DOUGLAS POE & SERVICE AREAS WATER & WASTEWATER INFRASTRUCTURE
30% DESIGN

FINAL BASIS OF DESIGN REPORT | DOUGLAS, ARIZONA | OCTOBER 21, 2022

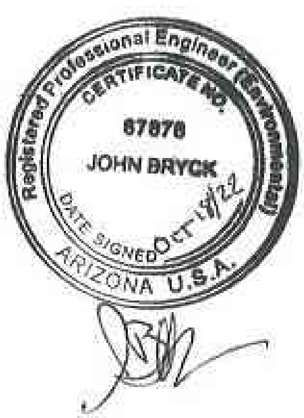
PREPARED BY
STANTEC CONSULTING SERVICES INC.

PREPARED FOR
COCHISE COUNTY & CITY OF DOUGLAS

BASIS OF DESIGN REPORT

30% DESIGN OF THE WATER & WASTEWATER INFRASTRUCTURE TO SERVE THE DOUGLAS POE & SERVICE AREAS

October 21, 2022



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Revision	Description	Author	Date	Quality Check	Date	Independent Review	Date
A Draft	Draft for City / County comments	Jack Bryck	8-31-22	Mark Peterson	8-31-22	Gary Brady	8-26-22
1	Final	Jack Bryck	10-21-22	Mark Peterson	10-21-22	Gary Brady	10-21-22

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Acronyms / Abbreviations

AAC	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
ADOT	Arizona Department of Transportation
ADCF	Arizona Department of Correction Facility
ADWR	Arizona Department of Water Resources
AOC	Approval of Construction
APS	Arizona Public Service
ATC	Approval to Construct
BDIA	Bisbee Douglas International Airport
bls	Below Land Surface
BODR	Basis of Design Report
CC	Cochise College
COD	City of Douglas
DCR	Design Concept Report
DIP	Ductile Iron Pipe
EEC	Engineering Certification of Completion
EPNG	El Paso Natural Gas
EOPC	Engineers Opinion of Probable Cost
East WW LS	East Wastewater Lift Station
EPA	Environmental Protection Agency
ES	Executive Summary
fps	Feet per second
FPUP	Flood Plain Use Permit
gpm	Gallons per Minute
gpd	Gallons per Day
GSA	General Services Administration
JRR	James Ranch Road
LIDAR	Light Detection and Ranging
LS	Lift Station
MAG	Maricopa Association of Governments
MGD	Million Gallons per Day
mg/L	Milligrams per liter
MCL	Maximum Contaminant Level

MH	Manhole
NEPA	National Environmental Policy Act
POC	Point Of Connection
POE	Port of Entry
psi	Pounds Per Square Inch
PSW	Pump Station – West
PVC	Polyvinyl Chloride
RAS	Return Activated Sludge
SCADA	Supervisory Control and Data Acquisition
SEAGO	South East Arizona Government Organization
SES	Serve Entrance Switchboard
SMCL	Secondary Maximum Contaminant Level
SR 80	State Route 80
TDS	Total Dissolved Solids
TBD	To Be Determined
WW	Wastewater
WAS	Waste Activated Sludge
West WW LS	West Wastewater Lift Station
WWTP	Wastewater Treatment Plant
2020 Feasibility Report	Stantec ‘Proposed Douglas Port of Entry Water and Wastewater Feasibility Report’

Executive Summary

This Basis of Design Report (BODR) establishes the design criteria and 30% detailed design for the water, wastewater and broadband conduit infrastructure to serve the proposed Douglas Port of Entry (POE) between Mexico and the USA and the planning area between the City of Douglas and the POE. The planning area was identified by Cochise County (County) and the City of Douglas (City). **Figure ES 1** illustrates the project area.

The proposed POE, a total of 80 acres in area, is approximately five (5) miles west of City of Douglas limits and south end of the currently undeveloped James Ranch Road (JRR). Starting in January 2023 the Arizona Department of Transportation (ADOT) will undertake a review of the connector highway alignment between SR 80 and the POE. A decision on the alignment will not be made by ADOT for another eighteen to twenty-four months. For purposes of this report the City and County directed that the James Ranch Road alignment be used. The existing land-use in the area between the City and the POE is generally agricultural but the City and County have detailed future land-use planning in support of the POE. The area includes Cochise College.

The POE development is being managed by the United States General Services Administration (GSA). The project stakeholders are part of the POE Technical Team coordinated by the City. The Technical Team includes but is not limited to the City of Douglas, Cochise County, GSA, ADOT, APS, El Paso Natural Gas, Cochise College, ADEQ and ADWR.

The current draft Integrated Project Schedule, illustrated on **Figure ES 2**, is for the GSA to have the POE in operation by 2028. The project schedule provided in this BODR is a snapshot as of early August 2022 but will most likely change as the overall POE project details are developed. The Integrated Project Schedule is updated monthly by the POE technical team. The water, wastewater and broadband conduit is to be in place by Q1 2024 (Quarter 1).

The regional approach to serve the POE and the broader area between James Ranch Road, the City, and the area of Bisbee Douglas International Airport (BDIA) was identified in the County and City December 11, 2020 report titled 'Proposed Douglas Port of Entry Water and Wastewater Feasibility Report' (2020 Feasibility Report). The report recommended an approach to providing water and wastewater infrastructure to serve the proposed Douglas commercial Port of Entry (POE). Within the planning area, there is an estimated 7,630 acres identified by the City and County as possible developable areas in support of the POE.

The water and wastewater infrastructure approach described in this BODR narrows the regional approach serving only the POE and adjoining lands. Generally, these areas are along SR 80 between Cochise College and the City and along JRR between SR 80 and the POE.

The POE Wastewater Service Area (**Figure ES 3**) is defined as all developable lands identified by the City and County that results in wastewater flow to a proposed wastewater lift station located at SR 80 and Whitewater Draw. The POE Water Service Area (**Figure ES 4**) is defined as all developable lands identified by the City and the County that would be served by a water supply system between a proposed groundwater well and storage tank in the vicinity of SR 80, Cochise College, and the POE. There are 2,986 acres of land within the POE Wastewater Service Area and 926 acres of land within the POE Water Service Area. The infrastructure will be owned by the City.

The 30% design approach for the water and wastewater infrastructure to serve the Douglas POE and Service Areas is as follows:

1. POE Wastewater Service Area: The POE Wastewater Service Area will be connected to the existing City of Douglas Wastewater Treatment Plant (WWTP). The proposed wastewater collection system along JRR from the POE to SR 80 and along SR 80 from the southeast corner of Cochise College to SR 191 will connect to the existing wastewater collection system at the intersection of SR 80 and SR 191. The wastewater collection system includes two wastewater lift stations; one located at the intersection of West Puzzi Ranch Road and James Ranch Road, identified as the West Wastewater Lift Station (West WW LS) and a second one in the vicinity of SR 80 and Whitewater Draw, identified as the East Wastewater Lift Station (East WW LS). The lands for the West WW LS and the East W LS will need to be acquired by the City. The estimated total length of wastewater collection pipe is 40,214-feet of diameters varying between 8-inch,10-inch, 12-inch, and 15-inch.

   The ADEQ permit for the City WWTP allows 2.6 MGD average day flow. The 2021 WWTP average annual day flow was 1.60 MGD. Working with City and County planners, growth and consequently flow estimates for the POE wastewater service area have been developed. The total wastewater flow to the WWTP, including the POE Wastewater Service Area, is estimated to be 2.17 MGD in 2033 and 2.70 MGD in 2053. The BODR analysis indicates the WWTP has the capacity to accommodate the increase in the average day flow from the POE Wastewater Service Area through approximately 2033 to 2040.

2. POE Water Service Area: The POE Water Service Area water supply is based on a new groundwater well and elevated storage tank in the general vicinity of JRR and SR 80 with a watermain between the storage tank and the POE. The land for the new groundwater well and elevated storage tank will need to be acquired by the City. The estimated total length of water distribution pipe is 19,705-feet of 12-inch and 16-inch diameter pipes.

   The groundwater well is sized to meet the POE Water Service Area estimated peak day water demand of 2.7 MGD (2,692,940 gpd or 1,870 gpm). The storage tank volume is sized to meet the expected fire flow and duration for a fire that occurs coincidentally with the estimated peak day demand. The governing fire flow is assumed to be 2,000 gpm for three hours at the POE.

3. Broadband Conduit: The broadband conduit system is proposed to cover the same alignment as the wastewater collection system. The supply and installation of the fiber optic cable is not included in this project. The estimated length of broadband conduit is 40,214-feet.

The BODR includes 30% detailed design Plan and Profile drawings (**Appendix J – see Volume 2**) and preliminary civil, mechanical, instrumentation and control, and electrical drawings for the East WW LS, West WW LS, and groundwater well and storage tank sites.

The anticipated POE Wastewater Service Area flows and POE Water Service Area demands are based on land-use within the POE Wastewater and Water service areas identified by the County and the City. For infrastructure phasing purposes, the anticipated POE Wastewater and Water Service Area flows have been estimated in the following five milestones:

1. Year 2028: The POE placed in operation.
2. Year 2033: Five-years (5) after the POE is placed in operation. The major equipment for the lift stations, the groundwater well, and storage tank was sized for the estimated flows in 2033.
3. Year 2053: Twenty-five-years (25) after the POE is placed in operation and the estimated life expectancy of the East WW LS and West WW LS equipment is reached.
4. Year 2078: Fifty-years (50) after the POE is placed in operation. The pipe diameters were based on estimated wastewater flows and water demands in 2078.This is the recommended ADEQ planning horizon.
5. Full Buildout: When land within the POE Wastewater Service Area is 100% developed. A date when this may occur has not been estimated.

The infrastructure has been sized to the year 2078 to accommodate the future water demand within the POE Water Service Area, and future wastewater flows within the POE Wastewater Service Area. Based on the assumed growth rate used in the BODR, it is estimated that a total of 54% of the entire service area will be developed by 2078.

An Engineer's Opinion of the Most Probable Construction Cost for the POE Water Service Area, POE Wastewater Service Area and the Broadband Conduit was prepared. The costing was based on the scope of work identified in this BODR and costing data for the Phoenix and Tucson, Arizona areas. The costing is to an AACE Class 3 Cost Estimate at an accuracy range from -15% to +20% (AACE International Recommended Practice No 18R-97).

The Most Probable Total Project Delivery Cost is the Most Probable Construction Cost with an additional 30% allowance for project considerations such as construction general conditions, permitting and detailed design. This also includes considerations such as geotechnical investigation, construction administration, project coordination, land, right-of-way and easement acquisition.

Cost estimating for the POE Water Service Area is broken down into the following project sections:

1. East Wastewater Lift Station
2. West Wastewater Lift Station
3. POE Wastewater Service Area Collection System
4. POE Water Service Area Distribution System
5. Groundwater Well - Storage Tank
6. Broadband Conduit

ES Table 1-1 provides a summary of the AAEE Class 3 Engineer's Opinion of the 2022 Probable Construction Cost and Engineer's Opinion of the 2022 Probable Project Cost to serve the POE Wastewater Service Area, POE Water Service Area, as well as Broadband Conduit only.

ES Table 1-1 Engineers Opinion of the Most Probable Cost

POE Service Area Utility	Most Probable Construction Cost, $	Most Probable Total Project Delivery Cost, $
POE Wastewater Collection System- West WW LS	$2,001,100	$2,601,430
POE Wastewater Collection System- East WW LS	$2,307,100	$2,999,230
POE Wastewater Collection System- Pipes	$7,967,850	$10,358,205
POE - Groundwater Well – Storage Tank	$5,130,100	$6,669,130
POE Water Distribution System- Pipes	$3,340,200	$4,342,260
Broadband Conduit	$402,140	$522,782
Total	**$21,148,490**	**$27,493,037**
+20% of Project Delivery Sub Total	$25,378,188	$32,991,644
-15% of Project Delivery Sub Total	$17, 976,217	$23,369,081

The total Engineer's Opinion of the Probable Construction Cost is $21,148,490 while the Engineer's Opinion of the Probable Project Delivery Cost is $27,493,037. The AAEE Class 3 estimate range of Engineer's Opinion of the Probable Construction Cost is $17,976,217 to $25,378,188. The AAEE Class 3 estimate range of Engineer's Opinion of the Probable Total Project Delivery Cost is $23,369,081 to $32,991,644. These costs will be further refined in subsequent design phases with the expectation that the range of possible cost will decrease.

The 2020 Feasibility Report costing did not include water, wastewater and broadband service to Cochise College. Estimated lengths of 5,800-feet of water line, 10,720-feet of wastewater collection pipe and 10,720-feet of broadband conduit are included in this BODR to serve Cochise College.

There are several outstanding costing considerations:

1. The Most Probable Construction Costing is based on a 2022 costing and will be updated as detailed design progresses to reflect the construction costing environment and project delivery conditions at the time of project delivery.
2. The GSA contracted with Tate, Snyder, Kimsey Architects, Ltd. in August 2022 to develop a 'Master Planning, Programming, Bridging Documents' for the POE development. The work is scheduled for completion in Q4 2023. Water, wastewater, and broadband conduit servicing requirements will be clarified by GSA during this Master Plan process and will affect the City/County Most Probable Construction Cost considerations in this report.
3. ADOT has responsibility to develop the POE connector road. At the date of this BODR, ADOT was in the process of selecting a consulting firm to work on the POE connector road study. ADOT has identified a 12-month (Q3 2023) to 18-month (Q1 2024) project period.

   The City's BODR water, wastewater and broadband conduit design in the JRR alignment will need to be coordinated with ADOT during their design. The outcome of the ADOT design could affect the City/County Most Probable Project Cost considerations in this report.
4. The City will need to agree on roles and responsibilities with ADOT for the procurement, construction scheduling and construction of the City water, wastewater and broadband infrastructure within the ADOT JRR project.
5. Costs for acquiring the West WW LS, East WW LS and Groundwater Well Storge Tank sites are not included in the Opinion of the Most Probable Construction Cost. Detailed site survey, geotechnical investigation and APS work are site specific and still need to be defined.
6. The location of any water, wastewater, and broadband connections will need to be identified by the City/County. Costs of the water, wastewater and broadband service connections are not included in the Opinion of the Most Probable Construction Cost.
7. Costs associated with crossing the high-pressure gas lines and potential modifications to the 30% Wastewater Collection System design, after potholing the gas lines, may affect the Opinion of the Most Probable Construction Cost.

The Basis of Design Report includes recommendations to advance the project from the 30% to the 60% detailed design.

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Figure ES 1 Project Area

HORIZONTAL SCALE: AS SHOWN VERTICAL SCALE: N/A

2042 634200

Figure ES 1

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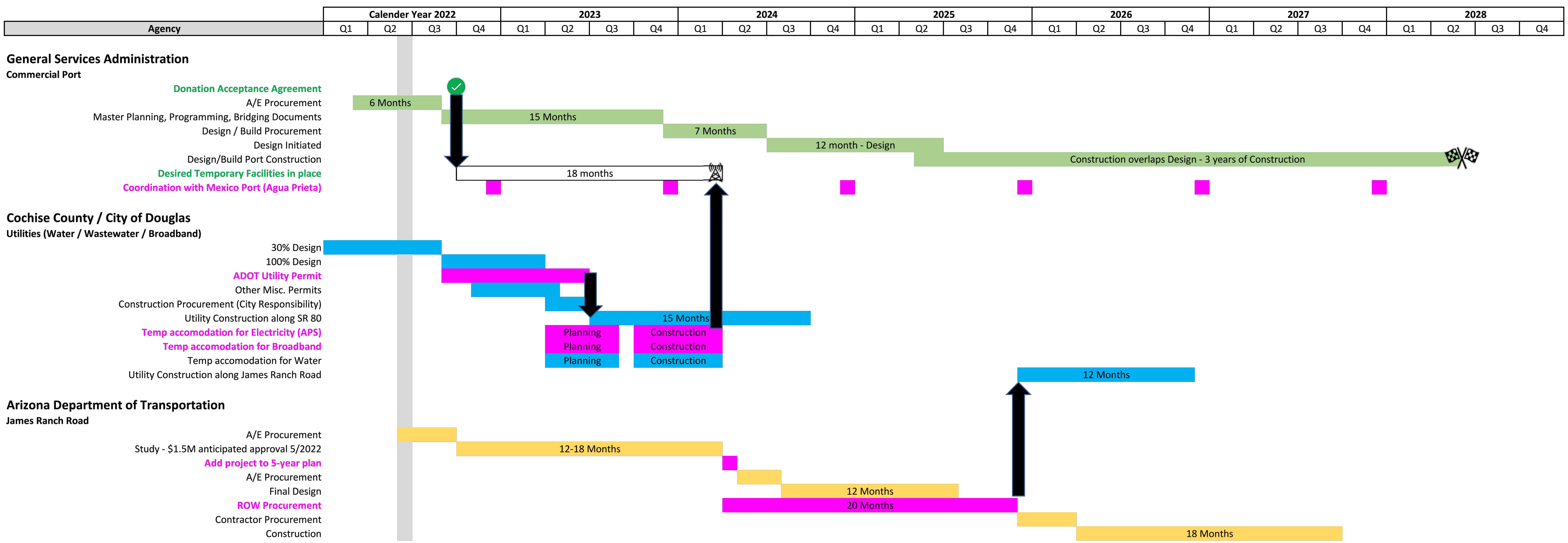
Integrated Schedule



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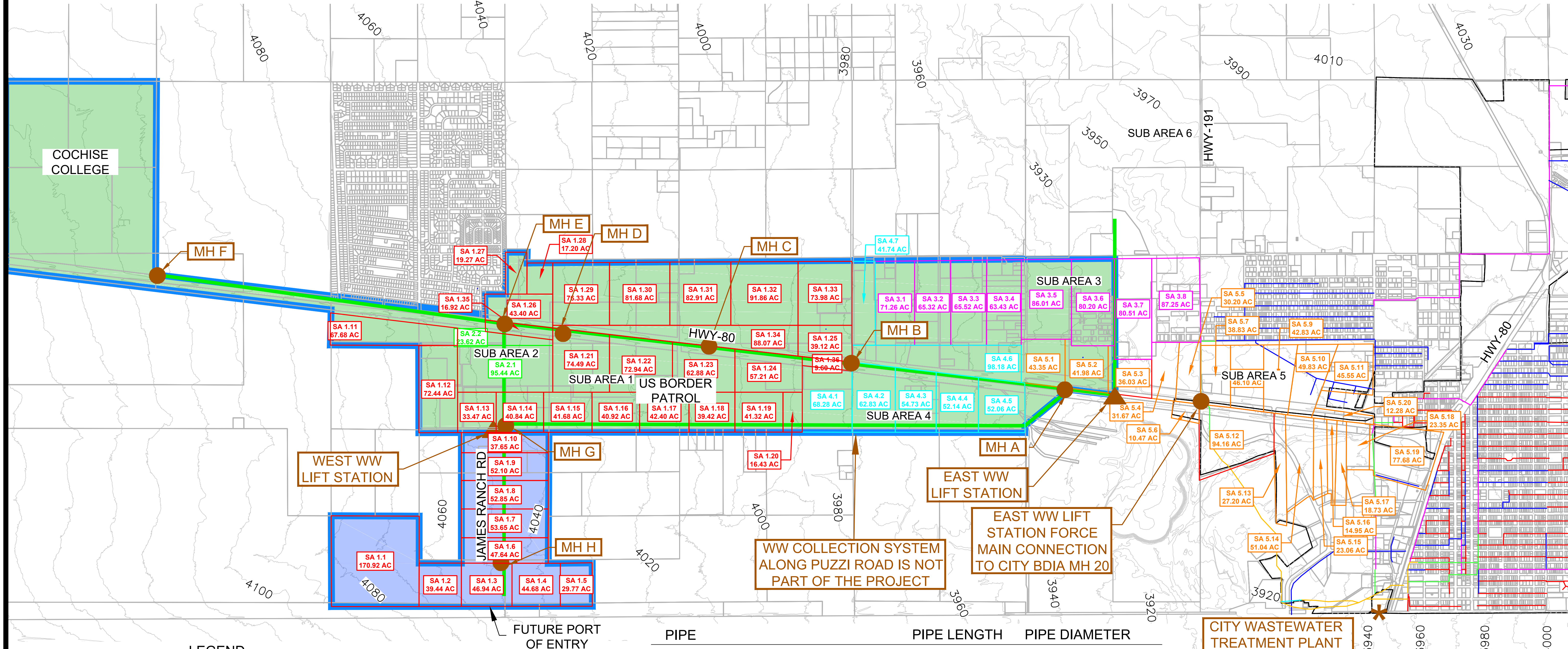
POE Wastewater Service Area - 30% Detailed Design



PIPE	PIPE LENGTH	PIPE DIAMETER
MH A – MH B	6,580 LF	15"
MH B – MH C	4,380 LF	12"
MH C – MH D	4,480 LF	12"
MH D – MH E	1,820 LF	12"
MH E – MH F	10,720 LF	8"
MH E – MH G	3,120 LF	12"
MH H – WEST WW LS	4,260 LF	12"
MH A – EAST WW LIFT	1,560 LF	15"
EAST WW LS – MH 20	3,294 LF	10"
TOTAL	40,214 LF	

LEGEND

- – UTILITY PLANNING AREA
- – CITY OF DOUGLAS LIMITS
- – 6" SANITARY SEWER LINES
- – 8" SANITARY SEWER LINES
- – 10" SANITARY SEWER LINES
- – 12" SANITARY SEWER LINES
- – 15" SANITARY SEWER LINES
- – 16" SANITARY SEWER LINES
- – 18" SANITARY SEWER LINES
- – 21" SANITARY SEWER LINES
- – 30% DETAILED DESIGN WASTEWATER ALIGNMENT
- – FORCEMAIN
- – WEST WW LIFT STATION SERVICE AREA BOUNDARY
- – EAST WW LIFT STATION SERVICE AREA BOUNDARY

NORTH
1"=3000'

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Figure ES 3 POE Wastewater Service Area

HORIZONTAL SCALE: AS SHOWN VERTICAL SCALE: N/A

2042 634200

Figure ES 3

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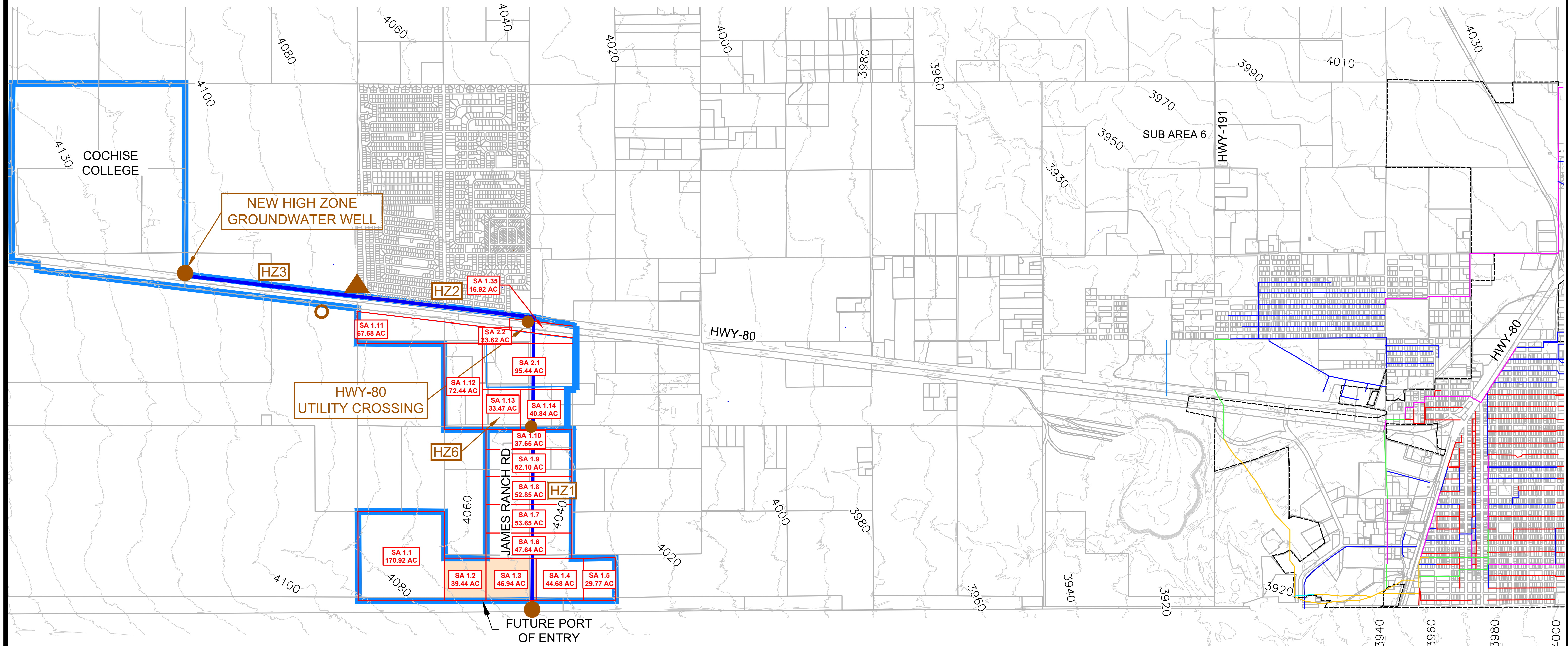
POE Water System Service Area - 30% DETAILED DESIGN



LEGEND

- UTILITY PLANNING AREA
- CITY OF DOUGLAS LIMITS
- PROPOSED UTILITY CORRIDOR
- NODE
- HZ5 – PIPE ID
- RESERVOIR
- FUTURE PORT OF ENTRY

PIPE	PIPE LENGTH (FEET)	PIPE DIAMETER (INCHES)
HZ1	5,890 LF	12"
HZ2	5,350 LF	16"
HZ3	5,300 LF	16"
HZ6	3,165 LF	16"
TOTAL	19,705 LF	

NORTH
1"=3000'

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POE 30% DETAILED DESIGN

Figure ES 4 POE Water Service Area

HORIZONTAL SCALE: AS SHOWN VERTICAL SCALE: N/A

2042 634200

Figure ES 4

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1.0 Introduction

This City of Douglas Water & Wastewater Infrastructure Basis of Design Report (BODR) provides the 30% preliminary design of the water, wastewater and broadband conduit infrastructure to serve the proposed Douglas Port of Entry (POE) between Mexico and the USA. This BODR also details the County and City identified planning area between the City and the POE location. The POE development is being managed by the United States General Services Administration (GSA).

The proposed POE area is approximately five (5) miles west of Douglas City limits and the south end of the currently undeveloped James Ranch Road connecting SR 80 to the POE. It totals 80 acres of land. James Ranch Road will be developed by ADOT. See **Figure 1-1** for a map reference.

The current schedule is to have the POE in operation by 2028. A draft project schedule dated August 8th 2022 illustrates the overall POE schedule (see **Figure 1-2**). It is noted that this project schedule is being updated monthly as the project moves forward.

The existing land-use in the area between the City of Douglas and the POE is generally agricultural but the City and County have detailed future land-use planning in support of the POE. The area includes the U.S. Customs and Border Patrol complex and Cochise College.

The regional approach to serve the POE and the broader area between 1) James Ranch Road and the City and 2) the City and the area of Bisbee Douglas International Airport (BDIA), was identified in the Cochise County and City of Douglas December 11, 2020 report titled ‘Proposed Douglas Port of Entry Water and Wastewater Feasibility Report’ (2020 Feasibility Report). The report recommended an approach to providing water and wastewater infrastructure to serve the proposed Douglas commercial Port of Entry (POE) between Mexico and the U.S., as well as the estimated 7,630 acres within a planning area identified by the City and the County as possible developable areas.

The specific water and wastewater infrastructure approach and the basis of this BODR is to narrow the regional approach at this time to serve only the POE and adjoining lands generally along SR 80 between Cochise College and the City and along James Ranch Road between SR 80 and the POE.

The POE Wastewater Service Area is defined as all developable lands identified by the City and County where wastewater will flow to a proposed wastewater lift station located at in the vicinity of SR 80 and Whitewater Draw. The POE Water Service Area is defined as all developable lands identified by the City and the County that would be served by a water supply system between a proposed groundwater well and storage tank in the vicinity of SR 80 and Cochise College and the POE.

The infrastructure in this BODR has been sized to accommodate future water demand within the POE Water Service Area, and wastewater flows within the POE Wastewater Service Area. There are 2,986 acres of land within the POE Wastewater Service Area and there are 926 acres of land within the POE Water Service Area. The infrastructure will be owned by the City.

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Stantec 3133 West Frye Road, Suite 300 Chandler, AZ. 85226 www.stantec.com	COCHISE COUNTY COCHISE COUNTY / CITY OF DOUGLAS 30% WASTEWATER DETAILED DESIGN 1415 MELODY LAND, BUILDING C BISBEE, ARIZONA 85603	POE WATER SERVICE AREA HORIZONTAL SCALE: AS SHOWN VERTICAL SCALE: N/A	2042 634200 FIGURE 1-1

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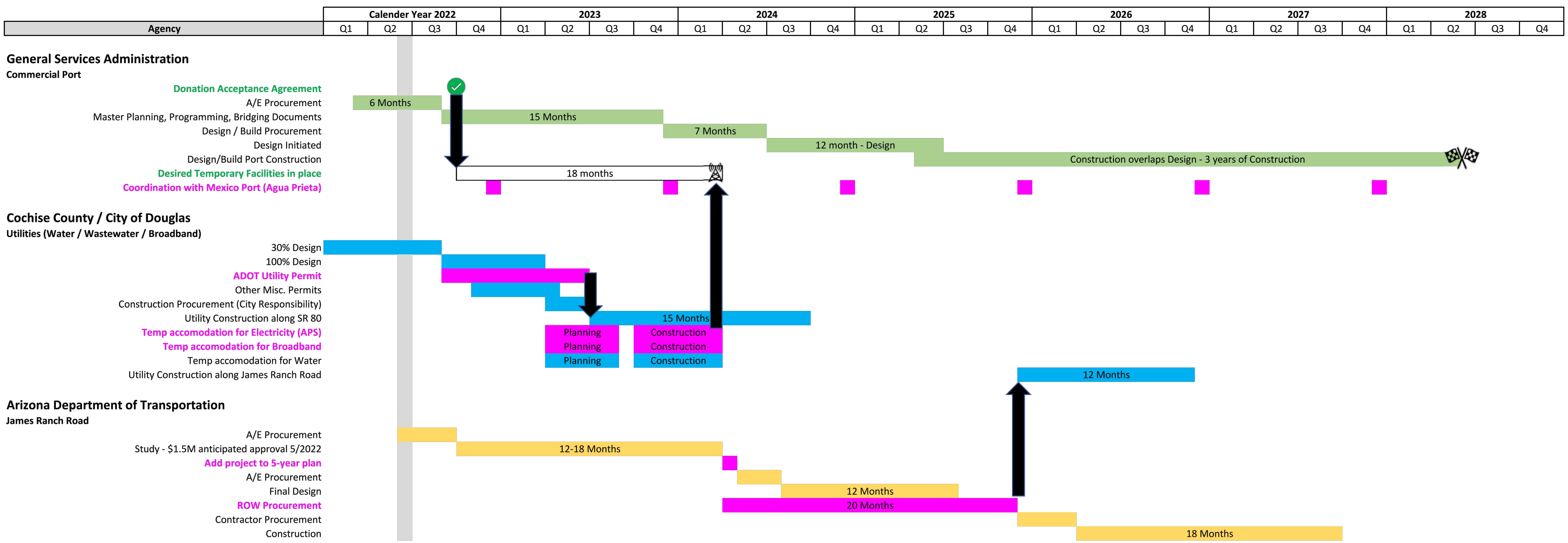
Integrated Schedule



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INTEGRATED SCHEDULE

HORIZONTAL SCALE: AS SHOWN VERTICAL SCALE: N/A

2042 634200

FIGURE 1.2

1.0 Introduction

Future development outside of the POE Water Service Area and the POE Wastewater Service Area but within the City and County planning boundaries (identified in the 2020 Feasibility Report) would be through future City and County planning as development occurs.

The adopted approach for this BODR is as follows:

1. POE Wastewater Service Area: Design and construction of a wastewater collection system along James Ranch Road from the POE to SR 80, along SR 80 from the southeast corner of Cochise College to a connection at the intersection off SR 80 and SR 191, and to the existing City wastewater collection system and the City's WWTP. The wastewater collection system includes two wastewater lift stations located in the following approximate vicinities
    a. Intersection of West Puzzi Ranch Road and James Ranch Road (the West Wastewater Lift Station – West WW LS).
    b. The vicinity of SR 80 and Whitewater Draw (the East Wastewater Lift Station - East WW LS).
2. The scope will include construction of wastewater connections to the wastewater collection system for lands within the service area.
3. POE Water Service Area: Design and construction of new groundwater well and elevated storage tank in the general vicinity of the James Ranch Road and SR 80 with a watermain between the storage tank and the POE. The scope will also include construction of water connections to the water distribution system for land within the service area.
4. Installation of broadband conduit only (without fiber optic cable) in parallel to the wastewater collection system.

The POE Wastewater Service Area map and details can be found in **Appendix A** and map and details for the POE Water Service Area can be found in **Appendix B**.

2.0 Project Description

2.1 Purpose and Description of Report

This Basis of Design Report (BODR) documents technical and engineering decisions for the design of the POE Water and Wastewater Infrastructure based on information from project stakeholders who are part of the POE Technical Team coordinated by the City. The Technical Team includes, but is not limited to, the City of Douglas, Cochise County, GSA, ADOT, APS, El Paso Natural Gas, Cochise College, ADEQ and ADWR.

The GSA is the lead agency for the development of the POE.ADOT is responsible for the development of James Ranch Road between SR 80 and the POE. Program schedules and delivery dates will be developed after the 30% Preliminary Infrastructure Water and Wastewater Design is completed. Assumptions and details pertinent to the 30% Preliminary Infrastructure Design, GSA POE program development, and ADOT James Ranch Road Development are noted in this BODR. The coordination details with GSA and ADOT will require resolution moving to the POE Water and Wastewater Infrastructure 60% Detailed Design.

2.2 Information Collected

The delivery of the 30% preliminary detailed design includes collaboration with a number of stakeholders who are members of the POE Technical Team coordinated by the City. The following information was provided by the stakeholder agencies:

1. City of Douglas: provided information from POE Water and Wastewater Service Areas land-use planning and provided guidance on the rate of land-use development. The City provided information on the City's existing water and wastewater infrastructure and design criteria. The POE wastewater and water infrastructure planning was predicated on integration of the POE Water and Wastewater Service Areas with the existing City water and wastewater infrastructure.
2. Cochise County: provided POE Water and Wastewater Service Areas land-use planning and LIDAR mapping used in the preparation of the plan and profiles.
3. GSA POE Program: will provide details and water, wastewater, and broadband conduit needs.
4. ADOT: will provide James Ranch Road design development and permitting management where water and wastewater infrastructure are located in an ADOT right-of-way.
5. APS: will provide design and primary power supply to the two lift stations and the groundwater well/storage site.
6. Cochise College: provided their water, wastewater, and broadband conduit needs.
7. El Paso Natural Gas: provided criteria for crossing of the high-pressure gas line at several locations.

This summarizes information provided by the Technical Stakeholder Committee members. Much of the information requested was after the project kickoff meeting that was held in the City of Douglas on February 24th 2022.

2.2.1 GENERAL SERVICES ADMINISTRATION (GSA)

At the project kickoff meeting, GSA staff shared general information about the new POE. The facility will occupy 80 acres, include 161,000 usable square feet of building facilities, and will process 31,000 commercial vehicles a year. It is anticipated that approximately 100 full-time employees will be on any individual shift.

In August 2022, the GSA contracted with Tate Snyder Kimsey Architects, Ltd. to develop the 'Master Planning, Programming, and Bridging Documents'. The project work is scheduled for completion in Q4 2023 (Quarter 4 of 2023 as seen in **Figure 1-2**). The specific potable water needs, and wastewater flows will be identified at the completion of this 30% BODR work.

GSA did share the 'Douglas Arizona Land Ports of Entry Regional Feasibility Study & Douglas Firing Range Report' (Line and Space, LLC, 11/25/2019) with the design team, but no specific utility demands or flows were outlined.

Recommendation:

1. **It is recommended that the water and wastewater POE design assumptions be reviewed and finalized with GSA on completion of the GSA's POE Master Planning, Programming, and Bridging Documents report.**

2.2.2 CITY OF DOUGLAS

The City of Douglas (City) provided guidance relative to the City's water design standards. The City uses Maricopa Association of Governments (MAG) specifications and details.

The design team approached the City about the BODR development efforts in the POE Water and Wastewater Service Areas to determine potable water demands and wastewater flows. This information was provided by the City and was used to size water and wastewater infrastructure to support the POE and potential future growth along the James Ranch Road (JRR) and State Route 80 (SR 80) corridors.

Stantec met with County and City Planners on May 4th 2022 about current land development planning efforts in the POE Water and Wastewater Service Areas. The planners confirmed that the planning boundaries and land development approach outline in the 2020 Stantec Report were to be used in the detailed design.

The planned land development approach was used in the estimation of potable water demands and wastewater flows. This information was used to size Water and Wastewater Service Areas infrastructure to support the POE and potential future growth along the JRR and SR 80 corridors.

The County recommended the use of the estimated demands and flows from the 2020 Feasibility Report.

2.2.3 COCHISE COUNTY

As discussed above, Stantec met with Cochise County and City Planners on May 4th 2022 about current land development planning efforts in the POE Water and Wastewater Service Areas. The planners confirmed that the planning boundaries and land development approach outline in the 2020 Stantec Report were to be used in the detailed design.

Cochise County provided Light Detection and Ranging (LIDAR) data that defined contours for the project area. This information was used to develop the 30% Preliminary Plan and Profile sheets and will be incorporated into subsequent detailed design packages found in **Appendix J - Volume 2**.

2.2.4 COCHISE COLLEGE, DOUGLAS CAMPUS

Cochise College is located approximately ten (10) miles west of Douglas City limits along SR80. Cochise College relies on groundwater wells for drinking water supply. The system includes a ground level concrete storage tank and pump station to maintain the water system pressure. Cochise College's wastewater system relies on a lagoon septic system with ground disposal.

Cochise College provided the following information on the historic water and wastewater systems:

Table 2-1 Cochise College Historic Water and Wastewater Systems

Cochise College Historic Data	
Wastewater Flows	a. Historic: 4.5 MG (million gallons) i. Data collection started on 2/18/2021 ii. Some storm drains flow into sanitation ponds, skewing the measured flow data b. Future: Douglas Campus building expansion plans in-progress, possible additional expansion at a future date
Water Demand	a. Historic: 33,372,050 gallons (annual average) b. Future: Douglas Campus building expansion plans in-progress, possible additional expansion at a future date
Fire Flow Requirement	a. Existing: 2,486 gallons per minute (gpm) b. Future: TBD (Douglas Campus building expansion plans in-progress)
Well Water System Data	a. Pressure: 60 pounds per square inch (psi) constant b. Capacity iii. Well: 600 gpm iv. Potable Water Pumps (3) – 801 gpm total (267 gpm rated capacity for each pump) v. Storage Tank: 100,000 gallons c. Water Treatment vi. Chlorination: average level 0.47 mg/L at storage tank outlet vii. Potential Arsenic: awaiting ADEQ compliance sampling results, currently scheduled for Fall 2022
Storage Tank Elevation	a. Base: 4,125.27-feet b. Top: 4,148-feet (based on height of tank overflow) c. Water system pressure is maintained at a constant 60 psi by three potable water pumps
Elevations	a. City Wastewater POC: 4,112.6-feet at southeast corner of Douglas Campus b. City Water POC: 4,160-feet as provided c. The highest campus elevation for water service is 4,155-feet (second floor of the Chiricahua and Huachuca Residence Halls)

2.2.5 ARIZONA DEPARTMENT OF TRANSPORTATION (ADOT)

ADOT has responsibility to develop the JRR design between SR 80 and the POE. ADOT at the date of this BODR was in the process of selecting a transportation consulting firm to work with ADOT on the James Ranch Road Predesign Development (DCR and NEPA). Assuming a Q4 2023 start, ADOT is identifying a 12-month (Q3 2023) to 18-month (Q1 2024) project period.

For purposes of the POE Water and Wastewater Service Areas infrastructure development to the JRR right-of-way cross section from the 2020 Feasibility Report was used in development of the water, wastewater, and broadband conduit location. The County LIDAR contours were used to develop the road profile.

ADOT directed the BODR team to ADOT's PDF plan sheets on their website to locate the ADOT right-of-way boundaries along SR 80 and JRR. These PDF's, coupled with the LIDAR data provided by the County, were used to position the ADOT right-of-way on the Stantec 30% preliminary water and infrastructure plan views.

Recommendation:

1. **It is recommended that the City and County collaborate with ADOT on the water, wastewater broadband centerlines, and profile pipe centerline. They should also collaborate on appurtenances such as service connections, manholes, fire hydrant locations along JRR during the ADOT James Ranch Road predesign. This will likely involve modifications to the 30% Preliminary Design.**

2. **It is recommended that the ADOT right-of-way boundaries should be confirmed along SR 80 and going forward with the JRR predesign development. Record right-of-way strip maps will be requested from ADOT during the design phase of the project.**

2.2.6 ARIZONA PUBLIC SERVICE (APS)

APS provided a general alignment (in a kmz file) of their three phase facilities along SR 80. The 30% Preliminary design has taken this into account. Further coordination with APS will be required at subsequent detailed design stages.

2.2.7 EL PASO NATURAL GAS (EPNG)

EPNG provided images with coordinates where the 30% Preliminary Infrastructure Design POE Water Service Area watermain and POE Wastewater Service Area pipes will cross the high-pressure natural gas pipeline. This information has been used in the 30% Preliminary Water and Wastewater Design.

Recommendation:

1. **Further coordination with EPNG will be required to determine the existing natural gas pipe crown and invert elevations at the water, wastewater, and broadband conduit crossing points and specific design details such as the vertical separation between the pipes. This may require the need to confirm the vertical and horizontal locations at all the cross points.**

2.2.8 US CUSTOMS AND BORDER PATROL

The U.S. Border Patrol Facility has a septic system with ground disposal and two groundwater wells. One well of poor raw water quality, the second well for domestic water use with water treatment for nitrate removal, and an elevated storage tank dedicated for site fire suppression. It is understood that this complex is not within the POE Wastewater and Water Service Areas. Water and wastewater service to this complex is not included in this BODR.

3.0 Wastewater Collection Design Criteria

This section develops an estimate of the POE Wastewater Service Area wastewater flows at milestone dates of 2028, 2033, 2053, 2078 and Full-Buildout for reasons discussed in the Section.

The POE Wastewater Service Area is defined by the tributary lands and potential development that flow to the City WWTP through the proposed East Wastewater Lift Station (East WW LS). The potential development has been reviewed with the City and County project planners. These estimates were used to calculate the wastewater collection system pipe diameters.

The estimates in timing and growth of the wastewater flows are as follows:

1. The POE construction is assumed to be complete and in operation by 2028.
2. An estimate of the wastewater flows were projected for 5 milestone years (2028, 2033, 2053, 2078 and Full-Buildout). Note, Full-Buildout is determined to be the year when development in the service area is at 100%. A date when this may occur has not been estimated.
3. The estimated wastewater flow for 2078 (50 years after study of the POE Wastewater Service Area) was used to determine the wastewater collection system pipe diameters and the East WW LS and West WW LS pumping capacities.
4. Milestone year 2078 wastewater and water flow estimates were used as the basis for sizing pipe diameters.

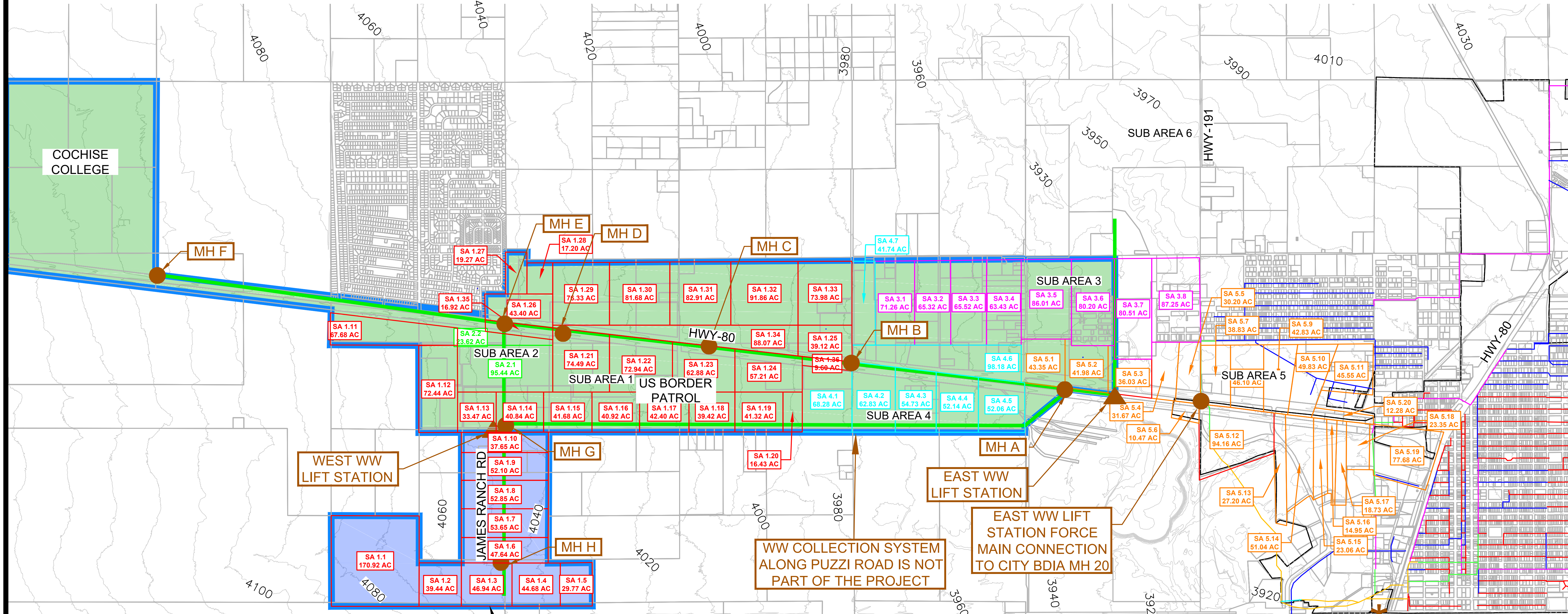
3.1 POE Wastewater Service Area

The POE Wastewater Service Area is illustrated in **Figure 3-1**. The boundary of the POE Wastewater Service Area and land-use within the service area were originally defined by the City and County in the 2020 Feasibility Report and subsequently re-confirmed in May 2022 by the City and County for this project. The POE Wastewater Service Area is generally defined by parts of the Planning Areas 1 to 5 in the 2020 Feasibility Report.

The POE Wastewater Service Area includes Cochise College and generally, the lands located between the Cochise College Douglas campus and SR 80 to the proposed East WW LS (western side of the ADOT bridge over Whitewater Draw). The POE Wastewater Service Area also includes the southern area of SR 80 along JRR. The wastewater from the POE Wastewater Service Area will be conveyed to the City of Douglas Wastewater Treatment Plant (WWTP). The POE Wastewater Service Area includes the existing Old County Hospital and adjacent developed lands served by individual on-site septic tanks systems in service for over 20-30 years. The total land area within the POE Wastewater Service Area is 2,986 acres. Note that the service area is not the same as the planning area proposed in the 2020 Feasibility Report.

For purposes of this design, the POE Wastewater Service Area is the land within Planning Areas 1 to 5 originally defined by the City and County in the 2020 Feasibility Report. Planning Areas 1 to 5 are described in greater detail in **Section 3.2.**

POE Wastewater Service Area - 30% Detailed Design



LEGEND

- UTILITY PLANNING AREA
- CITY OF DOUGLAS LIMITS
- 6" SANITARY SEWER LINES
- 8" SANITARY SEWER LINES
- 10" SANITARY SEWER LINES
- 12" SANITARY SEWER LINES
- 15" SANITARY SEWER LINES
- 16" SANITARY SEWER LINES
- 18" SANITARY SEWER LINES
- 21" SANITARY SEWER LINES
- 30% DETAILED DESIGN WASTEWATER ALIGNMENT
- FORCEMAIN
- WEST WW LIFT STATION SERVICE AREA BOUNDARY
- EAST WW LIFT STATION SERVICE AREA BOUNDARY

NORTH
1"=3000'

PIPE	PIPE LENGTH	PIPE DIAMETER
MH A – MH B	6,580 LF	15"
MH B – MH C	4,380 LF	12"
MH C – MH D	4,480 LF	12"
MH D – MH E	1,820 LF	12"
MH E – MH F	10,720 LF	8"
MH E – MH G	3,120 LF	12"
MH H – WEST WW LS	4,260 LF	12"
MH A – EAST WW LIFT	1,560 LF	15"
EAST WW LS – MH 20	3,294 LF	10"
TOTAL	40,214 LF	

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PREPARED FOR:
COCHISE COUNTY COCHISE COUNTY / CITY OF DOUGLAS 30% WASTEWATER DETAILED DESIGN
1415 MELODY LAND, BUILDING C
BISBEE, ARIZONA 85603

"POE WASTEWATER SERVICE AREA WASTEWATER COLLECTION SYSTEM"

HORIZONTAL SCALE: AS SHOWN VERTICAL SCALE: N/A

2042 634200

FIGURE 3-1

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3.2 Estimated Wastewater Flow

The 2020 Feasibility Report provided an estimate of the wastewater flows within Planning Areas 1 to 5. These wastewater flow estimates were based on the following criteria: land-use designation, the expected type of development in each land-use designation, and the unit wastewater rate. This criterion was also used to calculate the estimated POE Wastewater Service Area wastewater flows.

Table 3-1 City and County Land-Use Designations Within the Wastewater POE Wastewater Service Area

Planning Area Designation	Land-Use Designation	AZ Administration Code Designation	Average Dry Weather Flow (gallons per day per acre)
1	C- Developing	Commercial / Industrial	600
2	C- Developing	Commercial / Industrial	600
3	B- Developing	Residential	800
4	B- Enterprise	Commercial / Industrial	600
5	B- Developing	Commercial / Industrial	600

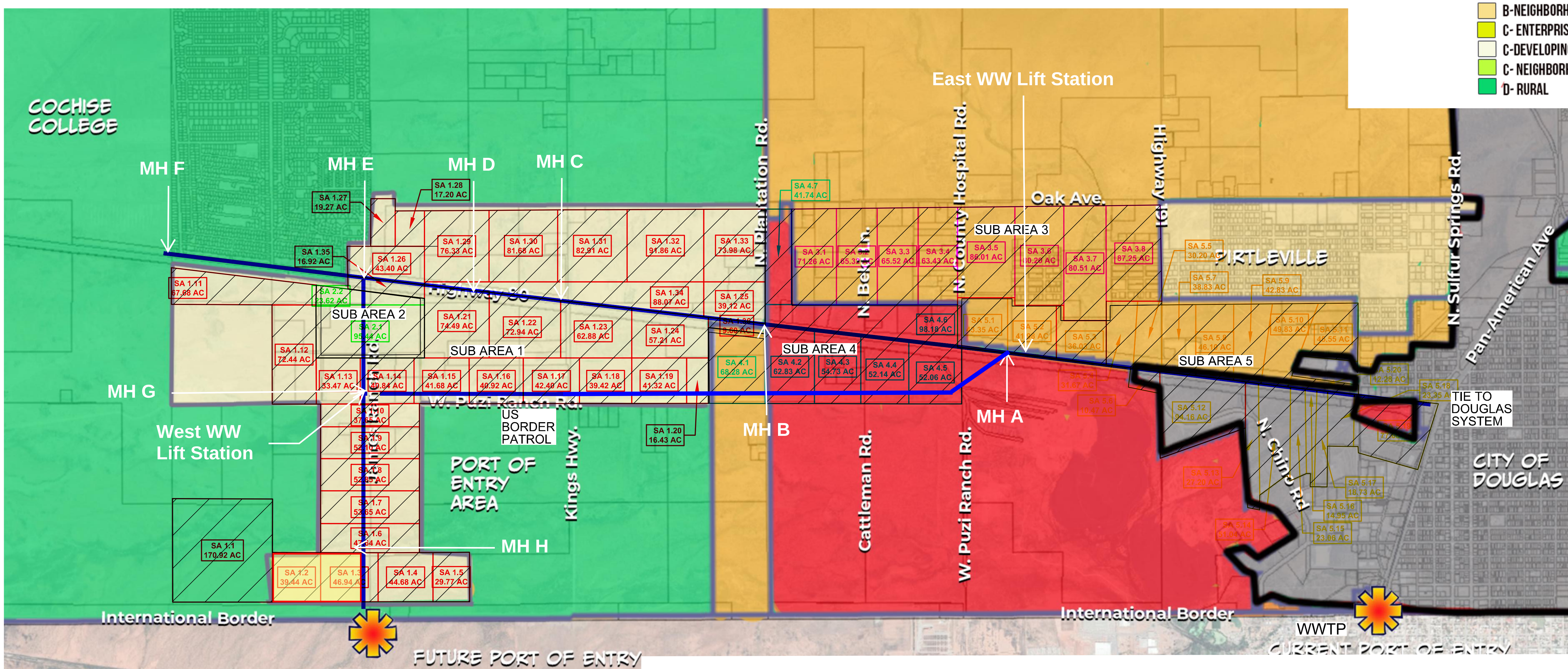
Presently there is very little development in the POE Wastewater Service Area. The percent development of the POE Wastewater Service Area used in the wastewater flow calculations are estimates.

For purposes of this project, Planning Areas 1 to 5 were further divided into subareas. This was done to improve the estimate of the early wastewater flows within the POE Wastewater Service Area in acknowledgement that recognizing the rate of development and wastewater flows will likely take many decades. The subareas and the boundaries of Planning Areas 1 to 5 are illustrated on **Figure 3-2.**

PORT OF ENTRY, U.S. BORDER PATROL AND COCHISE COLLEGE
UTILITY ROUTE, PLANNING AREA AND AVERAGE WATER/WASTEWATER USES

POTENTIAL LAND USE CATEGORY & DESIGNATION

- CITY OF DOUGLAS
- B- ENTERPRISE
- B- DEVELOPING
- B-NEIGHBORHOOD
- C- ENTERPRISE
- C-DEVELOPING
- C- NEIGHBORHOOD
- D- RURAL



LEGEND

- UTILITY PLANNING AREA
- PROPOSED UTILITY CORRIDOR FOR POE AND U.S. BORDER PATROL

Sub Area	Gross Area	Cochise County Land Use Designation	AZ Admin. Code Designation	Domestic Water		Wastewater			
	(acres)			Average[4]	Max Day -2	Per acre wastewater generation rate[1]	Average Daily Design Flow, ADWF (gpd)	Peaking Factor[2]	Peak Flow PDWF (gpd)
				Gals/acre	Gals/acre				
1	1941	C-Developing	Comercial/Industrial	2,717,400	5,434,800	600	1,164,600	2.38	2,771,748
2	103	C- Developing	Comercial/Industrial	144,200	288,400	600	61,800	2.38	147,084
3	609	B-Developing	Residential	852,600	1,705,200	800	487,200	2.38	1,159,536
4	425	B- Enterprise	Comercial/Industrial	595,000	1,190,000	600	255,000	2.38	606,900
5	747	B- Developing	Comercial/Industrial	1,045,800	2,091,600	600	448,200	2.38	1,066,716
SubTotals				**5,355,000**	**10,710,000**		**2,416,800**		**5,751,984**

NORTH

1"=3000'

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PREPARED FOR:

COCHISE COUNTY PROCUREMENT DEPARTMENT
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BISBEE, ARIZONA 85603

UTILITY PLANNING AREA
FOR
DOUGLAS PORT OF ENTRY
DOUGLAS, ARIZONA

2042 584400

HORIZONTAL SCALE: AS SHOWN VERTICAL SCALE: N/A

FIGURE 3.2

DRAWING: u:\2042634200\drawing\exhibit_files\634200c-ex7002.dwg PLOTTED: 4/19/2022 9:17 AM

It is important to note that within the POE Wastewater Service Area, subareas 1.1, 1.6 and 1.7 are in a floodplain zone. These areas are located south of SR 80 and directly north the future port of entry. Although these subareas within the POE Wastewater Service Area are in the floodplain zone, they are still included in the wastewater flow estimate calculations. An illustration of the floodplain zone within the POE Wastewater Service Area can be found in Appendix C.

Table 3-2 Subareas within the Planning Area Summary

Planning Area	Number of Subareas Within Each Planning Area	Comment
1	36	POE Wastewater Service Area to the west of N. Plantation Rd.
2	2	POE Wastewater Service Area between SR 80 and W. Puzzi Ranch Rd, on both sides (east and west) of JRR.
3	6	POE Wastewater Service Area north of SR 80 between N. Plantation Road and Highway 191.
4	7	POE Wastewater Service Area between SR 80 and W. Puzzi Ranch Rd.
5	2	POE Wastewater Service Area east of the East WW LS along SR 80.

The number of subareas shown in **Table 3-2** account for a total of 2,986 acres within the POE Wastewater Service Area. This acreage is less than the total area within the planning area noted in the 2020 Feasibility Report.

The anticipated POE Wastewater Service Area wastewater flows have been calculated in five milestones. The anticipated POE Wastewater Service Area development milestones are as follows:

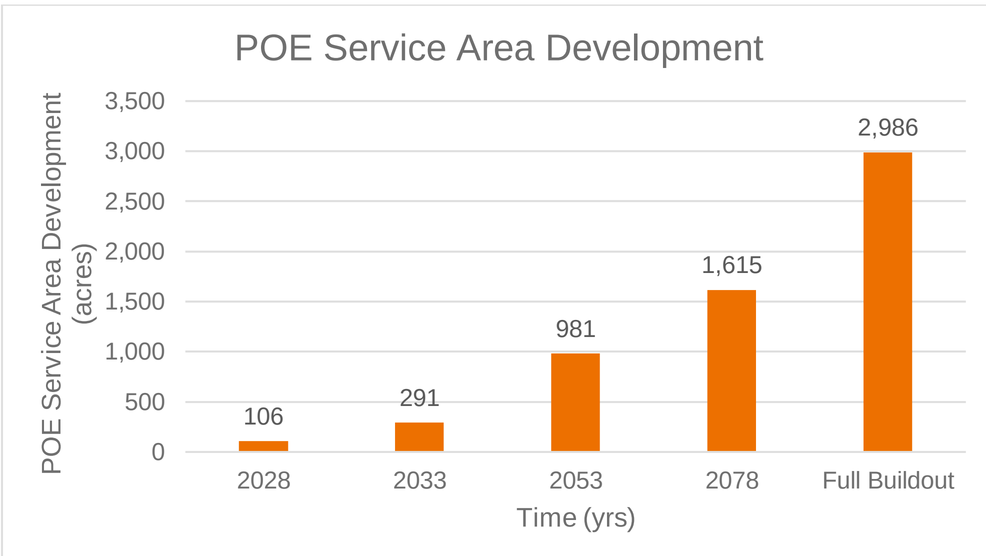
1. Year 2028: The POE placed in operation.
2. Year 2033: Five-years (5) after the POE is placed in operation. The major equipment for the lift stations, the groundwater well, and storage tank were sized for the estimated flow in 2033.
3. Year 2053: Twenty-five-years (25) after the POE is placed in operation and the estimated life expectancy of the East WW LS and West WW LS equipment is reached.

4. Year 2078: Fifty-years (50) after the POE is placed in operation. The pipe diameters were based on estimated wastewater flows and water demands for this milestone. This is the recommended ADEQ planning horizon.

5. Full-Buildout: When land within the POE Wastewater Service Area is 100% developed. A date when this may occur has not been estimated.

Figure 3-3 illustrates the number of acres that are estimated to be developed within each milestone year. It is estimated based on discussions with the County and City planners. It is estimated that 106 acres will be developed in 2028, 291 acres in 2033, 981 acres in 2053, 1,615 acres in 2078 and 2,986 acres in Full-Buildout. The date of Full-Buildout has not been estimated but is based on the assumption that 100% of the service area will be developed.

Figure 3-3 POE Wastewater Service Area Development in Acres



Recommendation:

1. **The City completed a Master wastewater plan covering the collection system and wastewater treatment plant in 2033. This is five years after the projected start of the POE and the POE Wastewater Service Area. The POE and POE Waster Service area start will provide insights into the estimated wastewater flows as discussed in this section and will provide insights to City wastewater system planning for needed improvements.**

The methodology used to estimate the wastewater flows from the POE Wastewater Service Area was to assign an estimated percent development of each subarea per milestone. The percent development of each subarea for each milestone was reviewed with the City and County planners. The estimated percent development per milestone as well as the average day wastewater flow and peak wastewater flow per milestone is summarized in **Table 3-3.**

Table 3-3 Summary of the POE Wastewater Service Area Estimated Wastewater Flows per Milestone

Year	Percent POE Wastewater Service Area Development (acres)	Average Day Wastewater Flow (gpd)	Peak Day Wastewater Flow (gpd)
2028	4%	79,018	188,062
2033	10%	190,144	452,542
2053	33%	719,380	1,712,123
2078	54%	1,200,318	2,856,756
Full-Buildout	100%	2,244,118	5,341,001

The ADEQ permit for the City of Douglas Wastewater Treatment Plant is 2.6 MGD Average Day flow.

The estimated percent POE Wastewater Service Area development in acres was multiplied by the corresponding land-use generation rate to calculate a flow rate. For a commercial or industrial area, the wastewater generation rate is 600 gallons per acre. For residential land-use, a generation rate of 800 gallons per acre is used. These generation rates were noted in the 2020 Feasibility Report and can also be seen in **Table 3-1** above.

Peak wastewater flow was calculated using a peaking factor of 2.8 and multiplied to the average day flow. This peaking factor is from the ADEQ and is based on the Arizona Administrative Code 18-9-E301.

The following example illustrates the approach:

In the year 2028, it was estimated that 20% of subarea 1.1 will be developed. Subarea 1.1 contains 171 acres. The County and City land-use designation for subarea 1.1 is Commercial/Industrial. Based on a unit wastewater rate of 600 gallons per acre per day and 34.2 developed acres (20% of the subarea), average day design flow is estimated to be 20,510 gpd and the peak flow 48,815 gpd.

A complete list of the estimated percent developments by each subarea and wastewater flows per milestone (2028, 2033, 2053, 2078 and Full-Buildout) is summarized in **Appendix D.**

3.3 POE Wastewater Service Area Collection Pipeline Sizing

This section describes the methodology to calculate the POE Wastewater Service Area pipe diameters. To determine the diameters of the pipes, the peak wastewater flows from milestone year 2078 (50 years after the POE startup) were used. During milestone 2078, it is estimated that 54% of the POE Wastewater Service Area will be developed. The determinations for pipe diameters were made using the OpenFlows FlowMaster software. The location of the POE Wastewater Service Area wastewater collection system (including the East and West WW LS) is illustrated in **Figure 3-1.**

The variables input into FlowMaster are seen in **Table 3-4** below.

Table 3-4 FlowMaster

Data Input into FlowMaster	
Variables Input into FlowMaster	**Variable Description**
Roughness Coefficient (n)	The roughness coefficient is dependent on the pipeline wall material, which in this case is PVC. PVC has a roughness coefficient factor of n = 0.013.
Channel Slope (S)	Slope is determined by the pipe length and manhole invert elevation. A summary of the pipe lengths, inverts and elevations is summarized in **Table 3-6**.
Discharge (Q)	Discharge, or flowrate are based on the 2078 peak wastewater flow estimates.
Diameter (d)	The diameters input to FlowMaster were 8”, 10”, 12” 15”, 16” and 18”.

The calculated pipe diameters by FlowMaster are summarized in **Table 3-5**. The inputs and result outputs are summarized **Appendix E**. Based on the minimum velocity of two (2) feet per second (fps) and normal depth results (normal depth results meaning a maximum of 75% of pipe diameter), the pipe diameters were determined for each pipeline segment.

A summary of the recommended pipe diameters for each pipeline segment of the wastewater collection system can be found in **Table 3-5** and **Appendix F.**

Table 3-5 Summary of POE Wastewater Service Area Collection Pipes

Pipeline Segment Identifier	Pipe Diameter (inches)	Pipe Invert Slope	Estimated Peak Wastewater Flow, 2078 (gpd)
MH H – West WW LS	12	0.27%	682,800
MH G - MH E	12	0.25%	983,000
MH F - MH E	8	0.93%	119,000
MH E - MH D	12	0.28%	1,102,000
MH D - MH C	12	0.50%	1,254,800
MH C - MH B	12	0.60%	1,496,400
MH B - MH A	15	0.60%	2,033,900
MH A – East WW LS	15	0.60%	2,541,100

Table 3-6 Summary of Pipe Inverts

Pipe Segments - Invert, Slope, and Total Length				
Pipe Segment	**Pipe Segment Inlet Invert Elevation (feet)**	**Pipe Segment Outlet Invert Elevation (feet)**	**Pipe Segment Length Elevation (feet)**	**Pipe Slope (percent)**
MH H – West WW LS	4040.00	4028.50	4,260	0.27%
MH G - MH E	4039.60	4031.80	3,120	0.25%
MH F - MH E	4133.80	4033.80	10,720	0.93%
MH E - MH D	4031.60	4027.05	1,820	0.25%
MH D - MH C	4026.95	4004.55	4,480	0.50%
MH C - MH B	4004.30	3978.02	4,380	0.60%
MH B - MH A	3977.77	3938.29	6,580	0.60%
MH A – East WW LS	3938.04	3928.68	1,560	0.60%

3.4 Estimated Flow to East and West Wastewater Lift Station

In this POE Wastewater Service Area, there are two wastewater lift stations, the West WW LS and the East WW LS. Their locations are illustrated on **Figure 3-1.**

The West WW LS is located at West Puzzi Ranch Road and JRR. Gravity flows from the POE to the West WW LS. The East WW LS is located at Whitewater draw at the eastern end of SR 80. Whitewater Draw is the lowest elevation along SR 80 between JRR and the City. The total flow from the POE Wastewater Service Area is tributary to this lift station

From the West WW LS, the wastewater is pumped to MH E and then flows east along SR 80. MH E also has an accumulated flow coming from MH F (flow from the southeast corner of Cochise College). Flow from MH E combines with flow from MH D, MH C, MH A which then flows to the East WW LS. There is a pair of high-pressure gas mains that cross SR 80 between MH B and MH A near the East WW LS.

The estimated POE Wastewater Service Area flows for milestone year 2078 is summarized in **Appendix D.4.**

For milestone 2078, the estimated total Peak Day flow to the West WW LS is 682,704 gallons per day. The total Peak Day flow to the East WW LS is 2,856,756 gallons per day. The estimated flows summary projected at the West WW LS and East WW LS Station are presented on **Table 3-7**.

For purposes of this design, the East WW LS and West WW LS masterplans and site areas are based on the 2078 estimated peak flows. Milestone years 2033 and 2053 have been used to size the pumping equipment and site features respectively.

Table 3-7 Wastewater Flows into East and West Wastewater Lift Stations

		2028	2033	2053	2078	Full Buildout
Total Flow into West WW LS	**AVG. Flow,** (gpd)	39,810	108,887	257,584	286,850	345,384
	Peak Flow, (gpd)	94,748	259,151	613,049	682,704	822,014
Total Flow into East WW LS	**AVG. Flow,** (gpd)	79,018	190,144	719,380	1,200,318	2,244,118
	Peak Flow, (gpd)	188,062	452,542	1,712,123	2,856,756	5,341,001

3.5 Wastewater Collection Systems Design Plan and Profile

The SR 80 wastewater collection alignment planned for this project is located from the southeastern corner of the Cochise College Douglas Campus (located at 4190 SR 80, Douglas, AZ 85607), approximately 32,834 ft. east along the northern side of SR 80 to connect to the existing City wastewater collection system. A branch of the wastewater JRR alignment is located approximately 7,380 ft. between the SR 80 and JRR intersection, the north boundary of the POE. The entire length of the wastewater collection line to be installed is approximately 40,214-feet.

The POE Wastewater Collection System 30% Preliminary Design is shown on **Figure 3-1**. The pipe-diameter sizes range from 8-inch, 10-inch, 12-inch, and 15-inch PVC pipes. In total, there are 10,720 linear feet of 8-inch PVC pipes, 3,294 linear feet of 10-inch HDPE pipes, 18,060 linear feet of 12-inch pipes and 8,140 linear feet of 15-inch pipes. Based on MAG standards, there are manholes placed every 500-feet. Within the POE Wastewater Service Area there are 74 manholes.

The service connections to the wastewater collection system along SR 80 and along JRR remain to be identified by the City and County. An approach on how to locate, plan and design service connections on the west and east sides of James Ranch Road between SR 80 and the POE will require collaboration with ADOT during the ADOT James Ranch Road Pre Design Development.

Recommendation:

1. **It is recommended that working with the City and County, the team will locate the service connections be determined and included in the Plan and Profile sheets at the 60% design.**

It is very important that this be done for James Ranch Road for consideration by ADOT in the ADOT James Ranch Road Pre Design Development.

The 30% Preliminary Wastewater Plan and Profile Sheets (appended as **Appendix J – Volume 2**) define the horizonal and vertical locations of the wastewater pipes.

SR 80 Alignment:

1. The following is noted along the SR 80 alignment: The ADOT right-of-way between Cochise College and the connection of the POE Wastewater Service Area at the intersection of SR 80 and SR 191 varies in width. ADOT has granted easements to other utilities located in the right-of-way. The main easement has been granted to APS for a high voltage power line. There is also buried telecom cable in the ADOT right-of-way.
2. Manhole stubs to the north have been left at the intersection of SR 80 at all existing County north/south roads. This includes the North Copper Avenue and County Hospital Road to serve all the existing development in the area of the Old County Hospital that are served by individual on site septic tank systems.
3. The pipe crosses the EPNG high-pressure line in the area of North Copper Avenue.

Recommendation:

1. **It is recommended that the centerline location be reviewed on site with ADOT to confirm the centerline location.**
2. **It is recommended that based on centerline of the POE Wastewater Service Area pipe in the SR 80 right-of-way that a utility locate program and geotechnical investigation be undertaken.**
3. **It is recommended the EPNG gas main be potholed to confirm vertical and horizontal locations.**

James Ranch Road Alignment:

1. There is no existing dedicated right-of-way for JRR. ADOT will retain an engineering consultant in Q1 2023 to work with ADOT to plan the JRR corridor for the intended purpose of vehicle movement from the POE to SR 80.
2. For purposes of the POE Water and Wastewater Service Areas infrastructure development along JRR from SR 80 to the POE, the JRR right-of-way cross section from the 2020 Feasibility Report was used in development of the water, wastewater and broadband conduit location within the right-of-way and the existing contours were used to develop the profiles.
3. The wastewater collection pipe Plan and Profile crosses SR 80 in alignment with an assumed JRR right-of-way. The wastewater collection pipe design approach will have to align with ADOT design approach to the intersection of JRR and SR 80.
4. There is an existing railway right-of way that runs east-west from the City south of SR 80 that is located through what will be the JRR right-of-way. For purposes of this report, the City infrastructure

is within a future ADOT JRR, it is assumed that the ADOT will have an unencumbered JRR right-of-way.

5. There is an APS easement located east-west in the ADOT SR 80 right-of-way. For purposes of this report, the City infrastructure is within a future ADOT JRR. It is assumed that ADOT will have an unencumbered JRR right-of-way.
6. The sanitary sewer crosses the EPNG high-pressure line.

Recommendation:

1. **It is recommended that the City and the County provide support to ADOT during the James Ranch Road Pre Design Development centered on the water, wastewater and broadband conduit including the location of the West WW LS, the manholes and water and wastewater service connections.**
2. **It is recommended that the City and County collaboration include any ADOT plans for the intersection of JRR and SR 80.**
3. **It is recommended that based on centerline of the POE Wastewater Service Area pipe in the JRR right-of-way a utility locate program and geotechnical investigation be undertaken.**
4. **It is recommended the EPNG gas main be potholed to confirm vertical and horizontal locations.**

The manhole identities on the Plan and Profile drawings (**Appendix J – Volume 2**) are different than the identifiers in **Figure 3-1**. The manhole identifiers used in the FlowMaster software were revised in the detailed design to account for the addition of another 60 manholes. The following table (**Table 3-8**) lists manhole identities as seen in **Figure 3-1** and the corresponding nomenclature as seen in the Plan and Profile drawings. **The FlowMaster manhole identifiers are for information only. For purposes of detailed design, the manhole identifiers in the detailed design Plan and Profile are to be used.**

Table 3-8 Manhole Nomenclature

Manhole Identifier Figure 3-1	Corresponding Manhole Identifier - Plan and Profile
MH H – West WW LS	MH 18 – MH 9
MH G - MH E	MH 9 – MH 1
MH F - MH E	MH 92 – MH 1
MH E - MH D	MH 1 – MH 64
MH D - MH C	MH 64 – MH 55
MH C - MH B	MH 55 – MH 45
MH B - MH A	MH 45 – MH 32
MH A – East WW LS	MH 32 – MH 27

East WW LS Force Main Crossing of Whitewater Draw:

The proposed wastewater force main alignment will be routed on the north side of SR 80 over Whitewater Draw to a point of connection to the City wastewater collection system at the north east intersection of SR 80 and SR 191. It is not recommended that the force main pipe go under the Whitewater Draw channel, which has a vertical difference of about 15 feet to 20 feet. This is suggested due to probable long term and reoccurring issues with East WW LS and force main operations, specifically pipe plugging with settled wastewater solid when the East WW LS is not in operation. Rather it is recommended that the force main maintain a constant increasing grade between the East WW LS and the connection to the City wastewater collection system. This would mean an elevated crossing over Whitewater Draw.

One option is the wastewater line could be attached to the existing ADOT bridge crossing Whitewater Draw. However, Paragraph 1.7.2 of *ADOT Guideline for Accommodating Utilities on Highway Rights-of-Way (August 2015)* states.

"A new utility will not be permitted to be installed on, within, or through an existing bridge after the time the highway route is improved, except in existing ducts or for special cases."

ADOT was approached to understand if this force main could qualify as a special case and be attached to the existing ADOT bridge over Whitewater Draw. ADOT denied the request for consideration to attach the proposed wastewater line to the existing bridge.

Consequently, a new wastewater pipe supported on a utility pipe bridge will need to be constructed to support the wastewater pipe crossing Whitewater Draw.

It is likely that the City may extend at some separate date the City watermain from the west City boundary to provide water service to the City and County identified developable lands along SR 80. Consideration for locating the watermain crossing on the utility bridge over Whitewater Draw should also be made.

Recommendation:

1. **It is recommended this "wastewater pipe bridge" design over Whitewater Draw, and any river/creek hydraulic and analysis design of piers associated with Whitewater Draw, be completed as part of the 60% design phase. This will include geotechnical investigation for pier design, location of piers, and design of the pipe bridge.**

3.5.1 WASTEWATER COLLECTION SYSTEM PIPE AND MANHOLE DESIGN CRITERIA

The final detailed wastewater plans, and specifications will be in alignment with the following reference standards:

1. ADEQ Engineering Bulletin No. 11 – Minimum Requirements for Design, Submission of Plans and Specifications of Sewage Works, July 1978
2. Maricopa Association of Governments (MAG) Standard Specifications and Details, 2022. The City and County have adopted these documents for water and wastewater conveyance design.
3. Pima County Regional Wastewater Reclamation Department, Engineering Design Standards 2022
4. ADOT Guidelines for Accommodating Utilities on Highway Rights-of-Way, August 2015
5. ADEQ Engineering Review Notice of Intent to Discharge (NOI) Sewage Collection System (4.01 GP), April 2020
6. City Subdivision Code and Engineering Design Standards Manual, February 2008

Other standards may be applied to the design as needed.

The following specific design criteria were used in the wastewater collection infrastructure design:

1. Wastewater pipes shall have a minimum pipe diameter of 8-inch and service connections between the wastewater pipe and the property lines connected to the wastewater collection system shall be a minimum of 4-inch. The service connection locations are to be determined by the City and County.
2. Wastewater pipes shall be installed with a minimum cover of 36-inch where in areas of no vehicle traffic and where in vehicle traffic the cover should be determined for the soil condition to accommodate traffic loading.
3. Wastewater pipes shall have a minimum horizontal separation of 6-feet from outside of pipe to outside of adjacent utility
4. Wastewater pipes shall have a minimum vertical separation from water lines that complies with Tucson Water Standard Detail SD-106

5. Wastewater pipes shall have a minimum vertical separation of 12-inch from outside of pipe to outside of electric, telephone, fiber, gas, etc.
6. Wastewater pipes shall be PVC (ASTM D3034 SDR 35 or less). Ductile iron pipe with an approved lining may also be used.
7. Manholes shall be located at all grade changes, size changes, alignment changes, sewer intersections, and meet the maximum spacing criteria that follows. Manholes with 8-inch stubs out 5-feet from the manhole wall were located at all the existing north south County Road right-of-way along SR 80.

Table 3-9 Pipe Diameters and Manhole Spacing

Sewer Pipe Diameter (inches)	Maximum Manhole Spacing (feet)
Less than 8	400
8 to less than 18	500
18 to less than 36	600
36 to less than 60	800
60 or greater	1300

- Manhole invert drops across a manhole may be required for certain slopes for inlet and outlet pipes with the same diameter. Horizontal deflection angles and their corresponding invert drops are as per the Pima County Regional Wastewater Reclamation Department, Engineering Design Standards 2022 Table 5.5 and can be seen in **Figure 3-4** below.

Figure 3-4 Pima County Engineering Design Standards 2022 - Required Manhole Invert Drops

Table 5.5
Required Manhole Invert Drops
(Inlet and Outlet Pipes with Same Diameter)

Horizontal Deflection Angle	Invert Drop (feet)
0 to 9 degrees	Maintain Average Slope of Incoming and Outgoing Sewer Lines through Manhole; or Invert Drop = Manhole Diam. in feet x $(S_1 + S_2)/2$ Where: S_1 = Slope of incoming Reach S_2 = Slope of outgoing Reach
10 to 45 degrees	0.10
46 to 90 degrees	0.20

Recommendations:

1. **It is recommended that the coordinate locations of wastewater service connections with City and County be included on the Plan and Profile drawings along SR 80 and JRR.**

2. **It is recommended that locations of the proposed wastewater infrastructure in JRR be located on the Plan and Profile drawings based upon coordination assistance efforts by the City, County, and ADOT.**

3.6 Connection of POE Wastewater Service Area and City of Douglas Wastewater Collection System

The POE Wastewater Service Area flows are conveyed to the East WW LS. From there it is pumped through a 10-inch diameter, 3,300-foot-long force main to discharge at the City's manhole number MH 20 Sta 69+28.48 located at the northeast corner of the intersection of SR 80 and SR 191. According to the Willdan Associates Sheet 8 dated 4/1/82, the inlet and outlet pipes are 12-inch diameter PVC with the inlet invert elevation at 926.6-feet, the outlet invert elevation 926.51-feet and the rim elevation of 940.80-feet.

Recommendation:

1. **It is recommended that the design of the POE East WW LS force main connection to the City wastewater collection system be undertaken in close consultation with the City.**

3.6.1 EXISTING WASTEWATER SYSTEM CAPACITY BEWTEEN POE AND WWTP

The City provided the Willdan Associates design drawings dated April 1, 1982 of the existing gravity collection system sewer between manhole number MH 20 Sta 69+28.48 and termination at the City's

WWTP. The pipe varies in diameter from 12-inch diameter increasing to 15-inch diameter closer to the WWTP. The 15-inch diameter pipe crosses a wash on an elevated steel trestle structure in the vicinity of the WWTP. It is reported that the trestle had structural problems that were repaired by the City. It still remains a City concern.

The City does not have documentation from 1982 on the design hydraulic capacity of the referenced existing gravity sewer. For purposes of this report the design hydraulic capacity was estimated by calculating the ¾ flow capacity using for the minimum pipe slope in the 12-inch diameter section of 0.40% and for minimum pipe slope for the 15-inch diameter section of 0.1%. The assumed roughness coefficient (n) used was 0.013.

It was calculated that the 75% flow capacity of the existing 12-inch pipe at referenced pipe section is 1.3 MGD and the 75% flow capacity of the existing 15-inch pipe flowing in the referenced pipe section is 1.2 MGD. The latter pipe section is minimum pipe slope in the referenced pipe section and is the controlling maximum flow.

This existing wastewater flow at City MH 20 starts at BDIA and includes a connection from the State of Arizona Prison. The average day flow from the prison is reported by the City is between 250,000 gpd to 260,000 gpd. The sewer from Pirteville/La Perilla Estates area is also connected to this pipe prior to MH 20 as is the Old County Hospital Building. The City assumes the average day flow ranges from 100,000 gpd to 150,000 gpd. For purposes of this report, this will be referred to as the BDIA Wastewater Collection Service area. The City indicated there are no other wastewater connections upstream of MH 20. The POE Wastewater Service Area flow will combine with these two flow streams at MH 20.

Table 3-10 Total Flow to the City WWTP Between MH 20 and the WWTP

Milestone	Average POE Service Area WW Flow (gpd)	Average BDIA Service Area Average Day Flow Range (gpd)	Average BDIA Service Area Average Day Flow (gpd)	Total Flow into Wastewater Treatment Plant (gpd) *
2028	79,018	350,000 – 410,000	380,000	459,018
2033	190,144	350,000 – 410,000	380,000	570,144
2053	719,380	350,000 – 410,000	380,000	1,099,380
2078	1,200,318	350,000 – 410,000	380,000	1,580,318
Full Buildout	2,244,118	350,000 – 410,000	380,000	2,624,118

*Total averaged day flow of the estimated POE Wastewater service Area and the BDIA Wastewater Service Area

For purposes of this report the BDIA Wastewater Service Area existing flow is 380,000 gpd. The estimated controlling capacity of the existing City sanitary sewer downstream of City MH 20 is 1.2 (15-inch diameter at 0.1%). By comparison, the existing City BDIA Service Area City flow of 380,000 gpd (average of 350,000 gpd and 410,000 gpd) plus the predicted POE Wastewater Service Area flows suggests that the existing pipeline has adequate capacity to handle the combined flows up to milestone 2053. The City should review this analysis before allowing additional connections to the City wastewater collection pipe upstream of City MH 20.

Recommendation:

1. **It is recommended by 2033 that the City undertake a review of the pipe hydraulic capacity between the City MH 20 and WWTP and future growth within the BDIA Wastewater Service Area. This is needed to ensure that total flow to the WWTP, including flow from the POE Wastewater Service Area, can be accommodated by the existing sewer.**
2. **It is recommended that a condition assessment be completed of the elevated steel trestle structure located at a wash in the vicinity of the WWTP that supports the existing 15-inch diameter wastewater pipe that the POE Wastewater flows will be conveyed to.**
3. **It is recommended that a BDIA flow metering program at City MH 20 be undertaken in 2022 to confirm the existing BDIA flows through MH 20. This would involve installation of a flow monitoring device in the MH 20.**

3.6.2 WWTP HISTORIC FLOWS

The City recently completed an upgrade to the City's WWTP. Improvements were substantially complete May 21st 2020. The upgrade of the wastewater treatment plant is known as the '2016 – 2020 Improvements Program (the WWTP Upgrade)'.The program upgrades included two new oxidation ditches, a new secondary clarifier, a new RAS/WAS Pump Station, retrofitting the existing RAS/WAS Pump Station, and converting the existing two aeration basins.

The historic annual average day flow and maximum average day flows are summarized in **Table 3-11**. The average annual day City WWTP metered flow was 1.961 MGD in 2019, decreased in 2020, and decreased again in 2021 to 1.591 MGD. The City did not have an explanation for the observed decrease between 2019 to 2021.

Table 3-11 Summary of Wastewater Plant Treatment Flows

Year	Average Annual Day Flow to WWTP (MGD)	Average Day Maximum Month Flow to the WWTP (MGD)	Ratio Average Day Maximum Month to Average Annual Day (MGD)
2019	1.961	2.271 - November 2019	1.2
2020	1.924	2.236 - August 2020	1.2
2021	1.591	2.139 - January 2021	1.3

3.6.3 EXISTING WASTEWATER TREATMENT PLANT CAPACITY

The August 29th 2016 CDM Final Basis of Design Report entitled 'The City of Douglas WWTP Upgrade to 2.6 MGD' details the process capacity after the WWTP Upgrade. The design planning period of 20 years was 2015 and 2035. The average day design flow of 2.6 MGD was established for design purposes. The WWTP influent flow was expected to reach 85% of the design flow in the year of 2020. As noted above it has not. **Table 3-12** is a summary of the key WWTP upgrade flows as part of the Improvements Program design flows.

Table 3-12 Wastewater Treatment Plant Upgrade Design Flow Summary

Average Annual Day Design Flow (MGD)	Max. Month Factor	Max. Month Flow (MGD)	Peak Hour Factor	Peak Hour Flow (MGD)	APP Alert Level (MGD)	Planning Action Level (MGD)
2.6	1.2	3.1	1.4	4.3	2.9	2.6

Prior to completion of the improvement program, WWTP discharged effluent meeting Class C reclaimed water standards as per Arizona Administrative Code (A.A.C.) R18-11-307 across the border into Mexico to a 240-acre community farm. After the upgrade, the WWTP continues to discharge effluent at the existing point of discharge. The existing point of discharge to Mexico is located at 31° 19' 14" N (Latitude) and 109° 34' 17" W (Longitude).

3.6.4 IMPACT TO EXISTING WASTEWATER TREATMENT PLANT CAPACITY FROM POE WASTEWATER SERVICE AREA

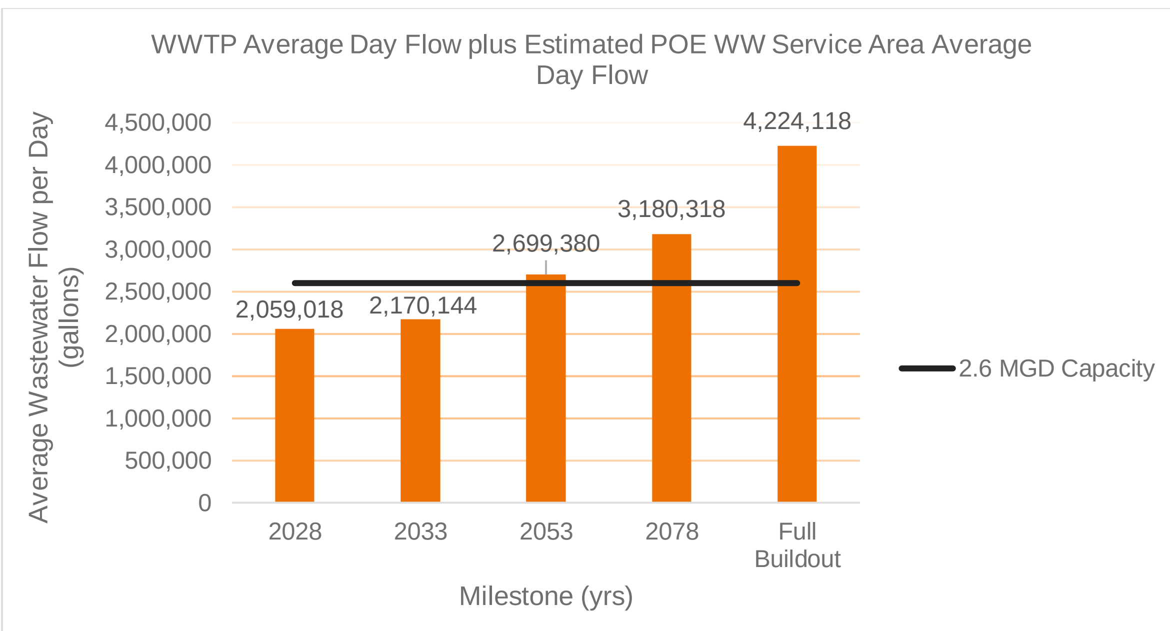
Permission of EPA through SEAGO (South-East Arizona Government Organization) will be needed to connect the POE Wastewater Service Area to the City wastewater collection system and the WWTP.

The ADEQ permit for the City Wastewater Treatment Plant is 2.6 MGD average day flow. The estimated average annual day flow from the POE Wastewater Service Area to the City's WWTP in 2028 and 2033 as discussed earlier is .079 MGD and 0.190 MGD respectively. Based on the 2021 WWTP average annual day flow of 1.6 MGD, the estimated wastewater flow into the WWTP within the POE Wastewater Service Area is estimated to be 2.06 MGD in 2028, 2.17 MGD 2033, and 2.70 MGD in 2053.

Figure 3-5 illustrates the 2021 average day flow to the wastewater treatment plant of 1.6 MGD plus the estimated flows from the POE Wastewater Service Area. This analysis does not include the impact of the possible growth in the BDIA Wastewater Service Area average day flow. From this analysis, the wastewater treatment plant has the capacity to accommodate the increase in the average day flow from the POE Wastewater Service Area to after years 2033 – 2040.

This will depend on the rate of growth in land development in the POE Wastewater Service Area.

Figure 3-5 2021 WWTP Average Day Flow + Estimated POE WW Service Area Average Day Flow



Recommendation:

1. **The City will have to receive permission of the EPA / Southeast Arizona Government Organization (SEAGO) to connect the POE Wastewater Service Area to the City's WWTP. It is recommended that the City and County submit a request to SEAGO during development**

of the 60% Detailed Design for permission to connect the POE Wastewater Service Area to the City's WWTP based on the above analysis.

2. **It is recommended that the City undertake a WWTP Master Plan update prior to 2033 that evaluates the rate of flow increase or decrease to the WWTP, including from the POE Wastewater Service Area, to develop a potential expansion plan to the WWTP possibly in the period 2033 to 2040.**

3.7 East and West WW Lift Stations

This section details the general location, design criteria, and phasing recommendations for the POE Wastewater Service Area development milestones and the collection system design life estimated for the year 2073. The preliminary design calculations are based on the estimated design flows detailed in **Table 3-3** in **Section 3.2** and were used to size the pumps, wetwells, and other major pump station components. The following presents the preliminary design data or criteria for both the West Wastewater Lift Station (West WW LS) and the East Wastewater Lift Station (East WW LS). This preliminary data is based on the best available information which will need to be verified and assessed further during future detailed design.

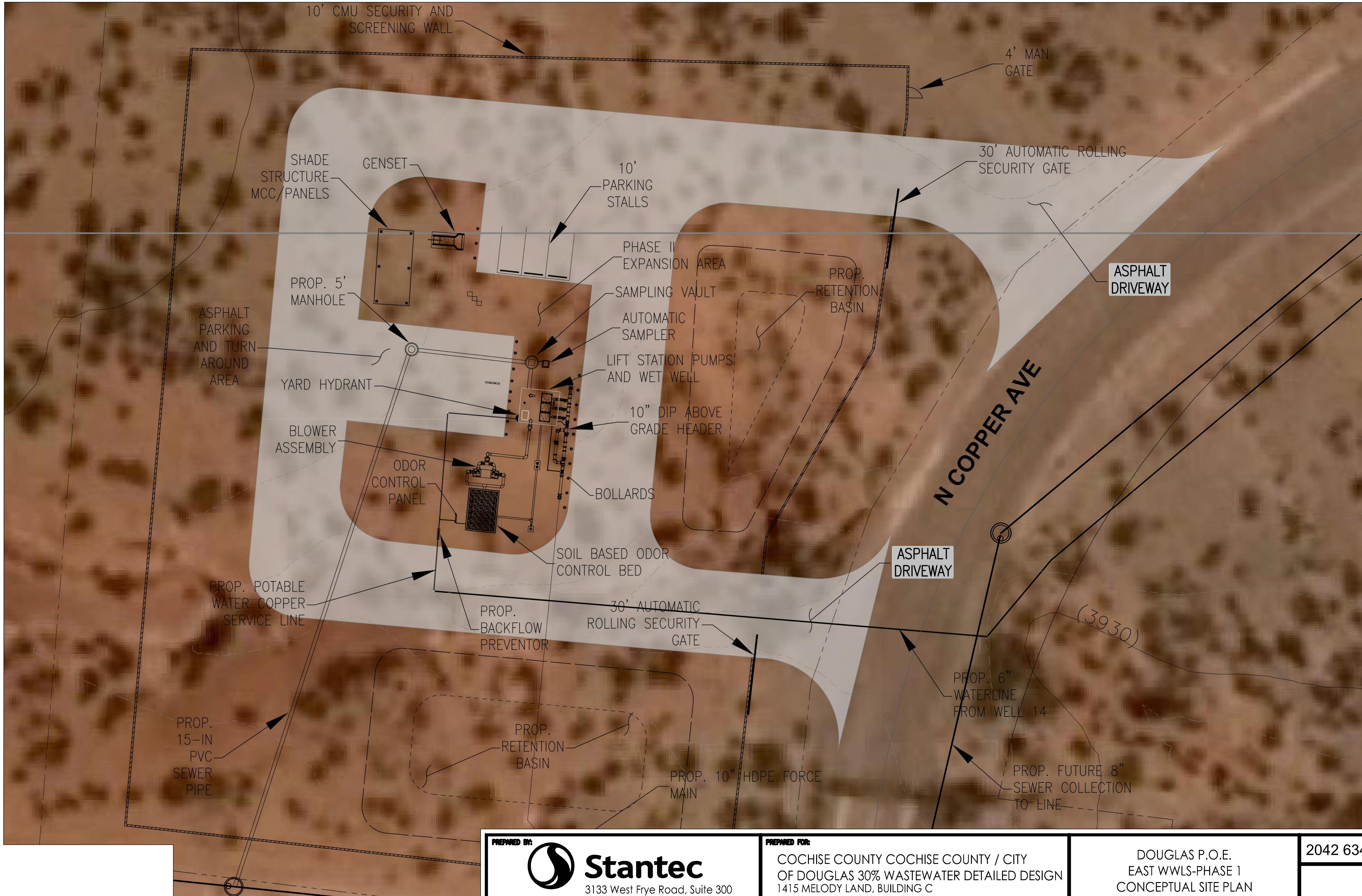
3.7.1 LIFT STATION LOCATION

There are two lift stations in the POE Wastewater Service Area; the West WW LS (**Figure 3-7**) located at the intersection of East Puzzi Ranch Road and JRR, and the East WW LS (**Figure 3-6**), located at the intersection of Copper Road and SR 80 on the east side of Whitewater Draw. The West WW LS will service the POE facilities and the East WW LS will connect to the existing BDIA Wastewater Service Area directly and the overall Douglas collection system via force main. More detail can be seen in the Plan and Profile Drawing Set in **Appendix J – Volume 2**. A specific site for each pump station has yet to be obtained by the City of Douglas. Acquisition of property for both lift station sites will need to be completed before the 60% POE Water and Wastewater Detailed Design can be finalized. The sites recommended for the lift stations are based upon estimated area needed to accommodate peak flows for initial POE construction and future phased milestone peak flow upgrades.

It is recommended that the West WW LS be located on what will be the northeast corner of East Puzzi Ranch Road and JRR. The property would consist of acquiring 2.1 acres in the southwest corner of the 10.06-acre parcel # 40801012. The parcel is zone RU-4 for Rural with a minimum lot size of 4 acres. These districts allow residential uses on large acreage, as well as some other uses typically found in rural areas. In addition, a wide range of commercial and industrial activities are also possible as Special Uses, which require a public hearing and approval by the Planning and Zoning Commission. The lot is naturally favorable for a lift station site as it has mild slopes between 0.5% and 0.8% so it has good drainage. Its higher than the land to the south so not susceptible to flooding and may not require significant cut and fill. A trio of natural gas transmission mains and associated easement exist to the south adjacent and parallel to the Puzzi Ranch Road alignment. Thus, it is recommended that any acquisition in this area be at least 50-feet from the existing pipeline easement boundary. Alternatively, should acquisition or design issues arise with the recommended site, the northwest corner of JRR and Puzzi Ranch Road is also suitable for lift station construction for many of the same parameters as the recommended site.

It is recommended that the East WW LS be located on the northwest corner of SR 80 and North Copper Avenue. The property would consist of acquiring 2.7 acres in the southeast corner of the 102.21-acre parcel # 40816990E2. The parcel is zone R-36, for Residential with a minimum lot size of 36,000 square feet, so rezoning of the parcel for municipal use may be necessary. The site is outside the Zone AE flood plain that exists on the east side of Copper Ave and its proximity to SR 80 makes maintenance accessibility favorable. There is a high-pressure gas main easement in proximity to the site but does not appear to be a mitigating factor for the initial design of the lift station, however, it may need further evaluation.

There is an alternative site for the East WW LS that can be considered in the event that there is a conflict between the gravity sewer design and where the afore referred gas mains cross SR 80 (see **Section 3.4**) or the Copper Road site is deemed unsuitable. The acquisition of 2.5 acres at the southeast corner of the 33.07-acre parcel # 40816009F is the secondary location for the lift station. This location would allow and extension of the 10-inch diameter HDPE force main which can be routed around the conflict without the same technical concerns as the 15-inch gravity main. Like the first parcel, this parcel is zone R-36, for Residential with a minimum lot size of 36,000 square feet, so rezoning of the parcel for municipal use may be necessary.



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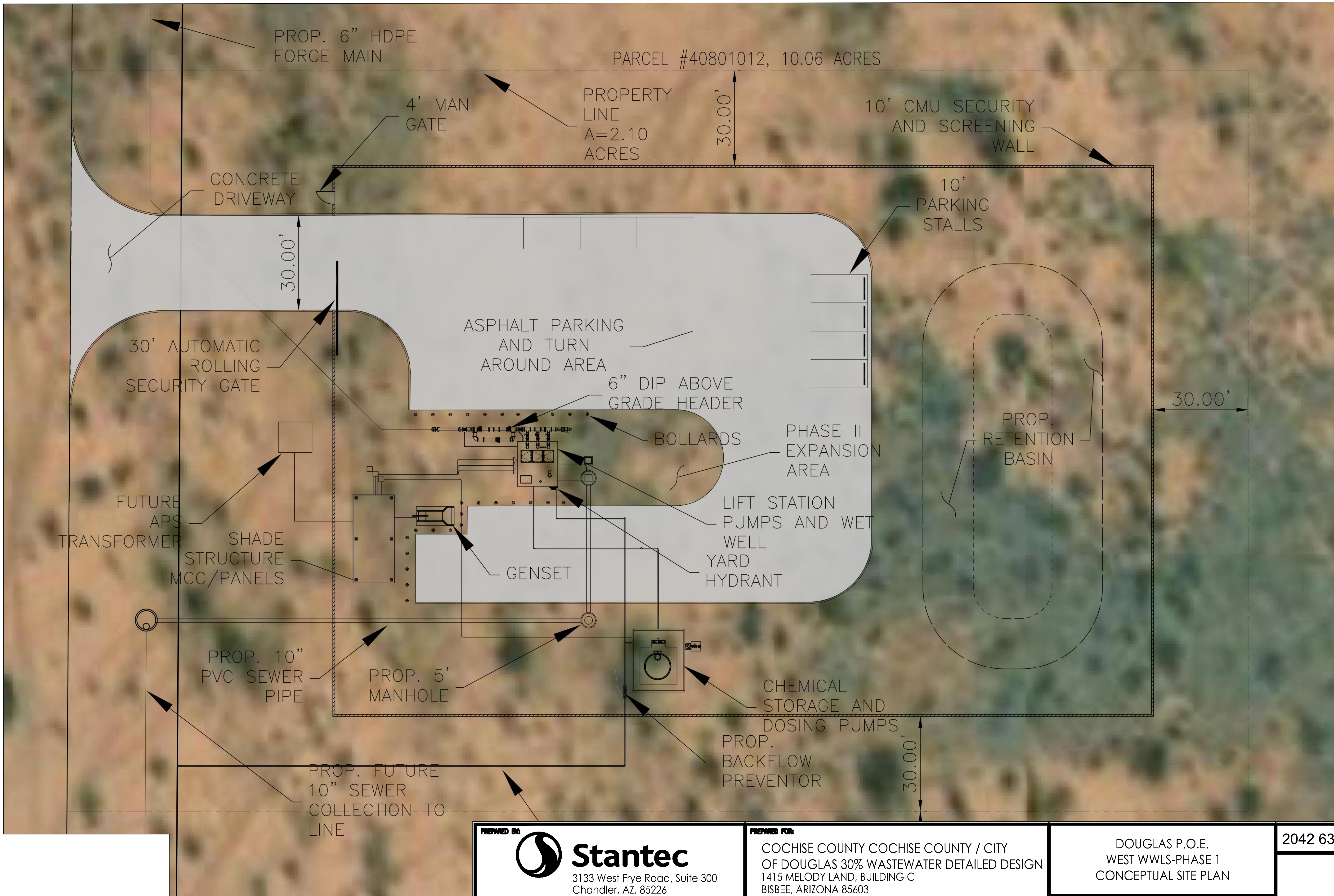
DOUGLAS P.O.E.
EAST WWLS-PHASE 1
CONCEPTUAL SITE PLAN

2042 634200

HORIZONTAL SCALE: AS SHOWN VERTICAL SCALE: N/A

FIGURE 3.6



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DOUGLAS P.O.E.
WEST WWLS-PHASE 1
CONCEPTUAL SITE PLAN

2042 634200

HORIZONTAL SCALE: AS SHOWN VERTICAL SCALE: N/A

FIGURE 3.7

3.7.2 LIFT STATION DESIGN CRITERIA

The design of for both the West WW LS and the East WW LS shall adhere to the criteria set forth in the Arizona Administrative Code (AAC) Title 18, Chapter 9, Section E301 and the Arizona Department of Environmental Quality (ADEQ) Engineering Bulletin 11, Chapter V: Sewage Pump Stations.

Due to the wide variation in design flow requirements for the West WW LS and the East WW LS during the years 2028 to 2078, the construction of the lift stations is recommended to be phased. The phasing of the design will be limited to conveying flows to 25 years (2053, Phase I) and 50 years (2078, Phase II). It is assumed that any increase in the rate of development around 10 to 15 years above what is anticipated may require upgrades at that time, well before the Phase I expiration of the 25-year design life. This suggests the flow rates for both lift stations will need to be carefully monitored from startup to buildout for rate increases that will trigger the site upgrades. These “trigger” flow rates may occur before or after the planned 25-year and 50-year phasing. Therefore, both lift stations should be upgraded to Phase II design (50-year) when it is determined that imminent planned development will exceed a “trigger” flow rate. The “trigger” rates have been chosen to allow adequate time for design and construction to be completed before Phase I capacity is exceed. These “trigger” flow rates have been calculated as 90% of the Phase I peak flow pumping capacity.

Recommendation:

1. **Due to the wide variation in design flow requirements for the West WW LS and the East WW LS during the years 2028 to 2078, the construction of the lift stations is recommended to be phased. The phasing (Phase 1) for purposes of this report is development of the two site master plans and designs limited to conveying flows to 25 years (2053 Phase I). The next phase (Phase 2) for conveying flows matching the 50-year period is (2078 Phase II). It is recommended that the flow rates for both lift stations must be carefully monitored by the City from startup to buildout for rate increases that will trigger the site upgrades. These “trigger” flow rates may occur before or after the planned 25-year and 50-year phasing.**

3.7.3 WEST WASTEWATER LIFT STATION (WEST WW LS)

The West WW LS Phase I design is based on the proposed minimum and maximum flow rates from startup to 25 years of operation (see **Section 3.4**). The minimum design flow is the projected startup average flow of 28 gpm and the maximum design flow is the projected peak flows of 430 gpm in the year 2053. The Phase I design period is intended to be 25 years, however, because development may proceed at a rate higher than expected, Phase II design may be needed before the 25-year threshold. When the average daily flow into the West WW LS reaches an average “trigger” flow rate of 236,160 gpd (164 gpm) or a peak flow of 561,600 gpd (390 gpm) the Phase II design process should begin. Pump capacity and head calculations for the Phase I West WW LS design are provided in **Appendix G.1**.

3.7.3.1 Pumps

The pumps for the West WW LS will be designed for operation at an initial minimum discharge rate of 220 gpm for the lead pump with a 220 gpm lag pump flow for a maximum design discharge of 440 gpm. Because of the medium flow and head needs, three (3) 5 HP non-clog submersible centrifugal sewage pumps (2 duty + 1 standby) are proposed to meet both design flow and head requirements. This design flow range allows one pump to handle most the expected low flows early in the operational life cycle and estimates 26 foot head requirement through the 25-year Phase I lifespan based on the flow estimates presented in **Section 3.4**. The estimated total dynamic head (TDH) for the pumps are 23-feet at 220 gpm and 25-feet at 440 gpm. These TDH values will need to be verified and finalized during detailed design.

All pumps will be equipped with a “soft-start” switch to accommodate the flow and head ranges for maintaining the pumps in operation under normal conditions. Each of the pumps are also equipped with flushing valves for mixing the wet well to control scum formation and re-suspend settled solids when the pump turns on. The pump motors and other electrical components within the wetwell and classified hazardous areas will be explosion proof rated per NFPA 820.

3.7.3.2 Piping

The recommended material for the West WW LS piping is 6-inch Class 50, concrete-lined, Ductile Iron Pipe (DIP) for the pump discharge piping and the above ground header piping with 6-inch DR 17 High Density Polyethylene pipe (HDPE) for the buried force main. The Phase I design consists of approximately 347-feet of piping: 25-feet for each 6-inch diameter DIP pump discharge, 30-feet of 6-inch diameter DIP above grade header, and 292-eet of 6-inch diameter HDPE buried force main to the discharge point at Manhole G.

The estimated flowing velocity in the 6-inch HDPE force main is 2.67 fps with the minimum design flow of 220 gpm and 5.35 fps at the max flow rate of 440 gpm. The estimated flowing velocity in the header pipe is 2.28 fps at design minimum flow of 220 gpm, and 4.56 fps at maximum pump design flow of 430 gpm. For each individual 6-inch pump discharge pipe, the estimated flow velocity is 2.28 fps at design minimum flow of 220 gpm and maximum flow rate of 440 gpm.

It is recommended the 6-inch discharge piping each have a swing check valve, pressure gauges, and a plug valve for isolation. The 6-inch header should be installed above ground to facilitate the accessibility of the discharge appurtenances, have an access point for cleanout, and transition underground to the discharge point. The velocities at the minimum flow condition in the above ground header and force main are 2.28 fps and 4.56 fps respectively. The recommended velocity for pressure pipe design is between 3.0 fps and 7.0 fps. Though a flow velocity of 2.0 fps is usually adequate for flushing velocity to prevent deposition of solids a maintenance program of periodic flushing of the lift station piping would be prudent to ensure functionality of the system for the first five years of operation.

3.7.3.3 Wetwell

Based on the three-pump configuration, a rectangular wetwell is recommended for the West WW LS. Based on preliminary design data, the wetwell will be 14-feet in length, 12-feet in width, with a depth of approximately 23-feet. At startup in 2028, wastewater flows the wetwell will fill to minimum volume in 20 minutes, well under the ADEQ required 30 minutes, however, as the inflow into the wetwell increases over time that fill time decreases significantly and it may be necessary to adjust the water surface elevations for pump start and stop commands to keep pump starts at the designed level of 7-8 per hour, and under the manufacturer recommended 15 per hour. Radar level sensors are recommended for monitoring wetwell water levels and pump control with hydrostatic sensors and float controls for redundancy.

The wetwell will be constructed of lined cast-in-place concrete or a precast polymer concrete with aluminum access hatches with a fall safety protection system. The final determination of wetwell construction material will be assessed during detailed design depending upon assessed soil conditions, wastewater contents, and cost. The polymer concrete is significantly more expensive than the cast-in-place with liner but requires little to no maintenance for corrosion over the lifetime of the lift station compared to cast-in-place concrete.

3.7.4 EAST WASTEWATER LIFT STATION (EAST WW LS)

The East WW LS Phase I design is based on proposed minimum and maximum flows from startup to 25 years of operation (see **Section 3.4**). The minimum flow is the projected average flow of 55 gpm at the startup and the maximum flow is the projected peak flow of 1,200 gpm in the year 2053. Like the West WW LS, Phase I is intended to reach 25-years of service but development rates may require a move to Phase II before the 25-year threshold. When the average daily flow into the East WW LS reaches a “trigger” flow rate of 653,750 gpd (454 gpm) or a peak flow of 1,555,200 gpd (1,080 gpm) the Phase II design process should begin. Pump capacity and head calculations for the East WW LS can be viewed in **Appendix G.2**.

3.7.4.1 Pumps

The pumps for the East WW LS are designed for operation with a single pump minimum discharge rate of 350 gpm, a single pump maximum discharge rate of 700 gpm, and total maximum discharge rate of 1,350 gpm. Because of the wide flow and head needs, three (3) 45 HP non-clog submersible centrifugal sewage pumps (2 duty + 1 standby) are proposed to meet both design flow and head requirements. This design flow range allows a single pump to handle most of the expected flows through the first 15 years of service and estimates a 117-foot head requirement through the 25-year Phase I lifespan based on the flow estimates presented in **Section 3.4**. The estimated total dynamic heads (TDH) for the pumps are 76-feet at the minimum flow rate of 350 gpm, 89-feet at a flow rate of 700 gpm, and 115-feet at the maximum flow rate of 1,350 gpm. These TDH values would need to be verified and finalized during detailed design.

All pumps will be equipped with three-phase variable frequency drive (VFD) to accommodate the flow and head ranges for maintaining pumps in operation under normal conditions. Two of the pumps will also be equipped with flushing valves for mixing the wet well to control scum formation and re-suspend settled solids when the pump turns on. The pump motors and other electrical components within the wetwell and classified hazardous areas will be explosion proof rated per NFPA 820.

3.7.4.2 Piping

The recommended material for the East WW LS piping is 6-inch Class 50, Concrete-lined, DIP for the pump discharge piping, 10-inch Concrete-lined, DIP for the above ground header piping, and 10-inch DR 17 High Density Polyethylene pipe (HDPE) for the buried force main. The Phase I design consists of approximately 3,540-feet of piping: 25-feet for each 6-inch diameter DIP pump discharge, 30-feet of 10-inch diameter DIP above grade header, and 3,435-feet of 10-inch diameter HDPE buried force main from the lift station to the discharge point at City of Douglas MH 20.

The estimated flowing velocity in the 10-inch HDPE force main is 1.62 fps at the minimum flow rate of 350 gpm, 3.23 fps at the individual pump max of 700 gpm, and 6.23 fps at the lift station max flow rate of 1,350 gpm. For each individual pump discharge pipe, the estimated flowing velocity is 3.63 fps at the design minimum flow of 350 gpm, 7.25 fps at single pump max flow of 700 gpm, and 7.00 fps at the total max design flow of 1,350 gpm. The estimated flowing velocity in the above grade header pipes is 1.32 fps at the design minimum flow of 350 gpm, 2.65 fps at single pump max flow of 700 gpm, and 5.10 fps at the max design flow of 1,350 gpm.

It is recommended the 6-inch discharge piping each have a swing check valve, pressure gauges, and a plug valve. The velocities at the minimum flow for the 6-inch pump discharge piping and the 10-inch buried force main are acceptable (recommended is between 3.0 fps and 7.0 fps) however the velocity in the 10-inch header pipes at minimum flow is low so a maintenance program of periodic flushing may be required to ensure the functionality of the system through the early years of operation.

3.7.4.3 Wetwell

Based on the three-pump configuration, a rectangular wetwell is recommended for the East WW LS. Based on preliminary design data, the wetwell will be 14-feet in length, 12-feet in width, with a depth of approximately 16-feet. At startup, wastewater flows the wetwell will fill to minimum volume in 16 minutes, well under the ADEQ required 30 minutes. However, as the inflow into the wetwell increases over time that fill time decreases significantly and it may be necessary to adjust the water surface elevations for pump start and stop commands to keep the manufacturer recommended starts under 15 per hour.

The wetwell will be constructed of lined cast-in-place concrete or a precast polymer concrete with an aluminum access hatches with a fall safety protection system. The final determination of wetwell construction material will be assessed during detailed design depending upon soil conditions, wastewater contents, and cost. The polymer concrete is significantly more expensive than the cast-in-place with liner but requires little to no maintenance for corrosion over the lifetime of the lift station compared to cast-in-place concrete.

3.7.5 OTHER MAJOR COMPONENTS

While the wetwell, pumps, and piping for the West WW LS and the East WW LS vary according to flow rate there are other major lift station components that will be similar for both sites. The following will detail major site features that are recommend being utilized for one or both units.

1. It is recommended that the lift stations have some means of odor control on site. Since the flows into the West WW LS are very low until the end of Phase I, a chemical injection system is the recommended as the most cost-effective method for the size of the wetwell vs. the expected wastewater volumes. The minimum size of the chemical storage facility will be determined at detailed design, but it will be UV resistant and large enough that it need not be filled with a frequency greater than once a month or be less than 2,500 gallons, whichever is greater. Two peristaltic pumps (1 duty + 1 standby) will deliver the chemicals from the storage unit to the wetwell. As with any site with chemical storage an eyewash station and emergency shower will be required onsite.

2. The East WW LS could also use a chemical injection system early in its operational lifetime, however, due to the high volume of wastewater expected as development increases thus increased exposure to (H_2S) that would require ever increasing amount of chemicals to mitigate, the foul air from wetwell is recommended to be treated with soil media biofilter or a packaged bio-trickling filter. The wetwell is recommended to be ventilated at 6 air changes per hour for odor control. There should be two (2) foul air blowers (1 duty+ 1 standby) for foul air exchange in the wetwell. During detailed design, if both chemical and biofiltration are determined cost effective both can be constructed and phased for the overall life cycle of the lift station.
3. A magnetic flow meter installed on the 6-inch DIP above ground headers is recommended for monitoring flows out of the lift stations in addition to installation of combination air/vacuum release valves (CARV). A yard hydrant should be located onsite near the wetwells for scheduled flushing and cleaning. The sites should be protected with a minimum 10-foot-high masonry wall along the entire perimeter with key card accessible motorized slide gates for ingress and egress buttressed by intrusion alarms. A stormwater runoff basin will allow the 100-year, 2-hour storm to be retained onsite for stormwater protection in addition to gravel surfacing on non-vehicular traffic areas for erosion protection. Concrete driveways and asphalt pavement will be constructed for ease of access by maintenance vehicles. Shade structures are recommended to be constructed to protect onsite electrical and instrumentation cabinets from weather. The site will be illuminated by a series of light emitting diode (LED) type area lights mounted on shared poles with security cameras in locations to be determined during detailed design.
4. The City will need to extend a 6-inch watermain from the general vicinity of the City's Well 14 to provide water service to the East WW LS.

3.7.6 ELECTRICAL

Electrical power for each lift station's serve entrance switchboard (SES) will be supplied via an offsite (right-of-way) 500 kilovolt ampere (kVA), 12,470V:480Y/277V transformer connected to local APS powerlines which, for this assessment, are assumed to be built along the JRR alignment for the West WW LS and existing powerlines on SR 80 for the East WW LS. This information is speculative based on previous project experience and will be finalized with coordination with APS after the 60% design level is reached. It is recommended that a standalone diesel-powered electrical generator capable of powering essential components for each lift station for 24 hours in the event of a catastrophic power failure. Based on power requirements for each lift station a 500 kilowatt (kW), 480Y/277V genset is recommended. The circuits for the electrical system will be located underground in PVC Schedule 40 conduit. The conduits routed under a roadway will be encased in reinforced concrete. The circuits located above ground will implement PVC coated rigid metal conduits. All electrical equipment will be housed in stainless steel cabinets and be rated for local temperatures and alarmed for security.

3.7.7 EXISTING CITY SCADA SYSTEM

The City SCADA system, radio based, is over 20 – 25 years old, serves the City Water infrastructure only and the system is incapable of receiving additional I/O information. The City has difficulty obtaining replacement parts.

The SCADA base station is located at the City's Public Works yard. Information and data from the remote locations are sent from the remote locations to the base station for display, alarming, trending, and printing. Equipment control signals are sent from the base station to the remote locations to start and stop pumps, adjust setpoints, and reset alarm conditions. Presently, the existing master SCADA system includes remote stations at about nine water distribution systems and in the future, there are 5-10 sites (water distribution and wastewater collection system including the West WW LS and the East WW LS) to be connected to the SCADA system.

The base station currently located at the City's public works yard will require new computers and SCADA software. Depending upon the type of communications system, these may sometimes be reused but typically are replaced. Radio technology changes as rapidly as computing equipment. Cost is determined by the anticipated size of the final SCADA system.

The City has plans to modernize the SCADA system that will serve both the water and wastewater systems. The City is developing a project time line.

3.7.8 EAST WW LS AND WEST WW LS INSTRUMENTATION AND CONTROL

The lift stations will communicate with Douglas's supervisory control and data acquisition (SCADA) primarily through radio connection when the SCADA upgrade is completed.

The communications infrastructure to SCADA will be connected through a Programmable Logic Controller (PLC). The PLC will allow for remote monitoring and control of the pumps and the wetwell as well as other lift station instrumentation. The PLC panel will be located in a standalone cabinet and will also have a touch screen operator interface terminal. The PLC cabinet will be installed with an air conditioner. The PLC will also include 20% spare input/output (I/O) capacity. Additionally, a security cabinet to allow remote monitoring

For the East WW LS, also networked to the PLC will be the three-phase variable frequency drive (VFD) type motor starters for the submersible pumps. This will allow for the pumps to vary their flow rates to accommodate varying flow conditions in the wetwell. The VFDs will be enclosed in their own individual freestanding cabinets and should be rated to withstand the local summer ambient temperatures without air conditioning.

Recommendations:

1. **City and County to coordinate with ADOT for POE access roadway design information so that right-of-way, easement, detailed locations, and road access requirements can be recommended for the East WW LS and West WW LS sites.**
2. **City and County to acquire the property for both the East WW LS and the West WW LS in the general locations identified above.**
3. **City and County to coordinate with APS regarding the locations of future electrical infrastructure to be constructed for the POE to facilitate electrical design decisions for the East WW LS and West WW LS sites.**

4. **City and County to coordinate geotechnical investigation and detailed topographic survey for East WW LS and West WW LS sites.**
5. **City and County to coordinate ADOT and other entity permits for construction or other encroachments on utilities in ADOT right-of-way.**
6. **City to undertake a radio path frequency study to ensure the two lift stations are on a radio path for the improved SCADA system.**
7. **City will need to extend a 6-inch watermain from the general vicinity of the City's Well 14 to provide water service to the East WW LS**

3.8 Design Considerations - Low Wastewater Flows in Initial Development of POE Wastewater Service Area

One of the biggest concerns is low wastewater flow from the POE Wastewater Service area to the West WW LS at the beginning of the pipes' lifetime, starting in year 2028. Even with the minimum 50-year design life pipe diameter of 10 inches, the slope constraints between the POE and West WW LS will result in a discharge velocity lower than the accepted pipe flushing speed of 2 fps for the first five to 10 years of operation. This could result in deposition of solids over time which may result in clogging and accelerated pipe and manhole corrosion due to hydrogen sulfide gas (H_2S) build up. It is because of these conditions that a periodic maintenance flushing program may be necessary.

Periodically flushing the pipes with water will remove deposited solids and slow corrosion thus preserving the pipes' 50-year design life. A flow meter should be installed upstream of the West WW LS to monitor velocity through Phase I operational life. Low velocity issued are not expected beyond a few years after startup downstream of the West WW LS to the East WW LS, however, for the first 5 years of operation it is recommended that velocities throughout the POE area collection system be monitored to alert operations staff to the need for spot maintenance flushing.

Recommendation:

1. **As discussed in Section 3.1 and in this section, in the initial years of the POE Wastewater Service Area some areas will require focused periodic flushing of selected wastewater pipes with water will be needed. It is recommended that an operation and maintenance plan be developed to reflect this.**

3.9 Wastewater Lift Stations Probable Costing

This section provides the basis of the costing of the two wastewater lift stations. The Engineer's Opinion of the Most Probable Cost is detailed in Section 9.

The design for both lift stations includes, in general:

1. Three submersible wastewater pumps
2. A concrete wetwell, manholes, and sampling vault
3. Transmission piping, fittings, and appurtenances
4. Mechanical equipment
5. Electrical Equipment and Genset
6. Instrumentation and Control Equipment with SCADA Integration
7. Shade Structure and various Concrete Pads and Bollards
8. Retention Basin
9. Security Wall, Paving, and Landscaping

The construction costs for the lift stations are based on similar projects and contractor/vendor quotes in 2020/2021 dollars and inflated to construction year 2022. The wetwell and manholes were costed out as lined, cast-in-place concrete as they are the less expensive option for construction. The detailed breakdown has costs included for comparison of using precast polymer concrete for the wetwell and manholes. The polymer structures have a significantly higher capital cost but require far less maintenance over the life of the structure than cast-in-place concrete. The cost benefit of polymer vs. cast-in-place will be vetted at the 60% design level when data concerning soil corrosivity and wastewater content has been investigated.

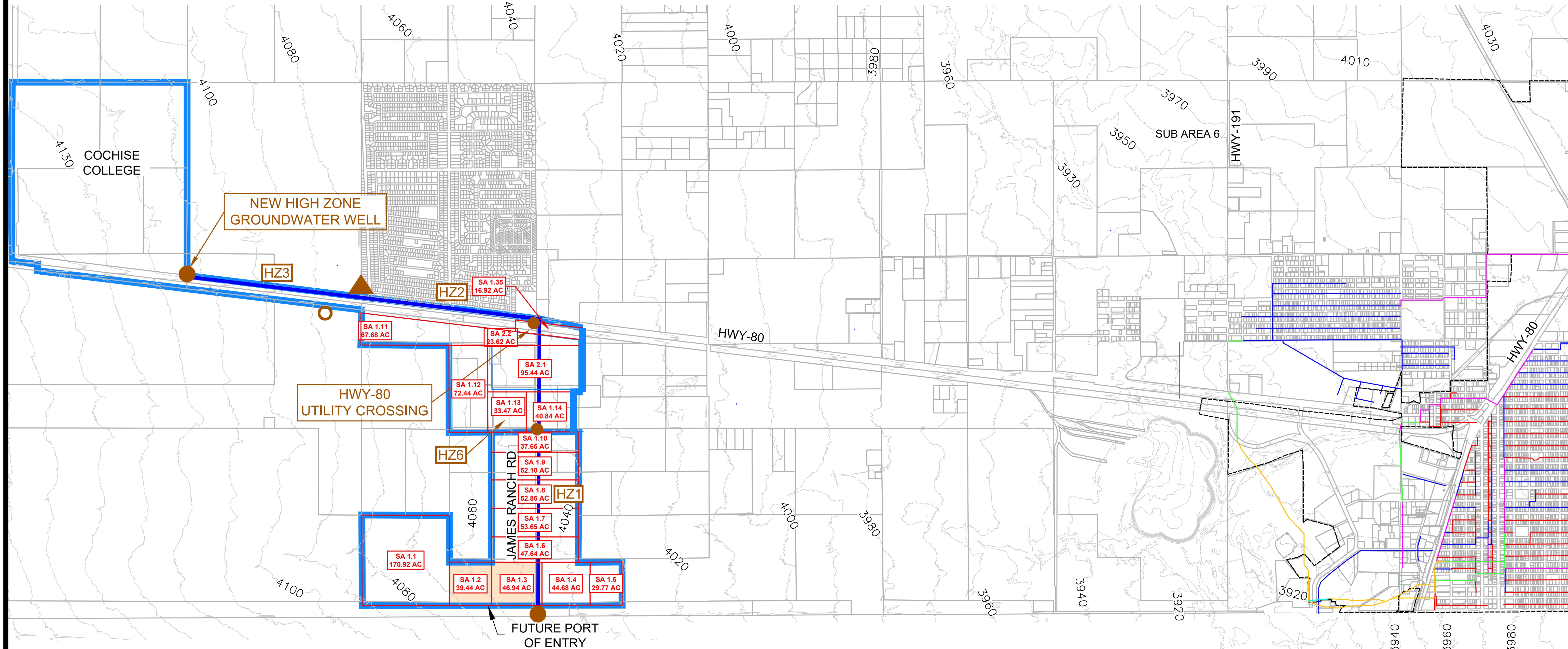
Additionally, the cost estimates for the West WW LS and the East WW LS are based on the assumption that they will be constructed at the locations recommended by this report. While this cost estimate does not include the cost of property acquisition, pipeline easements, or temporary construction easement, constructing the lift station on property other than the recommended parcels may require revaluation of the lift station hydraulics, pipeline lengths, and the site civil assumptions included in this cost breakdown.

This cost estimate was constructed with the best available data and assumes the lift stations will be constructed as the design is presented in this report. The lift station designs presented here are based on modern and SCADA integrated pump stations Stantec has designed in other Arizona jurisdictions. There are cost savings that can be implemented in the 60% design phase by changing or removing some of the recommended lift station features in this report.

4.0 POE Water Service Area

The POE Water Service Area includes Cochise College, both sides of JRR between south of SR 80 and the POE. The POE Water Service Area boundary is different than the POE Wastewater Service Area boundary. See **Figure 4-1** for the location on the POE Water Service Area boundary. The POE Water service Area water system hydraulic characteristics are established to integrate into the existing City water distribution system in the future by locating a watermain along SR 80 connecting the POE Water Distribution System to the City water distribution system as was discussed in the 2020 Feasibility Report.

POE Water System Service Area - 30% DETAILED DESIGN



LEGEND

- UTILITY PLANNING AREA
- CITY OF DOUGLAS LIMITS
- PROPOSED UTILITY CORRIDOR
- NODE
- HZ5 – PIPE ID
- RESERVOIR
- FUTURE PORT OF ENTRY

PIPE	PIPE LENGTH (FEET)	PIPE DIAMETER (INCHES)
HZ1	5,890 LF	12"
HZ2	5,350 LF	16"
HZ3	5,300 LF	16"
HZ6	3,165 LF	16"
TOTAL	19,705 LF	

NORTH

1"=3000'

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PREPARED FOR:

COCHISE COUNTY/CITY OF DOUGLAS
POE 30% DETAILED DESIGN

POE WATER SERVICE AREA

HORIZONTAL SCALE: AS SHOWN VERTICAL SCALE: N/A

2042 634200

FIGURE 4-1

DRAWING: u:\2042634200\drawing\exhibit_files\634200c-ex7003.dwg PLOTTED: 8/24/2022 9:02 AM

4.1 POE Water Service Area Domestic Water Demands and Fire Flow

This section summarizes the domestic demands and fire flow estimates in the POE Water Service Area.

4.1.1 DOMESTIC WATER DEMANDS

The average day water demands were calculated for five different milestones. The milestones can be seen in **Table 4-1**.

The anticipated POE Water Service Area development milestones are the same as the POE Wastewater Service Area milestones.

The estimated POE Water Service Area demand criteria are from the 2020 Feasibility Report.

The average unit water demand rate of 1,400 gallons per day per acre (2020 Feasibility Report) was multiplied by the number of acres in the subarea to estimate the average day water demand for that specific subarea. A detailed summary of the acres per subarea and the estimated flowrate is summarized in **Appendix H.** This peak day water demand was determined by multiplying the average day demand by a factor of 2. The factor of 2 was referenced in the (2020 Feasibility Report).

A summary of the POE Water Service Area average and peak day water demand can be seen in **Table 4-1**.

Table 4-1 POE Water Service Area Average Day and Peak Day Water Demand

Project Milestone	Percent Developed in POE Water Service Area	Avg Day Water Demand Flow (gpd)	Peak Day Water Demand (gpd)	Peak Day Water Demand (gpm)
2028	10%	145,964	291,929	203
2033	30%	405,258	810,517	563
2053	61%	847,258	1,694,516	1,177
2078	74%	1,013,662	2,027,324	1,408
Full Buildout	100%	1,346,470	2,692,940	1,870

4.1.2 FIRE FLOW DEMAND

The governing fire flow in the POE Water Service Area will be the flow to the POE. The GSA Fire flow requirements to the POE were not available for this report. For purposes of this report the governing fire flow in the POE Water Service Area is assumed to be 2,000 gpm for three hours to the Douglas POE. The latter is based on commercial/industrial development.

It is assumed that there is only one fire event, and it occurs coincidentally with the maximum day demand.

The storage volume is calculated as the sum of the assumed fire flow requirements plus 1.5 times the average day demand for one day. The estimated storage volume at full buildout for the POE Water Service Area is 550,000 gallons.

4.2 POE Water Service Area Distribution Pipeline

This section provides details on the Plan and Profile alignment along with design criteria.

4.2.1 PIPELINE ALIGNMENT

The proposed domestic waterline alignment for the POE Water Service Area will be between the new POE Water Service Area Storage Tank at the southeast corner of Cochise College and will extend approximately 2 miles east along the northern side of SR 80 to JRR. The waterline will then run south approximately 1.7 miles along JRR ending at the north boundary of the POE. The entire length of the water line to be installed is approximately 3.7 miles. The 30% Preliminary Water Plan and Profile Sheets define the horizonal and vertical locations of the waterline. The Plan and Profile sheets can be found in **Appendix J – Volume 2**.

Recommendation:

1. **The lands located within the POE Water Service Area can be served by this pipeline. It is recommended that working with the City and County, the location of the service connections be determined and included in the Plan and Profile sheets at the 60% design. It is very important that this be done for JRR for consideration by ADOT in the ADOT James Ranch Road Pre Design Development.**

4.2.2 DESIGN CRITERIA

The final detailed water plans and specifications will adhere to the following reference standards:

1. ADEQ Engineering Bulletin No. 10 – Guidelines for the Construction of Water Systems, May 1978
2. ADOT Guidelines for Accommodating Utilities on Highway Rights-of-Way, August 2015
3. City of Douglas Subdivision Code and Engineering Design Standards Manual, February 2008
4. Tucson Water Standard Specifications and Details, 2017
5. Maricopa Association of Governments (MAG) Standard Specifications and Details, 2022

Other standards may be applied to the design as needed.

The following design criteria will apply to the water line infrastructure:

1. Water lines shall be installed with a minimum cover of 36-inch where located in where in areas of no vehicle traffic and where in vehicle traffic the cover should be determined for the soil condition to accommodate traffic loading.

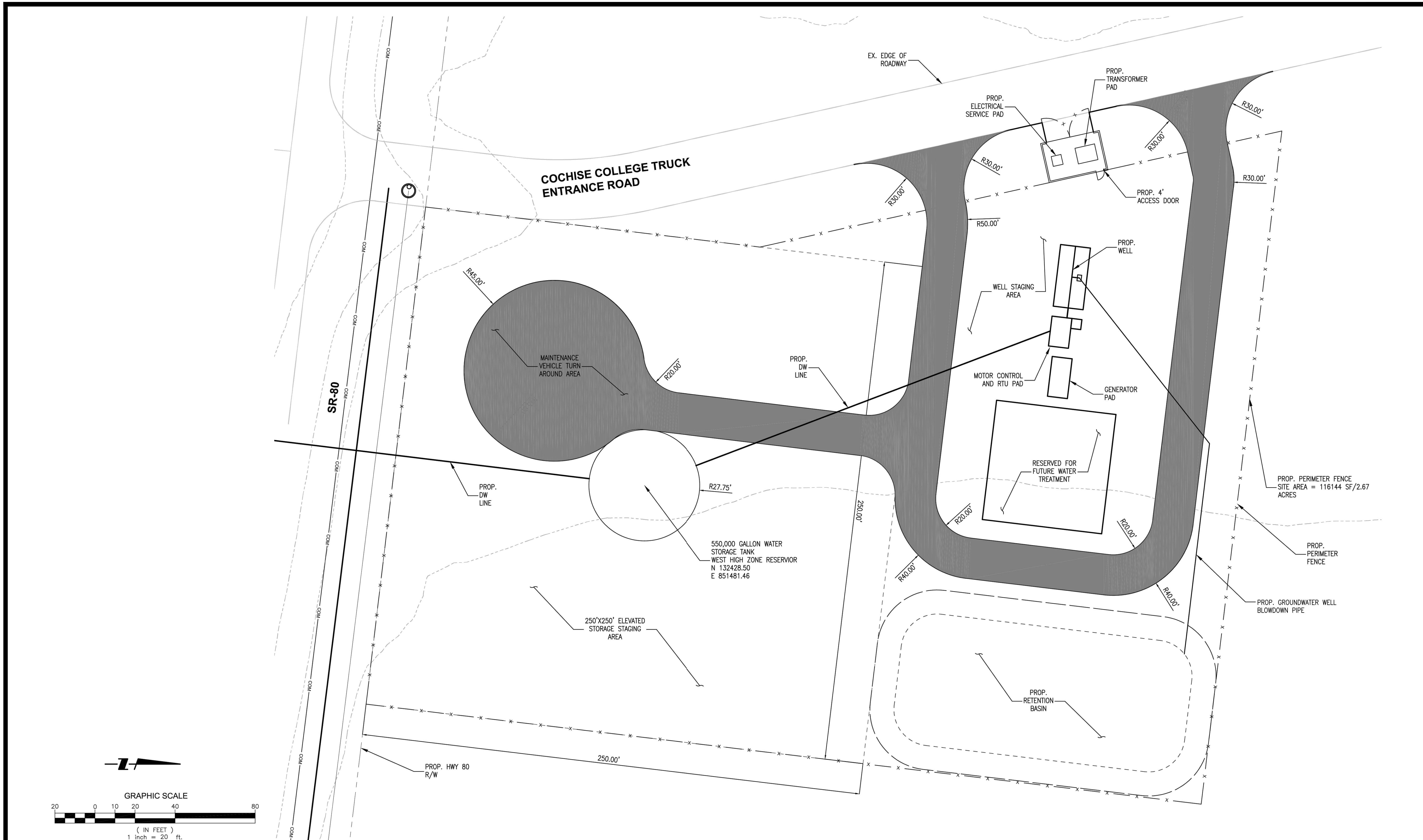
2. Water lines shall have a minimum horizontal separation of 6-feet from outside of pipe to outside of adjacent utility.
3. Water lines shall have a minimum vertical separation from wastewater lines that complies with Tucson Water Standard Detail SD-106.
4. Water lines shall be DIP.
5. Fire hydrants are spaced 500-feet to 1,000-feet apart to be confirmed with the City Fire Department.

Recommendation:

1. **The POE Water Service Area design fire flows and durations, as well as the water connection requirements transitioning from the City water system to the POE on site water system, should be identified by the GSA.**
2. **The fire flows, duration and spacing for the land use within the POW Water Service Area as identified by the City and County and fire hydrant spacing should be decided in consultation with the City Fire Department.**

4.3 Groundwater Well and Storage Tank Location

The Groundwater Well and Storage Tank Conceptual Site plan is illustrated in **Figure 4-2.** The City and County has yet to acquire the land for the groundwater well/storage tank. The site is generally located immediately north of SR 80 at the eastern edge of the Cochise College campus.



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COCHISE COUNTY COCHISE COUNTY / CITY OF DOUGLAS 30% WASTEWATER DETAILED DESIGN
1415 MELODY LAND, BUILDING C
BISBEE, ARIZONA 85603

WELL AND STORAGE TANK-SITE PLAN

HORIZONTAL SCALE: AS SHOWN VERTICAL SCALE: N/A

2042 634200

FIGURE 4.2

The key elements of the groundwater well/storage tank are illustrated in **Figure 4-2** and are summarized below.

1. Access from SR 80 point from an existing access road at the eastern portion of the Cochise College campus
2. Groundwater Well (anticipated for 1,000 gpm)
3. Chlorine Disinfection System (show Cl system dosage for 1,000 gpm well 1.5 mg/L Cl dosage). It is assumed no further water treatment processes are needed as discussed further below.
4. Standby generator (to power all of the electrical needs on site in case of power failure)
5. Retention Basin (to receive room for running a well to waste for 10 minutes + rainstorm)
6. Elevated Storage Tank (500,000 gallon)
7. SCADA Radio communication system (connected to the City SCADA system)
8. Primary power connection to the APS power system (site power requirements need to be determined)
9. Connection from groundwater well to the elevated storage tank and connection to the POE Water Service Area pipe to the POE site
10. Primary power transformer, control and instrumentation panels
11. Security fence around the site

The access point road to the site is currently unnamed but is located immediately north of SR 80. The groundwater well is anticipated to have a production capacity of 1,000 gpm. The 500,000-gallon elevated storage tank will be located in the southern most region of the site, closest to SR 80. A retention basin is conceptually located east of the well site. The northwest corner will contain a spot reserved for a future water treatment system if needed, the generator pad, the electrical service pad, and the point of entry. Surrounding the site is a fence.

4.4 Hydrogeological Data

Hydrogeological data was reviewed from ADWR well records and published reports. The hydrogeologic setting of the proposed well location includes alluvial basin fill of Douglas Basin (ADWR, 2009). Well yields in the vicinity of the proposed well site range from approximately 500 – 2,000 gpm (ADWR, 2009). The depth to bedrock in the area of the proposed well is approximately 2,000-feet below land surface (bls), and the saturated thickness of the aquifer is approximately 1,600-feet (ADWR, 2016). A water level decline of approximately 3 feet-per-year has been observed from data in the Douglas area (2020 Feasibility Report).

Review of nearby well logs from the ADWR well registry indicate that nearby wells are completed to depths of approximately 400-feet bls. Reported maximum production capacities from these nearby wells ranges from approximately 600 gpm – 2,000 gpm (the nearest agricultural well located approximately 1/2 mile northeast of the proposed well site reportedly had a maximum pumping capacity of 2,025 gpm). Based on the available data, it is estimated that the new production well for this area would be drilled to 1,000-feet bls and be capable of producing approximately 1,000 gpm.

Stantec (2020 Feasibility Report) completed a theoretical drawdown calculation for future production wells and reported in the 2020 which resulted in an approximately radius of influence of 800-feet. This suggests that the proposed location of the well should not interfere with the nearest identified well which is approximately 2,500-feet to the northeast. This evaluation assumes that aquifer properties are uniform. Since these parameters are variable, there is an undoubted margin of error within these results. ADWR will likely require a drawdown impact assessment prior to issuing a permit to drill the well (see Section 6.4 ADWR), but based on this high-level evaluation, impacts are not anticipated.

Groundwater quality in the Douglas area has been described as good to excellent (ADEQ, 2000; Rascona, 1993); however, elevated concentrations of some contaminants do occur within the basin. The primary parameters of interest, which are common constituents of concern in Arizona alluvial basins, include arsenic, fluoride, nitrate, and total dissolved solids (TDS). The U.S. Environmental Protection Agency (EPA) has Maximum Contaminant Levels (MCLs) for arsenic of 10 micrograms per liter (µg/L), fluoride of 4 milligrams per liter (mg/L), nitrate at 10 mg/L, and secondary Maximum Contaminant Levels (SMCLs) for fluoride of 2 mg/L and TDS of 500 mg/L. SMCLs are based on aesthetics and taste but are not human health concerns and are not regulated. Water quality parameter exceedances of the primary drinking water standards have been reported from some of the wells in the vicinity of the proposed well location near the Cochise College, including arsenic and nitrate (ADWR, 2009). Depending on the final well completion and resulting water quality, a wellhead treatment system may be necessary. During well drilling, a pilot borehole can be drilled and tested for estimating water quality conditions and optimizing the well design to improve production water quality. However, the final water quality conditions will not be known until the well is constructed, developed, pump tested, and sampled for parameter analysis. For purposes of this report the only water treatment required will be chlorination.

A possible alternative to drilling a new well could be the use of the existing Cochise College well. It is understood that Cochise College as described above has a groundwater well water system that pumps at ground level storage tank. A pumping system connected to the storage tank provides operating pressure throughout the Cochise College water distribution system. This includes domestic water use and water use for lawn irrigation of playing fields and landscaping. There is a possibility that Cochise College may be interested in sharing their existing well for POE Water Service Area supply. This should be further investigated with Cochise College.

Recommendation:

1. **It is recommended that the City and County work with Cochise College to develop further details to investigate this approach from a number of considerations from technical, financial, legal and costing.**

4.5 Groundwater Well

4.5.1 WELL DESIGN CRITERIA

Based on local and regional data published by ADWR (2009), production of 1,000 gpm is common in the area; therefore, this evaluation assumes the future well will produce 1,000 gpm. However, actual well production will be variable based upon specific hydrogeologic conditions at the well location. The development process to investigate a POE Water Service Well is discussed further in this section.

The production well drilling specifications will include procedures for testing and sampling of the pilot borehole so that final design criteria can be established. Important data collection parameters include lithologic grain size analysis, geophysical logs, and selected zonal water quality and production rates. From this data, a final well screened interval and slot size can be designed for maximizing production capacity while optimizing water quality. The sequence for well drilling, installation, and testing should be considered in the overall design and construction process. Ideally, the well should be installed, and pump tested before finalizing site, mechanical and electrical design so that flow rates and water quality are known. These parameters are important for mechanical and site design, especially if wellhead treatment infrastructure may be needed based on water quality. Therefore, it is recommended that well drilling be commenced early in the project.

The production well design criteria is summarized as follows. A conceptual well diagram is provided as **Figure 4-3**.

Production Well Design Criteria:

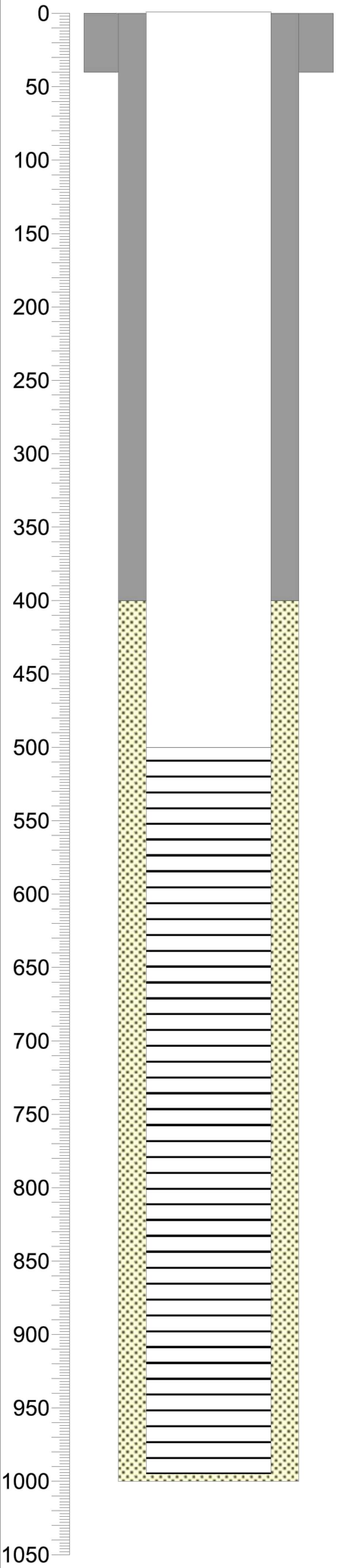
1. Targeted production rate of 1,000 gpm
2. Targeted production water quality to remain below MCLs
3. Drilling method of flooded reverse circulation
4. Steel conductor casing installed to 40-foot depth
5. 16-inch (minimum) pilot borehole total depth (1,010-feet)
6. 26-inch reamed borehole to total depth (1,010-feet) for well construction
7. 18-inch diameter steel well casing installed to 1,000-feet depth. Blank casing installed to approximately 500-feet depth to allow for pump intake above the screened interval and account for available drawdown.
8. Steel louvred well screen, approximately 400-feet to 500-feet
9. Steel casing centralizers at 80-feet (minimum) intervals
10. 1.5-inch (minimum) sounding tube for measuring water levels
11. An inert gravel or filter pack material that is at least 90% retained by the well screen louvres
12. Cement grout annular seal
13. Gravel feed tube for checking filter pack levels and/or adding filter pack
14. Well development that removes drilling mud residual and fine-grained formation sediments, resulting in <5 mg/L of sand production for a 2-hour development period at the designed production rate
15. Well plumbness (alignment) with vertical drift no more than 0.5 degree
16. Well production (pumping) test including step-drawdown and constant rate tests

Mechanical equipment:

17. Vertical lineshaft pump and turbine motor capable of 1,000 gpm and approximately 600-feet of total dynamic head
18. 10-inch column pipe and pump discharge head
19. 10-inch discharge conveyance line (with appropriate tees, elbows, and fittings); by-pass conveyance to retention pond for pumping to waste
20. 1-inch air-vacuum release valve, 10-inch check valves, and 10-inch gate valves
21. Magnetic flow meter and digital read-out
22. Pressure gauge and smooth nosed sampling tap
23. Chlorination

WELL DIAGRAM:	**POE Production Well**
CLIENT:	City of Douglas & Cochise County
PROJECT:	30% Conceptual Design Douglas
SITE LOCATION:	Arizona

DEPTH (feet)	PROPOSED WELL CONSTRUCTION DIAGRAM	CONSTRUCTION SPECIFICATIONS



36 inch steel conductor casing 0 to 40 feet

Grout seal from 0 to 400 feet bgs

18 inch blank steel casing from 0 to 500 feet bgs

18 inch louvred steel screen from 500 to 1000 feet bgs, with centralizers installed every 80 ft minimum

Gravel pack from 400 to 1,010 feet bgs

Total drilling depth 1,010 feet bgs

Notes: bgs = below ground surface

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"POE WASTEWATER SERVICE AREA WASTEWATER COLLECTION SYSTEM"

HORIZONTAL SCALE: AS SHOWN VERTICAL SCALE: N/A

2042 634200

FIGURE 4-3

4.5.2 ELECTRICAL, INSTRUMENTATION AND CONTROL

4.6 Elevated Storage Tank

An elevated storage tank of 500,000 gallons will be located along SR 80 and near JRR. This tank will be similar to those already existing in the City system. This tank will also be serving the area between the Storage Tank and the Port of Entry.

The ground elevation in the Cochise College site is about 4,130-feet in elevation. To provide a minimum water system pressure at the Cochise College site of 50 psi, the top water level of the storage tank will be 4,245-feet. The assumed peak day water pressure at the POE is 50 psi and is assumed to be 20 psi with the peak day demand and fire flow of 2,000 gpm. Using WaterCAD modeling, the estimated pipe diameter between the POE Water Service Area reservoir and the POE north boundary connection will be 16-inch in diameter.

The following is a list of recommendations.

Recommendation:

1. **The assumed water system pressure settings and fire flow and duration be reviewed and agreed to with GSA, the City, County, and Cochise College. Based on an understanding of these outcomes the pipe and the pipe sizing between the POE Water Service Area Reservoir and the connection point to the POE are to be confirmed.**
2. **A site is recommended to be acquired by the City and County for the groundwater well/storge tank as detailed above.**
3. **A site survey and geotechnical investigation will be completed for further development in the 60% design phase**
4. **The City and County plan with APS to provide primary power to the acquired site will be developed.**

4.6.1 TANK DESIGN CRITERIA

Design criteria for elevated storage tanks can be found in ADEQ's Engineering Bulleting No. 10 Guidelines for the Construction of Water Systems (Chapter 6). The following list provides a general overview of the design criteria to take into account. A more detailed description of each item can be found in Chapter 6 of Engineering Bulletin No. 10.

1. Location
2. Covers
3. Protection from Trespassers
4. Drains

5. Foundation
6. Overflow
7. Level Controls
8. Access
9. Vents
10. Roof and Sidewall
11. Safety
12. Freezing
13. Grading
14. Internal Catwalk
15. Silt Stop
16. Painting and/or Cathodic Protection
17. Disinfection
18. Pressure

4.6.2 ELECTRICAL, INSTRUMENTATION AND CONTROL

The draft instrumentation and control Input/Output points for the Groundwater Well/Storage Tank site are summarized on **Table 4-2**. This draft list was prepared in consultation with the City.

Table 4-2 Proposed Site Instrumentation & Control for Groundwater Well/Storage Tank Summary

Description	Location	Comments
Well operation status	Local panel	Hand/Auto/Reset/On/Off
Pump control valve	On discharge header from well	Open/close
Pump control valve	On waste discharge line	Open/close
Well level indicator	Water level in the well	Feet below ground, ft.
Well vibration sensor	At well pump	Vibration
Bearing temperature	At well pump	Degree F of the bearings.
Emergency well stop	Vibration or high temperature of the pump	Out of range pump vibration or temperature
Pressure gauge	On well column at the well head	Pumping pressure, psi. High-pressure alarm
Pressure gauge	On pipeline to the pump discharge location (e.g., elevated tank)	Tank water level in psi converted to feet of water depth
Magnetic flow meter	Well pumping rate	Flow rate, gpm Flow total, gallons
Ambient air chlorine detection	Device inside chlorine enclosure building	Local alarm light outside chlorine enclosure monitoring for chlorine gas, chlorine gas ppm
Chlorine residual	Measure the chlorine residual in water	Continuous basis but not for operation changes, mg/l free chlorine
Eye wash shower	In vicinity of chlorine enclosure	Alarm when in operation
Chlorine building entry alarm	On entrance door to chlorine enclosure	Open/Close/Alarm on door operation
Chlorine dual cylinder weigh scale	Device inside chlorine enclosure building	Measure weight of both chlorine gas cylinders, lbs.
Site entrance gate entry alarm	At vehicle gate to the well site	Open/Close/Alarm on site entrance gate
Valve actuator, well header	On located control valve on pipeline between the well head and connection to the distribution system	Remote operation of valve
Valve Actuator, blowdown	On valve located on blowdown pipe control valve on pipeline between the well head and connection to the distribution system	Remote operation of valve
Auxiliary Power Generator	Status	Automatic start on failure of primary power. Recommended in City Risk and Reliance Report. Optional
Security camera system	Monitoring well pumps and chlorine enclosure at Wells 6, 11 and 15 and water storage tank Well 6 Tank and 15th Street Park East and West Tanks	Recommended in City Risk and Reliance Report. Optional.

4.7 SCADA

The City SCADA system, radio based, is over 20 – 25 years old and the system is incapable of receiving additional I/O information). The City has difficulty obtaining replacement parts. The SCADA base station is located at the City's Public Works yard. Information and data from the remote locations are sent from the remote locations to the base station for display, alarming, trending, and printing. Equipment control signals are sent from the base station to the remote locations to start and stop pumps, adjust setpoints, and reset alarm conditions. Presently, the existing master SCADA system includes remote stations at about nine water distribution systems and in the future, there are 5-10 sites (water distribution and wastewater collection system including the West WW LS and the East WW LS) to be connected to the SCADA system.

The base station currently located at the City's public works yard will require new computers and SCADA software. Depending upon the type of communications system, these may sometimes be reused but typically are replaced. Radio technology changes as rapidly as computing equipment. Cost is determined by the anticipated size of the final SCADA system. The City has a process in place to upgrade the SCADA system.

5.0 Broadband Conveyance System Design Criteria

5.1 Broadband Conduit

The broadband conduit alignment planned for this project will begin at the southeastern corner of the Cochise College Douglas Campus located at 4190 SR 80, Douglas, AZ 85607. From that location, the alignment will extend approximately 7.5 miles east along the northern side of SR 80 where it will connect to the existing City of Douglas broadband conduit close to SR 191. A branch of the broadband conduit alignment will also run south approximately 1.7 miles from the SR 80 and James Ranch Road intersection until it reaches the POE. The installation of the fiber is not part of this project.

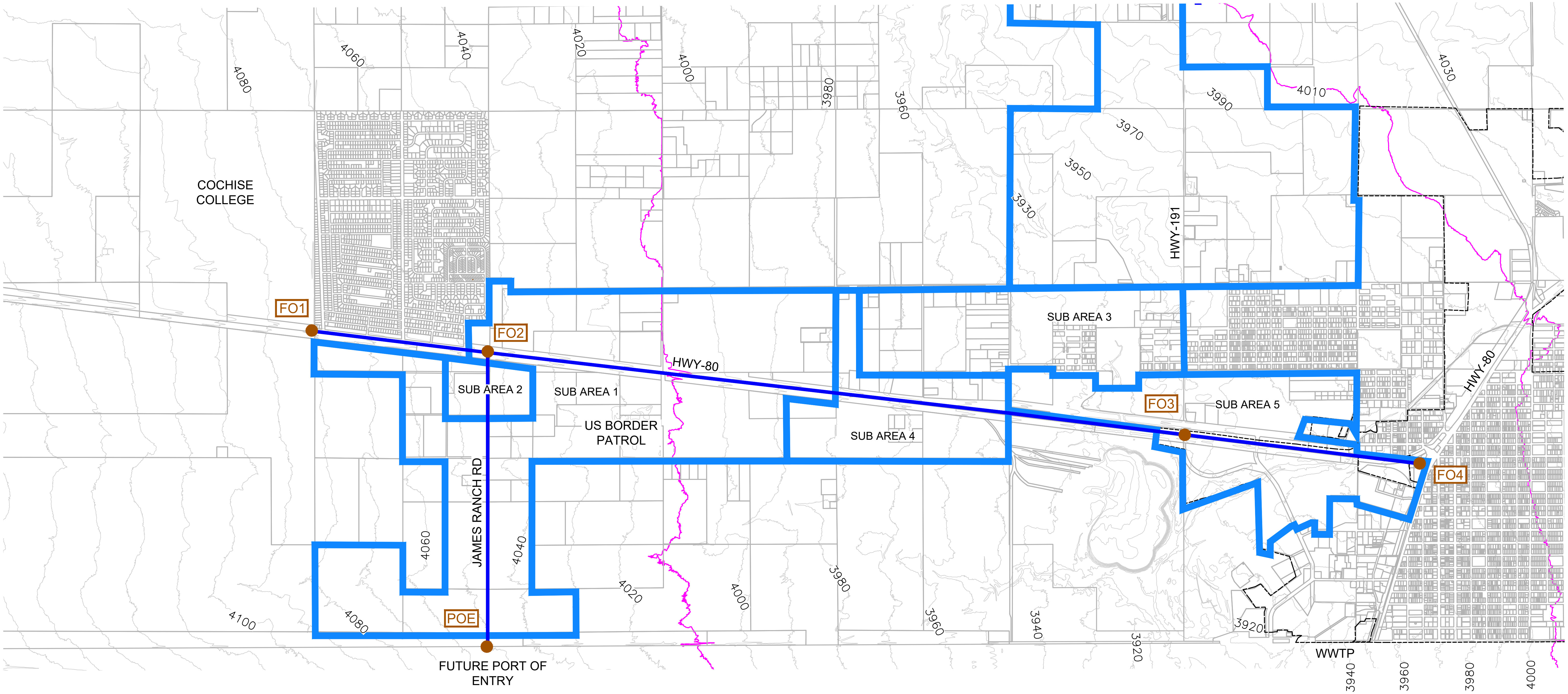
There are several broadband servicing planning studies that impact the broadband conduit design, including by Cochise County and by Cox Communication. The supply and installation of the broadband conduit under this project is separate from those efforts.

Recommendation:

1. **It is recommended that the City and County develop a strategy for supply and installation of the fiber with the broadband conduit including the points of connection both at the POE, at Cochise College, at the east termination at the SR 80 and SR 191 intersection and any connections between.**

See **Figure 5-1** for the 30% Preliminary POE design fiber optic routing for sub areas 1 to 5 (POE Broadband Conduit System). The entire length of the broadband conduit to be installed is approximately 9.2 miles. The 30% Preliminary Wastewater Plan and Profile Sheets (**Appendix J – Volume 2**) define the expected horizonal and vertical locations of the broadband conduit.

Concept Fiber Optic Routing – POE Planning Sub Areas 1-5



LEGEND

- UTILITY PLANNING AREA
- CITY OF DOUGLAS LIMITS
- FIBER OPTIC CONDUIT/CABLE

PIPE	CONDUIT/CABLE LENGTH
POE TO FO2	9000 LF
FO1 TO FO2	5500 LF
FO2 TO FO3	21500 LF
FO3 TO FO4	7300 LF
TOTAL	43300 LF

NORTH

1"=3000'

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PREPARED FOR:

COCHISE COUNTY PROCUREMENT DEPARTMENT
1415 MELODY LAND, BUILDING C
BISBEE, ARIZONA 85603

Concept Fiber Optic Routing – POE Planning Sub Areas 1-5

HORIZONTAL SCALE: AS SHOWN

2042 634200

FIGURE 5-1

DRAWING: v:\2042\active\2042584400\drawings\exhibit_files\figure 5-1 – conceptual fiber optic routing 1.dwg PLOTTED: 8/21/2020 1:19 PM

5.2 Design Criteria

The following design criteria will apply to the broadband conduit infrastructure:

1. Broadband conduit shall be installed with a minimum cover of 36 inches.
2. Broadband conduit shall have a minimum horizontal separation of 6-feet from outside of conduit to outside of adjacent utility.
3. Broadband conduit shall have a minimum vertical separation of 12-inches from outside of conduit to outside of adjacent utility.

At this phase of design, one 2-inch diameter HDPE SDR11 conduit and one 16/12 7-way conduit are recommended for installation. This recommendation shall be verified through subsequent design phases through coordination with all interested parties.

6.0 Project Design, Permitting and Right-of-Way Requirements

6.1 Funding Agencies

At the date of this report the City and County are in the process of finalizing the project funding sources. The project requirements of the project funding agency (or agencies) will be identified when the funding sources are confirmed.

6.2 ADEQ

An Approval to Construct (ATC) permit and an Approval of Construction (AOC) permit by the Arizona Department of Environmental Quality (ADEQ) will be required for the construction of the facilities within the POE Water Service Area (groundwater well, storage tank and distribution piping, and appurtenances) and the POE Wastewater Service Area (wastewater collection system including the East WW LS and the West WW LS).

The ADEQ ATC submittal will include the following:

1. 100% design drawings and specifications sealed by an Arizona registered professional engineer
2. Basis of Design Report
3. New Source Approval Analysis for the proposed POE Water Service Area groundwater well
4. Capacity Development Letter for connection to the City WWTP

No construction work can start until receipt of the ADEQ ATC permit. The review period by ADEQ will likely be a minimum of up to two months from date of submittal.

An AOC permit request is necessary once construction has been completed and before the system can be placed into service for the intended purposes. In general, the application requires an Engineering Certification of Completion (ECC), As-Built Plans, Quality Control Testing Results and Calculations, Operation and Maintenance Manual, and a New Source Analysis for the POE Water Service Area groundwater well.

Recommendation:

1. **It is recommended that that the City and County start the engagement process with ADEQ early during the 60% Detailed Design development. This would include briefing ADEQ permitting leadership on the details of the Design of 'The Water & Wastewater Infrastructure to Serve the Douglas POE & Service Area' by creating the POE Water Service Area and the POE Wastewater Service Area, a new water source, connection to the City wastewater collection system, and WWTP. The project schedule and milestones for the various submittals to ADEQ would be established.**

6.3 ADOT

The project will need to secure permits from ADOT to install utilities in the ADOT right-of-way. These utilities are generally located on the north side of SR 80 between Cochise College and the point of connection of the POE Wastewater Service Area to the City wastewater collection system at the intersection of SR 80 and SR 191. It also includes the proposed JRR right of water from SR 80 to the north boundary of the POE site.

Utility design requirements in ADOT right-of-way were referenced earlier in this document based on the *ADOT Guidelines for Accommodating Utilities on Highway Rights-Of-Way* (August 2015).

The ADOT Southeastern District was consulted to understand what ADOT requires to permit new utilities in their right-of-way. At a minimum, the following items will be needed:

1. Complete application
2. 100% design plans (need ADOT stationing in addition to project stationing)
3. Fire hydrant detail
4. Offsets from right-of-way to proposed waterline and white edge stripe
5. Method of installation
6. Depth of cover and proposed cover material
7. Points of ingress / egress
8. Contractor name and proof of insurance
9. Traffic Control Plans
10. Project owner proof on insurance
11. Sign inventory
12. Allow 6 – 8 weeks review time before permit is issued

Recommendation:

1. **It is recommended that that the City and County start the engagement process with ADOT early in the 60% Detailed Design development. The following should be shared with ADOT: the BODR, as well a detailed review of the BODR centerline locations for the water, wastewater and broadband conduit in the ADOT SR 80 right-of-way, and the proposed locations along JRR between SR and the POE north boundary. Included would be the location of the Groundwater Well/storage tank site, the sites of East WW LS and West WW LS, and vehicle access locations.**

6.4 ADWR

The POE Water Service Area groundwater well will require a withdrawal authority issued by ADWR pursuant to a water right (e.g., service area water right), and all new well locations would require an impact analysis to determine effects on nearby wells. An impact on a nearby well is defined by ADWR as 10-feet of drawdown in a five-year period. Prior to drilling a well, a Notice of Intent (NOI) application shall be filed with ADWR and the agency will issue an approval as a "drill card" to the selected driller.

6.5 Cochise County

The POE Water Service Area and the POE Wastewater Service Area are currently located in the County. It is understood that there are efforts in place to annex the property into the City.

At the moment, any work in the right-of-way of a County maintained road will need a right-of-way permit. At this time the ultimate formation and disposition of JRR between SR 80 and the POE remains unknown. Work in the floodplain of Whitewater Draw will need a Flood Plain Use Permit (FPUP).

6.6 City of Douglas

It is understood that the City will own the infrastructure to be constructed under this program in the POE Water Service Area and the POE Wastewater Service Area. It is understood that there will be no permits required. It is strongly recommended that the approach to the 60% and final design be done in close collaboration with the City.

7.0 Technical Specifications

7.1 General and Supplementary Conditions

It is assumed that the project delivery will be design, bid build for infrastructure along SR 80 between Cochise College and the intersection of SR 80 and SR 191. The City/County will provide the bidding and contracting conditions including the Contract and General and Supplementary Conditions.

An approach to construction and startup of the water, wastewater and broadband conduit along JRR is to be developed with ADOT and the City and County.

Recommendation:

1. **It is recommended that the City and County develop a strategy with ADOT to construct and startup the City's proposed infrastructure along JRR between SR 80 and the north boundary of the POE as part of the ADOT design and construction of the road between the POE and SR 80**.

7.2 Technical Specifications Table of Contents

The following is a list of Technical Specification Sections to be incorporated into the detailed design.

01 77 00	PROJECT CLOSEOUT
01 79 00	OWNER STAFF TRAINING
DIVISION 02 –	SITEWORK
02 01 00	ENVIRONMENTAL MITIGATION
02 41 19	DEMOLITION AND RECONSTRUCTION
DIVISION 03 –	CONCRETE
03 11 00	CONCRETE FORMING
03 21 00	REINFORCEMENT STEEL
03 31 00	CAST-IN-PLACE CONCRETE
03 31 60	POLYMER CONCRETE LIFT STATION AND MANHOLES
03 32 00	JOINTS IN CONCRETE
03 60 00	GROUTING
DIVISION 04 –	MASONRY
04 05 19.29	POST-INSTALLED ANCHORS IN MASONRY
04 22 00	REINFORCED CONCRETE BLOCK MASONRY
DIVISION 05 –	METALS
05 05 19	ANCHORS, INSERTS AND EPOXY DOWELS
05 12 00	STRUCTURAL STEEL
05 50 00	MISCELLANEOUS METALWORK
DIVISION 09 –	FINISHES
09 96 00	PROTECTIVE COATINGS
DIVISION 10 –	SPECIALTIES
10 14 00	IDENTIFYING DEVICES
10 28 13	WARNING SIGNS
DIVISION 22 –	PLUMBING
22 13 29	SANITARY SEWERAGE PUMPS GENERAL
22 45 16	EMERGENCY EYEWASH-SHOWER EQUIPMENT
DIVISION 26 –	ELECTRICAL
26 00 00	ELECTRICAL WORK, GENERAL
26 01 26	ELECTRICAL TESTS
26 05 10	ELECTRIC MOTORS
26 05 15	INDUSTRIAL CONTROL PANELS
26 05 19	WIRE AND CABLING
26 05 26	GROUNDING
26 05 33	ELECTRICAL RACEWAY SYSTEMS
26 05 36	WIRING DEVICES
26 05 43	UNDERGROUND RACEWAY SYSTEMS
26 05 73	PROTECTIVE DEVICE STUDIES
26 12 16	PANELBOARDS AND GENERAL-PURPOSE DRY TYPE TRANSFORMERS
26 22 00	LOW VOLTAGE TRANSFORMERS AND SWITCHBOARDS
26 29 23	VARIABLE FREQUENCY DRIVE UNITS
26 32 13	STANDBY POWER GENERATION
26 41 23	LIGHTNING PROTECTION

26 43 00	SURGE PROTECTION DEVICES (SPD)
26 50 00	LIGHTING
DIVISION 27 –	COMMUNICATIONS
27 15 26	OUTDOOR FIBER OPTIC CABLING
DIVISION 28 –	ELECTRONIC SAFETY AND SECURITY
28 13 19	SECURITY ACCESS AND SURVEILLANCE
28 50 00	GATE OPERATOR
DIVISION 31 –	EARTHWORK
31 10 00	SITE PREPARATION
31 30 00	EARTHWORK
31 34 19	GEOTEXTILES
31 37 00	RIPRAP
DIVISION 32 –	EXTERIOR IMPROVEMENTS
32 11 13	A.C. PAVEMENT AND BASE
32 17 23	PAVEMENT MARKING
DIVISION 33 –	UTILITIES
33 05 00	PIPING GENERAL
33 05 26.16	PIPING UTILITY IDENTIFICATION MARKERS
33 11 13.13	DUCTILE IRON PIPE (AWWA C151, MODIFIED)
33 11 13.23	PVC PIPES AND ACCESSORIES
33 11 13.25	HIGH DENSITY POLYETHYLENE PIPE (AWWA C906, MODIFIED)
33 11 17	COPPER WATER TUBE
33 39 50	SANITARY UTILITY SEWERAGE STRUCTURE – AUTO-SAMPLER
33 95 50	PVC NON-PRESSURE PIPING, RUBBER JOINTS
33 95 60	FIBERGLASS REINFORCED POLYMER MORTAR PIPING
DIVISION 40 –	PROCESS INTERCONNECTIONS
40 05 06	COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING
40 05 57	ACTUATORS FOR PROCESS VALVE AND GATES
40 05 60	WASTEWATER VALVES, GENERAL
40 05 62	PLUG VALVES
40 05 63	BALL VALVES
43 05 65.23	SWING CHECK VALVES
40 05 81	MISCELLANEOUS VALVES AND HYDRANT
40 61 21	PROCESS CONTROL SYSTEM TESTING
40 90 10	CONTROL STRATEGIES
40 91 00	PROCESS CONTROL AND INSTRUMENTATION SYSTEMS
40 91 02	IN-LINE LIQUID FLOW MEASURING
40 91 06	LEVEL MEASURING
40 91 07	LEVEL DETECTION
40 91 08	PRESSURE MEASURING
40 91 09	PRESSURE DETECTION
40 95 10	PLC-BASED CONTROL SYSTEMS HARDWARE
40 95 13	CONTROL PANELS

7.0 Technical Specifications

DIVISION 41 –	MATERIAL PROCESSING AND HANDLING EQUIPMENT
41 07 16	ODOR CONTROL SYSTEM
DIVISION 46 –	WATER AND WASTEWATER EQUIPMENT
46 01 00	EQUIPMENT, GENERAL PROVISIONS

MAG standard specifications will also be referenced and included as part of the project technical specifications.

8.0 Engineer's Opinion of the Most Probable Construction Cost

This section provides a summary of the capital cost of the water, wastewater, and broadband systems to serve the POE Water Service Area and the POE Wastewater Service Area including the POE and the lands within both Service Areas. The capital costing is for 2022.

An Engineer's Opinion of the Most Probable Construction Cost as based on the scope of work identified in the Basis of Design Report and costing data for the Phoenix / Tucson, Arizona areas. The costing is to a AACE Class 3 Cost Estimate at an accuracy range from -15% to +20% (AACE International Recommended Practice No 18R-97).

The Most Probable Total Project Delivery Cost is the Most Probable Construction Cost with an additional 30% allowance for construction general conditions, permitting, detailed design including geotechnical investigation, construction administration, project coordination, right-of-way and easement acquisition and construction cost increases from 2022 costing to the 2023/2024 estimated project bidding period.

The Most Probable Construction Cost and the Most Probable Total Project Delivery Cost for this project will be updated during the subsequent design phases. The Most Probable Construction Cost AACE costing accuracy range will gradually be reduced during the design stages until the Detailed Design is complete and permitting is in place for project bidding.

Construction costs have been estimated from data bases of work of a recent similar nature and with the best available data from contractors, manufacturers, and other expert sources. Stantec acknowledges the supply chain difficulties and inflation of material and fuel costs presented by the lingering effects of the COVID-19 pandemic compounded by the geopolitical crisis in Ukraine. With these factors in mind, Stantec presents the following Most Probable Construction Cost in good faith which may not include any future cost impacts that may occur as a result of these conditions. Stantec has no control over possible significant differences in cost that may occur as a result of this uncertainty in the time between the issuance of this report and the continuation of design and construction.

Cost estimating for the POE Water Service Area is broken down into the following sections. The breakdown consists of the following:

1. East Wastewater Lift Station
2. West Wastewater Lift Station
3. POE Wastewater Service Area Collection System
4. POE Water Service Area Distribution System
5. Groundwater Well and Storage Tank
6. Broadband Conduit

Table 8-1 provides a summary of the AAEE Class 3 Engineer's Opinion of the Probable Construction Cost and Engineer's Opinion of the Probable Project Cost to serve the POE Wastewater Service Area and the

POE Water Service Area as well as broadband conduit only. A detailed breakdown is provided in **Appendix I**.

Table 8-1 Engineers Opinion of the Most Probable Cost

POE Wastewater Service Area Utility	AAEE Class 3 Most Probable Construction Cost, $	Most Probable Total Project Delivery Cost, $
POE Wastewater Collection System- West WW LS	$2,001,100	$2,601,430
POE Wastewater Collection System- East WW LS	$2,307,100	$2,999,230
POE Wastewater Collection System- Pipes	$7,967,850	$10,358,205
POE - Groundwater Well – Storage Tank	$5,130,100	$6,669,130
POE Water Distribution System- Pipes	$3,340,200	$4,342,260
Broadband Conduit	$402,140	$522,782
Total	**$21,148,490**	**$27,493,037**
+20% of Project Delivery Sub Total	$25,378,188	$32,991,644
-15% of Project Delivery Sub Total	$17, 976,217	$23,369,081

The total Engineer's Opinion of the Probable Construction Cost is $21,148,490 while the Engineer's Opinion of the Probable Project Delivery Cost is $27,493,037. The AAEE Class 3 estimate range of Engineer's Opinion of the Probable Construction Cost is$17,976,217 to $25,378,188.

The 2020 Feasibility Report costing did not include water, broadband or wastewater service to Cochise College. For purposes of this report and costing in this report, an estimated additional length of water pipe to serve Cochise College is about 5,800-feet with 6 fire hydrants, an estimated additional length of wastewater collection pipe is 10,720-feet with 20 manholes and additional length of broadband conduit is 10, 720-feet.

8.1 Costing Considerations

There are several outstanding costing considerations:

1. The Most Probable Construction Costing is based on a 2022 costing. The Most Probable Construction Costing must be updated as detailed design progresses to reflect the construction costing environment and project delivery conditions at the time of the project delivery
2. The GSA contracted with Tate Snyder Kimsey Architects, Ltd. in August 2022 to develop a 'Master Planning, Programming, Bridging Documents'. The work is scheduled for completion in Q4 2023. Water, wastewater, and broadband conduit servicing requirements will be clarified by GSA during this Master Plan process and will affect the City/County Most Probable Construction Cost considerations in this report.
3. As discussed earlier, ADOT has responsibility to develop the connector highway between SR 80 and the POE. Starting in January 2023 the Arizona Department of Transportation (ADOT) will undertake a review of the connector highway alignment between SR 80 and the POE. A decision on the alignment will not be made by ADOT for another eighteen to twenty-four months. Assuming a Q3 2022 start, ADOT is identifying a 12-month (Q3 2023) to 18-month (Q1 2024) project period. Water, wastewater and broadband conduit infrastructure design in the JRR alignment between SR 80 and the POE will need to be clarified during this process and decisions made will affect the City/County Most Probable Project Cost considerations in this report.
4. For JRR between the POE and SR 80, the approach to contractor procurement, construction scheduling and construction of the City water, wastewater and broadband infrastructure within the construction procurement, construction scheduling and construction of the ADOT infrastructure will need planning and agreement of roles and responsibilities.
5. All land acquisition costs for acquiring the sites for the West WW LS, the East WW LS and the groundwater well / storage tank are not included in the Opinion of the Most Probable Construction Cost. The detailed site survey, geotechnical investigation and APS are site specific and remain to be defined.
6. The location of any water, wastewater and broadband connections, including to the POE, will need to be identified by the City and County. The costs of the water, wastewater and broadband service connections are not included in the Opinion of the Most Probable Construction Cost.
7. Cost of any requirements of crossing the high-pressure gas line at two locations and modifications or changes necessary in the design of the Wastewater Collection System may affect the Opinion of the Most Probable Construction Cost.

9.0 Summary and Conclusions

This section provides a number of recommendations needed to advance the Water, Wastewater, and Broadband Infrastructure project into subsequent phases.

9.0 Summary and Conclusions

Table 9-1 Summary of Basis of Design Recommendations

Section	Recommendations
GSA's POE Master Planning, Programming, Bridging (GSA Schedule Q3 2022 to Q3 2023)	
Section 2.2.1: General Services Administration (GSA)	1. The City and County should work with the GSA to identify the POE water, wastewater, and broadband conduit servicing needs and design details. It is expected that this would be finalized with GSA during the GSA's POE Master Planning, Programming, Bridging Documents.
Section 2.2.5: Arizona Department of Transportation (ADOT)	2. The City and County should collaborate with ADOT on the water, wastewater, broadband centerlines, and profile pipe centerline, as well as appurtenances such as service connections, manholes, fire hydrant locations along JRR during the ADOT James Ranch Road Predesign. This will involve modifications to the City's/County's 30% Water and Wastewater Infrastructure Design. 3. ADOT right-of-way location boundaries and existing easements within the ADOT right-of-way as identified on the 30% Detailed Design should be confirmed along SR 80 and going forward with the James Ranch Road Predesign development.
El Paso Natural Gas High-Pressure Gas Line Crossings by City Infrastructure	
Section 2.2.7: El Paso Natural Gas (EPNG)	1. Further coordination with EPNG will be required to determine the existing natural gas pipe crown and invert elevations at the water, wastewater, broadband conduit crossing points, and specific design details such as the vertical separation between the high-pressure gas line and the City water and wastewater pipes and broadband conduit. This will require confirmation of the vertical and horizontal locations at all the cross points. 2. The EPNG gas main should be potholed to confirm vertical and horizontal locations. 3. A plan should be developed with EPNG of construction schedules, construction requirements, and permitting requirements to construct the crossings of the high-pressure gas line 4. Work with EPNG to develop construction documentation to be included in the Technical Specifications and Design Drawings.
POE Wastewater Service Area to the City Wastewater Collection System and WWTP	
Based on the reported available existing WWTP influent flow information and the estimated POE Wastewater Service Area flow, the WWTP will be able to accommodate the POE Wastewater Service Area Flows beyond 2033 but not likely 2053.	
Section 3.6.1: Existing Wastewater System Capacity Between POE and WWTP	1. By 2033 (five years after POE startup), the City should undertake a review of the existing and estimated future flows between the City MH 20 and WWTP both from the POE Wastewater Service Area and the BDIA Wastewater Service Area. The goal is to ensure that total flow to the wastewater treatment plant is planned out to 2053. This assumes a startup of the POE and the POE Wastewater Service Area in 2028. It is recommended that a BDIA flow metering program at City MH 20 be undertaken in 2022. This would involve installation of a flow monitoring device in the MH 20.

	2. It is recommended that a condition assessment be completed of the elevated steel trestle structure located at a wash in the vicinity of the WWTP that supports the existing 15-inch diameter wastewater pipe that the POE Wastewater Flows will be conveyed to the WWTP.
Section 3.6.4: Impact to Existing Wastewater Treatment Plant Capacity from POE Wastewater Service Area	3. The City will need to receive permission of the EPA / Southeast Arizona Government Organization (SEAGO) to connect the POE Wastewater Service Area to the City's WWTP. It is recommended that the City/County begin the process with SEAGO during development of the 60% Infrastructure Detailed Design for permission to connect the POE Wastewater Service Area to the City's WWTP.
Section 3.2: Estimated Wastewater Flow	4. The City should complete a Master Wastewater Plan covering the collection system and wastewater treatment plant in 2033. This is five years after the projected start of the POE and the POE Wastewater Service Area. It will provide insights into the estimated wastewater flows to develop a WWTP expansion plan in the period 2033 to 2040.
Section 3.8: Design Considerations – Low Wastewater Flows in Initial Development of POE Wastewater Service Areas	5. In the initial years of the POE Wastewater Service Area some areas will require focused periodic flushing of selected wastewater pipes. It is recommended that an operation and maintenance plan be developed to reflect this.
Connection of POE Wastewater Service Area to the City Wastewater System	
Section 3.6: Connection of POE Wastewater Service Area and City of Douglas Wastewater Collection System	1. The design of the POE East WW LS force main connection to the City wastewater collection system be undertaken in close consultation with the City Wastewater Division.
Section 3.5: East WW LS Force Main Crossing of Whitewater Draw	2. It is recommended this "wastewater pipe bridge" design over Whitewater Draw and any river/creek hydraulic and analysis design of piers associated with Whitewater Draw, will need to be completed as part of the 60% Infrastructure Detailed Design. This will include geotechnical investigation for pier design, location of the piers and design of the pipe bridge.
POE Water Service Area and POE Wastewater Service Area Service Connections	
Section 3.5: Wastewater Collection System Design Plan and Profile	1. Should work with the City and County to locate the water and wastewater service connections along SR 80 to be included in the plan and profile sheets at the 60% Infrastructure Detailed Design.

	2. The length of JRR between the POE and SR 80 is about 7,380-feet. Recognizing that land development will occur on the east and west sides of JRR between the POE and SR 80 that will have connections to the water, wastewater, and broadband, it is very important that the City work with ADOT during ADOT's James Ranch Road Pre Design Development on a strategy for location and maintenance of the service connections to be installed during the construction of the water, wastewater, and broadband.
James Ranch Road Alignment - ADOT Pre Design Development (ADOT Schedule Q4 2022 to Q4 2023/Q2 2024)	
Section 3.5: JRR Alignment	1. The City and the County should provide support to ADOT during the James Ranch Road Predesign Development centered on the City's water, wastewater, and broadband conduit including the location of the West WW LS, the manholes, and water and wastewater service connections. 2. City and County collaboration should include any ADOT plans for the intersection of JRR and SR 80. The City buried water, wastewater, and broadband conduit has been located in this intersection in the 30% Water and Wastewater Infrastructure Design. 3. Based on centerline of the POE Wastewater Service Area pipe in the JRR right-of-way, a utility locate program and geotechnical investigation be undertaken. 4. City and County to develop an approach and agreement with ADOT for the detailed design, construction delivery and startup of the City's utilities within the ADOT's JRR corridor detailed design, construction delivery, and startup.
SR 80 Alignment	
Section 3.5.1: Wastewater Collection System Pipe and Manhole Design	1. In the 60% Water and Wastewater Detailed Design, the Plan and Profile drawings should locate the City's wastewater connections service connections along SR 80 2. The centerline location as located in the 30% Water and Wastewater Detailed design should be reviewed on site with ADOT to confirm the centerline location. 3. Based on centerline of the POE Wastewater Service Area pipe in the SR 80 right-of-way, a utility locate program and geotechnical investigation be undertaken.
East and West Wastewater Lift Stations	
Acquire Land for the East and West Wastewater Lift Stations	1. The design of the East and West Wastewater Lift Stations will require acquisition of property. The general locations are identified in the 30% Water and Wastewater Infrastructure Detailed Design. It is recommended that the City / County acquire the property for both the East WW LS and the West WW LS. 2. City and County to coordinate with ADOT for POE access roadway design information so that right-of-way, easement, detailed locations, and road access requirements can be prepared the East WW LS and West WW LS sites. 3. City and County to coordinate with APS regarding the power supply locations to the East WW LS and West WW LS sites. 4. City and County to undertake geotechnical investigations and detailed topographic surveys for East WW LS and West WW LS sites. 5. City and County to coordinate ADOT and other entity permits for construction or other encroachments on utilities in ADOT right-of-way. 6. The City will need to extend a 6-inch watermain from the general vicinity of the City's Well 14 to provide water service to the East WW LS.

9.0 Summary and Conclusions

Section 3.7.2: Lift Station Design Criteria	7. Due to the wide variation in design flow requirements for the West WW LS and the East WW LS during the years 2028 to 2078, the construction of the lift stations is recommended to be phased. The phasing for purposes of this report is development of the two site master plans and designs limited to conveying flows to 25 years (2053, Phase I) and 50 years (2078, Phase II). It is recommended that the flow rates for both lift stations must be carefully monitored by the City from startup in 2028 to buildout for rate increases that will trigger the site upgrades. These “trigger” flow rates may occur before or after the planned 25-year and 50-year phasing.
East WW LS and West WW LS, Groundwater Well/Storage Tank Instrumentation and Control	
	1. The City SCADA system is about 25 years old, has technical limitations and is not able to accept new radio signals including from the East and West WW LS’s and the groundwater well/storage tank. The City is developing a program to improve the existing SCADA system. It is recommended that a strategy be identified during the 60% Detailed Design on an approach to handle the integration of the East and West WW LS’s and groundwater well/storage tank into the City system. 2. City to undertake a radio path frequency study to ensure the two lift stations and groundwater well/ storage tank are on a radio path for the improved City SCADA system.
POE Water Service Area	
Section 4.2.1: Water Pipeline Alignment	1. The lands located within the POE Water Service Area will be served by this pipeline. It is recommended that service connection locations be determined and included in the plan and profile sheets at the 60% Infrastructure Detailed Design. It is important this be done for JRR by ADOT in the ADOT James Ranch Road Pre Design Development.
Design Criteria	2. The POE Water Service Area design fire flows and durations as well as the water connection requirements should be identified by the GSA. 3. The assumed storage tank critical water elevations, water system pressure settings, fire flow and duration should be reviewed and agreed to with GSA, the City and County, and Cochise College. Based on an understanding of these outcomes the pipe material and size between the POE Water Service Area Reservoir and connection point to the POE will be confirmed. 4. The fire flows, duration, and spacing for the land-use within the POE Water Service Area as identified by the City and County and fire hydrant spacing should be determined in consultation with the City Fire Department.
Section 4.4: Groundwater Well, Hydrogeological Data	5. The siting and development of the ‘below ground design’ of the groundwater well shall be completed including engagement of the ADWR.
Possible use of Existing Cochise College Well as a Water Service Area Water Source	6. The City and County should work with Cochise College to develop further details to investigate the approach to include the existing Cochise College drinking water well in the POE Water Service Area. This could eliminate the need to drill a new well based on a number of considerations including technical, financial, legal, and costing.
Section 4.6: Elevated Storage Tank	7. A site to be acquired by the City/County for the groundwater well/storge tank as generally located in the 30% Infrastructure Detailed Design. 8. A site survey and geotechnical investigation to be completed for further development in the 60% design phase. 9. The City/County to plan with APS to provide primary power to the acquired site.

9.0 Summary and Conclusions

Broadband Conduit	
	1. City and County to develop a strategy for supply and installation of the fiber within the broadband conduit including the points of connection both at the POE, at Cochise College, at the east termination at the SR 80 and SR 191 intersection and any connections between.
ADEQ Consultation and Permitting	
Section 6.2: ADEQ	1. City and County to start the engagement process with ADEQ early in the 60% Detailed Design development by sharing the 30% Detailed Design and BODR. The project schedule and milestones for the various submittals to ADEQ would be established.
ADOT SR 80 and JRR City Water, Wastewater, and Broadband Infrastructure Permitting	
Section 6.3: ADOT	1. City and County to start the engagement process with ADOT early in the 60% Detailed Design development. Items to be coordinated, include the location of the groundwater well and storage tank site, the sites of East WW LS and West WW LS and vehicle access locations. 2. Establish the protocol for City acquisition of the required easements within the ADOT rights-of-way.

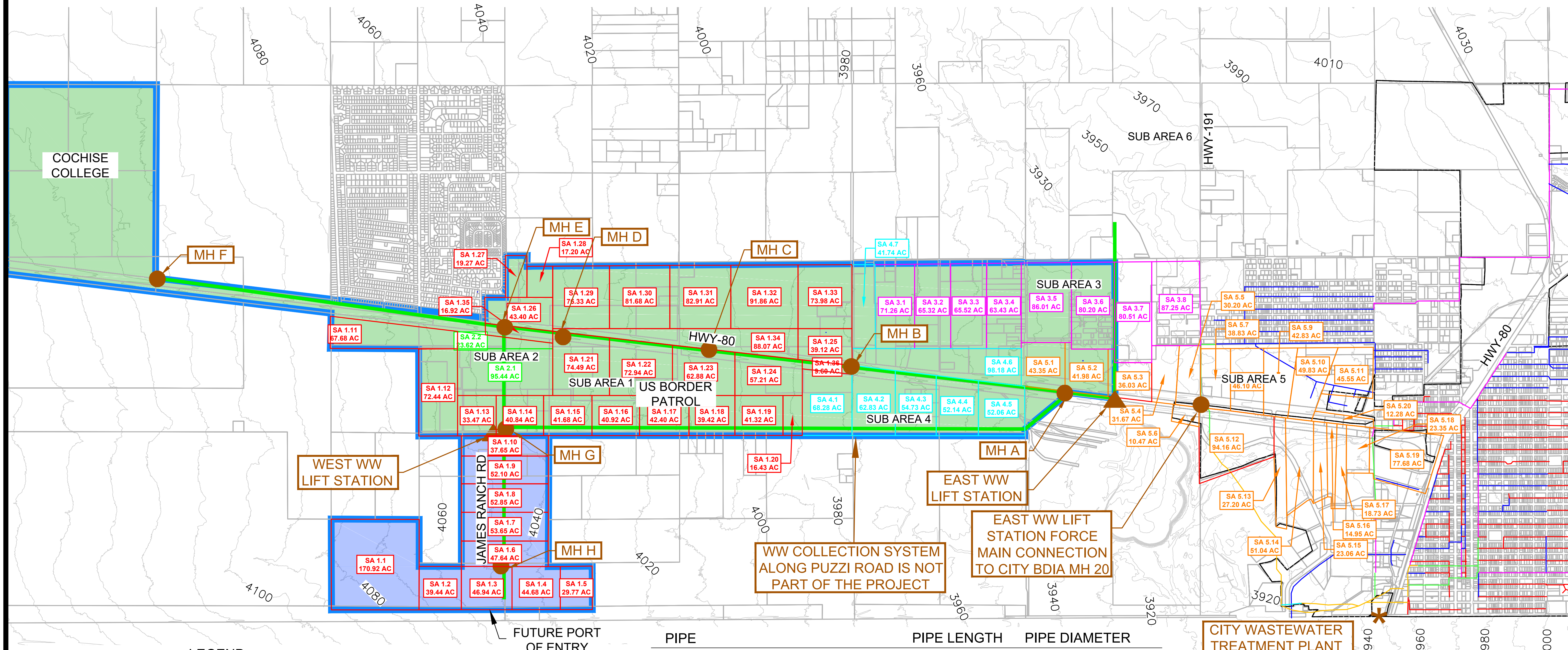
References

1. Arizona Department of Environmental Quality (ADEQ), 2000. Ambient Groundwater Quality of the Douglas Basin: An ADEQ 1995-1996 Baseline Study, ADEQ Fact Sheet 00-08.
2. Arizona Department of Water Resources (ADWR), 2009, Arizona Water Atlas: Section 3.52 Water Resource Characteristics of the Gila Bend Basin, November 2009.
3. ADWR, 2016. Douglas and Willcox Basins and San Simon Valley Sub-basin, South Eastern Arizona - Hydrologic Monitoring Report No. 9. May, 2016.
4. Rascona, S.J., 1993. Maps Showing Groundwater Conditions in the Douglas Basin, Cochise County, Arizona - 1990. Phoenix, AZ: ADWR
5. R12-15-1302 Well Spacing Requirements – Applications to Construct New Wells or Replacement Wells in New Locations Under A.R.S. 45-599
6. Stantec, 2020. Memorandum: The Port of Entry Water Assessment, *in* Master Plan Utility Engineering – Douglas, Arizona Port of Entry Project No. 20-24-BOS-03

APPENDIX

Appendix A POE Wastewater Service Area

POE Wastewater Service Area - 30% Detailed Design



LEGEND

- UTILITY PLANNING AREA
- CITY OF DOUGLAS LIMITS
- 6" SANITARY SEWER LINES
- 8" SANITARY SEWER LINES
- 10" SANITARY SEWER LINES
- 12" SANITARY SEWER LINES
- 15" SANITARY SEWER LINES
- 16" SANITARY SEWER LINES
- 18" SANITARY SEWER LINES
- 21" SANITARY SEWER LINES
- 30% DETAILED DESIGN WASTEWATER ALIGNMENT
- FORCEMAIN
- WEST WW LIFT STATION SERVICE AREA BOUNDARY
- EAST WW LIFT STATION SERVICE AREA BOUNDARY

NORTH
1"=3000'

PIPE	PIPE LENGTH	PIPE DIAMETER
MH A – MH B	6,580 LF	15"
MH B – MH C	4,380 LF	12"
MH C – MH D	4,480 LF	12"
MH D – MH E	1,820 LF	12"
MH E – MH F	10,720 LF	8"
MH E – MH G	3,120 LF	12"
MH H – WEST WW LS	4,260 LF	12"
MH A – EAST WW LIFT	1,560 LF	15"
EAST WW LS – MH 20	3,294 LF	10"
TOTAL	40,214 LF	

PREPARED BY:
Stantec
3133 West Frye Road, Suite 300
Chandler, AZ. 85226
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PREPARED FOR:
COCHISE COUNTY COCHISE COUNTY / CITY OF DOUGLAS 30% WASTEWATER DETAILED DESIGN
1415 MELODY LAND, BUILDING C
BISBEE, ARIZONA 85603

"POE WASTEWATER SERVICE AREA WASTEWATER COLLECTION SYSTEM"

HORIZONTAL SCALE: AS SHOWN VERTICAL SCALE: N/A

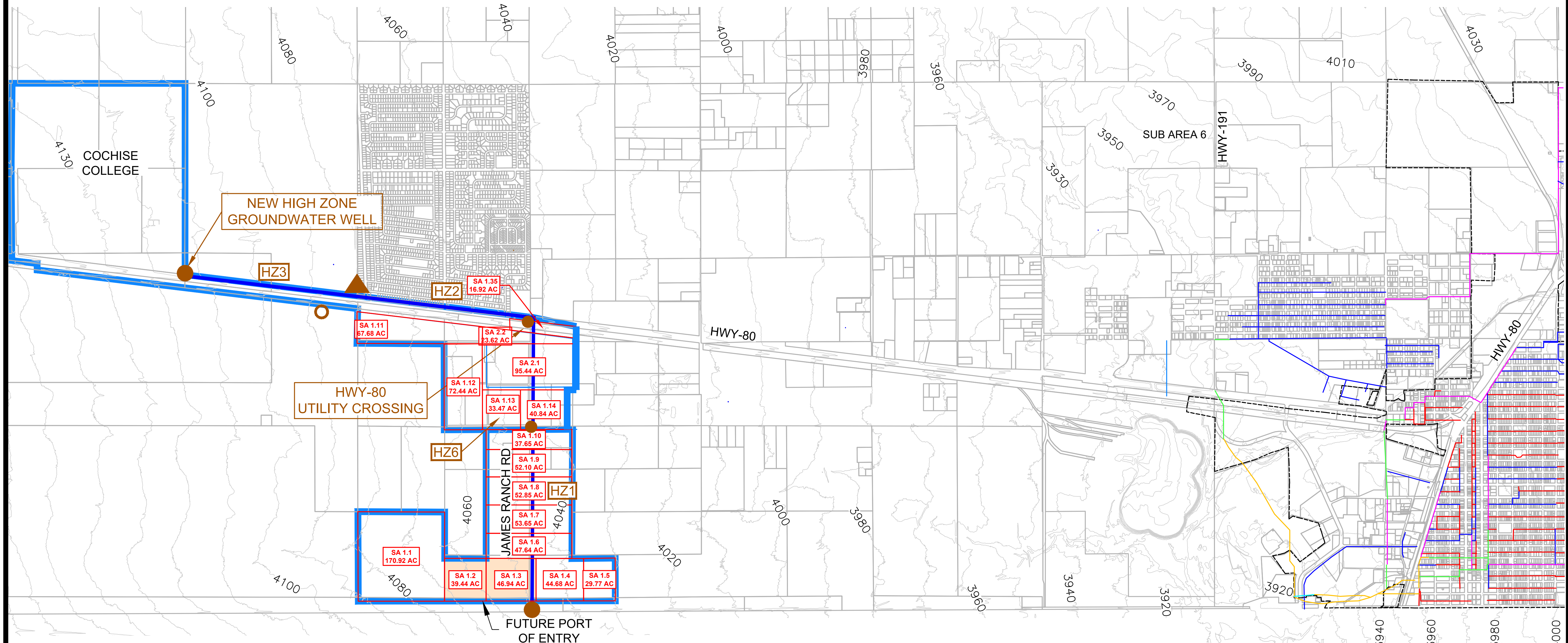
2042 634200

FIGURE 3-1

DRAWING: u:\2042634200\drawing\exhibit_files\634200c-ex7006.dwg PLOTTED: 8/24/2022 9:01 AM

Appendix B POE Water Service Area

POE Water System Service Area - 30% DETAILED DESIGN



LEGEND

- UTILITY PLANNING AREA
- CITY OF DOUGLAS LIMITS
- PROPOSED UTILITY CORRIDOR
- NODE
- HZ5 – PIPE ID
- RESERVOIR
- FUTURE PORT OF ENTRY

PIPE	PIPE LENGTH (FEET)	PIPE DIAMETER (INCHES)
HZ1	5,890 LF	12"
HZ2	5,350 LF	16"
HZ3	5,300 LF	16"
HZ6	3,165 LF	16"
TOTAL	19,705 LF	

NORTH

1"=3000'

PREPARED BY:

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PREPARED FOR:

COCHISE COUNTY/CITY OF DOUGLAS
POE 30% DETAILED DESIGN

POE WATER SERVICE AREA

2042 634200

HORIZONTAL SCALE: AS SHOWN VERTICAL SCALE: N/A

FIGURE 4-1

DRAWING: u:\2042634200\drawing\exhibit_files\634200c-ex7003.dwg PLOTTED: 8/24/2022 9:02 AM

Appendix C Floodplain Within the POE Service Areas

Cochise County GIS - Floodplain Zones

6/3/2022, 10:56:29 AM

1:18,056

0	0.17	0.35	0.7 mi
0	0.3	0.6	1.2 km

- County Boundary
- Roads
- Parcels

NFHL - National Flood Hazard Layer - Flood Hazard Zones

- 1% Annual Chance Flood Hazard
- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- 0.2% Annual Chance Flood Hazard

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Appendix D Estimated Wastewater Flows per Milestone

D.1 Estimated Wastewater Flows – 2028

Cochise County - City of Douglas 30% Port-Of-Entry Design
May-22
Summary of Land Development Planning Areas within the POE WW Service Area (East Wastewater Lift Station)

Areas in yellow are in the floodplain zone
Areas in green are NOT in the POE planning area

Estimated WW Flows on 2028 - Startup

Note 1: Assumed startup of the wastewater collection system is based on GSA schedule is 2028

SUB AREAS	ACRES	Land Use Designation	AZ Admin Code	% of Ultimate Development	Per Acre WW Generated (gal/acre/day)	Avg Day Design Flow (gpd)	Peaking Factor	Peak Flow (gpd)	Peak Flow (gpm)
SA 1.1	171	C-Developing	Commerical / Industrial	20.00%	600	20,510	2.38	48,815	34
SA 1.2	39	C-Developing	Commerical / Industrial	20.00%	600	4,733	2.38	11,264	8
SA 1.3	47	C-Developing	Commerical / Industrial	20.00%	600	5,633	2.38	13,406	9
SA 1.4	45	C-Developing	Commerical / Industrial	20.00%	600	5,362	2.38	12,761	9
SA 1.5	30	C-Developing	Commerical / Industrial	20.00%	600	3,572	2.38	8,502	6
SA 1.6	48	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.7	54	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.8	53	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.9	52	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.10	38	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
Total flow into West WW Lift Station						**39,810**		**94,748**	**66**
SA 1.11	68	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.12	72	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.13	33	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.14	41	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.35	17	C-Developing	Commerical / Industrial	20.00%	600	2,030	2.38	4,832	3
SA 2.1	95	C-Developing	Commerical / Industrial	20.00%	600	11,453	2.38	27,258	19
SA 2.2	24	C-Developing	Commerical / Industrial	20.00%	600	2,834	2.38	6,746	5
Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)						**16,318**		**38,836**	**27**
Flow from South Lateral into MH E						**56,128**		**133,584**	**93**
Flow from West Lateral (Cochise College) into MH E						**15,000**		**35,700**	**25**
Total flow into MH E						**71,128**		**169,284**	**118**
SA 1.15	42	C-Developing	Commerical / Industrial	5.00%	600	1,250	2.38	2,976	2
SA 1.16	41	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.17	42	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.18	39	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.19	41	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.20	16	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.21	74	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.22	73	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.23	63	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.24	57	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.36	10	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 4.1	68	B-Enterprise	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 4.2	63	B-Enterprise	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 4.3	55	B-Enterprise	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 4.4	52	B-Enterprise	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 4.5	52	B-Enterprise	Commerical / Industrial	0.00%	600	0	2.38	0	0
Flow from South Lateral into MH A						**1,250**		**2,976**	**2**
SA 1.26	43	C-Developing	Commerical / Industrial	5.00%	600	1,302	2.38	3,099	2
SA 1.27	19	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.28	17	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.29	76	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.30	82	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
Total fow in this area (SA 1.26-1.30)						**1,302**		**3,099**	**2**
Flow from West Lateral into MH C						**72,430**		**172,382**	**120**
Total flow into MH C						**72,430**		**172,382**	**120**
SA 1.31	83	C-Developing	Commerical / Industrial	5.00%	600	2,487	2.38	5,920	4
SA 1.32	92	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.33	74	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.34	88	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.25	39	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
Total flow in this area (SA 1.31-1.34, 1.25)						**2,487**		**5,920**	**4**
Flow from West Lateral into MH B						**74,917**		**178,302**	**124**
Total flow into MH B						**74,917**		**178,302**	**124**
SA 3.1	71	B-Developing	Residential	5.00%	800	2,850	2.38	6,784	5
SA 3.2	65	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 3.3	66	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 3.4	63	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 3.5	86	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 3.6	80	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 3.7	81	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 3.8	87	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 4.6	98	B-Enterprise	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 4.7	42	B-Enterprise	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 5.1	43	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.2	42	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.3	36	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.4	32	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.5	30	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.6	10	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.7	39	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.8	46	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.9	43	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.10	50	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0

SA 5.11	46	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.12	94	B-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 5.13	27	B-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 5.14	51	B-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 5.15	23	B-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 5.16	15	B-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 5.17	19	B-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 5.18	23	B-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 5.19	78	B-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 5.20	12	B-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)						**2,850**		**6,784**	**5**
Flow from West Lateral into MH A						**77,767**		**185,086**	**129**
Flow from South Lateral into MH A						**1,250**		**2,976**	**2**
Total flow into East WW Lift Station						**79,018**		**188,062**	**131**

D.2 Estimated Wastewater Flows – 2033

Cochise County - City of Douglas 30% Port-Of-Entry Design
May-22
Summary of Land Development Planning Areas within the POE WW Service Area (East Wastewater Lift Station)

Areas in yellow are in the floodplain zone
Areas in green are NOT in the POE service area

Estimated WW Flows on 2033 - 5-yr Development									
Note 1: Assumed startup of the wastewater collection system is based on GSA schedule is 2033									
SUB AREAS	**ACRES**	**Land Use Designation**	**AZ Admin Code**	**% of Ultimate Development**	**Per Acre WW Generated (gal/acre/day)**	**Avg Day Design Flow (gpd)**	**Peaking Factor**	**Peak Flow (gpd)**	**Peak Flow (gpm)**
SA 1.1	171	C-Developing	Commerical / Industrial	40.00%	600	41,021	2.38	97,630	68
SA 1.2	39	C-Developing	Commerical / Industrial	40.00%	600	9,466	2.38	22,528	16
SA 1.3	47	C-Developing	Commerical / Industrial	40.00%	600	11,266	2.38	26,812	19
SA 1.4	45	C-Developing	Commerical / Industrial	40.00%	600	10,723	2.38	25,521	18
SA 1.5	30	C-Developing	Commerical / Industrial	40.00%	600	7,145	2.38	17,005	12
SA 1.6	48	C-Developing	Commerical / Industrial	20.00%	600	5,717	2.38	13,606	9
SA 1.7	54	C-Developing	Commerical / Industrial	20.00%	600	6,438	2.38	15,322	11
SA 1.8	53	C-Developing	Commerical / Industrial	20.00%	600	6,342	2.38	15,094	10
SA 1.9	52	C-Developing	Commerical / Industrial	20.00%	600	6,252	2.38	14,880	10
SA 1.10	38	C-Developing	Commerical / Industrial	20.00%	600	4,518	2.38	10,753	7
Total flow into West WW Lift Station						**108,887**		**259,151**	**180**
SA 1.11	68	C-Developing	Commerical / Industrial	20.00%	600	8,122	2.38	19,329	13
SA 1.12	72	C-Developing	Commerical / Industrial	20.00%	600	8,693	2.38	20,689	14
SA 1.13	33	C-Developing	Commerical / Industrial	20.00%	600	4,016	2.38	9,559	7
SA 1.14	41	C-Developing	Commerical / Industrial	20.00%	600	4,901	2.38	11,664	8
SA 1.35	17	C-Developing	Commerical / Industrial	40.00%	600	4,061	2.38	9,665	7
SA 2.1	95	C-Developing	Commerical / Industrial	40.00%	600	22,906	2.38	54,515	38
SA 2.2	24	C-Developing	Commerical / Industrial	40.00%	600	5,669	2.38	13,492	9
Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)						**58,367**		**138,913**	**96**
Flow from South Lateral into MH E						**167,254**		**398,064**	**276**
Flow from West Lateral (Cochise College) into MH E						**15,000**		**35,700**	**25**
Total flow into MH E						**182,254**		**433,764**	**301**
SA 1.15	42	C-Developing	Commerical / Industrial	5.00%	600	1,250	2.38	2,976	2
SA 1.16	41	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.17	42	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.18	39	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.19	41	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.20	16	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.21	74	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.22	73	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.23	63	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.24	57	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.36	10	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 4.1	68	B-Enterprise	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 4.2	63	B-Enterprise	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 4.3	55	B-Enterprise	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 4.4	52	B-Enterprise	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 4.5	52	B-Enterprise	Commerical / Industrial	0.00%	600	0	2.38	0	0
Flow from South Lateral into MH A						**1,250**		**2,976**	**2**
SA 1.26	43	C-Developing	Commerical / Industrial	5.00%	600	1,302	2.38	3,099	2
SA 1.27	19	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.28	17	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.29	76	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.30	82	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
Total fow in this area (SA 1.26-1.30)						**1,302**		**3,099**	**2**
Flow from West Lateral into MH C						**183,556**		**436,862**	**303**
Total flow into MH C						**183,556**		**436,862**	**303**
SA 1.31	83	C-Developing	Commerical / Industrial	5.00%	600	2,487	2.38	5,920	4
SA 1.32	92	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.33	74	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.34	88	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 1.25	39	C-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
Total flow in this area (SA 1.31-1.34, 1.25)						**2,487**		**5,920**	**4**
Flow from West Lateral into MH B						**186,043**		**442,782**	**307**
Total flow into MH B						**186,043**		**442,782**	**307**
SA 3.1	71	B-Developing	Residential	5.00%	800	2,850	2.38	6,784	5
SA 3.2	65	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 3.3	66	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 3.4	63	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 3.5	86	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 3.6	80	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 3.7	81	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 3.8	87	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 4.6	98	B-Enterprise	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 4.7	42	B-Enterprise	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 5.1	43	B-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 5.2	42	B-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 5.3	36	B-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 5.4	32	B-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 5.5	30	B-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 5.6	10	B-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0
SA 5.7	39	B-Developing	Commerical / Industrial	0.00%	600	0	2.38	0	0

SA 5.8	46	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.9	43	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.10	50	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.11	46	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.12	94	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.13	27	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.14	51	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.15	23	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.16	15	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.17	19	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.18	23	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.19	78	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.20	12	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)						**2,850**		**6,784**	**5**
Flow from West Lateral into MH A						**188,893**		**449,566**	**312**
Flow from South Lateral into MH A						**1,250**		**2,976**	**2**
Total flow into East WW Lift Station						**190,144**		**452,542**	**314**

D.3 Estimated Wastewater Flows – 2053

Cochise County - City of Douglas 30% Port-Of-Entry Design

May-22

Summary of Land Development Planning Areas within the POE WW Service Area (East Wastewater Lift Station)

Areas in yellow are in the floodplain zone

Areas in green are NOT in the POE planning area

Estimated WW Flows on 2053 - 25-yr Development									
Note 1: Assumed startup of the wastewater collection system is based on GSA schedule is 2053									
SUB AREAS	**ACRES**	**Land Use Designation**	**AZ Admin Code**	**% of Ultimate Development**	**Per Acre WW Generated (gal/acre/day)**	**Avg Day Design Flow (gpd)**	**Peaking Factor**	**Peak Flow (gpd)**	**Peak Flow (gpm)**
SA 1.1	171	C-Developing	Commerical / Industrial	100.00%	600	102,552	2.38	244,074	169
SA 1.2	39	C-Developing	Commerical / Industrial	100.00%	600	23,664	2.38	56,320	39
SA 1.3	47	C-Developing	Commerical / Industrial	100.00%	600	28,164	2.38	67,030	47
SA 1.4	45	C-Developing	Commerical / Industrial	100.00%	600	26,808	2.38	63,803	44
SA 1.5	30	C-Developing	Commerical / Industrial	100.00%	600	17,862	2.38	42,512	30
SA 1.6	48	C-Developing	Commerical / Industrial	40.00%	600	11,434	2.38	27,212	19
SA 1.7	54	C-Developing	Commerical / Industrial	40.00%	600	12,876	2.38	30,645	21
SA 1.8	53	C-Developing	Commerical / Industrial	40.00%	600	12,684	2.38	30,188	21
SA 1.9	52	C-Developing	Commerical / Industrial	40.00%	600	12,504	2.38	29,760	21
SA 1.10	38	C-Developing	Commerical / Industrial	40.00%	600	9,036	2.38	21,506	15
Total flow into West WW Lift Station						**257,584**		**613,049**	**426**
SA 1.11	68	C-Developing	Commerical / Industrial	40.00%	600	16,243	2.38	38,659	27
SA 1.12	72	C-Developing	Commerical / Industrial	40.00%	600	17,386	2.38	41,378	29
SA 1.13	33	C-Developing	Commerical / Industrial	40.00%	600	8,033	2.38	19,118	13
SA 1.14	41	C-Developing	Commerical / Industrial	40.00%	600	9,802	2.38	23,328	16
SA 1.35	17	C-Developing	Commerical / Industrial	40.00%	600	4,061	2.38	9,665	7
SA 2.1	95	C-Developing	Commerical / Industrial	40.00%	600	22,906	2.38	54,515	38
SA 2.2	24	C-Developing	Commerical / Industrial	40.00%	600	5,669	2.38	13,492	9
Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)						**84,098**		**200,154**	**139**
Flow from South Lateral into MH E						**341,682**		**813,203**	**565**
Flow from West Lateral (Cochise College) into MH E						**50,000**		**119,000**	**83**
Total flow into MH E						**391,682**		**932,203**	**647**
SA 1.15	42	C-Developing	Commerical / Industrial	20.00%	600	5,002	2.38	11,904	8
SA 1.16	41	C-Developing	Commerical / Industrial	20.00%	600	4,910	2.38	11,687	8
SA 1.17	42	C-Developing	Commerical / Industrial	20.00%	600	5,088	2.38	12,109	8
SA 1.18	39	C-Developing	Commerical / Industrial	20.00%	600	4,730	2.38	11,258	8
SA 1.19	41	C-Developing	Commerical / Industrial	20.00%	600	4,958	2.38	11,801	8
SA 1.20	16	C-Developing	Commerical / Industrial	20.00%	600	1,972	2.38	4,692	3
SA 1.21	74	C-Developing	Commerical / Industrial	20.00%	600	8,939	2.38	21,274	15
SA 1.22	73	C-Developing	Commerical / Industrial	20.00%	600	8,753	2.38	20,832	14
SA 1.23	63	C-Developing	Commerical / Industrial	20.00%	600	7,546	2.38	17,959	12
SA 1.24	57	C-Developing	Commerical / Industrial	20.00%	600	6,865	2.38	16,339	11
SA 1.36	10	C-Developing	Commerical / Industrial	20.00%	600	1,152	2.38	2,742	2
SA 4.1	68	B-Enterprise	Commerical / Industrial	20.00%	600	8,194	2.38	19,501	14
SA 4.2	63	B-Enterprise	Commerical / Industrial	20.00%	600	7,540	2.38	17,944	12
SA 4.3	55	B-Enterprise	Commerical / Industrial	20.00%	600	6,568	2.38	15,631	11
SA 4.4	52	B-Enterprise	Commerical / Industrial	20.00%	600	6,257	2.38	14,891	10
SA 4.5	52	B-Enterprise	Commerical / Industrial	20.00%	600	6,247	2.38	14,868	10
Flow from South Lateral into MH A						**94,720**		**225,433**	**157**
SA 1.26	43	C-Developing	Commerical / Industrial	20.00%	600	5,208	2.38	12,395	9
SA 1.27	19	C-Developing	Commerical / Industrial	20.00%	600	2,312	2.38	5,504	4
SA 1.28	17	C-Developing	Commerical / Industrial	20.00%	600	2,064	2.38	4,912	3
SA 1.29	76	C-Developing	Commerical / Industrial	20.00%	600	9,160	2.38	21,800	15
SA 1.30	82	C-Developing	Commerical / Industrial	20.00%	600	9,802	2.38	23,328	16
Total fow in this area (SA 1.26-1.30)						**28,546**		**67,939**	**47**
Flow from West Lateral into MH C						**420,228**		**1,000,142**	**695**
Total flow into MH C						**420,228**		**1,000,142**	**695**
SA 1.31	83	C-Developing	Commerical / Industrial	20.00%	600	9,949	2.38	23,679	16
SA 1.32	92	C-Developing	Commerical / Industrial	20.00%	600	11,023	2.38	26,235	18
SA 1.33	74	C-Developing	Commerical / Industrial	20.00%	600	8,878	2.38	21,129	15
SA 1.34	88	C-Developing	Commerical / Industrial	20.00%	600	10,568	2.38	25,153	17
SA 1.25	39	C-Developing	Commerical / Industrial	20.00%	600	4,694	2.38	11,173	8
Total flow in this area (SA 1.31-1.34, 1.25)						**45,113**		**107,368**	**75**
Flow from West Lateral into MH B						**465,340**		**1,107,510**	**769**
Total flow into MH B						**465,340**		**1,107,510**	**769**
SA 3.1	71	B-Developing	Residential	20.00%	800	11,402	2.38	27,136	19
SA 3.2	65	B-Developing	Residential	20.00%	800	10,451	2.38	24,874	17
SA 3.3	66	B-Developing	Residential	20.00%	800	10,483	2.38	24,950	17
SA 3.4	63	B-Developing	Residential	20.00%	800	10,149	2.38	24,154	17
SA 3.5	86	B-Developing	Residential	20.00%	800	13,762	2.38	32,753	23
SA 3.6	80	B-Developing	Residential	20.00%	800	12,832	2.38	30,540	21
SA 3.7	81	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 3.8	87	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 4.6	98	B-Enterprise	Commerical / Industrial	20.00%	600	11,782	2.38	28,040	19
SA 4.7	42	B-Enterprise	Commerical / Industrial	20.00%	600	5,009	2.38	11,921	8

SA 5.1	43	B-Developing	Commercial / Industrial	20.00%	600	5,202	2.38	12,381	9
SA 5.2	42	B-Developing	Commercial / Industrial	20.00%	600	5,038	2.38	11,989	8
SA 5.3	36	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.4	32	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.5	30	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.6	10	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.7	39	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.8	46	B-Developing	Commercial / Industrial	20.00%	600	5,532	2.38	13,166	9
SA 5.9	43	B-Developing	Commercial / Industrial	20.00%	600	5,140	2.38	12,232	8
SA 5.10	50	B-Developing	Commercial / Industrial	20.00%	600	5,980	2.38	14,231	10
SA 5.11	46	B-Developing	Commercial / Industrial	20.00%	600	5,466	2.38	13,009	9
SA 5.12	94	B-Developing	Commercial / Industrial	20.00%	600	11,299	2.38	26,892	19
SA 5.13	27	B-Developing	Commercial / Industrial	20.00%	600	3,264	2.38	7,768	5
SA 5.14	51	B-Developing	Commercial / Industrial	20.00%	600	6,125	2.38	14,577	10
SA 5.15	23	B-Developing	Commercial / Industrial	20.00%	600	2,767	2.38	6,586	5
SA 5.16	15	B-Developing	Commercial / Industrial	20.00%	600	1,794	2.38	4,270	3
SA 5.17	19	B-Developing	Commercial / Industrial	20.00%	600	2,248	2.38	5,349	4
SA 5.18	23	B-Developing	Commercial / Industrial	20.00%	600	2,802	2.38	6,669	5
SA 5.19	78	B-Developing	Commercial / Industrial	20.00%	600	9,322	2.38	22,185	15
SA 5.20	12	B-Developing	Commercial / Industrial	20.00%	600	1,474	2.38	3,507	2
Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)						**159,320**		**379,181**	**263**
Flow from West Lateral into MH A						**624,660**		**1,486,691**	**1,032**
Flow from South Lateral into MH A						**94,720**		**225,433**	**157**
Total flow into East WW Lift Station						**719,380**		**1,712,123**	**1,189**

D.4 Estimated Wastewater Flows – 2078

Cochise County - City of Douglas 30% Port-Of-Entry Design

May-22

Summary of Land Development Planning Areas within the POE WW Service Area (East Wastewater Lift Station)

Areas in yellow are in the floodplain zone

Areas in green are NOT in the POE service area

Estimated WW Flows on 2078 - 50-yr Development

Note 1: Assumed startup of the wastewater collection system is based on GSA schedule is 2078

SUB AREAS	ACRES	Land Use Designation	AZ Admin Code	% of Ultimate Development	Per Acre WW Generated (gal/acre/day)	Avg Day Design Flow (gpd)	Peaking Factor	Peak Flow (gpd)	Peak Flow (gpm)
SA 1.1	171	C-Developing	Commerical / Industrial	100.00%	600	102,552	2.38	244,074	169
SA 1.2	39	C-Developing	Commerical / Industrial	100.00%	600	23,664	2.38	56,320	39
SA 1.3	47	C-Developing	Commerical / Industrial	100.00%	600	28,164	2.38	67,030	47
SA 1.4	45	C-Developing	Commerical / Industrial	100.00%	600	26,808	2.38	63,803	44
SA 1.5	30	C-Developing	Commerical / Industrial	100.00%	600	17,862	2.38	42,512	30
SA 1.6	48	C-Developing	Commerical / Industrial	60.00%	600	17,150	2.38	40,818	28
SA 1.7	54	C-Developing	Commerical / Industrial	60.00%	600	19,314	2.38	45,967	32
SA 1.8	53	C-Developing	Commerical / Industrial	60.00%	600	19,026	2.38	45,282	31
SA 1.9	52	C-Developing	Commerical / Industrial	60.00%	600	18,756	2.38	44,639	31
SA 1.10	38	C-Developing	Commerical / Industrial	60.00%	600	13,554	2.38	32,259	22
Total flow into West WW Lift Station						**286,850**		**682,704**	**474**
SA 1.11	68	C-Developing	Commerical / Industrial	60.00%	600	24,365	2.38	57,988	40
SA 1.12	72	C-Developing	Commerical / Industrial	60.00%	600	26,078	2.38	62,067	43
SA 1.13	33	C-Developing	Commerical / Industrial	60.00%	600	12,049	2.38	28,677	20
SA 1.14	41	C-Developing	Commerical / Industrial	60.00%	600	14,702	2.38	34,992	24
SA 1.35	17	C-Developing	Commerical / Industrial	60.00%	600	6,091	2.38	14,497	10
SA 2.1	95	C-Developing	Commerical / Industrial	60.00%	600	34,358	2.38	81,773	57
SA 2.2	24	C-Developing	Commerical / Industrial	60.00%	600	8,503	2.38	20,238	14
Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)						**126,148**		**300,231**	**208**
Flow from South Lateral into MH E						**412,998**		**982,935**	**683**
Flow from West Lateral (Cochise College) into MH E						**50,000**		**119,000**	**83**
Total flow into MH E						**462,998**		**1,101,935**	**765**
SA 1.15	42	C-Developing	Commerical / Industrial	45.00%	600	11,254	2.38	26,784	19
SA 1.16	41	C-Developing	Commerical / Industrial	45.00%	600	11,048	2.38	26,295	18
SA 1.17	42	C-Developing	Commerical / Industrial	45.00%	600	11,448	2.38	27,246	19
SA 1.18	39	C-Developing	Commerical / Industrial	45.00%	600	10,643	2.38	25,331	18
SA 1.19	41	C-Developing	Commerical / Industrial	45.00%	600	11,156	2.38	26,552	18
SA 1.20	16	C-Developing	Commerical / Industrial	45.00%	600	4,436	2.38	10,558	7
SA 1.21	74	C-Developing	Commerical / Industrial	45.00%	600	20,112	2.38	47,867	33
SA 1.22	73	C-Developing	Commerical / Industrial	45.00%	600	19,694	2.38	46,871	33
SA 1.23	63	C-Developing	Commerical / Industrial	45.00%	600	16,978	2.38	40,407	28
SA 1.24	57	C-Developing	Commerical / Industrial	45.00%	600	15,447	2.38	36,763	26
SA 1.36	10	C-Developing	Commerical / Industrial	45.00%	600	2,592	2.38	6,169	4
SA 4.1	68	B-Enterprise	Commerical / Industrial	45.00%	600	18,436	2.38	43,877	30
SA 4.2	63	B-Enterprise	Commerical / Industrial	45.00%	600	16,964	2.38	40,375	28
SA 4.3	55	B-Enterprise	Commerical / Industrial	45.00%	600	14,777	2.38	35,169	24
SA 4.4	52	B-Enterprise	Commerical / Industrial	45.00%	600	14,078	2.38	33,505	23
SA 4.5	52	B-Enterprise	Commerical / Industrial	45.00%	600	14,056	2.38	33,454	23
Flow from South Lateral into MH A						**213,119**		**507,223**	**352**
SA 1.26	43	C-Developing	Commerical / Industrial	45.00%	600	11,718	2.38	27,889	19
SA 1.27	19	C-Developing	Commerical / Industrial	45.00%	600	5,203	2.38	12,383	9
SA 1.28	17	C-Developing	Commerical / Industrial	45.00%	600	4,644	2.38	11,053	8
SA 1.29	76	C-Developing	Commerical / Industrial	45.00%	600	20,609	2.38	49,050	34
SA 1.30	82	C-Developing	Commerical / Industrial	45.00%	600	22,054	2.38	52,488	36
Total fow in this area (SA 1.26-1.30)						**64,228**		**152,862**	**106**
Flow from West Lateral into MH C						**527,226**		**1,254,797**	**871**
Total flow into MH C						**527,226**		**1,254,797**	**871**
SA 1.31	83	C-Developing	Commerical / Industrial	45.00%	600	22,386	2.38	53,278	37
SA 1.32	92	C-Developing	Commerical / Industrial	45.00%	600	24,802	2.38	59,029	41
SA 1.33	74	C-Developing	Commerical / Industrial	45.00%	600	19,975	2.38	47,540	33
SA 1.34	88	C-Developing	Commerical / Industrial	45.00%	600	23,779	2.38	56,594	39
SA 1.25	39	C-Developing	Commerical / Industrial	45.00%	600	10,562	2.38	25,139	17
Total flow in this area (SA 1.31-1.34, 1.25)						**101,504**		**241,579**	**168**
Flow from West Lateral into MH B						**628,729**		**1,496,376**	**1,039**
Total flow into MH B						**628,729**		**1,496,376**	**1,039**
SA 3.1	71	B-Developing	Residential	45.00%	800	25,654	2.38	61,056	42
SA 3.2	65	B-Developing	Residential	45.00%	800	23,515	2.38	55,966	39
SA 3.3	66	B-Developing	Residential	45.00%	800	23,587	2.38	56,138	39
SA 3.4	63	B-Developing	Residential	45.00%	800	22,835	2.38	54,347	38
SA 3.5	86	B-Developing	Residential	45.00%	800	30,964	2.38	73,693	51
SA 3.6	80	B-Developing	Residential	45.00%	800	28,872	2.38	68,715	48
SA 3.7	81	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 3.8	87	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 4.6	98	B-Enterprise	Commerical / Industrial	45.00%	600	26,509	2.38	63,090	44
SA 4.7	42	B-Enterprise	Commerical / Industrial	45.00%	600	11,270	2.38	26,822	19

SA 5.1	43	B-Developing	Commercial / Industrial	45.00%	600	11,705	2.38	27,857	19
SA 5.2	42	B-Developing	Commercial / Industrial	45.00%	600	11,335	2.38	26,976	19
SA 5.3	36	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.4	32	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.5	30	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.6	10	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.7	39	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.8	46	B-Developing	Commercial / Industrial	45.00%	600	12,447	2.38	29,624	21
SA 5.9	43	B-Developing	Commercial / Industrial	45.00%	600	11,564	2.38	27,523	19
SA 5.10	50	B-Developing	Commercial / Industrial	45.00%	600	13,454	2.38	32,021	22
SA 5.11	46	B-Developing	Commercial / Industrial	45.00%	600	12,299	2.38	29,270	20
SA 5.12	94	B-Developing	Commercial / Industrial	45.00%	600	25,423	2.38	60,507	42
SA 5.13	27	B-Developing	Commercial / Industrial	45.00%	600	7,344	2.38	17,479	12
SA 5.14	51	B-Developing	Commercial / Industrial	45.00%	600	13,781	2.38	32,798	23
SA 5.15	23	B-Developing	Commercial / Industrial	45.00%	600	6,226	2.38	14,818	10
SA 5.16	15	B-Developing	Commercial / Industrial	45.00%	600	4,037	2.38	9,607	7
SA 5.17	19	B-Developing	Commercial / Industrial	45.00%	600	5,057	2.38	12,036	8
SA 5.18	23	B-Developing	Commercial / Industrial	45.00%	600	6,305	2.38	15,005	10
SA 5.19	78	B-Developing	Commercial / Industrial	45.00%	600	20,974	2.38	49,917	35
SA 5.20	12	B-Developing	Commercial / Industrial	45.00%	600	3,316	2.38	7,891	5
Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)						**358,469**		**853,156**	**592**
Flow from West Lateral into MH A						**987,199**		**2,349,532**	**1,632**
Flow from South Lateral into MH A						**213,119**		**507,223**	**352**
Total flow into East WW Lift Station						**1,200,318**		**2,856,756**	**1,984**

D.5 Estimated Wastewater Flows - Full Buildout

Cochise County - City of Douglas 30% Port-Of-Entry Design

May-22

Summary of Land Development Planning Areas within the POE WW Service Area (East Wastewater Lift Station)

Areas in yellow are in the floodplain zone

Areas in green are NOT in the POE planning area

Estimated WW Flows at 100% Development - Full Buildout									
Note 1: Assumed startup of the wastewater collection system is based on GSA schedule is Full Buildout									
SUB AREAS	**ACRES**	**Land Use Designation**	**AZ Admin Code**	**% of Ultimate Development**	**Per Acre WW Generated (gal / acre)**	**Avg Day Design Flow (gpd)**	**Peaking Factor**	**Peak Flow (gpd)**	**Peak Flow (gpm)**
SA 1.1	171	C-Developing	Commerical / Industrial	100.00%	600	102,552	2.38	244,074	169
SA 1.2	39	C-Developing	Commerical / Industrial	100.00%	600	23,664	2.38	56,320	39
SA 1.3	47	C-Developing	Commerical / Industrial	100.00%	600	28,164	2.38	67,030	47
SA 1.4	45	C-Developing	Commerical / Industrial	100.00%	600	26,808	2.38	63,803	44
SA 1.5	30	C-Developing	Commerical / Industrial	100.00%	600	17,862	2.38	42,512	30
SA 1.6	48	C-Developing	Commerical / Industrial	100.00%	600	28,584	2.38	68,030	47
SA 1.7	54	C-Developing	Commerical / Industrial	100.00%	600	32,190	2.38	76,612	53
SA 1.8	53	C-Developing	Commerical / Industrial	100.00%	600	31,710	2.38	75,470	52
SA 1.9	52	C-Developing	Commerical / Industrial	100.00%	600	31,260	2.38	74,399	52
SA 1.10	38	C-Developing	Commerical / Industrial	100.00%	600	22,590	2.38	53,764	37
Total flow into West WW Lift Station						**345,384**		**822,014**	**571**
SA 1.11	68	C-Developing	Commerical / Industrial	100.00%	600	40,608	2.38	96,647	67
SA 1.12	72	C-Developing	Commerical / Industrial	100.00%	600	43,464	2.38	103,444	72
SA 1.13	33	C-Developing	Commerical / Industrial	100.00%	600	20,082	2.38	47,795	33
SA 1.14	41	C-Developing	Commerical / Industrial	100.00%	600	24,504	2.38	58,320	40
SA 1.35	17	C-Developing	Commerical / Industrial	100.00%	600	10,152	2.38	24,162	17
SA 2.1	95	C-Developing	Commerical / Industrial	100.00%	600	57,264	2.38	136,288	95
SA 2.2	24	C-Developing	Commerical / Industrial	100.00%	600	14,172	2.38	33,729	23
Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)						**210,246**		**500,385**	**347**
Flow from South Lateral into MH E						**555,630**		**1,322,399**	**918**
Flow from West Lateral (Cochise College) into MH E						**50,000**		**119,000**	**83**
Total flow into MH E						**605,630**		**1,441,399**	**1,001**
SA 1.15	42	C-Developing	Commerical / Industrial	100.00%	600	25,008	2.38	59,519	41
SA 1.16	41	C-Developing	Commerical / Industrial	100.00%	600	24,552	2.38	58,434	41
SA 1.17	42	C-Developing	Commerical / Industrial	100.00%	600	25,440	2.38	60,547	42
SA 1.18	39	C-Developing	Commerical / Industrial	100.00%	600	23,652	2.38	56,292	39
SA 1.19	41	C-Developing	Commerical / Industrial	100.00%	600	24,792	2.38	59,005	41
SA 1.20	16	C-Developing	Commerical / Industrial	100.00%	600	9,858	2.38	23,462	16
SA 1.21	74	C-Developing	Commerical / Industrial	100.00%	600	44,694	2.38	106,372	74
SA 1.22	73	C-Developing	Commerical / Industrial	100.00%	600	43,764	2.38	104,158	72
SA 1.23	63	C-Developing	Commerical / Industrial	100.00%	600	37,728	2.38	89,793	62
SA 1.24	57	C-Developing	Commerical / Industrial	100.00%	600	34,326	2.38	81,696	57
SA 1.36	10	C-Developing	Commerical / Industrial	100.00%	600	5,760	2.38	13,709	10
SA 4.1	68	B-Enterprise	Commerical / Industrial	100.00%	600	40,968	2.38	97,504	68
SA 4.2	63	B-Enterprise	Commerical / Industrial	100.00%	600	37,698	2.38	89,721	62
SA 4.3	55	B-Enterprise	Commerical / Industrial	100.00%	600	32,838	2.38	78,154	54
SA 4.4	52	B-Enterprise	Commerical / Industrial	100.00%	600	31,284	2.38	74,456	52
SA 4.5	52	B-Enterprise	Commerical / Industrial	100.00%	600	31,236	2.38	74,342	52
Flow from South Lateral into MH A						**473,598**		**1,127,163**	**783**
SA 1.26	43	C-Developing	Commerical / Industrial	100.00%	600	26,040	2.38	61,975	43
SA 1.27	19	C-Developing	Commerical / Industrial	100.00%	600	11,562	2.38	27,518	19
SA 1.28	17	C-Developing	Commerical / Industrial	100.00%	600	10,320	2.38	24,562	17
SA 1.29	76	C-Developing	Commerical / Industrial	100.00%	600	45,798	2.38	108,999	76
SA 1.30	82	C-Developing	Commerical / Industrial	100.00%	600	49,008	2.38	116,639	81
Total fow in this area (SA 1.26-1.30)						**142,728**		**339,693**	**236**
Flow from West Lateral into MH C						**748,358**		**1,781,092**	**1,237**
Total flow into MH C						**748,358**		**1,781,092**	**1,237**
SA 1.31	83	C-Developing	Commerical / Industrial	100.00%	600	49,746	2.38	118,395	82
SA 1.32	92	C-Developing	Commerical / Industrial	100.00%	600	55,116	2.38	131,176	91
SA 1.33	74	C-Developing	Commerical / Industrial	100.00%	600	44,388	2.38	105,643	73
SA 1.34	88	C-Developing	Commerical / Industrial	100.00%	600	52,842	2.38	125,764	87
SA 1.25	39	C-Developing	Commerical / Industrial	100.00%	600	23,472	2.38	55,863	39
Total flow in this area (SA 1.31-1.34, 1.25)						**225,564**		**536,842**	**373**
Flow from West Lateral into MH B						**973,922**		**2,317,934**	**1,610**
Total flow into MH B						**973,922**		**2,317,934**	**1,610**
SA 3.1	71	B-Developing	Residential	100.00%	800	57,008	2.38	135,679	94
SA 3.2	65	B-Developing	Residential	100.00%	800	52,256	2.38	124,369	86
SA 3.3	66	B-Developing	Residential	100.00%	800	52,416	2.38	124,750	87
SA 3.4	63	B-Developing	Residential	100.00%	800	50,744	2.38	120,771	84
SA 3.5	86	B-Developing	Residential	100.00%	800	68,808	2.38	163,763	114
SA 3.6	80	B-Developing	Residential	100.00%	800	64,160	2.38	152,701	106
SA 3.7	81	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 3.8	87	B-Developing	Residential	0.00%	800	0	2.38	0	0
SA 4.6	98	B-Enterprise	Commerical / Industrial	100.00%	600	58,908	2.38	140,201	97
SA 4.7	42	B-Enterprise	Commerical / Industrial	100.00%	600	25,044	2.38	59,605	41
SA 5.1	43	B-Developing	Commerical / Industrial	100.00%	600	26,010	2.38	61,904	43
SA 5.2	42	B-Developing	Commerical / Industrial	100.00%	600	25,188	2.38	59,947	42
SA 5.3	36	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0

SA 5.4	32	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.5	30	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.6	10	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.7	39	B-Developing	Commercial / Industrial	0.00%	600	0	2.38	0	0
SA 5.8	46	B-Developing	Commercial / Industrial	100.00%	600	27660	2.38	65830.8	46
SA 5.9	43	B-Developing	Commercial / Industrial	100.00%	600	25698	2.38	61161.24	42
SA 5.10	50	B-Developing	Commercial / Industrial	100.00%	600	29898	2.38	71157.24	49
SA 5.11	46	B-Developing	Commercial / Industrial	100.00%	600	27330	2.38	65045.4	45
SA 5.12	94	B-Developing	Commercial / Industrial	100.00%	600	56496	2.38	134460.48	93
SA 5.13	27	B-Developing	Commercial / Industrial	100.00%	600	16320	2.38	38841.6	27
SA 5.14	51	B-Developing	Commercial / Industrial	100.00%	600	30624	2.38	72885.12	51
SA 5.15	23	B-Developing	Commercial / Industrial	100.00%	600	13836	2.38	32929.68	23
SA 5.16	15	B-Developing	Commercial / Industrial	100.00%	600	8970	2.38	21348.6	15
SA 5.17	19	B-Developing	Commercial / Industrial	100.00%	600	11238	2.38	26746.44	19
SA 5.18	23	B-Developing	Commercial / Industrial	100.00%	600	14010	2.38	33343.8	23
SA 5.19	78	B-Developing	Commercial / Industrial	100.00%	600	46608	2.38	110927.04	77
SA 5.20	12	B-Developing	Commercial / Industrial	100.00%	600	7368	2.38	17535.84	12
Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)						**796,598**		**1,895,903**	**1,317**
Flow from West Lateral into MH A						**1,770,520**		**4,213,838**	**2,926**
Flow from South Lateral into MH A						**473,598**		**1,127,163**	**783**
Total flow into East WW Lift Station						**2,244,118**		**5,341,001**	**3,709**

Appendix E FlowMaster Results - Pipe Diameter Sizing

E.1 FlowMaster Results (Peak Flow Basis) – 2078

Total Flows - Downstream to Up Stream

	MH Number	Description - Location of Flow	AVG. Day Design Flow (GAL / DAY)					Peak Flow (GAL / MIN)					Peak Flow (GAL / DAY)		
			2028	2033	2053	2078	Full Buildout	2028	2033	2053	2078	Full Buildout	2078	2053	Full Buildout
15	East WW Lift Station	Total flow into East WW Lift Station	**79,018**	**190,144**	**660,429**	**1,067,679**	**1,949,366**	**131**	**314**	**1,092**	**1,765**	**3,222**	2,541,076	1,571,821	4,639,491
14	MH A	Flow from South Lateral into MH A	1,250	1,250	94,720	213,119	473,598	2	2	157	352	783	507,223	225,433	1,127,163
13		Flow from MH B (West) into MH A	77,767	188,893	565,710	854,560	1,475,768	129	312	935	1,412	2,439	2,033,853	1,346,389	3,512,328
12		Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,	2,850	2,850	100,369	225,831	501,846	5	5	166	373	829	537,477	238,879	1,194,393
11	MH B	Total flow into MH B	74,917	186,043	465,340	628,729	973,922	124	307	769	1,039	1,610	1,496,376	1,107,510	2,317,934
10		Flow from West Lateral into MH B	74,917	186,043	465,340	628,729	973,922	124	307	769	1,039	1,610	1,496,376	1,107,510	2,317,934
9		Total flow in this area (SA 1.31-1.34, 1.25)	2,487	2,487	45,113	101,504	225,564	4	4	75	168	373	241,579	107,368	536,842
8	MH C	Total flow into MH C**	72,430	183,556	420,228	527,226	748,358	120	303	695	871	1,237	1,254,797	1,000,142	1,781,092
7		Flow from West Lateral into MH C	72,430	183,556	420,228	527,226	748,358	120	303	695	871	1,237	1,254,797	1,000,142	1,781,092
6		Total fow in this area (SA 1.26-1.30)	1,302	1,302	28,546	64,228	142,728	2	2	47	106	236	152,862	67,939	339,693
5	MH E	Total flow into MH E*	71,128	182,254	391,682	462,998	605,630	118	301	647	765	1,001	1,101,935	932,203	1,441,399
4		Flow from West Lateral (Cochise College) in	15,000	15,000	50,000	50,000	50,000	25	25	83	83	83	119,000	119,000	119,000
3		Flow from MH G (South) into MH E	56,128	167,254	341,682	412,998	555,630	93	276	565	683	918	982,935	813,203	1,322,399
2		Total flow in this area (SA 1.11-1.14, 1.35, 2	16,318	58,367	84,098	126,148	210,246	27	96	139	208	347	300,231	200,154	500,385
1	West WW Lift Station	Total flow into West WW Lift Station***	39,810	108,887	257,584	286,850	345,384	**66**	**180**	**426**	**474**	**571**	682,704	613,049	822,014

***Total flow in pipe segment MH E - MH D**
**** Total flow in pipe segment MH D - MH C**
***** Total flow into MH A**

2078 Peak Flow

Discahrge (cfs)	Discharge (gpd)	Discharge (gpd)	Slope
3.93	2541076.50	**2,541,100**	0.60%
0.78	507223.46	**507,300**	0.60%
3.15	2033853.04	**2,033,900**	0.60%
0.83	537477.07	**537,500**	-
2.32	1496375.97	**1,496,400**	0.60%
2.32	1496375.97	**1,496,400**	-
0.37	241579.04	**241,600**	-
1.94	1254796.93	**1,254,800**	0.50%
1.94	1254796.93	**1,254,800**	-
0.24	152861.69	**152,900**	-
1.71	1101935.24	**1,102,000**	0.25%
0.18	119000.00	**119,000**	0.93%
1.52	982935.24	**983,000**	0.25%
0.46	300231.29	**300,300**	-
1.06	682703.95	**682,800**	0.27%

2078 PF				Input Data						Results								
18"	Discharge (gpd) (roundup)	Connection	Slope	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gpd)	Velocity (ft/s)	Velocity Head (ft)	Flow Area (ft2)	Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Maximum Discharge (gpd)	Discharge Full (gpd)	Slope Full (ft/ft)	Flow Type
MH A - PSE	2,541,100	Total flow into East WW Lift Station	0.60%	0.013	0.006	8.8	18	2,541,100.00	4.57	0.32	0.9	9.1	49	0.005	5,656,654.90	5,258,551.69	0.001	Supercritical
	507,300	Flow from South Lateral into MH A	0.60%	0.013	0.006	3.8	18	507,300.00	2.91	0.13	0.3	4	21	0.005	5,656,654.90	5,258,551.69	0	Supercritical
MH B - MH A	2,033,900	Flow from MH B (West) into MH A	0.60%	0.013	0.006	7.8	18	2,033,900.00	4.31	0.29	0.7	8.1	43.2	0.005	5,656,654.90	5,258,551.69	0.001	Supercritical
	537,500	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-															
MH C - MH B	1,496,400	Total flow into MH B	0.60%	0.013	0.006	6.6	18	1496400	3.97	0.24	0.6	6.9	36.5	0.005	5656654.9	5258551.69	0	Supercritical
	1,496,400	Flow from West Lateral into MH B	-															
	241,600	Total flow in this area (SA 1.31-1.34, 1.25)	-															
MH D - MH C	1,254,800	Total flow into MH C**	0.50%	0.013	0.005	6.3	18	1254800	3.54	0.19	0.5	6.3	34.9	0.005	5163795.82	4800378.96	0	Supercritical
	1,254,800	Flow from West Lateral into MH C	-															
	152,900	Total fow in this area (SA 1.26-1.30)	-															
MH E - MH D	1,102,000	Total flow into MH E*	0.25%	0.013	0.003	7.1	18	1,102,000.00	2.65	0.11	0.6	5.9	39.2	0.005	3,651,355.04	3,394,380.52	0	Subcritical
MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	1.7	18	119,000.00	2.21	0.08	0.1	1.9	9.3	0.006	7,042,478.56	6,546,844.05	0	Supercritical
MH G - MH E	983,000	Flow from MH G (South) into MH E	0.25%	0.013	0.003	6.6	18	983,000.00	2.57	0.1	0.6	5.6	36.9	0.005	3,651,355.04	3,394,380.52	0	Subcritical
	300,300	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-															
MH H - PSW	682,800	Total flow into West WW Lift Station***	0.27%	0.013	0.003	5.4	18	682,800.00	2.39	0.09	0.4	4.6	29.8	0.005	3,794,599.46	3,527,543.71	0	Subcritical

2078 PF				Input Data						Results								
16"	Discharge (gpd) (roundup)	Connection	Slope	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gpd)	Velocity (ft/s)	Velocity Head (ft)	Flow Area (ft2)	Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Maximum Discharge (gpd)	Discharge Full (gpd)	Slope Full (ft/ft)	Flow Type
MH A - PSE	2,541,100	Total flow into East WW Lift Station	0.60%	0.013	0.006	9.5	16	2,541,100.00	4.55	0.32	0.9	9.4	59.4	0.006	4,131,930.02	3,841,133.67	0.003	Subcritical

	507,300	Flow from South Lateral into MH A	0.60%	0.013	0.006	3.9	16	507,300.00	2.95	0.14	0.3	4.1	24.5	0.005	4,131,930.02	3,841,133.67	0	Supercritical
MH B - MH A	2,033,900	Flow from MH B (West) into MH A	0.60%	0.013	0.006	8.3	16	2,033,900.00	4.32	0.29	0.7	8.4	51.7	0.006	4,131,930.02	3,841,133.67	0.002	Supercritical
	537,500	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-	0														
MH C - MH B	1,496,400	Total flow into MH B	0.60%	0.013	0.006	6.9	16	1496400	3.99	0.25	0.6	7.2	43.4	0.005	4131930.02	3841133.67	0.001	Supercritical
	1,496,400	Flow from West Lateral into MH B	-	0														
	241,600	Total flow in this area (SA 1.31-1.34, 1.25)	-	0														
MH D - MH C	1,254,800	Total flow into MH C**	0.50%	0.013	0.005	6.6	16	1254800	3.56	0.2	0.5	6.5	41.4	0.005	3771918.8	3506459.26	0.001	Subcritical
	1,254,800	Flow from West Lateral into MH C	-	0														
	152,900	Total fow in this area (SA 1.26-1.30)	-	0														
MH E - MH D	1,102,000	Total flow into MH E*	0.25%	0.013	0.003	7.5	16	1,102,000.00	2.67	0.11	0.6	6.1	46.7	0.005	2,667,149.36	2,479,441.12	0	Subcritical
MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	1.7	16	119,000.00	2.24	0.08	0.1	2	10.9	0.006	5,144,211.39	4,782,172.85	0	Supercritical
MH G - MH E	983,000	Flow from MH G (South) into MH E	0.25%	0.013	0.003	7	16	983,000.00	2.59	0.1	0.6	5.8	43.8	0.005	2,667,149.36	2,479,441.12	0	Subcritical
	300,300	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-	0														
MH H - PSW	682,800	Total flow into West WW Lift Station***	0.27%	0.013	0.003	5.6	16	682,800.00	2.41	0.09	0.4	4.8	35.1	0.005	2,771,782.92	2,576,710.80	0	Subcritical

2078 PF				Input Data							Results							
15"	Discharge (gpd) (roundup)	Connection	Slope	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gpd)	Velocity (ft/s)	Velocity Head (ft)	Flow Area (ft2)	Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Maximum Discharge (gpd)	Discharge Full (gpd)	Slope Full (ft/ft)	Flow Type
MH A - PSE	2,541,100	Total flow into East WW Lift Station	0.60%	0.013	0.006	10	15	2,541,100.00	4.52	0.32	0.9	9.6	66.8	0.007	3,478,641.67	3,233,822.34	0.004	Subcritical
	507,300	Flow from South Lateral into MH A	0.60%	0.013	0.006	4	15	507,300.00	2.97	0.14	0.3	4.2	26.8	0.005	3,478,641.67	3,233,822.34	0	Supercritical
MH B - MH A	2,033,900	Flow from MH B (West) into MH A	0.60%	0.013	0.006	8.6	15	2,033,900.00	4.31	0.29	0.7	8.6	57.5	0.006	3,478,641.67	3,233,822.34	0.002	Subcritical
	537,500	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-	0														
MH C - MH B	1,496,400	Total flow into MH B	0.60%	0.013	0.006	7.2	15	1496400	4	0.25	0.6	7.3	47.8	0.006	3478641.67	3233822.34	0.001	Supercritical
	1,496,400	Flow from West Lateral into MH B	-	0														
	241,600	Total flow in this area (SA 1.31-1.34, 1.25)	-	0														
MH D - MH C	1,254,800	Total flow into MH C**	0.50%	0.013	0.005	6.8	15	1254800	3.57	0.2	0.5	6.7	45.5	0.005	3175550.85	2952062.41	0.001	Subcritical
	1,254,800	Flow from West Lateral into MH C	-	0														
	152,900	Total fow in this area (SA 1.26-1.30)	-	0														
MH E - MH D	1,102,000	Total flow into MH E*	0.25%	0.013	0.003	7.7	15	1,102,000.00	2.67	0.11	0.6	6.2	51.6	0.005	2,245,453.54	2,087,423.35	0.001	Subcritical
MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	1.8	15	119,000.00	2.26	0.08	0.1	2	11.8	0.006	4,330,873.95	4,026,076.35	0	Supercritical
MH G - MH E	983,000	Flow from MH G (South) into MH E	0.25%	0.013	0.003	7.2	15	983,000.00	2.59	0.1	0.6	5.9	48.3	0.005	2,245,453.54	2,087,423.35	0.001	Subcritical
	300,300	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-	0														
MH H - PSW	682,800	Total flow into West WW Lift Station***	0.27%	0.013	0.003	5.8	15	682,800.00	2.42	0.09	0.4	4.9	38.6	0.005	2,333,543.77	2,169,313.98	0	Subcritical

2078 PF				Input Data							Results							
12"	Discharge (gpd) (roundup)	Connection	Slope	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gpd)	Velocity (ft/s)	Velocity Head (ft)	Flow Area (ft2)	Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Maximum Discharge (gpd)	Discharge Full (gpd)	Slope Full (ft/ft)	Flow Type
MH A - PSE	2,541,100	Total flow into East WW Lift Station	ERROR															
	507,300	Flow from South Lateral into MH A	0.60%	0.013	0.006	4.4	12	507,300.00	3.03	0.14	0.3	4.4	36.5	0.006	1,918,593.61	1,783,567.11	0	Supercritical
MH B - MH A	2,033,900	Flow from MH B (West) into MH A	ERROR															
	537,500	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-	0														
MH C - MH B	1,496,400	Total flow into MH B	0.60%	0.013	0.006	8.4	12	1496400	3.94	0.24	0.6	7.8	70.1	0.007	1918593.61	1783567.11	0.004	Subcritical
	1,496,400	Flow from West Lateral into MH B	-	0														
	241,600	Total flow in this area (SA 1.31-1.34, 1.25)	-	0														
MH D - MH C	1,254,800	Total flow into MH C**	0.50%	0.013	0.005	7.9	12	1254800	3.54	0.19	0.5	7.1	65.9	0.007	1751428.33	1628166.57	0.003	Subcritical
	1,254,800	Flow from West Lateral into MH C	-	0														
	152,900	Total fow in this area (SA 1.26-1.30)	-	0														
MH E - MH D	1,102,000	Total flow into MH E*	0.25%	0.013	0.003	9.4	12	1,102,000.00	2.58	0.1	0.7	6.7	78.4	0.006	1,238,446.85	1,151,287.62	0.002	Subcritical

MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	1.9	12	119,000.00	2.33	0.08	0.1	2.1	15.7	0.006	2,388,629.78	2,220,523.15	0	Supercritical
MH G - MH E	983,000	Flow from MH G (South) into MH E	0.25%	0.013	0.003	8.5	12	983,000.00	2.55	0.1	0.6	6.3	71	0.006	1,238,446.85	1,151,287.62	0.002	Subcritical
	300,300	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-	0														
MH H - PSW	682,800	Total flow into West WW Lift Station***	0.27%	0.013	0.003	6.5	12	682,800.00	2.43	0.09	0.4	5.2	54.1	0.006	1,287,031.72	1,196,453.19	0.001	Subcritical

2078 PF				Input Data						Results								
10"	Discharge (gpd) (roundup)	Connection	Slope	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gpd)	Velocity (ft/s)	Velocity Head (ft)	Flow Area (ft2)	Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Maximum Discharge (gpd)	Discharge Full (gpd)	Slope Full (ft/ft)	Flow Type
MH A - PSE	2,541,100	Total flow into East WW Lift Station	ERROR	0														
	507,300	Flow from South Lateral into MH A	0.60%	0.013	0.006	4.8	10	507,300.00	3.05	0.14	0.3	4.7	47.8	0.006	1,179,866.86	1,096,830.37	0.001	Subcritical
MH B - MH A	2,033,900	Flow from MH B (West) into MH A	ERROR	0														
	537,500	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-	0														
MH C - MH B	1,496,400	Total flow into MH B	ERROR															
	1,496,400	Flow from West Lateral into MH B	-	0														
	241,600	Total flow in this area (SA 1.31-1.34, 1.25)	-	0														
MH D - MH C	1,254,800	Total flow into MH C**	ERROR															
	1,254,800	Flow from West Lateral into MH C	-	0														
	152,900	Total fow in this area (SA 1.26-1.30)	-	0														
MH E - MH D	1,102,000	Total flow into MH E*	ERROR															
MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	2	10	119,000.00	2.38	0.09	0.1	2.2	20	0.006	1,468,922.40	1,365,542.80	0	Supercritical
MH G - MH E	983,000	Flow from MH G (South) into MH E	ERROR															
	300,300	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-	0														
MH H - PSW	682,800	Total flow into West WW Lift Station***	0.27%	0.013	0.003	7.6	10	682,800.00	2.37	0.09	0.4	5.5	76.2	0.007	791,478.75	735,776.18	0.002	Subcritical

2078 PF				Input Data						Results								
8"	Discharge (gpd) (roundup)	Connection	Slope	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gpd)	Velocity (ft/s)	Velocity Head (ft)	Flow Area (ft2)	Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Maximum Discharge (gpd)	Discharge Full (gpd)	Slope Full (ft/ft)	Flow Type
MH A - PSE	2,541,100	Total flow into East WW Lift Station	ERROR	0														
	507,300	Flow from South Lateral into MH A	0.60%	0.013	0.006	5.6	8	507,300.00	3	0.14	0.3	5	70.1	0.008	650,738.20	604,940.65	0.004	Subcritical
MH B - MH A	2,033,900	Flow from MH B (West) into MH A	ERROR	0														
	537,500	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-	0														
MH C - MH B	1,496,400	Total flow into MH B	ERROR	0														
	1,496,400	Flow from West Lateral into MH B	-	0														
	241,600	Total flow in this area (SA 1.31-1.34, 1.25)	-	0														
MH D - MH C	1,254,800	Total flow into MH C**	ERROR	0														
	1,254,800	Flow from West Lateral into MH C	-	0														
	152,900	Total fow in this area (SA 1.26-1.30)	-	0														
MH E - MH D	1,102,000	Total flow into MH E*	ERROR	0														
MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	2.2	8	119,000.00	2.44	0.09	0.1	2.4	26.9	0.006	810,162.53	753,145.03	0	Supercritical
MH G - MH E	983,000	Flow from MH G (South) into MH E	ERROR	0														
	300,300	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-	0														
MH H - PSW	682,800	Total flow into West WW Lift Station***	ERROR	0.013														

2078 PF - update 6/15/2022 with slope from MH E to MH D changed to .0028	Input Data	Results

12"	Discharge (gpd) (roundup)	Connection	Slope	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gpd)	Velocity (ft/s)	Velocity Head (ft)	Flow Area (ft2)	Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Maximum Discharge (gpd)	Discharge Full (gpd)	Slope Full (ft/ft)	Flow Type
MH E - MH D	1,102,000	Total flow into MH E*	0.28%	0.013	0.003	8.9	12	1,102,000.00	2.72	0.11	0.6	6.7	74.5	0.006	1,310,648.95	1,218,408.29	0.002	Subcritical

E.2 FlowMaster Results (Peak Flow Basis) – 2053

Total Flows - Downstream to Up Stream

	MH Number	Description - Location of Flow	AVG. Day Design Flow (GAL / DAY)					Peak Flow (GAL / MIN)					Peak Flow (GAL / DAY)		
			2028	2033	2053	2078	Full Buildout	2028	2033	2053	2078	Full Buildout	2078	2053	Full Buildout
15	East WW Lift Station	Total flow into East WW Lift Station	**79,018**	**190,144**	**660,429**	**1,067,679**	**1,949,366**	**131**	**314**	**1,092**	**1,765**	**3,222**	2,541,076	1,571,821	4,639,491
14	MH A	Flow from South Lateral into MH A	1,250	1,250	94,720	213,119	473,598	2	2	157	352	783	507,223	225,433	1,127,163
13		Flow from MH B (West) into MH A	77,767	188,893	565,710	854,560	1,475,768	129	312	935	1,412	2,439	2,033,853	1,346,389	3,512,328
12		Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	2,850	2,850	100,369	225,831	501,846	5	5	166	373	829	537,477	238,879	1,194,393
11	MH B	Total flow into MH B	74,917	186,043	465,340	628,729	973,922	124	307	769	1,039	1,610	1,496,376	1,107,510	2,317,934
10		Flow from West Lateral into MH B	74,917	186,043	465,340	628,729	973,922	124	307	769	1,039	1,610	1,496,376	1,107,510	2,317,934
9		Total flow in this area (SA 1.31-1.34, 1.25)	2,487	2,487	45,113	101,504	225,564	4	4	75	168	373	241,579	107,368	536,842
8	MH C	Total flow into MH C**	72,430	183,556	420,228	527,226	748,358	120	303	695	871	1,237	1,254,797	1,000,142	1,781,092
7		Flow from West Lateral into MH C	72,430	183,556	420,228	527,226	748,358	120	303	695	871	1,237	1,254,797	1,000,142	1,781,092
6		Total fow in this area (SA 1.26-1.30)	1,302	1,302	28,546	64,228	142,728	2	2	47	106	236	152,862	67,939	339,693
5	MH E	Total flow into MH E*	71,128	182,254	391,682	462,998	605,630	118	301	647	765	1,001	1,101,935	932,203	1,441,399
4		Flow from West Lateral (Cochise College) into MH E	15,000	15,000	50,000	50,000	50,000	25	25	83	83	83	119,000	119,000	119,000
3		Flow from MH G (South) into MH E	56,128	167,254	341,682	412,998	555,630	93	276	565	683	918	982,935	813,203	1,322,399
2		Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	16,318	58,367	84,098	126,148	210,246	27	96	139	208	347	300,231	200,154	500,385
1	West WW Lift Station	Total flow into West WW Lift Station***	39,810	108,887	257,584	286,850	345,384	**66**	**180**	**426**	**474**	**571**	682,704	613,049	822,014

***Total flow in pipe segment MH E - MH D**
**** Total flow in pipe segment MH D - MH C**
***** Total flow into MH A**

2053 Peak Flow

Discahrge (cfs)	Discharge (gpd)	Discharge (gpd)	Slope
2.43	1571821.50	**1,571,900**	0.60%
0.35	225432.65	**225,500**	0.60%
2.08	1346388.85	**1,346,400**	0.60%
0.37	238878.70	**238,900**	-
1.71	1107510.15	**1,107,600**	0.60%
1.71	1107510.15	**1,107,600**	-
0.17	107368.46	**107,400**	-
1.55	1000141.69	**1,000,200**	0.50%
1.55	1000141.69	**1,000,200**	-
0.11	67938.53	**68,000**	-
1.44	932203.16	**932,300**	0.25%
0.18	119000.00	**119,000**	0.93%
1.26	813203.16	**813,300**	0.25%
0.31	200154.19	**200,200**	-
0.95	613048.97	**613,100**	0.27%

2053 PF				Input Data					Results									
18"	Discharge (gpd) (roundup)	Connection	Slope	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gpd)	Velocity (ft/s)	Velocity Head (ft)	Flow Area (ft2)	Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Maximum Discharge (gpd)	Discharge Full (gpd)	Slope Full (ft/ft)	Flow Type
MH A - PSE	1,571,900	Total flow into East WW Lift Station	0.60%	0.013	0.006	6.7	18	1,571,900.00	4.02	0.25	0.6	7.1	37.5	0.005	5,656,654.90	5,258,551.69	0.001	Supercritical
	225,500	Flow from South Lateral into MH A	0.60%	0.013	0.006	2.5	18	225,500.00	2.29	0.08	0.2	2.6	14.1	0.005	5,656,654.90	5,258,551.69	0	Supercritical
MH B - MH A	1,346,400	Flow from MH B (West) into MH A	0.60%	0.013	0.006	6.2	18	1,346,400.00	3.85	0.23	0.5	6.5	34.5	0.005	5,656,654.90	5,258,551.69	0	Supercritical
	238,900	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-															
MH C - MH B	1,107,600	Total flow into MH B	0.60%	0.013	0.006	5.6	18	1107600	3.65	0.21	0.5	5.9	31.2	0.005	5656654.9	5258551.69	0	Supercritical
	1,107,600	Flow from West Lateral into MH B	-															
	107,400	Total flow in this area (SA 1.31-1.34, 1.25)	-															
MH D - MH C	1,000,200	Total flow into MH C**	0.50%	0.013	0.005	5.6	18	1000200	3.32	0.17	0.5	5.6	31	0.005	5163795.82	4800378.96	0	Supercritical
	1,000,200	Flow from West Lateral into MH C	-															
	68,000	Total fow in this area (SA 1.26-1.30)	-															
MH E - MH D	932,300	Total flow into MH E*	0.25%	0.013	0.003	6.4	18	932,300.00	2.54	0.1	0.6	5.4	35.8	0.005	3,651,355.04	3,394,380.52	0	Subcritical
MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	1.7	18	119,000.00	2.21	0.08	0.1	1.9	9.3	0.006	7,042,478.56	6,546,844.05	0	Supercritical
MH G - MH E	813,300	Flow from MH G (South) into MH E	0.25%	0.013	0.003	6	18	813,300.00	2.44	0.09	0.5	5	33.3	0.005	3,651,355.04	3,394,380.52	0	Subcritical
	200,200	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-															
MH H - PSW	613,100	Total flow into West WW Lift Station***	0.27%	0.013	0.003	5.1	18	613,100.00	2.32	0.08	0.4	4.4	28.2	0.005	3,794,599.46	3,527,543.71	0	Subcritical

2053 PF				Input Data					Results									
16"	Discharge (gpd) (roundup)	Connection	Slope	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gpd)	Velocity (ft/s)	Velocity Head (ft)	Flow Area (ft2)	Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Maximum Discharge (gpd)	Discharge Full (gpd)	Slope Full (ft/ft)	Flow Type
MH A - PSE	1,571,900	Total flow into East WW Lift Station	0.60%	0.013	0.006	7.1	16	1,571,900.00	4.04	0.25	0.6	7.3	44.6	0.005	4,131,930.02	3,841,133.67	0.001	Supercritical
	225,500	Flow from South Lateral into MH A	0.60%	0.013	0.006	2.6	16	225,500.00	2.33	0.08	0.1	2.7	16.4	0.005	4,131,930.02	3,841,133.67	0	Supercritical
MH B - MH A	1,346,400	Flow from MH B (West) into MH A	0.60%	0.013	0.006	6.5	16	1,346,400.00	3.88	0.23	0.5	6.8	40.9	0.005	4,131,930.02	3,841,133.67	0.001	Supercritical
	238,900	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-															
MH C - MH B	1,107,600	Total flow into MH B	0.60%	0.013	0.006	5.9	16	1107600	3.68	0.21	0.5	6.1	36.8	0.005	4131930.02	3841133.67	0	Supercritical
	1,107,600	Flow from West Lateral into MH B																

	107,400	Total flow in this area (SA 1.31-1.34, 1.25)	-															
MH D - MH C	1,000,200	Total flow into MH C**	0.50%	0.013	0.005	5.8	16	1000200	3.35	0.17	0.5	5.8	36.6	0.005	3771918.8	3506459.26	0	Subcritical
	1,000,200	Flow from West Lateral into MH C																
	68,000	Total fow in this area (SA 1.26-1.30)	-															
MH E - MH D	932,300	Total flow into MH E*	0.25%	0.013	0.003	6.8	16	932,300.00	2.55	0.1	0.6	5.6	42.5	0.005	2,667,149.36	2,479,441.12	0	Subcritical
MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	1.7	16	119,000.00	2.24	0.08	0.1	2	10.9	0.006	5,144,211.39	4,782,172.85	0	Supercritical
MH G - MH E	813,300	Flow from MH G (South) into MH E	0.25%	0.013	0.003	6.3	16	813,300.00	2.46	0.09	0.5	5.2	39.4	0.005	2,667,149.36	2,479,441.12	0	Subcritical
	200,200	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-															
MH H - PSW	613,100	Total flow into West WW Lift Station***	0.27%	0.013	0.003	5.3	16	613,100.00	2.34	0.09	0.4	4.5	33.2	0.005	2,771,782.92	2,576,710.80	0	Subcritical

2053 PF				Input Data					Results									
15"	Discharge (gpd) (roundup)	Connection	Slope	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gpd)	Velocity (ft/s)	Velocity Head (ft)	Flow Area (ft2)	Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Maximum Discharge (gpd)	Discharge Full (gpd)	Slope Full (ft/ft)	Flow Type
MH A - PSE	1,571,900	Total flow into East WW Lift Station	0.60%	0.013	0.006	7.4	15	1,571,900.00	4.05	0.25	0.6	7.5	49.2	0.006	3,478,641.67	3,233,822.34	0.001	Supercritical
	225,500	Flow from South Lateral into MH A	0.60%	0.013	0.006	2.7	15	225,500.00	2.35	0.09	0.1	2.7	17.9	0.005	3,478,641.67	3,233,822.34	0	Supercritical
MH B - MH A	1,346,400	Flow from MH B (West) into MH A	0.60%	0.013	0.006	6.8	15	1,346,400.00	3.89	0.24	0.5	6.9	45	0.006	3,478,641.67	3,233,822.34	0.001	Supercritical
	238,900	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-															
MH C - MH B	1,107,600	Total flow into MH B	0.60%	0.013	0.006	6.1	15	1107600	3.69	0.21	0.5	6.2	40.4	0.005	3478641.67	3233822.34	0.001	Supercritical
	1,107,600	Flow from West Lateral into MH B																
	107,400	Total flow in this area (SA 1.31-1.34, 1.25)	-															
MH D - MH C	1,000,200	Total flow into MH C**	0.50%	0.013	0.005	6	15	1000200	3.36	0.18	0.5	5.9	40.1	0.005	3175550.85	2952062.41	0.001	Subcritical
	1,000,200	Flow from West Lateral into MH C																
	68,000	Total fow in this area (SA 1.26-1.30)	-															
MH E - MH D	932,300	Total flow into MH E*	0.25%	0.013	0.003	7	15	932,300.00	2.56	0.1	0.6	5.7	46.8	0.005	2,245,453.54	2,087,423.35	0	Subcritical
MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	1.8	15	119,000.00	2.26	0.08	0.1	2	11.8	0.006	4,330,873.95	4,026,076.35	0	Supercritical
MH G - MH E	813,300	Flow from MH G (South) into MH E	0.25%	0.013	0.003	6.5	15	813,300.00	2.47	0.09	0.5	5.3	43.4	0.005	2,245,453.54	2,087,423.35	0	Subcritical
	200,200	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-															
MH H - PSW	613,100	Total flow into West WW Lift Station***	0.27%	0.013	0.003	5.5	15	613,100.00	2.35	0.09	0.4	4.6	36.4	0.005	2,333,543.77	2,169,313.98	0	Subcritical

2053 PF				Input Data					Results									
12"	Discharge (gpd) (roundup)	Connection	Slope	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gpd)	Velocity (ft/s)	Velocity Head (ft)	Flow Area (ft2)	Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Maximum Discharge (gpd)	Discharge Full (gpd)	Slope Full (ft/ft)	Flow Type
MH A - PSE	1,571,900	Total flow into East WW Lift Station	0.60%	0.013	0.006	8.7	12	1,571,900.00	3.97	0.24	0.6	8	72.9	0.008	1,918,593.61	1,783,567.11	0.005	Subcritical
	225,500	Flow from South Lateral into MH A	0.60%	0.013	0.006	2.9	12	225,500.00	2.4	0.09	0.1	2.9	24	0.006	1,918,593.61	1,783,567.11	0	Supercritical
MH B - MH A	1,346,400	Flow from MH B (West) into MH A	0.60%	0.013	0.006	7.8	12	1,346,400.00	3.86	0.23	0.5	7.4	64.9	0.007	1,918,593.61	1,783,567.11	0.003	Subcritical
	238,900	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-															
MH C - MH B	1,107,600	Total flow into MH B	0.60%	0.013	0.006	6.8	12	1107600	3.7	0.21	0.5	6.7	57	0.006	1918593.61	1783567.11	0.002	Subcritical
	1,107,600	Flow from West Lateral into MH B																
	107,400	Total flow in this area (SA 1.31-1.34, 1.25)	-															
MH D - MH C	1,000,200	Total flow into MH C**	0.50%	0.013	0.005	6.8	12	1000200	3.37	0.18	0.5	6.3	56.7	0.006	1751428.33	1628166.57	0.002	Subcritical
	1,000,200	Flow from West Lateral into MH C																
	68,000	Total fow in this area (SA 1.26-1.30)	-															
MH E - MH D	932,300	Total flow into MH E*	0.25%	0.013	0.003	8.2	12	932,300.00	2.53	0.1	0.6	6.1	68.3	0.006	1,238,446.85	1,151,287.62	0.002	Subcritical
MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	1.9	12	119,000.00	2.33	0.08	0.1	2.1	15.7	0.006	2,388,629.78	2,220,523.15	0	Supercritical
MH G - MH E	813,300	Flow from MH G (South) into MH E	0.25%	0.013	0.003	7.4	12	813,300.00	2.46	0.09	0.5	5.7	62	0.006	1,238,446.85	1,151,287.62	0.001	Subcritical
	200,200	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-															
MH H - PSW	613,100	Total flow into West WW Lift Station***	0.27%	0.013	0.003	6.1	12	613,100.00	2.37	0.09	0.4	4.9	50.7	0.006	1,287,031.72	1,196,453.19	0.001	Subcritical

2053 PF				Input Data					Results									
10"	Discharge (gpd) (roundup)	Connection	Slope	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gpd)	Velocity (ft/s)	Velocity Head (ft)	Flow Area (ft2)	Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Maximum Discharge (gpd)	Discharge Full (gpd)	Slope Full (ft/ft)	Flow Type
MH A - PSE	1,571,900	Total flow into East WW Lift Station	ERROR															
	225,500	Flow from South Lateral into MH A	0.60%	0.013	0.006	3.1	10	225,500.00	2.45	0.09	0.1	3.1	30.8	0.006	1,179,866.86	1,096,830.37	0	Supercritical
MH B - MH A	1,346,400	Flow from MH B (West) into MH A	ERROR															
	238,900	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-															
MH C - MH B	1,107,600	Total flow into MH B	0.60%	0.013	0.006	8.3	10	1107600	3.55	0.2	0.5	7	82.9	0.009	1179866.86	1096830.37	0.006	Subcritical
	1,107,600	Flow from West Lateral into MH B																
	107,400	Total flow in this area (SA 1.31-1.34, 1.25)	-															

MH D - MH C	1,000,200	Total flow into MH C**	0.50%	0.013	0.005	8.2	10	1000200	3.24	0.16	0.5	6.7	81.9	0.008	1077066.16	1001264.56	0.005	Subcritical
	1,000,200	Flow from West Lateral into MH C																
	68,000	Total fow in this area (SA 1.26-1.30)	-															
MH E - MH D	932,300	Total flow into MH E*	ERROR															
MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	2	10	119,000.00	2.38	0.09	0.1	2.2	20	0.006	1,468,922.40	1,365,542.80	0	Supercritical
MH G - MH E	813,300	Flow from MH G (South) into MH E	ERROR															
	200,200	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-															
MH H - PSW	613,100	Total flow into West WW Lift Station***	0.27%	0.013	0.003	7	10	613,100.00	2.33	0.08	0.4	5.2	69.8	0.007	791,478.75	735,776.18	0.002	Subcritical

2053 PF				**Input Data**					**Results**									
8"	**Discharge (gpd) (roundup)**	**Connection**	**Slope**	**Roughness Coefficient**	**Channel Slope (ft/ft)**	**Normal Depth (in)**	**Diameter (in)**	**Discharge (gpd)**	**Velocity (ft/s)**	**Velocity Head (ft)**	**Flow Area (ft2)**	**Critical Depth (in)**	**Percent Full (%)**	**Critical Slope (ft/ft)**	**Maximum Discharge (gpd)**	**Discharge Full (gpd)**	**Slope Full (ft/ft)**	**Flow Type**
MH A - PSE	1,571,900	Total flow into East WW Lift Station	ERROR															
	225,500	Flow from South Lateral into MH A	0.60%	0.013	0.006	3.4	8	225,500.00	2.49	0.1	0.1	3.3	42.3	0.007	650,738.20	604,940.65	0.001	Subcritical
MH B - MH A	1,346,400	Flow from MH B (West) into MH A	ERROR	0.013														
	238,900	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-															
MH C - MH B	1,107,600	Total flow into MH B	ERROR	0.013														
	1,107,600	Flow from West Lateral into MH B																
	107,400	Total flow in this area (SA 1.31-1.34, 1.25)	-															
MH D - MH C	1,000,200	Total flow into MH C**	ERROR	0.013														
	1,000,200	Flow from West Lateral into MH C																
	68,000	Total fow in this area (SA 1.26-1.30)	-															
MH E - MH D	932,300	Total flow into MH E*	ERROR	0.013														
MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	2.2	8	119,000.00	2.44	0.09	0.1	2.4	26.9	0.006	810,162.53	753,145.03	0	Supercritical
MH G - MH E	813,300	Flow from MH G (South) into MH E	ERROR	0.013														
	200,200	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-															
MH H - PSW	613,100	Total flow into West WW Lift Station***	ERROR	0.013														

E.3 FlowMaster Results (Peak Flow Basis) – Full Buildout

Total Flows - Downstream to Up Stream

	MH Number	Description - Location of Flow	AVG. Day Design Flow (GAL / DAY)					Peak Flow (GAL / MIN)					Peak Flow (GAL / DAY)		
			2028	2033	2053	2078	Full Buildout	2028	2033	2053	2078	Full Buildout	2078	2053	Full Buildout
15	East WW Lift Station	Total flow into East WW Lift Station	**79,018**	**190,144**	**660,429**	**1,067,679**	**1,949,366**	**131**	**314**	**1,092**	**1,765**	**3,222**	2,541,076	1,571,821	4,639,491
14	MH A	Flow from South Lateral into MH A	1,250	1,250	94,720	213,119	473,598	2	2	157	352	783	507,223	225,433	1,127,163
13		Flow from MH B (West) into MH A	77,767	188,893	565,710	854,560	1,475,768	129	312	935	1,412	2,439	2,033,853	1,346,389	3,512,328
12		Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	2,850	2,850	100,369	225,831	501,846	5	5	166	373	829	537,477	238,879	1,194,393
11	MH B	Total flow into MH B	74,917	186,043	465,340	628,729	973,922	124	307	769	1,039	1,610	1,496,376	1,107,510	2,317,934
10		Flow from West Lateral into MH B	74,917	186,043	465,340	628,729	973,922	124	307	769	1,039	1,610	1,496,376	1,107,510	2,317,934
9		Total flow in this area (SA 1.31-1.34, 1.25)	2,487	2,487	45,113	101,504	225,564	4	4	75	168	373	241,579	107,368	536,842
8	MH C	Total flow into MH C**	72,430	183,556	420,228	527,226	748,358	120	303	695	871	1,237	1,254,797	1,000,142	1,781,092
7		Flow from West Lateral into MH C	72,430	183,556	420,228	527,226	748,358	120	303	695	871	1,237	1,254,797	1,000,142	1,781,092
6		Total fow in this area (SA 1.26-1.30)	1,302	1,302	28,546	64,228	142,728	2	2	47	106	236	152,862	67,939	339,693
5	MH E	Total flow into MH E*	71,128	182,254	391,682	462,998	605,630	118	301	647	765	1,001	1,101,935	932,203	1,441,399
4		Flow from West Lateral (Cochise College) into MH E	15,000	15,000	50,000	50,000	50,000	25	25	83	83	83	119,000	119,000	119,000
3		Flow from MH G (South) into MH E	56,128	167,254	341,682	412,998	555,630	93	276	565	683	918	982,935	813,203	1,322,399
2		Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	16,318	58,367	84,098	126,148	210,246	27	96	139	208	347	300,231	200,154	500,385
1	West WW Lift Station	Total flow into West WW Lift Station***	39,810	108,887	257,584	286,850	345,384	66	180	426	474	571	682,704	613,049	822,014

***Total flow in pipe segment MH E - MH D**
**** Total flow in pipe segment MH D - MH C**
***** Total flow into MH A**

Full Buildout Peak Flow

Discahrge (cfs)	Discharge (gpd)	Discharge (gpd)	Slope
7.18	4639491.08	**4,639,500**	0.60%
1.74	1127163.24	**1,127,200**	0.60%
5.44	3512327.84	**3,512,400**	0.60%
1.85	1194393.48	**1,194,400**	-
3.59	2317934.36	**2,318,000**	-
3.59	2317934.36	**2,318,000**	0.60%
0.83	536842.32	**536,900**	-
2.76	1781092.04	**1,781,100**	-
2.76	1781092.04	**1,781,100**	0.50%
0.53	339692.64	**339,700**	-
2.23	1441399.40	**1,441,400**	0.25%
0.18	119000.00	**119,000**	0.93%
2.05	1322399.40	**1,322,400**	0.25%
0.77	500385.48	**500,400**	-
1.27	822013.92	**822,100**	0.27%

Ful Buildout PF			Input Data					Results										
18"	Discharge (gpd) (roundup)	Connection	Slope	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gpd)	Velocity (ft/s)	Velocity Head (ft)	Flow Area (ft2)	Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Maximum Discharge (gpd)	Discharge Full (gpd)	Slope Full (ft/ft)	Flow Type
MH A - PSE	4,639,500	Total flow into East WW Lift Station	0.60%	0.013	0.006	13.1	18	4,639,500.00	5.2	0.42	1.4	12.5	73	0.007	5,656,654.90	5,258,551.69	0.005	Subcritical
	1,127,200	Flow from South Lateral into MH A	0.60%	0.013	0.006	5.7	18	1,127,200.00	3.67	0.21	0.5	6	31.4	0.005	5,656,654.90	5,258,551.69	0	Supercritical
MH B - MH A	3,512,400	Flow from MH B (West) into MH A	0.60%	0.013	0.006	10.8	18	3,512,400.00	4.93	0.38	1.1	10.8	59.8	0.006	5,656,654.90	5,258,551.69	0.003	Supercritical
	1,194,400	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-															
MH C - MH B	2,318,000	Total flow into MH B	-															
	2,318,000	Flow from West Lateral into MH B	0.60%	0.013	0.006	8.4	18	2,318,000.00	4.46	0.31	0.8	8.7	46.5	0.005	5,656,654.90	5,258,551.69	0.001	Supercritical
	536,900	Total flow in this area (SA 1.31-1.34, 1.25)	-															
MH D - MH C	1,781,100	Total flow into MH C**	-															
	1,781,100	Flow from West Lateral into MH C	0.50%	0.013	0.005	7.6	18	1,781,100.00	3.89	0.24	0.7	7.6	42.2	0.005	5,163,795.82	4,800,378.96	0.001	Subcritical
	339,700	Total fow in this area (SA 1.26-1.30)	-															
MH E - MH D	1,441,400	Total flow into MH E*	0.25%	0.013	0.003	8.2	18	1,441,400.00	2.85	0.13	0.8	6.8	45.5	0.005	3,651,355.04	3,394,380.52	0	Subcritical
MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	1.7	18	119,000.00	2.21	0.08	0.1	1.9	9.3	0.006	7,042,478.56	6,546,844.05	0	Supercritical
MH G - MH E	1,322,400	Flow from MH G (South) into MH E	0.25%	0.013	0.003	7.8	18	1,322,400.00	2.79	0.12	0.7	6.5	43.4	0.005	3,651,355.04	3,394,380.52	0	Subcritical
	500,400	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-															
MH H - PSW	822,100	Total flow into West WW Lift Station***	0.27%	0.013	0.003	5.9	18	822,100.00	2.52	0.1	0.5	5.1	32.8	0.005	3,794,599.46	3,527,543.71	0	Subcritical

Ful Buildout PF			Input Data					Results										
16"	Discharge (gpd) (roundup)	Connection	Slope	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gpd)	Velocity (ft/s)	Velocity Head (ft)	Flow Area (ft2)	Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Maximum Discharge (gpd)	Discharge Full (gpd)	Slope Full (ft/ft)	Flow Type
MH A - PSE	4,639,500	Total flow into East WW Lift Station	ERROR															
	1,127,200	Flow from South Lateral into MH A	0.60%	0.013	0.006	5.9	16	1,127,200.00	3.7	0.21	0.5	6.2	37.1	0.005	4,131,930.02	3,841,133.67	0.001	Supercritical
MH B - MH A	3,512,400	Flow from MH B (West) into MH A	0.60%	0.013	0.006	12	16	3,512,400.00	4.83	0.36	1.1	11.2	75.2	0.007	4,131,930.02	3,841,133.67	0.005	Subcritical
	1,194,400	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-															
MH C - MH B	2,318,000	Total flow into MH B	-															
	2,318,000	Flow from West Lateral into MH B	0.60%	0.013	0.006	9	16	2,318,000.00	4.46	0.31	0.8	9	56	0.006	4,131,930.02	3,841,133.67	0.002	Supercritical
	536,900	Total flow in this area (SA 1.31-1.34, 1.25)	-															
MH D - MH C	1,781,100	Total flow into MH C**	-															
	1,781,100	Flow from West Lateral into MH C	0.50%	0.013	0.005	8.1	16	1,781,100.00	3.9	0.24	0.7	7.8	50.5	0.006	3,771,918.80	3,506,459.26	0.001	Subcritical

	339,700	Total fow in this area (SA 1.26-1.30)	-															
MH E - MH D	1,441,400	Total flow into MH E*	0.25%	0.013	0.003	8.8	16	1,441,400.00	2.85	0.13	0.8	7	54.7	0.005	2,667,149.36	2,479,441.12	0.001	Subcritical
MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	1.7	16	119,000.00	2.24	0.08	0.1	2	10.9	0.006	5,144,211.39	4,782,172.85	0	Supercritical
MH G - MH E	1,322,400	Flow from MH G (South) into MH E	0.25%	0.013	0.003	8.3	16	1,322,400.00	2.79	0.12	0.7	6.7	52	0.005	2,667,149.36	2,479,441.12	0.001	Subcritical
	500,400	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-															
MH H - PSW	822,100	Total flow into West WW Lift Station***	0.27%	0.013	0.003	6.2	16	822,100.00	2.54	0.1	0.5	5.2	38.8	0.005	2,771,782.92	2,576,710.80	0	Subcritical

Ful Buildout PF				Input Data					Results									
15"	Discharge (gpd) (roundup)	Connection	Slope	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gpd)	Velocity (ft/s)	Velocity Head (ft)	Flow Area (ft2)	Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Maximum Discharge (gpd)	Discharge Full (gpd)	Slope Full (ft/ft)	Flow Type
MH A - PSE	4,639,500	Total flow into East WW Lift Station	ERROR															
	1,127,200	Flow from South Lateral into MH A	0.60%	0.013	0.006	6.1	15	1,127,200.00	3.71	0.21	0.5	6.3	40.8	0.005	3,478,641.67	3,233,822.34	0.001	Supercritical
MH B - MH A	3,512,400	Flow from MH B (West) into MH A	ERROR															
	1,194,400	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-															
MH C - MH B	2,318,000	Total flow into MH B	0.60%	0.013	0.006	9.4	15	2,318,000.00	4.43	0.31	0.8	9.2	62.7	0.006	3,478,641.67	3,233,822.34	0.003	Subcritical
	2,318,000	Flow from West Lateral into MH B	0.60%	0.013	0.006	9.4	15	2,318,000.00	4.43	0.31	0.8	9.2	62.7	0.006	3,478,641.67	3,233,822.34	0.003	Subcritical
	536,900	Total flow in this area (SA 1.31-1.34, 1.25)	-															
MH D - MH C	1,781,100	Total flow into MH C**	0.50%	0.013	0.005	8.4	15	1,781,100.00	3.9	0.24	0.7	8	56	0.006	3,175,550.85	2,952,062.41	0.002	Subcritical
	1,781,100	Flow from West Lateral into MH C	0.50%	0.013	0.005	8.4	15	1,781,100.00	3.9	0.24	0.7	8	56	0.006	3,175,550.85	2,952,062.41	0.002	Subcritical
	339,700	Total fow in this area (SA 1.26-1.30)	-															
MH E - MH D	1,441,400	Total flow into MH E*	0.25%	0.013	0.003	9.2	15	1,441,400.00	2.84	0.13	0.8	7.2	61.1	0.006	2,245,453.54	2,087,423.35	0.001	Subcritical
MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	1.8	15	119,000.00	2.26	0.08	0.1	2	11.8	0.006	4,330,873.95	4,026,076.35	0	Supercritical
MH G - MH E	1,322,400	Flow from MH G (South) into MH E	0.25%	0.013	0.003	8.7	15	1,322,400.00	2.79	0.12	0.7	6.8	57.8	0.006	2,245,453.54	2,087,423.35	0.001	Subcritical
	500,400	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-															
MH H - PSW	822,100	Total flow into West WW Lift Station***	0.27%	0.013	0.003	6.4	15	822,100.00	2.55	0.1	0.5	5.3	42.7	0.005	2,333,543.77	2,169,313.98	0	Subcritical

Ful Buildout PF				Input Data					Results									
12"	Discharge (gpd) (roundup)	Connection	Slope	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gpd)	Velocity (ft/s)	Velocity Head (ft)	Flow Area (ft2)	Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Maximum Discharge (gpd)	Discharge Full (gpd)	Slope Full (ft/ft)	Flow Type
MH A - PSE	4,639,500	Total flow into East WW Lift Station	ERROR															
	1,127,200	Flow from South Lateral into MH A	0.60%	0.013	0.006	6.9	12	1,127,200.00	3.72	0.21	0.5	6.7	57.7	0.007	1,918,593.61	1,783,567.11	0.002	Subcritical
MH B - MH A	3,512,400	Flow from MH B (West) into MH A	ERROR															
	1,194,400	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-															
MH C - MH B	2,318,000	Total flow into MH B	ERROR															
	2,318,000	Flow from West Lateral into MH B																
	536,900	Total flow in this area (SA 1.31-1.34, 1.25)	-															
MH D - MH C	1,781,100	Total flow into MH C**	ERROR															
	1,781,100	Flow from West Lateral into MH C																
	339,700	Total fow in this area (SA 1.26-1.30)	-															
MH E - MH D	1,441,400	Total flow into MH E*	ERROR															
MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	1.9	12	119,000.00	2.33	0.08	0.1	2.1	15.7	0.006	2,388,629.78	2,220,523.15	0	Supercritical
MH G - MH E	1,322,400	Flow from MH G (South) into MH E	ERROR															
	500,400	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-															
MH H - PSW	822,100	Total flow into West WW Lift Station***	0.27%	0.013	0.003	7.3	12	822,100.00	2.54	0.1	0.5	5.7	60.9	0.006	1,287,031.72	1,196,453.19	0.001	Subcritical

Ful Buildout PF				Input Data								Results						
10"	Discharge (gpd) (roundup)	Connection	Slope	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gpd)	Velocity (ft/s)	Velocity Head (ft)	Flow Area (ft2)	Critical Depth (in)	Percent Full (%)	Critical Slope (ft/ft)	Maximum Discharge (gpd)	Discharge Full (gpd)	Slope Full (ft/ft)	Flow Type
MH A - PSE	4,639,500	Total flow into East WW Lift Station	ERROR															
	1,127,200	Flow from South Lateral into MH A	0.60%	0.013	0.006	8.5	10	1,127,200.00	3.54	0.19	0.5	7.1	84.7	0.009	1,179,866.86	1,096,830.37	0.006	Subcritical
MH B - MH A	3,512,400	Flow from MH B (West) into MH A	ERROR															
	1,194,400	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-															
MH C - MH B	2,318,000	Total flow into MH B	ERROR															
	2,318,000	Flow from West Lateral into MH B																
	536,900	Total flow in this area (SA 1.31-1.34, 1.25)	-															
MH D - MH C	1,781,100	Total flow into MH C**	ERROR															
	1,781,100	Flow from West Lateral into MH C																
	339,700	Total fow in this area (SA 1.26-1.30)	-															
MH E - MH D	1,441,400	Total flow into MH E*	0.25%															
MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	2	10	119,000.00	2.38	0.09	0.1	2.2	20	0.006	1,468,922.40	1,365,542.80	0	Supercritical
MH G - MH E	1,322,400	Flow from MH G (South) into MH E	ERROR															

	500,400	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-															
MH H - PSW	822,100	Total flow into West WW Lift Station***	ERROR															

Ful Buildout PF				**Input Data**							**Results**							
8"	**Discharge (gpd) (roundup)**	**Connection**	**Slope**	**Roughness Coefficient**	**Channel Slope (ft/ft)**	**Normal Depth (in)**	**Diameter (in)**	**Discharge (gpd)**	**Velocity (ft/s)**	**Velocity Head (ft)**	**Flow Area (ft2)**	**Critical Depth (in)**	**Percent Full (%)**	**Critical Slope (ft/ft)**	**Maximum Discharge (gpd)**	**Discharge Full (gpd)**	**Slope Full (ft/ft)**	**Flow Type**
MH A - PSE	4,639,500	Total flow into East WW Lift Station	ERROR															
	1,127,200	Flow from South Lateral into MH A	0.60%															
MH B - MH A	3,512,400	Flow from MH B (West) into MH A	ERROR															
	1,194,400	Total flow in this area (SA 3.1 - 3.8, 4.6,4.7,5.1-5.20)	-															
MH C - MH B	2,318,000	Total flow into MH B	ERROR															
	2,318,000	Flow from West Lateral into MH B																
	536,900	Total flow in this area (SA 1.31-1.34, 1.25)	-															
MH D - MH C	1,781,100	Total flow into MH C**	ERROR															
	1,781,100	Flow from West Lateral into MH C																
	339,700	Total fow in this area (SA 1.26-1.30)	-															
MH E - MH D	1,441,400	Total flow into MH E*	ERROR															
MH F - MH E	119,000	Flow from West Lateral (Cochise College) into MH E	0.93%	0.013	0.009	2.2	8	119,000.00	2.44	0.09	0.1	2.4	26.9	0.006	810,162.53	753,145.03	0	Supercritical
MH G - MH E	1,322,400	Flow from MH G (South) into MH E	ERROR															
	500,400	Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)	-															
MH H - PSW	822,100	Total flow into West WW Lift Station***	ERROR															

Appendix F Pipe Sizes

FlowMaster Inputs/Outputs - Douglas POE Sewer Mains

Link	Slope (ft/ft)	Size (in)	2078 Avg. Day Flow (gpd)	2078 Avg. Day Flow (gpm)	2078 Avg. Day Flow (cfs)	Normal Depth (in)	Normal Depth (% full)	Velocity (fps)	2078 Peak Flow (gpd)	2078 Peak Flow (gpm)	2078 Peak Flow (cfs)	Normal Depth (in)	Normal Depth (% full)	Velocity (fps)
MH H - West WW LS	0.0027	12 15	286,900	199	0.53	4.00 3.70	33% 25%	1.94 1.90	682,800	474	1.27	6.5 5.80	54% 39%	2.43 2.42
MH G - MH E	0.0025	12 15 16	413,000	287	0.77	5.00 4.50 4.40	42% 30% 28%	2.08 2.05 2.04	983,000	683	1.83	8.5 7.20 7.00	71% 48% 44%	2.55 2.59 2.59
MH F - MH E	0.0093	8 10	50,000	35	0.09	1.40 1.30	18% 13%	1.89 1.84	119,000	83	0.22	2.20 1.90	28% 19%	2.44 2.33
MH E - MH D	0.0028	12	463,000	322	0.86	5.10	43%	2.24	1,102,000	765	2.05	8.90	74%	2.72
MH D - MH C	0.0050	12 15	527,300	366	0.98	4.70 4.30	39% 29%	2.86 2.81	1,254,800	872	2.33	7.9 6.80	66% 45%	3.54 3.57
MH C - MH B	0.0060	12 15	628,800	437	1.17	4.90 4.50	41% 30%	3.21 3.16	1,496,400	1,039	2.78	8.4 7.20	70% 48%	3.94 4.0
MH B - MH A	0.0060	12 15 16 18	854,600	594	1.59	5.90 5.30 5.10 4.9	49% 35% 32% 27%	3.48 3.44 3.42 3.39	2,033,900	1,413	3.78	over 8.60 8.30 7.8	over 57% 52% 43%	over 4.31 4.32 4.31
MH A - East WW LS	0.0060	12 15 16 18	1,067,700	742	1.98	6.70 5.90 5.80 5.5	56% 39% 36% 31%	3.67 3.66 3.64 3.61	2,541,100	1,765	4.72	over 10.00 9.50 8.8	over 67% 59% 49%	over 4.52 4.55 4.57

* 2078 is 50 years after startup

Recommended pipe diameter sizes are highlighted

Appendix G Lift Stations

G.1 West Wastewater Lift Station

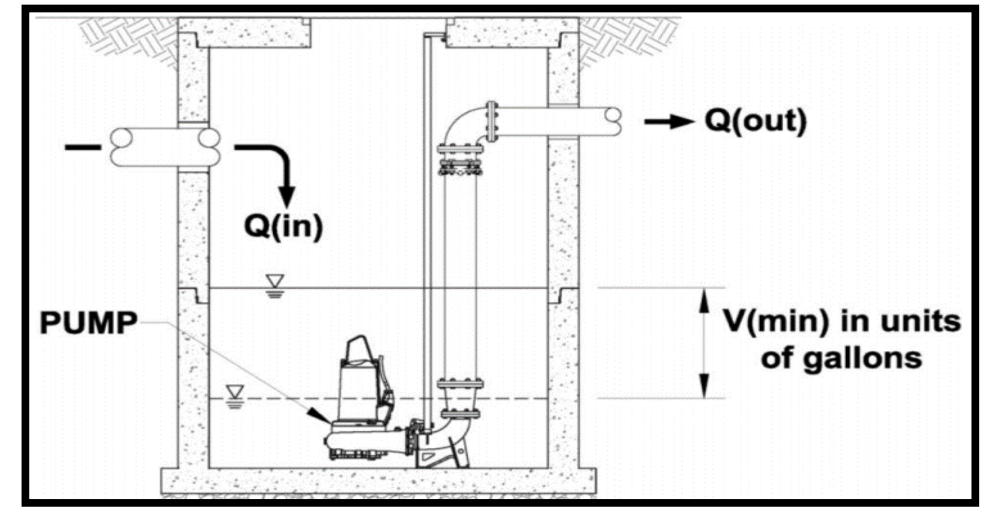
Douglas POE LIFT STATION WEST and LIFT STATION EAST

Pump and Wetwell Sizing

Updated 07/01/2022

Blue text indicates input cells

1. West Lift Station design pipe sizes and flows - Phase 1



Discharge pipe line for individual pump, nominal pipe size =			**6**	**inches**	
Pipe ID =	6.28	inches, =	0.52	ft	Class 50 DIP, Cement lined
Cross section area, A =	0.21	sf			
Header force main, nominal pipe size =			**6**	**inches**	
Pipe ID =	6.28	inches, =	0.52	ft	Class 50 DIP,cement lined
Cross section area, A =	0.21	sf			
Buried force main, nominal pipe size =			**6**	**inches**	
Pipe ID =	5.8	inches, =	0.48	ft	HDPE
Cross section area, A =	0.18	sf			
Pump 1 Qmax=	220	gpm, =	0.49	cfs	Lead pumps, no VFD - soft start, steady rate
Pump 2 Qmax =	220	gpm, =	0.49	cfs	Lag pump, no VFD - soft start, steady rate
Total Station Qtmax =	440	gpm, =	0.98	cfs	2- duty, 1 standby

2. West Lift Station wet well design

Tmin =	8	mins			Pump rep said that could have maximum 15 starts / hour (4 mins); use conservative 8 mins.
Qout =	220	gpm, =	0.49	cfs	
Vmin = (Tmin)*(Qout)/4	440	gallons, =	58.82	cf	Minimum storage of volume of wet well to hold/ gather fluid during pump off

Precast or Cast in Place Concrete - Interior Dimensions

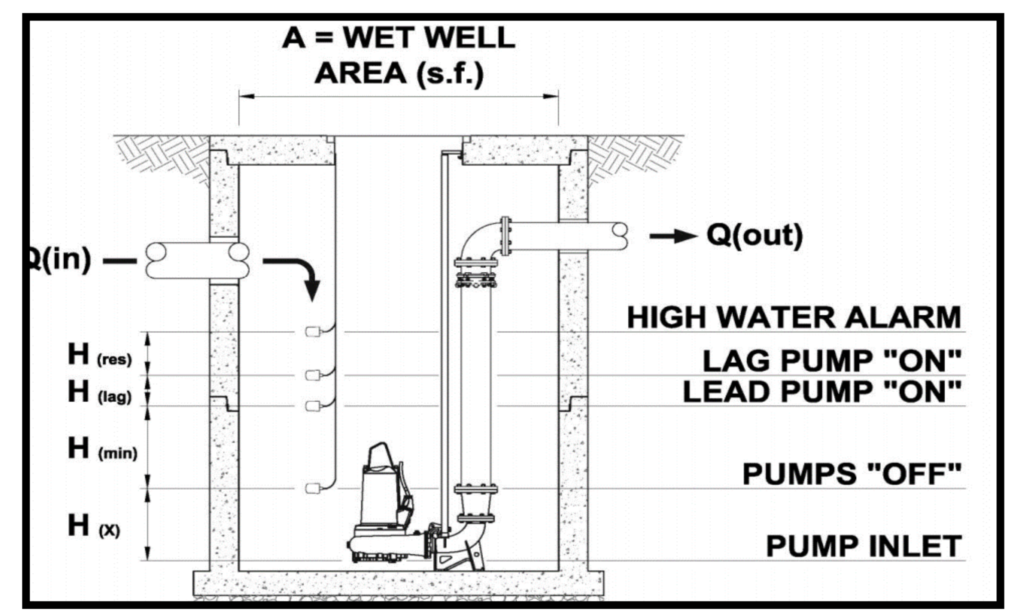
Width =	168.00	inches =	14.00	ft
Length =	144.00	inches =	12.00	ft
Cross section area			168.00	sf

Req'd depth for the min storage vol= **0.35 ft** Based on one pump operation at minimum pump flow

Time to fill to min depth at 2028 average flow rate = 15 minutes Below ADEQ recommended 30 minute max

Time to fill to min depth at 2038 average flow rate = 5 minutes

Time to fill to min depth at 2053 average flow rate = 2 minutes



Wetwell elevations

Finished ground elevation	**4044.67**	**ft**	Assumed from ADOT POE proposal
top of pipe	4027.53	ft	
inv in	4026.70	ft	Assumed from preliminary design
High high alarm water level=	4026.20	ft	0.5 ft below influent sewer invert
High alarm water level=	4025.70	ft	0.5 ft below HHAWL
1st lag pump on water level=	4024.95	ft	Set 0.75 ft high on level
Lead pump on water level=	4024.20	ft	Set 0.75 ft 1st lag pump on level
Pumps stop level =	4023.85	ft	Based on estimated 8 min cycle time volume
Low water alarm/pump power cutoff=	4023.95		3" below the pump stop level
Pump minimum submergence =	1.40	ft	Typical min submergence for similarly sized pumps
Bottom of wetwell	4022.22	**ft**	Assumed 4" slab for the pump base installation
Total depth of the wetwell	**22.45**		
Depth of wetwell from EG			

Douglas POE LIFT STATION WEST and LIFT STATION EAST
Hydraulic Analysis and TDH Estimates
7/1/2022

1. WWWLS design pipe sizes and flows

Discharge pipe line for individual pump, nominal pipe size =		**6 inches**	
Pipe ID =	6.28 inches, =	0.52 ft	Class 50 DIP, Cement lined
Cross section area, A =	0.21 sf		
Exposed header force main, nominal pipe size =		**6 inches**	
Pipe ID =	6.28 inches, =	0.52 ft	Class 50 DIP, cement lined
Cross section area, A =	0.21 sf		
Buried force main, nominal pipe size =		**6 inches**	
Pipe ID =	5.8 inches, =	0.48 ft	6" DR 17 HDPE Pipe
Cross section area, A =	0.18 sf		
Lead Pump Qmax=	220 gpm, =	0.49 cfs	Soft start, single phase, single flow rate pump
Lag Pump Qmax =	220 gpm, =	0.49 cfs	Soft start, single phase, single flow rate pump
Two pumps Qtmax =	440 gpm, =	0.98 cfs	
Each pump flow at Qtmax=	292 gpm, =	0.65 cfs	Three pumps in operation

3. Flowing velocity in WWWLS force mains

6" force main

Vmin =	2.28	ft/s, single lead pump at Qmin
Vmax =	2.28	ft/s, single lag pump at Qmax
Vtmax =	2.28	ft/s, two pumps at Qtmax

6" DIP force main

V min =	2.28	ft/s, single lead pump at Qmin
Vmax =	2.28	ft/s, single lag pump at Qmax
Vtmax =	4.56	ft/s, two pumps at Qtmax

6" HDPE force main

V min =	2.67	ft/s, single lead pump at Qmin
Vmax =	2.67	ft/s, single lag pump at Qmax
Vtmax =	5.35	ft/s, two pumps at Qtmax

3. Force main pipe lengths

6" DIP discharge force main=	25 ft	from each individual pump
6" DIP header force main=	30 ft	from far west pump to transition point
Total 6" HDPE force main =	292 ft	Estimated from location assessment

4. Hazen Williams C factors

HDPE force main pipe, C factor = 150 Lead pump low flow condition, Qmax
150 Qtmax flow conditions

Literatures recommended C factor for the HDPE is experimentally 155.
But 150 is usually used for design for new pipe.
Due to low flowing velocity in the pipe for majority of the time for this project
Some solids depositions are expected in the pipeline. This will reduce C
factor at low flow condition. So for this project design, a low C value is used for low
flow conditions, and a high C value is used for high flow conditions.

DIP Class 50 cement lined pipe, C factor = 130 for all flow conditions

5. Hazen-Williams Friction Headloss and Darcy-Weisbach Formula (Referenced in 2nd Edition of "Pumping Station Design" by Sanks)

Hazen-Williams Friction Headloss Formula

hf =0.002083*L*[(100/C)^1.85]*[(gpm^1.85)/(D^4.8655)]

Where: hf = head loss in feet of water
L = length of pipe in feet

C = friction coefficient
gpm = gallons per minute
D = inside diameter of the pipe in inches

Hazen-Williams equation is simple and easy to use and widely used for water and wastewater engineering. But the equation is empirical & applicability range is limited. Historic experimental data demonstrated that C is a strong function of Reynolds number and pipe. So Hazen-Williams has narrow ranges for R number and pipe size.

Limitatons = The formula is valid with the following conditions:

* flowing velocity is less than 10 ft/s, not suitabe for extremely high or low velocities
* Pipe diameter must be greater than 2-inch, but erroes are noticeable for pipes that are smaller than 8" or greater than 60"
* Fluid kniematic viscosity is 1.13 centistokes (note, water at 60F is 1.13 CS), water at room temperature
* Flow regime must be turbulent
* C factor actually varies with pipe size, increases with pipe size

Based on above, use of H-W equation is ok when static head is a major part of the TDH and the force main is less than 500 feet. But if static head is very small and force main is very long, H-W equation can lead to serious errors and Darcy Weisbach must be used to check TDH.

Darcy-Weisbach Friction Headloss Formula

hf = f*(L/D)*(V^2/2g)

Where : hf = headloss in feet of water
f = a coefficient of friction, depends on pipe roughness and Reynold number, R
L = pipe length in feet
D = inside diamter of the pipe in feet
V = flowing velocity in ft/s
g = acceleration of gravity, = 32.2 ft/s2

This formula is rational, fundemental, dimensionally consistent, applies to both laminar and turbulent flow regimes
For project with low static head, long force main pipe, Darcy-Weisbach is more accurate for TDH estimate
Reynold number, R = VD/ʋ
where ʋ is kinematic viscosity in ft2/s

f determination
R<2000 f = 64/R, f is independent of roughness
2000>R<4000, flow is not stable fluctuate between laminar and turbulent flow, both roughness and R affect f

f can be calculated with this equation: $\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon/D}{3.7} + \frac{2.51}{R\sqrt{f}}\right)$ or $f = \frac{0.25}{\left[\log_{10}\left(\frac{\varepsilon/D}{3.7} + \frac{5.74}{R^{0.9}}\right)\right]^2}$

where: ε is absolute roughness, ε/D is dimensionless

R>100,000 flow is completely turbulent, f depends on roughness only

It should be noted that the limitation of the equations lies in the estimation or use of the appropriate coefficient of friction, a value that cannot be physically measured, hence is subject to errors. The proper use of friction factor is uncertain because of variations of pipe roughness, installation quality, water quality, angular offsets of laying pipe, corrosion, deposit and grease accumulation etc.

6. Estimated friction headloss in the force main

Using Hazen Williams Equation

6" DIP, hf =	0.15 ft	at Qmin flow condition
	0.15 ft	at Qtmax flow condition
6" DIP, hf =	0.18 ft	at Qmin flow condition
	0.39 ft	at Qtmax flow condition
6" HDPE, hf =	2.02 ft	at Qmin flow condition
	4.31 ft	at Qtmax flow condition

Using Darcy-Weisbach equation for 6" HDPE force main only

Assuming wastewater temperatures	minimum = 10 C =		50 F	
	maximum =25 C =		77 F	
Kinematic viscosity,	ʋ =	1.41E-05	at 50 F	
		9.34E-06	at 77 F	
Reynold numbers,	R=	9.29E+04	>100,000	turbulent flow at 50F and Qmax
		1.86E+05	>100,000	turbulent flow at 50F and Qtmax
		1.40E+05	>100,000	turbulent flow at 77F and Qmax

2.81E+05 >100,000 turbulent flow at 77F and Qtmax

HDPE pipe absolute roughness ε per literatures

HDPE pipe absolute roughness ε =	0.00009 ft	Qmin flow condition, equivalent of C=135
	0.00007 ft	Qmax condition, equivalent of C=140
	0.00003 ft	Qtmax or Q2max high velocity condition, equivalent C=150
	0.000005 ft	New condition

Relative roughness =	ε/D =	0.00018	Based on Qmin flow condition
		0.00014	Based on Qmax flow condition
		0.00006	Based on high velocity condition under Qtmax or Q2max
		0.000010	Based on new pipe condition or high velocity condition

For R >4000, turbulent flow, 1/(f^0.5) = -2*log10*{[ε/(3.7*D)]+[2.51/(R*(f^0.5))], based on 77F wastewater condition

Calulating f by trial and error method

Trial, f =	0.0177	For Qmax flow condition		
Left side =	7.516	Right side =	7.524	okay
Trial, f =	0.0152	For high velocity condition under Qtmax		
Left side =	8.111	Right side =	8.100	okay

f factor =	0.0177	Based on Qmax flow condition
	0.0152	Based on high velocity condition under Qtmax

Friction headloss hf =	**1.17 ft**	at Qmin flow condition
	2.01 ft	at Qtmax flow condition

7. Minor headloss estimates

6" DIP Fittings and K factors at WWWLS

Fitting Descriptions	No of fittings	K Values	Total K Values
Entrance into pump, submerged	1	0.04	0.04
90 degree elbows =	2	0.3	0.6
Plug valve =	1	4	4
Check valve =	1	2.5	2.5
Tee branch flow =	1	1	1
Total values=			**8.14**

Minor headloss, hm

hm =	0.66 ft	at Qmin flow condition
	0.66 ft	at Qtmax flow condition

6" DIP Fitting and K factors at WWWLS

Tee straight flow =	2	0.2	0.4
Plug valves =	1	4	4
90 degree elbows	3	0.3	0.9
45 degree elbows	2	0.3	0.6
Total values =			**5.9**

Minor headloss, hm

hm =	0.48 ft	at Qmin flow condition
	1.91 ft	at Qtmax flow condition

6" HDPE fittings and K factors

90 degree elbows	0	0.3	0
45 degree elbows	2	0.3	0.6
Total values =			**0.6**

Minor headloss

hm =	0.07 ft	at Qmin flow condition
	0.27 ft	at Qtmax flow condition

8. Static head estimates

6" HDPE force main discharge at MH G =	4039.6 ft, per design discharge point	
Assumed min water level in the lift station =	4024.20 ft, Qmax condition	
Assumed water level in the lift station =	4024.95 ft, Qmax condition	
Assumed max water level in the lift station =	4025.70 ft, Qtmax condition	
Static head at minimum water level =	15.40 ft	Qmin flow condition
Static head at maximum water level =	13.9 ft	Qtmax flow condition

9. Pump Station TDH Estimates

Based on Hazen Williams equation (include 5 ft of head for safety factor)

TDH =	**24 ft**	Qmin flow condition
	27 ft	Qtmax flow condition

Based on Darcy Weisback equation

TDH =	18 ft	Qmin flow condition
	19 ft	Qtmax flow condition

Will use the Hazen head calcs as they are more conservative

Basin Calculations for Drain Down

Drain down time equation used (9.3 from MCFCD Drainage Design Manual Pg. 9-17) Td = V/(Ap*Pd/12)

Design Percolation Rate (in/hr)		
P_r (in/hr)	2	Assumed Percolation Rate (To be revised with POE LS Geotechnical Reports)
D_r	2	De-rating Factor (MCFCD Hydraulics Manual 4th Edition, Pg 9-18)
P_d (in/hr)	1	Eq. **P_d=P_r/D_r** where **P_d**=design rate, **P_r**=field test rate, **D_r**=de-rating factor (MCFCD Hydraulics Manual 4th Edition, Pg 9-17)

Basin Drain Time without Drywell		
Drywell Design Rate (cfs)	0.00	Design Disposal Rate (COG Engineering Design Standards, Section 5.G.2.b, Pg 5-21)
Volume (ac-ft)	0.00	Run off volume reduced by drywell
V (ac-ft)	0.16	Volume to be infltrated per basin volume minus drywell volume infiltrated in 36 hrs
A_p (sq ft)	2,325	Required bottom area in sq ft
A_p (ac)	0.053	Required bottom area in acres
P_d (in/hr)	1.0	
***T_d (hr)**	35.6	***Drain down time within 36 hrs**
***Td = V/(A_p*P_d/12);** where **T_d**=drain time, **V**=runoff volume, **A_p**=basin bottom area, **P_d**=infiltration rate		

Note: Drywell not to be used for LS site.

Basin Drain Time with Drywell		
Drywell Design Rate (cfs)	0.10	Design Disposal Rate (COG Engineering Design Standards, Section 5.G.2.b, Pg 5-21)
Volume (ac-ft)	0.30	Run off volume reduced by drywell within 36-hr drain time
V (ac-ft)	0.06	Volume to be infltrated per basin minus drywell volume infiltrated in 36 hrs
A_p (sq ft)	N/A	Bottom area in sq ft
A_p (ac)	N/A	Bottom area in acres
P_d (in/hr)	N/A	Use rate for drywell only; infiltration volume for drywell exceed total runoff volume
***T_d (hr)**	7.3	***Calculation reflects time for drywell to drain total runoff only**
***Td = V/(A_p*P_d/12);** where **T_d**=drain time, **V**=runoff volume, **DWR** = drywell infiltration rate		

Stantec **CALCULATIONS**

Client:	*City of Douglas*	**Sheet:**	1 of 2
Project:	*Douglas POE Lift Station West*	**Date:**	*7/6/2022*
Description:	*This sheet estimates the rainfall runoff Volume and Peak Flow using the Maricopa County Hydrology Design Manual (p. 3-1 to 3-8)*	**Job No:**	*2042634200*
By:	*T. Crouthamel*	**Chkd By:**	

Stantec **CALCULATIONS**

Client:	*City of Douglas*	**Sheet:**	2 of 2
Project:	*Douglas POE Lift Station West*	**Date:**	*7/6/2022*
Description:	*This sheet estimates the rainfall runoff Volume and Peak Flow using the Maricopa County Hydrology Design Manual (p. 3-1 to 3-8)*	**Job No:**	*2042634200*
By:	*T. Crouthamel*	**Chkd By:**	

Basin including Plant, Undeveloped Area, Retention Basin

Rational C-Values	**100-YR**	**100-YR**	
C1 (Land Use Code P)	0.95	0.95	Runoff coef. For Asphalt and Rooftops
C2 (Land Use Code I1)	0.95	0.95	Runoff coef. Industrial 1
C3 (No Runoff, contained)	1.00	1.00	Runoff coef. for retention basin, odor control bed, peroxide pad
C4 (Land Use Code GR)	0.88	0.88	Runoff coef. for decomposed granite / gravel
Composite C	**0.93**	**0.93**	Composite Runoff coefficient for whole sub-basin

Contributing Drainage Areas for full build out:			
Entire Contributing Area (C)	42,275	sq ft	This is the entire contributing area for the lift station site
Roofs and Asphalt (C1)	20,382	sq ft	
Equipment Areas (C2)	325	sq ft	
Retention (C3)	6,739	sq ft	*Assume that recharge basins will be self-retained.*
Decomposed Granite (C4)	14,829	sq ft	

Volume Calculation			
100-YR	**2-hr**	**24-hr**	
Composite C-value	0.93	0.93	
Precipitation, P (in)	2.10	3.60	per figure A.60 and A.56 Drainage Design Manual Maricopa County
Area, A (sq ft)	42,275	42,275	
Area, A (ac)	0.97	0.97	
Volume, V (ac-ft)	**0.16**	**0.27**	**Note:** Regulations require 100-yr, 2-hr storage.
Volume, V (cu ft)	6,906	11,838	24-hr volume will pass through.

Retention Basin Calculation		
Retention Basin Bottom Area (sq ft)	2,325	
Required Depth	2.97	Water depth to be no more that 3-ft
Freeboard	1.00	
Basin top area @ 4:1 (sq ft)	6,703	

Flow Calculations

Determining Roughness Kb		$Kb = m \log_{10}A + b$ (FCDMC Table 3.1)
m (Type A)	-0.00625	
b (Type A)	0.04	
Computed Kb	***0.0401***	

Determining Tc		$Tc = 11.4L^{0.5} K_b^{0.52} S^{-0.31} i^{-0.38}$ (FCDMC Hydrology Manual, eq 3.2)
L (mi)	0.0144	
Kb	0.0401	

BACKGROUND CALCS

LAFB LS		
AREA DESIGNATION NAME	**AREAS (SF)**	**TOTAL LS AREA**
Asphalt & Rooftops (C1)	20,382	
Equipment (industrial) (C2)	325	
Ret. Basin	6,739	
Decomposed granite (C4)	14,829	
Non-contributing areas: odor control, chemical containment (no	335	
PHASE 1 CONTRIBUTING AREA	**42,275**	**42,275**

3.4 VOLUME CALCULATIONS

Volume calculations should be done by applying the following equation:

$$V = C\left(\frac{P}{12}\right)A \qquad (3.3)$$

where:

V = calculated volume, in acre-feet.

C = runoff coefficient from Table 3.2.

P = rainfall depth, in inches.

A = drainage area, in acres.

In the case of volume calculations for stormwater storage facility design, P equals the 100-year, 2-hour depth, in inches, as discussed in Section 2.2, and is determined from Figure A.56 of Appendix A.1.

S (ft/mi)	104.2105	

Flow Calculations (cont)	10-YR	100-YR		
Assumed T_c (min):	5.0-min	5.0-min		
Intensity (in/hr):	4.68	7.40		
Computed T_c (hr)	0.034	0.028	**10-yr T_c**	**100-yr T_c**
Computed T_c (min)	2.0	1.7	OK, Tc < 5-min	OK, Tc < 5-min

Determining Q	10-YR	100-YR		
Runoff coefficent C	0.933	0.933	Q = CIA	source: (FCDMC Hydrology Manual, eq 3.1)
Rainfall intensity (in/hr)	5.00	7.40		
A (ac)	0.97	0.97		
Q (cfs)	**4.5**	**6.7**		
Q (gpm)	**2,032.9**	**3,008.7**		

Time of Concentration INPUTS:			
Longest Flow Path		Elevatons, in feet	
L (ft)	L (mi)	Top EL	Bottom EL
76	0.014394	1.5	0
S (ft/mi):	104.2105		

G.2 East Wastewater Lift Station

Douglas POE LIFT STATION WEST and LIFT STATION EAST
Pump and Wetwell Sizing

Updated 07/01/2022

Blue text indicates input cells

1. EWWLS design pipe sizes and flows

Discharge pipe line for individual pump, nominal pipe size =				**6**	**inches**	
Pipe ID =		6.28	inches, =	0.52	ft	Class 50 DIP, Cement lined
Cross section area, A =	0.21	sf				
Exposed header force main, nominal pipe size =				**10**	**inches**	
Pipe ID =		10.4	inches, =	0.87	ft	Class 50 DIP,cement lined
Cross section area, A =	0.59	sf				
Buried force main, nominal pipe size =				**10**	**inches**	
Pipe ID =	9.41	inches, =		0.784	ft	
Cross section area, A =	0.48	sf				

Each Pump Qmin=	350	gpm, =	0.78	cfs	
Each Pump Qmax =	700	gpm, =	1.56	cfs	
Two pumps Q2max =	1350	gpm, =	3.01	cfs	
Total Station Qtmax =	1350	gpm, =	3.01	cfs	
Each pump flow at Q2max=	675	gpm, =	1.50	cfs	Two pumps in operation
Each pump flow at Qtmax=	675	gpm, =	1.50	cfs	Two pumps in operation

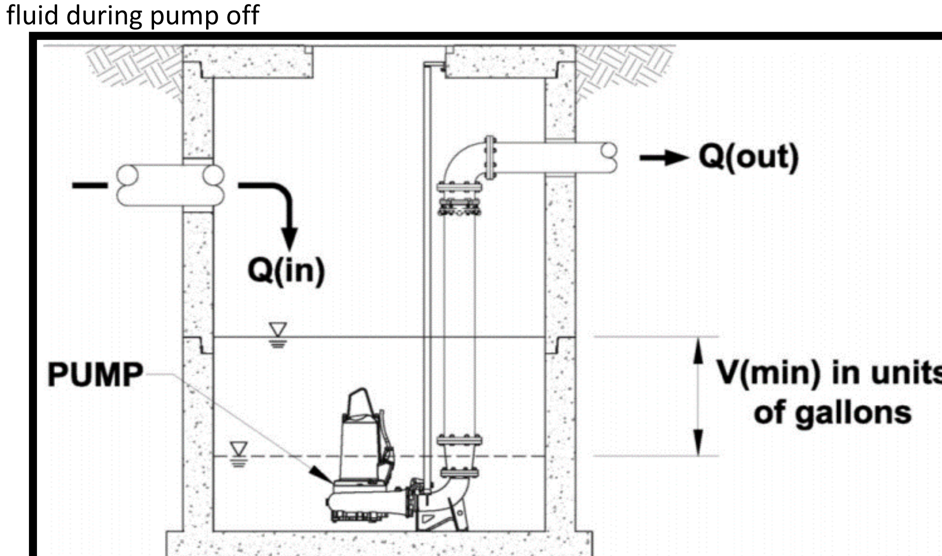
2. EWWLS wet well design

Tmin =	8	mins			Pump rep said that could have maximum 15 starts / hour (4 mins); use conservative 8 mins.
Qout =	350	gpm, =	0.78	cfs	
Vmin = (Tmin)*(Qout)/4	700	gallons, =	93.58	cf	minimum storage of volume of wet well to hold/ gather fluid during pump off

Precast or Cast in Place Concrete - Interior Dimensions				
width =	168.00	inches =	14.00	ft
length =	144.00	inches =	12.00	ft
Cross section area			168.00	sf

Req'd depth for the min storage vol= **0.56 ft** Based on one pump operation at minimum pump flow

Time to fill to min depth at 2028 average flow rate =	13	mins	Below ADEQ recommended 30 minute max
Time to fill to min depth at 2038 average flow rate =	3	mins	
Time to fill to min depth at 2053 average flow rate =	2	mins	



3. Wetwell Depth and Influent Sewer Designs

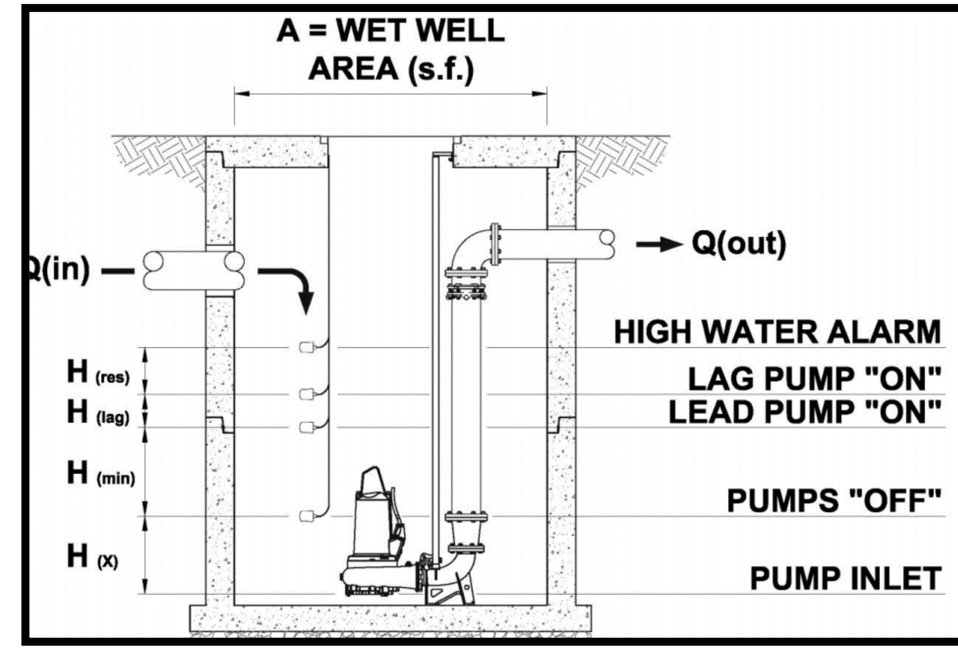
assumed site data - will adjust with survey

Pipe between sampling vault and wetwell

slope	0.006	ft/ft	As designed
length	310	ft	*Assumed*

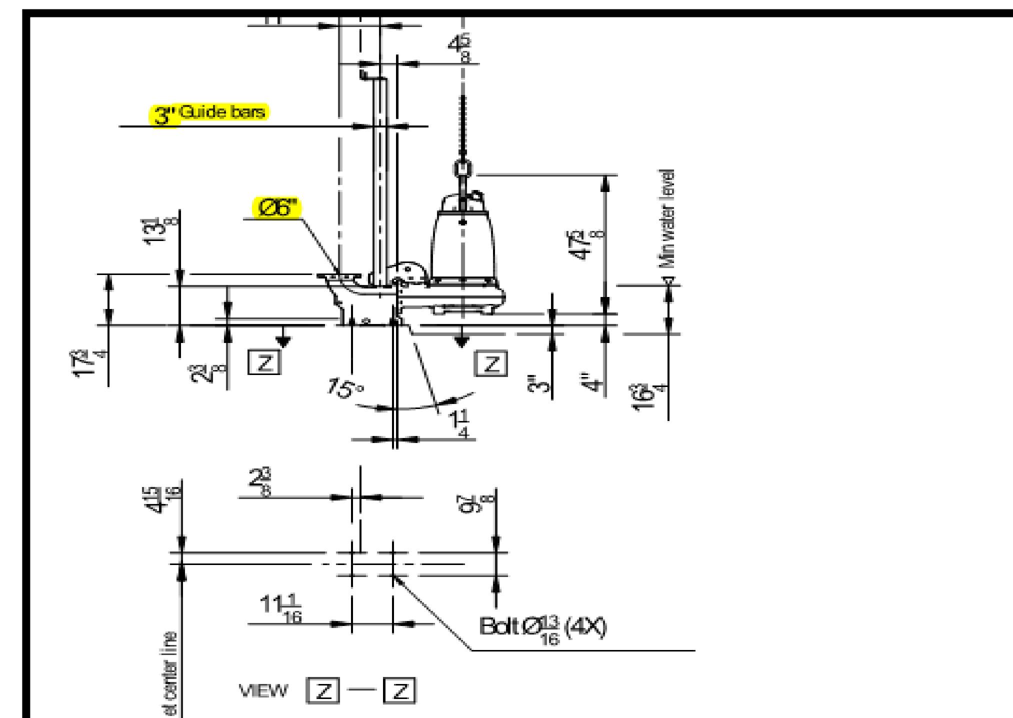
Wetwell elevations

Finished ground elevation	**3934.00**	**ft**	
top of pipe	3924.74	ft	No cover concerns
inv in	**3923.49**	**ft**	
High high alarm water level=	3922.99	ft	0.5 ft below influent sewer invert
High alarm water level=	3922.49	ft	0.5 ft below HHAWL
1st lag pump on water level=	3921.74	ft	Set 0.75 ft high on level
Lead pump on water level=	3920.99	ft	Set 0.75 ft 1st lag pump on level
Pumps stop level =	3920.43	ft	Based on estimated 8 min cycle time volume need at minimium design flow
Low water alarm/pump power cutoff=	3920.18	ft	3" below the pump stop level
Pump minimum submergence =	1.40	ft	Per Flygt pump cut sheet data
Bottom of wetwell	3918.45	ft	Assumed 4" slab for the pump base installation
Total depth of the wetwell	**15.55**	**ft**	
Depth of wetwell from EG	16.55		



3. Wetwell Foul Air Flow Estimate:

Wetwell length =	16.00	ft	
Wetwell width =	14.00	ft	
Pump stop level =	3920.43	ft	
Top of the wetwell =	3933.17	ft	Under the slab
Air space volume =	2852	ft^3	Between pump stop level to under slab
Design air change =	6.0	per hour	
Estimated Air flow =	285	cfm	
Design air flow =	**300.00**	**cfm**	



Weight (lbs)	Pump	Discharge
with cooling jacket	1260	180
without cooling jacket	1150	180

FP,NP | 3202 | HT
090, 095, 180, 185, 350, 390, 660, 670
1:40 | 180813
6664300 | 9

Douglas POE LIFT STATION WEST and LIFT STATION EAST
Hydraulic Analysis and TDH Estimates
7/1/2022

1. EWWLS design pipe sizes and flows

Discharge pipe line for individual pump, nominal pipe size =			**6 inches**	
Pipe ID =		6.28 inches, =	0.52 ft	Class 50 DIP, Cement lined
Cross section area, A =	0.21 sf			
Exposed header force main, nominal pipe size =			**10 inches**	
Pipe ID =		10.4 inches, =	0.87 ft	Class 50 DIP,cement lined
Cross section area, A =	0.59 sf			
Buried force main, nominal pipe size =			**10 inches**	
Pipe ID =	9.41 inches, =		0.78 ft	10" DR 17 DIPS HDPE Pipe
Cross section area, A =	0.48 sf			
Each Pump Qmin=		350 gpm, =	0.78 cfs	
Each Pump Qmax =		700 gpm, =	1.56 cfs	
Two pumps Qtmax =		1350 gpm, =	3.01 cfs	
Each pump flow at Qtmax=		675 gpm, =	1.50 cfs	Two pumps in operation

3. Flowing velocity in EWWLS force mains

6" force main

Vmin =	3.63	ft/s, single pump at Qmin
Vmax =	7.25	ft/s, single pump at Qmax
Vtmax =	7.00	ft/s, two pumps at Qtmax

10" DIP force main

V min =	1.32	ft/s, single pump at Qmin
Vmax =	2.65	ft/s, single pump at Qmax
Vtmax =	5.10	ft/s, 2 pumps at Qtmax

10" HDPE force main

V min =	1.62	ft/s, single pump at Qmin
Vmax =	3.23	ft/s, single pump at Qmax
Vtmax =	6.23	ft/s, 2 pumps at Qtmax

5. Force main pipe lengths

6" DIP discharge force main=	25 ft	from each individual pump
10" DIP header force main=	30 ft	from far east pump to transition point
Total 10" HDPE force main =	3,435 ft	From buried point at EWWLS to discharge at Douglas MH 20

6. Hazen Williams C factors

HDPE force main pipe, C factor = 135 low flow condition, Qmin
140 Qmax flow condition
150 Q2max and Qtmax flow conditions

Literatures recommended C factor for the HDPE is experimentally 155
But 150 is usually used for design for new pipe.
Due to low flowing velocity in the pipe for majority of the time for this projec
Some solids depositions are expected in the pipeline. This will reduce C
factor at low flow condition. So for this project design, a low C value is used for low
flow conditions, and a high C value is used for high flow conditions

DIP Class 50 cement lined pipe, C factor = 130 for all flow conditions

7. Hazen-Williams Friction Headloss and Darcy-Weisbach Formula (Referenced in 2nd Edition of "Pumping Station Design" by Sanks)

Hazen-Williams Friction Headloss Formula

hf =0.002083*L*[(100/C)^1.85]*[(gpm^1.85)/(D^4.8655)]

Where: hf = head loss in feet of water
L = length of pipe in feet

C = friction coefficient
gpm = gallons per minute
D = inside diameter of the pipe in inches

Hazen-Williams equation is simple and easy to use and widely used for water and wastewater engineering. But the equation is empirical & applicability range is limited. Historic experimental data demonstrated that C is a strong function of Reynolds number and pipe. So Hazen-Williams has narrow ranges for R number and pipe size.

Limitatons = The formula is valid with the following conditions:

* flowing velocity is less than 10 ft/s, not suitabe for extremely high or low velocities
* Pipe diameter must be greater than 2-inch, but erroes are noticeable for pipes that are smaller than 8" or greater than 60"
* Fluid kniematic viscosity is 1.13 centistokes (note, water at 60F is 1.13 CS), water at room temperature
* Flow regime must be turbulent
* C factor actually varies with pipe size, increases with pipe size

Based on above, use of H-W equation is ok when static head is a major part of the TDH and the force main is less than 500 feet. But if static head is very small and force main is very long, H-W equation can lead to serious errors and Darcy Weisbach must be used to check TDH.

Darcy-Weisbach Friction Headloss Formula

hf = f*(L/D)*(V^2/2g)

Where : hf = headloss in feet of water
f = a coefficient of friction, depends on pipe roughness and Reynold number, R
L = pipe length in feet
D = inside diamter of the pipe in feet
V = flowing velocity in ft/s
g = acceleration of gravity, = 32.2 ft/s2

This formula is rational, fundemental, dimensionally consistent, applies to both laminar and turbulent flow regimes
For project with low static head, long force main pipe, Darcy-Weisbach is more accurate for TDH estimate

Reynold number, R = VD/υ
where υ is kinematic viscosity in ft2/s

f determination

R<2000 f = 64/R, f is independent of roughness
2000>R<4000, flow is not stable fluctuate between laminar and turbulent flow, both roughness and R affect f

f can be calculated with this equation: $\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon/D}{3.7} + \frac{2.51}{R\sqrt{f}}\right)$ or $f = \frac{0.25}{\left[\log_{10}\left(\frac{\varepsilon/D}{3.7} + \frac{5.74}{R^{0.9}}\right)\right]^2}$

where: ε is absolute roughness, ε/D is dimensionless

R>100,000 flow is completely turbulent, f depends on roughness only

It should be noted that the limitation of the equations lies in the estimation or use of the appropriate coefficient of friction, a value that cannot be physically measured, hence is subject to errors. The proper use of friction factor is uncertain because of variations of pipe roughness, installation quality, water quality, angular offsets of laying pipe, corrosion, deposit and grease accumulation etc.

8. Estimated friction headloss in the force main

Using Hazen Williams Equation

6" DIP, hf =	0.21 ft	at Qmin flow condition
	0.76 ft	at Qmax flow condition
	0.71 ft	at Qtmaxflow condition
10" DIP, hf =	0.02 ft	at Qmin flow condition
	0.08 ft	at Qmax flow condition
	0.26 ft	at Qtmax flow condition
10" HDPE, hf =	3.83 ft	at Qmin flow condition
	12.90 ft	at Qmax flow condition
	38.28 ft	at Qtmax flow condition

Using Darcy-Weisbach equation for 10" HDPE force main only

Assuming wastewater temperatures	minimum = 10 C =		50 F	
	maximum =25 C =		77 F	
Kinematic viscosity,	υ =	1.41E-05	at 50 F	
		9.34E-06	at 77 F	
Reynold numbers,	R=	8.98E+04	>100,000	turbulent flow at 50F and Qmin
		1.80E+05	>100,000	turbulent flow at 50F and Qmax

3.47E+05	>100,000	turbulent flow at 50F and Qtmax
3.47E+05	>100,000	turbulent flow at 50F and Qtmax
1.36E+05	>100,000	turbulent flow at 77F and Qmin
2.71E+05	>100,000	turbulent flow at 77F and Qmax
5.23E+05	>100,000	turbulent flow at 77F and Qtmax
5.23E+05	>100,000	turbulent flow at 77F and Qtmax

HDPE pipe absolute roughness ε per literatures

HDPE pipe absolute roughness ε =	0.00009	ft	Qmin flow condition, equivalent of C=135
	0.00007	ft	Qmax condition, equivalent of C=140
	0.00003	ft	Qtmax or Q2max high velocity condition, equivalent C=150
	0.000005	ft	New condition

Relative roughness =	ε/D =	0.00011	Based on Qmin flow condition
		0.00009	Based on Qmax flow condition
		0.00004	Based on high velocity condition under Qtmax or Q2max
		0.000006	Based on new pipe condition or high velocity condition

For R >4000, turbulent flow, 1/(f^0.5) = -2*log10*{[ε/(3.7*D)]+[2.51/(R*(f^0.5))], based on 77F wastewater condition

Calulating f by trial and error method

Trial, f =	0.0169	For Qmin flow condition		
Left side =	7.692	Right side =	7.522	okay
Trial, f =	0.0156	For Qmax flow condition		
Left side =	8.006	Right side =	8.016	okay
Trial, f =	0.0136	For high velocity condition under Qtmax or Q2max		
Left side =	8.575	Right side =	8.577	okay
Trial, f =	0.0130	For new pipe or high velocity condition		
Left side =	8.771	Right side =	8.717	okay

f factor =	0.0169	Based on Qmin flow condition
	0.0156	Based on Qmax flow condition
	0.0136	Based on high velocity condition under Qtmax or Q2max
	0.0130	Based on new pipe condition or high velocity condition

Friction headloss hf =	**3 ft**	at Qmin flow condition
	11 ft	at Qmax flow condition
	36 ft	at Qtmax flow condition

9. Minor headloss estimates

6" DIP Fittings and K factors at the EWWLS

Fitting Descriptions	No of fittings	K Values	Total K Values
Entrance into pump, submerged	1	0.04	0.04
90 degree elbows =	2	0.3	0.6
Plug valve =	1	4	4
Check valve =	1	2.5	2.5
Tee branch flow =	1	1	1
Total values=			**8.14**

Minor headloss, hm

hm =	1.66 ft	at Qmin flow condition
	6.65 ft	at Qmax flow condition
	6.19 ft	at Q2max flow condition

10" DIP Fitting and K factors at the EWWLS

Tee straight flow =	5	0.2	1
Plug valves =	1	4	4
90 degree elbows	3	0.3	0.9
45 degree elbows	2	0.3	0.6

Total values =			**6.5**

Minor headloss, hm

hm =	0.22 ft	at Qmin flow condition
	0.88 ft	at Qmax flow condition
	3.29 ft	at Q2max flow condition

10" HDPE fittings and K factors

90 degree elbows	0	0.3	0
45 degree elbows	2	0.3	0.6
Total values =			**0.6**

Minor headloss without GRPSTC flow

hm =	0.02 ft	at Qmin flow condition
	0.10 ft	at Qmax flow condition
	0.36 ft	at Q2max flow condition

10. Static head estimates

10" HDPE force main discharge at Douglas MH 20 =	3985 ft, per design discharge point
Assumed min water level in the lift station =	3920 ft, Qmin condition
Assumed water level in the lift station =	3921 ft, Qmax condition
Assumed max water level in the lift station =	3922 ft, Q2max and Qtmax condition

Static head at minimum water level =	64.73 ft	Qmin flow condition
Static head at maximum water level =	64 ft	Qmax flow condition
Static head at maximum water level =	63 ft	Q2max and Qtmax condition

11. Pump Station TDH Estimates

Based on Hazen Williams Equation

TDH =	**76 ft**	Qmin flow condition Including 5 ft discharge head
	90 ft	Qmax flow condition Including 5 ft discharge head
	117 ft	Q2max flow condition including 5 ft discharge head

Based on Darcy Weisback eqution

TDH =	**75 ft**	Qmin flow condition Including 5 ft discharge head
	89 ft	Qmax flow condition Including 5 ft discharge head
	115 ft	Q2max flow condition including 5 ft discharge head

Will use the Hazen head calcs as they are more conservative

Basin Calculations for Drain Down

Drain down time equation used (9.3 from MCFCD Drainage Design Manual Pg. 9-17) Td = V/(Ap*Pd/12)

Design Percolation Rate (in/hr)		
P_r (in/hr)	2	Assumed Percolation Rate (To be revised with POE LS Geotechnical Reports)
D_r	2	De-rating Factor (MCFCD Hydraulics Manual 4th Edition, Pg 9-18)
P_d (in/hr)	1	Eq. **P_d=P_r/D_r** where **P_d**=design rate, **P_r**=field test rate, **D_r**=de-rating factor (MCFCD Hydraulics Manual 4th Edition, Pg 9-17)

Basin Drain Time without Drywell		
Drywell Design Rate (cfs)	0.00	Design Disposal Rate (COG Engineering Design Standards, Section 5.G.2.b, Pg 5-21)
Volume (ac-ft)	0.00	Run off volume reduced by drywell
V (ac-ft)	0.28	Volume to be infltrated per basin volume minus drywell volume infiltrated in 36 hrs
A_p (sq ft)	4,033	Required bottom area in sq ft
A_p (ac)	0.093	Required bottom area in acres
P_d (in/hr)	1.0	
***T_d (hr)**	**36.0**	***Drain down time within 36 hrs**
***Td = V/(A_p*P_d/12);** where **T_d**=drain time, **V**=runoff volume, **A_p**=basin bottom area, **P_d**=infiltration rate		

Note: Drywell not to be used for LS site.

Basin Drain Time with Drywell		
Drywell Design Rate (cfs)	0.10	Design Disposal Rate (COG Engineering Design Standards, Section 5.G.2.b, Pg 5-21)
Volume (ac-ft)	0.30	Run off volume reduced by drywell within 36-hr drain time
V (ac-ft)	0.06	Volume to be infltrated per basin minus drywell volume infiltrated in 36 hrs
A_p (sq ft)	N/A	Bottom area in sq ft
A_p (ac)	N/A	Bottom area in acres
P_d (in/hr)	N/A	Use rate for drywell only; infiltration volume for drywell exceed total runoff volume
***T_d (hr)**	**7.3**	***Calculation reflects time for drywell to drain total runoff only**
***Td = V/(A_p*P_d/12);** where **T_d**=drain time, **V**=runoff volume, **DWR** = drywell infiltration rate		

Client:	*City of Douglas*	**Sheet:**	1 of 2		
Project:	*Douglas POE Lift Station East*	**Date:**	*7/6/2022*		
Description:	*This sheet estimates the rainfall runoff Volume and Peak Flow using the Maricopa County Hydrology Design Manual (p. 3-1 to 3-8)*	**Job No:**	*2042634200*		
		By:	*T. Crouthamel*	**Chkd By:**	

Basin including Plant, Undeveloped Area, Retention Basin

Rational C-Values	100-YR	100-YR	
C1 (Land Use Code P)	0.95	0.95	Runoff coef. For Asphalt and Rooftops
C2 (Land Use Code I1)	0.95	0.95	Runoff coef. Industrial 1
C3 (No Runoff, contained)	1.00	1.00	Runoff coef. for retention basin, odor control bed, peroxide pad
C4 (Land Use Code GR)	0.88	0.88	Runoff coef. for decomposed granite / gravel
Composite C	**0.93**	**0.93**	Composite Runoff coefficient for whole sub-basin

Contributing Drainage Areas for full build out:			
Entire Contributing Area (C)	74,697	sq ft	This is the entire contributing area for the lift station site
Roofs and Asphalt (C1)	31,796	sq ft	
Equipment Areas (C2)	325	sq ft	
Retention (C3)	9,683	sq ft	*Assume that recharge basins will be self-retained.*
Decomposed Granite (C4)	32,893	sq ft	

Volume Calculation			
100-YR	**2-hr**	**24-hr**	
Composite C-value	0.93	0.93	
Precipitation, P (in)	2.10	3.60	per figure A.60 and A.56 Drainage Design Manual Maricopa County
Area, A (sq ft)	74,697	74,697	
Area, A (ac)	1.71	1.71	
Volume, V (ac-ft)	**0.28**	**0.48**	**Note:** Regulations require 100-yr, 2-hr storage.
Volume, V (cu ft)	12,100	20,743	24-hr volume will pass through.

Retention Basin Calculation			
Retention Basin Bottom Area (sq ft)	4,033		
Required Depth	3.00		Water depth to be no more that 3-ft
Freeboard	1.00		
Basin top area @ 4:1 (sq ft)	6,703		

Flow Calculations

Determining Roughness Kb		$Kb = m \log_{10}A + b$	(FCDMC Table 3.1)
m (Type A)	-0.00625		
b (Type A)	0.04		
Computed Kb	***0.0385***		

Determining Tc		$Tc = 11.4L^{0.5} K_b^{0.52} S^{-0.31} i^{-0.38}$	(FCDMC Hydrology Manual, eq 3.2)
L (mi)	0.0144		
Kb	0.0385		

Stantec CALCULATIONS

Client:	*City of Douglas*	**Sheet:**	2 of 2		
Project:	*Douglas POE Lift Station East*	**Date:**	*7/6/2022*		
Description:	*This sheet estimates the rainfall runoff Volume and Peak Flow using the Maricopa County Hydrology Design Manual (p. 3-1 to 3-8)*	**Job No:**	*2042634200*		
		By:	*T. Crouthamel*	**Chkd By:**	

BACKGROUND CALCS

LAFB LS		
AREA DESIGNATION NAME	**AREAS (SF)**	**TOTAL LS AREA**
Asphalt & Rooftops (C1)	31,796	
Equipment (industrial) (C2)	325	
Ret. Basin	9,683	
Decomposed granite (C4)	32,893	
Non-contributing areas: odor control (no runoff)	178	
PHASE 1 CONTRIBUTING AREA	**74,875**	**74,875**

3.4 VOLUME CALCULATIONS

Volume calculations should be done by applying the following equation:

$$V = C\left(\frac{P}{12}\right)A \quad (3.3)$$

where:

V = calculated volume, in acre-feet.
C = runoff coefficient from Table 3.2.
P = rainfall depth, in inches.
A = drainage area, in acres.

In the case of volume calculations for stormwater storage facility design, P equals the 100-year, 2-hour depth, in inches, as discussed in Section 2.2, and is determined from Figure A.56 of Appendix A.1.

S (ft/mi)	104.2105	

Flow Calculations (cont)	10-YR	100-YR		
Assumed T_c (min):	5.0-min	5.0-min		
Intensity (in/hr):	4.68	7.40		
Computed T_c (hr)	0.033	0.028	**10-yr T_c**	**100-yr T_c**
Computed T_c (min)	2.0	1.7	OK, Tc < 5-min	OK, Tc < 5-min

Determining Q	10-YR	100-YR	
Runoff coefficent C	0.926	0.926	Q = CIA
Rainfall intensity (in/hr)	5.00	7.40	
A (ac)	1.71	1.71	
Q (cfs)	**7.9**	**11.7**	
Q (gpm)	**3,562.2**	**5,272.0**	

source: (FCDMC Hydrology Manual, eq 3.1)

Time of Concentration INPUTS:

Longest Flow Path		Elevatons, in feet	
L (ft)	L (mi)	Top EL	Bottom EL
76	0.014394	1.5	0
S (ft/mi):	104.2105		

Appendix H Estimated Water Flows per Milestone

Cochise County - City of Douglas 30% Port-Of-Entry Design

Jun-22

Summary of Land Development Planning Areas within the POE Water Service Area

Areas in yellow are in the floodplain zone

Areas in green are NOT in the POE service area

Estimated Water Flows - 2028

Note 1: Assumed startup of the wastewater collection system is based on GSA schedule is 2078

SUB AREAS	ACRES	Land Use Designation	AZ Admin Code	% of Ultimate Development	Per Acre Avg. Water Generation Rate (gal/acre/day)	Avg Day Design Flow (gpd)	Peaking Factor	Peak Flow (gpd)	Peak Flow (gpm)
SA 1.1	171	C-Developing	Commerical / Industrial	20.00%	1,400	47,858	2	95,715	66
SA 1.2	39	C-Developing	Commerical / Industrial	20.00%	1,400	11,043	2	22,086	15
SA 1.3	47	C-Developing	Commerical / Industrial	20.00%	1,400	13,143	2	26,286	18
SA 1.4	45	C-Developing	Commerical / Industrial	20.00%	1,400	12,510	2	25,021	17
SA 1.5	30	C-Developing	Commerical / Industrial	20.00%	1,400	8,336	2	16,671	12
SA 1.6	48	C-Developing	Commerical / Industrial	0.00%	1,400	0	2	0	0
SA 1.7	54	C-Developing	Commerical / Industrial	0.00%	1,400	0	2	0	0
SA 1.8	53	C-Developing	Commerical / Industrial	0.00%	1,400	0	2	0	0
SA 1.9	52	C-Developing	Commerical / Industrial	0.00%	1,400	0	2	0	0
SA 1.10	38	C-Developing	Commerical / Industrial	0.00%	1,400	0	2	0	0
Total flow into West WW Lift Station						**92,890**		**185,780**	**129**
SA 1.11	68	C-Developing	Commerical / Industrial	0.00%	1,400	0	2	0	0
SA 1.12	72	C-Developing	Commerical / Industrial	0.00%	1,400	0	2	0	0
SA 1.13	33	C-Developing	Commerical / Industrial	0.00%	1,400	0	2	0	0
SA 1.14	41	C-Developing	Commerical / Industrial	0.00%	1,400	0	2	0	0
SA 1.35	17	C-Developing	Commerical / Industrial	20.00%	1,400	4,738	2	9,475	7
SA 2.1	95	C-Developing	Commerical / Industrial	20.00%	1,400	26,723	2	53,446	37
SA 2.2	24	C-Developing	Commerical / Industrial	20.00%	1,400	6,614	2	13,227	9
Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)						**38,074**		**76,149**	**53**
Flow from South Lateral into MH E						**130,964**		**261,929**	**182**
Flow from West Lateral (Cochise College) into MH E						**15,000**		**30,000**	**21**
Total flow into MH E						**145,964**		**291,929**	**203**

	ACRES	% Development	Total Acres Developed
	171	20.00%	34
	39	20.00%	8
	47	20.00%	9
	45	20.00%	9
	30	20.00%	6
	48	0.00%	0
	54	0.00%	0
	53	0.00%	0
	52	0.00%	0
	38	0.00%	0
	68	0.00%	0
	72	0.00%	0
	33	0.00%	0
	41	0.00%	0
	17	20.00%	3
	95	20.00%	19
	24	20.00%	5
Total	926		94
Percent developed	10%		

Cochise County - City of Douglas 30% Port-Of-Entry Design
Jun-22
Summary of Land Development Planning Areas within the POE Water Service Area

Areas in yellow are in the floodplain zone
Areas in green are NOT in the POE service area

Estimated Water Flows - 2033

Note 1: Assumed startup of the wastewater collection system is based on GSA schedule is 2078

SUB AREAS	ACRES	Land Use Designation	AZ Admin Code	% of Ultimate Development	Per Acre Avg. Water Generation Rate (gal/acre/day)	Avg Day Design Flow (gpd)	Peaking Factor	Peak Flow (gpd)	Peak Flow (gpm)
SA 1.1	171	C-Developing	Commerical / Industrial	40.00%	1,400	95,715	2	191,430	133
SA 1.2	39	C-Developing	Commerical / Industrial	40.00%	1,400	22,086	2	44,173	31
SA 1.3	47	C-Developing	Commerical / Industrial	40.00%	1,400	26,286	2	52,573	37
SA 1.4	45	C-Developing	Commerical / Industrial	40.00%	1,400	25,021	2	50,042	35
SA 1.5	30	C-Developing	Commerical / Industrial	40.00%	1,400	16,671	2	33,342	23
SA 1.6	48	C-Developing	Commerical / Industrial	20.00%	1,400	13,339	2	26,678	19
SA 1.7	54	C-Developing	Commerical / Industrial	20.00%	1,400	15,022	2	30,044	21
SA 1.8	53	C-Developing	Commerical / Industrial	20.00%	1,400	14,798	2	29,596	21
SA 1.9	52	C-Developing	Commerical / Industrial	20.00%	1,400	14,588	2	29,176	20
SA 1.10	38	C-Developing	Commerical / Industrial	20.00%	1,400	10,542	2	21,084	15
Total flow into West WW Lift Station						**254,069**		**508,138**	**353**
SA 1.11	68	C-Developing	Commerical / Industrial	20.00%	1,400	18,950	2	37,901	26
SA 1.12	72	C-Developing	Commerical / Industrial	20.00%	1,400	20,283	2	40,566	28
SA 1.13	33	C-Developing	Commerical / Industrial	20.00%	1,400	9,372	2	18,743	13
SA 1.14	41	C-Developing	Commerical / Industrial	20.00%	1,400	11,435	2	22,870	16
SA 1.35	17	C-Developing	Commerical / Industrial	40.00%	1,400	9,475	2	18,950	13
SA 2.1	95	C-Developing	Commerical / Industrial	40.00%	1,400	53,446	2	106,893	74
SA 2.2	24	C-Developing	Commerical / Industrial	40.00%	1,400	13,227	2	26,454	18
Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)						**136,189**		**272,378**	**189**
Flow from South Lateral into MH E						**390,258**		**780,517**	**542**
Flow from West Lateral (Cochise College) into MH E						**15,000**		**30,000**	**21**
Total flow into MH E						**405,258**		**810,517**	**563**

	ACRES	% Development	Total Acres Developed
	171	40.00%	68
	39	40.00%	16
	47	40.00%	19
	45	40.00%	18
	30	40.00%	12
	48	20.00%	10
	54	20.00%	11
	53	20.00%	11
	52	20.00%	10
	38	20.00%	8
	68	20.00%	14
	72	20.00%	14
	33	20.00%	7
	41	20.00%	8
	17	40.00%	7
	95	40.00%	38
	24	40.00%	9
Total	926		279
Percent developed	30%		

Cochise County - City of Douglas 30% Port-Of-Entry Design

Jun-22

Summary of Land Development Planning Areas within the POE Water Service Area

Areas in yellow are in the floodplain zone

Areas in green are NOT in the POE service area

Estimated Water Flows - 2053									
Note 1: Assumed startup of the wastewater collection system is based on GSA schedule is 2078									
SUB AREAS	**ACRES**	**Land Use Designation**	**AZ Admin Code**	**% of Ultimate Development**	**Per Acre Avg. Water Generation Rate (gal/acre/day)**	**Avg Day Design Flow (gpd)**	**Peaking Factor**	**Peak Flow (gpd)**	**Peak Flow (gpm)**
SA 1.1	171	C-Developing	Commerical / Industrial	100.00%	1,400	239,288	2	478,576	332
SA 1.2	39	C-Developing	Commerical / Industrial	100.00%	1,400	55,216	2	110,432	77
SA 1.3	47	C-Developing	Commerical / Industrial	100.00%	1,400	65,716	2	131,432	91
SA 1.4	45	C-Developing	Commerical / Industrial	100.00%	1,400	62,552	2	125,104	87
SA 1.5	30	C-Developing	Commerical / Industrial	100.00%	1,400	41,678	2	83,356	58
SA 1.6	48	C-Developing	Commerical / Industrial	40.00%	1,400	26,678	2	53,357	37
SA 1.7	54	C-Developing	Commerical / Industrial	40.00%	1,400	30,044	2	60,088	42
SA 1.8	53	C-Developing	Commerical / Industrial	40.00%	1,400	29,596	2	59,192	41
SA 1.9	52	C-Developing	Commerical / Industrial	40.00%	1,400	29,176	2	58,352	41
SA 1.10	38	C-Developing	Commerical / Industrial	40.00%	1,400	21,084	2	42,168	29
Total flow into West WW Lift Station						**601,028**		**1,202,057**	**835**
SA 1.11	68	C-Developing	Commerical / Industrial	40.00%	1,400	37,901	2	75,802	53
SA 1.12	72	C-Developing	Commerical / Industrial	40.00%	1,400	40,566	2	81,133	56
SA 1.13	33	C-Developing	Commerical / Industrial	40.00%	1,400	18,743	2	37,486	26
SA 1.14	41	C-Developing	Commerical / Industrial	40.00%	1,400	22,870	2	45,741	32
SA 1.35	17	C-Developing	Commerical / Industrial	40.00%	1,400	9,475	2	18,950	13
SA 2.1	95	C-Developing	Commerical / Industrial	40.00%	1,400	53,446	2	106,893	74
SA 2.2	24	C-Developing	Commerical / Industrial	40.00%	1,400	13,227	2	26,454	18
Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)						**196,230**		**392,459**	**273**
Flow from South Lateral into MH E						**797,258**		**1,594,516**	**1,107**
Flow from West Lateral (Cochise College) into MH E						**50,000**		**100,000**	**69**
Total flow into MH E						**847,258**		**1,694,516**	**1,177**

	ACRES	**% Development**	**Total Acres Developed**
	171	100.00%	171
	39	100.00%	39
	47	100.00%	47
	45	100.00%	45
	30	100.00%	30
	48	40.00%	19
	54	40.00%	21
	53	40.00%	21
	52	40.00%	21
	38	40.00%	15
	68	40.00%	27
	72	40.00%	29
	33	40.00%	13
	41	40.00%	16
	17	40.00%	7
	95	40.00%	38
	24	40.00%	9
Total	926		569
Percent developed	61%		

Cochise County - City of Douglas 30% Port-Of-Entry Design
Jun-22
Summary of Land Development Planning Areas within the POE Water Service Area

Areas in yellow are in the floodplain zone
Areas in green are NOT in the POE service area

Estimated Water Flows - 2078									
Note 1: Assumed startup of the wastewater collection system is based on GSA schedule is 2078									
SUB AREAS	**ACRES**	**Land Use Designation**	**AZ Admin Code**	**% of Ultimate Development**	**Per Acre Avg. Water Generation Rate (gal/acre/day)**	**Avg Day Design Flow (gpd)**	**Peaking Factor**	**Peak Flow (gpd)**	**Peak Flow (gpm)**
SA 1.1	171	C-Developing	Commerical / Industrial	100.00%	1,400	239,288	2	478,576	332
SA 1.2	39	C-Developing	Commerical / Industrial	100.00%	1,400	55,216	2	110,432	77
SA 1.3	47	C-Developing	Commerical / Industrial	100.00%	1,400	65,716	2	131,432	91
SA 1.4	45	C-Developing	Commerical / Industrial	100.00%	1,400	62,552	2	125,104	87
SA 1.5	30	C-Developing	Commerical / Industrial	100.00%	1,400	41,678	2	83,356	58
SA 1.6	48	C-Developing	Commerical / Industrial	60.00%	1,400	40,018	2	80,035	56
SA 1.7	54	C-Developing	Commerical / Industrial	60.00%	1,400	45,066	2	90,132	63
SA 1.8	53	C-Developing	Commerical / Industrial	60.00%	1,400	44,394	2	88,788	62
SA 1.9	52	C-Developing	Commerical / Industrial	60.00%	1,400	43,764	2	87,528	61
SA 1.10	38	C-Developing	Commerical / Industrial	60.00%	1,400	31,626	2	63,252	44
Total flow into West WW Lift Station						**669,318**		**1,338,635**	**930**
SA 1.11	68	C-Developing	Commerical / Industrial	60.00%	1,400	56,851	2	113,702	79
SA 1.12	72	C-Developing	Commerical / Industrial	60.00%	1,400	60,850	2	121,699	85
SA 1.13	33	C-Developing	Commerical / Industrial	60.00%	1,400	28,115	2	56,230	39
SA 1.14	41	C-Developing	Commerical / Industrial	60.00%	1,400	34,306	2	68,611	48
SA 1.35	17	C-Developing	Commerical / Industrial	60.00%	1,400	14,213	2	28,426	20
SA 2.1	95	C-Developing	Commerical / Industrial	60.00%	1,400	80,170	2	160,339	111
SA 2.2	24	C-Developing	Commerical / Industrial	60.00%	1,400	19,841	2	39,682	28
Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)						**294,344**		**588,689**	**409**
Flow from South Lateral into MH E						**963,662**		**1,927,324**	**1,338**
Flow from West Lateral (Cochise College) into MH E						**50,000**		**100,000**	**69**
Total flow into MH E						**1,013,662**		**2,027,324**	**1,408**

	ACRES	**% Development**	**Total Acres Developed**
	171	100.00%	171
	39	100.00%	39
	47	100.00%	47
	45	100.00%	45
	30	100.00%	30
	48	60.00%	29
	54	60.00%	32
	53	60.00%	32
	52	60.00%	31
	38	60.00%	23
	68	60.00%	41
	72	60.00%	43
	33	60.00%	20
	41	60.00%	25
	17	60.00%	10
	95	60.00%	57
	24	60.00%	14
Total	926		688
Percent developed	74%		

Cochise County - City of Douglas 30% Port-Of-Entry Design
Jun-22
Summary of Land Development Planning Areas within the POE Water Service Area

Areas in yellow are in the floodplain zone
Areas in green are NOT in the POE service area

Estimated Water Flows - Full Buildout

Note 1: Assumed startup of the wastewater collection system is based on GSA schedule is 2078

SUB AREAS	ACRES	Land Use Designation	AZ Admin Code	% of Ultimate Development	Per Acre Avg. Water Generation Rate (gal/acre/day)	Avg Day Design Flow (gpd)	Peaking Factor	Peak Flow (gpd)	Peak Flow (gpm)
SA 1.1	171	C-Developing	Commerical / Industrial	100.00%	1,400	239,288	2	478,576	332
SA 1.2	39	C-Developing	Commerical / Industrial	100.00%	1,400	55,216	2	110,432	77
SA 1.3	47	C-Developing	Commerical / Industrial	100.00%	1,400	65,716	2	131,432	91
SA 1.4	45	C-Developing	Commerical / Industrial	100.00%	1,400	62,552	2	125,104	87
SA 1.5	30	C-Developing	Commerical / Industrial	100.00%	1,400	41,678	2	83,356	58
SA 1.6	48	C-Developing	Commerical / Industrial	100.00%	1,400	66,696	2	133,392	93
SA 1.7	54	C-Developing	Commerical / Industrial	100.00%	1,400	75,110	2	150,220	104
SA 1.8	53	C-Developing	Commerical / Industrial	100.00%	1,400	73,990	2	147,980	103
SA 1.9	52	C-Developing	Commerical / Industrial	100.00%	1,400	72,940	2	145,880	101
SA 1.10	38	C-Developing	Commerical / Industrial	100.00%	1,400	52,710	2	105,420	73
Total flow into West WW Lift Station						**805,896**		**1,611,792**	**1,119**
SA 1.11	68	C-Developing	Commerical / Industrial	100.00%	1,400	94,752	2	189,504	132
SA 1.12	72	C-Developing	Commerical / Industrial	100.00%	1,400	101,416	2	202,832	141
SA 1.13	33	C-Developing	Commerical / Industrial	100.00%	1,400	46,858	2	93,716	65
SA 1.14	41	C-Developing	Commerical / Industrial	100.00%	1,400	57,176	2	114,352	79
SA 1.35	17	C-Developing	Commerical / Industrial	100.00%	1,400	23,688	2	47,376	33
SA 2.1	95	C-Developing	Commerical / Industrial	100.00%	1,400	133,616	2	267,232	186
SA 2.2	24	C-Developing	Commerical / Industrial	100.00%	1,400	33,068	2	66,136	46
Total flow in this area (SA 1.11-1.14, 1.35, 2.1,2.2)						**490,574**		**981,148**	**681**
Flow from South Lateral into MH E						**1,296,470**		**2,592,940**	**1,801**
Flow from West Lateral (Cochise College) into MH E						**50,000**		**100,000**	**69**
Total flow into MH E						**1,346,470**		**2,692,940**	**1,870**

	ACRES	% Development	Total Acres Developed
	171	100.00%	171
	39	100.00%	39
	47	100.00%	47
	45	100.00%	45
	30	100.00%	30
	48	60.00%	29
	54	60.00%	32
	53	60.00%	32
	52	60.00%	31
	38	60.00%	23
	68	60.00%	41
	72	60.00%	43
	33	60.00%	20
	41	60.00%	25
	17	60.00%	10
	95	60.00%	57
	24	60.00%	14
Total	926		688
Percent developed	74%		

Appendix I Cost Estimates

I.1 Total Project Delivery Cost

DOUGLAS PORT OF ENTRY 30 % DETAILED DESIGN

POE Wastewater Service Area - Total Project Delivery Cost Summary

Engineer's Estimate of Probable Cost

Date Created: 10/04/2022

By: Mark Peterson, Jack Bryck, Todd Crouthamel, Cassandra Flores

Stantec

Cost Summary		Description	Unit	Unit Cost	Quantity	Cost
West WW LS	**Construction Cost Sub Total**					**$2,001,100**
Project Delivery Cost						
	General Conditions, Engineering, Contingency	30% of Construction Sub Total	LS		30%	$600,330
	Total Project Delivery Cost					**$2,601,430**
	Total Wastewater Treatment Order of Magnitude Cost High Cost of Range	+20% of Project Delivery Sub Total			20%	$3,121,716
	Total Wastewater Treatment Order of Magnitude Cost Low Cost of Range	-15% of Project Delivery Sub Total			-15%	$2,211,216
East WW LS	**Construction Cost Sub Total**					**$2,307,100**
Project Delivery Cost						
	General Conditions, Engineering, Contingency	30% of Construction Sub Total	LS		30%	$692,130
	Total Project Delivery Cost					**$2,999,230**
	Total Wastewater Treatment Order of Magnitude Cost High Cost of Range	+20% of Project Delivery Sub Total			20%	$3,599,000
	Total Wastewater Treatment Order of Magnitude Cost Low Cost of Range	-15% of Project Delivery Sub Total			-15%	$2,549,000
WW Collection System	**Construction Cost Sub Total**					**$7,967,850**
Project Delivery Cost						
	General Conditions, Engineering, Contingency	30% of Construction Sub Total	LS		30%	$2,390,355
	Project Delivery Cost					**$10,358,205**
	Total Wastewater Treatment Order of Magnitude Cost High Cost of Range	+20% of Project Delivery Sub Total			20%	$12,429,846
	Total Wastewater Treatment Order of Magnitude Cost Low Cost of Range	-15% of Project Delivery Sub Total			-15%	$8,804,474
Groundwater Well - Storage Tank	**Construction Cost Sub Total**					**$5,130,100**
Project Delivery Cost						
	General Conditions + Engineering + Construction Administration	30% of Construction Sub Total	LS		30%	$1,539,030
	Project Delivery Sub Total					**$6,669,130**
	Total Water System Order of Magnitude Cost High Cost of Range	+20% of Project Delivery Sub Total			20%	$8,002,956
	Total Water System Order of Magnitude Cost Low Cost of Range	-15% of Project Delivery Sub Total			-15%	$5,668,761
Water Distribution System	**Construction Sub Total**					**$3,340,200**
Project Delivery Cost						
	General Conditions + Engineering + Construction Administration	30% of Construction Sub Total	LS		30%	$1,002,060
	Project Delivery Sub Total					**$4,342,260**
	Total Water System Order of Magnitude Cost High Cost of Range	+20% of Project Delivery Sub Total			20%	$5,210,712
	Total Water System Order of Magnitude Cost Low Cost of Range	-15% of Project Delivery Sub Total			-15%	$3,690,921
Broadband Conduit	**Construction Cost Sub Total**					**$402,140**

Project Delivery Cost						
	General Conditions + Engineering + Construction Administration	30% of Construction Sub Total	LS		30%	$120,642
	Project Delivery Cost					**$522,782**
	Total Water System Order of Magnitude Cost High Cost of Range	+20% of Project Delivery Sub Total			20%	$627,338
	Total Water System Order of Magnitude Cost Low Cost of Range	-15% of Project Delivery Sub Total			-15%	$444,365
TOTAL Construction Cost						**$21,148,490**
					20%	$25,378,188
					-15%	$17,976,217
					30%	$6,344,547
TOTAL Project Delivery Cost						**$27,493,037**
					20%	$32,991,644
					-15%	$23,369,081

I.2 East Wastewater Lift Station

DOUGLAS PORT OF ENTRY 30 % DETAILED DESIGN

POE Wastewater Service Area - East Wastewater Lift Station

Engineer's Estimate of Probable Cost

Date Created: 10/04/2022

By: Mark Peterson, Jack Bryck, Todd Crouthamel, Cassandra Flores

	Item	Description	Unit	Unit Cost	Quantity	Cost	Notes
1.0	**SITE WORK**						
1.1	Clearing and Grubbing	Preparation of site for const.	LS	$15,000	1	$15,000	Based contractor estimates for site size, inflated to 2022
1.2	Grading and Drainage	Grading site and excavation of retention basin	LS	$25,000	1	$25,000	Based contractor estimates for site size, inflated to 2022
1.3	Structural Excavation/Prep/Backfill	Excavation of wetwell and other structural modifications on site	CY	$60	548	$32,880	Based on 12'x14'x16' wetwell, costs are 2020 contractor estimates, inflated to 2022
1.4	Decomposed Granite	Min 4" thick on all unpaved areas including retention.	SF	$4	32,893	$131,572	
1.6	Asphalt Paving	Parking and truck turn around areas	SY	$85	2,208	$187,686	Based on 2022 contractor quotes, inflated to 2022
1.7	Pedestrian Gate	Manually opened, badge access gate, 4-ft wide	LS	$5,500	1	$5,500	Based on similar gate design at site in Phx area in 2020, inflated
1.8	Motorized Rolling Gate	30-ft automatic, badge accessed vehicle gate to site and motors.	LF	$1,800	60	$108,000	Based on manufacturer quotes, inflated to 2022
	Sub Total					**$506,000**	
2.0	**CONCRETE/MASONRY**						
2.1a	Wetwell - Option 1	Corrosion resistant, precast polymer concrete wetwell, including access hatches	LS	$300,000	1	$300,000	Estimated from similar wetwell in a 2022 project, added for comparison, not included in LS total, adjusted for inflation
2.1b	Wetwell - Option 2	Cast in Place wetwell with plastic lining, including access hatches	CY	$45,000	1	$45,000	Used in total cost as cheaper option, polymer need less maitneance over long term compared to cast in place
2.2	Odor Control Concrete	Includes containment curb	LS	$12,500	1	$12,500	Costs from similar project, inflated to 2022
2.3	MCC/Panel Pad	Includes shade structure footings	LS	$24,000	1	$24,000	Costs from similar project, inflated to 2022
2.4	Wall Footings	For CMU security wall	LF	$125	0	$0	Costs from similar project, inflated to 2022
2.5	Genset Pad	Standby generator	LS	$5,500	1	$5,500	Costs from similar project, inflated to 2022
2.6	Concrete Paving	Driveway connecting JJR to site	SY	$190	327	$62,219	2022 contractor quote, inflated to 2022
2.7	DIP Support Pad	For setting pipe supports for above grade header	LS	$6,800	1	$6,800	
2.8a	Manholes - Option 1	Corrosion resistant, precast polymer concrete manholes	EA	$38,000	2	$76,000	Estimated from similar manholes in a 2022 project, added for comparison, not included in LS total, adjusted for inflation to 2022
2.8b	Manholes - Option 2	Cast in Place wetwell with plastic lining	EA	$20,000	2	$40,000	Used in total cost as cheaper option, polymer need less maitneance over long term compared to cast in place
2.9	Misc Pads	Transformers, Sampler, etc	LS	$4,000.00	1	$4,000	Costs from similar project, inflated to 2022
2.10	CMU Wall	10' high security wall	LF	$300	1041	$312,300	2022 contractor quote, inflated to 2022
	Sub Total					**$512,000**	
3.0	**LIFT STATION EQUIPMENT**						
3.1	Submersible Pumps	40 HP submersible wastewater pumps	EA	$15,000	3	$45,000	Quote from vendor, inflated to 2022
3.2	Biofilter Odor Control System	Includes media, sprinklers, blowers, and other systems equipment	LS	$185,000	1	$185,000	Similar project in 2021, inflated to 2022
3.3	Refrigerated Sampler	Includes sampler, encasement and tubing	LS	$25,000	1	$25,000	Similar project in 2021, inflated to 2022
	Sub Total					**$255,000**	

4.0	**MISC CONSTRUCTION**						
4.1	MCC Shade Structure	Supports and roofing	LS	$35,000	1	$35,000	Similar project in 2021, inflated to 2022
4.2	Bollards	MAG 140 - Type 1	EA	$2,500	30	$75,000	Similar project in 2021, inflated to 2022
4.3	Yard Hydrant	Includes nozzle, hose racks, and hoses	LS	$250	1	$250	Similar project in 2021, inflated to 2022
4.4	Site Signage	Warning, Identification, and Project	LS	$3,700	1	$3,700	Similar project in 2021, inflated to 2022
4.5	Pipe Supports	Supports for above grade headers	LS	$15,500	1	$15,500	Similar project in 2021, inflated to 2022
	Sub Total					**$129,000**	
5.0	**MECHANICAL**						
5.1	10" DR 17 HDPE Pipe	Force main between above grade headers and Manhole 20	LF	$225	408	$91,800	Costs from contractor quote, 2022, installed & inflated to 2022
5.2	6" Class 50 DIP	Pump discharge and above grade headers	LF	$153	30	$4,590	Costs from contractor quote, 2022, installed & inflated to 2022
5.3	1.5" Copper Piping	Potable water for the eye wash and yard hydrant	LF	$15	103	$1,545	Costs from contractor quote, 2022, installed & inflated to 2022
5.4	15" PVC SDR 35Piping	Gravity influent pipe	LF	$175	271	$47,425	Costs from contractor quote, 2022, installed & inflated to 2022
5.5	Swing Check Valves	6" on discharge piping	LF	$6,500	3	$19,500	Costs from contractor quote, 2022, installed & inflated to 2022
5.6	Plug Valves	6" on discharge and header	LF	$2,300	4	$9,200	Costs from contractor quote, 2022, installed & inflated to 2022
5.7	Combination Air/Vacuum Valves	On header	LF	$5,800	1	$5,800	Costs from contractor quote, 2022, installed & inflated to 2022
5.8	10" FRP	Foul air piping for odor control system	LF	$800	72	$57,600	Costs from contractor quote, 2022, installed & inflated to 2022
5.9	Gooseneck Vents	Drain vents for CARV	LF	$3,500	1	$3,500	Costs from contractor quote, 2022, installed & inflated to 2022
	Sub Total					**$241,000**	
6.0	**ELECTRICAL/I&C**						
6.1	SES	Service Entrance Switchboard	EA	$32,000	1	$32,000	Similar project in 2021, inflated to 2022
6.2	Mag Meter	SCADA readable flow meter on header	EA	$9,100	1	$9,100	Similar project in 2021, inflated to 2022
6.3	Misc. Electrical Equipment	Panelbooards, trandformers, fuse disconnects, LCPs, etc.	LS	$150,000	1	$150,000	Similar project in 2021, inflated to 2022
6.4	Conduit, conductors, groundwire and groundrods	Yard wiring	LS	$200,000	1	$200,000	Similar project in 2021, inflated to 2022
6.5	Genset	XXXMW emergency generator	LS	$98,000	1	$98,000	Similar project in 2021, inflated to 2022
6.6	Lighting	LED on-pole lights	LS	$22,000	1	$22,000	Similar project in 2021, inflated to 2022
6.7	Transformer (APS)	Power to site from overhead lines to transformer	LS	$0	0	$0	Pending APS utility future locations
6.8	Instrumentation & Scada	Instrumentation devices and PLC	LS	$150,000	1	$150,000	Similar project in 2021, inflated to 2022
6.9	Security	CC Cameras and intrusion alarms	LS	$3,000	1	$3,000	Similar project in 2021, inflated to 2022
	SubTotal					**$664,100**	
	Construction Cost Sub Total					**$2,307,100**	
Project Delivery Cost							
	General Conditions, Engineering, Contingency	30% of Construction Sub Total	LS		30%	$692,130	
	Total Project Delivery Cost					**$2,999,230**	*Includes only cast in place option for the wetwell and manhole
	Total Wastewater Treatment Order of Magnitude Cost High Cost of Range	+20% of Project Delivery Sub Total			20%	$3,599,000	
	Total Wastewater Treatment Order of Magnitude Cost Low Cost of Range	-15% of Project Delivery Sub Total			-15%	$2,549,000	

Assumptions

1 Land acquisition. This cost is not included in this estimate.

2 Wastewater lift station and forcemain unit costs are based on 2020/2021 estimates with 5% annual rate of

The larger inflation rate is an attempt to address potential COVID induced supply chain issues and other inflationary economoic pressures. Stantec will revise these costs at the 60% level and may revise inflation rate should economic trends change. This is a conservative approach to the costing the project as 'worst case' for future economic conditions.

3 Costing for recommended site at the intersection of Copper Rd and SR 80

I.3 West Wastewater Lift Station

DOUGLAS PORT OF ENTRY 30 % DETAILED DESIGN
POE Wastewater Service Area - West Wastewater Lift Station
Engineer's Estimate of Probable Cost
Current Date: 10/04/2022
By: Mark Peterson, Jack Bryck, Todd Crouthamel, Cassandra Flores

Stantec

	Item	Description	Unit	Unit Cost	Quantity	Cost	Notes
1.0	**SITE WORK**						
1.1	Clearing and Grubbing	Preparation of site for const.	LS	$15,000	1	$15,000	Based contractor estimates for site size, inflated to 2022
1.2	Grading and Drainage	Grading site and excavation of retention basin	LS	$25,000	1	$25,000	Based contractor estimates for site size, inflated to 2022
1.3	Structural Excavation/Prep/Backfill	Excavation of wetwell and other structural modifications on site	CY	$60	398	$23,880	Based on 12'x14'x23' wetwell, costs are 2020 contractor estimates, inflated to 2022
1.4	Decomposed Granite	Min 4" thick on all unpaved areas including retention.	SF	$4	14,892	$59,568	
1.6	Asphalt Paving	Parking and truck turn around areas	SY	$85	3,492	$296,820	Based on 2022 contractor quotes, inflated to 2022
1.7	Pedestrian Gate	Manually opened, badge access gate, 4-ft wide	LS	$5,500	1	$5,500	Based on similar gate design at site in Phx area in 2020, inflated to 2022
1.8	Motorized Rolling Gate	30-ft automatic, badge accessed vehicle gate to site and motors.	LF	$1,800	30	$54,000	Based on manufacturer quotes, inflated to 2022
	Sub Total					**$480,000**	
2.0	**CONCRETE/MASONRY**						
2.1a	Wetwell - Option 1	Corrosion resistant, precast polymer concrete wetwell, including access hatches	LS	$300,000	1	$300,000	Estimated from similar wetwell in a 2022 project, added for comparison, not included in LS total, adjusted for inflation 2022
2.1b	Wetwell - Option 2	Cast in Place wetwell with plastic lining, including access hatches	LS	$45,000	1	$45,000	Used in total cost as cheaper option, polymer need less maintenance over long term compared to cast in place
2.2	Chemical Feed Pad	Includes containment curb	LS	$14,000	1	$14,000	Costs from similar project, inflated to 2022
2.3	MCC/Panel Pad	Includes shade structure footings	LS	$24,000	1	$24,000	Costs from similar project, inflated to 2022
2.4	Wall Footings	For CMU security wall	LF	$125	0	$0	Costs from similar project, inflated to 2022
2.5	Genset Pad	Standby generator	LS	$5,500	1	$5,500	Costs from similar project, inflated to 2022
2.6	Concrete Paving	Driveway connecting JJR to site	SY	$190	162	$30,780	2022 contractor quote, inflated to 202
2.7	DIP Support Pad	For setting pipe supports for above grade header	LS	$6,800	1	$6,800	Based on size in 2022 dollars, inflated to 2022
2.8a	Manholes - Option 1	Corrosion resistant, precast polymer concrete manholes	EA	$38,000	1	$38,000	Estimated from similar manholes in a 2020 project, added for comparison, not included in LS total, adjusted for inflation to 2022
2.8b	Manholes - Option 2	Cast in Place wetwell with plastic lining	EA	$20,000	1	$20,000	Used in total cost as cheaper option, polymer need less maitneance over long term compared to cast in place
2.9	Misc Pads	Transformers, Sampler, etc	LS	$4,000.00	1	$4,000	Costs from similar project, inflated to 2022
2.10	CMU Wall	10' high security wall	LF	$300	1334	$400,200	2022 contractor quote, inflated
	Sub Total					**$550,000**	
3.0	**LIFT STATION EQUIPMENT**						
3.1	Submersible Pumps	5 HP submersible wastewater pumps	EA	$5,000	3	$15,000	Quote from vendor, inflated to 2022
3.2	Chemical Storage and Dosing System	Includes tank, pumps, and disbursment piping	LS	$10,700	1	$10,700	Similar project in 2021, inflated to 2022
3.3	Refrigerated Sampler	Includes sampler, encasement and tubing	LS	$25,000	1	$25,000	Similar project in 2021, inflated to 2022
3.4	Eye Wash and Emergency Shower	At the chemical storage site	EA	$2,000	1	$2,000	Similar project in 2021, inflated to 2022
	Sub Total					**$53,000**	
4.0	**MISC CONSTRUCTION**						
4.1	MCC Shade Structure	Supports and roofing	LS	$35,000	1	$35,000	Similar project in 2021, inflated to 2022
4.2	Bollards	MAG 140 - Type 1	EA	$2,500	29	$72,500	Similar project in 2021, inflated to 2022
4.3	Yard Hydrant	Includes nozzle, hose racks, and hoses	LS	$250	1	$250	Similar project in 2021, inflated to 2022
4.4	Site Signage	Warning, Identification, and Project	LS	$3,700	1	$3,700	Similar project in 2021, inflated to 2022
4.5	Pipe Supports	Supports for above grade headers	LS	$15,500	1	$15,500	Similar project in 2021, inflated 2022
	Sub Total					**$127,000**	
5.0	**MECHANICAL**						
5.1	6" DR 17 HDPE Pipe	Force main between above grade headers and Manhole G	LF	$135	292	$39,420	Costs from contractor quote, 2022, installed & inflated to 2022

5.2	6" Class 50 DIP	Pump discharge and above grade headers	LF	$153	30	$4,590	Costs from contractor quote, 2022, installed & inflated to 2022
5.3	1.5" Copper Piping	Potable water for the eye wash and yard hydrant	LF	$15	180	$2,700	Costs from contractor quote, 2022, installed & inflated to 2022
5.4	12" PVC SDR 35 Piping	Gravity influent pipe	LF	$140	305	$42,700	Costs from contractor quote, 2022, installed & inflated to 2022
5.5	Swing Check Valves	6" on discharge piping	EA	$6,500	3	$19,500	Costs from contractor quote, 2022, installed & inflated to 2022
5.6	Plug Valves	6" on discharge and header	EA	$2,300	4	$9,200	Costs from contractor quote, 2022, installed & inflated to 2022
5.7	Combination Air/Vacuum Valves	On header	EA	$5,800	1	$5,800	Costs from contractor quote, 2022, installed & inflated to 2022
5.8	Gooseneck Vents	Drain vents for CARV	EA	$3,500	1	$3,500	Costs from contractor quote, 2022, installed & inflated to 2022
	SubTotal					**$127,000**	
6.0	**ELECTRICAL/I&C**						
6.1	SES	Service Entrance Switchboard	EA	$32,000	1	$32,000	Similar project in 2021, inflated to 2022
6.2	Mag Meter	SCADA readable flow meter on header	EA	$9,100	1	$9,100	Similar project in 2021, inflated to 2022
6.3	Misc. Electrical Equipment	Panelbooards, trandformers, fuse disconnects, LCPs, etc.	LS	$150,000	1	$150,000	Similar project in 2021, inflated to 2022
6.4	Conduit, conductors, groundwire and groundrods	Yard wiring	LS	$200,000	1	$200,000	Similar project in 2021, inflated to 2022
6.5	Genset	500kV emergency generator	LS	$98,000	1	$98,000	Similar project in 2021, inflated to 2022
6.6	Lighting	LED on-pole lights	LS	$22,000	1	$22,000	Similar project in 2021, inflated to 2022
6.7	Transformer (APS)	Power to site from overhead lines to transformer	LS	$0	0	$0	Pending APS utility future locations
6.8	Instrumentation & Scada	Instrumentation devices and PLC	LS	$150,000	1	$150,000	Similar project in 2021, inflated to 2022
6.9	Security	CC Cameras and intrusion alarms	LS	$3,000	1	$3,000	Similar project in 2021, inflated to 2022
	SubTotal					**$664,100**	
	Construction Cost Sub Total					**$2,001,100**	
Project Delivery Cost							
	General Conditions, Engineering, Contingency	30% of Construction Sub Total	LS		30%	$600,330	
	Total Project Delivery Cost					**$2,601,430**	*Includes only cast in place option for the wetwell and manhole
	Total Wastewater Treatment Order of Magnitude Cost High Cost of Range	+20% of Project Delivery Sub Total			20%	$3,121,716	
	Total Wastewater Treatment Order of Magnitude Cost Low Cost of Range	-15% of Project Delivery Sub Total			-15%	$2,211,216	

Assumptions

1. Land acquisition, APS Power Supply and City SCADA integration are not included. This cost is not included in this estimate.
2. Wastewater lift station and forcemain unit costs are based on 2020/2021 estimates with 5% annual rate of inflation. The larger inflation rate is an attempt to address potential COVID induced supply chain issues and other inflationary economoic pressures. Stantec will revise these costs at the 60% level and may revise inflation rate should economic trends change. This is a conservative approach to the costing the project as 'worst case' for future economic conditions.
3. West Lift Station design and costing to be defined through the current ADOT JRR predesign process starting in September 2022 and complete by September 2023 / December 2023

I.4 POE Wastewater Service Area Collection System

DOUGLAS PORT OF ENTRY 30 % DETAILED DESIGN

Wastewater Collection to the POE Service Area

Engineer's Estimate of Probable Cost

Date Created: 10/04/2022

By: Mark Peterson, Jack Bryck, Todd Crouthamel, Cassandra Flores

Stantec

	Wastewater Collection System	Description	Unit	Unit Cost	Quantity	Cost	Notes
1.0							
1.1	8-inch SDR 35 PVC Piping	Collection system gravity sewer piping	LF	$100	10,720	$1,072,000	
1.2	12-inch SDR 35 PVC Piping	Collection system gravity sewer piping	LF	$140	18,060	$2,528,400	Estimated through recent projects and contractor quotes for similar sized PVC.
1.3	15-inch SDR 35 PVC Piping	Collection system gravity sewer piping	LF	$175	8,140	$1,424,500	
1.4	10-inch DR 17 HDPE Piping	Force Main from EWWLS to discharge MH	LF	$225	3,294	$741,150	Total linear feet, from connection at Copper Rd and SR80/SR 191 intersection to discharge point at existing MH
1.5	Manholes	Install MH every 500', cast in place concrete with liner	EA	$20,000	74	$1,476,800	Estimated through recent projects and contractor quotes for similar sized PVC. PVC is SDR 35
			LF		40,214		Total linear feet, including force main
	Sub Total					**$7,242,850**	
2.0							
2.1	Whitewater Draw Above Ground Crossing		LS	$500,000	1	$500,000	Crossing of Whitewater Draw on elevated piers. Final costing will depend on environmental, permitting, scour depth, etc. considerations. Estimated minimum.
2.2	Intersection SR 80 and JRR - ADOT Alignment Requirements		LS	$200,000	1	$200,000	ADOT will determine the location of wastewater connection piping and manholes based on ADOT intersection design. Assumed allowance.
2.3	Connect to City of Douglas Wastewater Collection System at City's BDIA Manhole 20		LS	$25,000	1	$25,000	Manhole 20 on City's BDIA Gravity Sewer
	Sub Total					**$725,000**	
	Construction Cost Sub Total					**$7,967,850**	
Project Delivery Cost							
	General Conditions, Engineering, Contingency	30% of Construction Sub Total	LS		30%	$2,390,355	
	Project Delivery Cost					**$10,358,205**	
	Total Wastewater Treatment Order of Magnitude Cost High Cost of Range	+20% of Project Delivery Sub Total			20%	$12,429,846	
	Total Wastewater Treatment Order of Magnitude Cost Low Cost of Range	-15% of Project Delivery Sub Total			-15%	$8,804,474	

Assumptions

1 Land acquisition. This cost is not included in this estimat

2 Wastewater lift station and forcemain unit costs are based on 2020 - 2021 estimates with 5% annual rate of inflation The larger inflation rate is an attempt to address potential COVID induced supply chain issues an other inflationary economoic pressures. Stantec will revise these costs at the 60% level and may revise inflation rate should economic trends change. This is a conservative approach to the costing the project as 'worst case for future economic conditions.

3 Design delivery and cost on JRR between SR80 and the POE will be dependent upon agreement between ADOT and the City. The capital cost implications are unknown at this time

I.5 POE Water Service Area Distribution System

DOUGLAS PORT OF ENTRY 30 % DETAILED DESIGN

POE Water Service Area - Water Distribution System

Engineer's Estimate of Probable Cost

Date Created: 10/04/2022

By: Mark Peterson, Jack Bryck, Todd Crouthamel, Cassandra Flores

Stantec

	City Water System	Description	Unit	Unit Cost	Quantity	Cost	Notes
1.0							
1.1	DIP Water Line - HZ1	12", included fittings / hydrants	LF	$120	5,890	$706,800	
1.2	DIP Water Line - HZ2	16", included fittings / hydrants	LF	$160	5,350	$856,000	Within ADOT, SR80 ROW between CC and JRR
1.3	DIP Water Line - HZ3	16", included fittings / hydrants	LF	$160	5,300	$848,000	Within ADOT, SR80 ROW between CC and JRR
1.4	DIP Water Line - HZ6	16", included fittings / hydrants	LF	$160	3,165	$506,400	Within ADOT future JRR ROW
1.5					19,705		
1.6	Fire Hydrants	Assume every 1000ft	LF	$10,000	19	$190,000	
1.7	Service Connection to POE					$75,000	
1.8	Service Connection to POE Service Area Properties	Assumes 5 water service connections				$0	Not costed
1.9	Intersection SR 80 and JRR-ADOT Alignment Requirements					$0	To be defined based on ADOT intersection design
1.10	Water Line Highway Crossings	1 Highway Crossings at 250 feet each	LF	$432	250	$108,000	
1.11	Water Dsitribution Flushing Point	Locate flushing point at FEMA floodplain	LS			$50,000	
	Construction Sub Total					**$3,340,200**	
Project Delivery Cost							
	General Conditions + Engineering + Construction Administration	30% of Construction Sub Total	LS		30%	$1,002,060	
	Project Delivery Sub Total					**$4,342,260**	
	Total Water System Order of Magnitude Cost High Cost of Range	+20% of Project Delivery Sub Total			20%	$5,210,712	
	Total Water System Order of Magnitude Cost Low Cost of Range	-15% of Project Delivery Sub Total			-15%	$3,690,921	

Assumptions

1 Land acquisition to be done by others. This cost is not included in this estimate

I.6 Broadband Conduit

DOUGLAS PORT OF ENTRY 30 % DETAILED DESIGN

POE Water Service Area - Broadband Conduit

Engineer's Estimate of Probable Cost

Date Created: 10/04/2022

By: Mark Peterson, Jack Bryck, Todd Crouthamel, Cassandra Flores

	City Broadband Conduit	Description	Unit	Unit Cost	Quantity	Cost	Notes
1.0							
1.1	Broadband Conduit	Does not include fiber optic cable	LF	$10	40,214	$402,140	
	Construction Cost Sub Total					**$402,140**	
Project Delivery Cost							
	General Conditions + Engineering + Construction Administration	30% of Construction Sub Total	LS		30%	$120,642	
	Project Delivery Cost					**$522,782**	
	Total Water System Order of Magnitude Cost High Cost of Range	+20% of Project Delivery Sub Total			20%	$627,338	
	Total Water System Order of Magnitude Cost Low Cost of Range	-15% of Project Delivery Sub Total			-15%	$444,365	

Assumptions

1 Land acquisition to be done by others. This cost is not included in this estimate

I.7 Groundwater Well – Storage Tank

DOUGLAS PORT OF ENTRY 30 % DETAILED DESIGN

POE Water Service Area - Groundwater Well and Storage Tank

Engineer's Estimate of Probable Cost

Date Created: 10/04/2022

By: Mark Peterson, Jack Bryck, Todd Crouthamel, Cassandra Flores

Stantec

	Item	Description	Unit	Unit Cost	Quantity	Cost	Notes
1.0	**SITE WORK**						
1.1	Clearing and Grubbing	Preparation of site for const.	LS	$15,000	1	$15,000	Based contractor estimates for site size, inflated to 2022
1.2	Grading and Drainage	Grading site and excavation of retention basin	LS	$25,000	1	$25,000	Based contractor estimates for site size, inflated to 2022
1.4	Decomposed Granite	Min 4" thick on all unpaved areas including retention.	SF	$4	14,892	$59,568	
1.6	Asphalt Paving	Parking and truck turn around areas	SY	$85	2,500	$212,500	Based on 2022 contractor quotes, inflated to 2022
1.7	Pedestrian Gate	Manually opened, badge access gate, 4-ft wide	LS	$5,500	1	$5,500	Based on similar gate design at site in Phx area in 2020, inflated to 2022
1.8	Motorized Rolling Gate	30-ft automatic, badge accessed vehicle gate to site and motors.	LF	$1,800	30	$54,000	Based on manufacturer quotes, inflated to 2022
	Sub Total					**$372,000**	
2.0							
2.3	Groundwater Well	Drill and develop well	LS	$1,200,000	1	$1,200,000	Scope of work is infrastructure below the ground surface
2.4	Groundwater Well connection to Storage Tank and from the Storage tank to the Water Distribution System	16" diameter	LF	$160	250	$40,000	
2.5	Elevated Storage Tank	500,000 elevated steel tank	LS	$1,500,000	1	$1,500,000	$1.5M multicolum - Estimates given by Phoenix Fabricators & Erectors, LLC.
2.6	Land Purchase					$0	
	Sub Total					**$2,740,000**	
3.0	**CONCRETE/MASONRY**						
3.1	MCC/Panel Pad	Includes shade structure footings	LS	$24,000	1	$24,000	Costs from similar project, inflated to 2022
3.2	Wall Footings	For CMU security wall	LF	$125	0	$0	Costs from similar project, inflated to 2022
3.3	Genset Pad	Standby generator	LS	$5,500	1	$5,500	Costs from similar project, inflated to 2022
3.4	Concrete Paving	Driveway connecting to site SR 80	SY	$190	162	$30,780	2022 contractor quote, inflated to 202
3.5	DIP Support Pad	For setting pipe supports for above grade header	LS	$6,800	1	$6,800	Based on size in 2022 dollars, inflated to 2022
3.6	Chlorination Building Pad	Chlorination Treatment Equipment	LS	$5,500	1	$5,500	
3.7	Groundwater Well Support Block	Support the well column		$20,000	1	$20,000	
3.8	Misc Pads	Transformers, Sampler, etc	LS	$4,000.00	1	$4,000	Costs from similar project, inflated to 2022
3.9	CMU Wall	10' high security wall	LF	$300	1334	$400,200	2022 contractor quote, inflated to 2022
	Sub Total					**$497,000**	
4.0	**Groundwater Well Equipment**						
4.1	Well Pump / Well Column	200 HP vertical turbine pump	EA	$600,000	1	$600,000	Motor, pump, and well column
4.2	Chlorine Disinfection System and Pre-fab building	Includes 150lb chlorine cylinder and injection pump	LS	$70,000	1	$70,000	Similar project in 2021, inflated to 2022

4.3	Chlorine Residual Analyzer	Includes sampler, encasement and tubing	LS	$25,000	1	$25,000	Similar project in 2021, inflated to 2022
4.4	Eye Wash and Emergency Shower	At the chemical storage site	EA	$2,000	1	$2,000	Similar project in 2021, inflated to 2022
	Sub Total					**$697,000**	
5.0	**MISC CONSTRUCTION**						
5.1	MCC Shade Structure	Supports and roofing	LS	$35,000	1	$35,000	Similar project in 2021, inflated to 2022
5.2	Bollards	MAG 140 - Type 1	EA	$2,500	29	$72,500	Similar project in 2021, inflated to 2022
5.3	Yard Hydrant	Includes nozzle, hose racks, and hoses	LS	$250	1	$250	Similar project in 2021, inflated to 2022
5.4	Site Signage	Warning, Identification, and Project	LS	$3,700	1	$3,700	Similar project in 2021, inflated to 2022
5.5	Pipe Supports	Supports for above grade headers	LS	$15,500	1	$15,500	Similar project in 2021, inflated 2022
	Sub Total					**$127,000**	
6.0	**MECHANICAL**						
6.1	10" DIP Above Ground Header Pipe	Forcemain between the well and piping to elevated storage tank with flowmeter, pump control valve, isolation valve, pump to waste	LF	$150	100	$15,000	Costs from contractor quote, 2022, installed & inflated to 2022
6.2	8" Class 50 DIP	Forcemain between the well and the retention pond	LF	$153	100	$15,300	Costs from contractor quote, 2022, installed & inflated to 2022
6.3	1.5" Copper Piping	Potable water for the eye wash and yard hydrant	LF	$15	180	$2,700	Costs from contractor quote, 2022, installed & inflated to 2022
	SubTotal					**$33,000**	
7.0	**ELECTRICAL/I&C**						
7.1	SES	Service Entrance Switchboard	EA	$32,000	1	$32,000	Similar project in 2021, inflated to 2022
7.2	Mag Meter	SCADA readable flow meter on header	EA	$9,100	1	$9,100	Similar project in 2021, inflated to 2022
7.3	Misc. Electrical Equipment	Panelbooards, trandformers, fuse disconnects, LCPs, etc.	LS	$150,000	1	$150,000	Similar project in 2021, inflated to 2022
7.4	Conduit, conductors, groundwire and groundrods	Yard wiring	LS	$200,000	1	$200,000	Similar project in 2021, inflated to 2022
7.5	Genset	500kV emergency generator	LS	$98,000	1	$98,000	Similar project in 2021, inflated to 2022
7.6	Lighting	LED on-pole lights	LS	$22,000	1	$22,000	Similar project in 2021, inflated to 2022
7.7	Transformer (APS)	Power to site from overhead lines to transformer	LS	$0	0	$0	Pending APS utility future locations
7.8	Instrumentation & Scada	Instrumentation devices and PLC	LS	$150,000	1	$150,000	Similar project in 2021, inflated to 2022
7.9	Security	CC Cameras and intrusion alarms	LS	$3,000	1	$3,000	Similar project in 2021, inflated to 2022
	SubTotal					**$664,100**	
	Construction Cost Sub Total					**$5,130,100**	
Project Delivery Cost							
	General Conditions + Engineering + Construction Administration	30% of Construction Sub Total	LS		30%	$1,539,030	
	Project Delivery Sub Total					**$6,669,130**	
	Total Water System Order of Magnitude Cost High Cost of Range	+20% of Project Delivery Sub Total			20%	$8,002,956	
	Total Water System Order of Magnitude Cost Low Cost of Range	-15% of Project Delivery Sub Total			-15%	$5,668,761	

Assumptions

1	Land acquisition, APS Power Supply and City SCADA integration are not included in this cost estimate.
2	Groundwater well and storage tank unit costs are based on 2020/2021 estimates with 5% annual rate of inflation. The larger inflation rate is an attempt to address potential COVID induced supply chain issues and other inflationary economoic pressures. Stantec will revise these costs at the 60% level and may revise inflation rate should economic trends change. This is a conservative approach to the costing the project as 'worst case' for future economic conditions.
3	Groundwater welll and storage tank design and costing to be defined through the current ADOT JRR predesign
4	The diameter of the DIP between the storage tank and the POE and the volume of the storage tank will be dependent on the fireflow requirements established by GSA for the POE

Appendix J Plan and Profile – See Volume 2, October 21st 2022