitted to the City of Scottsdale in support of the project's rezoning submittal (7-GP-2019 & 19-ZN-2019). This report has been prepared in accordance with Wood, Patel & Associates, Inc.'s (WOODPATEL's) understanding of the City of Scottsdale's technical requirements for stormwater drainage and collection systems (Ref. 1, 3).

2.0 EXISTING DRAINAGE CONDITIONS

2.1 Onsite Drainage

The Site is currently a vacant pad site which is part of the phased, 14-acre Liberty Property Trust for Vanguard master planned development. The existing topography of the Site is nearly flat with a gentle slope from northeast to southwest.

An existing onsite storm water detention system is currently in place across the master planned development including multiple interconnecting surface detention basins that bleed off into the city's Northsight Boulevard storm drain system. Per the Addendum to Final Drainage Report for Liberty Property Trust for Vanguard (Ref. 6), drainage sub basin areas 1, 2A and 3A cover the developed Phase I portion of the master planned development. The undeveloped Phase III (Site) includes drainage sub basin areas 2B, 3B, 4. Also refer to Exhibit 3 – *2006 Liberty Property Trust for Vanguard Drainage Exhibit A* for a graphical depiction of the master planned drainage sub basin areas and volumes.

2.2 Offsite Drainage

No offsite drainage is anticipated to impact the Site. According to the *Master Drainage Report* by Gilbertson Associates Inc. (Ref. 4), offsite regional runoff is intercepted by the offsite Central Arizona Project (CAP) which is located approximately one (1) mile north of the proposed Site. Additionally, the area between the CAP and the Site is mostly developed with existing storm water retention onsite or conveyed to the Northsight Park regional retention basin by storm drain or street flow (Ref. 4, 6). Locally, the adjacent roadways each have existing storm drain infrastructure and the existing private drive has a high point near Raintree Drive that prohibits offsite flow from the public right-of-way entering the Site.

2.3 FEMA Floodplain

The Federal Emergency Management Agency (FEMA) has published Flood Insurance Rate Maps for Maricopa County and Incorporated Areas. The Site is located within "Other Flood Areas" Zone "X" shaded per Flood Insurance Rate Map (FIRM) Panel 1760 of 4425, Map Number 04013C1760L, dated October 16, 2013. Refer to Exhibit 2 - *FEMA FIRM Exhibit*.

"Other Flood Areas" Zone "X" shaded is defined by FEMA as follows:

"Area of 0.2% annual chance flood; areas of 1" annual chance flood with average depths less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood".

3.0 PROPOSED DRAINAGE PLAN

3.1 Drainage Conditions

The Site will comply with the previous, City-approved Final Drainage Reports for the Liberty Property Trust for Vanguard development (Ref. 4, 5, 6) and the Raintree Office Building (Ref. 7) that dictate the required drainage methodology for the Site.

Onsite grades will direct stormwater runoff away from the building to the adjacent private drive and/or directly into the surface basins. Area drains will be located at the Site's concentration points to capture onsite surface runoff. A proposed, small diameter onsite private storm drain system will convey stormwater to their respective detention basins and direct connect to the building's roof drains.

3.2 Lowest Floor Elevation

The proposed floor elevation of the occupied portion of the building is 1462.00. This floor elevation is substantially higher than the ultimate site outfall elevation of 1454.00 at the southwest corner of the Site. A small, unoccupied portion of the building's southeast corner has a floor elevation of 1459.00 to allow refuse containers to be moved in and out of the building at grade.

3.3 Retention and Dissipation

Per the *Addendum to Final Drainage Report for Liberty Property Trust for Vanguard* (Ref. 6), drainage sub basin areas 1, 2A and 3A cover the developed Phase I portion of the master planned development. The undeveloped Phase III (Site) includes drainage sub basin areas 2B, 3B, 4.

Onsite peak runoff flow estimates for the proposed Site were generated using the Rational Method, as outlined in the *Drainage Design Manual for Maricopa County, Arizona: Volume I – Hydrology* (Ref. 2). NOAA Atlas 14 precipitation data was obtained and utilized to develop Intensity-Duration-Frequency (I-D-F) curves for the Site. Rational Method peak flows were computed at concentration points within the Site at key design locations. Runoff coefficients were estimated to reflect post-developed land use conditions for the 100-year and 2-year events. Refer to Appendix A – *Hydrology Calculations*.

The *Master Drainage Report for Northsight Commercial Development* (Ref.4) states detention for Phase I (existing Vanguard property, western portion of the master plan) and III (Site) must be provided for storm water runoff in excess of that generated under the existing conditions (pre versus post-developed scenario). In addition, the *City of Scottsdale Design Policies and Standards Manual* (Ref. 3) states the Site is required to detain the greater of the first flush storm event or the difference in runoff between the pre-developed and post-developed flows. Note that Phase II (Raintree Office property) is entirely independent and provides its own full detention.

In accordance with the current *City of Scottsdale's Design Standards and Policies Manual*, the following required detention volume equation was used for this project with the current precipitation depth of 2.3 inches:

$$\text{Vol}_{\text{req}} = \frac{P}{12} \times A \times C$$

P = Precipitation Depth (in)

A = Total Area (sq. ft.)

C = Increase in Average Runoff Coefficient (Varies)

For this analysis, it was determined the existing Site's hydrologic soil group 'B' correlates to a predeveloped runoff coefficient of 0.31. The Site's post developed runoff coefficient is estimated at 0.90. The runoff coefficient utilized in the above calculation is 0.59. Note, the 100-year, 2-hour rainfall depth at the time of the *Master Drainage Report for Northsight Commercial Development* was 2.82 inches. Refer to Appendix A – *Hydrology Calculations* for detailed detention calculations.

Storm water detention for the Site will be provided by the four (4) existing surface basins (Basins A-D) which have been designed for the 100-year, 2-hour storm event. Although several existing basins will be modified to accommodate development, no new detention facilities are proposed. All detention basins discharge to the City of Scottsdale storm drain located in Northsight Boulevard. Basins A and B, as well as basins C and D, are connected by 18" equalizer pipes. The existing Phase I and III drainage methodology is detailed within the *Addendum to Final Drainage Report for Liberty Property Trust for Vanguard* (Ref. 6).

Per Appendix A calculations, the 100-year, 2-hour detention required volume for Phases I and III is 42,912 cubic-feet. In comparison, the lesser first flush storm event required volume for Phases I and III is 15,811 cubic-feet. The total volume provided for Phase I and III (Basins A-D) is 57,438 cubic-feet. The provided detention includes additional volumes that will be achieved by regrading Basin A and D in the developed condition. Refer to Exhibit 5 – *Proposed Drainage Exhibit*.

3.4 Ongoing Maintenance

Ongoing maintenance of the designed and recommended drainage systems is required to preserve the system's integrity. Failure to provide maintenance can prevent the drainage system from performing its intended design purpose and can result in reduced performance. Maintenance within the public right-of-way is the responsibility of the governing municipality. The property owner shall be solely responsible for the operation and maintenance of facilities on private property and within drainage easements, including private streets.

4.0 SPECIAL CONDITIONS

Currently, there are no washes with 100-year flows greater than 50 cfs traversing the Site. Also, there are no designated Section 404 washes within the Site. Therefore, a Section 404 permit is not required for development.

5.0 CONCLUSIONS

Based on our analysis of the Site, the following conclusions can be made:

1. The proposed drainage infrastructure will be designed in accordance with the *City of Scottsdale's Design Standards & Policies Manual, 2018*.
2. The proposed Site lies within a FEMA-designated "Other Flood Areas" Zone "X" shaded. Per the FEMA map (Panel 1760L), the FIRM information is as follows: "0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flow with average depth less than one foot or with drainage areas of less than one square mile".
3. Offsite flows do not appear to impact the Site.
4. The Rational Method was used to estimate peak discharges for all onsite drainage areas in this report.
5. In accordance with City of Scottsdale design guidelines, this Site is required to detain the greater of the first flush storm event or the difference in runoff between the pre-developed and post-developed 100-year, 2-hour event. Based on this analysis, a greater detention volume will be required and provided for difference in runoff between the pre and post-developed 100-year, 2-hour event.
6. The required detention volume for Phase I and III is 42,912 cubic-feet. The volume provided for Phase I and III (Basins A-D) is 57,438 cubic-feet.
7. The occupied portion of the proposed building has a floor elevation of 1462.00. This floor elevation is substantially higher than the ultimate site outfall elevation of 1454.00 at the southwest corner of the Site.
8. The property owner shall perform ongoing maintenance of the onsite storm water system.

6.0 REFERENCES

1. *Drainage Design Manual, Hydrology, Edition 4*, Flood Control District of Maricopa County, August 15, 2013.
2. *Drainage Design Manual, Hydraulic, Edition 4*, Flood Control District of Maricopa County, August 15, 2013.
3. *Design Standards and Policies Manual, Chapter 4: Grading and Drainage*, City of Scottsdale, January 2018
4. *Master Drainage Report for Northsight Commercial Development*, Gilbertson Associates, Inc., October 11, 2001.
5. *Final Drainage Report for Liberty Property Trust for Vanguard*, DEI Professional Services L.L.C., June 8, 2005.
6. *Addendum to Final Drainage Report for Liberty Property Trust for Vanguard*, DEI Professional Services L.L.C., January 26, 2006.
7. *Final Drainage Report for Raintree Office Building*, Wood, Patel & Associates, Inc., September 25, 2019.

APPENDIX A – HYDROLOGY CALCULATIONS

**RETENTION VOLUMES REQUIRED
FIRST FLUSH VOLUME**

Project Raintree Phase III Residential
Location Scottsdale AZ
Project Number 195063
Project Engineer Darin Moore, P.E.

Rainfall Depth "P" = 0.5 inches

Weighted "C" Factor "C" = 1.0

	Drainage Subbasin ID	Retention Basin ID	Drainage Area "A" (Acres)	Runoff Coefficient "C"	A*C	Required Retention (AF)*	Required Retention (CF)*
OFFSITE	DEI 1	A	0.23	1.00	0.23	0.01	426
	DEI 2A	B	3.58	1.00	3.58	0.15	6,503
	DEI 3A	C	1.83	1.00	1.83	0.08	3,330
ONSITE	Proposed 2B	A-Addition	0.84	1.00	0.84	0.04	1,531
	Proposed 3B	D	0.85	1.00	0.85	0.04	1,537
	Proposed 4	B	1.37	1.00	1.37	0.06	2,483
TOTAL FIRST FLUSH VOLUME REQUIRED:						0.36	15,811

*Calculated Values:

$$\text{Required Retention} = V_{\text{required}} = (P/12) * C * A$$



RETENTION VOLUMES REQUIRED
100 YEAR, 2-HOUR VOLUME

Project Raintree Phase III Residential
Location Scottsdale AZ
Project Number 195063
Project Engineer Darin Moore, P.E.

Rainfall Depth "P" = 2.30 inches

	Drainage Subbasin ID	Retention Basin ID	Drainage Area "A"	100 YR Runoff Coefficient "C"	A*C	Required Retention	Required Retention
			(Acres)			(AF)	(CF)
OFFSITE	DEI 1	A	0.23	0.59	0.14	0.03	1,157.29
	DEI 2A	B	3.58	0.59	2.11	0.41	17,649.14
	DEI 3A	C	1.83	0.59	1.08	0.21	9,037.96
ONSITE	Proposed 2B	A-Addition	0.84	0.59	0.50	0.10	4,156.15
	Proposed 3B	D	0.85	0.59	0.50	0.10	4,171.76
	Proposed 4	B	1.37	0.59	0.81	0.15	6,739.99
TOTAL 100-YR 2-HR VOLUME REQUIRED:						0.99	42,912

*Calculated Values:
 Weighted "C" = $C_{Post} - C_{Pre}$

**RETENTION VOLUME PROVIDED
ON-SITE RETENTION**

Project Raintree Phase III Residential
Location Scottsdale AZ
Project Number 195063
Project Engineer Darin Moore, P.E.

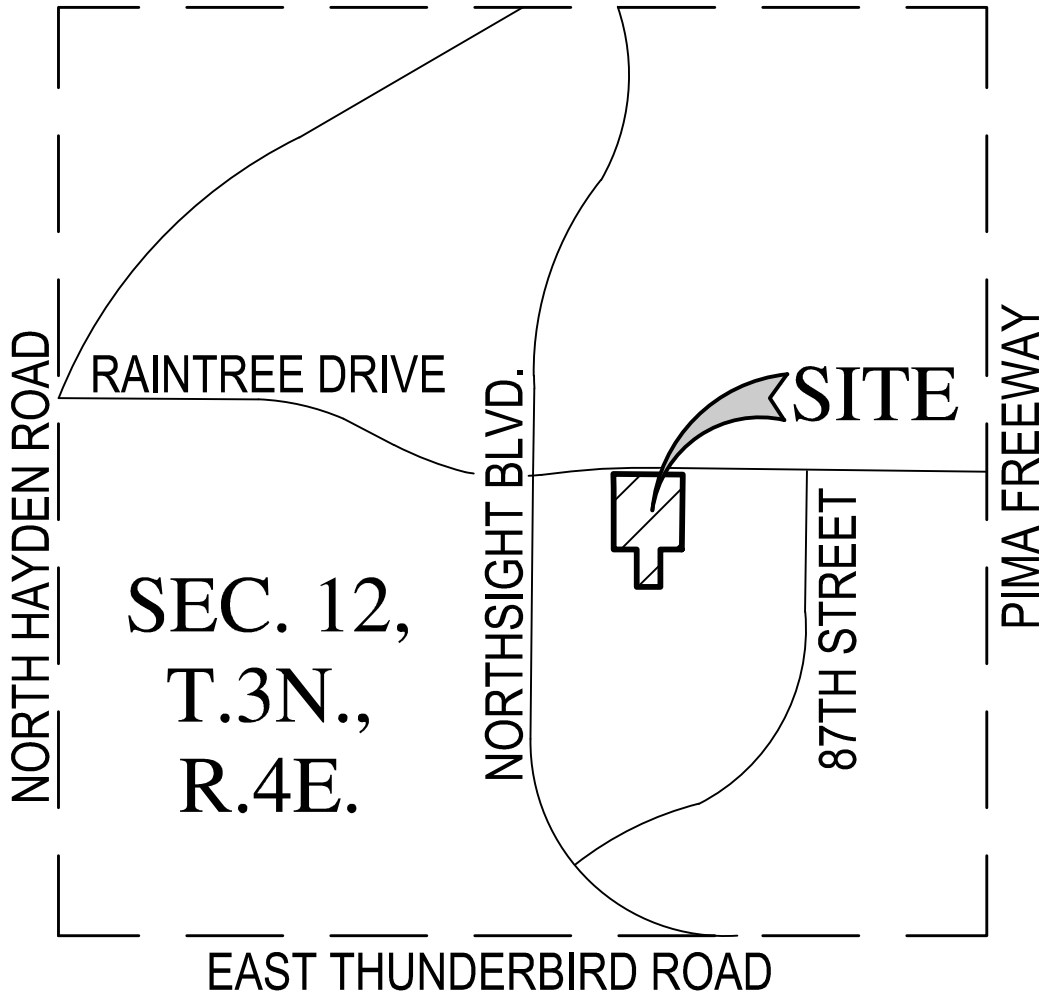
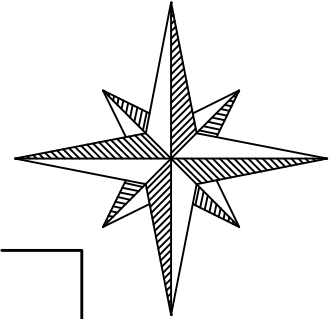
Volume Method Used **Conic Approximation**

	Drainage Subbasin ID	Retention Basin ID	Bottom Elevation	Top Elevation	Bottom Area	Top Area	Cumulative Volume	Cumulative Volume	Total Volume Provided	Total Volume Provided
					(SF)	(SF)	(CF)	(AF)	(AF)	(CF)
OFFSITE	DEI 1	A								4,000
	DEI 2A	B								29,000
	DEI 3A	C								21,000
ONSITE	Proposed 2B	A-Addition	1,453.0	1,454.0	1,390	2,259	1,807	0.04	0.04	1,807
	Proposed 3B	D	1,457.0	1,458.0	56	691	315	0.01		-
			1,458.0	1,459.0	691	2,063	1,631	0.04	0.04	1,631
	Proposed 4	B								-
TOTAL VOLUME PROVIDED:										57,438

*Average End Area Method:
The Equation is $V = (A1 + A2)/2 \times \text{Depth}$

EXHIBIT 1 – VICINITY MAP

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RAINTREE PHASE III

**EXHIBIT 1
VICINITY MAP**

DATE	03-03-2020	SCALE	N/A	SHEET	01 OF 01
JOB NO.	195063	DESIGN	DM	CHECK	TB
		DRAWN	AF	RFI #	N/A

EXHIBIT 2 – FEMA FIRM EXHIBIT

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Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		Cross Sections with 1% Annual Chance
		Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped
		The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards.

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/28/2019 at 4:21:33 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



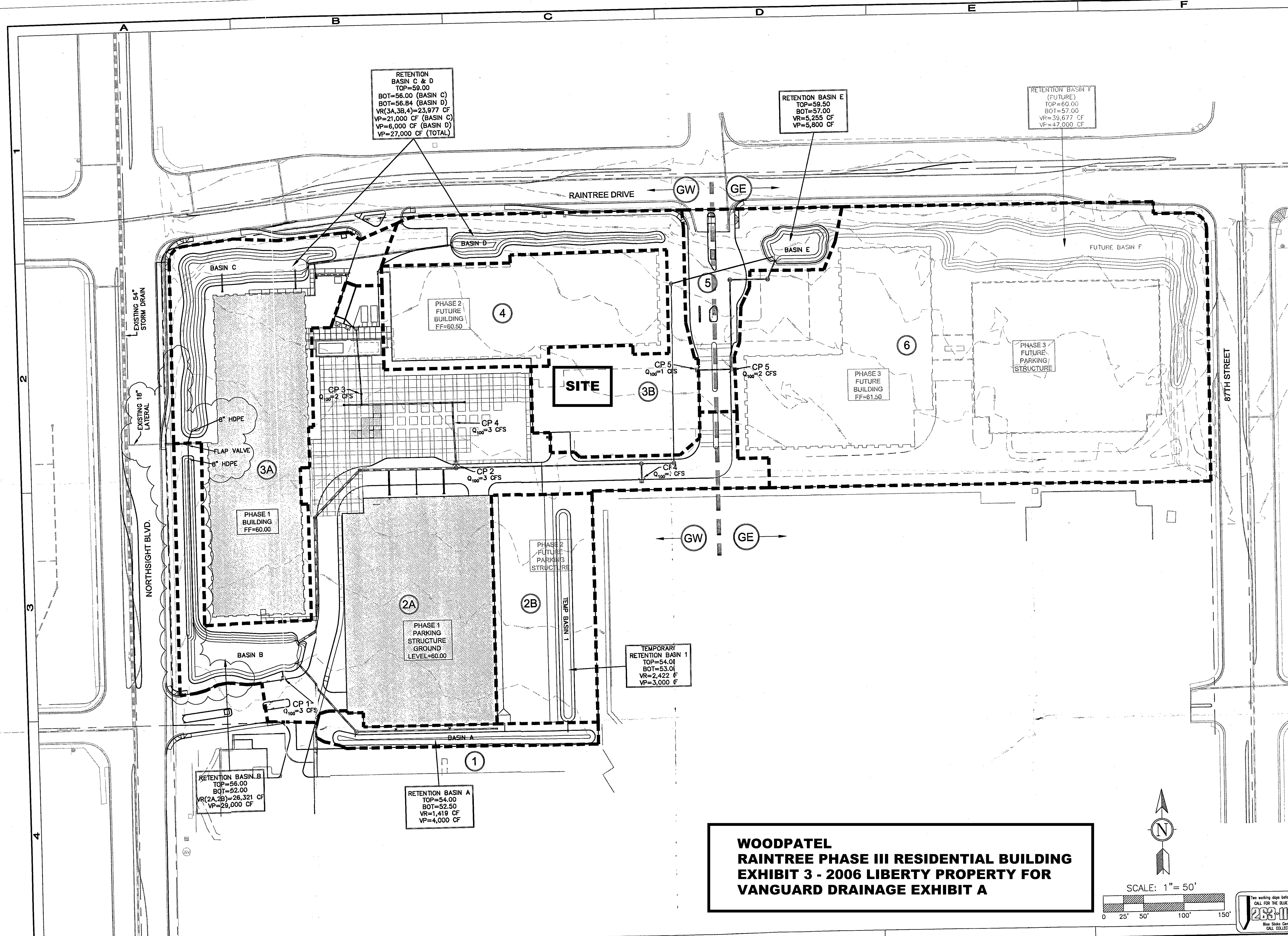
PROJECT AREA

<p>NOT FOR CONSTRUCTION OR RECORDING</p>	<p>WOOD/PATEL MISSION: CLIENT SERVICE® (602) 335-8500 WWW.WOODPATEL.COM</p>	<p>RAINTREE OFFICE DEVELOPMENT</p>	
		<p>EXHIBIT 2</p>	
		<p>FEMA FIRM EXHIBIT</p>	
		<p>DATE: 03-03-2020</p>	<p>SCALE: N.T.S.</p>
<p>JOB NO.: 195063</p>	<p>DESIGN: DM DRAWN: AF</p>		

EXHIBIT 3 – 2006 LIBERTY PROPERTY TRUST FOR VANGUARD DRAINAGE EXHIBIT A

REVISIONS	DATE	BY

DATE: 01/26/06
PROJ. NO.: 04147
DESIGN: MRR
DRAWN:
CHECK: PV
SCALE: 1"=50'
CAD FILE: DrnExb



**WOODPATEL
RAINTREE PHASE III RESIDENTIAL BUILDING
EXHIBIT 3 - 2006 LIBERTY PROPERTY FOR
VANGAURD DRAINAGE EXHIBIT A**

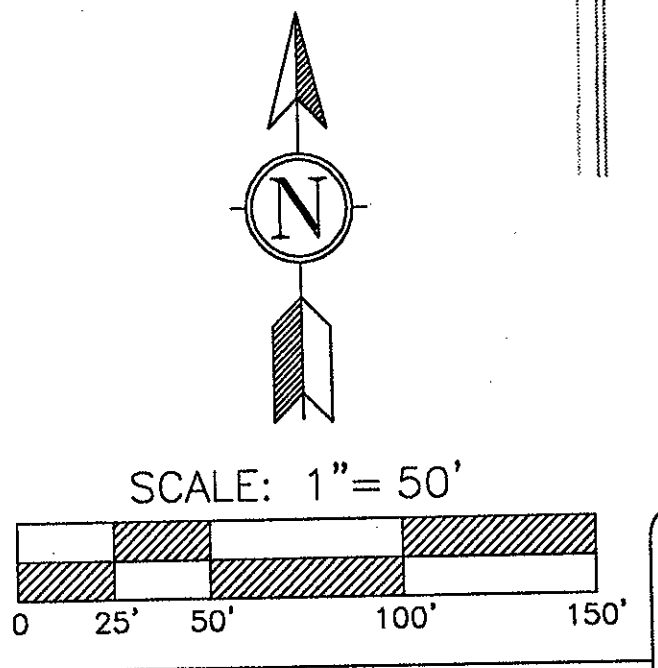
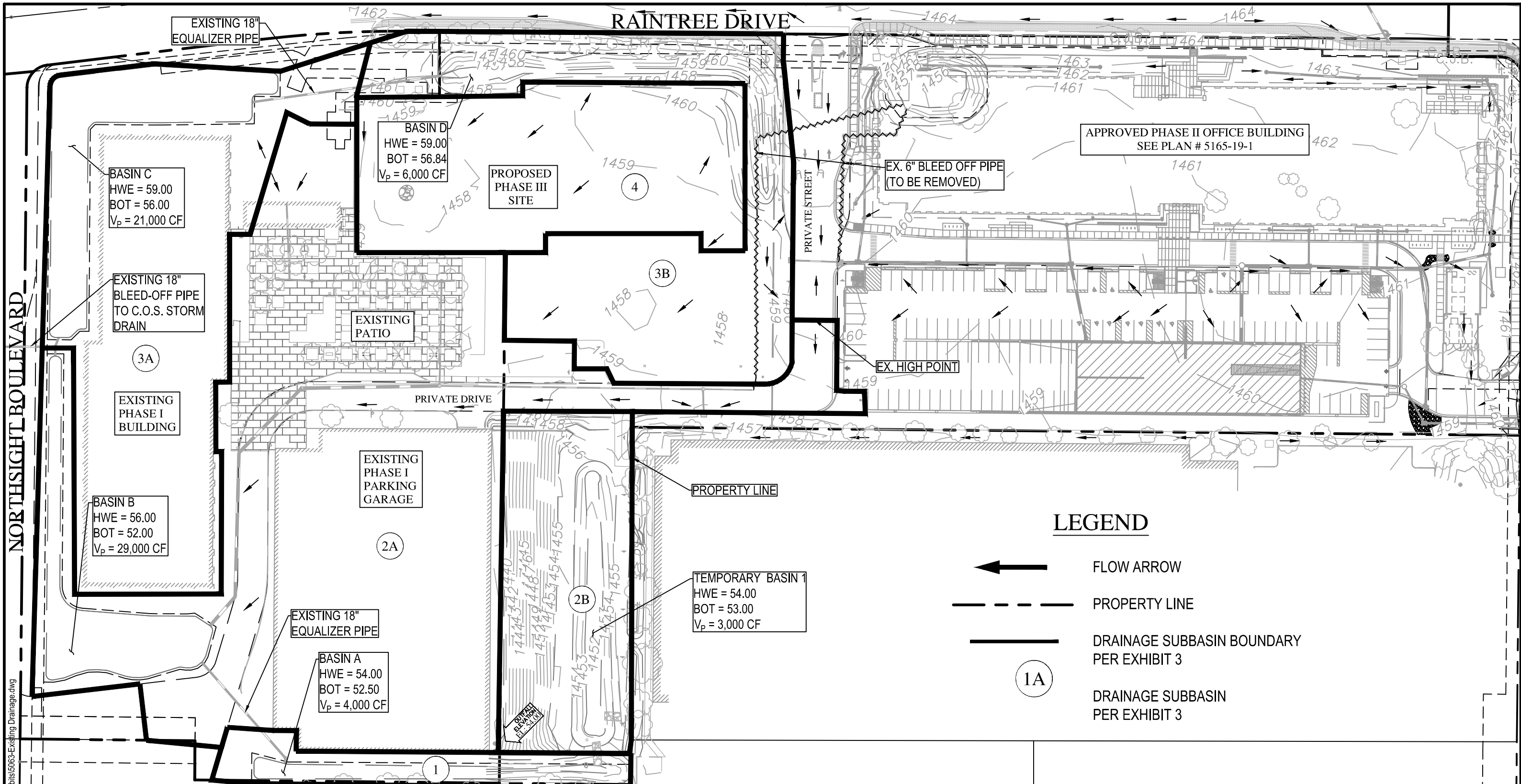
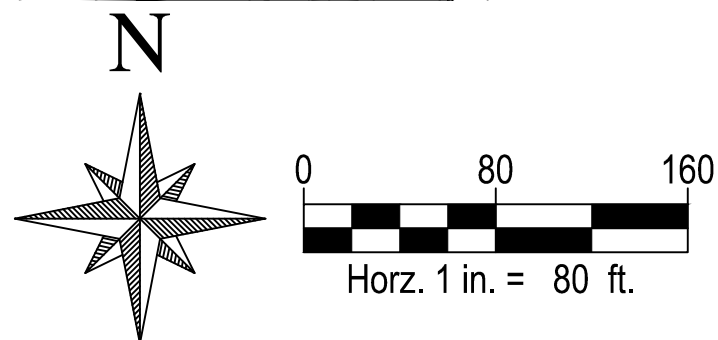


EXHIBIT 4 – EXISTING DRAINAGE EXHIBIT



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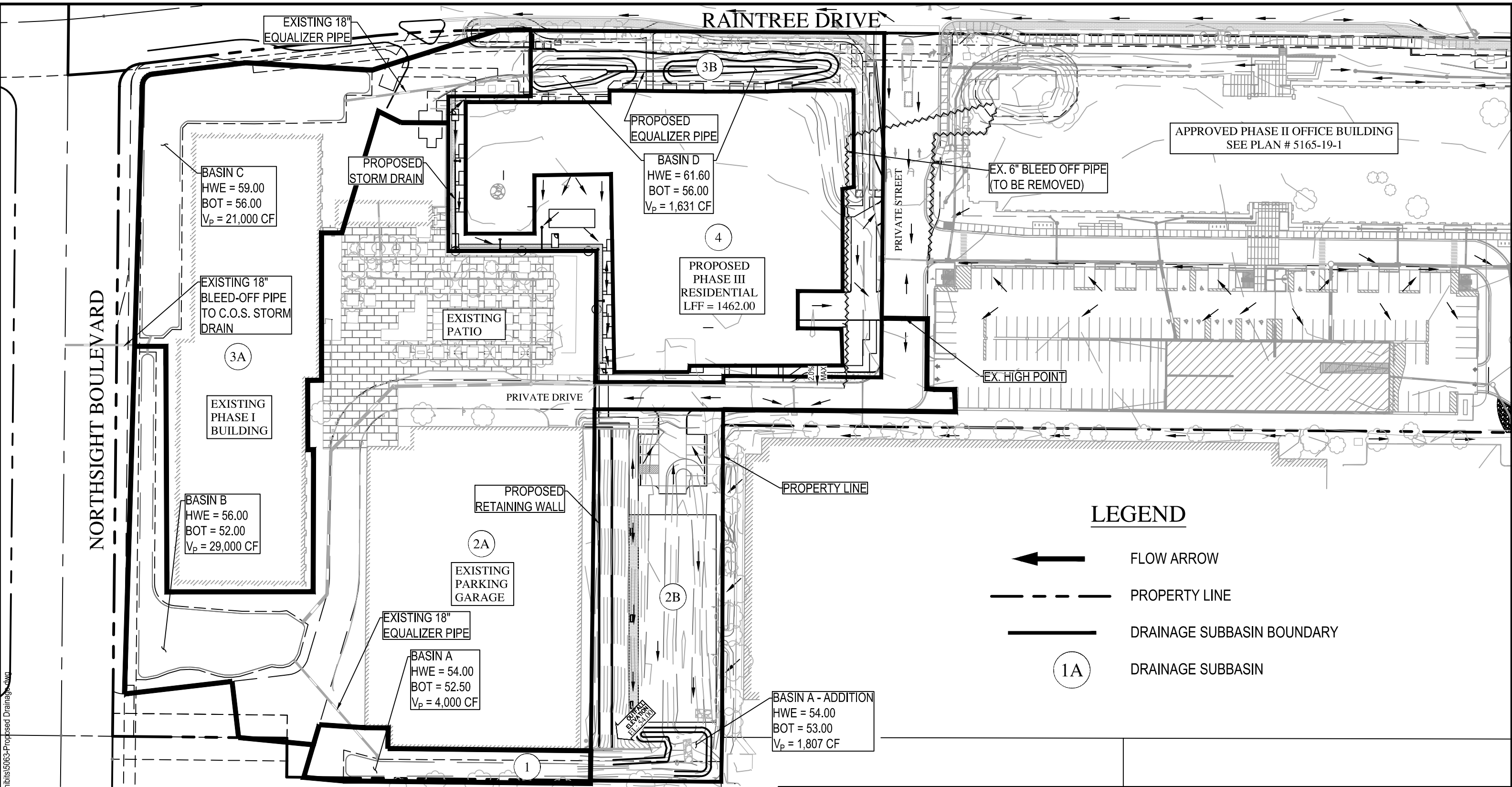


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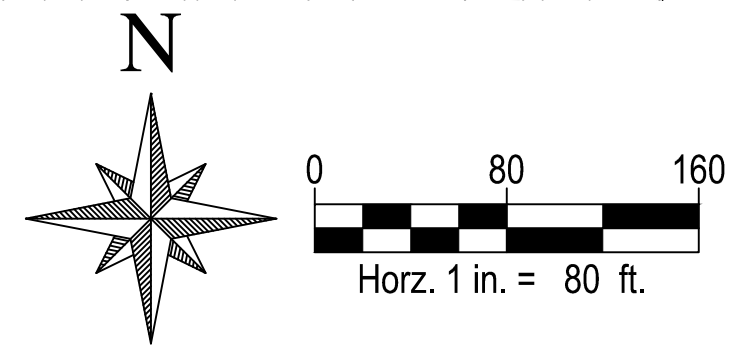
RAINTREE PHASE III RESIDENTIAL BUILDING		
EXHIBIT 4 EXISTING DRAINAGE EXHIBIT		
DATE: 03-03-2020	SCALE: 1" = 80'	SHEET 01 OF 01 19-ZN-2019 3/10/2020
JOB NO.: 195063	DESIGN: DM DRAWN: AF	

EXHIBIT 5 – PROPOSED DRAINAGE EXHIBIT



NOTE:

- REFER TO EXHIBIT 3 FOR MASTER DRAINAGE BASIN IDS
- PHASES I AND III HAVE SHARED DETENTION BASINS (A-D) WITH EQUALIZER PIPES.
- THE REQUIRED DETENTION FOR PHASES I AND III = 42,912 CF.
- THE PROVIDED DETENTION FOR PHASES I AND III = 57,438 CF.
- ALL STORM WATER IS DETAINED ONSITE. EXISTING 18" BLEED-OFF TO CITY STORM DRAIN WILL BE MAINTAINED IN DEVELOPED CONDITION.



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RAINTREE PHASE III RESIDENTIAL BUILDING		
EXHIBIT 5 PROPOSED DRAINAGE EXHIBIT		
DATE: 03-03-2020	SCALE: 1" = 80'	SHEET 01 OF 01 19-ZN-2019 3/10/2020
JOB NO.: 195063	DESIGN: DM DRAWN: AF	

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