

MACRO STORM WATER DRAINAGE STUDY

East Village

NE & SE Quadrant SE Bailey Road & MO 291 South

Site Acreage: 129.54 Acres

Lee's Summit, MO

PREPARED BY:



Prepared On: August 8, 2025



Revision

Date	Comment	By

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3. GENERAL INFORMATION

The macro storm study has been prepared to evaluate potential negative downstream hydraulic impacts and propose potential mitigation measures associated with the redevelopment of the proposed Planned Mixed Use Development, East Village. The proposed redevelopment will consist of multi-family communities in addition to multiple commercial and retail establishments. The site is located east of South 291 Highway, west of the railroad tracks and bounded by 50 Highway to the North and SE 16th Street to the south. The proposed master development contains 129.54 acres. The proposed site has been home to multiple developments over time consisting mainly of planned industrial usages. Currently there is one industrial development active on the property which is to be abandoned and demolished. The northwest portion of the property drains west to Oldham Village where it has been accounted for in the Oldham Village Retention System. The Oldham Village system is tributary to Cedar Creek. Property south of Oldham Parkway drains to the south and is tributary to an unnamed branch of Big Creek. The site consists of land located in Sections 17 and 8, Township 47 North, and Range 31 West. See Exhibit A for an aerial view of the site in addition to the site and surrounding area. The proposed grading plan is also included in Exhibit A.

3.1 FEMA FLOODPLAIN DETERMINATION

The property is located in an Area of Minimal Flood Hazard, Zone X, according to Flood Emergency Management Agency (FEMA) Firm Map Numbers 29095C0419G and 29095C0438G, effective January 20, 2017.

See Exhibit B for (3) FEMA FIRMette maps which encompass the proposed project site.

3.2 NRCS SOIL CLASSIFICATION

Soil classifications published by the United States Department of Agriculture/National Resources Conservation Service (USDA/NRCS) website for Jackson County, Missouri, Version 27, August 27, 2024. The existing site contains two major soil types:

- | | |
|-------|--|
| 10082 | Arisburg-Urban Land Complex, 1 to 5 Percent Slopes
Hydrologic Soils Group (HSG): Type C |
| 10181 | Udarents-Urban Land-Sampsel Complex, 5 to 9 Percent Slopes
(HSG): Type C |

See Exhibit C for a detailed soils report of the proposed project site.

4. METHODOLOGY

The Macro Storm Drainage Study has been prepared to evaluate potential hydrologic impacts from the proposed redevelopment and recommend improvements to eliminate any potential negative impacts. The study utilized existing contours to create the Existing Drainage Area Map. The study conforms to the requirements of the City of Lee's Summit, Missouri "Design and Construction Manual" and all applicable codes and criteria referred to therein. If attenuation is to be employed it shall meet the Comprehensive Control Strategy with extended detention as outlined in APWA Section 5600.

Using the above criteria, the proposed site was evaluated using SCS Methods to calculate storm runoff volumes, peak rates of discharge, existing and proposed hydrographs and required storage volumes for attenuation facilities. The analysis contains results for the 2, 10 and 100-year design storms.

5. EXISTING CONDITIONS ANALYSIS

The project site consists of 129.54 acres. There have been several large industrial users that have been housed on the subject property in recent history. The property currently houses one large industrial user. The existing industrial site is to be decommissioned and its existing infrastructure demolished. The existing project site will be evaluated in its pre-developed condition. The site consists of four (4) drainage subareas.

The North subarea is the smallest of the four subareas (1.40 acres) and consists of a small sliver of land running adjacent to the north property line. The North subarea consists of mainly turf with a few trees. The North subarea drains via sheet flow to the enclosed storm system located along US 50 Highway. The West subarea is located on the west side of the property and runs adjacent to MO S. 291 Highway. The subarea stretches from the north boundary to a midway point between SE Oldham Parkway and SE Bailey Road. The subarea consist of 15.76 acres and contributes runoff to the existing enclosed storm sewer system running along MO S. 291 Highway. Runoff from the West subarea is tributary to the Oldham Village Retention System and was accounted for in that design. The west subarea is tributary to Cedar Creek and makes up part of the Cedar Creek Headwaters. The East subarea is located in the northeast portion of the property and consists of 18.40 acres. The East subarea drains via sheet and shallow concentrated flow to a culvert located under the railroad tracks. The East subarea is tributary to an unnamed branch of Big Creek. The South subarea is by far the largest subarea on the property consisting of 93.98 acres in addition to two offsite tributaries of 17.91 and 5.64 acres contributing from the Southeast and Southwest, respectively, for a total tributary area to POI South of 117.53 acres. The South Offsite subarea consists mainly of railroad and street right-of-way with a small portion of green space on a developed lot. A curve number of 82 was utilized for the offsite area. The South subarea drains via sheet, shallow concentrated and channelized flow to the south where runoff is collected by dual culverts at SE 16th Street for further conveyance downstream. The drainage patterns appear to be segmented due to past developments and SE Bailey Road which bisects the South subarea. The South Subarea is also tributary to Big Creek and makes up part of the Big Creek Headwaters.

An Existing Drainage Map may be found in Exhibit D. Hydraflow Hydrograph software was utilized to calculate SCS Method peak discharge rates. A complete breakdown of Existing and Proposed hydrographs may be found in Exhibit E. The following tables summarize the results of the Existing Conditions analysis.

Table 5.1 Existing Conditions Subarea

Subarea	Area (ac.)	Curve Number	Tc (min)
North	1.40	74	8.7
West	15.76	74	14.3
East	18.40	74	19.5
South	117.53	76	42.3

Table 5.2 Existing Conditions Runoff Data: Peak Discharge Rates

Subarea	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
North	3.10	5.67	10.55
West	28.95	53.68	100.49
East	28.84	53.82	101.31
South	120.39	219.62	406.40

Per APWA Section 5608.4 and City of Lee's Summit criteria, the performance criteria for detention is to provide detention to limit peak flow rates at downstream points of interest to maximum release rates:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
- 1% storm peak rate less than or equal to 3.0 cfs per site acre

The South subarea is the only subarea that has offsite runoff draining to it. The allowable offsite contribution was determined by the area ratio method. The allowable offsite peak discharge is the product of the ratio of offsite area to onsite area multiplied by a given storm's existing peak discharge rate. The allowable peak discharge rate is the sum of the offsite allowable plus the onsite allowable per APWA Section 5608.4. See allowable 100-year peak discharge rate calculation below.

$$\text{Example (100-YR): } [(23.55 / 117.53 \times 406.40) + (93.98 \times 3.0)] = 363.37 \text{ cfs}$$

Table 5.3 Existing Conditions APWA Allowable Peak Discharge Release Rates

POI	Onsite Area (ac.)	Offsite Area (ac.)	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
North	1.40	0	0.70	2.80	4.20
West	15.76	0	7.88	31.52	47.28
East	18.40	0	9.20	36.80	55.20
South	93.98	23.55	71.11	231.97	363.37

The North subarea consists of a long narrow sliver of land adjacent to the north property line that sheet flows directly to the right-of-way of US 50 Highway. Due to the size, geometry and proposed land usage runoff originating from the North subarea will continue to be free released via sheet flow to the enclosed storm sewer running along US 50 Highway. The proposed North subarea will not create a negative impact (reduced footprint, no hard infrastructure) to the adjacent property and storm sewer system therefore it will not be discussed any further in this report. An accounting of the proposed North Subarea will be provided in Tables 6.1 and 6.2 below to confirm our findings.

6. PROPOSED CONDITIONS ANALYSIS

The proposed development is planned to consist of both commercial and multi-family residential usages. A composite curve number for each Subarea was determined based upon proposed usage. A curve number of 88 was used for multi-family and 94 for commercial. The proposed conditions for the project site will consist of ten (10) subareas. The original four (4) subareas North, West, East and South plus five (5) additional subareas Detained Northwest, Detained Southwest, Detained East, Detained South 1, Detained South 2 and Detained South 3. Peak discharge rates for all subareas will be combined together at their given Point of Interest to ensure allowable release rates as identified in Table 5.3 are not exceeded. The five additional subareas contain attenuation systems utilized to reduce proposed peak discharge rates. The West subarea will utilize parallel attenuation systems. The East subarea will utilize one attenuation system. The South subarea will utilize three attenuation systems in series. The South subarea will be designed to free release large portions of downstream runoff south of SE Bailey Road and attenuate the majority of upstream runoff north of SE Bailey Road helping maximize attenuation in the South subarea. The combined proposed peak discharge rates at each POI will be compared to allowable discharge rates to determine if they meet or exceed the City's Comprehensive Control Storm Water Management criteria. The Proposed Drainage Map may be found in Exhibit F.

Table 6.1 Proposed Conditions Subarea Data

Subarea	Area (ac.)	Composite CN	Tc (min)
North	0.45	90	5.0
Detained Northwest	5.73	90	12.6
Detained Southwest	5.07	90	9.3
West	3.01	90	12.1
Detained East	9.87	90	10.7
East	0.74	90	11.7
Detained South (1)	13.70	90	18.5
Detained South (2)	21.26	90	19.3
*Detained South (3)	84.61	88	27.0
South	8.59	78	11.8

*Detained South (3) Includes Offsite Southeast and Southwest Subareas

Table 6.2 Proposed Conditions Runoff Data: Subarea Peak Discharge Rates

Subarea/POI	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
North	2.10	3.15	4.96
Detained Northwest	20.82	31.29	49.35
Detained Southwest	20.77	31.17	49.10
West	10.94	16.44	25.92
POI West	52.05	78.22	123.33
Detained East	38.69	58.12	91.62
East	2.90	4.36	6.87
POI East	41.59	62.48	98.49
Detained South (1)	43.01	64.84	102.63
Detained South (2)	64.19	96.82	153.36
Detained South (3)	203.77	315.10	508.51
South	20.10	34.97	62.14
POI South	317.25	490.29	791.36

As shown in Table 6.2 above POI West, East and South will all require attenuation of storm runoff peak discharge rates to achieve release rates at or below regulatory levels. Data shown in the tables above confirm the North Subarea peak discharge rates will be well below existing peak discharge rates due to reduction in tributary area therefore there will be no further evaluation of the North subarea.

6.1. ATTENUATION

Detention basins are being proposed to attenuate peak discharge rates from the West and East subareas. Two single stage earthen detention basins in parallel are being proposed in the West Subarea. The basins are referred to as the Northwest and the Southwest Detention Basins for the purposes of this report. The East subarea will utilize one single stage earthen detention basin referred to as the East Detention Basin. Both the West and East basins are being designed by another consultant and their design report will be included in this Macro Storm Study as Exhibit L. The South subarea will utilize three (3) earthen retention basins to attenuate peak discharge rates. This section will focus on the design of the South subarea attenuation system which includes Retention Basin (1) most northerly, Retention Basin (2) centrally located and Retention Basin (3) near the southern

property boundary. South Retention Basins 1 and 2 are in series. Following are a list of design parameters for the attenuation system.

Designation: South Retention Basin (1)

Type: Earthen Basin

Side Slopes: 3:1 Max.

Bottom Slope: 2%

Basin Bottom Elevation: 1027.50

Permanent Pool Elevation: 1034.00

Basin Top Berm Elevation: 1044.00 (Top crowned for drainage)

Basin Spillway Crest Width: 150' @ 1042.00

Basin Volume: 483,392 cf @ 1044.00

Control Structure Effluent Pipe: 15" HDPE, FL (In) = 1034.00, FL (Out) = 1,033.45, L=55.50', S=1.00%

Emergency Spillway: Earthen Broad Crested Weir, Crest Elevation=1042.00, Crest Length=150'

Consecutive 100-YR Q=102.63 cfs, Emergency Spillway HGL=1042.41, Freeboard=1.59'

Sediment Storage Required: 5-Year Accumulated per APWA Figure 5608-1 = 80 x 13.70 x 5 = 5,480 cf

Sediment Storage Provided: Bottom = 1027.50, Depth = 0.50', V = 20,932 cf @ El = 1028.00

The Attenuation Plans for the South subarea may be found in Exhibit G. Emergency spillway calculations may be found in Exhibit H. See Table 6.3 for a summary of retention basin data.

Table 6.3 Proposed Conditions South Retention Basin (1) Data

	Peak Q In (cfs)	Tp In (min.)	Peak Q Out (cfs)	Tp Out (min)	Peak W.S.E.	Max. Storage Vol. (cf)
South Basin (1)						
2-Year	43.01	724	6.54	748	1035.85	66,186
10-Year	64.84	723	8.66	752	1036.78	103,056
100-Year	102.63	723	11.30	757	1038.28	168,609

As shown in the table above all proposed peak discharge rates from Subarea Detained South (1) have been attenuated.

Designation: South Retention Basin (2)

Type: Earthen Basin

Side Slopes: 3:1 Max.

Bottom Slope: 2%

Basin Bottom Elevation: 1024.50

Permanent Pool Elevation: 1031.00

Basin Top Berm Elevation: 1039.00 (Top crowned for drainage)

Basin Spillway Crest Width: 150' at 1037.00

Basin Volume: 796,653 cf @ 1039.00

Control Structure Effluent Pipe: 18" HDPE, FL (In) = 1031.00, FL (Out) = 1,029.71, L=129.00', S=1.00%

Emergency Spillway: Earthen Broad Crested Weir, Crest Elevation=1037.00, Crest Length=150'

Consecutive 100-YR Q=255.99 cfs, Emergency Spillway HGL=1037.76, Freeboard=1.24'

Sediment Storage Required: 5-Year Accumulated per APWA Figure 5608-1 = 80 x 21.26 x 5 = 8,504 cf

Sediment Storage Provided: Bottom = 1024.50, Depth = 0.50', V = 32,000 cf @ El = 1025.00

See Table 6.4 for a summary of retention basin data.

Table 6.4 Proposed Conditions South Retention Basin (2) Data

	Peak Q In (cfs)	Tp In (min.)	Peak Q Out (cfs)	Tp Out (min)	Peak W.S.E.	Max. Storage Vol. (cf)
South Basin (2)						
2-Year	69.09	725	6.21	812	1033.04	176,006
10-Year	103.75	725	9.84	902	1033.87	253,286
100-Year	162.41	725	14.38	911	1035.45	407,515

As shown in the table above all proposed peak discharge rates from Subarea Detained South (2) have been attenuated.

Designation: South Retention Basin (3)

Type: Earthen Basin

Side Slopes: 3:1 Max.

Bottom Slope: 2%

Basin Bottom Elevation: 996.50

Permanent Pool Elevation: 1003.00

Basin Top Berm Elevation: 1012.00 (Top crowned 2% for drainage)

Basin Spillway Crest Width: 300' @ 1010.25

Basin Retention Volume: 1,442,522 cf from 1003.00 to 1012.00 (Normal Pool to Top Dam)

Control Structure: (3) 8'x6' Precast Concrete Box with Interior 6" Baffle/Weir Wall

Baffle Wall Orifice: (1) 8" Dia. Orifice (WQv Orifice) Screened

Weir Wall Crest Elevation: 1005.75, L = 24'

Control Structure Top Elevation: 1010.00

Control Structure Emergency Overflow: N/A – Solid Top

Control Structure Influent Pipe: 60" HDPE, FL (In) = 1003.00, FL (Out) = 1002.90, L=14.50', S= 0.69%

Control Structure Effluent Pipe: 60" HDPE, FL (In) = 1002.70, FL (Out) = 1002.40, L=44.50', S=0.67%

Emergency Spillway: Earthen Broad Crested Weir, Crest Elevation=1010.00, Crest Length=300'

Consecutive 100-YR Q=508.51 cfs, Emergency Spillway HGL=1011.00, Freeboard=1.00'

Sediment Storage Required: 5-Year Accumulated per APWA Figure 5608-1 = 80 x 61.06 x 5 = 24,424 cf

Sediment Storage Provided: Bottom = 996.50, Depth = 0.50', V = 25,000 cf @ El = 997.00

The permanent pool shall be 6' deep with an additional 0.50' of sedimentation allowance. The pond will not support fish which requires a minimum 10' of depth plus sedimentation allowance. See Table 6.5 for a summary of retention basin data.

Table 6.5 Proposed Conditions South Retention Basin (3) Data

	Peak Q In (cfs)	Tp In (min.)	Peak Q Out (cfs)	Tp Out (min)	Peak W.S.E.	Max. Storage Vol. (cf)
South Basin (3)						
2-Year	203.77	729	22.90	778	1006.16	452,987
10-Year	315.10	729	65.87	756	1007.38	644,856
100-Year	508.51	729	173.01	750	1009.44	984,804

As shown in the table above all proposed peak discharge rates from Subarea South Detained (3) have been attenuated. See Table 6.6 below for a summary of proposed peak discharge rates at POI South which consists of combined subareas post detained South Detained (1), South Detained (2), South Detained (3) and South.

Table 6.6 Proposed Conditions Post Attenuation Point of Interest Peak Discharge Rates

Point of Interest	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
South	29.15	77.98	193.24

As shown in the above table all peak discharge rates attributable to Proposed POI South have been attenuated below both Existing and Allowable Peak Discharge rates as outlined in Tables 5.2 and 5.3, respectively.

Table 6.7 below provides a comparison of runoff data between Proposed, Existing and Allowable Conditions for the Proposed Development.

Table 6.7 Point of Interest Discharge Comparison

POI	Condition	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
South	Proposed	29.15	77.98	193.24
	Existing	120.39	219.62	406.40
	Difference	-91.24	-141.64	-213.16
	Allowable	71.11	231.97	363.37
	Difference	-41.96	-153.99	-170.13

All proposed peak discharge rates as shown in Table 6.7 will be significantly below allowable providing flexibility for FDPs.

7. 40 HOUR EXTENDED DETENTION

In addition to mitigation of peak flow rates, APWA Section 5608.4 also requires 40 hour extended detention of runoff from the local 90% mean annual event (1.37"/24-hour rainfall). The proposed attenuation facility will release the water quality event over a period of 40-72 hours. South Retention Basin (3) will provide extended detention for the entire South Subarea of 93.98 acres. See Exhibit I for 40 hour extended detention calculations for South Retention Basin (3).

8. STREAM BUFFER DETERMINATION

Stream buffers are provided for natural streams which contain wide swaths of riparian area consisting of mature trees and steep slopes. The buffer is formed to protect the natural stream and surrounding property from stream encroachment of permanent hard surface development and other construction activities. One factor used to determine if a natural stream requires a buffer is tributary area. The regulatory threshold according to APWA is 40 acres. The South subarea is the only tributary on the property that is large enough to potentially constitute the requirement of a natural stream buffer setback. The South subarea was subdivided in accordance with its natural drainage flow paths. Four (4) subareas were delineated with the following designations and associated tributary areas; "A" – 8.40 acres, "B" – 43.90 acres, "C" – 20.50 acres and "D" 33.90 acres. See Exhibit J Stream Buffer Map for a depiction of the South subarea and its corresponding tributary areas contributing to natural drainage ways. Drainage Area "B" meets the minimum tributary area criteria for stream preservation and buffer zones, however, the stream characteristics for all channels are highly eroded with minimal vegetation and limited stabilization. The natural/unimproved drainage ways located within the South subarea have limited stream characteristics and present a severe erosion potential which would be magnified with additional hard infrastructure upstream. The development of this area will create a series of detention/BMP facilities that will serve the overall watershed by limiting erosion and providing improved storm water quality. We recommend eliminating the existing unimproved drainage ways for an enclosed sewer system with multiple detention/BMP facilities.

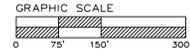
9. WETLAND DETERMINATION

We have had several lengthy conversations with representatives from the United States Army Corp of Engineers (USACE) over the last several months for various projects concerning USACE jurisdiction of streams/creeks and wetlands. Mrs. Danielle Brunin with USACE Regulatory Branch in Kansas City, Missouri has been especially gracious in helping us better understand and determine potential USACE jurisdictional waters. The property in question makes up the headwaters for an unnamed tributary of Cedar Creek and Big Creek. The channels located on the property are ephemeral and connected to a non-navigable intrastate water therefore not under United States Army Corp of Engineers (USACE) jurisdiction.

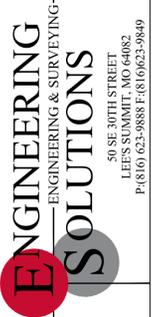
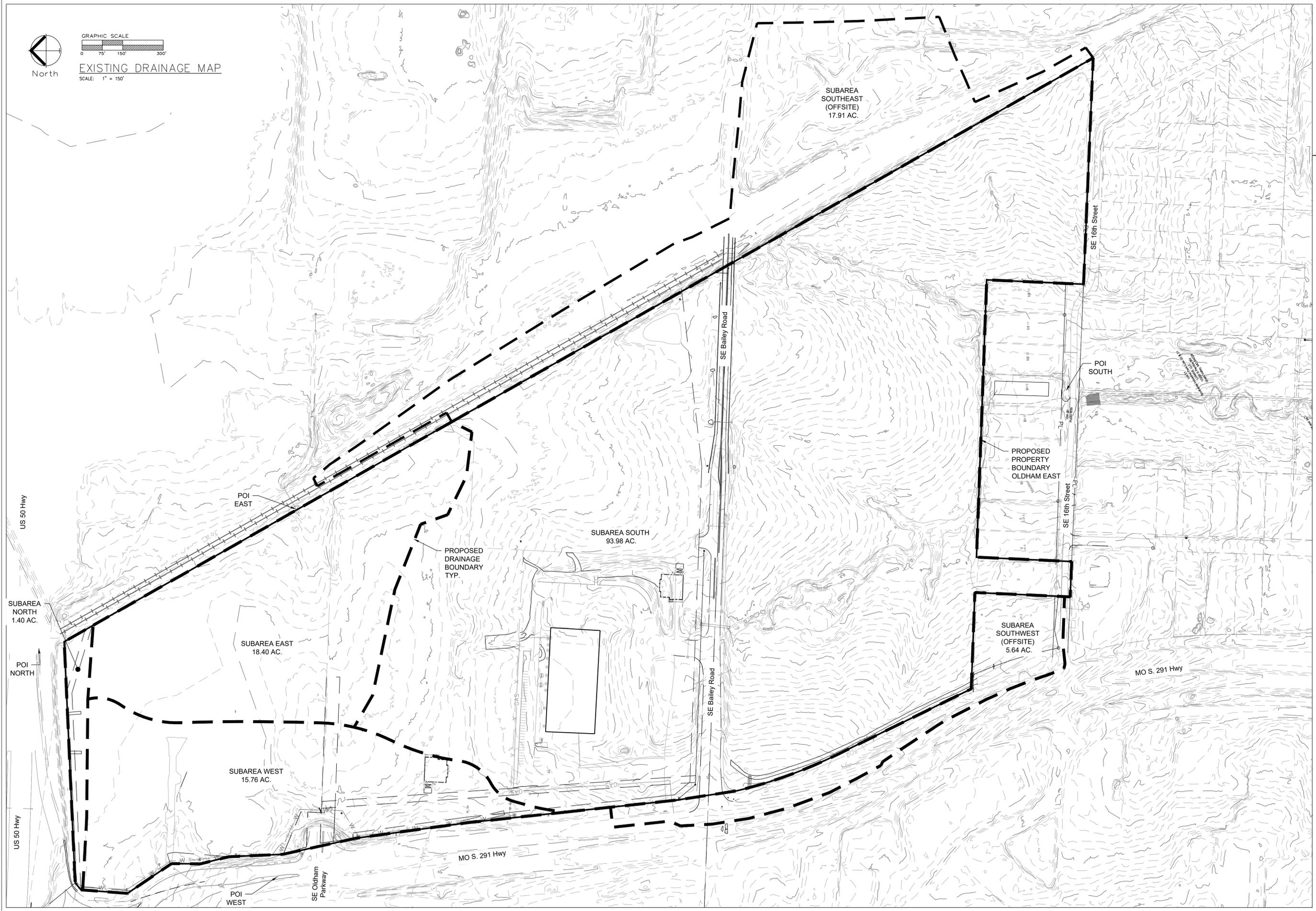
The property is not identified as having wetlands in the National Wetlands Inventory. Based on site investigations no wetlands appear to be present. Jurisdiction extends to only those “wetlands with a continuous surface connection to bodies that are ‘waters of the united states’ in their own right,” so that they are “indistinguishable” from those waters. See Exhibit K for an aerial photo from the National Wetlands Inventory of the subject property and surrounding area. The main branch of Big Creek is identified as Riverine in the National Wetlands Inventory. It is our opinion that the subject property does not contain wetlands as defined by the USACE.

10. CONCLUSIONS & RECOMMENDATIONS

Runoff from the Development will be reduced below both existing and allowable for each Subarea. Attenuation systems are being proposed in the West, East and South Subareas to reduce proposed peak discharge rates. The proposed attenuation systems will reduce all proposed regulatory peak discharge rates below both Existing and Allowable. Proposed peak discharge rates meet or exceed APWA Section 5600 Comprehensive Control Strategy targets. Onsite Attenuation utilizing comprehensive control strategy with extended detention as outlined will reduce peak discharge rates downstream. It is the opinion of the Professional Engineer that the proposed storm water management improvements outlined in the report will help mitigate any potential negative hydraulic impacts onsite and downstream and therefore recommends approval of said improvements and the storm study.



EXISTING DRAINAGE MAP
SCALE: 1" = 150'



Professional Registration
Missouri
Engineering 2005002186-D
Surveying 2005008319-D
Kansas
Engineering E-1695
Surveying LS-218
Oklahoma
Engineering 5254
Nebraska
Engineering CA2821

Project: OLDHAM EAST
Issue Date: August 8, 2025
Professional Registration:
Missouri
Engineering 2005002186-D
Surveying 2005008319-D
Kansas
Engineering E-1695
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Engineering CA2821

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Existing Drainage Map
Preliminary Development Plans for:
East Village
Lee's Summit, Jackson County, Missouri

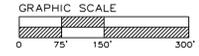


Matthew J. Schlicht
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KS PE 19071
OK PE 25226
NE PE E-14335

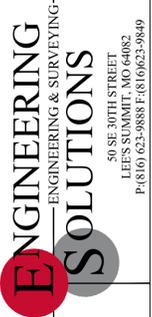
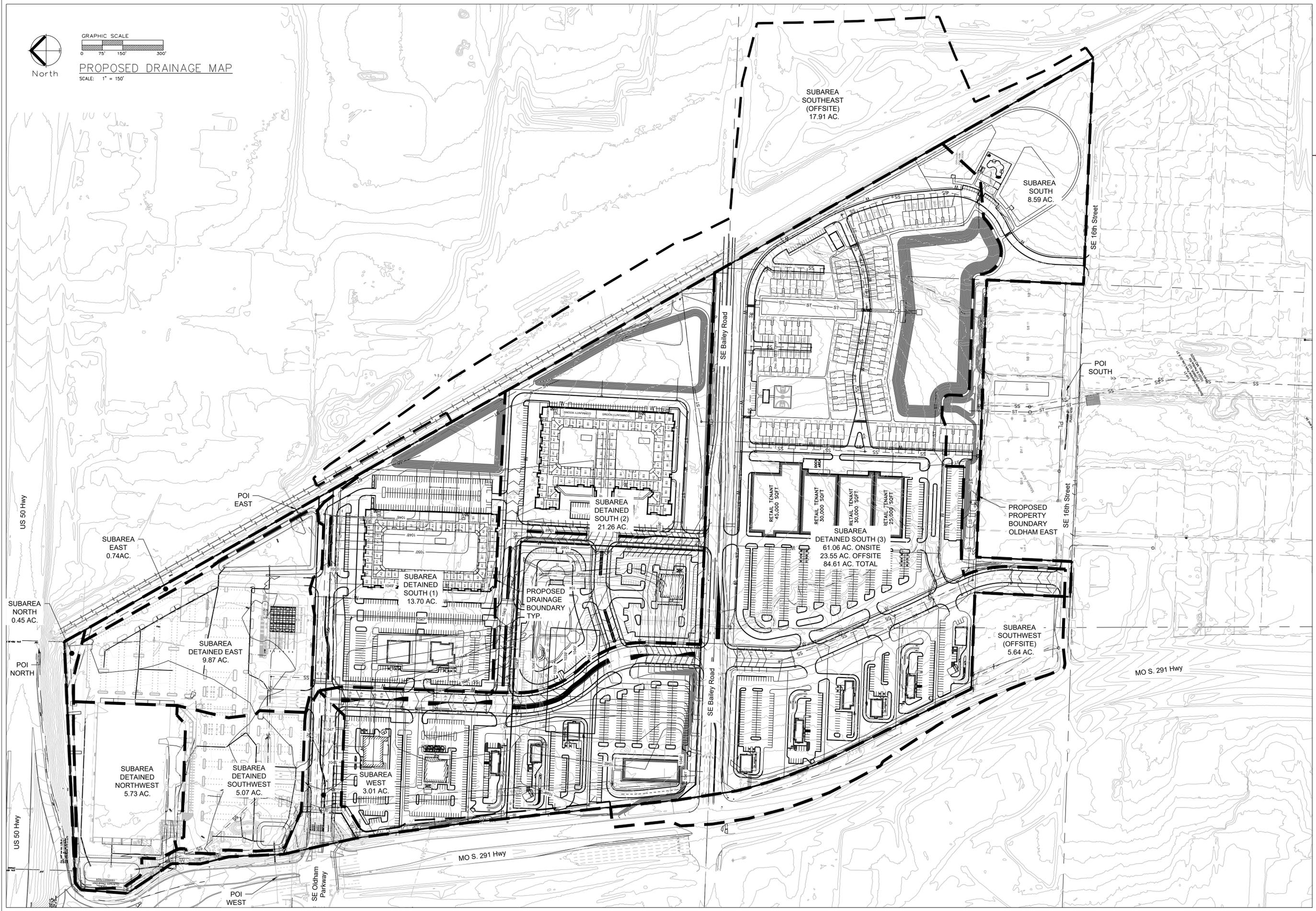
REVISIONS

NO.	DESCRIPTION

EXHIBIT



PROPOSED DRAINAGE MAP
SCALE: 1" = 150'



Professional Registration
Missouri
Engineering 2005002186-D
Surveying 2005008319-D
Kansas
Engineering E-1695
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Project: Oldham East
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East Village
Lee's Summit, Jackson County, Missouri

Proposed Drainage Map
Preliminary Development Plans for:
East Village
Lee's Summit, Jackson County, Missouri



Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226
NE PE E-14335

REVISIONS

NO.	DESCRIPTION

EXHIBIT