
Troweling floor
Mach. Shop.

APPENDICES

APPENDIX A: SOURCES AND CREDITS

- ULI Advisory Services Panel, 2008, "Albuquerque Rail Yards," prepared at the invitation of the City of Albuquerque, the WHEELS Museum, and the University of New Mexico School of Architecture and Planning.

- Wilson, Chris, 1986, "The Historic Railroad Buildings of Albuquerque, an Assessment of Significance," prepared for the Redevelopment Division, Planning Department, City of Albuquerque.

- Dodge, Bill et al, 2014, "National Register of Historic Place Nomination Form, Atchison, Topeka & Santa Fe Railway Locomotive Shops Historic District," prepared for the City of Albuquerque for submittal to the New Mexico State Historic Preservation Office.

- City of Santa Fe, 2002, "Santa Fe Railyard, Master Plan and Design Guidelines." Master Plan prepared for the former Rail Yard site at the terminus of the former ATSF line in Santa Fe.

- City of Albuquerque, 2008, "Barelas Sector Development Plan." Document prepared as a replacement to the Barelas Sector Development Plan written in 1978 and amended in 1993.

- City of Albuquerque, 1986 (amended 2002) "South Broadway Neighborhoods Sector Development Plan."

- Historic District Improvement Company, 1999, "Master Plan, Alvarado Transportation Center Project Area."

- City of Albuquerque, Department of Finance and Administrative Services, 2010, "Request For Proposals, Solicatation Number: RFP 2011-003-JR."

APPENDIX B: TRAFFIC IMPACT STUDY

Terry O. Brown P.E.

Railyard Re-development
(Second St. S. of Hazeldine Ave.)

Traffic Impact Study

October 1, 2013

Presented to:

City of Albuquerque

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STUDY PURPOSE

The purpose of this study is to identify the development's impact on the adjacent transportation system. The study is being conducted in conjunction with a request for approval of a proposed plan for a commercial retail, office, and residential development located at Second St. south of Hazeldine Ave. in Albuquerque, New Mexico. This study is presented to satisfy the requirements of the City of Albuquerque.

GENERAL

The proposed development is located along the east side of Second St. between Hazeldine Ave. and Bridge Blvd. (see Appendix Page A-1 - Vicinity Map). It is the old AT&SF Railyard. The existing intersections of Gold Ave. / Second St., Lead Ave. / Second St., Coal Ave. / Second St., and Bridge Blvd. / Third St. are currently signalized intersections and the existing intersections of Hazeldine Ave. / Second St. and Santa Fe Ave. / Second St. are unsignalized intersections and will be analyzed in this study.

Currently, properties in the area are a mix of commercial, office, and residential in nature.

PROPOSED DEVELOPMENT

The proposed plan for this site consists of an approximately 1 million SF mixed use project described in the table below. This study will analyze only the full development of the project.

Use	Scenario 1 – Samitaur Master Plan (1-4-13)
Cultural Facilities	239,229 – 271,767
Housing	77,927 – 110,465
Public/Open Space	<123,466
Comm./Retail/Restaurant	100,000
Light Manufacturing	<430,100
Office	<430,100
Training/Education	<430,100
TOTAL SQFT	**1,003,260**

The anticipated implementation year for this site is the year 2018.

STUDY PROCEDURES

A Scoping Meeting was with City of Albuquerque staff to discuss scope and methodology to be utilized within the report before the start of the project. Specific items included format, intersections to be studied, intersection analysis procedures, existing traffic counts, trip distribution methodology, and implementation year definition.

The basic procedure followed for this traffic impact study is outlined as follows:

- Calculate the generated trips for this proposed development as defined on Page A-3 of the Appendix of this report and more specifically defined in the Trip Generation Table on Page A-5 of the Appendix of this report. The trips generated for the implementation year analyses (2018) will assume that 100% of the development has occurred.
- Calculate trip distribution for the newly generated trips by this development. The new trips will be distributed based on a two-mile radius distribution of population for the commercial portion of the development and based on city-wide socio-economic data from the Mid-Region Council of Governments (2035 data set) for the residential and office portions of the development, Appendix Pages A-15 thru A-20, A-23 thru A-27, and A-30 thru A-35.
- Determine Trip Assignments for the newly generated trips based on the results of the Trip Distribution Analysis and logical routing to and from the new site, Appendix Pages A-21 thru A-22, A-28 thru A-29, and A-36 thru A-37.
- Obtain AM Peak Hour and PM Peak Hour Turning Movement Volumes Traffic Counts for the intersections of Gold Ave. / Second St., Lead Ave. / Second St., Coal Ave. / Second St., Bridge Blvd. / Third St., Hazeldine Ave. / Second St., and Santa Fe Ave. / Second St., Appendix Pages A-115 thru A-120.
- Determine Historic Growth Rates for background traffic volumes based on an analysis of the growth trend of recent AWDT Volumes obtained from 2002 thru 2011 MRCOG Traffic Flow Maps, Appendix Pages A-38 thru A-52.
- Determine the 2018 NO BUILD Volumes for each intersection to be analyzed by growing the background traffic growth from the year of the counts to 2018, Appendix Pages A-53 thru A-72.
- Add newly generated trips from the proposed development to the 2018 NO BUILD Volumes to obtain the 2018 BUILD Volumes for this project, Appendix Pages A-53 thru A-72.
- Provide signalized and / or unsignalized intersection analyses for the following intersections:

INTERSECTION	TYPE CONTROL	NO BUILD ANALYSIS	BUILD ANALYSIS
Gold Ave. / Second St.	Traffic Signal	2018	2018
Lead Ave. / Second St.	Traffic Signal	2018	2018
Coal Ave. / Second St.	Traffic Signal	2018	2018
Bridge Blvd. / Third St.	Traffic Signal	2018	2018
Hazeldine Ave. / Second St.	Stop Sign	2018	2018
Santa Fe Ave. / Second St.	Stop Sign	2018	2018
Driveway 'A' / Second St.	Stop Sign	N/A	2018
Driveway 'B' / Second St.	Stop Sign	N/A	2018

TRIP GENERATION WORKSHEET

Projected trips were calculated based on the ITE trip generation data for library, apartment, city park, shopping center, variety store, high turnover (sit-down) restaurant, manufacturing, general office, and junior / community college. Trips for the development were determined based on land use defined by the developer. See Conceptual Site Development Plan on Page A-3 in the Appendix of this report. The following table summarizes the trip generation rate for the project:

Railyard Re-development (Second St S. of Hazeldine)

Trip Generation Data (ITE Trip Generation Manual - 9th Edition)

COMMENT	USE (ITE CODE) DESCRIPTION		24 HR VOL GROSS	A. M. PEAK HR. ENTER	A. M. PEAK HR. EXIT	P. M. PEAK HR. ENTER	P. M. PEAK HR. EXIT
	Summary Sheet	Units					
Cultural Facilities	Library (590)	270.00	7,427	249	102	721	781
Housing	Apartment (220)	160	1,093	16	66	69	37
Open Space	City Park (411)	120.00	227	302	238	239	181
40%	Shopping Center (820)	40.00	3,743	55	34	156	169
40%	Variety Store (814)	40.00	2,561	76	76	136	136
20%	High Turnover (Sit-Down) Restaurant (932)	20.00	2,543	119	97	118	79
Light Mfg	Manufacturing (140)	430.00	1,689	255	72	115	204
Office	General Office Building (710)	430.00	3,978	541	74	95	465
Training / Ed.	Junior / Community College (540)	430.00	698	123	23	114	67
	Total		**23,959**	**1,736**	**782**	**1,763**	**2,119**

See Appendix Page A-5 thru A-14 for the Trip Generation Summary Table and Worksheets for this project.

Pass-by trips were not considered for this study in order to maintain a more conservative analysis.

BACKGROUND TRAFFIC GROWTH

Background traffic growth rates were considered for each individual approach to an intersection that was targeted for analysis based on data from the 2002 through 2011 Traffic Flow maps prepared by the Mid-Region Council of Governments. Most of the Traffic Flow Data for those years taken from the MRCOG Traffic Flow Maps were Standard Data. The data from those years for each approach was plotted on a graph and a linear "regression trend line" calculated using the equation format $y=mx+b$. The growth rate was determined by calculating the average volume increase per year during the time period considered and dividing that volume into the most recent AWDT used in the analysis from which future volumes will be calculated. The rate of growth of that trend line was utilized as the annual growth rate for each approach if that calculated rate appeared feasible. However, there were some instances where the rate indicated a negative growth trend or appeared to be unreasonably high or low. In those cases, an appropriate growth rate from an adjacent segment of the same roadway was used, a shorter time span was used to determine the growth rate, or the growth rate was considered to be 0.5% or a generic 1% if appropriate. Due to the limited potential for growth in the area, it was believed that a 0.5% growth rate was appropriate for this study. Therefore, a growth rate of 0.5% was used if the linear regression analysis showed the growth rate to be negative. Additionally, if the R^2 value of the trend line was low, other means of establishing a probable growth rate from the data accumulated was considered. Historical Growth Rate Graphs with linear regression trendlines are shown in the Appendix on Pages A-38 thru A-52. Additionally, the growth rate utilized for each approach to an intersection is printed at the top of the Turning Movement sheets for each intersection (Appendix Pages A-53 thru A-72).

PROJECTED PEAK HOUR TURNING MOVEMENTS FOR 2018 BUILDOUT

The calculated growth rates were applied to the most recent (2013) peak hour traffic counts to derive the 2018 AM and PM Peak Hour NO BUILD Volumes. To these volumes, the generated trips based on implementation of the proposed Site Development Plan (100% development) were added to obtain BUILD volumes for the intersection analyses. See Appendix Pages A-53 thru A-72 for further information regarding the turning movement counts.

TRIP DISTRIBUTION

Primary and Diverted Linked Trips:

Commercial Land Use

Primary and diverted linked trips for the commercial land use development were distributed proportionally to the 2018 projected population of Data Analysis Subzones within a two-mile radius of the proposed development. Population data for the years 2015 and 2035 were taken from the 2035 Socioeconomic Forecasts by Data Analysis Subzones for the MRCOG Region, supplied by the Mid-Region Council of Governments (MRCOG). Population data from the years 2015 and 2035 was interpolated linearly to obtain 2018 population data to utilize for this analysis. Population Subzones were grouped based on the most likely major street(s) or route(s) to the subject development. The trip distribution worksheets and associated map of subareas and data analysis subzones is shown on Appendix Pages A-30 thru A-37.

Office Land Use

Primary and diverted linked trips for the office land use development were distributed proportionally to the 2018 projected population of Subareas citywide. Population data for the years 2015 and 2035 were taken from the 2035 Socioeconomic Forecasts by Data Analysis Subzones for the MRCOG Region, supplied by the Mid-Region Council of Governments (MRCOG). Population data from the years 2015 and 2035 was interpolated linearly to obtain 2018 population data to utilize for this analysis. Population Subzones were grouped based on the most likely major street(s) or route(s) to the subject development. The trip distribution worksheets and associated map of subareas and data analysis subzones is shown on Appendix Pages A-23 thru A-39.

Residential Land Use

Primary and diverted linked trips for residential development have been distributed proportionally to the 2018 projected employment of Subareas citywide. Employment data for 2015 and 2035 were taken from the 2035 Socioeconomic Forecasts for Data Analysis Subzones for the MRCOG Region, supplied by the Mid-Region Council of Governments (MRCOG). Employment Data was interpolated linearly to obtain 2018 values and adjusted for distance from the proposed new facility. The trip distribution worksheets and associated map of subareas are shown in the Appendix Pages A-15 thru A-22.

RESULTS OF SIGNALIZED INTERSECTION CAPACITY ANALYSES

#1 – Gold Ave. / Second St. - Pages A-73 thru A-76

The results of the implementation year analysis of the signalized intersection of Gold Ave. / Second St. are summarized in the following table:

Intersection: 1 - GOLD AVE. / SECOND ST.

		2018 AM Peak Hour BUILD					2018 PM Peak Hour BUILD				
		(EXIST. GEOM.)					(EXIST. GEOM.)				
		NO BUILD		BUILD			NO BUILD		BUILD		
		Lanes	LOS-Delay	Lanes	LOS-Delay		Lanes	LOS-Delay	Lanes	LOS-Delay	
EB	L	>	B - 13.8	>	B - 17.4	L	>	B - 13.0	>	C - 25.9	
	T	1	B - 13.8	1	B - 17.4	T	1	B - 13.0	1	C - 25.9	
	R	>	B - 13.8	>	B - 17.4	R	>	B - 13.0	>	C - 25.9	
WB	L	>	B - 12.9	>	B - 15.4	L	>	B - 11.6	>	C - 21.6	
	T	1	B - 12.9	1	B - 15.4	T	1	B - 11.6	1	C - 21.6	
	R	>	B - 12.9	>	B - 15.4	R	>	B - 11.6	>	C - 21.6	
NB	L	1	A - 6.3	1	A - 4.3	L	1	A - 7.8	1	B - 16.0	
	T	1	B - 14.3	1	A - 8.9	T	1	B - 14.6	1	C - 23.3	
	R	>	B - 14.3	>	A - 8.9	R	>	B - 14.6	>	C - 23.3	
SB	L	1	A - 5.9	1	A - 6.1	L	1	A - 6.5	1	A - 9.8	
	T	1	A - 4.0	1	A - 6.3	T	1	A - 5.0	1	A - 6.4	
	R	>	A - 4.0	>	A - 6.3	R	>	A - 5.0	>	A - 6.4	
Intersection:		***B - 12.2***		***A - 9.4***			***B - 11.4***		***B - 18.2***		

Note: ">" designates a shared right or left turn lane.

The implementation year analysis of the intersection of Gold Ave. / Second St. demonstrates that the level-of-service will be acceptable for both the AM Peak Hour and PM Peak Hour NO BUILD and BUILD conditions. The implementation year analysis shows that the proposed development increases the delay at the intersection by 6.8 seconds. Therefore, this study concludes that the development presents no significant impact to the calculated delays at the intersection of Gold Ave. / Second St.

The following table summarizes the results of the queuing analysis for the auxiliary lanes at the intersection:

Queueing Analysis Summary Sheet

roject: Railyard Re-development (Second St S. of Hazeldine)

ıtersection: **Gold Ave SW / Second St**

2018

Approach	Left Turns			Thru Movements			Right Turns		
Eastbound	# Lanes	Vol.	Length	# Lanes	Vol.	Length	# Lanes	Vol.	Length
xisting Lane Length	*0*	*19*	*0*	*1*	*66*	*Cont*	*0*	*22*	*0*
M NO BUILD Queue	0	23	75	1	81	150	0	27	75
M BUILD Queue	**0**	**23**	**75**	**1**	**81**	**150**	**0**	**71**	**125**
xisting Lane Length	*0*	*50*	*0*	*1*	*99*	*Cont*	*0*	*15*	*0*
M NO BUILD Queue	0	61	125	1	121	200	0	18	**50**
M BUILD Queue	**0**	**61**	**125**	**1**	**121**	**200**	**0**	**75**	**125**
Westbound	# Lanes	Vol.	Length	# Lanes	Vol.	Length	# Lanes	Vol.	Length
xisting Lane Length	*0*	*14*	*0*	*1*	*22*	*Cont*	*0*	*21*	*0*
M NO BUILD Queue	0	14	50	1	23	75	0	22	50
M BUILD Queue	**0**	**14**	**50**	**1**	**23**	**75**	**0**	**22**	**50**
xisting Lane Length	*0*	*15*	*0*	*1*	*20*	*Cont*	*0*	*30*	*0*
M NO BUILD Queue	0	15	50	1	21	50	0	31	75
M BUILD Queue	**0**	**15**	**50**	**1**	**21**	**50**	**0**	**31**	**75**
Northbound	# Lanes	Vol.	Length	# Lanes	Vol.	Length	# Lanes	Vol.	Length
xisting Lane Length	*1*	*18*	*75*	*1*	*266*	*Cont*	*0*	*12*	*0*
M NO BUILD Queue	1	18	50	1	273	375	0	12	50
M BUILD Queue	**1**	**41**	**100**	**1**	**401**	**525**	**0**	**12**	**50**
xisting Lane Length	*1*	*13*	*75*	*1*	*204*	*Cont*	*0*	*21*	*0*
M NO BUILD Queue	1	13	**50**	1	209	**300**	0	22	50
M BUILD Queue	**1**	**72**	**125**	**1**	**583**	**675**	**0**	**22**	**50**
Southbound	# Lanes	Vol.	Length	# Lanes	Vol.	Length	# Lanes	Vol.	Length
xisting Lane Length	*1*	*25*	*100*	*1*	*58*	*Cont*	*0*	*13*	*0*
M NO BUILD Queue	1	26	75	1	59	125	0	13	50
M BUILD Queue	**1**	**26**	**75**	**1**	**382**	**500**	**0**	**13**	**50**
xisting Lane Length	*1*	*36*	*100*	*1*	*117*	*Cont*	*0*	*11*	*0*
M NO BUILD Queue	1	37	75	1	120	**200**	0	11	50
M BUILD Queue	**1**	**37**	**75**	**1**	**402**	**500**	**0**	**11**	**50**

	AM	PM
Cycle Length:	130	120

NOTE: Queue lengths are in feet.

The following table summarizes the recommendations of the queuing analysis for the auxiliary lanes at the intersection:

Lane Description	Existing Length (Ft)	NO BUILD Length (Ft)	BUILD Length (Ft)	Lengthen Existing Auxiliary Lane to:
Eastbound Left Turn:	0	125	125	No Recommendation
Eastbound Right Turn:*	0	40	60	No Recommendation
Westbound Left Turn:	0	50	50	No Recommendation
Westbound Right Turn:*	0	40	40	No Recommendation
Northbound Left Turn:	75	50	125	**125' plus transition.**
Northbound Right Turn:*	0	30	30	No Recommendation
Southbound Left Turn:	100	75	75	No Recommendation
Southbound Right Turn:*	0	30	30	No Recommendation

* - Calculated right turn queue lengths have been reduced by 50% to account for right-turns-on red and overlap phases.

The queuing analysis recommends that the northbound left turn lane be lengthened from 75 feet to 125 feet. This intersection is completely built out and there is no available right-of-way to construct this improvement. Therefore, no recommendations are made for the auxiliary lanes at the intersection of Gold Ave. / Second St.

#2 – Lead Ave. / Second St. - Pages A-77 thru A-82

The results of the implementation year analysis of the signalized intersection of Lead Ave. / Second St. are summarized in the following table:

Intersection: 2 - LEAD AVE. / SECOND ST.

2018 AM Peak Hour BUILD

		(EXIST. GEOM.) NO BUILD		(EXIST. GEOM.) BUILD		(MIT. GEOM.) BUILD	
		Lanes	LOS-Delay	Lanes	LOS-Delay	Lanes	LOS-Delay
EB	L	1	A - 8.3	1	C - 28.7	1	D - 53.0
	R	1	A - 4.9	1	B - 17.9	1	E - 61.3
WB	L	1	A - 5.2	1	D - 44.2	1	D - 40.1
	T	2	A - 6.8	2	C - 23.3	2	C - 26.4
	R	>	A - 6.8	>	C - 23.4	>	C - 26.4
NB	L	>	A - 10.0	>	D - 38.2	>	C - 20.2
	T	1	A - 10.0	1	D - 38.2	1	C - 20.2
SB	T	1	A - 7.5	1	D - 51.2	1	D - 47.8
	R	1	A - 6.6	1	C - 32.4	1	C - 30.3
Intersection:			***A - 7.4***		***D - 36.7***		***C - 34.1***

2018 PM Peak Hour BUILD

		(EXIST. GEOM.) NO BUILD		(EXIST. GEOM.) BUILD		(MIT. GEOM.) BUILD	
		Lanes	LOS-Delay	Lanes	LOS-Delay	Lanes	LOS-Delay
EB	L	1	A - 7.4	1	D - 42.7	1	D - 41.5
	R	1	A - 4.3	1	C - 26.1	1	D - 47.1
WB	L	1	A - 4.9	1	**F - 93.1**	1	E - 69.0
	T	2	A - 5.9	2	C - 34.2	2	C - 29.9
	R	>	A - 5.9	>	C - 34.3	>	C - 30.0
NB	L	>	B - 10.5	>	E - 77.5	>	D - 40.2
	T	1	B - 10.5	1	E - 77.5	1	D - 40.2
SB	T	1	B - 11.2	1	D - 36.3	1	A - 1.9
	R	1	A - 8.5	1	C - 23.0	1	A - 0.1
Intersection:			***A - 7.0***		***E - 55.8***		***C - 34.5***

Note: ">" designates a shared right or left turn lane.

The implementation year analysis of the intersection of Lead Ave. / Second St. demonstrates that the level-of-service will be acceptable for both the AM Peak Hour and PM Peak Hour NO BUILD conditions and for the AM Peak Hour BUILD conditions. The PM Peak Hour BUILD condition will experience excessive delays. The intersection can be mitigated by changing the westbound left turn lane signal type from permitted to permitted plus protected. This mitigation demonstrates an acceptable level-of-service for the PM Peak Hour BUILD condition. Signal modifications will probably be required.

The following table summarizes the results of the queuing analysis for the auxiliary lanes at the intersection:

Queueing Analysis Summary Sheet

Project: Railyard Re-development (Second St S. of Hazeldine)

Intersection: **Lead Ave SW / Second St**

2018

Approach	Left Turns # Lanes	Vol.	Length	Thru Movements # Lanes	Vol.	Length	Right Turns # Lanes	Vol.	Length
Eastbound									
Existing Lane Length	*1*	*9*	*125*	*1*	*0*	*Cont*	*0*	*11*	*0*
AM NO BUILD Queue	1	9	25	1	0	0	0	11	50
AM BUILD Queue	**1**	**9**	**25**	**1**	**0**	**0**	**0**	**66**	**125**
Existing Lane Length	*1*	*7*	*125*	*1*	*0*	*Cont*	*0*	*30*	*0*
PM NO BUILD Queue	1	7	25	1	0	0	0	31	**75**
PM BUILD Queue	**1**	**7**	**25**	**1**	**0**	**0**	**0**	**102**	**175**
Westbound									
Existing Lane Length	*1*	*55*	*590*	*2*	*581*	*Cont*	*0*	*73*	*0*
AM NO BUILD Queue	1	56	125	2	596	450	0	75	150
AM BUILD Queue	**1**	**452**	**575**	**2**	**596**	**450**	**0**	**75**	**150**
Existing Lane Length	*1*	*109*	*590*	*2*	*691*	*Cont*	*0*	*74*	*0*
PM NO BUILD Queue	1	112	**175**	2	708	475	0	76	125
PM BUILD Queue	**1**	**420**	**500**	**2**	**708**	**475**	**0**	**76**	**125**
Northbound									
Existing Lane Length	*0*	*7*	*0*	*1*	*203*	*Cont*	*0*	*0*	*0*
AM NO BUILD Queue	0	7	25	1	208	300	0	0	0
AM BUILD Queue	**0**	**36**	**75**	**1**	**359**	**475**	**0**	**0**	**0**
Existing Lane Length	*0*	*9*	*0*	*1*	*141*	*Cont*	*0*	*0*	*0*
PM NO BUILD Queue	0	9	**25**	1	145	**225**	0	0	0
PM BUILD Queue	**0**	**82**	**150**	**1**	**578**	**675**	**0**	**0**	**0**
Southbound									
Existing Lane Length	*0*	*0*	*0*	*1*	*64*	*Cont*	*1*	*15*	*170*
AM NO BUILD Queue	0	0	0	1	66	125	1	15	50
AM BUILD Queue	**0**	**0**	**0**	**1**	**433**	**550**	**1**	**15**	**50**
Existing Lane Length	*0*	*0*	*0*	*1*	*120*	*Cont*	*1*	*28*	*170*
PM NO BUILD Queue	0	0	0	1	123	**200**	1	29	75
PM BUILD Queue	**0**	**0**	**0**	**1**	**462**	**550**	**1**	**29**	**75**

	AM	PM
Cycle Length:	130	120

NOTE: Queue lengths are in feet.

The following table summarizes the recommendations of the queuing analysis for the auxiliary lanes at the intersection:

Lane Description	Existing Length (Ft)	NO BUILD Length (Ft)	BUILD Length (Ft)	Lengthen Existing Auxiliary Lane to:
Eastbound Left Turn:	125	25	25	No Recommendation
Eastbound Right Turn:*	0	40	90	No Recommendation
Westbound Left Turn:	590	175	575	No Recommendation
Westbound Right Turn:*	0	80	80	No Recommendation
Northbound Left Turn:	0	25	150	No Recommendation
Northbound Right Turn:*	0	0	0	No Recommendation
Southbound Left Turn:	0	0	0	No Recommendation
Southbound Right Turn:*	170	40	40	No Recommendation

* - Calculated right turn queue lengths have been reduced by 50% to account for right-turns-on red and overlap phases.

There are no recommendations for the auxiliary lanes at the intersection of Lead Ave. / Second St.

#3 – Coal Ave. / Second St. - Pages A-83 thru A-86

The results of the implementation year analysis of the signalized intersection of Coal Ave. / Second St. are summarized in the following table:

Intersection: 3 - COAL AVE. / SECOND ST.

		2018 AM Peak Hour BUILD (EXIST. GEOM.)				2018 PM Peak Hour BUILD (EXIST. GEOM.)			
		NO BUILD		BUILD		NO BUILD		BUILD	
		Lanes	LOS-Delay	Lanes	LOS-Delay	Lanes	LOS-Delay	Lanes	LOS-Delay
EB	L	>	B - 10.1	>	D - 53.4	>	A - 7.9	>	E - 67.1
	T	3	A - 9.8	3	D - 48.1	3	A - 7.7	3	E - 57.6
	R	>	A - 9.8	>	D - 48.7	>	A - 7.7	>	E - 59.2
NB	L	1	A - 7.2	1	C - 35.0	1	A - 8.3	1	A - 6.2
	T	1	B - 13.1	1	B - 12.3	1	A - 9.6	1	C - 29.7
	R	>	B - 13.1	>	B - 12.3	>	A - 9.6	>	C - 29.7
SB	L	1	A - 6.2	1	B - 19.0	1	A - 6.2	1	E - 79.0
	T	1	A - 3.0	1	B - 13.5	1	A - 5.7	1	A - 1.9
	R	>	A - 3.0	>	B - 13.5	>	A - 5.7	>	A - 1.9
Intersection:		***B - 10.2***		***C - 24.9***		***A - 7.6***		***C - 30.3***	

Note: ">" designates a shared right or left turn lane.

The implementation year analysis of the intersection of Coal Ave. / Second St. demonstrates that the level-of-service will be acceptable for both the AM Peak Hour and PM Peak Hour NO BUILD and BUILD conditions. The implementation year analysis shows that the proposed development increases the delay at the intersection by 14.7 to 26.5 seconds. Therefore, this study concludes that the development presents no significant impact to the calculated delays at the intersection of Coal Ave. / Second St.

The following table summarizes the results of the queuing analysis for the auxiliary lanes at the intersection:

Queueing Analysis Summary Sheet

Project: Railyard Re-development (Second St S. of Hazeldine)

Intersection: **Coal Ave SW / Second St**

2018

Approach	Left Turns			Thru Movements				Right Turns		
Eastbound	# Lanes	Vol.	Length	# Lanes	Vol.	Length		# Lanes	Vol.	Length
Existing Lane Length	*0*	*28*	*0*	*3*	*582*	*Cont*		*0*	*8*	*0*
AM NO BUILD Queue	0	31	75	3	637	350		0	9	25
AM BUILD Queue	**0**	**31**	**75**	**3**	**637**	**350**		**0**	**70**	**125**
Existing Lane Length	*0*	*19*	*0*	*3*	*611*	*Cont*		*0*	*10*	*0*
PM NO BUILD Queue	0	21	50	3	669	350		0	11	**50**
PM BUILD Queue	**0**	**21**	**50**	**3**	**669**	**350**		**0**	**92**	**150**
Westbound	# Lanes	Vol.	Length	# Lanes	Vol.	Length		# Lanes	Vol.	Length
Existing Lane Length	*0*	*0*	*0*	*0*	*0*	*Cont*		*0*	*0*	*0*
AM NO BUILD Queue	0	0	0	0	0	0		0	0	0
AM BUILD Queue	**0**	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**
Existing Lane Length	*0*	*0*	*0*	*0*	*0*	*Cont*		*0*	*0*	*0*
PM NO BUILD Queue	0	0	0	0	0	0		0	0	0
PM BUILD Queue	**0**	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**
Northbound	# Lanes	Vol.	Length	# Lanes	Vol.	Length		# Lanes	Vol.	Length
Existing Lane Length	*1*	*7*	*75*	*1*	*246*	*Cont*		*0*	*101*	*0*
AM NO BUILD Queue	1	7	25	1	252	350		0	104	175
AM BUILD Queue	**1**	**40**	**100**	**1**	**433**	**550**		**0**	**249**	**350**
Existing Lane Length	*1*	*18*	*75*	*1*	*119*	*Cont*		*0*	*70*	*0*
PM NO BUILD Queue	1	18	**50**	1	122	**200**		0	72	**125**
PM BUILD Queue	**1**	**101**	**175**	**1**	**628**	**725**		**0**	**514**	**600**
Southbound	# Lanes	Vol.	Length	# Lanes	Vol.	Length		# Lanes	Vol.	Length
Existing Lane Length	*1*	*34*	*75*	*1*	*74*	*Cont*		*0*	*15*	*0*
AM NO BUILD Queue	1	35	75	1	76	150		0	15	50
AM BUILD Queue	**1**	**35**	**75**	**1**	**892**	**>1,000**	*	**0**	**15**	**50**
Existing Lane Length	*1*	*99*	*75*	*1*	*171*	*Cont*		*0*	*29*	*0*
PM NO BUILD Queue	1	101	175	1	175	**250**		0	30	75
PM BUILD Queue	**1**	**101**	**175**	**1**	**893**	**>1,000**	*	**0**	**30**	**75**

	AM	PM
Cycle Length:	130	120

NOTE: Queue lengths are in feet.

The following table summarizes the recommendations of the queuing analysis for the auxiliary lanes at the intersection:

Lane Description	Existing Length (Ft)	NO BUILD Length (Ft)	BUILD Length (Ft)	Lengthen Existing Auxiliary Lane to:
Eastbound Left Turn:	0	75	75	No Recommendation
Eastbound Right Turn:*	0	30	80	No Recommendation
Westbound Left Turn:	0	0	0	No Recommendation
Westbound Right Turn:*	0	0	0	No Recommendation
Northbound Left Turn:	75	50	175	**175' plus transition.**
Northbound Right Turn:*	0	90	300	No Recommendation
Southbound Left Turn:	75	175	175	**175' plus transition.**
Southbound Right Turn:*	0	40	40	No Recommendation

* - Calculated right turn queue lengths have been reduced by 50% to account for right-turns-on red and overlap phases.

The queuing analysis recommends that the northbound and southbound left turn lanes be lengthened from 75 feet to 175 feet. This intersection is completely built out and there is no available right-of-way to construct this improvement. Furthermore, lengthening the northbound left turn lane would adversely impact the southbound left turn at the intersection of Iron Ave. / Second St. Therefore, no recommendations are made for the auxiliary lanes at the intersection of Coal Ave. / Second St.

#4 – Bridge Blvd. / Third St. - Pages A-87 thru A-92

The results of the implementation year analysis of the signalized intersection of Bridge Blvd. / Third St. are summarized in the following table:

Intersection: 4 - BRIDGE BLVD. / THIRD ST.

		2018 AM Peak Hour BUILD						2018 PM Peak Hour BUILD					
		(EXIST. GEOM.)				(MIT. GEOM.)		(EXIST. GEOM.)				(MIT. GEOM.)	
		NO BUILD		BUILD		BUILD		NO BUILD		BUILD		BUILD	
		Lanes	LOS-Delay	Lanes	LOS-Delay	Lanes	LOS-Delay	Lanes	LOS-Delay	Lanes	LOS-Delay	Lanes	LOS-Delay
EB	L	>	A - 3.5	>	A - 6.8	>	D - 37.3	>	A - 8.5	>	B - 15.3	>	C - 24.9
	T	2	A - 3.6	2	A - 7.0	2	D - 41.7	2	A - 8.6	2	B - 15.6	2	C - 25.5
	R	1	A - 1.5	1	A - 3.4	1	B - 15.0	1	A - 5.9	1	B - 12.1	1	B - 19.1
WB	L	1	B - 11.0	1	**F - 402**	1	**F - 105**	1	B - 13.9	1	**F - 102**	1	C - 26.2
	T	1	A - 1.9	1	A - 4.4	1	A - 8.4	1	B - 10.7	1	C - 32.1	1	C - 28.9
	R	2	A - 1.9	2	A - 4.5	2	A - 8.5	2	B - 10.7	2	D - 44.1	2	D - 38.9
NB	L	>	D - 47.3	>	E - 55.8	>	D - 53.5	>	D - 44.6	>	D - 35.4	>	D - 48.6
	T	1	D - 47.3	1	E - 55.8	1	D - 53.5	1	D - 44.6	1	D - 35.4	1	D - 48.6
	R	1	D - 50.0	1	**F - 177**	1	**F - 177**	1	C - 31.1	1	E - 58.6	1	**F - 194**
SB	L	>	D - 50.9	>	**F - 390**	1	D - 49.0	>	D - 38.3	>	**F - 471**	1	**F - 147**
	T	1	D - 50.9	1	**F - 390**	1	D - 44.9	1	D - 38.3	1	**F - 471**	1	C - 33.1
	R	>	D - 50.9	>	**F - 390**	>	D - 44.9	>	D - 38.3	>	**F - 471**	>	C - 33.1
Intersection:		***A - 5.1***		***E - 56.6***		***D - 39.8***		***B - 12.1***		***E - 76.8***		***D - 52.0***	

Note: ">" designates a shared right or left turn lane.

The implementation year analysis of the intersection of Bridge Blvd. / Third St. demonstrates that the level-of-service will be acceptable for both the AM Peak Hour and PM Peak Hour NO BUILD conditions and will experience excessive delays for the AM Peak Hour and PM Peak Hour BUILD conditions. The intersection can be partially mitigated by adding a 200 foot southbound left turn lane with a permitted plus protected turn signal. This mitigation demonstrates acceptable levels-of-service for both the AM Peak Hour and PM Peak Hour BUILD conditions. No other improvements are physically possible at this intersection.

The following table summarizes the results of the queuing analysis for the auxiliary lanes at the intersection:

Queueing Analysis Summary Sheet

Project: Railyard Re-development (Second St S. of Hazeldine)

Intersection: **Bridge Blvd / Third St**

2018

Approach	Left Turns			Thru Movements				Right Turns		
Eastbound	# Lanes	Vol.	Length	# Lanes	Vol.	Length		# Lanes	Vol.	Length
Existing Lane Length	*0*	*1*	*0*	*2*	*1,544*	*Cont*		*1*	*123*	*260*
AM NO BUILD Queue	0	1	0	2	1,583	>1,000	*	1	126	200
AM BUILD Queue	**0**	**1**	**0**	**2**	**1,583**	**>1,000**	*	**1**	**276**	**375**
Existing Lane Length	*0*	*0*	*0*	*2*	*1,083*	*Cont*		*1*	*64*	*260*
PM NO BUILD Queue	0	0	0	2	1,110	700		1	66	**125**
PM BUILD Queue	**0**	**0**	**0**	**2**	**1,110**	**700**		**1**	**249**	**325**
Westbound	# Lanes	Vol.	Length	# Lanes	Vol.	Length		# Lanes	Vol.	Length
Existing Lane Length	*1*	*57*	*50*	*2*	*723*	*Cont*		*0*	*12*	*0*
AM NO BUILD Queue	1	58	125	2	741	525		0	12	50
AM BUILD Queue	**1**	**217**	**325**	**2**	**741**	**525**		**0**	**358**	**475**
Existing Lane Length	*1*	*45*	*50*	*2*	*1,498*	*Cont*		*0*	*31*	*0*
PM NO BUILD Queue	1	46	**100**	2	1,535	>1,000	*	0	32	**75**
PM BUILD Queue	**1**	**200**	**275**	**2**	**1,535**	**>1,000**	*	**0**	**380**	**475**
Northbound	# Lanes	Vol.	Length	# Lanes	Vol.	Length		# Lanes	Vol.	Length
Existing Lane Length	*0*	*14*	*0*	*1*	*2*	*Cont*		*1*	*34*	*80*
AM NO BUILD Queue	0	14	50	1	2	0		1	35	75
AM BUILD Queue	**0**	**55**	**125**	**1**	**2**	**0**		**1**	**188**	**275**
Existing Lane Length	*0*	*59*	*0*	*1*	*2*	*Cont*		*1*	*22*	*80*
PM NO BUILD Queue	0	60	**125**	1	2	0		1	23	**50**
PM BUILD Queue	**0**	**166**	**250**	**1**	**2**	**0**		**1**	**448**	**550**
Southbound	# Lanes	Vol.	Length	# Lanes	Vol.	Length		# Lanes	Vol.	Length
Existing Lane Length	*0*	*9*	*0*	*1*	*20*	*Cont*		*0*	*30*	*0*
AM NO BUILD Queue	0	9	25	1	21	50		0	31	75
AM BUILD Queue	**0**	**75**	**150**	**1**	**21**	**50**		**0**	**65**	**125**
Existing Lane Length	*0*	*12*	*0*	*1*	*52*	*Cont*		*0*	*84*	*0*
PM NO BUILD Queue	0	12	**50**	1	53	100		0	86	**150**
PM BUILD Queue	**0**	**199**	**275**	**1**	**53**	**100**		**0**	**176**	**250**

	AM	PM
Cycle Length:	130	120

NOTE: Queue lengths are in feet.

The following table summarizes the recommendations of the queuing analysis for the auxiliary lanes at the intersection:

Lane Description	Existing Length (Ft)	NO BUILD Length (Ft)	BUILD Length (Ft)	Lengthen Existing Auxiliary Lane to:
Eastbound Left Turn:	0	0	0	No Recommendation
Eastbound Right Turn:*	260	100	190	No Recommendation
Westbound Left Turn:	50	125	325	**325' plus transition.**
Westbound Right Turn:*	0	40	240	No Recommendation
Northbound Left Turn:	0	125	250	No Recommendation
Northbound Right Turn:*	80	40	280	**280' plus transition.**
Southbound Left Turn:	0	50	275	No Recommendation
Southbound Right Turn:*	0	80	130	No Recommendation

* - Calculated right turn queue lengths have been reduced by 50% to account for right-turns-on red and overlap phases.

The queuing analysis recommends that the westbound left turn lane be lengthened from 50 feet to 325 feet and the northbound left turn lane be lengthened from 80 feet to 280 feet. Lengthening the westbound left turn lane is not feasible without widening the bridge along Bridge Blvd. Lengthening the northbound left turn lane would adversely impact the eastbound left turn lane at First St. Therefore, no recommendations are made for the auxiliary lanes at the intersection of Bridge Blvd. / Third St.

RESULTS OF UNSIGNALIZED INTERSECTION CAPACITY ANALYSES

#5 –Santa Fe Ave. / Second St. – Pages A-93 thru A-98

The results of the analysis of the unsignalized intersection of Santa Fe Ave. / Second St. are summarized in the following table:

Intersection: 5 - SANTA FE AVE. / SECOND ST.

		2018 AM Peak Hour BUILD (EXIST. GEOM.)				2018 PM Peak Hour BUILD (EXIST. GEOM.)			
		NO BUILD		BUILD		NO BUILD		BUILD	
		Lanes	LOS-Delay	Lanes	LOS-Delay	Lanes	LOS-Delay	Lanes	LOS-Delay
EB	L	1	A - 9.8	1	F - 195	1	A - 9.7	1	F - 999
	R	>	A - 9.8	>	F - 195	>	A - 9.7	>	F - 999
NB	L	>	A - 7.4	>	A - 9.9	>	A - 7.6	>	B - 12.2
	T	1	A - 7.4	1	A - 9.9	1	A - 7.6	1	B - 12.2
Intersection:		*u - N/A*		*u - N/A*		*u - N/A*		*u - N/A*	

Note: ">" designates a shared right or left turn lane.

This analysis indicates that the tee intersection will operate at acceptable levels-of-service in the implementation year (2018) for both the AM Peak Hour and PM Peak Hour NO BUILD conditions and will experience excessive delays for both the AM Peak Hour and PM Peak Hour BUILD conditions. The delays for the eastbound shared left/right turn movement are so excessive during the PM Peak Hour that Synchro 8 cannot calculate the actual delay. This intersection can be improved by constructing a single lane roundabout as demonstrated in the following table.

2018 Peak Hour BUILD

		(MIT. GEOM.) AM BUILD			PM BUILD		
		Lanes	LOS	Delay	Lanes	LOS	Delay
EB	LR	1	B	11.2	1	C	22.5
NB	LT	1	E	45.9	1	F	131
SB	TR	1	C	19.8	1	F	108
Intersection:		*u - N/A*			*u - N/A*		

#6 –Hazeldine Ave. / Second St. – Pages A-99 thru A-104

The results of the analysis of the unsignalized intersection of Hazeldine Ave. / Second St. are summarized in the following table:

Intersection: 6 - HAZELDINE AVE. / SECOND ST.

2018 AM Peak Hour BUILD

		(EXIST. GEOM.) NO BUILD		(EXIST. GEOM.) BUILD		(MIT. GEOM.) BUILD	
		Lanes	LOS-Delay	Lanes	LOS-Delay	Lanes	LOS-Delay
EB	L	>	B - 12.0	>	**F** - 999	1	D - 41.4
	T	1	B - 12.0	1	**F** - 999	1	E - 68.4
	R	>	B - 12.0	>	**F** - 999	>	E - 68.4
WB	L	>	B - 12.7	>	**F** - 999	1	D - 38.9
	T	1	B - 12.7	1	**F** - 999	1	D - 40.2
	R	>	B - 12.7	>	**F** - 999	1	D - 41.5
NB	L	>	A - 7.4	>	A - 8.8	1	B - 14.2
	T	1	A - 7.4	1	A - 8.8	1	C - 24.9
	R	>	A - 7.4	>	A - 8.8	1	B - 12.3
SB	L	>	A - 8.3	>	C - 20.1	1	C - 22.1
	T	1	A - 8.3	1	C - 20.1	1	B - 10.3
	R	>	A - 8.3	>	C - 20.1	>	B - 10.3
Intersection:		***u - N/A***		***u - N/A***		***C - 24.9***	

2018 PM Peak Hour BUILD

		(EXIST. GEOM.) NO BUILD		(EXIST. GEOM.) BUILD		(MIT. GEOM.) BUILD	
		Lanes	LOS-Delay	Lanes	LOS-Delay	Lanes	LOS-Delay
EB	L	>	B - 10.2	>	**F** - 999	1	D - 45.0
	T	1	B - 10.2	1	**F** - 999	1	**F** - 172
	R	>	B - 10.2	>	**F** - 999	>	**F** - 172
WB	L	>	B - 10.8	>	**F** - 999	1	**F** - 183
	T	1	B - 10.8	1	**F** - 999	1	D - 44.8
	R	>	B - 10.8	>	**F** - 999	1	**F** - 88.7
NB	L	>	A - 7.5	>	A - 9.0	>	B - 10.6
	T	1	A - 7.5	1	A - 9.0	1	E - 62.3
	R	>	A - 7.5	>	A - 9.0	>	A - 9.7
SB	L	>	A - 7.6	>	C - 22.0	1	**F** - 158
	T	1	A - 7.6	1	C - 22.0	1	A - 3.2
	R	>	A - 7.6	>	C - 22.0	>	A - 3.2
Intersection:		***u - N/A***		***u - N/A***		***E - 69.5***	

Note: ">" designates a shared right or left turn lane.

This analysis indicates that the full intersection, which will also be the northernmost driveway of the proposed development, will operate at acceptable levels-of-service in the implementation year (2018) for both the AM Peak Hour and PM Peak Hour NO BUILD conditions and will experience excessive delays for the AM Peak Hour and PM Peak Hour BUILD conditions for the eastbound and westbound movements. The delays for the eastbound and westbound shared left/thru/right turn movements are so excessive during the AM Peak Hour and PM Peak Hour that Synchro 8 cannot calculate the actual delay. This intersection can be improved by constructing second northern driveway for the proposed development at the intersection of Atlantic Ave. / Second St. and by constructing a traffic signal as demonstrated in the table above. Coal Ave. / Second St. is the nearest signalized intersection and is approximately 1,000 feet to the north. Stover Ave. / Second St. is the nearest unsignalized intersection to the north and is approximately 360 feet away from the Hazeldine Ave. / Second St. intersection. Atlantic Ave. / Second St. is the nearest unsignalized intersection and is approximately 300 feet to the south. The analysis of the Atlantic Ave. / Second St. intersection is discussed in the #9 - Atlantic Ave. / Second St. section on Page 22.

#7 –Driveway 'A' / Second St. – Pages A-105 thru A-108

The results of the analysis of the unsignalized intersection of Driveway 'A' / Second St. are summarized in the following table:

Intersection: 7 - DRIVEWAY 'A' / SECOND ST.

2018 Peak Hour BUILD

		(EXIST. GEOM.) AM BUILD		(EXIST. GEOM.) PM BUILD	
		Lanes	LOS-Delay	Lanes	LOS-Delay
WB	L	1	**F** - 999	1	**F** - 999
	R	>	**F** - 999	>	**F** - 999
SB	L	>	B - 14.7	>	B - 14.5
	T	1	B - 14.7	1	B - 14.5
Intersection:		***u - 0.0***		***u - N/A***	

Note: ">" designates a shared right or left turn lane.

This analysis indicates that the driveway will experience excessive delays for both the AM Peak Hour and PM Peak Hour BUILD conditions for the westbound movement. The delays for the westbound shared left/right turn movement are so excessive during the AM Peak Hour and PM Peak Hour that Synchro 8 cannot calculate the actual delay. This intersection can be improved by constructing a single lane roundabout as demonstrated in the following table.

2018 Peak Hour BUILD

		(MIT. GEOM.) AM BUILD		(MIT. GEOM.) PM BUILD	
		Lanes	LOS-Delay	Lanes	LOS-Delay
WB	LR	1	C - 17.0	1	**F** - 131
NB	TR	1	**F** - 148	1	**F** - 139
SB	LT	1	D - 26.9	1	**F** - 222
Intersection:		***u - N/A***		***u - N/A***	

#8 –Driveway 'B' / Second St. – Pages A-109 thru A-112

The results of the analysis of the unsignalized intersection of Driveway 'B' / Second St. are summarized in the following table:

Intersection: 8 - DRIVEWAY 'B' / SECOND ST.

2018 Peak Hour BUILD

		(EXIST. GEOM.) AM BUILD Lanes	LOS-Delay	PM BUILD Lanes	LOS-Delay
WB	L	1	F - 999	>	F - 999
	R	>	F - 999	>	F - 999
SB	L	>	B - 14.3	>	B - 11.4
	T	1	B - 14.3	1	B - 11.4
Intersection:		u - 0.0		u - N/A	

Note: ">" designates a shared right or left turn lane.

This analysis indicates that the driveway will experience excessive delays for both the AM Peak Hour and PM Peak Hour BUILD conditions for the westbound movement. The delays for the westbound shared left/right turn movement are so excessive during the AM Peak Hour and PM Peak Hour that Synchro 8 cannot calculate the actual delay. This intersection can be improved by constructing a single lane roundabout as demonstrated in the following table.

2018 Peak Hour BUILD

		(MIT. GEOM.) AM BUILD Lanes	LOS-Delay	PM BUILD Lanes	LOS-Delay
WB	LR				
		1	C - 15.4	1	C - 22.0
NB	TR				
		1	F - 136	1	E - 35.9
SB	LT				
		1	B - 11.1	1	F - 89.4
Intersection:		u - N/A		u - N/A	

#9 –Atlantic Ave. / Second St. – Pages A-113 thru A-114

This intersection will be used as a second northern driveway for the proposed development to improve the delays at the intersection (northern most driveway) of Hazeldine Ave. / Second St. The results of the analysis of the unsignalized intersection of Atlantic Ave. / Second St. are summarized in the following table:

Intersection: 9 - ATLANTIC AVE. / SECOND ST.

2018 Peak Hour BUILD

		(MIT. GEOM.) AM BUILD Lanes	LOS-Delay	PM BUILD Lanes	LOS-Delay
EB	LTR				
		1	C - 28.2	1	E - 57.4
WB	LTR				
		1	B - 16.9	1	F - 391
NB	LTR				
		1	F - 225	1	F - 317
SB	LTR				
		1	E - 64.8	1	F - 297
Intersection:		u - N/A		u - N/A	

This intersection was analyzed as a single lane roundabout. The analysis indicates that the driveway will experience excessive delays for both the AM Peak Hour and PM Peak Hour BUILD conditions. But is necessary to improve the delays at Hazeldine Ave. / Second St.

It should be noted that Levels of Service (LOS) for unsignalized intersections cannot be compared directly with Levels of Service for signalized intersections. LOS for unsignalized intersections is based on reserve capacity, which is converted to generalized levels of delay; LOS for signalized intersections is based on actual delay in seconds.

LEVEL-OF-SERVICE CRITERIA FOR SIGNALIZED INTERSECTIONS

Average Delay (secs)	Level-of-Service
≤ 10	A
> 10 and ≤ 20	B
> 20 and ≤ 35	C
> 35 and ≤ 55	D
> 55 and ≤ 80	E
> 80	F

LEVEL-OF-SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS

Average Delay (secs)	Level-of-Service
≤ 10	A
> 10 and ≤ 15	B
> 15 and ≤ 25	C
> 25 and ≤ 35	D
> 35 and ≤ 50	E
> 50	F

Generally speaking, a Level-of-Service D or better is an acceptable parameter for design purposes.

CONCLUSIONS

This analysis demonstrates that the existing signalized intersections of Gold Ave. / Second St., Lead Ave. / Second St. Coal Ave. / Second St., and Bridge Blvd. / Third St. will operate at acceptable levels-of-service with some mitigation. The existing unsignalized intersections of Hazeldine Ave. / Second St., Santa Fe Ave. / Second St., and Atlantic Ave. / Second St. will require more substantial improvements and will still experience long delays for some of the turning movements upon implementation of the proposed project along with Driveways 'A' and 'B'.

Utilizing projected traffic volumes resulting from the development of this site into a mixed use facility such as the one shown on Page A-3 in the Appendix in conjunction with projected 2018 traffic volumes this report concludes that development of the subject site will have no significant adverse impact on the existing signalized intersections of the adjacent transportation system and will have moderate adverse impacts to the existing unsignalized intersections of the adjacent transportation system, provided that the following recommendations are followed:

RECOMMENDATIONS

- Design of the site should maintain adequate sight distances for traffic approaching, entering, and exiting the site from the proposed driveways.
- All driveways should be constructed utilizing 30 feet minimum radius curb returns or larger if needed to accommodate delivery trucks. The new development should be implemented utilizing at least four driveways for access - the intersections of Hazeldine Ave. / Second St. and Atlantic Ave. / Second St. and Driveway 'A' and 'B' (from Second St.). The driveway (Hazeldine Ave. / Second St. intersection) should be signalized and the others should be constructed as single lane roundabouts.
- #2 – Lead Ave. / Second St. – Change the westbound left turn signalized movement from permitted to permitted plus protected.
- #4 – Bridge Blvd. / Third St. – Construct a 200 foot long southbound left turn lane along Second St. with a permitted plus protected left turn signal.
- #5 – Santa Fe Ave. / Second St. – Construct as a single lane roundabout.
- #6 – Hazeldine Ave. / Second St. - Construct as a signalized intersection with the mitigated geometry described on Page 19.
- #9 – Atlantic Ave. / Second St. – Construct a single lane roundabout with a driveway to the proposed development.

APPENDIX C: PHOTOGRAPHIC SURVEY OF HISTORIC STRUCTURES

Appendix C provides a photographic summary of some of the historic buildings and structures on the Rail Yards site. There are a number of historic documents that address the site. Rather than compiling an exhaustive list, this appendix focuses on information that would be pertinent in the future adaptive reuse of the site. Some is technical pulled from literature, some is based on site observation. The photographic survey was conducted in 2011 by Giora Solar.

The current configuration of the Rail Yards site was constructed between 1915 and 1925 and represented the height of modern industrial design and achievement at the time. The photographic survey covers several of the buildings and structures to be preserved: the Machine Shop (1921), the Boiler Shop (1923), the Blacksmith Shop (1917), the Flue Shop (1920), the Tank Shop (also known as the Tender Repair, 1925), the Firehouse (1920), the Transfer Table (1919), the Storehouse and its platform (1915), the Turntable (1915) and the Bridge Crane (also known as the Crane Runway and the Gantry Crane, 1921).

Aerial photograph showing the historic buildings and structures to be preserved.

MACHINE SHOP

Built in 1921. A footprint of 139,316sf and includes a partial mezzanine in the Bench Bay. Divided into 4 bays, with an exterior 5th bay at the South for unloading, also known as the Crane Runway.

Entirely glazed north and south façades. ¼" thick, single glazed panels, 14"x20", set in steel sashes. Partially glazed East and West façades set into reinforced concrete frames.

The Lower 18' of the north façade contains continuous bi-fold steel frame doors, supported on rollers, that allowed the locomotives to move from Machine Shop to the exterior Transfer Table.

Mechanically operated natural ventilation, large crank/pulley devices controlled multiple operable sashes at once. Equipment looks to be in decent shape.

Rooftop skylights allowing no direct sun. Single glazed, ribbed, wire glass. Skylights are also mechanically operable on one side only. Almost all panels are broken, resulting from apparent vandalism (target practice).

2 large mechanical rooms contained two large electrical fans providing 90,000cfm and 68,000cfm respectively, capable of 3 complete air changes per hour. Air was forced across steam heated coils when required for heating load. Ductwork throughout structure followed column lines to the distribution point 7' above floor.

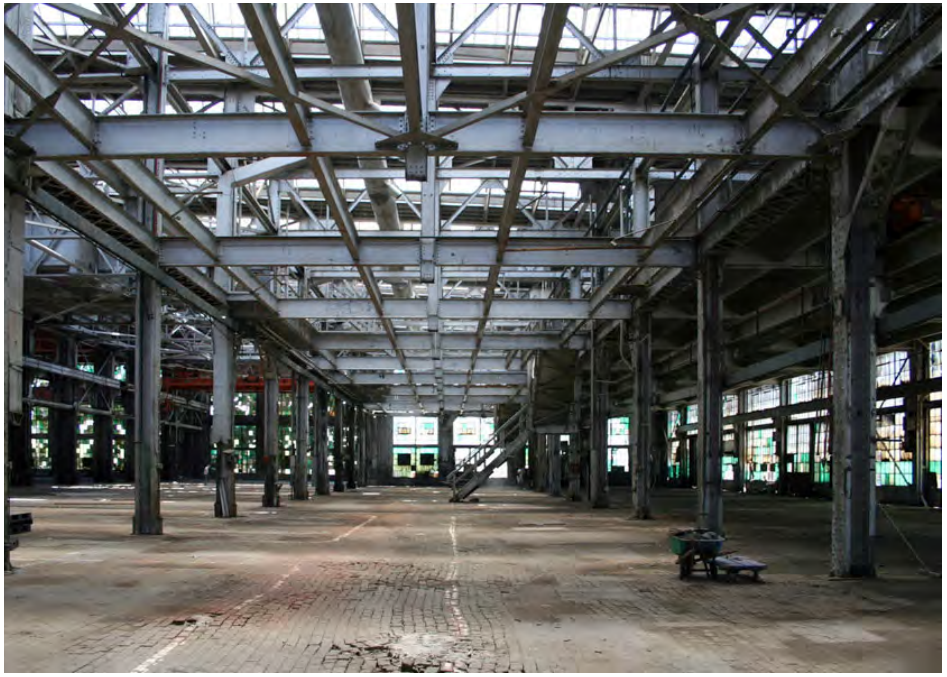
Flooring: 6" concrete slab, finished to a true surface, primed with a 1/8" bituminous coating, upon which 3" creosoted (distillate derived entirely from tars produced from the carbonization of bituminous coal) end-grain wood blocks were laid, with pitch interlaid between for waterproofing. Wood floor is in poor condition and creosote is carcinogenic.

Steel Frame Structure, columns designed to support 16 tons each. Each column is supported on a concrete foundation supported upon creosoted wooded piles, driven on average 26' into the earth. Frame also supports various cranes, still intact, not known if still operable, largest crane supports 250 tons.

Building contained 3 electric Otis elevators serving one Mezzanine Level that was historically used for offices and files. Elevators have been removed, only shafts remain.

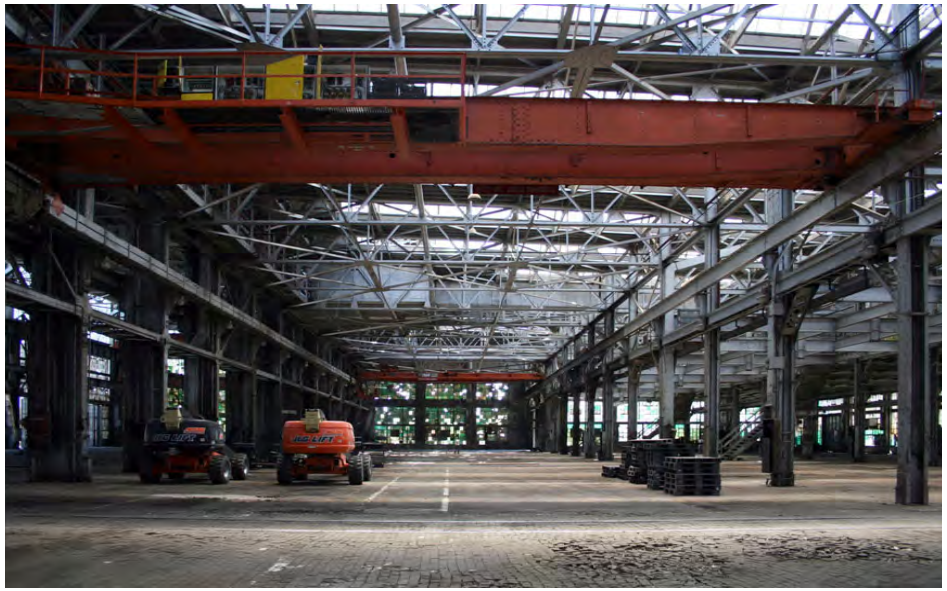
Roof is double sheathed with built-up roofing. Roof surface is in poor condition although the Machine Shop roof looks to be in better shape than other buildings on-site.

Machine Shop, Bench Bay - Below board formed, cast in place, concrete mezzanine.



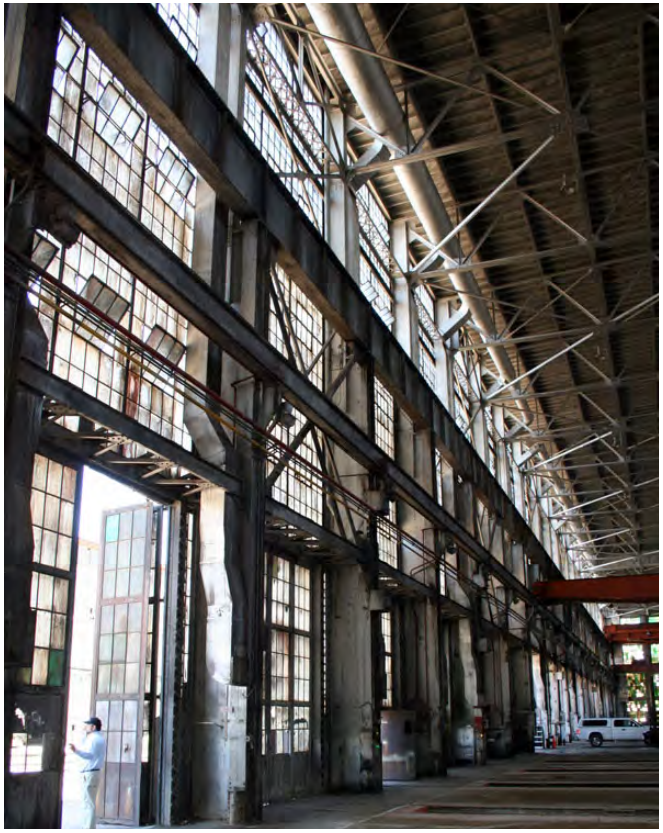
Machine Shop, Light Machinery Bay, Pyramidal skylights run between the Heavy and Light Machinery Bays

Machine Shop, View Towards East Elevation



Machine Shop, Heavy Machinery Bay

Machine Shop, Erecting Bay, 57' clear height to underside of truss structure. Floor troughs can be seen across slab.



North interior elevation showing large operarable doors.

Machine Shop, Erecting Bay - View from within floor trough.

HVAC Duct distribution from Central Plant.

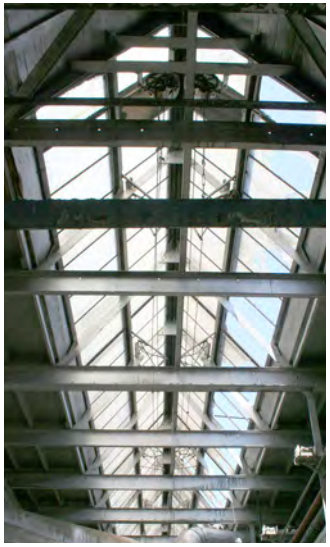
North interior elevation.

North elevation, Operable doors.

North elevation, Operable doors.

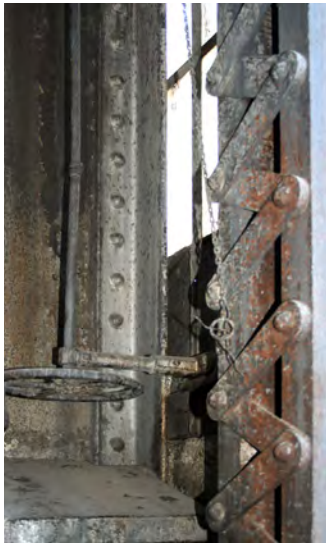
North elevation, Completely glazed façade.

Machine Shop, North elevation, View from Transfer Table.



Skylight detail.

Gear/Pulley mechanism for skylight operation.



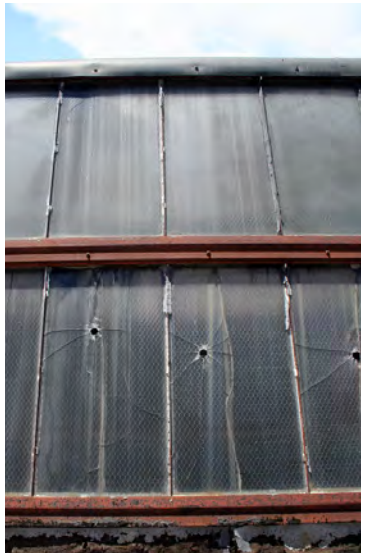
Crank mechanism for skylight operation.

Machine Shop, Pyramidal skylights over the Heavy and Light Machinery Bays.

Longitudinal view from mezzanine catwalk.

Mezzanine elevator machine room (cab has been removed).

Transverse view from mezzanine.



Wired skylight glazing.

Machine Shop, View up toward mezzanine level.

Machine Shop, View from Roof looking North.

Pyramidal skylights.

Clerestory skylight at Eerecting Bay.

View of Erecting Bay from roof clerestory.

Built-up roofing, positive slope to South.

Machine Shop, Erecting Bay, Main 250 ton crane.

Flooring, 3" thick creosoted end-grain wood blocks.

West Elevation, Cast in Place Concrete Frame.

Erecting Bay columns supported on deep piles, dampened by springs.

Southeast corner, adjacent to active BNSF rail lines .

Erecting Bay, Floor trough.

BRIDGE CRANE

The Bridge Crane, also known as the Gantry Crane or the Crane Runway is a 15 ton crane that runs along the South elevation of the Machine Shop.

15 Ton Bridge Crane Connected to South Elevation of Machine Shop.

Bridge Crane, View from Machine Shop Roof, North towards South.

Bridge Crane, View from South West Corner.

Bridge Crane, View from East Elevation.

South bay, Crane Runway , Exterior loading crane.

Bridge Crane, View from West Elevation.

TURNTABLE

Plate girder steel turntable with head frame, motorized, set in 120' diameter cylindrical pit c.4 feet deep with poured concrete walls. The structure served a supporting function in a complex proposed for City Landmark designation in the City's Barelas Sector Development Plan. The turntable is an essential part of the complex. Currently used by BNSF Railway Co. The turntable is a key remnant of the shops complex, its historic integrity is high. It is driven by an internal combustion engine and drive gear.

Turntable, View from South.

Machine Shop, South Elevation, View across turntable.

Turntable, View from South.

Turntable, View from North side.

Turntable, View from Machine Shop Roof.

BOILER SHOP

Built in 1923. Contains 58,100sf. Divided into 2 bays. Entirely glazed south façade and partially glazed north façade. ¼" thick, single glazed panels, 14"x20", set in steel sashes. Partially glazed East and West façades set into reinforced concrete frames. The Lower 18' of the south façade contains continuous bi-fold steel frame doors, supported on rollers, that allowed the locomotives to move from Boiler Shop to the exterior Transfer Table. Mechanically operated natural ventilation, large crank/pulley devices controlled multiple operable sashes at once. Equipment looks to be in decent shape.

Rooftop skylights allowing no direct sun over Northern bay only. Single glazed, ribbed, wire glass. Skylights are also mechanically operable on one side only.

Mechanical rooms similar in concept to that of the Machine Shop although much smaller due to the fact that the Boiler Shop is 1/3 the area.

Flooring: 6" concrete slab, finished to a true surface, primed with a 1/8" bituminous coating, upon which 3" creosoted (distillate derived entirely from tars produced from the carbonization of bituminous coal) end-grain wood blocks were laid, with pitch interlaid between for waterproofing. Wood floor is in poor condition and creosote is carcinogenic.

Steel Frame Structure. Frame supports various cranes, still intact, not known if still operable.

Exposed wood plank ceiling is intact, although severe damage can be seen at the southern edge of the South Bay.

Roof is double sheathed with built-up roofing. Roof surface is in poor condition, and in some cases, completely void where the plank ceiling has been damaged.

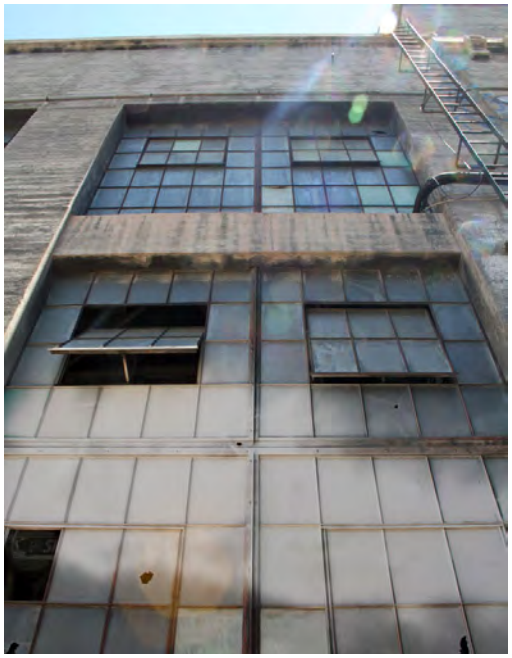
Various auxiliary buildings are directly connected to the Boiler Shop, e.g. Tank Shop, Flue Shop, and the firing shed.

Electric Transformer, not original to the site, has been located at the Western edge of Heavy Equipment Bay and looks to be still active.

Northeast corner, Reinforced concrete with fully glazed perimeter wall.

North elevation, Exterior courtyard in foreground.

Firing Shed attached to West elevation, Transfer Table in foreground.



West elevation, Glazing inset to concrete frame.

Boiler Shop, South elevation, View from Transfer Table.

Boiler Shop, View from South Operable Doors

Boiler Shop, Erecting Bay, Fully Glazed southern elevation, Crane at rear. Floor troughs seen across floor.

Boiler Shop, Eercting Bay, Fully Glazed southern elevation with 18' tall operable doors.

Boiler Shop, Heavy Eqipment Bay, Pyramidal skylights

Boiler Shop, Heavy Equipment Bay, Pyramidal skylights, entrance to Flue Shop at immediate right.

Crane operator workstation, Heavy Equipment Bay.

Boiler Shop, Cranes in Erecting Bay.

Crane Controls.

Damaged flooring, 3" thick creosoted end-grain wood blocks

Stair access to mechanical rooms, at columns lines between the Erecting and Heavy Equipment Bays.

BLACKSMITH SHOP

Built in 1917, with the exception of the Storehouse, the Blacksmith Shop is the oldest remaining building on-site. Contains 24,879sf.

Predominantly glazed east and west façades set between vertical bands of masonry. The Blacksmith Shop is the only brick shop building on the site.

North and South façades are primarily masonry with much smaller openings, except for a large bi-fold central door at both façades. Interior of masonry walls have been painted white.

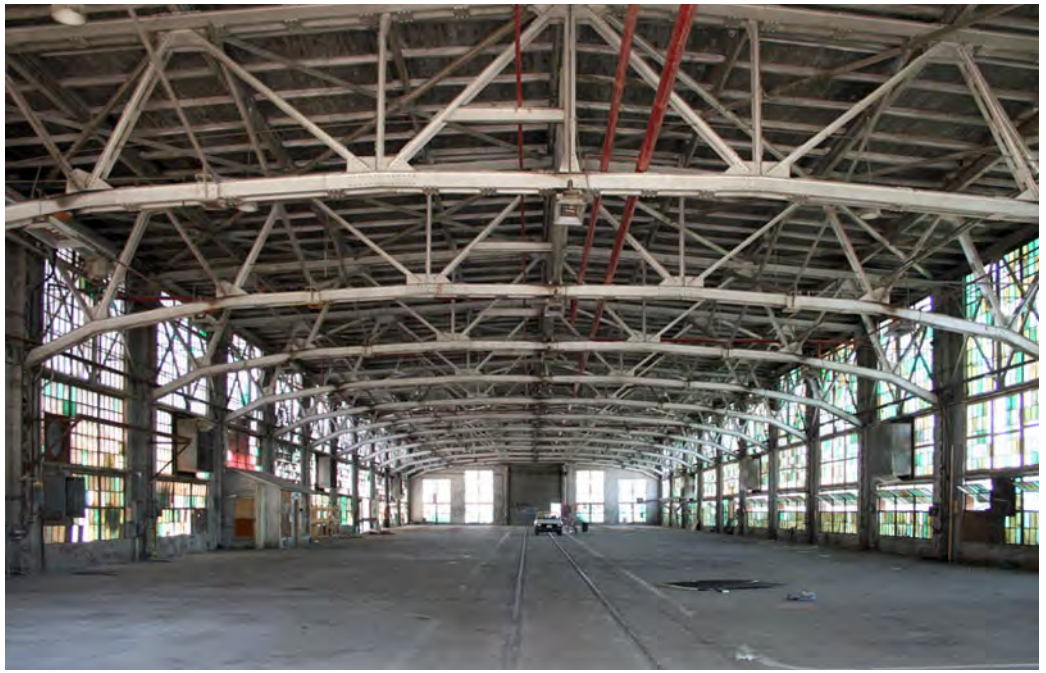
South elevation abuts Transfer Table, and east elevation abuts the railroad tracks. Very little provision for mechanically operated natural ventilation, fan units were integrated into the East and West façades in subsequent years.

No Rooftop skylights. No Mechanical rooms.
Flooring: Concrete slab on grade.
Steel Frame Structure. Columns are themselves built up trusses. No cranes evident in space. Truss shape is unique.

Exposed wood plank ceiling is intact, water damage is evident although ceiling is in relatively good condition.

Seismic retrofitting is evident at exterior masonry walls at attachments to steel support structure. Alternatively, steel plates may have resulted from some early form of post-tensioning.

Central rail lines remain through center of bay, recessed into the concrete floor.



Blacksmith Shop, Steel Trusses, Wood Plank Ceiling, Glazed East and West elevations.

Blacksmith Shop, South Elevation.

Exterior walkway between Blacksmith Shop (Left) and Flue Shop (Right), Machine Shop/Transfer Table shown in background.

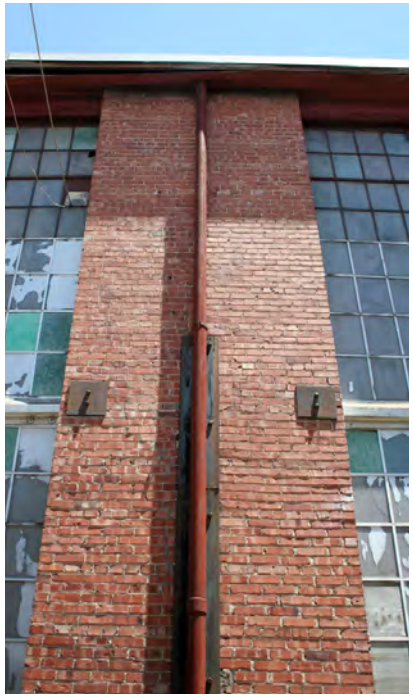
Blacksmith Shop, Steel Truss at column surrounded by masonry wall.

South Elevation showing proximity to Boiler Shop to the West.

Interior View toward South Elevation Masonry wall.

North Elevation from adjacent parcel.

Fan equipment at Glazed Elevation.



West/East Elevation, Steel Plate upgrades.

Steel 'trussed' column.

FLUE SHOP

Built in 1920. Contains 9,464sf.

All concrete cast in place construction makes it unique to the complex with the exception of the Storehouse and some less significant miscellaneous site buildings.

Predominantly glazed east and west façades set between vertical bands of concrete.

North façade is primarily cast in place concrete with two large openings. South end of building opens directly to adjoining Boiler Shop. East elevation abuts Blacksmith Shop/exterior walkway and West elevation abuts exterior courtyard. Courtyard surface is hardscape but cracked with weeds. A few trees have grown up over the years.

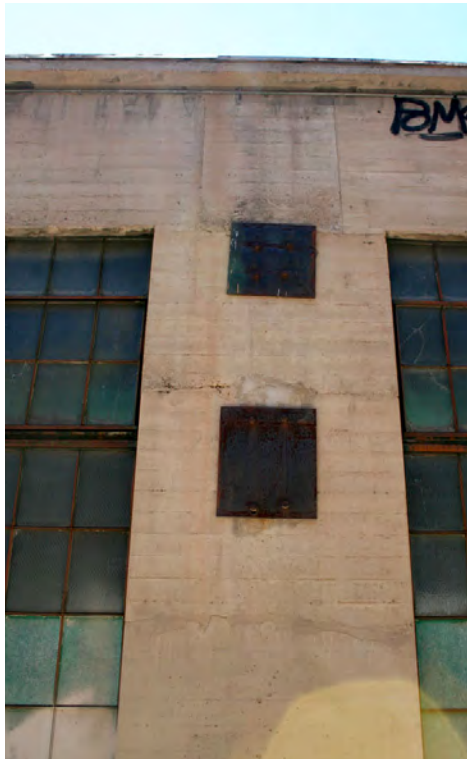
Mechanically operated natural ventilation made possible by operable clerestory skylights.

Unlike other buildings, lighting fixtures can be seen throughout, a small amount of mechanical ductword is visible, with registers supplying the shop. These are not original to the structure.

Ceiling, walls, beams, and slab are all cast in place concrete.

Seismic retrofitting is evident at exterior concrete walls at attachments to concrete beams. Alternatively, steel plates may have resulted from some early form of post-tensioning.

Flue Shop, View down center of Bay.



Steel plate upgrades.

Operable windows.

Flue Shop, Interior view of entrance, Boiler shop shown beyond.

Flue Shop, View up toward operable clerestory windows.

TANK SHOP

Also known as the Tender Repair Shop. Built in 1925. Contains 18,564sf.

Building is very similar in structure to the Heavy Equipment Bay (northern bay) of the Boiler Shop.

Entirely glazed east and west façades, although the Cab Paint Shop blocks the lower 15' of the western façade.
¼" thick, single glazed panels, 14"x20", set in steel sashes throughout. Partially glazed North façade with large openings to accommodate locomotive transfer set into reinforced concrete frames. South façade opens directly to the Boiler Shop.

Mechanically operated natural ventilation, large crank/pulley devices controlled multiple operable sashes at once. Equipment looks to be in decent shape.

Rooftop clerestory skylights allowing no direct sun run down center of bay. Clerestory shape is distinctive from 'A' frame skylights found in the Boiler and Machine Shops. Single glazed, ribbed, wire glass. Skylights are mechanically operable on both sides.

Mechanical ductwork is visible running through the space is likely to contain asbestos. Mechanical equipment is probably located on rooftop, although this would need to be confirmed. Flooring: Concrete slab on grade.

Steel Frame Structure. Frame supports one central 30 ton crane, manufactured by Shaw, still intact, not known if still operable. Full height, large braced frames exist in 3 locations on both East and West façades to deal with lateral loading in North/South direction. Exposed wood plank ceiling is intact, although severe damage can be seen at the western edge.

Northwest Corner, Cab Paint Shop in the foreground.

Tank Shop, North elevation.

Tank Shop, Interior view, central bay with Shaw 30-ton crane in foreground.

Interior view, West fully glazed elevation.

FIREHOUSE

Built in 1920. Contains 3,936sf on two floors. With the exception of the mezzanine in the Machine Shop, this is the only above grade floor in the complex. The Firehouse is the only building in the complex recognized as a City Landmark by the City of Albuquerque. Below find the City's description taken from their website:

Historic Photos, AT&SF Firehouse, Courtesy of City of Albuquerque.

"The Atchison, Topeka and Santa Fe Railway Fire Station was built in 1920 to serve the railroad's shop and roundhouse complex, located south of the passenger depot and Alvarado Hotel. It was one of the last buildings constructed by the railroad in Albuquerque, and reflected the company's interest in providing independent services and utilities for its operations.

This is Albuquerque's oldest remaining fire station. Its rustic architecture is rare in the city, conveying the railroad architect's romantic images of the Southwest. E.A. Harrison's design features a rough, sandstone exterior with an asymmetrical tower, crenellated parapet and sleeping porch. The tower itself is decorated with tiled overhangs, protruding beams, a stone insignia and ornamental globes. The building's sandstone, quarried at Laguna Pueblo, was taken from a demolished 1881 roundhouse built by the Atlantic and Pacific Railroad, a forerunner to the AT&SF. The protection of all of these features is included under its Landmark status.

The fire station was used as offices for several years following the demolition of the roundhouse. It is currently vacant but still stands as a reminder of the important role that the AT&SF industrial complex played in Albuquerque's economy through most of the 20th century."

Firehouse, West Elevation.

Firehouse, South Elevation - Detail.

Firehouse, South Elevation.

Southwest Corner showing proximty to Tank Shop in background.

East Elevation.

STOREHOUSE WITH PLATFORM

Built in 1915. 1-story, poured concrete building of 50 feet by 417 feet plan dimensions. Storehouse sits on a concrete platform with 10- foot wide runways/ loading docks on east and west sides. Platform extends south of building and beyond. Building held stores for AT&SF Railway Company administration and management- forms, tools, toilet paper- for the entire line. Storehouse is ancillary to the shops operation but served other AT&SF facilities near and far during the 1914-1953 period. Its historic integrity is high. An oil cellar is partly exposed on the platform just south of the building. Storehouse's southern bay is a space unto itself and accessible only via two exterior doors.

Aerial view of Storehouse from roof of Machine Shop.

Storehouse, View from North.

Storehouse, View from roof of Machine Shop.

Storehouse, View from Inside.

TRANSFER TABLE

Concrete-lined pit with east-west tracks and electrically powered gear-driven table with operators' cab and north/south track in a steel-plate deck. Also includes a nonpowered table with north-south track. Transfer Table was an essential part of locomotive shops operation and the complex. Electric motor housing by cab, electrical service frames Transfer Tables are rare, far more so than railway turntables. The Transfer Table made this shops complex work as a cross-axial design.

Transfer Table, West Elevation.

Transfer Table, View from West.

Transfer Table, View from East side.

Transfer Table, View from southeast corner to BlackSmith Shop and Boiler Shop.

Transfer Table, View from the southeast corner to BlackSmith Shop and Boiler Shop.

Transfer Table, View from the East Side.

APPENDIX D: INFRASTRUCTURE REPORT

The infrastructure report deals broadly with systems designed to convey utilities to and from the Rail Yards site. Systems are analyzed to determine existing capacity and against this baseline, the development proforma of the Concept Plan is evaluated and recommendations for its accommodation are provided.

Note that the information contained in this section is preliminary in nature and intended to provide a baseline analysis and rough order of magnitude summary of future infrastructure requirements only. Specific infrastructural requirements will be detailed prior to Site Plan for Building Permit approvals.

D.1 Infrastructure - Executive Summary:

The redevelopment of the Albuquerque Rail Yards located at 2nd Street SW and Santa Fe Avenue SW has been investigated. Infrastructure needed to support the redevelopment concepts has been analyzed. The analysis will review the existing adjacent infrastructure and capacities, to meet the full proposed build-out of the redevelopment, estimated at 30 work force residences, and 801,592 square feet of "heavy commercial" land use. This report will show existing capacities available for both wet and dry utilities; as well as demands and concept improvements for future redevelopment.

At this time, analysis of the infrastructure to support phasing of the project in order to minimize working capital and maintenance requirements has not yet been undertaken. Rather the current examination is to show the amount of infrastructure required to support the full build-out of the project only.

D.1.1 Water Distribution System

Significant improvements must be made to the potable water distribution system between Hazeldine Avenue and Cromwell Avenue along 2nd Street SW to satisfy fire flow demands for the future development. The Rail Yard appeared to have had its own private water line, consisting of both 6-inch and 8-inch pipes. The recommendation is to replace the existing old on-site system with the a proposed public distribution system that will consist of 8-inch pipes, with the appropriate placed fire hydrants, valves, service meters, and a large cistern that will be used to augment fire flows. Each building will be sized for its own independent water meter; and will also be analyzed for the number of fire hydrants that are required for its building type to meet fire code requirements. Requests to the Albuquerque Bernalillo County Water Utility Authority (ABCWUA) have been made to prepare a fire flow test for the existing distribution system adjacent to the Rail Yard. The results of this analysis have not been received so for the purposes of the master plan, the assumption is that a maximum fire demand for the existing infrastructure of 1,500 gallons per minute (GPM), is achievable. The existing public line in 2nd Street SW will be connected in several locations to the new proposed line within the development.

All new hydrants will be located by the City Fire Marshal's office, and subsequent utility plans will need to be prepared and approved, by the ABCWUA. Public easements will be required for the proposed on-site distribution system.

The site will require an on-site cistern with an additional water supply volume of 46,300 cf; with a peak potable demand of 520 gpm and a maximum fire demand of 4000 gpm; for a two hour duration. Wilson & Company has addressed these requirements in the body of this master plan. The 46,300 cubic foot cistern with booster pump will be required to support the existing infrastructure to provide fire flow for the project. The cistern and the booster pump may need to be installed during the first phase of the project in case the existing system pressure in 2nd Street SW drops below 20 psi, to address an emergency situation.

The project is also planned to have open space areas, which will be irrigated; with low flow or special irrigation to prevent the unnecessary use of potable water.

D.1.2 Wastewater Collection

Wastewater generated from the proposed developed site will be collected by a series of internal private systems. The proposed system will connect to the existing 8-inch line in 2nd Street SW at 2 locations: near the crossing streets of Atlantic Avenue SW; and Santa Fe Avenue SW. The existing 8-inch line has a capacity of 0.85 cfs. The existing 8-inch line is required to be upsized to a 12-inch line as part of this project. A third connection will be made to the proposed 12-inch line in 2nd Street SW south of Pacific Avenue in order to handle the additional flows. The proposed 12-inch line has a capacity of 2.52 cfs. The line at the intersection of Cromwell Avenue SW and 2nd Street SW is a 12-inch line. The existing capacity of the 12-inch line is 2.52 cfs. Each proposed 8-inch sanitary sewer line has capacity of 0.85 cfs. The technical discussion in the body of this report shows the peak demand at each of the proposed sanitary connections within the development.

The existing on-site sanitary system will be completely replaced for the purpose of this report.

D.1.3 Stormwater Management System

Stormwater management is a critical element for the proposed development. Drainage patterns will remain similar to those of the existing condition; however, no detention is currently provided for the mostly impervious Rail Yard. Through an existing agreement with the City of Albuquerque, the proposed project will be allowed to release at a rate of 2.75 cfs per acre of development. The existing drainage patterns, with very flat slopes running from east to west, show 3 natural drainage basins, which will be similar for final grading of the proposed site. Each basin (Basin A-1 located at the northern end of the development, Basin A-2 located in the middle of the development and Basin A-3, located in the southern portion of the development) will provide its own detention areas, whether by underground cistern, porous landscape techniques, bio-swales, rain gardens, or other general low impact improvements accepted for high density urban environments. The onsite system for collection and detention will be a private system connecting to the public gravity system located in 2nd Street SW. It is anticipated that each of the basins will require:

- Basin A-1; total volume of storage required 17,978 cf, with max discharge of 20.1 cfs

- Basin A-2; total volume of storage required 20,309 cf, with max discharge of 22.6 cfs

- Basin A-3; total volume of storage required 28,807 cf, with max discharge of 32.2 cfs

For the purposes of this report, Wilson & Company proposes to incorporate an extensive array of best management practices that respect the flat topography; which reflect the stormwater criteria and regulations. We propose a gravity system consisting of swales, ditches, small diameter piping, and shallow ponds, while attenuating peak discharges, which also adhere to a sustainable design practice for open space and landscape areas.

D.1.4 Dry Utilities

- Gas availability; Contact was made with the New Mexico Gas Company. Based on the general concepts of the site plan, it was determined that there will be no problem servicing the anticipated load.

- Century Link availability; Contact was made with Century Link. Its main copper and fiber optic facilities located at 4th Street SW, between Coal and Bridge can be extended to serve the Rail Yard development.

- Comcast availability; Contact was also made with Comcast; Capacity is available to provide service to the proposed Rail Yard site.

- PNM availability; An existing substation is located at the northern

end of the project across 2nd Street SW that has been estimated to provide 1.5 megawatts. The assumption for the development is that the electricity demand will exceed 8 megawatts; requiring the existing substation to be expanded, along with the construction of primary distribution lines to the proposed development. The project may also require a new 115kV transmission line to be extended to connect to the expanded substation. Additional analysis through PNM will be required to develop a final conceptual plan for this development.

D.2 Water Distribution

This section of the report is intended to address the future water distribution system for the Albuquerque Rail Yard. The proposed public water distribution system within the site is intended to serve a dual function of domestic service, as well was fire protection flows. Based on the proposed Parcel Map, Floor Area Ratios (FAR), and Projected Usages prescribed within the Master Development Plan, the demands on the water service system have been estimated as outlined within this section of the report.

D.2.1 Existing Infrastructure

According to municipal maps, a private water distribution system within the Rail Yard did exist at one time. It has since been abandoned and its size and condition is unknown at this time. Therefore, for the purposes of this section of the report, it has been deemed infeasible to re-use the existing on-site system. Instead, this section will schematically layout a new system designed to specifically meet the requirements of the proposed development.

The existing public potable water distribution system to the west of the site within 2nd Street SW consists of a 6" main. An 8" main also exists within Commercial Street SE to the east. However, due to the feasibility and potential expense of crossing the existing railroad tracks to reach the main in Commercial Street the recommendation of this document is that water services be obtained from 2nd Street SW.

*Note: If additional resources can be identified through working with the Albuquerque Bernalillo County Water Utility Authority this could be revisited during the initial designs.

D.2.2 Proposed Development

The proposed concept for development will consist of numerous buildings, both existing buildings to be rehabilitated and new construction. The site is proposed to be divided into ten parcels as part of the master planning process. Each of these parcels was assigned a floor area ratio (FAR) and proposed use. The FAR and parcel area then dictated the potential build-out for development within each parcel. It is these fully built-out square footages that were used in the calculations of the domestic and fire demands.

D.2.3 Domestic Demand Calculation

The Volume II – Design Criteria, Chapter 25: Waste System Design Criteria of the Albuquerque Development Process Manual does not dictate a method for estimating design flows. Therefore, the domestic demand has been calculated by use of the sanitary sewer flows based on the potential build-out outlined above. The sanitary sewer flows were modified to approximate domestic demand by assuming a 20% water consumption rate. Domestic demands for the proposed development are as follows:

Parcel ID	Proposed Use (Per Master Plan)	Domestic Demand (MGD)
1	Cultural Facilities: Museum, Performing Arts	0.174
2	Work-Force Housing	0.122
3	Cultural Facilities: Museum, Live Work	0.029
4	Open Space; Accessory Retail	N/A
5	Business/Professional Uses: Office, Light Manufacturing, Training/Education, R&D, Media. Accessory Cultural Uses.	0.157
6	Open Space	N/A
7	Business/Professional Uses: Office, Light Manufacturing, Training/Education, R&D, Media	0.040
8	Business/Professional Uses: Office, Light Manufacturing, Training/Education, R&D, Media	0.104
9	Open Space/Commercial: Retail, Restaurant, Service	0.023
10	Business/Professional Uses: Office, Light Manufacturing, Training/Education, R&D, Media	0.100

D.2.4 Fire Flow Demand Calculation

Fire flows for the proposed development were approximated using the International Fire Code Table B105.1. Building Type IIB was assumed for both existing structures to be rehabilitated and proposed new structures. Type IIB was selected due to its non-combustible, non-rated classification. The flow rates from the table were then reduced by 50% due to the assumption that all buildings will be sprinkled as allowed by the Fire Code. The required flow durations were also obtained based on the projected demands. See the table for a summary:

Parcel ID	Buildable Area (SF)	Construction Type*	Fire Flow** (GPM)	50% Reduction for Sprinklers (GPM)	Flow Duration As Required by Code (Hours)
1	240,567	IIB	8000	4000	4
2	77,264	IIB	6000	3000	3
3	31,791	IIB	4750	2375	2
4	N/A	N/A	N/A	N/A	4
5	214,121	IIB	8000	4000	4
6	N/A	N/A	N/A	N/A	4
7	45,447	IIB	4750	2375	2
8	134,984	IIB	7750	3875	3
9	24,554	IIB	4750	2375	2
10	128,304	IIB	7500	3750	3

D.2.5 Proposed System Layout and Design

The proposed water distribution system on site was laid out with two main objectives. The first was to provide infrastructure to fully service various connection points throughout the parcel as well as place new fire hydrants to meet the spacing requirements. The second objective was to provide an independently looped system within the boundaries of the site. By doing so it allows fire demands for the development to be met by a single cistern and pump system, which will be installed during the initial phasing of the project.

At the time this document was prepared, no existing flow data was available for the municipal water distribution system adjacent to the site. It has been assumed that the 6" water main in 2nd Street SW will not have an ability to sufficiently supply fire flows for the proposed development. Therefore, it is proposed a booster pump and cistern system be centrally located within the site's water distribution network to meet the demands estimated in the table above. The proposed cistern size of 46,300 cf and pump size of 2,500 GPM is intended to supplement a projected draw of 1,500 GPM from the city infrastructure to meet the maximum flow of 4,000 GPM for a maximum duration of 2 hours.

It is important to note that the Code requires flow durations in excess of that which the pump system can supply. This non-compliance with Code has been disregarded due to the nature of the flows that have been calculated. The flows are calculated using bulk buildable square footages for different parcels of the site that in many cases include multiple structures. During the formal design of the development more accurate, building specific calculations will be performed that will result in lower flow values and durations. The conceptual fire system is, therefore, conservative and appropriate for planning purposed as the project moves forward. Also use of fire rated construction in larger buildings can be used to reduce demand.

Attachments:

Domestic Demand Calculations
Fire Demand Calculations
Existing Water Infrastructure Map
Conceptual Water Infrastructure Map

Albuquerque Rail Yard - Domestic Demand Estimation

Parcel ID	Proposed Use (Per Masterplan)	Parcel Area (SF)	Proposed FAR	Buildable Area (SF)	Proposed Use (For Utility Sizing)*	Design Flow Per Sanitary* (MGD)	Useage Factor	Domestic Demand (MGD)
1	Cultural Facilities: Museum, Performing Arts	370,103	0.65	240,567	Heavy Commercial	0.145	1.2	0.174
2	Work-Force Housing	77,264	1.00	77,264	80 DU (~1,000SF/DU)	0.101	1.2	0.122
3	Cultural Facilities: Museum, Live Work	63,582	0.50	31,791	Heavy Commercial	0.024	1.2	0.029
4	Open Space; Accessory Retail	40,120	N/A	N/A	N/A	N/A	N/A	N/A
5	Business/Professional Uses: Office, Light Manufacturing, Training/Education, R&D, Media. Accessory Cultural Uses.	142,747	1.50	214,121	Heavy Commercial	0.131	1.2	0.157
6	Open Space	79,893	N/A	N/A	N/A	N/A	N/A	N/A
7	Business/Professional Uses: Office, Light Manufacturing, Training/Education, R&D, Media.	30,298	1.50	45,447	Heavy Commercial	0.033	1.2	0.040
8	Business/Professional Uses: Office, Light Manufacturing,	89,989	1.50	134,984	Heavy Commercial	0.087	1.2	0.104
9	Open Space/Commercial: Retail, Restaurant, Service.	98,216	0.25	24,554	Heavy Commercial	0.019	1.2	0.023
10	Business/Professional Uses: Office, Light Manufacturing, Training/Education, R&D, Media.	197,390	0.65	128,304	Heavy Commercial	0.083	1.2	0.100

* - Per Albuquerque Development Process Manual - Chapter 24 - Sanitary Sewer Design Criteria

Albuquerque Rail Yard - Fire Demand Estimation

Parcel ID	Proposed Use (Per Masterplan)	Parcel Area (SF)	Proposed FAR	Buildable Area (SF)	Construction Type*	Fire Flow** (GPM)	50% Reduction for Sprinklers (GPM)	Flow Duration (Hours)
1	Cultural Facilities: Museum, Performing Arts	370,103	0.65	240,567	IIB	8000	4000	4
2	Work-Force Housing	77,264	1.00	77,264	IIB	6000	3000	3
3	Cultural Facilities: Museum, Live Work	63,582	0.50	31,791	IIB	4750	2375	2
4	Open Space; Accessory Retail	40,120	N/A	N/A	N/A	N/A	N/A	4
5	Business/Professional Uses: Office, Light Manufacturing, Training/Education, R&D, Media. Accessory Cultural Uses	142,747	1.50	214,121	IIB	8000	4000	4
6	Open Space	79,893	N/A	N/A	N/A	N/A	N/A	4
7	Business/Professional Uses: Office, Light Manufacturing, Training/Education, R&D, Media	30,298	1.50	45,447	IIB	4750	2375	2
8	Business/Professional Uses: Office, Light Manufacturing, Training/Education, R&D, Media	89,989	1.50	134,984	IIB	7750	3875	3
9	Open Space/Commercial: Retail, Restaurant, Service	98,216	0.25	24,554	IIB	4750	2375	2
10	Business/Professional Uses: Office, Light Manufacturing, Training/Education, R&D, Media.	197,390	0.65	128,304	IIB	7500	3750	3

* - Construction Type IIB assumed for all buildings: non-combustable, non-rated

** - Fire Flows per IFC Table B105.1

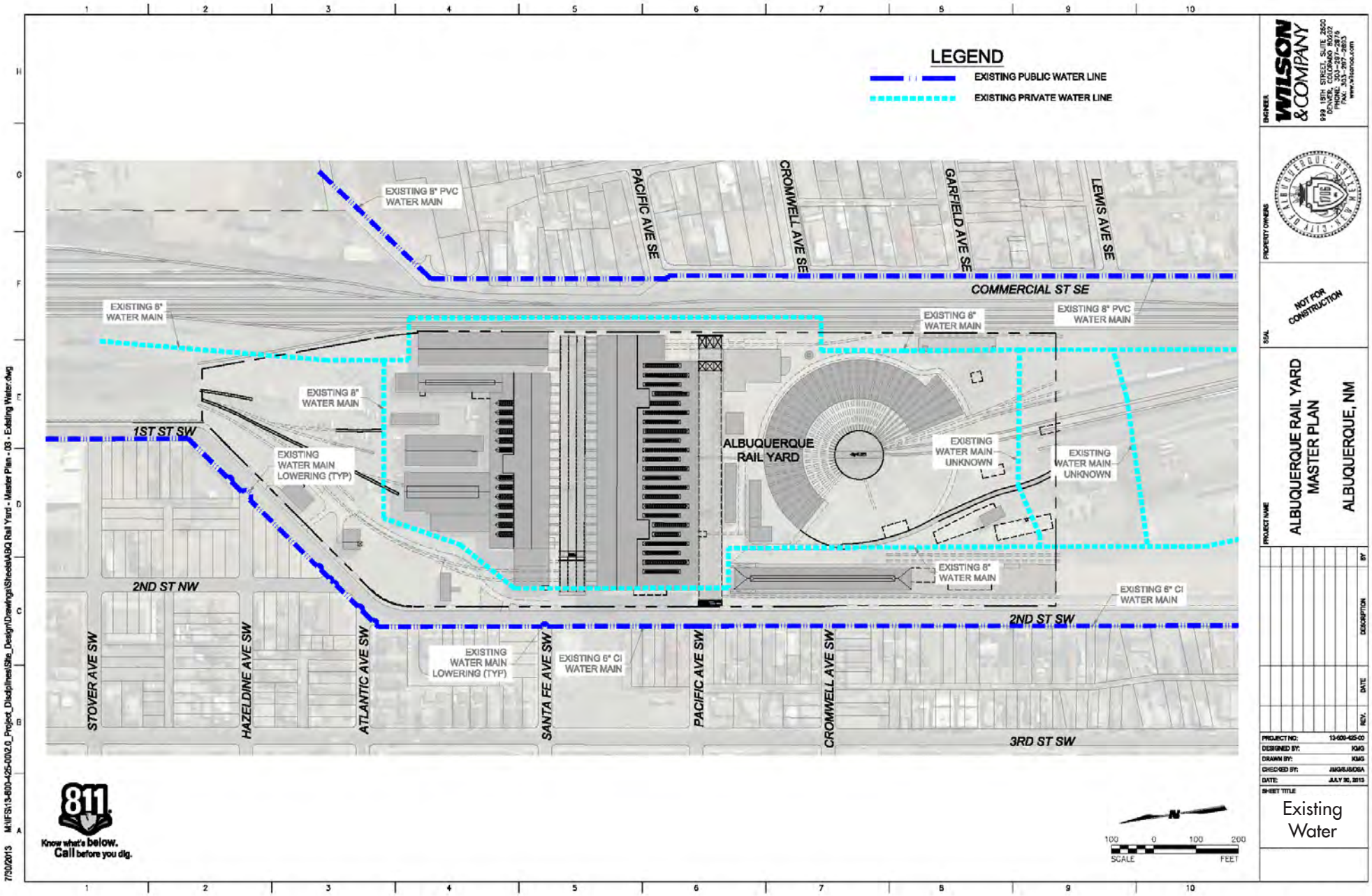


Figure 21a: Existing Water

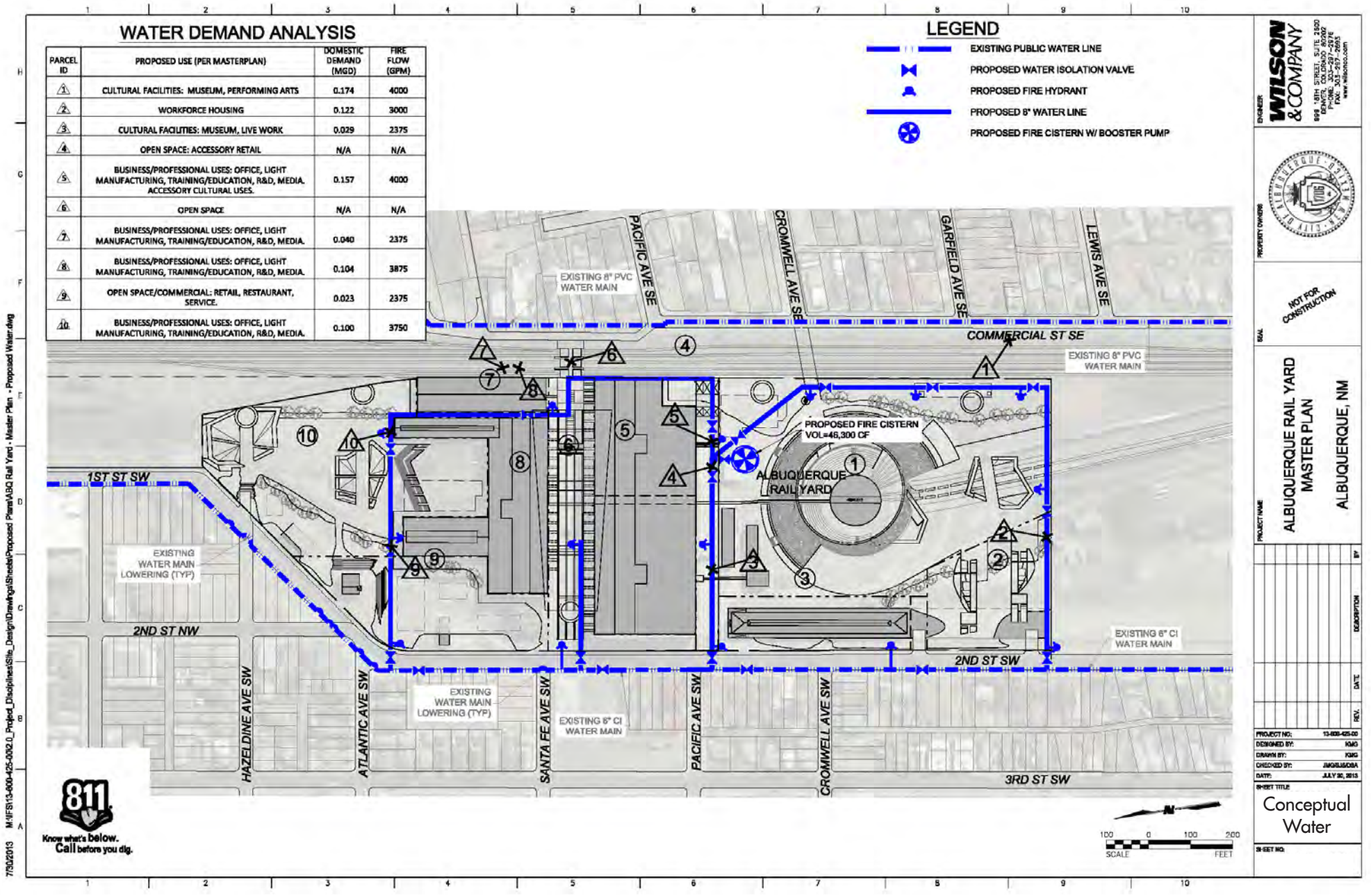


Figure 21b: Conceptual **Water**

D.3 Wastewater Collection

This section of the report is intended to address the proposed sanitary flows that will be contributed from the Albuquerque Rail Yard. The development concepts will be comprised of a minimum 30 dwelling units and 5 analysis points of mixed commercial use that has a total parcel area of 1,189,602 square feet, of which 801,592 square feet is the allowable buildable "heavy commercial" land use area. The analysis points are laid out as such:

- Analysis point 1 consist of Parcels 9 and 10
- Analysis point 2 consist of Parcels 5, 7, and 8,
- Analysis point 3 consist of Parcels 1, 2, and 3,
- Analysis point 4 is the combination of analysis points 1 and 2, and
- Analysis point is the combination of analysis point 1 and 4

**Note: See attached Figure 22b Conceptual Wastewater for analyses point locations and Parcel ID.

The following calculations have been prepared to meet the requirements of Volume II – Design Criteria, Chapter 24: Sanitary Sewer Design Criteria of the Albuquerque Development Process Manual.

- Analysis Point 1 Proposed Flow
  Avg Flow = (5,968 GPD/AC)(6.79 AC)(10-6) = 0.040 MGD
  Peak Flow = 2.5(0.040)0.8875 = 0.145 MGD
  Design Flow = (1.2)(0.145 MGD)(1.547) = 0.270 cfs
  Total Design Flow for Analysis Point 1
  Total Design Flow = 0.27 cfs

- Analysis Point 2 Proposed Flow
  Avg Flow = (5,968 GPD/AC)(6.04 AC)(10-6) = 0.036 MGD

  Peak Flow = 2.5(0.036)0.8875 = 0.131 MGD
  Design Flow = (1.2)(0.145 MGD)(1.547) = 0.243 cfs
  Total Design Flow for Analysis Point 2
  Total Design Flow = 0.24 cfs

- Analysis Point 3 Proposed Flow
  Commercial Portion
  Avg Flow = (5,968 GPD/AC)(9.96 AC)(10-6) = 0.059 MGD
  Peak Flow = 2.5(0.059)0.8875 = 0.204 MGD
  Design Flow = (1.2)(0.204 MGD)(1.547) = 0.379 cfs

  Dwelling Portion
  Avg Flow = (80 DU)(2.5 People/DU)(110 GPD/Person)(10-6) = 0.022 MGD
  Peak Flow = 2.5(0.022)0.8875 = 0.084 MGD
  Design Flow = (1.2)(0.084 MGD)(1.547) = 0.157 cfs
  Total Design Flow for Analysis Point 3
  Total Design Flow = 0.157 cfs +0.379 cfs = 0.54 cfs

The above mentioned results are the quantities that were obtained using the heavy commercial sanitary average flows provided by Volume II – Design Criteria, Chapter 24: Sanitary Sewer Design Criteria of the Albuquerque Development Process Manual. The heavy commercial sanitary flows were chosen to be conservative when projecting the additional flows and were compared the City and Country of Denver Department of Public Works Sanitary Sewer Design Technical Criteria Manual (See attached CCD Table 2.04.3 – Commercial/Industrial Flow Factors), in order to allow for reasonable assumptions to be made. No data on existing sanitary sewer conditions have been provided prior to this report, such as slope and sanitary flows.

Analyses were performed using FlowMaster software to determine the allowable capacities of the existing sanitary sewer system. The analysis revealed the existing 8" Vitrified Clay Pipe, VCP, running along the west side of the future development had an allowable capacity of 0.85 cfs, assuming the current system runs at a 0.5% slope. Thus

the 0.27 cfs calculated at analysis point 1 (See attached Proposed Sanitary Site Layout for location) could flow into the existing 8" VCP with a remaining capacity of 0.58 cfs (68.2%). Analysis point 4, which is a second proposed connection to the above mentioned existing 8" VCP pipe in 2nd Street SW, will be the combination of the flows from analysis points 1 and 2, which have a total projected flow of 0.51 cfs. The additional 0.51 cfs could be added to the existing 8" VCP sanitary with a remaining 0.34 cfs (40.0%). These analyses were done separate due to the lack of data provided on current conditions.

South of analysis point 5, the report proposes the replacement of the 8" VCP with a 12" PVC sanitary pipe, due to the additional flow that will be contributed from analysis point 5, which is a combination of analysis point 1, 2, and 3. The project flow at this portion of the sanitary sewer system will be 1.05 cfs. An analysis was done using FlowMaster to determine the allowable capacity in the proposed 12" PVC pipe. The results of the FlowMaster analysis it was determined the allowable flow capacity of the proposed 12" PVC pipe was 2.52 cfs, therefore a remaining capacity of 1.47 cfs (58.3%) would be allowable for future developments.

With the above mentioned results, it is assumed that with the additional flows and the proposed change to the portion of the existing 8" VCP to a 12" PVC sanitary pipe, between Pacific Avenue SW and Cromwell Avenue SW, that there will be adequate capacities to handle proposed and existing flows.

Attachments:
- Existing Wastewater
- Conceptual Wasterwater
- Spread Sheet of Analysis Points with Calculated Flows
- Section 2 of Chapter 24: Sanitary Sewer Design Criteria
- CCD Table 2.04.3 – Commercial/Industrial Flow Factors
- FlowMaster Worksheet for Existing 8" VCP @ Assumed 0.5% (Allowable Capacity)
- FlowMaster Worksheet for Existing 12" PVC @ Assumed 0.5% (Allowable Capacity)

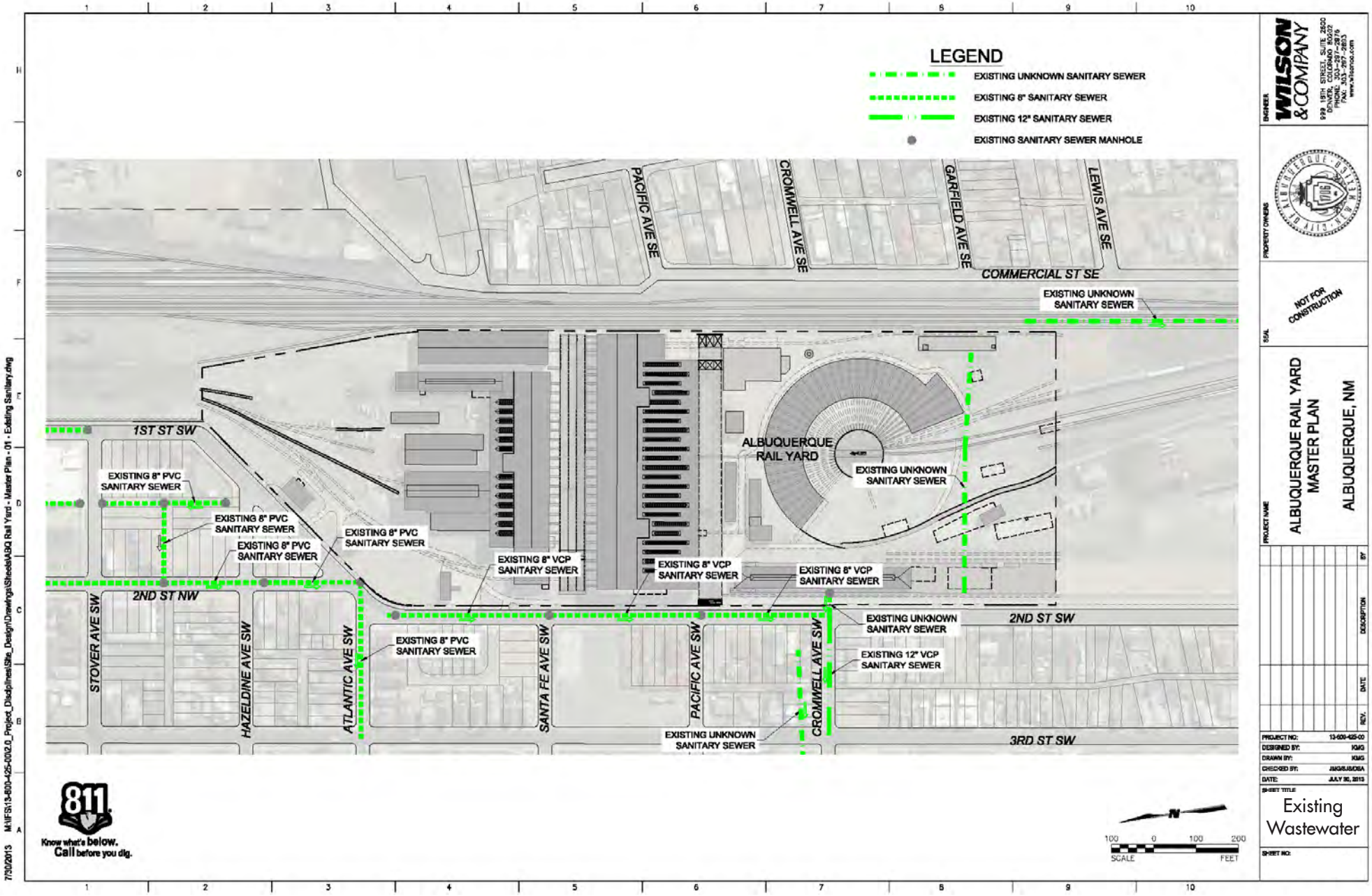


Figure 22a: Existing Wastewater

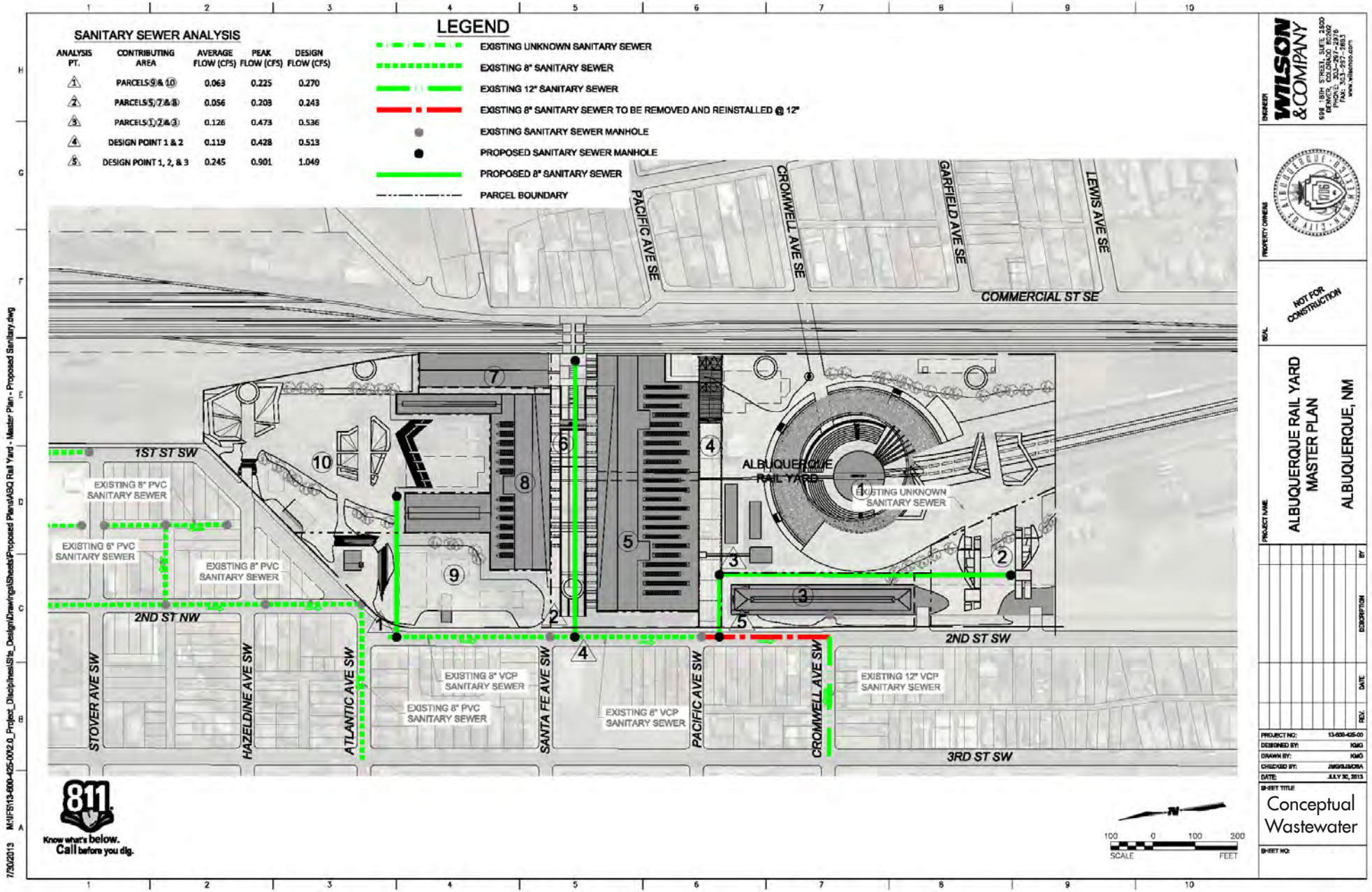


Figure 22b: Conceptual **Wastewater**

Analysis Point 3

Parcel ID	Proposed Use (Per Masterplan)	Parcel Area	Proposed FAR	Buildable Area	Proposed Use (For Utility Sizing)*
1	Cultrual Facilities: Museum, Performing Arts	370,103	0.65	240,567	Heavy Commercial
2	Work-Force Housing	77,264	1.00	77,264	80 DU (~1,000SF/DU)
3	Cultural Facilities: Museum, Live Work	63,582	0.50	31,791	Heavy Commercial

Total area (minus WFH Parcel 2 & Open Space Parcel 4) (SF)	433,685	
	MGD	CFS
Ave Flow	0.059	0.092
Peak Flow	0.204	0.316
Design Flow	0.245	0.379
Work-Force Housing	Population	
2.5 persons/DU	200	
	MGD	CFS
Ave Flow	0.022	0.034
Peak Flow	0.084	0.131
Design Flow	0.101	0.157
	MGD	CFS
Total Design Flow for Analysis Point 3	0.346	0.536

Analysis Point 2

Parcel ID	Proposed Use (Per Masterplan)	Parcel Area	Proposed FAR	Buildable Area	Proposed Use (For Utility Sizing)*
5	Business/Professional Uses: Office, Light Manufacturing, Training/Education, R&D, Media. Accessory Cultural Uses.	142,747	1.50	214,121	Heavy Commercial
7	Business/Professional Uses: Office, Light Manufacturing, Training/Education, R&D, Media.	30,298	1.50	45,447	Heavy Commercial
8	Business/Professional Uses: Office, Light Manufacturing, Training/Education, R&D, Media.	89,989	1.50	134,984	Heavy Commercial

Total area (minus open space Parcel 6) (SF)	263,034	
	MGD	CFS
Ave Flow	0.036	0.056
Peak Flow	0.131	0.203
Design Flow	0.157	0.243
	MGD	CFS
Total Design Flow for Analysis Point 2	0.157	0.243

Analysis Point 1

Parcel ID	Proposed Use (Per Masterplan)	Parcel Area	Proposed FAR	Buildable Area	Proposed Use (For Utility Sizing)*
9	Open Space/Commercial: Retail, Restaurant, Service.	98,216	0.25	24,554	Heavy Commercial
10	Business/Professional Uses: Office, Light Manufacturing, Training/Education, R&D, Media.	197,390	0.65	128,304	Heavy Commercial

Total area (minus open space Parcel 6) (SF)	295,606	
	MGD	CFS
Ave Flow	0.040	0.063
Peak Flow	0.145	0.225
Design Flow	0.174	0.270
	MGD	CFS
Total Design Flow for Analysis Point 1	0.174	0.270
	MGD	**CFS**
Total additional flow	**0.678**	**1.048**

No water or sanitary sewer service accounts shall be sold to any development project prior to issuance of a Water and Sanitary Sewer Availability Statement for that specific project. No property may develop or take service in such a manner that leaves adjacent unserviced properties without means to obtain service. In accordance with the Water and Sewer Expansion Policies, line extensions are required to cover all frontage of the property requesting service unless all adjacent properties have other means of being served.

Section 2. ENGINEERING DESIGN CRITERIA

Unless modified for a specific project, specifications for pipe and other construction materials and specifications for construction will be as required in the current City of Albuquerque Standard Specifications for Public Works Construction and Standard Details.

A. Design Capacity Criteria Section, Development and Development Service

1. Off-site flows will be typically determined by the Planning Department/Utility Development.

2. In areas with a mix of residential, commercial, industrial, etc., roughly representative of the city as a whole, the population of the contributing area is determined and the design flows are calculated as follows:

Average Flow = 110 X Population/10^6, in MGD
Peak Flow = 2.5 X (Avg.) $^{.8875}$, in MGD
Design Flow = 1.2 X Peak, in MGD
(for cfs, multiply MGD by 1.547)

3. Population loadings are assumed to be:

2.5 persons per DU for apartments, townhouses and mobile homes

3.0 persons per DU for R-1 single-family homes

Where DU = Dwelling Unit

4. In primarily non-residential areas, design flows are determined by other methods as may be appropriate with the approval of the Planning Department/Utility Development, Development & Building Services Center. Following is a summary of non-residential sewer use categories and estimated demand currently used by City staff in the Albuquerque Sewer Analysis Model (ASAM) of the City's major sewer lines:

NOTE: The following land use categories and associated sewer use loading values are established for use with development within the City of Albuquerque Wastewater collection basin. The Land Use Categories relate to standard "Sewer Use Unit Hydrographs" within the City's computer model of the sewer system, Albuquerque Sewer Analysis Model (ASAM). Alternative loadings may be considered or required when justified for a specific development. Impact fees analysis may reflect variations in flows.

LAND USE CATEGORY	AVERAGE FLOW (gpd / Acre)	PEAK FLOW (gpd / Acre)
Light Commercial	1,230	1,621
Heavy Commercial	5,968	7,600
Light Institutional	226	310
Heavy Institutional	1,788	2,448
Light Industrial	447	745
Medium Industrial	1,680	1,982
Heavy Industrial	9,266	10,300

Section 4 of this chapter contains a detailed listing of Land Use Codes and classifications for nearly all possible developed uses, as they are applied in ASAM. Contact Planning Department /Utility Development for assistance in applying rates and determining applicable loadings.

5. Design is for full pipe flow at the design flow.

6. Manning's Formula is to be used for determination of pipe flow velocities and capacities using a value for Manning's "n" = 0.013.

a. Peak velocity = Velocity at peak flow conditions

b. Average velocity = Velocity at average flow conditions

B. Manhole Criteria

1. Manholes must generally be located on the centerline of street right-of-way or of street width if the street is not concentric with the right-of-way. Manholes for straight lines in curved streets may be located as much as 5' off from centerline of street or right-of-way; however, required clearances from other utilities must be maintained. The offset of such manholes is to be dimensioned from center of manhole barrel to the centerline of the street or right-of-way. In narrow, curving, residential streets, greater than 5' offset may be appropriate to maintain separation from other utilities. Avoid locating manholes in the "wheel path" on arterial and collector roadways, and keep them out of "Parking" lanes and spaces. Manhole locations that conflict with centerline monumentation required for subdivisions, should be shifted, when practical, to eliminate the conflict. Manholes will not be allowed outside of public right-of-way within residential areas except in private streets or within multifamily housing with public easements. All manholes must be accessible by sewer maintenance truck. Manhole locations in residential rear or side yards are not acceptable.

2. Standard minimum manhole depth is 6.0', measured from rim to invert. Manhole depths greater than 20 feet shall be avoided.

3. The required inside diameter for a manhole is determined as follows:

a. Minimum inside diameter is 4.0'.

b. A minimum 9" wide shelf must be provided on each side of each main line within the manhole.

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CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS

SECTION 2: SANITARY PLANNING CRITERIA

TABLE 2.04.3 - COMMERCIAL/INDUSTRIAL FLOW FACTORS

Type of Establishment Future Average Flow	(GPD/1000 Gross Building sq. ft.)
Office Buildings	200
Restaurants	500
Bar & Lounges	300
Hotels & Motels	350
Neighborhood Stores	200
Department Stores	200
Laundries & Dry Cleaning	1000
Banks & Financial Buildings	300
Medical Buildings & Clinics	300
Warehouses	100
Meat & Food Processing Plants	2800
Car Washes	1900
Service Stations	20
Auto Dealer, Repair & Service	150
Super Market	200
Trade Businesses - Plumbers, Exterminator, etc.	200
Mobile Home Dealer, Lumber Co., Drive-In Movies, Flea Markets	300
Places of Assembly - Churches, Schools, Libraries, Theaters	600
Factories - Manufacturing raw products into finished products	800
Hospitals	450 gal/bed

Worksheet for 8" Sewer - Capacity

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Normal Depth	0.67	ft
Diameter	0.67	ft
Discharge	0.85	ft³/s

Results

Discharge	0.85	ft³/s
Normal Depth	0.67	ft
Flow Area	0.35	ft²
Wetted Perimeter	2.09	ft
Hydraulic Radius	0.17	ft
Top Width	0.00	ft
Critical Depth	0.44	ft
Percent Full	100.0	%
Critical Slope	0.00848	ft/ft
Velocity	2.45	ft/s
Velocity Head	0.09	ft
Specific Energy	0.76	ft
Froude Number	0.00	
Maximum Discharge	0.92	ft³/s
Discharge Full	0.85	ft³/s
Slope Full	0.00500	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for 12" Sewer - Capacity

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Normal Depth	1.00	ft
Diameter	1.00	ft
Discharge	2.52	ft³/s

Results

Discharge	2.52	ft³/s
Normal Depth	1.00	ft
Flow Area	0.79	ft²
Wetted Perimeter	3.14	ft
Hydraulic Radius	0.25	ft
Top Width	0.00	ft
Critical Depth	0.68	ft
Percent Full	100.0	%
Critical Slope	0.00770	ft/ft
Velocity	3.21	ft/s
Velocity Head	0.16	ft
Specific Energy	1.16	ft
Froude Number	0.00	
Maximum Discharge	2.71	ft³/s
Discharge Full	2.52	ft³/s
Slope Full	0.00500	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for 12" Sewer - Capacity

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.68	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00770	ft/ft

Worksheet for 8" Sewer - Capacity

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.67	ft
Critical Depth	0.44	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00848	ft/ft

D.4 Stormwater Management System

This section of the report is intended to address the drainage analysis for the Rail Yards , and the proposed detention volumes that can be expected with the various basins of the proposed project. The following calculations have been prepared to meet the requirements of Volume II – Design Criteria, Chapter 22: Drainage, Flood Control and Erosion Control of the Albuquerque Development Process Manual (The Manual).

The proposed conditions are obtained from the concepts for the site. The land treatments for the site have been weighted with 90% Impervious (Treatment D) to comply with a commercial development per The Manual. In the interest of being conservative and because the final ground cover for the site is unknown, the remaining 10% is assumed to be Treatment C. The site is located between the Rio Grande and the San Mateo, and therefore has been determined that the site falls within the Zone '2' precipitation zone. Due to the existing drainage patterns observed on site and the conceptual layout of the site we have analyzed the site with three separate drainage basins: A-1, A-2, and A-3. It should be noted that Conceptual Basin A-2 is the Transfer Table, a historic feature that is proposed to be preserved. Use of the space for stormwater retention may not be compatible with preservation of the Transfer Table.

The 100-year 6-hour event was used as the principal design storm per The Manual. A summary of the hydrology for each basin is as follows:

100-Year 6-Hour Storm Hydrology

- Basin A-1:
  Area = 7.37 ac
  P360 = 2.35 in
  Excess Precipitation = 2.021 in
  Peak Intensity = 5.05 in/hr
  C100 Coefficient = 0.899
  Peak Discharge = 33.2 cfs

- Basin A-2:
  Area = 8.23 ac
  P360 = 2.35 in
  Excess Precipitation = 2.021 in
  Peak Intensity = 5.05 in/hr
  C100 Coefficient = 0.899
  Peak Discharge = 37.4 cfs

- Basin A-3:
  Area = 11.71 ac
  P360 = 2.35 in
  Excess Precipitation = 2.021 in
  Peak Intensity = 5.05 in/hr
  C100 Coefficient = 0.899
  Peak Discharge = 53.2 cfs

The allowable peak discharge for the site post development has been established at 2.75 cfs/acre per the city engineering department. The peak discharge for the developed site is projected to be 4.54 cfs/acre. Therefore, stormwater volume detention will be necessary to reduce the peak discharge to the allowable rate. Stormwater detention volumes could be captured and stored within numerous cisterns, or other approved catchment system, on the site. The water captured within the catchment systems will be released to the municipal storm sewer system at a rate no larger than allowable discharge rate. Stormwater runoff may also be retained for use of irrigation at elevations less than the outfall to the municipal system. Should this option be exercised during final design of the storm system, the retained volume cannot exceed 10 acre-ft.

As defined by The Manual, the Hydrograph for Small Watershed method was used to determine the volume of stormwater that must be detained to meet allowable discharge rates for the site. Each of the three (3) basins was analyzed separately. Each basin will contain multiple cisterns so the volumes calculated below represent

the total that must be detained. During the formal design process of the campus, it may be determined that it is more feasible to slow discharge for some cisterns and allow other areas of the site to discharge at a rate faster than that allowed or even freely discharge. This design approach would be acceptable as long as two criteria were met: 1) the total site discharge were to be below the allowable rate of 2.75 cfs/acre; and 2) no cistern were to retain water for a period greater than 6 hours. Should drain times exceed the 6 hour limit, design storms in excess of the 100-year 6-hour storm must be analyzed.

Below is a summary of the analysis for the three (3) major basins of the proposed site. Hydrographs representing the 100-year 6-hour design storm were plotted using the parameters defined by The Manual. The allowable discharge was also plotted on the hydrograph. The area between the two is representative of the detention volume necessary. See the attached Hydrographs for more information.

- Basin A-1:
  Peak Discharge = 33.2 cfs
  Allowable Discharge = 20.1 cfs
  Base Time, tb = 0.713 hours
  Time to Peak, tp = 0.198 hours
  Peak Duration = 0.225 hours
  Detention Volume = 17,978 cf
  = 0.413 ac-ft

- Basin A-2:
  Peak Discharge = 37.4 cfs
  Allowable Discharge = 22.6 cfs
  Base Time, tb = 0.712 hours
  Time to Peak, tp = 0.198 hours
  Peak Duration = 0.225 hours
  Detention Volume = 20,309 cf
  = 0.466 ac-ft

- Basin A-3:
  Peak Discharge = 11.71 cfs
  Allowable Discharge = 32.2 cfs
  Base Time, tb = 0.712 hours
  Time to Peak, tp = 0.198 hours
  Peak Duration = 0.225 hours
  Detention Volume = 28,807 cf
  = 0.661 ac-ft

In summary, the resultant volumes yielded are approximately 2,500 cf of storage required for each acre of the parcel. The consistent unit storage volume is due to use of the uniform Land Treatment of 90% impervious and the uniform allowable discharge of 2.75 cfs/acre. Assumptions made for the non-impervious Land Treatment as well as the time of concentration were conservative. Therefore, the unit storage rate of 2,500 cf/acre is appropriate for future conceptual layout of cisterns as the development of the campus moves forward and drainage basins shift to accommodate desired grading and surface treatments. Use of Low Impact Design techniques such as rain gardens or infiltration swales in the design of the site would result in necessary detention volumes decreasing.

Attachments: Existing Drainage
Conceptual Drainage
Existing Dry Utilities

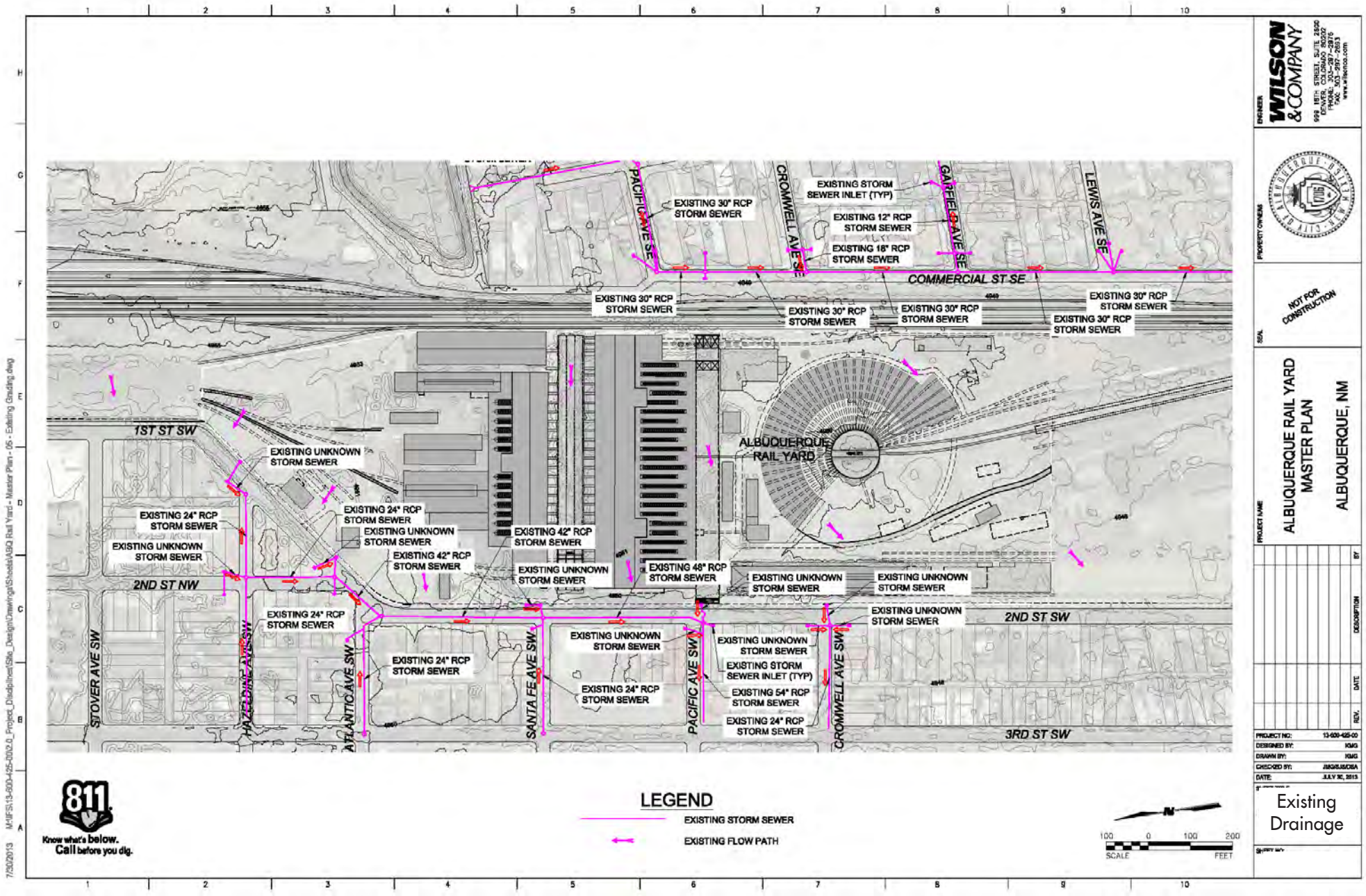

Figure 23a: Existing Drainage

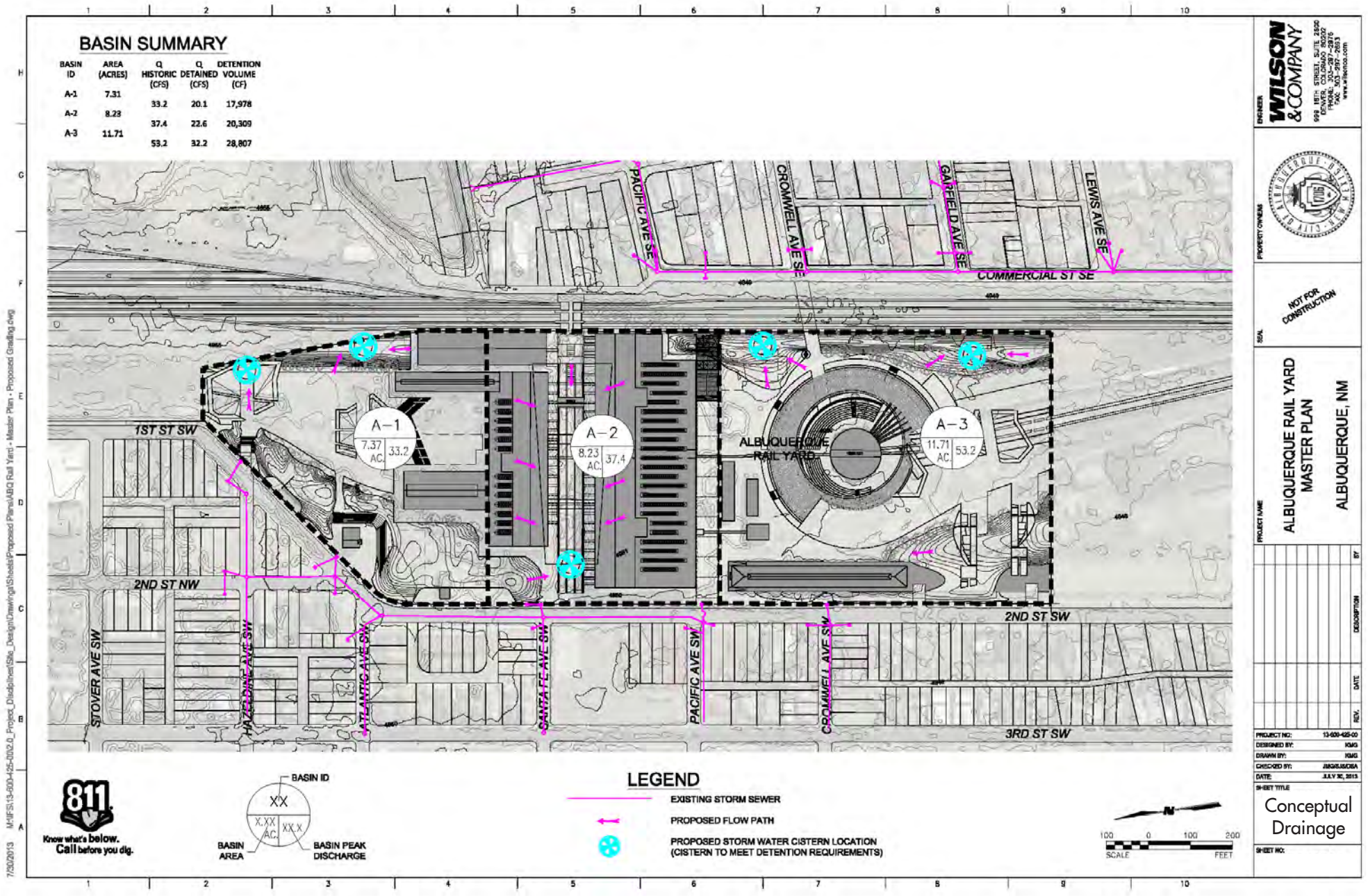

Figure 23b: Conceptual Drainage

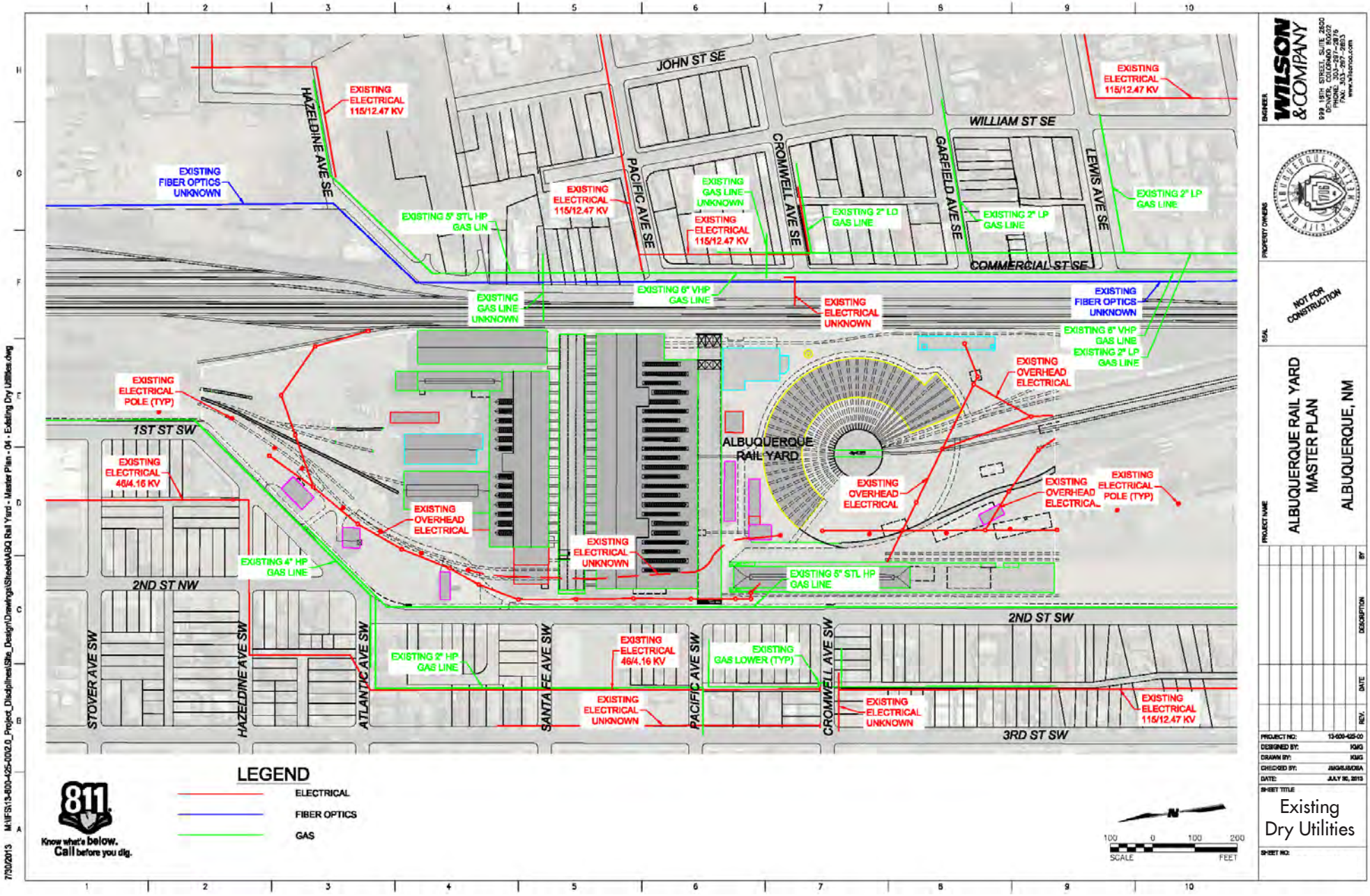

Figure 24: Existing Dry Utilities