AGENDA
GROUNDWATER BANKING JOINT POWERS AUTHORITY
SPECIAL PROJECT COMMITTEE MEETING

December 02, 2020
10:00 AM

Due to COVID-19, this meeting will be conducted as a teleconference pursuant to the provisions of the Governor's Executive Orders N-25-20 and N-29-20, which suspend certain requirements of the Ralph M. Brown Act. Members of the public may not attend this meeting in person.

Participation by members of the Committee will be from remote locations. Public access and participation will only be available telephonically/electronically.

To virtually attend the meeting and to be able to view any presentations or additional materials provided at the meeting, please join online using the link and information below:

Via Web: https://zoom.us/j/82911662129
Meeting Number (Access Code): 829 1166 2129
Meeting Password: 197524
Telephone Dial In: (669) 900-6833

As courtesy to the other participants, please mute your phone when you are not speaking.

PLEASE NOTE: Participants joining the meeting will be placed into the lobby when the Committee enters closed session. Participants who remain in the "lobby" will automatically be returned to the open session of the Committee once the closed session has concluded. Participants who join the meeting while the Committee is in closed session will be placed in the waiting room. When the Committee has returned to open session, the participants will be automatically added to the meeting.

CALL TO ORDER 10:00 AM

ROLL CALL Jason Selvidge, Doug Reinhart, Dan Bartel, Paul Cook, Eric Averett, Cheryl Clary

PUBLIC COMMENT NOTICE

If you wish to address the Committee on any item, please submit a request to speak via the "chat" feature available when joining the meeting virtually. Remarks are limited to three minutes per speaker on each subject. You may also submit a public comment in advance of the meeting by emailing mmisuraca@rrbwsd.com before 5:00 pm. on Tuesday, December 01, 2020.

ALL VOTES SHALL BE TAKEN BY A ROLL CALL VOTE.

1. **Consideration of Technical Memos 1-3.**

2. **Overview of Key Comments on Kern Fan Project Draft EIR (Jennifer Jacobus)**

3. **Closed Session**

   a) CLOSED SESSION CONFERENCE WITH REAL PROPERTY NEGOTIATORS – Pursuant to Government Code Section 54956.8:

   Property: Parcels 103-110-02; 103-110-04; 103-110-09; 103-120-14; 103-120-15; 103-120-16; 103-120-17; 103-130-01; 103-130-03; 103-130-05; 103-130-07; 103-140-02; 103-140-05; 103-140-06; 103-140-12; 103-140-15; 103-140-16; 103-140-17; 103-140-18; 103-140-19; 103-180-01; 103-180-05; 103-180-07; 103-190-13; 103-190-14; 103-200-23; 103-200-25; 103-200-26; 103-200-27; 103-200-28; 103-200-29, County of Kern

   Agency negotiators: Eric Averett

   Negotiating parties: Belluomini Ranches, LP, Tech Ag Financial Group, Inc., Diamond Farming, McCaslin, Bolthouse Properties and Rosedale-Rio Bravo Water Storage District

   Under negotiation: Price and Terms of Payment

   b) CLOSED SESSION CONFERENCE WITH REAL PROPERTY NEGOTIATORS – Pursuant to Government Code Section 54956.8:

   Property: Various Parcels

   Agency negotiators: Eric Averett

   Negotiating parties: Various parties and Groundwater Banking Joint Powers Authority

   Under negotiation: Price and Terms of Payment

4. **Adjournment**

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Availability of agenda materials: Agenda exhibits and other writings that are disclosable public records distributed to all or a majority of the members of the above-named Committee in connection with a matter subject to discussion or consideration at an open meeting of the Committee are available for public inspection by contacting Megan Misuraca at mmisuraca@rrbwsd.com. If such writings are distributed to members of the Committee less than 72 hours prior to the meeting, they will be available to the public at the same time as they are distributed to Committee Members, except that if such writings are distributed one hour prior to, or during, the meeting, they will be available electronically during the meeting.

Accommodations: Upon request, the Committee will provide for written agenda materials in appropriate alternative formats, and reasonable disability-related modification or accommodation to enable individuals with disabilities to participate in and provide comments at the meeting. Please submit a request, including your name, phone number and/or email address, and a description of the modification, accommodation, or alternative format requested at least two days before the meeting. Requests should be emailed to mmisuraca@rrbwsd.com. Requests made by mail must be received at least two days before the meeting. Requests will be granted whenever possible and resolved in favor of accessibility.

TO: Eric Averett

FROM: Dan W. Bartel

DATE: December 2, 2020

RE: Kern Fan Project Construction Team

Discussion:

The Kern Fan Project Construction Team (Ray Bennett, Curtis Skaggs, Markus Nygren, Bill Zeiders and myself) has begun weekly meetings to begin facilitation of project design and construction process. As part of the process we have developed a plan to create technical memoranda addressing various aspects of the project. The premises of the technical memoranda are to:

- Document the previously developed preliminary design work provided by Curtis Skaggs.
- Incorporate RRBWSD and IRWD design, construction, and operational experience into the design process.
- Provide a forum for agreement by the Districts on design decisions prior to hard design process.
- Perform Value Engineering as previously discussed by the Districts.
- Provide thorough project documentation for clarity of client expectation to be used for RFP and final design purposes.

Content and development priority has been established by the team. Progress to date is listed below. Technical Memoranda No. 1, 2, and 3 are attached for consideration.

Priority 1

1.	Project Phasing and Design / Contractor Selection	95% Complete
2.	Conveyance Capacity Requirements	95% Complete
3.	Pipeline Requirements	95% Complete
4.	Pump Station Requirements	50% Complete

Priority 2

5.	Geotechnical Report	10% Complete
6.	Canal Liner and Turnout Requirements	10% Complete
7.	Well Drilling and Equipping Requirements	10% Complete
8.	ROW Acquisitions	

Priority 3

9.	Recharge Basin Requirements	10% Complete
10.	Facility Operation and SCADA Requirements	10% Complete
11.	Engineer's Estimates	10% Complete

A detail of each document is shown on page 2.

Memo #	Title	Key Elements
1	Project Phasing and Design / Contractor Selection	Project Schedule Project Phasing (Construction Bid Packages) Design Firm Selection Contractor Selection
2	Conveyance Capacity Requirements	Recharge Pond Infiltration & filling rates In-Lieu Demands Goose Lake Channel Other Opportunities Pump Stations and reach Capacities
3	Pipeline Requirements	PVC, HDPE, Wet SpunRCP & Dry Spun RCP, Cement Mortar Lined and Coated Steel Pipe for: Aqueduct Turnout Siphon Crossings Phase II Property Turnouts West Basin Turnouts Canal Extension Well Conveyance
4	Pump Station Requirements	Pump Station Design Standard Pump Configuration Discharge pipe Sizing Special Considerations (Appurtances) Modeling Requirements Voltage Requirements Utility Interface Control Building
5	Geotechnical Report	Recharge Facility Soils Work Conveyance Soils Work Pump Station Soils Work Well Pad Soils Work
6	Canal Liner and Turnout Requirements	HDPE, Earth, Shotcrete, Concrete Pipeline Extension Option Turnout Requirements
7	Well Drilling and Equipping Requirements	Impact Analysis Well Layout Requirements Well Design Requirements Well Equipping Requirements Well Site Requirements
8	ROW Acquisitions	ROW Requirements Land Valuations Crop Valuations Phase I Assessment Title Work Land Surveying
9	Recharge Basin Requirements	Basin Layout/Orientation Levee Slopes/Design Freeboard Habital Elements Interbasin Structures Fence Requirements
10	Facility Operaton and SCADA Requirements	Conveyane Canal / Pump Station Control Philosophy Conveyance / Pump Station Instrumentation Recovery Well Instrumentation Canal Turnout Instrumentation SCADA Platforms Radio Survey SCADA Monitoring and Control
11	Engineer's Estimates	Phase 1, Phase 2, …, Phase N.

Recommendations:

1. Recommend Technical Memoranda No. 1, 2, and 3 for consideration by full JPA Board.

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KERN FAN GROUNDWATER STORAGE PROJECT

TECHNICAL MEMORANDUM NO. 1

(Project Phasing and Design/Contractor Selection)

PREPARED FOR: Groundwater Banking Joint Powers Authority (JPA)
PREPARED BY: Curtis Skaggs, P.E., Dee Jaspar & Associates, Inc.
DATE: August 15, 2020

SUBJECT: ***Project Phasing and Design/Contractor Selection***
(90% Draft)

I. Executive Summary

The Kern Fan Groundwater Storage Project is planned to have multiple phases for the design and the construction of the project with the goal of lean project management. This effort will divide the project into subsets that will lead to the most qualified firms and contractors working on those phases as well as break the project down into more manageable sizes.

The project duration is anticipated to be six to eight years from start to finish. The JPA is currently working on land acquisition, environmental documents, funding options, and preliminary engineering design in the form of technical memoranda. The technical memoranda will be incorporated into requests for proposals (RFP's) or requests for qualifications (RFQ's) in the selection of engineering design firms.

It is envisioned that there may be up to five different design firms and potentially multiple construction administration and inspection contracts for the following project phases:

1. Phase I Recharge Basins & Goose Lake Channel Pump Station, Check Structure, Interbasin Structures, and Well Pipelines and Intertie; Phase II Recharge Basins & Phase II Well Pipelines and Interbasin Structures

2. Phase I Well Drilling and Equipping; Phase II Well Drilling and Equipping

3. Aqueduct Turnout Facility

4. Conveyance Facilities including Turnouts & Pump Stations

5. SCADA and PLC Programming

The design will include multiple project construction packages. These construction packages are outlined below and describe the type of work to be completed, the typical Contractor licensing requirements, the minimum contents of the bid packages, and sample front-end contract documents. The licensing requirements, bid packages, and sample contract documents outlined herein are not intended to be comprehensive, but provide a framework and understanding of the work involved in the engineering design and preparation of bid packages. It is envisioned that there will be ten project bid packages as outlined below:

1. Phase I Recharge Basins

2. Phase I Goose Lake Channel Pump Station, Check Structure, Interbasin Structures, and Well Pipelines and Intertie

3. Phase I Well Drilling and Equipping

4. Phase II Recharge Basins

5. Phase II Well Pipelines and Interbasin Structures

6. Phase II Well Drilling and Equipping

7. Aqueduct Turnout Facility

8. Conveyance Facilities including Turnouts & Pump Stations

9. Pump Station Equipping

10. SCADA and PLC Programming

The projects will be competitively bid in order to comply with all grant funding requirements, however a pre-qualification process may be implemented for more unique project phases.

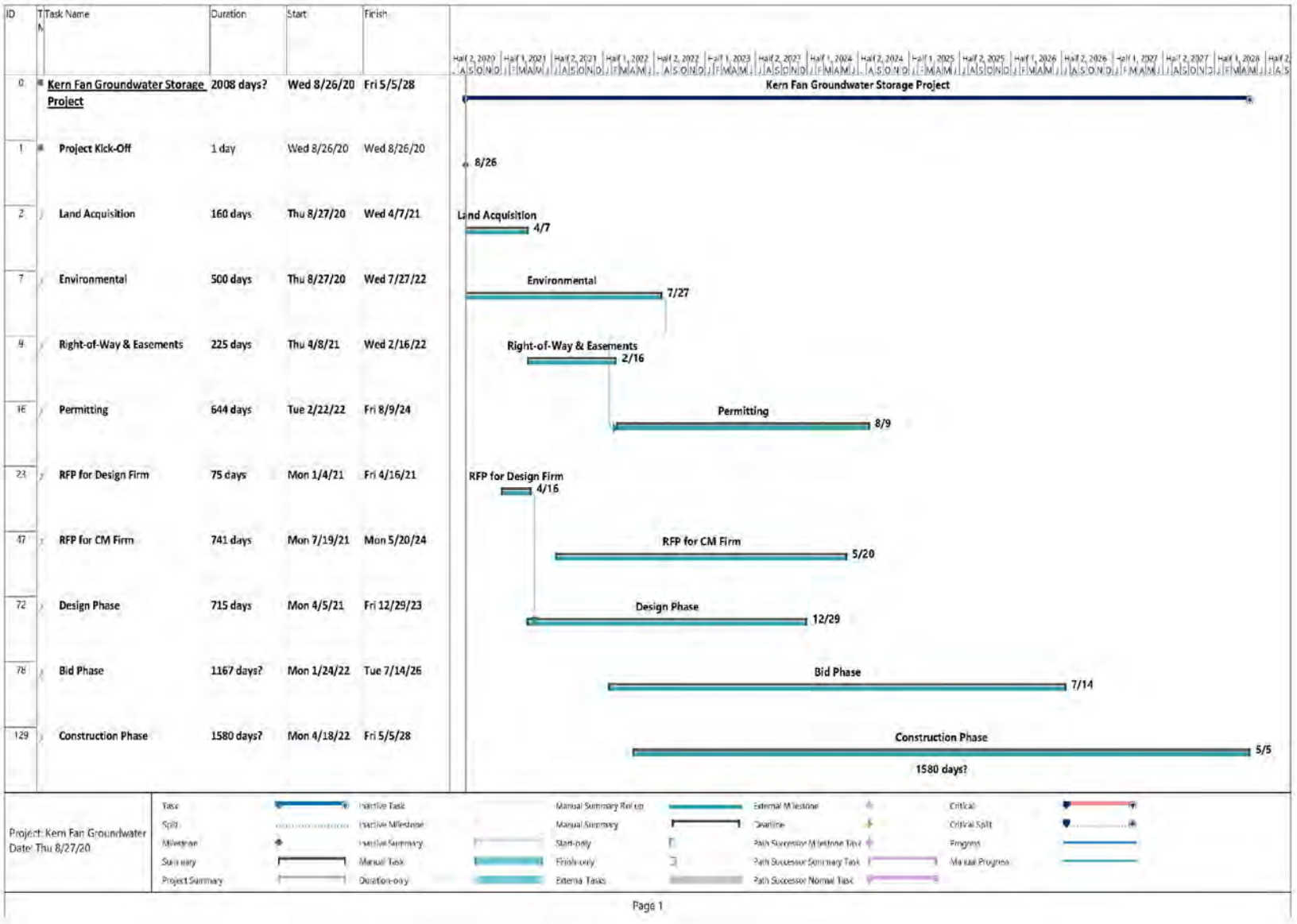
II. Project Schedule

A preliminary project schedule has been prepared based on the JPA formation date of August 25th, 2020. The schedule includes timeframes for land acquisition, environmental work, project rights-of-way, permitting, engineering design, the bid process, and construction.

A compressed project schedule is illustrated in Figure 1 below and a more detailed schedule is attached in Appendix A. The project is shown to begin on

August 26, 2020 after the formation of the JPA and is completed and operational by May 5, 2028.

Figure 1: Project Schedule



III. Project Phasing (Construction Bid Packages)

A. Phase I Recharge Basins

- Type of Work

  The Recharge Basin work will consist primarily of earthwork and earth moving activities. This will include, but not be limited to, crop removal, utility and underground locating work as well as utility/facility removal or relocation, clearing and grubbing, over-excavation and re-compaction, obtaining borrow material, hauling, filling and compacting levee embankments, ramps, and islands, fine grading, and slope grading. In addition, this may include the placement of all-weather surfacing on levee embankment roads as well as ripping/slip plowing of recharge basin bottoms.

- Contractor Licensing

  Contractors for this work shall be licensed with the State of California for a Class A General Engineering Contractors License or a C-12 Earthwork and Paving Contractors License.

- Bid Package

  1. Cover Sheet
  2. Demolition Plan for Tree Removal, Oil/Gas/Irrigation Line Removal or Relocation, Power Line Relocations, etc.
  3. Site Plan
  4. Plan Sheets illustrating Levee Embankment Layouts, Dimensions, Grades, Borrow Areas, & Well Pads
  5. Embankment Cross-Sections
  6. Earthwork Details – Embankment Over-Ex and Re-Compact, Keyways, Slopes, etc.
  7. Fence Plan, if applicable
  8. Project Specifications including Earthwork Volumes and Geotechnical Report

- Design Standards/Project Specification Format

  See attached boiler plate specifications in Appendix B for reference. The boiler plate front-end specifications shall be reviewed and revised as a joint effort between the engineering design firm and the JPA at the time of design.

The technical specifications will be developed to be project specific. Sample technical specifications are provided in subsequent technical memoranda.

B. Phase I Goose Lake Channel Pump Station, Check Structure, Interbasin Structures, and Well Pipelines and Intertie

- Type of Work

  This work will include, but not be limited to, the installation of interbasin structures through the Phase I Recharge Basin levee embankments, the installation of underground well conveyance pipelines through the basins with a connection to the RRBWSD Intake Canal, construction of a check structure in the Goose Lake Channel, and construction of a pump station in the Goose Lake Channel.

- Contractor Licensing

  Contractors for this work shall be licensed with the State of California for a Class A General Engineering Contractors License.

- Bid Package

  1. Cover Sheet
  2. Site Plan
  3. Interbasin Structure Plan View Layout
  4. Interbasin Structure & Piping Elevation
  5. Interbasin Details
  6. Existing Well & Irrigation Lateral Plan
  7. Well Conveyance Piping Layout Plan including modifications to existing irrigation lines
  8. Well Conveyance Plan & Profile Sheets
  9. Well Conveyance In-Lieu Service Turnouts
  10. Well Conveyance Details
  11. Goose Lake Channel Check Structure Site Plan
  12. Check Structure Elevation Views
  13. Check Structure Details
  14. Goose Lake Channel Pump Station Site Plan
  15. Pump Station Elevation Views
  16. Pump Station Structural Details
  17. Pump Station Pump & Motor Details
  18. Pump Station Discharge Piping Plan & Profile Sheets
  19. Pump Station Recharge Basin Outlet Plan & Elevation Views
  20. Pump Station Security & Remote Monitoring

21. Pump Station Fencing, if applicable
22. Pump Station Detail Sheets
23. Pump Station Electrical & Controls
24. PG&E Electrical Supply Plan
25. Project Specifications

- Design Standards/Project Specification Format

  See attached boiler plate specifications in Appendix B for reference. The boiler plate front-end specifications shall be reviewed and revised as a joint effort between the engineering design firm and the JPA at the time of design.

  The technical specifications will be developed to be project specific. Sample technical specifications are provided in subsequent technical memoranda.

C. Phase I Well Drilling and Equipping

- Type of Work

  The Phase I Well Drilling and Equipping work will consist primarily of well drilling and well equipping work for up to six wells in the Phase I Recharge area as well as constructing monitoring wells. This work will include, but not be limited to, drilling reverse rotary pilot holes, performing geophysical logging, water depth sampling, reaming of the pilot holes, casing installation, gravel installation, cement annular seal placement, well development, and testing. In addition, the work will include site development and well equipping with a deep well vertical turbine pump, vertical hollowshaft electric motor, discharge piping, appurtenances, well motor enclosure, concrete foundations, electrical and controls, shade structure, site lighting, site security, remote monitoring, and all-weather surfacing.

- Contractor Licensing

  Contractors for this work shall be licensed with the State of California for the following:

  1. Class C57 Well Drilling Contractors License
  2. Class C10 Electrical Contractors License

- Bid Package

  1. Cover Sheet
  2. Site Plan showing Existing and Proposed Well Locations
  3. Well Rehabilitation and Equipping Plan for Existing Wells

4. Well Destruction Plan for Existing Wells
5. Well Drilling Cross Section
6. Well Drilling Details
7. Monitoring Well Construction
8. Well Site Plan Layout
9. Well Pump & Motor Cross Section
10. Well Discharge Piping Plan & Elevation
11. Well Pump Foundation
12. Well Motor Enclosure
13. Well Electrical Foundation
14. Well Electrical Shade Structure
15. Well Site Details
16. Well Site Security & Remote Monitoring
17. Well Site Fencing, if applicable
18. Well Electrical and Controls
19. PG&E Electrical Supply Plan
20. Project Specifications

- Design Standards/Project Specification Format

  See attached boiler plate specifications in Appendix B for reference. The boiler plate front-end specifications shall be reviewed and revised as a joint effort between the engineering design firm and the JPA at the time of design.

  The technical specifications will be developed to be project specific. Sample technical specifications are provided in subsequent technical memoranda.

D. Phase II Recharge Basins

- Type of Work

  The Recharge Basin work will consist primarily of earthwork and earth moving activities. This will include, but not be limited to, crop removal, utility and underground locating work as well as utility removal or relocation, clearing and grubbing, over-excavation and re-compaction, obtaining borrow material, hauling, filling and compacting levee embankments, ramps, and islands, fine grading, and slope grading. In addition, this may include the placement of all-weather surfacing on levee embankment roads as well as ripping/slip plowing of recharge basin bottoms.

- Contractor Licensing

  Contractors for this work shall be licensed with the State of California for a Class A General Engineering Contractors License or a C-12 Earthwork and Paving Contractors License.

- Bid Package

    1. Cover Sheet
    2. Demolition Plan for Tree Removal, Oil/Gas/Irrigation Line Removal or Relocation, Power Line Relocations, etc.
    3. Site Plan
    4. Plan Sheets illustrating Levee Embankment Layouts, Dimensions, Grades, Borrow Areas, & Well Pads
    5. Embankment Cross-Sections
    6. Earthwork Details – Embankment Over-Ex and Re-Compact, Keyways, Slopes, etc.
    7. Fence Plan, if applicable
    8. Project Specifications including Earthwork Volumes and Geotechnical Report

- Design Standards/Project Specification Format

    See attached boiler plate specifications in Appendix B for reference. The boiler plate front-end specifications shall be reviewed and revised as a joint effort between the engineering design firm and the JPA at the time of design.

    The technical specifications will be developed to be project specific. Sample technical specifications are provided in subsequent technical memoranda.

E. Phase II Well Pipelines and Interbasin Structures

- Type of Work

    This work will include, but not be limited to, the installation of interbasin structures through the Phase II Recharge Basin levee embankments and the installation of underground well conveyance pipelines through the basins with connections to the Conveyance Canal.

- Contractor Licensing

    Contractors for this work shall be licensed with the State of California for a Class A General Engineering Contractors License.

- Bid Package

    1. Cover Sheet
    2. Site Plan
    3. Interbasin Structure Plan View Layout
    4. Interbasin Structure & Piping Elevation

5. Interbasin Details
6. Existing Well & Irrigation Lateral Plan
7. Well Conveyance Piping Layout Plan including modifications to existing irrigation lines
8. Well Conveyance Plan & Profile Sheets
9. Well Conveyance In-Lieu Service Turnouts
10. Well Conveyance Details
11. Project Specifications

- Design Standards/Project Specification Format

  See attached boiler plate specifications in Appendix B for reference. The boiler plate front-end specifications shall be reviewed and revised as a joint effort between the engineering design firm and the JPA at the time of design.

  The technical specifications will be developed to be project specific. Sample technical specifications are provided in subsequent technical memoranda.

F. Phase II Well Drilling and Equipping

- Type of Work

  The Phase II Well Drilling and Equipping work will consist primarily of well drilling and well equipping work for up to six wells in the Phase II Recharge area as well as constructing monitoring wells. This work will include, but not be limited to, drilling reverse rotary pilot holes, performing geophysical logging, water depth sampling, reaming of the pilot holes, casing installation, gravel installation, cement annular seal placement, well development, and testing. In addition, the work will include site development and well equipping with a deep well vertical turbine pump, vertical hollowshaft electric motor, discharge piping, appurtenances, well motor enclosure, concrete foundations, electrical and controls, shade structure, site lighting, site security, remote monitoring, and all-weather surfacing.

- Contractor Licensing

  Contractors for this work shall be licensed with the State of California for the following:

  1. Class C57 Well Drilling Contractors License
  2. Class C10 Electrical Contractors License

- Bid Package

  1. Cover Sheet

2. Site Plan showing Existing and Proposed Well Locations
3. Well Rehabilitation and Equipping Plan for Existing Wells
4. Well Destruction Plan for Existing Wells
5. Well Drilling Cross Section
6. Well Drilling Details
7. Monitoring Well Construction
8. Well Site Plan Layout
9. Well Pump & Motor Cross Section
10. Well Discharge Piping Plan & Elevation
11. Well Pump Foundation
12. Well Motor Enclosure
13. Well Electrical Foundation
14. Well Electrical Shade Structure
15. Well Site Details
16. Well Site Security & Remote Monitoring
17. Well Site Fencing, if applicable
18. Well Electrical and Controls
19. PG&E Electrical Supply Plan
20. Project Specifications

- Design Standards/Project Specification Format

  See attached boiler plate specifications in Appendix B for reference. The boiler plate front-end specifications shall be reviewed and revised as a joint effort between the engineering design firm and the JPA at the time of design.

  The technical specifications will be developed to be project specific. Sample technical specifications are provided in subsequent technical memoranda.

G. Aqueduct Turnout Facility

- Type of Work

  This work will include, but not be limited to, the installation of the aqueduct turnout which shall involve coordination with the Department of Water Resources, mobilization/installation/demobilization of a cofferdam, earthwork, reinforced concrete construction, installation of miscellaneous steel, installation of a sluice gate, installation of electrical and controls, site security, remote monitoring, installation of the turnout piping, and the restoration of all-weather surfacing on the Aqueduct embankment road.

- Contractor Licensing

  Contractors for this work shall be licensed with the State of California for the following:

  1. Class A General Engineering Contractors License.
  2. Class C10 Electrical Contractors License

- Bid Package

  1. Cover Sheet
  2. Aqueduct Cofferdam Plan
  3. Aqueduct Turnout Site Plan
  4. Aqueduct Turnout Grading Plan
  5. Aqueduct Turnout Elevation Views
  6. Aqueduct Turnout Structural Details
  7. Aqueduct Turnout Pipe Plan & Profile
  8. Aqueduct Turnout Trashrack
  9. Aqueduct Turnout Details
  10. Aqueduct Turnout Electrical and Controls
  11. Aqueduct Turnout Security & Remote Monitoring
  12. PG&E Electrical Supply Plan
  13. Project Specifications

- Design Standards/Project Specification Format

  See attached boiler plate specifications in Appendix B for reference. The boiler plate front-end specifications shall be reviewed and revised as a joint effort between the engineering design firm and the JPA at the time of design.

  The technical specifications will be developed to be project specific. Sample technical specifications are provided in subsequent technical memoranda.

H. Conveyance Facilities including Turnouts & Pump Stations

- Type of Work

  This work will include, but not be limited to, crop removal, utility and underground locating work as well as utility removal or relocation, the installation of the conveyance canal facility, siphon crossings, road crossings, utility crossings, highway cased crossings, pump station facilities, pump station forebays, pump station afterbays, in-lieu service turnouts, turnout facilities to the Phase II Recharge Basins, turnout facilities to the West Recharge Basins, site security, and remote monitoring.

The pump station facility work will need to be coordinated with the pump station equipping work. Pump station hydraulic design and modeling will be performed and recommended design features and mitigation measures will need to be incorporated into the structure design and pump design.

- Contractor Licensing

  Contractors for this work shall be licensed with the State of California for the following:

  1. Class A General Engineering Contractors License.
  2. Class C10 Electrical Contractors License

- Bid Package

  1. Cover Sheet
  2. Site Plan
  3. Utility Plan & Utility Relocation/Removal Plan
  4. Conveyance Canal Plan & Profile Sheets
  5. Conveyance Canal Cross Sections
  6. Conveyance Canal Transition Structure Plan & Elevation
  7. Conveyance Canal Forebay Plan & Elevation
  8. Conveyance Canal Afterbay Plan & Elevation
  9. Conveyance Canal Details
  10. Conveyance Canal In-Lieu Service Turnouts
  11. Conveyance Canal Fencing Site Plan, if applicable
  12. Conveyance Canal Fence Details, if applicable
  13. Adohr Road Crossing Site Plan
  14. Adohr Road Crossing Plan & Elevation
  15. Adohr Road Crossing Details
  16. East Side Canal Crossing Site Plan
  17. East Side Canal Crossing Plan & Elevation
  18. East Side Canal Crossing Details
  19. Stockdale Hwy Site Plan
  20. Stockdale Hwy Plan & Elevation
  21. Stockdale Hwy Crossing Details
  22. Road Crossing/Bridge Site Plan
  23. Road Crossing/Bridge Plan & Elevation
  24. Road Crossing/Bridge Details
  25. Interstate 5 Fwy Site Plan

26. Interstate 5 Fwy Plan & Elevation
27. Interstate 5 Fwy Crossing Details
28. Phase II Property Turnout Site Plan
29. Phase II Property Turnout Grading Plan
30. Phase II Property Turnout Plan & Elevations
31. Phase II Property Turnout Structural Details
32. Phase II Property Turnout Pipe Profile
33. Phase II Property Turnout Details
34. Phase II Property Turnout Electrical and Controls
35. Phase II Property Turnout Security & Remote Monitoring
36. West Basins Turnout Site Plan
37. West Basins Turnout Grading Plan
38. West Basins Turnout Plan & Elevation
39. West Basins Turnout Structural Details
40. West Basins Turnout Pipe Profile
41. West Basins Turnout Details
42. West Basins Turnout Electrical and Controls
43. West Basins Turnout Security & Remote Monitoring
44. Pump Station Site Plan Layout
45. Pump Station Grading Plans
46. Pump Station Elevation Views
47. Pump Station Structural Details
48. PG&E Electrical Supply Plan
49. Project Specifications

- Design Standards/Project Specification Format

  See attached boiler plate specifications in Appendix B for reference. The boiler plate front-end specifications shall be reviewed and revised as a joint effort between the engineering design firm and the JPA at the time of design.

  The technical specifications will be developed to be project specific. Sample technical specifications are provided in subsequent technical memoranda.

I. Pump Station Equipping

- Type of Work

  This work will include, but not be limited to, the procurement, testing, and installation of the conveyance canal pump station pumps and motors, the pump discharge piping and appurtenances, site electrical and controls, electrical control building and appurtenances,

site security, remote monitoring, and site development. This work shall be coordinated with the pump station design and structural concrete construction.

The pump station equipping work will need to be coordinated with the pump station structure work. Pump station hydraulic design and modeling will be performed and recommended design features and mitigation measures will need to be incorporated into the structure design and pump design.

- Contractor Licensing

  Contractors for this work shall be licensed with the State of California for the following:

  1. Class A General Engineering Contractors License.
  2. Class C10 Electrical Contractors License

- Bid Package

  1. Cover Sheet
  2. Site Plan
  3. Pump Station Site Plans
  4. Pump Station Elevation Views
  5. Pump & Motor Cross Section Views
  6. Pump & Motor Details
  7. Pump Station Pump & Motor Base Plate Details
  8. Pump Station Discharge Piping Plan & Profile Sheets
  9. Pump Station Detail Sheets
  10. Pump Station Control Building Foundation
  11. Pump Station Control Building Plan & Elevation Exterior Views
  12. Pump Station Control Building Plan & Elevation Interior Views
  13. Pump Station Control Building Details
  14. Pump Station Electrical & Controls
  15. Cathodic Protection Details
  16. Pump Station Site Security & Remote Monitoring
  17. Pump Station Fence Plan, if applicable
  18. Return Water Pump Station Site Plan
  19. Return Water Pump Station Grading Plan
  20. Return Water Pump Station Elevation Views
  21. Return Water Pump Station Structural

Details
22. Return Water Pump Station Pump & Motor Base Plate Details
23. Return Water Pump Station Discharge Piping Plan & Profile Sheets
24. Return Water Pump Station Detail Sheets
25. Return Water Pump Station Electrical Foundation
26. Return Water Pump Station Electrical Shade Structure/Control Building
27. Return Water Pump Station Electrical & Controls
28. Return Water Pump Station Site Security & Remote Monitoring
29. Return Water Pump Station Fence Plan, if applicable
30. PG&E Electrical Supply Plan
31. Project Specifications

- Design Standards/Project Specification Format

  See attached boiler plate specifications in Appendix B for reference. The boiler plate front-end specifications shall be reviewed and revised as a joint effort between the engineering design firm and the JPA at the time of design.

  The technical specifications will be developed to be project specific. Sample technical specifications are provided in subsequent technical memoranda.

J. SCADA and PLC Programming

- Type of Work

  This work will include, but not be limited to, the preparation of a control narrative and preparation of programmable logic for the PLC units at all pump stations, turnouts, and wells for the project as well as radio surveys. In addition, this work will include furnishing and installing all SCADA equipment including all hardware and software for each facility and the master headquarters.

  This work shall be coordinated with the design and construction of the well sites, pump stations, and turnouts. The SCADA work and PLC programming will be implemented in conjunction with each phase of the work described above.

- Contractor Licensing

  Contractors for this work shall be licensed with the State of California for a Class C-7 or C-10 Contractors License.

- Bid Package

  1. Cover Sheet
  2. Site Plan
  3. Control Narrative
  4. PLC Diagrams
  5. SCADA Block Diagrams
  6. P&ID Drawings
  7. Electrical Details
  8. Project Specifications including Control Logic/Philosophy

- Design Standards/Project Specification Format

  See attached boiler plate specifications in Appendix B for reference. The boiler plate front-end specifications shall be reviewed and revised as a joint effort between the engineering design firm and the JPA at the time of design.

  The technical specifications will be developed to be project specific. Sample technical specifications are provided in subsequent technical memoranda.

IV. Design Firm Selection

A. Design Effort Groupings

a. Phase I Recharge Basins & Goose Lake Channel Pump Station, Check Structure, Interbasin Structures, and Well Pipelines and Intertie Phase II Recharge Basins & Phase II Well Pipelines and Interbasin Structures

Once property acquisition is finalized, the priority will be to design the Phase I and Phase II recharge basins along with the necessary infrastructure to take advantage of available water if the opportunity presents itself. This work is outlined above under Item III. A, B, D, and F and includes the following:

- Phase I Recharge Basins
- Goose Lake Channel Pump Station
- Goose Lake Channel Check Structure
- Phase I Interbasin Structures
- Phase I Well Pipelines & Intertie
- Phase II Recharge Basins
- Phase II Interbasin Structures
- Phase II Well Pipelines

The scope of work for engineering design shall include:

- Review of Preliminary Engineering documents including Technical Memorandums
- Provide Feedback on Technical Memorandum and any suggested value engineering alternatives or suggested changes
- Attendance and Participation in monthly Project Design meetings
- Hydraulic Analysis and Design
- Site and Topographic Surveying
- Preparation of 60% Level Drawings and Engineer's Estimate for Review and Comment
- Preparation of 90% Level Drawings, Specifications, and Engineer's Estimate for Review and Comment
- Incorporation of Environmental Mitigation Measures into Bid Documents (Measures provided by District)
- Preparation of 100% Level Drawings, Specifications, and Engineer's Estimate for Bidding Purposes
- Bid Assistance with Responses to RFI's and Addenda
- Assistance with Power Service to Pump Station
- Preparation of Conformed Documents
- Construction Phase Services for responses to RFI's (Est. 10), shop drawing review (Est. 50 plus 25 resubmittals), and preparation of Record Drawings

b. Phase I Well Drilling and Equipping
Phase II Well Drilling and Equipping

Upon completion of the recharge basins, it is planned to drill and construct the water recovery wells and monitoring wells. This work will include the equipping of the water wells with pumps, motors, discharge piping, and electrical and connection to the underground well conveyance pipelines. The work is outlined above under Item III. C and E.

- Phase I Well Drilling
- Phase I Well Equipping
- Phase II Well Drilling
- Phase II Well Equipping

The scope of work for engineering design shall include:

- Review of Preliminary Engineering documents including Technical Memorandums
- Provide Feedback on Technical Memorandum and any suggested value engineering alternatives or suggested changes
- Attendance and Participation in monthly Project Design meetings
- Incorporation of Well Design and Specification information from Thomas Harder & Associates, Inc.
- Hydraulic Analysis and Design
- Site and Topographic Surveying
- Preparation of 60% Level Drawings and Engineer's Estimate for Review and Comment
- Preparation of 90% Level Drawings, Specifications, and Engineer's Estimate for Review and Comment
- Incorporation of Environmental Mitigation Measures into Bid Documents (Measures provided by District)
- Preparation of 100% Level Drawings, Specifications, and Engineer's Estimate for Bidding Purposes
- Bid Assistance with Responses to RFI's and Addenda
- Assistance with Power Service to Wells
- Preparation of Conformed Documents
- Construction Phase Services including responses to RFI's (Est. 15), shop drawing review (Est. 70 plus 35 resubmittals), and preparation of Record Drawings

c. Aqueduct Turnout Facility

It is planned for the Aqueduct turnout facility to be one package as outlined above under Item III. G.

The scope of work for engineering design shall include:

- Review of Preliminary Engineering documents including Technical Memorandums
- Provide Feedback on Technical

Memorandum and any suggested value engineering alternatives or suggested changes
- Attendance and Participation in monthly Project Design meetings
- Hydraulic Analysis and Design
- Site and Topographic Surveying
- Preparation of 60% Level Drawings and Engineer's Estimate for Review and Comment
- Preparation of 90% Level Drawings, Specifications, and Engineer's Estimate for Review and Comment
- Incorporation of Environmental Mitigation Measures into Bid Documents (Measures provided by District)
- Preparation of 100% Level Drawings, Specifications, and Engineer's Estimate for Bidding Purposes
- Permit Assistance
- Coordination with Department of Water Resources
- Bid Assistance with Responses to RFI's and Addenda
- Assistance with Power Service to Turnout
- Preparation of Conformed Documents
- Construction Phase Services including responses to RFI's (Est. 50), shop drawing review (Est. 200 plus 100 resubmittals), and preparation of Record Drawings

d. Conveyance Facilities including Turnouts & Pump Stations

It is planned for the conveyance facilities, pump stations, and turnout facilities to be one package as outlined above under Item III. H and I.

The scope of work for engineering design shall include:

- Review of Preliminary Engineering documents including Technical Memorandums and Hydraulic Analysis
- Provide Feedback on Technical Memorandum and any suggested value engineering alternatives or suggested changes
- Attendance and Participation in monthly Project Design meetings

- Site and Topographic Surveying
- Hydraulic Modeling, Analysis, and Design
- Preparation of 60% Level Drawings and Engineer's Estimate for Review and Comment
- Preparation of 90% Level Drawings, Specifications, and Engineer's Estimate for Review and Comment
- Incorporation of Environmental Mitigation Measures into Bid Documents (Measures provided by District)
- Preparation of 100% Level Drawings, Specifications, and Engineer's Estimate for Bidding Purposes
- Permit Assistance
- Bid Assistance with Responses to RFI's and Addenda
- Assistance with Power Service to Pump Stations and Turnouts
- Preparation of Conformed Documents
- Construction Phase Services including responses to RFI's (Est. 50), shop drawing review (Est. 200 plus 100 resubmittals), and preparation of Record Drawings

e. SCADA and PLC Programming

It is planned for the SCADA and PLC Programming to be one package as outlined above under Item III. J. This work will need to be coordinated with the design of the electrical and controls for each of the other design packages. This work will be implemented and installed with each of the construction phases and then coordinated to add additional communications and remote monitoring as the rest of the overall project is constructed.

The scope of work for engineering design shall include:

- Review of Preliminary Engineering documents including Technical Memorandums and Hydraulic Analysis
- Provide Feedback on Technical Memorandum and any suggested value engineering alternatives or suggested changes
- Attendance and Participation in monthly Project Design meetings
- Preparation of a Control Narrative

for the Overall Project as well as for Specific Phases of Project
- Coordination with other Design Firms and Project Phases
- Preparation of 60% Level Drawings and Engineer's Estimate for Review and Comment
- Preparation of 90% Level Drawings, Specifications, and Engineer's Estimate for Review and Comment
- Incorporation of Environmental Mitigation Measures into Bid Documents (Measures provided by District)
- Preparation of 100% Level Drawings, Specifications, and Engineer's Estimate for Bidding Purposes
- Permit Assistance
- Bid Assistance with Responses to RFI's and Addenda
- Preparation of Conformed Documents
- Construction Phase Services including responses to RFI's (Est. 20), shop drawing review (Est. 50 plus 25 resubmittals), and preparation of Record Drawings

B. Selection Process – Qualifications vs Contract Amount

It is anticipated that there may be up to five engineering design firms selected as divided up above. The Item A "Phase I Recharge Basins & Goose Lake Channel Pump Station, Check Structure, Interbasin Structures, and Well Pipelines and Intertie; Phase II Recharge Basins & Phase II Well Pipelines and Interbasin Structures" and Item B "Phase I Well Drilling and Equipping; Phase II Well Drilling and Equipping" will be selected based upon a traditional proposal process.

A traditional proposal process or pre-qualification process may be administered for all interested engineering firms for Item C above "Turnout Facility", Item D above "Conveyance Facilities including Turnouts and Pump Stations", and Item E above "SCADA and PLC Programming". The firm selection process will be at the discretion of the JPA. The pre-qualification process may require the presentation of the Engineering Team to the District in proposal format including not only the partnering of firms (joint ventures), but also the proposed staff that will lead the design efforts and perform the actual work.

The pre-qualification process would evaluate the experience and capabilities of the Engineering Teams and result in the selection of a short-list of Engineering Teams that would be asked to submit a

project proposal. The final firm selection may not necessarily be made based upon cost as all aspects of the qualifications will be considered.

C. Firm Qualifications

Engineering Team: Provide a description of the Engineering Team for this project and include an outline and organizational chart of the personnel that will be assigned to this project. Include a description and location of where the primary engineering work will be performed.

The proposal shall describe the specific experience and capabilities of each project staff member along with an outline of their responsibilities on this project. Include a schedule showing the percentage of time each member will contribute to the project.

The proposal shall include a project understanding and approach and describe how the work product will be performed and the level of quality control to be provided.

The proposal shall include a schedule showing the critical path with milestones for deliverables as outlined herein. The schedule shall provide an assurance of the firm's ability to complete all work with consideration given to current and future workload and include a list of outside factors that could affect the schedule. All assumptions shall be clearly identified.

D. Firm Reputation

Firm reputation will be a critical component of this evaluation. The proposal shall include a list of recent projects of a similar nature that the proposed Engineering Team and Project Staff were involved with. If this is a first time partnership for the Engineering Team then each respective firm may submit independent lists, however these should be lists that the proposed project staff was intimately involved in.

The recent project list shall include project details, project costs, Contractor name, project timeframe, contact information for the Owner's Representative, and any other pertinent information.

E. Firm Experience

The proposal shall include a list of similar projects that have been completed in the last ten (10) years by the Engineering Team. This experience shall only include projects that the proposed project staff were intimately involved in. Include a discussion of such factors as control of costs, quality of work, and ability to meet project schedule.

V. Construction Administration Firm Selection

A. Construction Administration Effort Groupings

a. Phase I Recharge Basins & Goose Lake Channel Pump Station, Check Structure, Interbasin Structures, and Well Pipelines and Intertie Phase II Recharge Basins & Phase II Well Pipelines and Interbasin Structures

The priority will be to construct the Phase I and Phase II recharge basins along with the necessary infrastructure to take advantage of available water if the opportunity presents itself. This work is outlined above under Item III. A, B, D, and F and includes the following:

- Phase I Recharge Basins
- Goose Lake Channel Pump Station
- Goose Lake Channel Check Structure
- Phase I Interbasin Structures
- Phase I Well Pipelines & Intertie
- Phase II Recharge Basins
- Phase II Interbasin Structures
- Phase II Well Pipelines

The scope of work for construction administration and inspection shall include:

- Facilitate a Pre-Construction Kick-off Meeting.
- Coordinate Submittal Reviews
- Coordinate RFI Responses
- Review & Evaluate Change Orders
- Perform Daily Site Inspections and Quality Control
- Perform Materials Testing
- Monitor Permit Compliance
- Monitor Environmental Compliance
- Prepare Inspection Reports with Photo Log
- Provide Labor Compliance Monitoring
- Monitor Buy American Affidavits
- Monitor MBE/WBE/DBE Compliance
- Review & Approve Progress Payments and Quantities
- Facilitate Weekly Project Meetings
- Facilitate Conflict Resolutions

- Coordinate Power Service
- Maintain Construction Records
- Perform Start-up & Testing
- Facilitate Project Close-Out and Preparation of Record Drawings

b. Phase I Well Drilling and Equipping
Phase II Well Drilling and Equipping

Upon completion of the recharge basins, it is planned to drill and construct the water recovery wells. This work will include the equipping of the water wells with pumps, motors, discharge piping, and electrical and connection to the underground well conveyance pipelines. The work is outlined above under Item III. C and E.

- Phase I Well Drilling
- Phase I Well Equipping
- Phase II Well Drilling
- Phase II Well Equipping

The scope of work for engineering design shall include:

- Facilitate a Pre-Construction Kick-off Meeting.
- Coordinate Submittal Reviews
- Coordinate RFI Responses
- Review & Evaluate Change Orders
- Perform Daily Site Inspections and Quality Control
- Perform Materials Testing
- Monitor Environmental Compliance
- Prepare Inspection Reports with Photo Log
- Provide Labor Compliance Monitoring
- Monitor Buy American Affidavits
- Monitor MBE/WBE/DBE Compliance
- Review & Approve Progress Payments and Quantities
- Facilitate Weekly Project Meetings
- Facilitate Conflict Resolutions
- Coordinate Power Service
- Maintain Construction Records
- Perform Start-up & Testing
- Facilitate Project Close-Out and
- Preparation of Record Drawings

c. Aqueduct Turnout Facility

It is planned for the Aqueduct turnout facility to be one package as outlined above under Item III. G.

The scope of work for engineering design shall include:

- Facilitate a Pre-Construction Kick-off Meeting.
- Coordinate Submittal Reviews
- Coordinate RFI Responses
- Review & Evaluate Change Orders
- Perform Daily Site Inspections and Quality Control
- Perform Materials Testing
- Monitor Permit Compliance
- Monitor Environmental Compliance
- Prepare Inspection Reports with Photo Log
- Provide Labor Compliance Monitoring
- Monitor Buy American Affidavits
- Monitor MBE/WBE/DBE Compliance
- Review & Approve Progress Payments and Quantities
- Facilitate Weekly Project Meetings
- Facilitate Conflict Resolutions
- Coordinate Power Service
- Maintain Construction Records
- Perform Start-up & Testing
- Facilitate Project Close-Out and
- Preparation of Record Drawings

d. Conveyance Facilities including Turnouts & Pump Stations

It is planned for the conveyance facilities, pump stations, and turnout facilities to be one package as outlined above under Item III. H and I.

The scope of work for engineering design shall include:

- Facilitate a Pre-Construction Kick-off Meeting.
- Coordinate Submittal Reviews
- Coordinate RFI Responses
- Review & Evaluate Change Orders

- Perform Daily Site Inspections and Quality Control
- Perform Materials Testing
- Monitor Permit Compliance
- Monitor Environmental Compliance
- Prepare Inspection Reports with Photo Log
- Provide Labor Compliance Monitoring
- Monitor Buy American Affidavits
- Monitor MBE/WBE/DBE Compliance
- Review & Approve Progress Payments and Quantities
- Facilitate Weekly Project Meetings
- Facilitate Conflict Resolutions
- Coordinate Power Service
- Maintain Construction Records
- Perform Start-up & Testing
- Facilitate Project Close-Out and
- Preparation of Record Drawings

e. SCADA and PLC Programming

It is planned for the SCADA and PLC Programming to be one package as outlined above under Item III. J, however it will be implemented as each of the above phases of the project are constructed and completed.

The scope of work for engineering design shall include:

- Facilitate a Pre-Construction Kick-off Meeting.
- Coordinate Submittal Reviews
- Coordinate RFI Responses
- Review & Evaluate Change Orders
- Perform Daily Site Inspections and Quality Control
- Perform Materials Testing
- Prepare Inspection Reports with Photo Log
- Provide Labor Compliance Monitoring
- Monitor Buy American Affidavits
- Monitor MBE/WBE/DBE Compliance
- Review & Approve Progress Payments and Quantities
- Facilitate Weekly Project Meetings

- Facilitate Conflict Resolutions
- Coordinate with other Construction Contracts
- Maintain Construction Records
- Perform Start-up & Testing
- Facilitate Project Close-Out and
- Preparation of Record Drawings

B. Selection Process – Qualifications vs Contract Amount

It is anticipated that there may be up to five construction management firms selected as divided up above. The Item A "Phase I Recharge Basins & Goose Lake Channel Pump Station, Check Structure, Interbasin Structures, and Well Pipelines and Intertie; Phase II Recharge Basins & Phase II Well Pipelines and Interbasin Structures" and Item B "Phase I Well Drilling and Equipping; Phase II Well Drilling and Equipping" will be selected based upon a traditional proposal process.

A traditional proposal process or pre-qualification process may be administered for all interested construction management firms for Item C above "Aqueduct Turnout Facility, Item D above "Conveyance Facilities including Turnouts and Pump Stations", and Item E above "SCADA and PLC Programming". The firm selection process will be at the discretion of the JPA. The pre-qualification process may require the presentation of the Construction Management Team to the District in proposal format including not only the partnering of firms (joint ventures), but also the proposed staff that will lead the construction management efforts and perform the actual work.

The pre-qualification process would evaluate the experience and capabilities of the Construction Management Teams and result in the selection of a short-list of CM Teams that would be asked to submit a project proposal. The final firm selection may not necessarily be made based upon cost as all aspects of the qualifications will be considered.

C. Firm Qualifications

Construction Management Team: Provide a description of the CM Team for this project and include an outline and organizational chart of the personnel that will be assigned to this project.

The proposal shall describe the specific experience and capabilities of each project staff member along with an outline of their responsibilities on this project. Include a schedule showing the percentage of time each member will contribute to the project.

The proposal shall include a project understanding and approach and describe how the work product will be performed and the level of quality control to be provided.

The proposal shall include a schedule showing the critical path with milestones for deliverables as outlined herein. The schedule shall provide an assurance of the firm's ability to complete all work with consideration given to current and future workload and include a list of outside factors that could affect the schedule. All assumptions shall be clearly identified.

D. Firm Reputation

Firm reputation will be a critical component of this evaluation. The proposal shall include a list of recent projects of a similar nature that the proposed Construction Management Team and Project Staff were involved with. If this is a first time partnership for the CM Team then each respective firm may submit independent lists, however these should be lists that the proposed project staff was intimately involved in.

The recent project list shall include project details, project costs, Contractor name, project timeframe, contact information for the Owner's Representative, and any other pertinent information.

E. Firm Experience

The proposal shall include a list of similar projects that have been completed in the last ten (10) years by the Construction Management Team. This experience shall only include projects that the proposed project staff were intimately involved in. Include a discussion of such factors as control of costs, quality of work, and ability to meet project schedule.

VI. Contractor Selection

A. Selection Process – Qualifications vs Contract Amount

The Contractor selection may be made based upon a competitive bid process or may include a combination pre-qualification and competitive bid process at the discretion of the JPA.

The pre-qualification process may require the presentation of the Construction Team to the District including not only the General Contracting Firm but also all subcontractors or vendors that will be responsible for greater than 10% of the work (cost wise).

The pre-qualification process would evaluate the experience and capabilities of the Construction Teams and result in the selection of a short-list of Construction Teams that would be asked to submit a project proposal.

The proposals will be evaluated based upon competitive bid and the lowest responsive and responsible bidder selected. Bids will include the following requirements:

- Prevailing Wage and Certified Payroll
- Labor Compliance Monitoring
- American Steel & Iron Compliance
- MBE/WBE/DBE Good Faith Effort

B. Company Qualifications

Construction Team: Provide a description of the Construction Team for this project and include an outline and organizational chart of the personnel that will be assigned to this project.

The proposal shall describe the specific experience and capabilities of key construction staff along with an outline of their responsibilities on this project. Include a schedule showing the percentage of time each member will contribute to the project.

The proposal shall include a project understanding and approach and describe how the work product will be performed and the level of quality control to be provided.

The proposal shall include a list of similar projects that have been completed in the last ten (10) years by the Construction Team. This experience shall only include projects that the proposed project staff were intimately involved in. Include a discussion of such factors as control of costs, number of change orders and reason for, quality of work, and ability to meet project schedule.

The recent project list shall include project details, project costs, project timeframe, contact information for the Owner's Representative, and any other pertinent information.

The proposal shall include a schedule showing the critical path with milestones for deliverables as outlined herein. The schedule shall provide an assurance of the firm's ability to complete all work with consideration given to current and future workload. Clearly identify all third-party aspects that could affect the project schedule.

VII. Related Work Specified Elsewhere

A. TM 2 – Conveyance Capacity Requirements
B. TM 3 – Pipeline Requirements
C. TM 4 - Pump Station Requirements
D. TM 5 – Geotechnical Investigation
E. TM 6 – Canal Liner and Turnout Requirements
F. TM 7 – Well Drilling and Equipping Requirements
G. TM 8 – Right of Way Acquisition
H. TM 9 – Recharge Basin Requirements
I. TM 10 – Facility Operation and SCADA Requirements
J. TM 11 – Engineer's Estimates

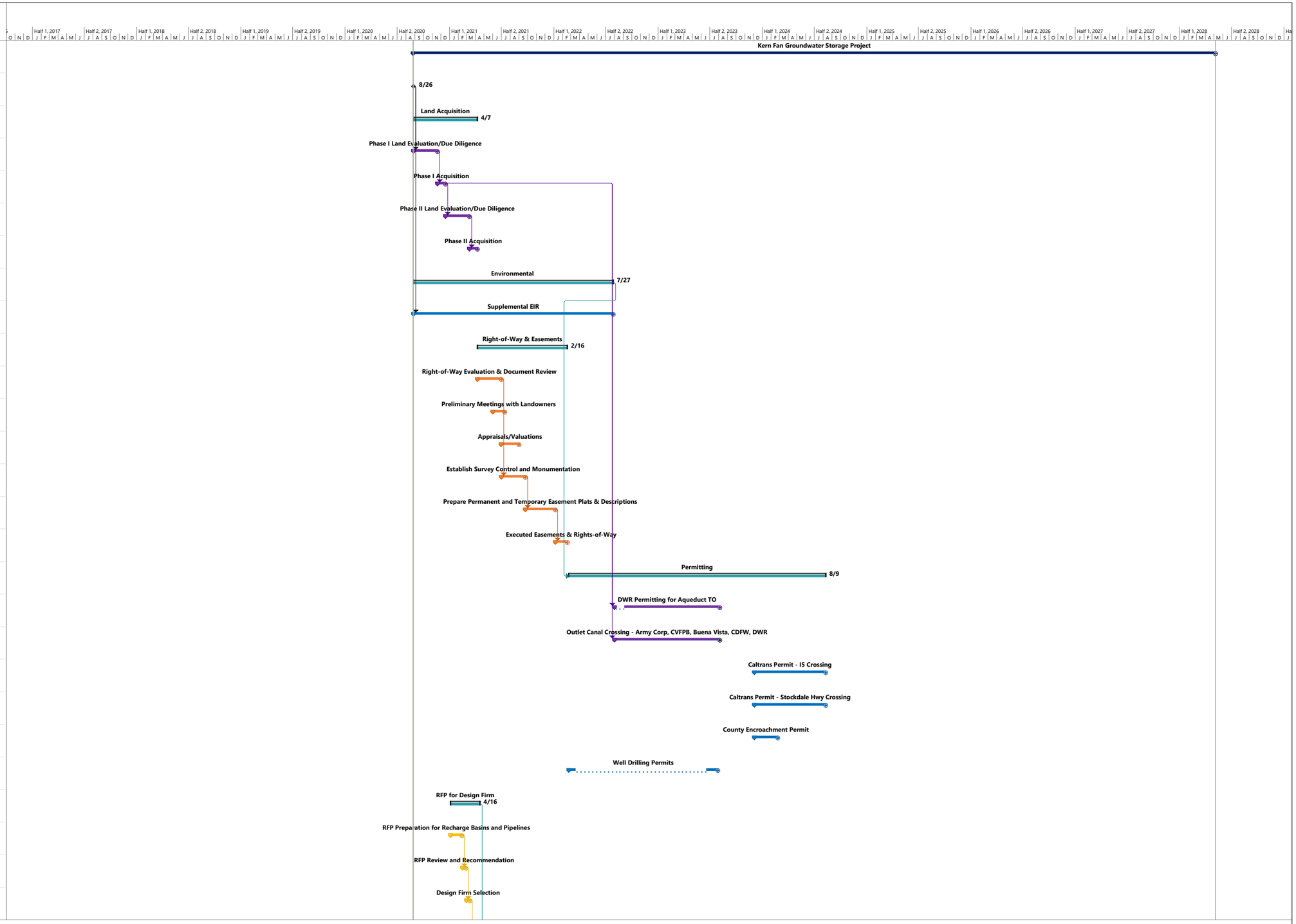
Appendices

Appendix A – Project Schedule 11 x 17
Appendix B – Sample Front End Specifications

APPENDIX A

Project Schedule 11 x 17

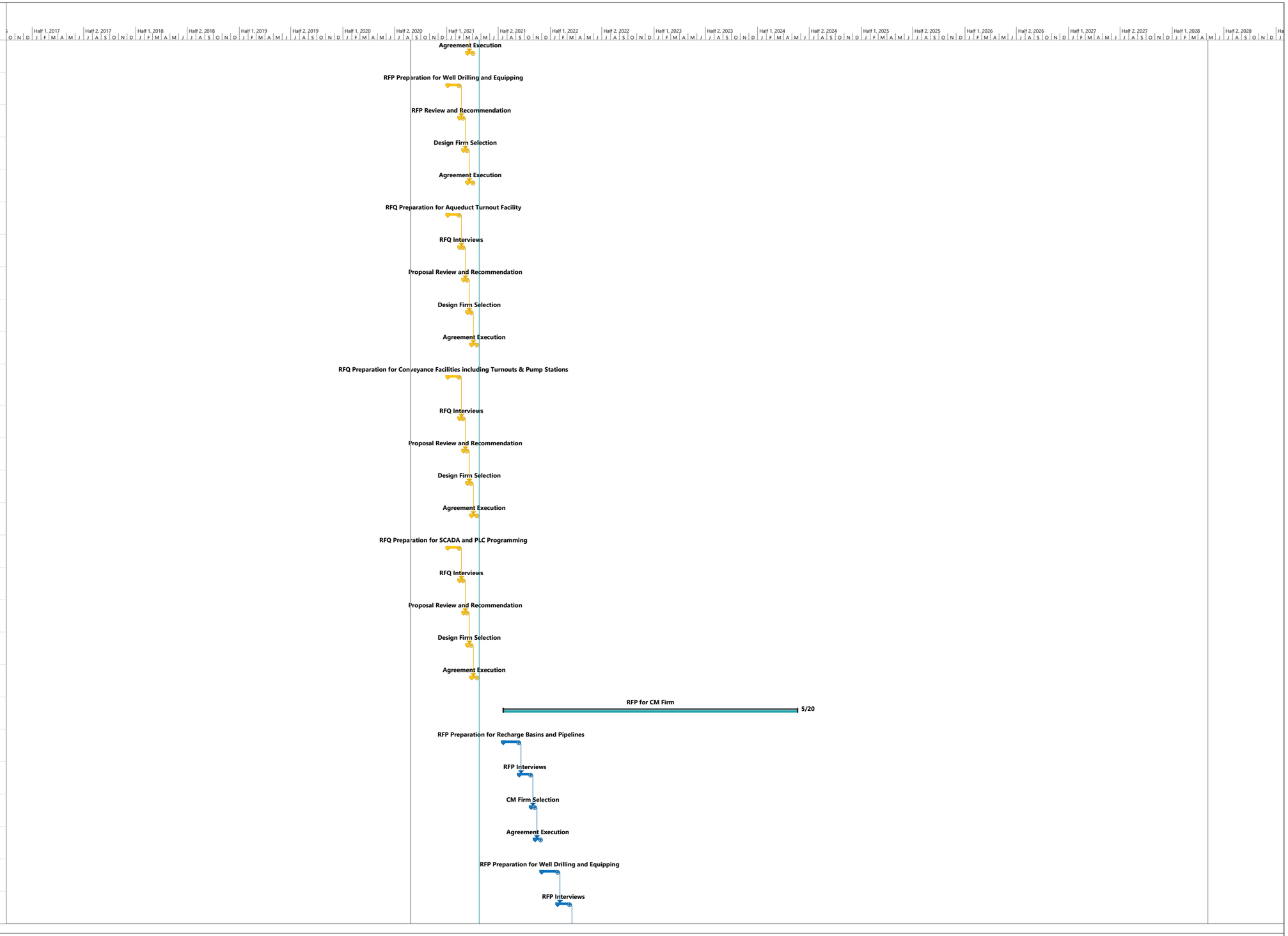
ID	Task Name	Duration	Start	Finish
0	**Kern Fan Groundwater Storage Project**	**2008 days?**	**Wed 8/26/20**	**Fri 5/5/28**
1	**Project Kick-Off**	1 day	Wed 8/26/20	Wed 8/26/20
2	**Land Acquisition**	**160 days**	**Thu 8/27/20**	**Wed 4/7/21**
3	Phase I Land Evaluation/Due Diligence	60 days	Thu 8/27/20	Wed 11/18/20
4	Phase I Acquisition	20 days	Thu 11/19/20	Wed 12/16/20
5	Phase II Land Evaluation/Due Diligence	60 days	Thu 12/17/20	Wed 3/10/21
6	Phase II Acquisition	20 days	Thu 3/11/21	Wed 4/7/21
7	**Environmental**	**500 days**	**Thu 8/27/20**	**Wed 7/27/22**
8	Supplemental EIR	500 days	Thu 8/27/20	Wed 7/27/22
9	**Right-of-Way & Easements**	**225 days**	**Thu 4/8/21**	**Wed 2/16/22**
10	Right-of-Way Evaluation & Document Review	60 days	Thu 4/8/21	Wed 6/30/21
11	Preliminary Meetings with Landowners	30 days	Tue 6/1/21	Mon 7/12/21
12	Appraisals/Valuations	45 days	Wed 6/30/21	Tue 8/31/21
13	Establish Survey Control and Monumentation	60 days	Thu 7/1/21	Wed 9/22/21
14	Prepare Permanent and Temporary Easement Plats & Descriptions	75 days	Thu 9/23/21	Wed 1/5/22
15	Executed Easements & Rights-of-Way	30 days	Thu 1/6/22	Wed 2/16/22
16	**Permitting**	**644 days**	**Tue 2/22/22**	**Fri 8/9/24**
17	DWR Permitting for Aqueduct TO	245 days	Mon 8/1/22	Fri 8/4/23
18	Outlet Canal Crossing - Army Corp, CVFPB, Buena Vista, CDFW, DWR	265 days	Mon 8/1/22	Fri 8/4/23
19	Caltrans Permit - I5 Crossing	180 days	Mon 12/4/23	Fri 8/9/24
20	Caltrans Permit - Stockdale Hwy Crossing	180 days	Mon 12/4/23	Fri 8/9/24
21	County Encroachment Permit	60 days	Mon 12/4/23	Fri 2/23/24
22	Well Drilling Permits	47 days	Tue 2/22/22	Fri 7/28/23
23	**RFP for Design Firm**	**75 days**	**Mon 1/4/21**	**Fri 4/16/21**
24	RFP Preparation for Recharge Basins and Pipelines	30 days	Mon 1/4/21	Fri 2/12/21
25	RFP Review and Recommendation	10 days	Mon 2/15/21	Fri 2/26/21
26	Design Firm Selection	10 days	Mon 3/1/21	Fri 3/12/21



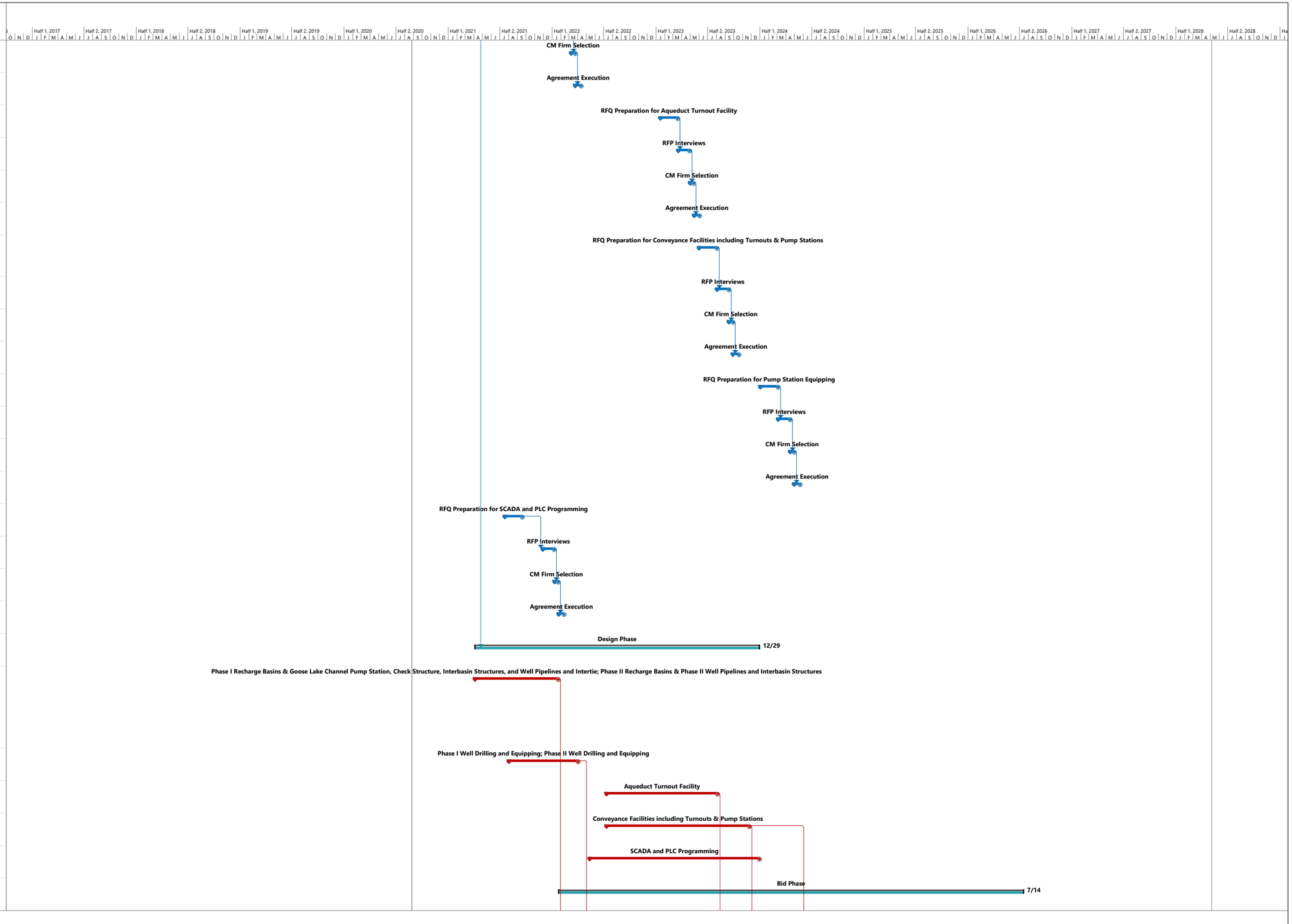
Project: Kern Fan Groundwater
Date: Thu 8/27/20

Task | Milestone | Project Summary | Inactive Milestone | Manual Task | Manual Summary Rollup | Start-only | External Tasks | Deadline | Path Successor Summary Task | Critical | Progress
Split | Summary | Inactive Task | Inactive Summary | Duration-only | Manual Summary | Finish-only | External Milestone | Path Successor Milestone Task | Path Successor Normal Task | Critical Split | Manual Progress

ID	Task Mode	Task Name	Duration	Start	Finish
27		Agreement Execution	15 days	Mon 3/15/21	Fri 4/2/21
28		RFP Preparation for Well Drilling and Equipping	30 days	Mon 1/4/21	Fri 2/12/21
29		RFP Review and Recommendation	10 days	Mon 2/15/21	Fri 2/26/21
30		Design Firm Selection	10 days	Mon 3/1/21	Fri 3/12/21
31		Agreement Execution	15 days	Mon 3/15/21	Fri 4/2/21
32		RFQ Preparation for Aqueduct Turnout Facility	30 days	Mon 1/4/21	Fri 2/12/21
33		RFQ Interviews	10 days	Mon 2/15/21	Fri 2/26/21
34		Proposal Review and Recommendation	10 days	Mon 3/1/21	Fri 3/12/21
35		Design Firm Selection	10 days	Mon 3/15/21	Fri 3/26/21
36		Agreement Execution	15 days	Mon 3/29/21	Fri 4/16/21
37		RFQ Preparation for Conveyance Facilities including Turnouts & Pump Stations	30 days	Mon 1/4/21	Fri 2/12/21
38		RFQ Interviews	10 days	Mon 2/15/21	Fri 2/26/21
39		Proposal Review and Recommendation	10 days	Mon 3/1/21	Fri 3/12/21
40		Design Firm Selection	10 days	Mon 3/15/21	Fri 3/26/21
41		Agreement Execution	15 days	Mon 3/29/21	Fri 4/16/21
42		RFQ Preparation for SCADA and PLC Programming	30 days	Mon 1/4/21	Fri 2/12/21
43		RFQ Interviews	10 days	Mon 2/15/21	Fri 2/26/21
44		Proposal Review and Recommendation	10 days	Mon 3/1/21	Fri 3/12/21
45		Design Firm Selection	10 days	Mon 3/15/21	Fri 3/26/21
46		Agreement Execution	15 days	Mon 3/29/21	Fri 4/16/21
47		**RFP for CM Firm**	**741 days**	**Mon 7/19/21**	**Mon 5/20/24**
48		RFP Preparation for Recharge Basins and Pipelines	40 days	Mon 7/19/21	Fri 9/10/21
49		RFP Interviews	30 days	Mon 9/13/21	Fri 10/22/21
50		CM Firm Selection	10 days	Mon 10/25/21	Fri 11/5/21
51		Agreement Execution	15 days	Mon 11/8/21	Fri 11/26/21
52		RFP Preparation for Well Drilling and Equipping	40 days	Wed 12/1/21	Tue 1/25/22
53		RFP Interviews	30 days	Wed 1/26/22	Tue 3/8/22



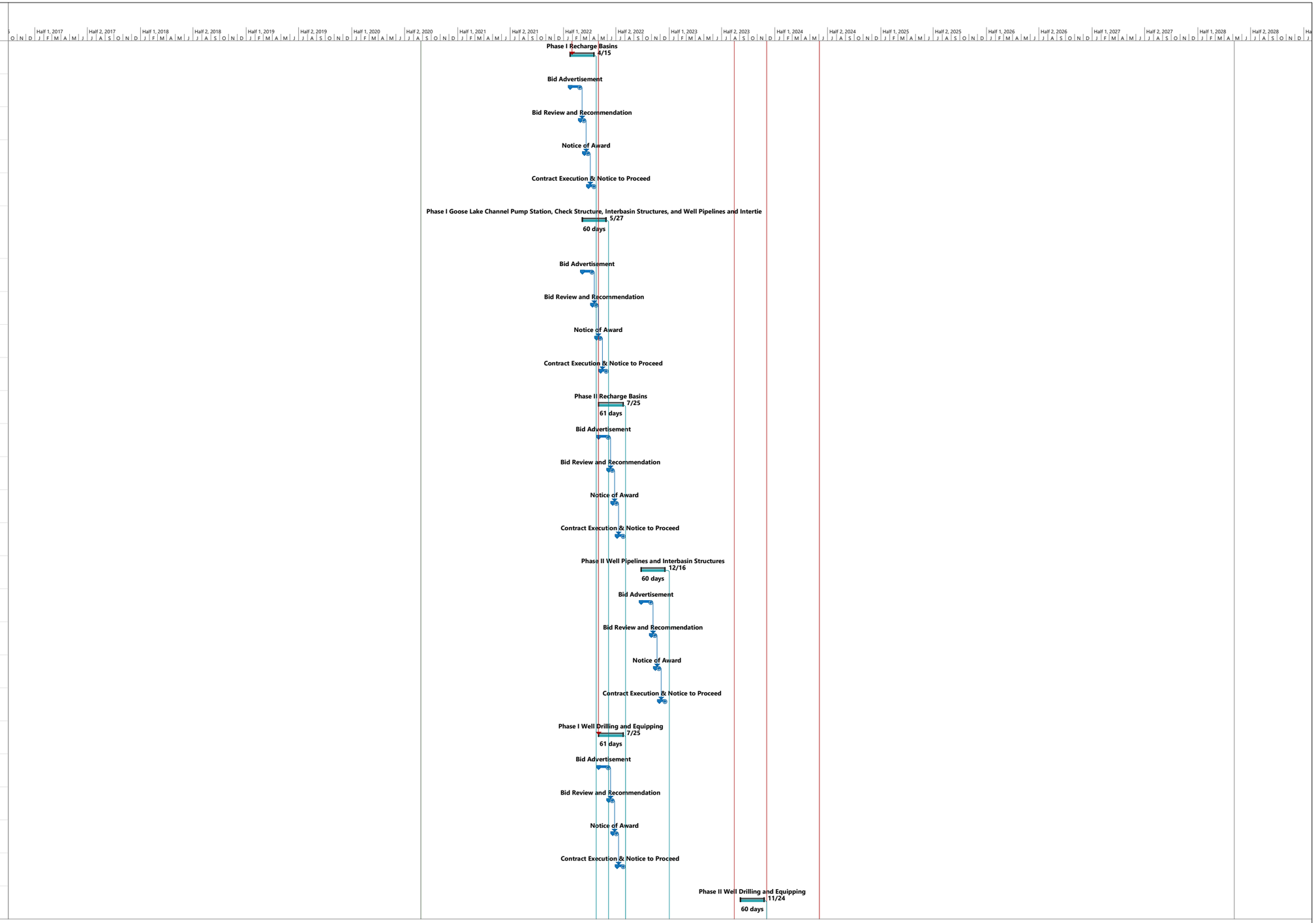
ID	Task Mode	Task Name	Duration	Start	Finish
54		CM Firm Selection	10 days	Wed 3/9/22	Tue 3/22/22
55		Agreement Execution	15 days	Wed 3/23/22	Tue 4/12/22
56		RFQ Preparation for Aqueduct Turnout Facility	45 days	Mon 1/16/23	Fri 3/17/23
57		RFP Interviews	30 days	Mon 3/20/23	Fri 4/28/23
58		CM Firm Selection	10 days	Mon 5/1/23	Fri 5/12/23
59		Agreement Execution	15 days	Mon 5/15/23	Fri 6/2/23
60		RFQ Preparation for Conveyance Facilities including Turnouts & Pump Stations	45 days	Thu 6/1/23	Wed 8/2/23
61		RFP Interviews	30 days	Thu 8/3/23	Wed 9/13/23
62		CM Firm Selection	10 days	Thu 9/14/23	Wed 9/27/23
63		Agreement Execution	15 days	Thu 9/28/23	Wed 10/18/23
64		RFQ Preparation for Pump Station Equipping	45 days	Tue 1/2/24	Mon 3/4/24
65		RFP Interviews	30 days	Tue 3/5/24	Mon 4/15/24
66		CM Firm Selection	10 days	Tue 4/16/24	Mon 4/29/24
67		Agreement Execution	15 days	Tue 4/30/24	Mon 5/20/24
68		RFQ Preparation for SCADA and PLC Programming	45 days	Mon 7/19/21	Fri 9/17/21
69		RFP Interviews	30 days	Mon 11/29/21	Fri 1/7/22
70		CM Firm Selection	10 days	Mon 1/10/22	Fri 1/21/22
71		Agreement Execution	15 days	Mon 1/24/22	Fri 2/11/22
72		**Design Phase**	**715 days**	**Mon 4/5/21**	**Fri 12/29/23**
73		Phase I Recharge Basins & Goose Lake Channel Pump Station, Check Structure, Interbasin Structures, and Well Pipelines and Intertie; Phase II Recharge Basins & Phase II Well Pipelines and Interbasin Structures	210 days	Mon 4/5/21	Fri 1/21/22
74		Phase I Well Drilling and Equipping; Phase II Well Drilling and Equipping	8.75 mons	Mon 8/2/21	Fri 4/1/22
75		Aqueduct Turnout Facility	14 mons	Mon 7/11/22	Fri 8/4/23
76		Conveyance Facilities including Turnouts & Pump Stations	18 mons	Mon 7/11/22	Fri 11/24/23
77		SCADA and PLC Programming	21.3 mons	Fri 5/13/22	Fri 12/29/23
78		**Bid Phase**	**1167 days?**	**Mon 1/24/22**	**Tue 7/14/26**



Project: Kern Fan Groundwater
Date: Thu 8/27/20

Task, Split, Milestone, Summary, Project Summary, Inactive Task, Inactive Milestone, Inactive Summary, Manual Task, Duration-only, Manual Summary Rollup, Manual Summary, Start-only, Finish-only, External Tasks, External Milestone, Deadline, Path Successor Milestone Task, Path Successor Summary Task, Path Successor Normal Task, Critical, Critical Split, Progress, Manual Progress

ID	Task Name	Duration	Start	Finish
79	**Phase I Recharge Basins**	**60 days?**	**Mon 1/24/22**	**Fri 4/15/22**
80	Bid Advertisement	25 days	Mon 1/24/22	Fri 2/25/22
81	Bid Review and Recommendation	10 days	Mon 2/28/22	Fri 3/11/22
82	Notice of Award	10 days	Mon 3/14/22	Fri 3/25/22
83	Contract Execution & Notice to Proceed	15 days	Mon 3/28/22	Fri 4/15/22
84	**Phase I Goose Lake Channel Pump Station, Check Structure, Interbasin Structures, and Well Pipelines and Intertie**	**60 days**	**Mon 3/7/22**	**Fri 5/27/22**
85	Bid Advertisement	25 days	Mon 3/7/22	Fri 4/8/22
86	Bid Review and Recommendation	10 days	Mon 4/11/22	Fri 4/22/22
87	Notice of Award	10 days	Mon 4/25/22	Fri 5/6/22
88	Contract Execution & Notice to Proceed	15 days	Mon 5/9/22	Fri 5/27/22
89	**Phase II Recharge Basins**	**61 days**	**Mon 5/2/22**	**Mon 7/25/22**
90	Bid Advertisement	25 days	Mon 5/2/22	Fri 6/3/22
91	Bid Review and Recommendation	10 days	Mon 6/6/22	Fri 6/17/22
92	Notice of Award	10 days	Mon 6/20/22	Fri 7/1/22
93	Contract Execution & Notice to Proceed	15 days	Tue 7/5/22	Mon 7/25/22
94	**Phase II Well Pipelines and Interbasin Structures**	**60 days**	**Mon 9/26/22**	**Fri 12/16/22**
95	Bid Advertisement	25 days	Mon 9/26/22	Fri 10/28/22
96	Bid Review and Recommendation	10 days	Mon 10/31/22	Fri 11/11/22
97	Notice of Award	10 days	Mon 11/14/22	Fri 11/25/22
98	Contract Execution & Notice to Proceed	15 days	Mon 11/28/22	Fri 12/16/22
99	**Phase I Well Drilling and Equipping**	**61 days**	**Mon 5/2/22**	**Mon 7/25/22**
100	Bid Advertisement	25 days	Mon 5/2/22	Fri 6/3/22
101	Bid Review and Recommendation	10 days	Mon 6/6/22	Fri 6/17/22
102	Notice of Award	10 days	Mon 6/20/22	Fri 7/1/22
103	Contract Execution & Notice to Proceed	15 days	Tue 7/5/22	Mon 7/25/22
104	**Phase II Well Drilling and Equipping**	**60 days**	**Mon 9/4/23**	**Fri 11/24/23**



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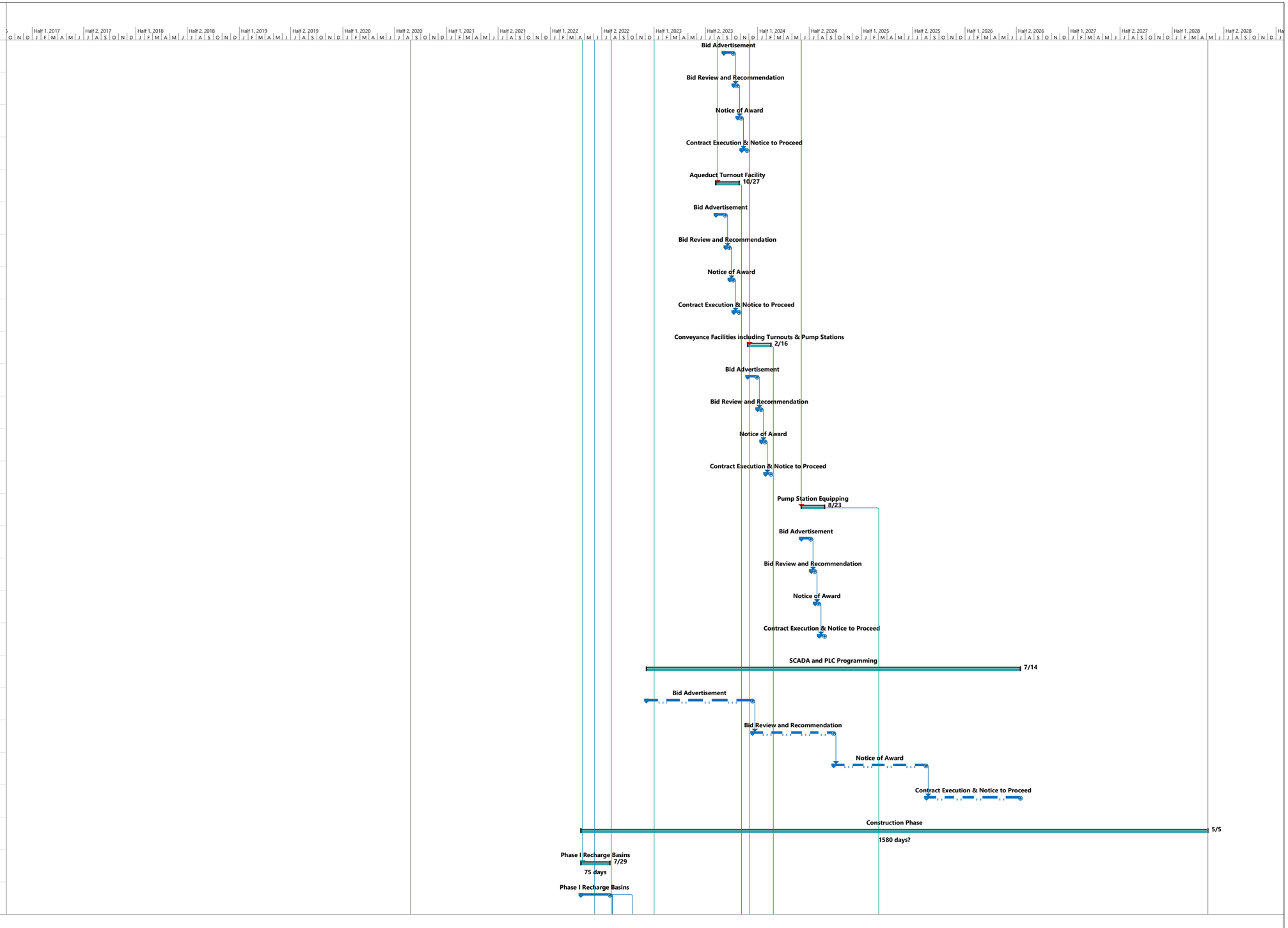
ID	Task Name	Duration	Start	Finish
105	Bid Advertisement	25 days	Mon 9/4/23	Fri 10/6/23
106	Bid Review and Recommendation	10 days	Mon 10/9/23	Fri 10/20/23
107	Notice of Award	10 days	Mon 10/23/23	Fri 11/3/23
108	Contract Execution & Notice to Proceed	15 days	Mon 11/6/23	Fri 11/24/23
109	**Aqueduct Turnout Facility**	**60 days**	**Mon 8/7/23**	**Fri 10/27/23**
110	Bid Advertisement	25 days	Mon 8/7/23	Fri 9/8/23
111	Bid Review and Recommendation	10 days	Mon 9/11/23	Fri 9/22/23
112	Notice of Award	10 days	Mon 9/25/23	Fri 10/6/23
113	Contract Execution & Notice to Proceed	15 days	Mon 10/9/23	Fri 10/27/23
114	**Conveyance Facilities including Turnouts & Pump Stations**	**60 days**	**Mon 11/27/23**	**Fri 2/16/24**
115	Bid Advertisement	25 days	Mon 11/27/23	Fri 12/29/23
116	Bid Review and Recommendation	10 days	Mon 1/1/24	Fri 1/12/24
117	Notice of Award	10 days	Mon 1/15/24	Fri 1/26/24
118	Contract Execution & Notice to Proceed	15 days	Mon 1/29/24	Fri 2/16/24
119	**Pump Station Equipping**	**60 days**	**Mon 6/3/24**	**Fri 8/23/24**
120	Bid Advertisement	25 days	Mon 6/3/24	Fri 7/5/24
121	Bid Review and Recommendation	10 days	Mon 7/8/24	Fri 7/19/24
122	Notice of Award	10 days	Mon 7/22/24	Fri 8/2/24
123	Contract Execution & Notice to Proceed	15 days	Mon 8/5/24	Fri 8/23/24
124	**SCADA and PLC Programming**	**942 days**	**Mon 12/5/22**	**Tue 7/14/26**
125	Bid Advertisement	180 days	Mon 12/5/22	Wed 12/13/23
126	Bid Review and Recommendation	115 days	Thu 12/14/23	Tue 9/24/24
127	Notice of Award	145 days	Wed 9/25/24	Fri 8/15/25
128	Contract Execution & Notice to Proceed	150 days	Mon 8/18/25	Tue 7/14/26
129	**Construction Phase**	**1580 days?**	**Mon 4/18/22**	**Fri 5/5/28**
130	**Phase I Recharge Basins**	**75 days**	**Mon 4/18/22**	**Fri 7/29/22**
131	Phase I Recharge Basins	75 days	Mon 4/18/22	Fri 7/29/22



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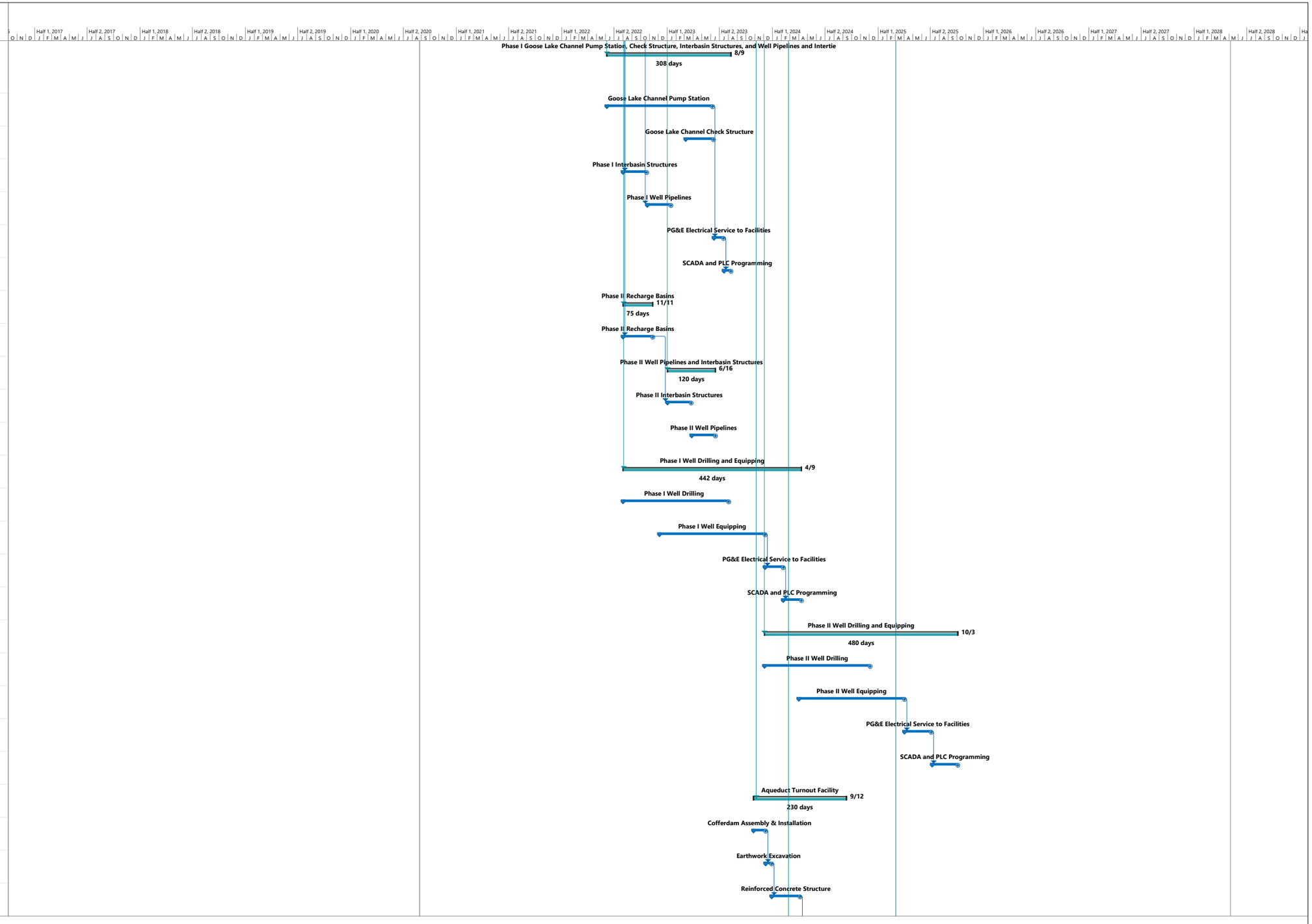
ID	Task Name	Duration	Start	Finish
132	**Phase I Goose Lake Channel Pump Station, Check Structure, Interbasin Structures, and Well Pipelines and Intertie**	**308 days**	**Mon 6/6/22**	**Wed 8/9/23**
133	Goose Lake Channel Pump Station	262 days	Mon 6/6/22	Tue 6/6/23
134	Goose Lake Channel Check Structure	70 days	Mon 3/6/23	Fri 6/9/23
135	Phase I Interbasin Structures	60 days	Mon 8/1/22	Fri 10/21/22
136	Phase I Well Pipelines	60 days	Mon 10/24/22	Fri 1/13/23
137	PG&E Electrical Service to Facilities	25 days	Mon 6/12/23	Fri 7/14/23
138	SCADA and PLC Programming	18 days	Mon 7/17/23	Wed 8/9/23
139	**Phase II Recharge Basins**	**75 days**	**Mon 8/1/22**	**Fri 11/11/22**
140	Phase II Recharge Basins	75 days	Mon 8/1/22	Fri 11/11/22
141	**Phase II Well Pipelines and Interbasin Structures**	**120 days**	**Mon 1/2/23**	**Fri 6/16/23**
142	Phase II Interbasin Structures	60 days	Mon 1/2/23	Fri 3/24/23
143	Phase II Well Pipelines	60 days	Mon 3/27/23	Fri 6/16/23
144	**Phase I Well Drilling and Equipping**	**442 days**	**Mon 8/1/22**	**Tue 4/9/24**
145	Phase I Well Drilling	262 days	Mon 8/1/22	Tue 8/1/23
146	Phase I Well Equipping	262 days	Mon 12/5/22	Tue 12/5/23
147	PG&E Electrical Service to Facilities	45 days	Wed 12/6/23	Tue 2/6/24
148	SCADA and PLC Programming	45 days	Wed 2/7/24	Tue 4/9/24
149	**Phase II Well Drilling and Equipping**	**480 days**	**Mon 12/4/23**	**Fri 10/3/25**
150	Phase II Well Drilling	262 days	Mon 12/4/23	Tue 12/3/24
151	Phase II Well Equipping	262 days	Mon 4/1/24	Tue 4/1/25
152	PG&E Electrical Service to Facilities	67 days	Wed 4/2/25	Thu 7/3/25
153	SCADA and PLC Programming	65 days	Mon 7/7/25	Fri 10/3/25
154	**Aqueduct Turnout Facility**	**230 days**	**Fri 10/27/23**	**Thu 9/12/24**
155	Cofferdam Assembly & Installation	30 days	Fri 10/27/23	Thu 12/7/23
156	Earthwork Excavation	15 days	Fri 12/8/23	Thu 12/28/23
157	Reinforced Concrete Structure	70 days	Fri 12/29/23	Thu 4/4/24



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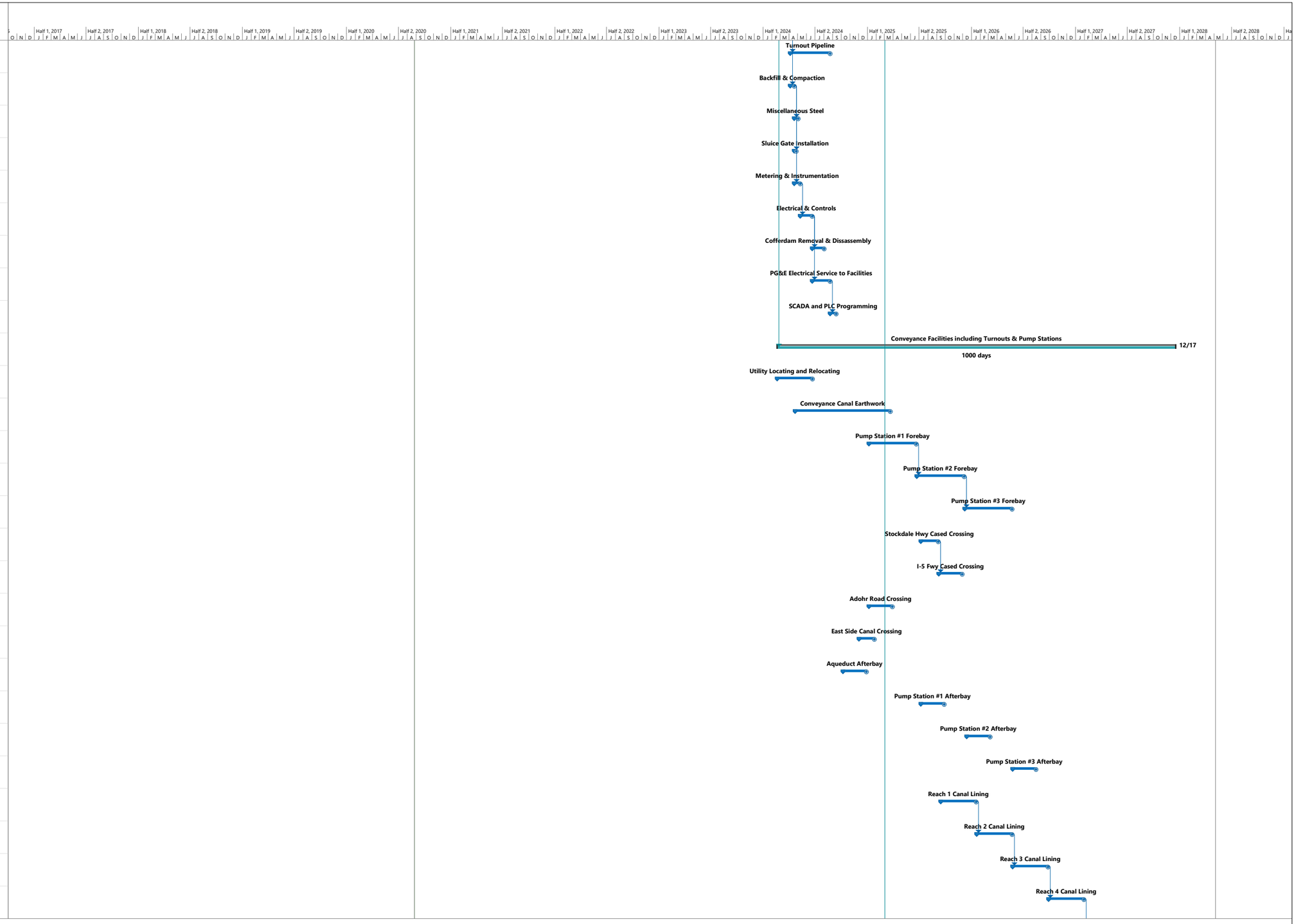
ID	Task Name	Duration	Start	Finish
158	Turnout Pipeline	100 days	Fri 4/5/24	Thu 8/22/24
159	Backfill & Compaction	10 days	Fri 4/5/24	Thu 4/18/24
160	Miscellaneous Steel	10 days	Fri 4/19/24	Thu 5/2/24
161	Sluice Gate Installation	5 days	Fri 4/19/24	Thu 4/25/24
162	Metering & Instrumentation	15 days	Fri 4/19/24	Thu 5/9/24
163	Electrical & Controls	30 days	Fri 5/10/24	Thu 6/20/24
164	Cofferdam Removal & Dissassembly	30 days	Fri 6/21/24	Thu 8/1/24
165	PG&E Electrical Service to Facilities	45 days	Fri 6/21/24	Thu 8/22/24
166	SCADA and PLC Programming	15 days	Fri 8/23/24	Thu 9/12/24
167	**Conveyance Facilities including Turnouts & Pump Stations**	**1000 days**	**Mon 2/19/24**	**Fri 12/17/27**
168	Utility Locating and Relocating	90 days	Mon 2/19/24	Fri 6/21/24
169	Conveyance Canal Earthwork	240 days	Mon 4/22/24	Fri 3/21/25
170	Pump Station #1 Forebay	120 days	Mon 1/6/25	Fri 6/20/25
171	Pump Station #2 Forebay	120 days	Mon 6/23/25	Fri 12/5/25
172	Pump Station #3 Forebay	120 days	Mon 12/8/25	Fri 5/22/26
173	Stockdale Hwy Cased Crossing	45 days	Mon 7/7/25	Fri 9/5/25
174	I-5 Fwy Cased Crossing	60 days	Mon 9/8/25	Fri 11/28/25
175	Adohr Road Crossing	60 days	Mon 1/6/25	Fri 3/28/25
176	East Side Canal Crossing	40 days	Mon 12/2/24	Fri 1/24/25
177	Aqueduct Afterbay	60 days	Mon 10/7/24	Fri 12/27/24
178	Pump Station #1 Afterbay	60 days	Mon 7/7/25	Fri 9/26/25
179	Pump Station #2 Afterbay	60 days	Mon 12/15/25	Fri 3/6/26
180	Pump Station #3 Afterbay	60 days	Mon 5/25/26	Fri 8/14/26
181	Reach 1 Canal Lining	90 days	Mon 9/15/25	Fri 1/16/26
182	Reach 2 Canal Lining	90 days	Mon 1/19/26	Fri 5/22/26
183	Reach 3 Canal Lining	90 days	Mon 5/25/26	Fri 9/25/26
184	Reach 4 Canal Lining	90 days	Mon 9/28/26	Fri 1/29/27



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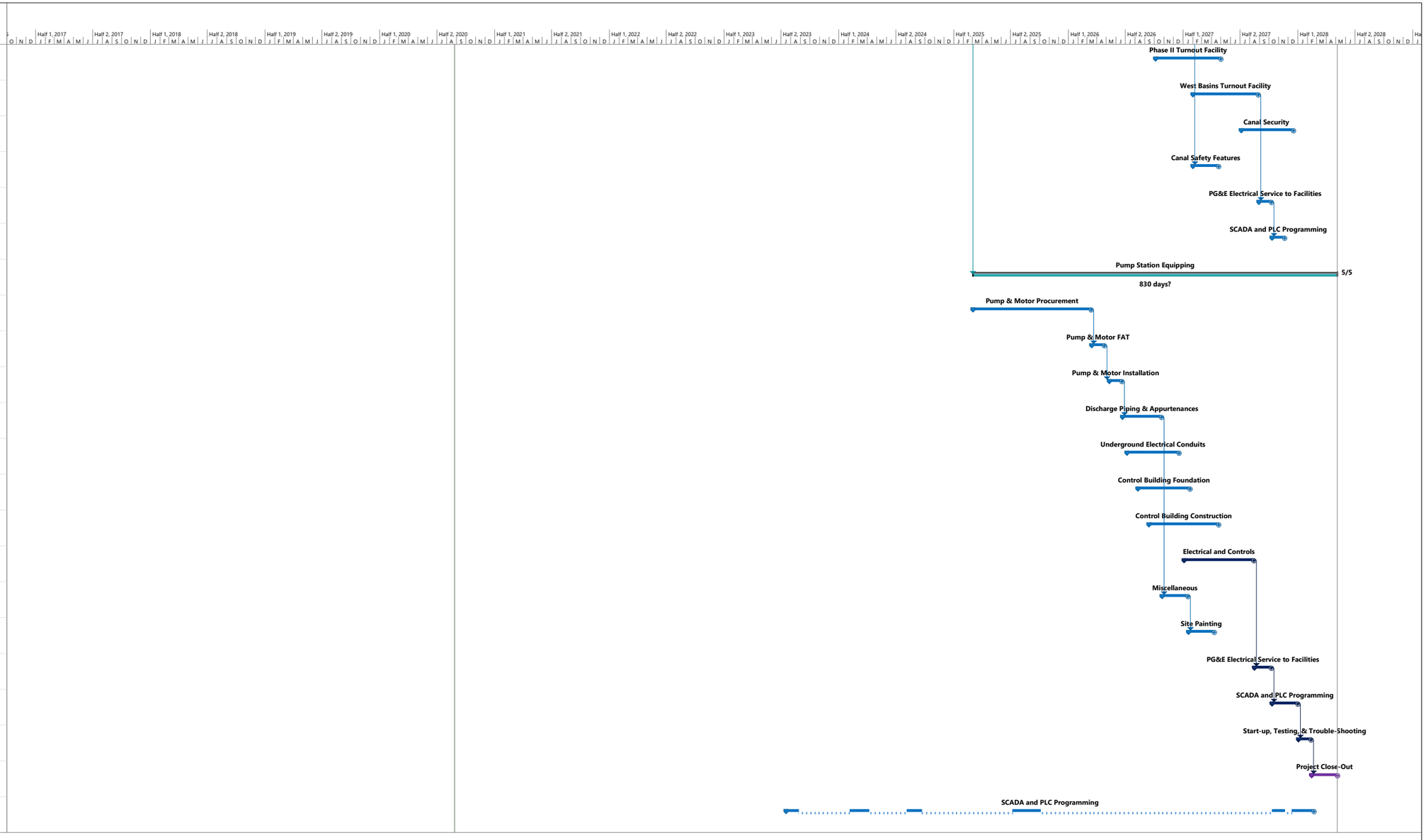
ID	Task Name	Duration	Start	Finish
185	Phase II Turnout Facility	150 days	Mon 10/5/26	Fri 4/30/27
186	West Basins Turnout Facility	150 days	Mon 2/1/27	Fri 8/27/27
187	Canal Security	120 days	Mon 7/5/27	Fri 12/17/27
188	Canal Safety Features	60 days	Mon 2/1/27	Fri 4/23/27
189	PG&E Electrical Service to Facilities	30 days	Mon 8/30/27	Fri 10/8/27
190	SCADA and PLC Programming	30 days	Mon 10/11/27	Fri 11/19/27
191	**Pump Station Equipping**	**830 days?**	**Mon 3/3/25**	**Fri 5/5/28**
192	Pump & Motor Procurement	270 days	Mon 3/3/25	Fri 3/13/26
193	Pump & Motor FAT	30 days	Mon 3/16/26	Fri 4/24/26
194	Pump & Motor Installation	30 days	Mon 5/11/26	Fri 6/19/26
195	Discharge Piping & Appurtenances	90 days	Mon 6/22/26	Fri 10/23/26
196	Underground Electrical Conduits	120 days	Mon 7/6/26	Fri 12/18/26
197	Control Building Foundation	120 days	Mon 8/10/26	Fri 1/22/27
198	Control Building Construction	160 days	Mon 9/14/26	Fri 4/23/27
199	Electrical and Controls	160 days	Mon 1/4/27	Fri 8/13/27
200	Miscellaneous	60 days	Mon 10/26/26	Fri 1/15/27
201	Site Painting	60 days	Mon 1/18/27	Fri 4/9/27
202	PG&E Electrical Service to Facilities	40 days	Mon 8/16/27	Fri 10/8/27
203	SCADA and PLC Programming	60 days	Mon 10/11/27	Fri 12/31/27
204	Start-up, Testing, & Trouble-Shooting	30 days	Mon 1/3/28	Fri 2/11/28
205	Project Close-Out	3 mons	Mon 2/14/28	Fri 5/5/28
206	SCADA and PLC Programming	255.38 days	Mon 7/17/23	Mon 2/21/28



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APPENDIX B

Sample Front End Specifications

PROJECT MANUAL

FOR

_____

_____

_____

PROJECT NO. XXXXX

CODE XXXX

MONTH 20XX

GROUNDWATER BANKING
JOINT POWERS AUTHORITY (JPA)

PROJECT MANUAL

FOR

_____

_____

_____

PROJECT NO. XXXXX

MONTH 20XX

Insert Engineer's Stamp and Signature Here

_____

JPA Engineering Manager Date

PROJECT MANUAL

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BID DOCUMENTS

Contents

NOTICE INVITING SEALED PROPOSALS (BIDS)

FOR THE

_____

_____

PROJECT NO. XXXXX

GROUNDWATER BANKING JOINT POWERS AUTHORITY

NOTICE IS HEREBY GIVEN that the Groundwater Banking Joint Powers Authority ("JPA") invites and will receive electronically submitted proposals ("Bids") up to the hour of 2:00 PM on the ___ day of _____, 20__, at the PlanetBids website, for furnishing to JPA all transportation, materials, equipment, labor, services, and supplies necessary to construct the Work for JPA. At the time specified above the Bids will be electronically opened, and Bidders may view the bid opening online at the PlanetBids website.

Prospective bidders must be on the Bidders List accompanying this Notice. Bids will not be accepted from bidders that are not on the Bidders List. Prequalification to be placed on the Bidders List for this project is closed. Bids must be submitted to JPA through the PlanetBids website as given below.

https://www.planetbids.com/portal/portal.cfm?CompanyID=39499

Bids shall conform to and be responsive to all of the Contract Documents for the Work as heretofore approved by JPA and must be accompanied by the security referred to in the Instructions to Bidders.

The Contract Documents consist of the IRWD Construction Manual, the Project Manual, and the Plans, and may be downloaded free of charge at the PlanetBids website. Complete hard copy sets of the Project Manual and Plans may be purchased from _____.

Under the provisions of the California Labor Code, the Director of the Department of Industrial Relations has determined the prevailing rate of wages for the locality in which the Work is to be performed and JPA has adopted said prevailing rate of wages. A copy of the prevailing wage rates can be found online with the State of California at http://www.dir.ca.gov/dlsr/pwd. A copy of such prevailing wage rates shall be posted on the jobsite by CONTRACTOR.

It shall be mandatory for the bidder to whom the Work is awarded, and upon any subcontractor under the successful bidder, to pay not less than the specified rates to all workers employed by them in the execution of the Work. The project is subject to compliance monitoring and enforcement by the Department of Industrial Relations.

The Contractor and subcontractors, require proof of current registration. A bid shall not be accepted nor any contract or subcontract entered into without proof of the contractor's and subcontractor's current registration.

The Contractor to whom this project is awarded must possess a class _____ contractor's license, issued by the State of California, which is current and full.

The Contractor will be permitted to substitute securities for moneys withheld under this Agreement to ensure performance. Such substitution shall be subject to the provisions of Article 11.8 of the General Provisions of the Agreement. A payment bond and performance bond are required to be provided by the Contractor.

A pre-bid meeting and site visit will be held at the hour of ___:00 _M on the ___ day of _____, 20__, at _____.

SUBSTANTIALLY COMPLEX PROJECT FINDING

_____

_____

PROJECT NO. XXXXX

(Delete this page unless the Board has made a finding on the project complexity.)

JPA's Board of Directors on _____ approved the following finding during a properly noticed and normally scheduled public hearing and prior to bid: "That this project is substantially complex and therefore requires a higher retention amount than five (5) percent, and that the actual retention amount of _____ percent be established for this project." All references in the Contract Documents indicating a five (5) percent retention amount are hereby superseded and replaced with the higher retention amount specified in the preceding sentence. The basis of the finding, including a description of the project and why it is a unique project that is not regularly, customarily or routinely performed by JPA or licensed contractors, is set forth below.

Insert information from the Board write-up on the basis of the finding, including a description of the project and why it is a unique project that is not regularly, customarily or routinely performed by JPA or licensed contractors.

BIDDERS LIST

_____

_____

PROJECT NO. XXXXX

BIDDERS LIST

_____

_____

PROJECT NO. XXXXX

*Delete the names of the **Mechanical** firms not to be invited to bid on this project.*

BIDDERS LIST

_____

_____

PROJECT NO. XXXXX

Contractor categories other than Pipeline or Mechanical:

1. *Insert contractor names from JPA's Prequalified Contractor List*
2.
3.
4.
5.

INSTRUCTIONS TO BIDDERS

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INSTRUCTIONS TO BIDDERS

ARTICLE 1 PROPOSAL REQUIREMENTS AND CONDITIONS

1.1 Contract Documents

The documents that comprise the Contract Documents are set forth in the Agreement and the definition of "Contract Documents" in Article 1 of the General Provisions.

1.2 Contractor's License

No bid will be accepted from a Bidder who is not a licensed contractor in the State of California for the contracting class indicated in the Notice Inviting Sealed Proposals.

1.3 Proposals

1.3.1 Bids shall be made in accordance with the following: Bids shall be submitted electronically through JPA's PlanetBids website. The electronically submitted bid is a part of the Contract Documents. All bids shall be properly executed and with all items filled in; the signatures of all persons signing shall be in longhand. Erasures, interlineations, or other corrections shall be authenticated by affixing in the margin immediately adjacent to the correction the initials of a person signing the bid.

1.3.2 Bids shall not contain any additional description or summaries of the work to be done. Alternative proposals will not be considered, except as called for. No paper copy, oral, telegraphic, or telephonic proposals or modifications will be considered.

1.3.3 The Bid Security Declaration and proposal guarantee in the form of cash, a cashier's or a certified check, or bidder's bond, in an amount not less than ten (10) percent of the amount of bid, made payable to or for the benefit of JPA shall be submitted in paper form in a sealed envelope to JPA prior to the bid opening. The envelope exterior shall indicate "Bid Security" and the project title. The check or bond shall be given as a guarantee that the Bidder will enter into a contract if awarded the Work, and in case of refusal or failure to enter into said contract and furnish the required bonds and insurance certificates and endorsements within fifteen (15) calendar days after Notice of Award by JPA in writing, the check and the money represented by the check shall be forfeited to JPA, or in the event that a bond is deposited, said bond shall be deemed to be forfeited. Forfeiture does not preclude JPA from seeking all other remedies provided by law to recover losses sustained as a result of Bidder's failure to enter into the contract or to furnish the required bonds, insurance certificates and endorsements.

1.3.4 Bids shall be submitted on or before the day and hour set for the opening of bids in the Notice Inviting Sealed Proposals. It is the sole responsibility of the Bidder to see that their bid is submitted and received in proper time.

1.3.5 Prospective bidders must be on the Bidders List accompanying the Notice Inviting Sealed Proposals. Bids will not be accepted from bidders that are not on the Bidders List. Prequalification to be placed on the Bidders List for this project is closed.

1.4 Withdrawal of Bid

A Bidder may withdraw their bid electronically through PlanetBids any time prior to the scheduled time for opening of the bids.

1.5 Bidders Interested in More Than One Bid

No person, partnership, or corporation shall be allowed to make or file or be interested in more than one bid for the Work, unless alternative bids are called for. A person, partnership, or corporation submitting a subproposal to a Bidder, or who has quoted prices on material to a Bidder, is not disqualified from submitting a subproposal or quoting prices to other Bidders.

1.6 Interpretation of Plans and Other Documents

If any prospective Bidder is in doubt as to the true meaning of any part of the plans, specifications, or other Contract Documents, or finds discrepancies in, or omissions from the Plans and specifications or other Contract Documents, they may submit to JPA through PlanetBids a written request for an interpretation or correction. An interpretation or correction of the documents will be made solely at JPA's discretion and only by addendum duly issued by JPA; a copy of such addendum will be made available to Bidders through PlanetBids. JPA and the Engineer will not be responsible for any other explanation or interpretation of the documents.

1.7 Substitute and Or Equivalent Items

The contract, if awarded, will be on the basis of materials and equipment shown or specified in the Contract Documents without consideration of possible substitute or "or equivalent" items. Application for acceptance of a substitute or "or equivalent" item of material or equipment will not be considered by JPA until after the effective date of the Agreement except as may be specified for major items of equipment in the Special Provisions. The procedure for submission of a request for substitution is set forth in the general provisions.

1.8 Engineer's Opinion of Probable Cost

The quantities of work to be done and materials to be furnished are approximate as shown in the Contract Documents and are given as a basis for comparison of bids only. JPA does not expressly or by implication agree or represent that the actual amount of work will correspond with the engineer's opinion of probable cost.

1.9 Addenda

Addenda issued through PlanetBids before the time in which to submit bids expires shall be covered in the bid and shall form a part of the Contract Documents.

1.10 Registration To Perform Public Work

Contractor and subcontractors, if required in Article 1.11, require proof of current registration. A bid shall not be accepted nor any contract or subcontract entered into without proof of the contractor’s or subcontractor’s current registration.

1.11 Subcontractors

The bidder shall provide the name, State of California license number, Department of Industrial Relations registration number, location of place of business, type of work which will be done, and percentage of work of each subcontractor who will perform work or labor or render service to the bidder in or about the construction of the Work in an amount in excess of 1/2 of 1 percent (0.5%) of the bidder's total Bid on the PlanetBids website.

ARTICLE 2 EXISTING CONDITIONS AND EXAMINATION OF CONTRACT DOCUMENTS

2.1 General

2.1.1 Any investigations and reports related to the Work are listed in the Special Provisions and are available for review at JPA's office. Bidder should visit the project site prior to submitting a bid in order to confirm soil and groundwater conditions in the project area at the time of bidding. If additional information is required, it is recommended that it be obtained from a qualified soils engineer.

2.1.2 The Bidder shall examine the Contract Documents and the site where the Work is to be performed. The submittal of a bid shall be conclusive evidence that the Bidder has investigated and has determined to their satisfaction the conditions to be encountered and the character, quality, and scope of the Work.

2.1.3 The plans for the Work show conditions as they are supposed or believed by JPA to exist; but it is not represented or intended to be inferred that the conditions are actually existent. JPA and the Engineer will not be liable for any loss sustained by CONTRACTOR as a result of any variance between the conditions as shown on the plans and the actual conditions revealed during the progress of the Work or otherwise.

2.1.4 Where JPA or the Engineer or their consultants have made investigations of subsurface conditions in areas where the Work is to be performed, such investigations were made only for the purpose of study and design. The conditions indicated by such investigations apply only at the specific location of each boring or excavation at the time the borings or excavations were made. Where such investigations have been made, the records as to such investigations are available for inspection at the office of JPA.

2.1.5 The records of such investigations are not a part of the Contract Documents and are available solely for the convenience of the Bidder or CONTRACTOR. It is expressly understood and agreed that JPA, the Engineer, and their consultants assume no responsibility whatsoever in respect to the sufficiency or accuracy of the investigations, the records, or of the interpretations set forth or made by JPA, the Engineer or their consultants. There is no warranty or guarantee, either expressed or implied, that the conditions indicated by such investigations or records are representative of those existing throughout the area, or any part of an area, or that unlooked for developments may not occur, or that materials other than, or in proportions different from, those indicated may not be encountered.

2.1.6 When a log of test borings showing a record of the data obtained by the investigation of subsurface conditions by JPA, the Engineer, or their consultants is included with the Contract Documents it is expressly understood and agreed that said log of test borings does not constitute a part of the Agreement, that it represents only the opinion of JPA or the Engineer or their consultants as to the character of the materials encountered by them in the test borings at the time they were made, that it is included in the plans only for the convenience of Bidders, and that their use is subject to all of the conditions and limitations set forth in this Article.

2.1.7 The availability or use of information described in this Article is not to be construed in any way as a waiver of the provisions of subparagraph 2.1.2 and a Bidder or CONTRACTOR is cautioned to make such independent investigations and examination as they deem necessary to satisfy themselves as to conditions to be encountered in the performance of the Work.

2.1.8 No information derived from such inspection of records of investigations or compilation of records made by JPA, the Engineer, or their consultants will in any way relieve the Bidder or CONTRACTOR from any risk or from properly fulfilling the terms of the Agreement.

ARTICLE 3 AWARD OF CONTRACT OR REJECTION OF BIDS

3.1 Award

3.1.1 The award of the Agreement, if it is awarded, will be to the lowest responsive and responsible Bidder complying with the instructions contained in the Contract Documents. JPA, however, reserves the right to reject any and all bids and to waive any informality in bids received. If, in the judgment of JPA, a bid is unbalanced or if the Bidder is not responsive and responsible, it shall be considered sufficient grounds for rejection of the entire bid.

3.1.2 JPA shall have sixty (60) days, unless otherwise specified in the Special Provisions, after the opening of bids within which to accept or reject the bids. No Bidder may withdraw their bid during said period. JPA will return the proposal guarantees, except Bidders' bonds and any guarantees that have been forfeited, to the respective Bidders whose proposals they accompanied within ten (10) days after the execution of the Agreement by the successful Bidder or rejection of all bids.

3.1.3 Before award of the contract, any Bidder upon request shall furnish a recent statement of their financial condition and previous construction experience or such other evidence of their qualifications as may be requested by JPA. Failure to do so upon request shall constitute grounds for rejection of the bid.

3.1.4 If the schedule of work items includes bid items or schedule(s) of bid items that may be added to (“Additive Items”) or deducted from (“Deductive Items”) the bids, the lowest responsive and responsible Bidder will be determined by adding all Additive Items to, and deducting all Deductive Items from, the total of the base bid, unless another method is provided in the Special Provisions. JPA reserves the right to award the Work to the lowest responsive and responsible bidder based on any single schedule or combination of schedules of bid items deemed by JPA, in its sole discretion, to be in JPA's best interest.

3.2 Agreement and Bonds

3.2.1 The form of Agreement, bonds, and other documents that the successful Bidder, as CONTRACTOR, shall be required to execute are included in the Contract Documents and should be carefully examined by the Bidder.

3.2.2 The successful Bidder, simultaneously with the execution of the Agreement, will be required to furnish a payment bond and a performance bond, each in an amount equal to one hundred (100) percent of the Contract Price. Said bonds shall be secured from a surety company satisfactory to JPA and who is admitted and authorized to transact business in California. A certified copy of Power of Attorney must be attached to each bond. Said bonds shall continue in full force and effect for the guarantee period.

3.2.3 Should any surety or sureties be deemed unsatisfactory at any time by JPA, notice will be given CONTRACTOR to that effect, and CONTRACTOR shall substitute a new surety or sureties satisfactory to JPA. No further payment shall be deemed due or will be made under the Agreement until the new sureties qualify and are accepted by JPA.

3.2.4 All alterations, time extensions, extra and additional work, and other changes authorized by the Specifications, or any part of the Agreement, may be made without securing consent of the surety or sureties on the contract bonds.

3.3 Insurance Requirements

The successful Bidder will be required to furnish JPA proof of full compliance with all insurance requirements as specified in the Articles on CONTRACTOR's Insurance in the General and Special Provisions. The form of certificates of insurance and endorsements which the successful Bidder, as CONTRACTOR, shall be required to furnish are included in the Contract Documents and should be carefully examined by the Bidder. No alteration or substitution of said forms will be allowed.

3.4 Execution of Agreement

The Agreement shall be signed by the successful Bidder and returned to JPA, together with the contract bonds and certificates of insurance coverage and endorsements, within fifteen (15) calendar days after the mailing date of the Notice of Award. The date of commencement stated in the Notice of Award will constitute the beginning of the Contract Time. The Agreement, bonds, certificates of insurance and endorsements, and other documents to be executed by CONTRACTOR shall be executed and submitted in original-triplicate, two of which shall be filed with JPA and one returned to CONTRACTOR after execution by JPA. Following receipt and approval of the executed Contract Documents, JPA will issue a Notice to Proceed. The receipt of the Notice to Proceed will be authorization for CONTRACTOR to begin work in the field and to start ordering of equipment and material.

3.5 Failure to Execute Agreement or Submit Insurance

3.5.1 Failure by a Bidder to whom the Work is awarded to execute the Agreement and file acceptable bonds and certificates of insurance coverage and endorsements as provided herein shall be just cause for the annulment of the award and the forfeiture of the proposal guarantee, and shall make the Bidder liable to JPA for all damages resulting from the failure, including reasonable attorneys' fees. The value of the proposal guarantee shall not be a limitation of damages.

3.5.2 The insurance certificates and endorsements included in the Contract Documents shall be completed, without alteration, to the satisfaction of JPA, and submitted to JPA by CONTRACTOR or CONTRACTOR's insurance company within fifteen (15) calendar days of the date of the Notice of Award. JPA shall be allotted seven (7) calendar days for review of insurance documents. Additional time as may be required for transmittal and review of follow-up insurance submittals shall not result in an extension of the Contract Time. The insurance certificates and endorsements shall reflect coverage that complies with all insurance requirements in the general provisions and Special Provisions.

ARTICLE 4 ASSIGNMENT OF ANTITRUST ACTIONS

4.1 General

In entering into a public works contract or subcontract to supply goods, services, or materials pursuant to a public works contract, CONTRACTOR or Subcontractor offers and agrees to assign to the awarding body all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Section 15) or under the Cartwright Act (Chapter 2, commencing with Section 16700, of Part 2 of Division 7 of the Business and Professions Code), arising from purchases of goods, services, or materials pursuant to the public works

contract or the subcontract. This assignment shall be made and become effective at the time the awarding body tenders final payment to CONTRACTOR, without further acknowledgment by the parties.

ARTICLE 5 MISCELLANEOUS

5.1 Bid Breakdown

Lump-sum and unit-price bid items shall be broken down as indicated on the Schedule of Work. CONTRACTOR may be directed to provide greater detail of the items making up the Contract Price prior to submission of the first Progress Payment Request as indicated in the General Provisions.

5.2 Contract Time

The Contract Time shall be as set forth in the Agreement.

5.3 Liquidated Damages

Liquidated damages shall be as set forth in the Agreement.

5.4 Unit Price Bid Item Quantities

It is understood that the unit price bid item quantities listed in the Schedule of Work are approximate only and are solely for the purpose of facilitating the comparison of bids, and that CONTRACTOR's compensation will be computed upon the basis of the actual quantities in the completed Work whether they be more or less than those shown in the bid.

SCHEDULE OF WORK

_____
_____

PROJECT NO. XXXXX

Base Bid Items

Item No.	Approx. Quantity	Description	Unit Price Dlrs./Cts.	Total Amount Dlrs./Cts.
1-N		(PROJECT BID ITEMS AS REQUIRED)	ENTER AMOUNTS ON PLANETBIDS	
N+1		Trench Safety Measures		
N+2		Startup Testing		
N+3		Final Record Drawings		
		SUBTOTAL, Base Bid Items		

Additive and Deductive Bid Items

Item No.	Approx. Quantity	Description	Unit Price Dlrs./Cts.	Total Amount Dlrs./Cts.
A-1		Builder's Risk Insurance	ENTER AMOUNTS ON PLANETBIDS	
A-2		Additive Bid Item No. 2		
D-1		Deductive Bid Item No. 1		
		SUBTOTAL, Additive/Deductive Bid Items		
		SUBTOTAL, Base Bid and Additive/Deductive Bid Items		
		ADDITION (+) OR		
		DEDUCTION (-)*		
		TOTAL AMOUNT OF BID		

Fill in total amounts for specified Bid Item numbers N+1, N+2, N+3, etc. in blanks above; leave remaining blank for CONTRACTOR to fill in. Only CONTRACTOR entered bid amounts should be greyed out.

*Provision is made here for the bidder to include an addition or deduction in their Bid, if bidder wishes, to reflect any last-minute adjustments in price. The addition or deduction, if made, will be proportionately applied to all of the base bid items.

BID PROPOSAL

DOCUMENT CHECKLIST

_____

_____

PROJECT NO. XXXXX

Bid proposals shall include the following information entered electronically on PlanetBids:

☐ Schedule of Work

Bid proposals shall include the Bid Form and all contents provided therein as listed below that shall be completed by hand and uploaded to PlanetBids as a compiled single document:

☐ Bid Form

- ☐ Statements by Bidder
- ☐ Certification of Bidder and Qualifications
- ☐ Safety Program Certification
- ☐ Non-Collusion Declaration

Bid proposals shall include the following documents that shall be submitted in a sealed envelope to JPA prior to Bid Opening in accordance with the Article 1.3.3 of the Instructions to Bidders:

- ☐ Bid Security Declaration
- ☐ Bid Bond, Cash, or Certified Check

BID FORM

PROPOSAL TO

GROUNDWATER BANKING JOINT POWERS AUTHORITY (JPA)

_____

_____

PROJECT NO. XXXXX

Name of Bidder:_____

TO: BOARD OF DIRECTORS, JPA

Pursuant to and in compliance with your notice inviting sealed proposals (the "Bids") and the other documents relating thereto, the bidder, having familiarized himself with the terms of the Contract Documents, local conditions affecting the performance of the Work, and the cost of the Work at the place where the Work is to be done, hereby proposes and agrees to perform the Work within the Contract Time stipulated in the Agreement, including all of its component parts and everything required to be performed, and to provide and furnish any and all of the labor, material, tools, expendable equipment, and all utility and transportation services necessary to perform and complete in a workmanlike manner, all of the Work required by the Contract Documents, including Addenda, for the prices hereinafter set forth.

The bidder declares that the only persons or parties interested in this proposal as principals are those named herein; that this proposal is made without collusion with any person, firm, or corporation; and bidder proposes and agrees, if the proposal is accepted, that bidder will execute an Agreement with JPA in the form set forth in the Contract Documents and that bidder will accept in full payment thereof the prices submitted electronically on PlanetBids.

Signed this ____ day of _____, 20 __

_____
Name of Bidder

_____
Signature of Bidder

_____
Title of Signatory

STATEMENTS BY BIDDER

_____

_____

PROJECT NO. XXXXX

Bidder shall indicate opposite each item listed by JPA below the name of the manufacturer or supplier proposed to be used under the Agreement. Award of an Agreement under this proposal (bid) will not imply approval by JPA of a manufacturer or supplier listed by the bidder. However, if a manufacturer or supplier is acceptable to JPA, the successful bidder shall furnish the items from the manufacturer or supplier indicated. Any manufacturer or supplier listed in the Agreement may be substituted, changed, or omitted by the successful bidder, subject to the approval of JPA, without subjecting JPA to any liability for the substitution, change or omission.

The listing of any manufacturer or supplier in the Agreement does not, and is not intended to, grant any right, title, or interest in the Agreement for the benefit of the named manufacturer or supplier. Each bidder shall inform in writing each named manufacturer or supplier that the so named manufacturer or supplier is listed for information purposes only and they may be substituted, changed, or omitted by the successful bidder, subject to the approval of JPA, without subjecting JPA to any liability for the substitution, change or omission. The successful bidder shall reimburse JPA for any expenses incurred by JPA as a result of the successful bidder's failure to so notify each named manufacturer or supplier.

A. For each item listed by JPA below, the bidder intends to furnish materials supplied by the following manufacturers: (Bidder to list one manufacturer only for each item.)

Item	Manufacturer
Insert "None" if no items are going to be listed	

Signed this ____ day of _____, 20 __

_____
Name of Bidder

_____
Signature of Bidder

_____
Title of Signatory

CERTIFICATION OF BIDDER AND QUALIFICATIONS

_____
_____

PROJECT NO. XXXXX

The undersigned bidder certifies that bidder is, at the time of bidding, and shall be, throughout the period of the Contract, licensed by the State of California to do the type of work required under the terms of the Contract Documents. Bidder further certifies that bidder is skilled and regularly engaged in the general class and type of work called for in the Contract Documents.

The undersigned bidder certifies that it is not an ineligible contractor for the purposes of California Labor Code Section 1777.1 or 1777.7. The undersigned further certifies that no subcontractor to be used for the performance of the Work is an ineligible contractor for the purposes of Labor Code Section 1777.1 or 1777.7.

The bidder represents that bidder is competent, knowledgeable and has special skills regarding the nature, extent and inherent conditions of the Work to be performed. Bidder further acknowledges that there are certain peculiar and inherent conditions existent in the construction of the Work which may create, during the Work, unusual or peculiar unsafe conditions hazardous to persons and property.

Bidder expressly acknowledges that bidder is aware of such peculiar risks and that they have the skill and experience to foresee and to adopt protective measures to adequately and safely perform the Work with respect to such hazards.

Furthermore, Bidder hereby certifies to JPA that all representations, certifications, and statements made by Bidder, as set forth in this bid, are true and correct and are made under penalty of perjury.

Signed this ____ day of _____, 20 __

_____
Name of Bidder

_____
Signature of Bidder

_____
Title of Signatory

SAFETY PROGRAM CERTIFICATION

_____
_____

PROJECT NO. XXXXX

CONTRACTOR acknowledges that CONTRACTOR has read Section 01410 of Division 1 – General Requirements, Construction Safety Procedures.

CONTRACTOR certifies to JPA that CONTRACTOR's SAFETY PROGRAM includes the following elements:

Safety Policy
Incident Investigation Program
Safety Meeting Program
Statistical Injury and Illness Data
Safety Training Program and Records
Disciplinary Procedures
Safety Inspection Program
OSHA T1 Annual Trench Excavation Permit: Permit No. _____

Signed this ____ day of _____, 20 __

_____
Name of Bidder

_____
Signature of Bidder

_____
Title of Signatory

NON-COLLUSION DECLARATION

_____
_____

PROJECT NO. XXXXX

The undersigned declares:

I am the _____ of _____, the party making the foregoing bid.

The bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation. The bid is genuine and not collusive or sham. The bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid. The bidder has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or to refrain from bidding. The bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder. All statements contained in the bid are true. The bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, to any corporation, partnership, company association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid, and has not paid, and will not pay, any person or entity for such purpose.

Any person executing this declaration on behalf of a bidder that is a corporation, partnership, joint venture, limited liability company, limited liability partnership, or any other entity, hereby represents that he or she has full power to execute, and does execute, this declaration on behalf of the bidder.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct and that this declaration is executed on _____ [date], at _____ [city], _____ [state].

_____
Name of Bidder

_____
Signature of Bidder

_____
Title of Signatory

BID SECURITY DECLARATION

_____
_____

PROJECT NO. XXXXX

THIS PROPOSAL INCLUDES _____
(Insert the words "cash", "bidder's bond", “cashier’s check”, or "certified check", as the case may be) in an amount equal to at least ten percent (10%) of the total amount of the bid, payable in lawful money of the United States of America to the JPA.

Prior to bid opening, the Bid Security Declaration and the bid security must be received in a sealed envelope by mail or hand delivery to JPA at _____, Attention: _____.

The undersigned deposits the security in the form set forth above as a proposal guarantee and agrees that it shall be forfeited to JPA in case this is accepted by JPA and the undersigned fails to execute an Agreement with JPA as specified in the Contract Documents accompanied by the required payment and faithful performance bonds with sureties satisfactory to JPA, and accompanied by the required certificates of insurance coverage and endorsements. Should JPA be required to engage the services of an attorney(s) in connection with the enforcement of this Bid, bidder promises to pay all of JPA's reasonable attorneys' fees and costs incurred with or without suit. The bidder's liability to JPA for failure to do any of the foregoing shall not be limited to the amount of the deposited security in the form set forth above.

The names of all persons interested in the foregoing proposal as principals are as follows:

(NOTICE: If bidder or other interested person is a **corporation**, state legal name of corporation also names of the president, secretary, treasurer and manager thereof; if a **general partnership**, state true name of firm, also names of all individual partners and limited partners; if bidder or other interested person is an **individual**, state first and last names in full; if the bidder is a **joint venture**, state the complete name of each venture; if the bidder is a **limited liability company**, state the complete name of each manager and each member, and if the manager or member is a corporation, its president, secretary and treasurer, and state the complete name of the chief executive officer, if any, of the limited liability company).

_____

_____

_____

_____

_____

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we

_____

_____

as Principal, and _____ as Surety, are held and

firmly bound unto the

GROUNDWATER BANKING JOINT POWERS AUTHORITY (JPA)

hereinafter called JPA, in the penal sum of

_____

_____ Dollars ($_____),

lawful money of the United States of America, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, assigns, and successors, jointly and severally, firmly by these presents. The condition of this obligation is such that whereas the Principal has submitted a Bid for the construction of:

_____

_____

PROJECT NO. XXXXX

NOW THEREFORE, if the Principal shall not withdraw said Bid within the period of time set forth in the Contract Documents, and shall within fifteen (15) calendar days after the prescribed forms are presented to the Principal for signature enter into a written contract with JPA in accordance with the Bid as accepted, and if the Principal shall give the required bonds with good and sufficient sureties for the faithful performance and proper fulfillment of such contract, and for the protection of laborers and material men, or in the event of the withdrawal of the Bid within the period specified, or the failure to enter into the Agreement, and give such bonds within the time specified, if the Principal shall within sixty (60) days after request by JPA pay to JPA the difference between the amount specified in the Bid and the amount for which JPA may procure the required work, if the latter amount be in excess of the former, then the above obligation shall be void and of no effect, otherwise it shall remain in full force and virtue.

Forfeiture of this bond shall not preclude JPA from seeking any or all other remedies provided by law to cover losses sustained as a result of the Principal's failure to do any of the foregoing, and this bond shall not be a limitation on Principal's liability therefor.

It is further agreed that if JPA is required to initiate legal proceedings to recover on this bond, it may also recover its costs relating thereto including a reasonable amount for attorneys' fees incurred with or without suit.

IN WITNESS WHEREOF the above-bounded parties have executed this instrument this day of _____, 20___, the name and corporate seal for each corporate party being hereto affixed and these presents duly signed by its undersigned representative pursuant to authority of its governing body.

Two Witnesses (if individual)

_____

_____

_____
PRINCIPAL

By _____

Title _____

ATTEST: (if corporation, or limited liability company with officers)

_____

_____
Title

Corporate Seal

Attach acknowledgments of authorized representative of Principal.

Any claims under this bond may be addressed to:

_____ (name and address of Surety)

_____

_____

_____ (name and address of agent or representative in California, if different from above)

_____

_____

_____ (telephone number of Surety and agent of representative in California)

_____
SURETY

By _____

Title _____

ATTEST: (if corporation)

_____

_____
Title

Corporate Seal

Attach acknowledgments of authorized representatives of Surety.

AGREEMENT, BONDS, AND INSURANCE

Contents

AGREEMENT

THIS AGREEMENT, made and entered into by and between the GROUNDWATER BANKING JOINT POWERS AUTHORITY hereinafter referred to as "JPA" and _____ a corporation organized and existing under the laws of the State of _____; a partnership consisting of _____; a joint venture consisting of _____; a limited liability company consisting of _____; or an individual trading as _____; in the City of _____, County of _____, State of _____, hereinafter referred to as "CONTRACTOR".

WITNESSETH: That JPA and CONTRACTOR, for the consideration hereinafter named, agree as follows:

1. SCOPE OF WORK: CONTRACTOR will furnish all materials and will perform all of the work for the construction of:

(PROJECT NAME)
PROJECT NO. XXXXX (XXXX)

in accordance with the Contract Documents therefor.

2. CONTRACT TIME:

2.1 The work shall be substantially completed within one hundred eighty (180) calendar days from the date of the Notice of Award.

3. CONTRACT PRICE: JPA will pay CONTRACTOR in accordance with the prices shown in the bid form.

4. PAYMENTS: Monthly progress payments and the final payment will be made in accordance with the General Provisions. The filing of the notice of completion by JPA shall be preceded by final acceptance of the Work by JPA.

5. LIQUIDATED DAMAGES:

5.1 Liquidated Damages shall be assessed at the rate of $XXX.00 per calendar day, in accordance with the General Provisions.

6. COMPLIANCE WITH PUBLIC CONTRACTS LAW: JPA is a public agency in the State of California and is subject to provisions of law relating to public contracts. It is agreed that all applicable provisions of law related to public contracts are a part of this Agreement to the same extent as though set forth herein and will be complied with by CONTRACTOR.

7. CONTRACT DOCUMENTS: The complete contract includes all the contract documents set forth herein, to wit: Project Manual, Construction Manual, Plans, Addenda, and supplemental agreements.

IN WITNESS WHEREOF, this agreement is executed by the Executive / General Manager and the Secretary of JPA pursuant to Minutes of the meeting of the Board of Directors held on _____, authorizing the same, and CONTRACTOR has caused this agreement to be executed.

Dated: _____

GROUNDWATER BANKING
JOINT POWERS AUTHORITY
Owner

By _____
General Manager

ATTEST: _____
Secretary to the Board

(SEAL)

Dated: _____

_____
Contractor

By _____

APPROVED:

Title _____

_____
Attorney for JPA

(SEAL)

CORPORATE CERTIFICATE

I, _____, certify that I am the _____

Secretary of _____, a _____corporation;

That said corporation executed the foregoing Agreement as *(check only one):*

☐ CONTRACTOR,

☐ venturer of the joint venture named as CONTRACTOR in the foregoing Agreement,

☐ partner of the partnership named as CONTRACTOR in the foregoing Agreement,

☐ manager or member of the limited liability company named as CONTRACTOR in the foregoing Agreement;

that _____, who signed said agreement on behalf of CONTRACTOR was then _____ of said corporation; and that said corporation is in good standing; and that said contract was duly signed for and in behalf of CONTRACTOR by said corporation by express authority of its governing body and is within the scope of its corporate powers; and that if CONTRACTOR is a joint venture, partnership or limited liability company that includes said corporation, said corporation is CONTRACTOR's duly authorized signatory.

By _____

Bond No._____

Premium $_____

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: THAT

WHEREAS, THE Board of Directors of the

GROUNDWATER BANKING JOINT POWERS AUTHORITY

by Minute Order at the meeting held the ___ day of _____, 20__, has awarded to

_____ hereinafter designed as the "Principal", a contract for the construction of:

(PROJECT NAME)
PROJECT NO. XXXX (XXXX)

WHEREAS, said Principal is required under the terms of the Contract to furnish a bond for the faithful performance of the Contract,

NOW, THEREFORE, we the Principal and

_____

as Surety, and held firmly bound unto the

GROUNDWATER BANKING JOINT POWERS AUTHORITY

hereinafter called the "Obligee", in the penal sum of _____

_____

_____Dollars ($_____), lawful money of the United States of America, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, and firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that if the above-bounded Principal, his or its heirs, executors, administrators, successors, or assigns shall in all things stand to and abide by, and well and truly keep and perform the covenants, conditions, and agreements in the Contract and any alteration thereof made as therein provided, on his or their part to be kept and performed at the time and in the manner therein specified, and in all respects according to their true intent and meaning, and shall indemnify and save harmless the Obligee, the Obligee's Representative, the

Engineer/Architect and their consultants and each of their officers, directors, agents and employees, as therein stipulated, this obligation shall become null and void, otherwise, it shall be and remain in full force and virtue inclusive of the entire Contract guarantee period. And the said Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the Contract, or to the Work to be performed thereunder, or the plans or specifications accompanying the same, shall in any way affect its obligation on this bond, and it does hereby waive notice by JPA of any such change, extension of time, alteration or addition to the terms of the Contract, or to the work or to the plans or specifications. Principal and Surety agree that if Obligee is required to engage the services of an attorney(s) in connection with the enforcement of this bond, each shall also pay Obligee's reasonable attorneys' fees incurred with or without suit.

IN WITNESS WHEREOF, three counterparts of this instrument, each of which shall for all purposed be deemed an original hereof, have been duly executed by the Principal and Surety above named, on the ___ day of _____ 20___.

APPROVED:

_____
Principal
By _____

_____ Title _____
(Attorney for the JPA)

Any Claims under this bond may be addressed to:

_____ (Name and address of Surety)

_____

_____

_____ (Name and Address of Agent or Representative in California,
_____ if different from above)

_____

_____ (Telephone Number of Surety and Agent or Representative in
_____ California)

_____
Surety

(Attach Acknowledgment) By_____

Title _____

NOTICE: No substitution or revision to this bond form will be accepted. Sureties must be admitted and authorized to do business in and have an agent for service of process in California. A certified copy of Power of Attorney must be attached.

PAYMENT BOND

We,_____

as Principal, and _____

as Surety, jointly and severally, bind ourselves, our heirs, representatives, successors and assigns, as set forth herein, to the Joint Powers Authority (herein called Owner) for payment of the penal of sum of _____ Dollars ($_____), lawful money of the United States of America. Owner has awarded Principal a contract for the construction of:

(PROJECT NAME
PROJECT NO. XXXXX (XXXX)

If Principal or any of his subcontractors fails to pay any of the persons named in Section 3181 of the California Civil Code, or amounts due under the California Unemployment Insurance Code with respect to work or labor performed under the Contract or during the one-year guarantee period, or for any amounts required to be deducted, withheld, and paid over to the Employment Development Department Franchise Tax Board from wages of employees of the Contractor and his subcontractors pursuant to Section 13020 of the California Unemployment Insurance Code, with respect to such work and labor, then Surety will pay the same in an amount not exceeding the sum specified above, and also will pay, in case suit is brought upon this bond, such reasonable attorney's fees as shall be fixed by the court.

This bond shall inure to the benefit of any of the persons named in Section 3181 of the California Civil Code, so as to give a right of action to them or their assigns in any suit brought upon this bond.

Surety agrees that no change, extension of time, alteration, or addition to the terms of the Contract, or the work to be performed thereunder, or the plans and specifications shall in any way affect its obligation on this bond, and it does hereby waive notice by JPA thereof.

Principal and Surety agree that should Owner become a party to any action on this bond that each will also pay Owner reasonable attorneys' fees incurred therein in addition to the sum above set forth.

Executed in three original counterparts on

_____, 20___.

_____
Principal

(Seal of Corporation)

By _____

Title _____

Any claims under this bond may be addressed to:

_____ (Name and Address of Surety)

_____

_____

_____ (Name and Address of Agent or Representative in California, if different from above)

_____

_____

_____ (Telephone Number of Surety's Agent in California)

(Attach Acknowledgment)

_____
Surety

By _____
Attorney-in-Fact

APPROVED:

_____
Attorney for JPA

NOTICE: No substitution or revision to this bond form will be accepted. Sureties must be admitted and authorized to do business in and have an agent for service of process in California. Certified copy of Power of Attorney must be attached.

CONTRACTOR'S CERTIFICATE
REGARDING WORKER'S COMPENSATION

Description of Contract:

(PROJECT NAME
PROJECT NO. XXXXX (XXXX)

California Labor Code Section 3700 provides:

> "Every employer, except the state shall secure the payment of compensation in one or more of the following ways:
>
> (a) By being insured against liability to pay compensation in one or more insurers duly authorized to write compensation insurance in this state.
>
> (b) By securing from the Director of Industrial Relations a certificate of consent to self-insure, which may be given upon furnishing proof satisfactory to the Director of Industrial Relations of ability to self-insure and to pay any compensation that may become due to his employees...."

I am aware of the provisions of Section 3700 of the California Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of the Labor Code, and I will comply with such provisions before commencing the performance of any and all work required under the terms and conditions of this Contract.

Dated: _____, 20___ _____
Contractor

By _____

_____

(SEAL)

(In accordance with Article 5 commencing at Section 1860, Chapter 1, Division 2, Part 7, of the California Labor Code, the above certificate must be signed and filed with the JPA (the awarding body) prior to performing any work under this contract.)

SECTION 0

SPECIAL PROVISIONS

(PROJECT NAME)

PROJECT NO. XXXXX (XXXX)

SECTION 0
SPECIAL PROVISIONS

Table of Contents

SECTION 00100

BID MODIFICATIONS

1.01 BASIS FOR DETERMINING LOWEST RESPONSIBLE BIDDER

See Paragraph 3.1.4 of Instructions to Bidders.

1.02 BIDDING ON SUBSTITUTE ITEMS

See language in Instruction to Bidders IB 1.7

1.03 TIME ALLOWED FOR ACCEPTANCE OF BIDS

See Instructions to Bidders IB 3.1.2.

END OF SECTION

SECTION 00110

DEFINITIONS

1.01 DEFINITIONS

Owner Groundwater Banking Joint Powers Authority (JPA)

Engineer

(*Any other agencies involved*)

END OF SECTION

SECTION 00200

THE WORK

1.01 GENERAL

The work to be done by the Contractor under these Specifications shall consist of performing all operations necessary for the construction of the (*Project Name*) at the locations, in the positions, to the elevations and dimensions and conforming to the design shown on the plans and in accordance with these specifications.

The Contractor shall furnish all transportation, materials (except where stipulated otherwise), equipment, labor, and supplies to complete installation of the (*Project Name*) together with all appurtenant work necessary or incidental to complete in a workmanlike manner the improvements as contemplated and as intended by the plans and these specifications.

1.02 LOCATION OF PROJECT SITE

The project site is located in Sections X & X, Township XX South, Range XX East and is (*description of project location relative to known landmarks, highways, roads, etc.*).

1.03 DESCRIPTION OF THE WORK

(*General Description of project as a whole and major components*)

1.04 ORDER OF WORK

Contractor will be responsible for complying with the Environmental Commitments included in these specifications. The Contractor shall submit a construction schedule within fifteen (15) calendar days of the date of the Notice to Proceed from the JPA. The schedule shall outline the various phases of work, estimate the dates of commencement and completion for each phase.

1.05 WORK BY OTHERS

The CONTRACTOR shall coordinate work with the JPA or the JPA'S Representative at all times. Work by others may be taking place in the project vicinity by (*list other possible agency's that may be working in the vicinity*) and the CONTRACTOR shall not interfere with their activities or maintenance operations.

1.06 WORKING HOURS AND HOLIDAYS

Normal working hours are from 7:00 am to 3:30 pm, Monday through Friday, excluding holidays. JPA inspection hours are from 7:00 a.m. to 3:30 p.m., Monday through Friday. No work shall be performed on Saturdays, Sundays, or JPA holidays. See appendix for list of JPA holidays. In instances where contract time extends past the year's list of JPA holidays, regularly observed holidays shall be followed.

The Contractor shall be responsible for all costs associated with inspection services outside JPA inspection hours at the rate of $150.00 per hour.

1.07 OBSTRUCTIONS AND COORDINATION WITH OTHER WORK

At least forty-eight (48) hours prior to construction and prior to any operations involving existing JPA or RRBWSD facilities, the Contractor shall notify the JPA's Representative.

Prior to construction, the Contractor shall expose all known utility crossings in order to provide for grade and alignment adjustments, if necessary.

END OF SECTION

SECTION 00210

INVESTIGATIONS AND REPORTS

1.01 INVESTIGATIONS AND REPORTS

A. The following investigations and reports are included herewith in Appendix:

1. (*List investigations and reports*)

B. The following investigations and reports are available at JPA for review:

1. (*List investigations and reports*)

END OF SECTION

SECTION 00220

LANDS AND RIGHTS-OF-WAY

1.01 LANDS AND RIGHTS-OF-WAY

See General Provisions GP 5.4.

END OF SECTION

SECTION 00300

CONTRACTOR'S INSURANCE

1.01 GENERAL

A. Contractor's insurance coverage shall be as specified in the General Provisions, shall provide the following amounts of coverage, shall include additional insureds, and shall include additional information as set forth below.

1.02 COMMERCIAL GENERAL LIABILITY INSURANCE

A. Bodily injury and property damage coverage shall be for not less than one million dollars ($1,000,000) for each occurrence and for not less than three million dollars ($3,000,000) per project aggregate.

B. Products/Completed Operations coverage shall be for not less than three million dollars ($3,000,000) aggregate.

1.03 AUTOMOBILE LIABILITY

A. Contractor shall carry and maintain a business automobile policy or equivalent coverage for bodily injury and property damage on all owned, non-owned and hired automobiles or other licensed highway vehicles used in the performance of the Contract. The limit shall be for not less than two million ($2,000,000) for each accident.

1.04 WORKER'S COMPENSATION INSURANCE AND EMPLOYER'S LIABILITY INSURANCE

A. Worker's Compensation Insurance coverage shall comply with statutory limits.

B. Employer's Liability Insurance shall be for not less than:

$1,000,000 Each Accident
$1,000,000 Each Disease – Policy Limit
$1,000,000 Each Disease – Each Employee

C. State Compensation Insurance Fund: Notwithstanding the requirements of General Provisions Section 4.2, JPA will accept Workers Compensation Insurance from the State Compensation Fund (State Fund) that is not rated and that is evidenced on the State Fund's certificate form. Except as provided above with respect to State Fund, all other insurance shall comply with all requirements of the General and Special Provisions.

1.05 ADDITIONAL INSUREDS

A. Commercial General Liability Insurance shall include as additional insureds: JPA, (List all other applicable) _____

_____

1.06 ADDITIONAL INFORMATION

A. Certificates of Insurance shall:

1. List all Endorsement forms that are part of said policy.
2. List all entities required to be named as additional insureds.
3. Include a statement that no less than 30 days written notice will be provided by certified mail to the JPA prior to any material change or cancellation of said policy.

END OF SECTION

SECTION 00400

SHOP DRAWINGS

1.01 SHOP DRAWING SUBMITTALS

A. Shop drawings shall be submitted in accordance with Article 9 of the General Provisions and Section 01210 of the General Requirements.

END OF SECTION

SECTION 00500

CONSTRUCTION SCHEDULE

1.01 CONSTRUCTION SCHEDULE

A. The Contractor shall submit a construction progress schedule in compliance with Article 10 of the General Provisions. The schedule shall be a Gantt Chart, and shall show the various parts of the work in sufficient detail so as to identify the beginning and end of each of the various construction activities. The schedule shall include the following at the minimum:

Submittal milestones
All construction activities
Equipment/material procurement and deliveries
Permit imposed work times
Partial, substantial, and final completion milestones
Critical path activities

1.02 SCHEDULE CONSTRAINTS

A. No construction activities shall be allowed at the project site prior to receiving the Notice to Proceed, including any mobilization activities.

B. (List any other constraints)

END OF SECTION

SECTION 00500A

CONSTRUCTION SCHEDULE

1.01 CONSTRUCTION SCHEDULE

A. CONTRACTOR shall submit a construction progress schedule in compliance with Article 10 of the General Provisions. The schedule shall show the various parts of the work in detail so as to identify the beginning and end of each of the various construction activities. The schedule shall include the following at the minimum:

Submittal milestones
All construction activities
Equipment/material procurement and deliveries
Permit imposed work times
Partial, substantial, and final completion milestones
Critical path activities

B. Within ten (10) days after Notice of Award, JPA will schedule and conduct a Preconstruction Scheduling Conference to commence development of the required project schedule. At this meeting, scheduling requirements will be reviewed with CONTRACTOR. CONTRACTOR shall be prepared to review and discuss methodology for the schedule and sequence of operations plus cost and manpower loading methodology.

C. CONTRACTOR shall submit Construction Schedule to JPA for review within thirty (30) days after Notice of Award. CONTRACTOR's Construction Schedule shall be comprised of a detailed Network Diagram as described in Paragraph F. All on site construction activities shall be cost loaded. The cost value of all on site construction activities shall equal the Contract value.

D. Time extensions shall not be granted nor delay damages paid until a delay occurs which is beyond the control and without the fault or negligence of CONTRACTOR and its SUBCONTRACTORS or SUPPLIERS, at any tier and which extends actual performance of the work beyond the current Contract Completion Date. If the delay occurs along a path which the current approved Construction Schedule update projects late completion prior to addition of any JPA caused delay, then the time extension allowed will be only for the additional delay demonstrated by the approved Time Impact Analysis. Time extensions shall be granted only if they are clearly demonstrated by CONTRACTOR through the submittal of a Time Impact Analysis which demonstrates the estimated impact on the end date of the work; is based upon the updated Construction Schedule current as of the month the delay occurred; and demonstrates that the delay cannot be mitigated, offset, or eliminated through such actions as revising the intended sequence of work or other means. Since float time within the Construction Schedule is jointly owned, it is acknowledged that JPA caused delays on the project may be offset by JPA caused time savings (*e.g.* critical path submittals returned in less time than allowed by the Contract, approval of substitution requests which result in a savings of time to CONTRACTOR). In such an event, CONTRACTOR shall not be entitled to receive a time extension or delay damages until all JPA caused time savings are exceeded and the Contract completion date is also exceeded.

E. Upon JPA's request, CONTRACTOR shall participate in the review of CONTRACTOR's Construction Schedule submissions (including the original

material, all update submittals, and any resubmittals). All revisions shall be submitted within fifteen (15) calendar days after JPA's review.

F. The Detailed Network Diagram shall provide a workable plan for performing the work, establish and clearly display the critical elements of the work, forecast completions of the construction, and match the Contract duration in time. Exclusive of those activities for submittal review and material fabrication and delivery, activity durations shall not be less than one (1) nor more than thirty (30) calendar days, unless otherwise approved by JPA. In addition to the detailed network diagram, CONTRACTOR shall submit the following reports with the original submittal:

1. Predecessor/ Successor Report or a list showing the predecessor activities and successor activities for each activity in the schedule sorted by Early Start.
2. Activity Report sorted by activity number or a list showing each activity in the schedule.

G. An updated Construction Schedule shall be submitted to JPA with the submittal of CONTRACTOR's monthly payment request. For those activities started but not yet completed at the time of submittal, the updated schedule shall reflect the percentage complete, as agreed between CONTRACTOR and JPA, and an estimate of the remaining duration. The monthly update of the construction schedule shall include a copy of the following:

1. A bar chart diagram showing target versus actual dates for each activity remaining to be completed.
2. The Predecessor/Successor report sorted by Early Start.
3. The Activity Report sorted by activity number.
4. The updated network diagram or the data necessary to produce such a diagram on computer diskette(s), as agreed with JPA.

H. Upon approval of a change order or issuance of a notice to proceed with a change, the approved change shall be reflected in the next schedule update submittal by CONTRACTOR.

I. If completion of any part of the work, the delivery of equipment or materials, or submittal of CONTRACTOR submittals is behind the updated Construction Schedule, and will impact the end date of the work past the contract completion date, CONTRACTOR shall submit in writing, a recovery plan acceptable to JPA for completing the work by the current Contract completion date, if requested by JPA.

1.02 SCHEDULE CONSTRAINTS

A. None at this time.

END OF SECTION

SECTION 00600

PERMITS

1.01 PERMITS OBTAINED BY JPA

A. The JPA has obtained or applied for and not yet received the following permits required to construct the project. Proper notification to the agencies affected is the responsibility of the Contractor. The Contractor shall conform to the requirements of the permits and all costs therefor shall be included in the contract prices bid for the items involved. Copies or sample copies of these permits are included in the Appendix of these specifications.

1. The JPA will have submitted a Notice of Intent to Discharge, along with appurtenant fee, under the Construction Activities Storm Water General Permit (99- 08-DWQ). Under this permit the Contractor must prepare and submit Storm Water Pollution Prevent Plan per Section 01120 of the General Requirements.

1.02 PERMITS TO BE OBTAINED BY CONTRACTOR

A. Prepare and comply with a Storm Water Pollution Prevention Plan (SWPPP).

B. Prepare and comply with a San Joaquin Valley Air Pollution Control District Dust Control Plan.

C. (*List all other applicable permits*)

1.03 PERMIT-REQUIRED INSPECTION COSTS

CONTRACTOR shall pay the cost of inspection by Permit Issuer for work that is required by permit conditions to be performed on weekends or outside normal working hours. See individual permits for information on weekend work.

END OF SECTION

SECTION 00700

CONNECTIONS TO EXISTING SERVICES

1.01 COSTS OF CONNECTION TO EXISTING SERVICES

General Provisions Article GP 6.24 calls for Contractor to make connections to existing services at no additional expense to JPA.

END OF SECTION

SECTION 00800

SPECIAL STORAGE REQUIREMENTS

1.01 SPECIAL STORAGE REQUIREMENTS

General Provisions Article GP 7.10.2 indicates special methods may be required for storing excavated materials and materials and equipment in general.

END OF SECTION

GENERAL REQUIREMENTS

SECTION 1

(PROJECT NAME)

PROJECT NO. XXXXX (XXXX)

SECTION 1
GENERAL REQUIREMENTS

Table of Contents

SECTION 01000

INITIAL SUBMITTAL REQUIREMENTS

1.01 SUBMITTALS:

A. Initial Submittals shall be made in accordance with General Provisions Article GP 2.

B. Shop drawings shall be submitted in accordance with Article 9 of the General Provisions.

C. Shop drawings related to instrumentation shall be submitted with two (2) additional copies. (i.e. 10 sets instead of 8 sets of drawings.)

   a. Section 9.1.3 of Article 9 of the General Provisions shall be modified to reflect that the JPA will return three (3) sets of shop drawings with comments.

   b. If the CONTRACTOR desires more than three (3) sets of shop drawings, then the number of drawings shall be incremented by the number of additional shop drawings desired. For example, if the CONTRACTOR would like to have four (4) copies returned, then his initial submittal shall have nine (9) sets rather than the specified eight (8) sets.

1.02 SHOP DRAWING TRANSMITTAL FORM:

A. The Shop Drawing Submittal Form, a copy of which is included in the appendix, shall accompany all shop drawing submittals. Submittals shall be returned "unreviewed" if not accompanied by a submittal form or if the form is not completed in full.

1.03 REVISION OR RESUBMITTAL OF SHOP DRAWINGS:

A. Please insert the following revision to the wording at the lower portion of Section 9.2.5 after this sentence:

   CONTRACTOR shall make corrections required by the GROUNDWATER BANKING JOINT POWERS AUTHORITY (JPA), and shall return the required number of corrected copies of Shop Drawings and submit new samples as required for review and approval. Corrected Shop Drawings shall retain the number assigned to it upon the first submittal and shall be given an R (for revision) and the number of revision of that Shop Drawing. For example: Submittal No. 15-R1 (Submittal No. 15, Revision 1). CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by the JPA on previous submittals.

END OF SECTION

SECTION 01100

CONSTRUCTION SURVEY STAKING

1.01 SURVEY STAKING FOR CLEARING LANDS AND RIGHTS-OF-WAY:

A. JPA shall provide field markers along both sides of the construction right-of-way (except where a side is contiguous with an improved road, street, or property) at horizontal curve BCs and ECs, at angle points, and at 100-foot-maximum intervals in horizontal curves and 500-foot-maximum intervals along horizontal tangent runs.

B. Markers will be wooden laths in open terrain and painted marks on structures and pavements.

1.02 SURVEY STAKING FOR CONSTRUCTING PIPELINES

A. For use in constructing pipelines, construction stakes and grade sheets shall be provided by JPA as follows based upon the CONTRACTOR'S pipeline installation drawings:

B. For pipelines not installed in tunnels or casings, one stake will be set at 50-foot intervals , for water lines, 25-foot intervals for sewer lines, and at all angle points and grade breaks. One additional reference stake and/or witness lath will be provided for each pipeline appurtenance. Stakes will be set at the surface of the ground or painted on the paved surface of the ground or painted on the paved surface along a mutually acceptable offset to the centerline of the pipeline. The offset shall be constant both as to side and distance from centerline for runs of not less than 2,000 feet where physically practicable with the provided easements. Station, offset, and cut/fill to flow line will appear on these stakes. The elevation of each point and the cut/fill to the pipe invert will be given on grade sheets. The Contractor shall exercise care in determining what offset is to be used, if sloping of the trench is anticipated. In no instance will the JPA'S Representative stake safety sloping. It shall be the CONTRACTOR'S responsibility to accurately transfer the line and grade for the facility to the trench bottom. Pavement scoring, cutting, and removal shall be accomplished from this same set of construction stakes. No additional stakes will be set for such purpose.

C. For pipe inside tunnels, two benchmarks and principal control monuments shall be provided for line and grade inside the tunnel or casing. The exact location of these benchmarks and monuments will be dictated by conditions at the site.

1.03 SURVEY STAKING FOR CONSTRUCTING STRUCTURES AND APPURTENANCES

A. JPA shall provide survey staking and reference points.

B. Major structures will be controlled by two lines set at right angles to each other, along two faces of the structure, the ends of each line to be beyond the limits of the work, and with elevations only marked on at least two of these control points.

C. Minor structures, manways, and appurtenances will have a stake set along the pipeline construction offset, with the respective pipeline station for its centerline shown.

D. Stakes will be provided after site rough grading has been completed.

1.04 SURVEY STAKING FOR CONSTRUCTING JACKING PITS AND RECEIVING PITS

A. The Contractor shall submit to the JPA'S Representative a separate diagram for each jacking and receiving pit showing the desired control and offset. No more than six (6) stakes will be set for each such pit. Grade sheets (with diagram) will show the stake elevations and the pipeline elevations calculated from the elevations and grades shown on the construction drawings.

B. JPA shall provide survey staking and reference points.

1.05 CONSTRUCTION STAKING PROVIDED BY THE JPA SHALL BE SUBJECT TO THE FOLLOWING CONDITIONS

A. The request for construction stakes shall be received in writing at least three (3) working days in advance of needed staking on the form provided in the Appendix.

B. The stakes, reference markers, and other survey points shall be carefully preserved. Otherwise, the Contractor will be charged for their replacement and will assume any expense resulting from their loss or disturbance. Should the JPA'S Representative be required to reset construction stakes, the cost for such resetting will be at the then current per diem rates. The full charges will include additional administrative and supervisory time charges as billed to the JPA and will be deducted by the JPA from the progress payments to the Contractor for the month in which the surveying work is done, and thereon paid to the JPA'S Representative.

C. Unless otherwise specified, the construction staking provided by the JPA'S Representative will be only for those items specified to be constructed or reconstructed on the plans or in the specifications. Any additional construction stakes required for the replacement of existing improvements that have been

removed or disturbed at the CONTRACTOR'S option shall be the CONTRACTOR'S responsibility.

1.06 COMMENCEMENT OF WORK

A. Work shall not proceed until construction stakes, which constitute instructions from the JPA'S representative, are provided.

END OF SECTION

SECTION 01110

COMPACTION TESTING

1.01 REQUIREMENTS

A. The JPA shall perform all compaction tests on backfill.

B. The request for compaction testing shall be made to the JPA in writing at least forty-eight (48) hours before the Contractor is ready for compaction tests to be taken.

C. The Contractor shall make available construction equipment necessary to assist the JPA'S Representative in taking the tests.

D. If the backfill should fail the compaction test, the Contractor shall pay the cost of retesting.

E. If the Contractor is not ready to have compaction tests taken at the time and in the locations indicated on the written request, the Contractor shall be responsible for all standby charges and/or return visit costs to take the requested tests.

F. If the Contractor plans to use imported sand or other imported material for backfill, a sample of the material to be used for the backfill shall be delivered to the JPA for testing, prior to the commencement of backfilling. If the test fails, the Contractor shall pay the cost of retesting.

END OF SECTION

SECTION 01120

EROSION CONTROL

1.01 REQUIREMENTS

A. The Contractor shall employ methods and approved devices for the control of erosion within the project construction area during the contract period.

B. All work shall be in accordance with the grading code of Kern County and any special requirements of the California Regional Water Quality Control Board, Central Valley Region.

.

C. Erosion Control Plans are required from October 15 to May 15, and shall be submitted to the JPA for approval prior to September 25. If plans are not submitted by September 25, or within 21 days from Notice of Award for projects that commence work after September 25, JPA will withhold 30 percent of progress payment amount until plans are submitted and approved.

D. Loose excavated material shall not be placed or stored in waterways or storm drain channels.

E. All excess excavated soil and materials shall be removed and disposed of in a proper and legal manner by the Contractor.

F. All disturbed surface areas shall be shaped to facilitate drainage and avoid ponding and restored to near natural or preconstruction conditions. Work under this section shall also extend to include those erosion control measures indicated on the plans.

G. In the event that erosion control repairs or corrections are required, if CONTRACTOR does not initiate erosion control repair or corrective action within four (4) hours of notification by JPA, JPA may take action it deems necessary to prevent erosion. CONTRACTOR shall be responsible for all costs of repairs performed by JPA.

END OF SECTION

SECTION 01130

DEWATERING

1.01 GENERAL

A. No excavation shall take place below the water level until the area has been dewatered. Dewatering shall be done in such a manner as to protect adjacent structures.

B. Dewatering shall consist of furnishing all permits, plans, labor, equipment and materials, and performing all work to design, construct, and operate dewatering systems, dispose of the water from the operation and maintain in a safe and dewatered condition the areas on which the construction work will be performed, and remove the dewatering system upon completion of the work. If CONTRACTOR is unable to obtain a permit with a project specific monitoring and reporting program in a timely manner from the Regional Water Quality Control Board, CONTRACTOR may request and on approval be allowed to perform dewatering under JPA dewatering permit and monitoring and reporting program.

C. Dewatering systems shall be equipped with meters that register in gallons in order to measure dewatering volumes.

1.02 DEWATERING PLAN

A. CONTRACTOR shall submit for the JPA'S review, drawings and data showing proposed plan for dewatering of all work areas, which shall include the planned method of dewatering, excavation plan, location and capacity of such facilities as dewatering wells, well points, pumps, sumps, collection and discharge lines, standby units proposed, receiving streams, and protective fills and ditches required for control of ground-water and surface water. The plan for dewatering shall be submitted within fifteen (15) days after the date of receipt of the Notice to Proceed. CONTRACTOR shall furnish such other information as may be required for the complete under-standing and analysis of the dewatering and excavation plan by JPA. Information on groundwater conditions may be found in the Soil Investigation Reports listed in Section 00210, Investigations and Reports of the Special Provisions. CONTRACTOR is advised that the reports present conditions which existed at the time of the investigation.

B. Review by JPA will not relieve CONTRACTOR of the responsibility for the adequacy of the dewatering and excavation plan, compliance with dewatering permit requirements or for furnishing all equipment, labor, and materials necessary for performing the various parts of the work. If, during the progress of the work, it is determined by JPA that the dewatering system and excavation plan are inadequate, not in compliance with discharge requirements, or

CONTRACTOR'S plan of construction is inoperative, CONTRACTOR shall, at CONTRACTOR'S expense, furnish, install, and operate such additional dewatering equipment and make such changes in other features of the plan or operation as may be necessary to perform the work in a manner satisfactory to the JPA. CONTRACTOR shall, at CONTRACTOR'S expense, pay any fines or penalties assessed against CONTRACTOR, JPA, Owner, ENGINEER, or their affiliates by the Regional Water Quality Control Board and other applicable agencies as a result of noncompliance with dewatering discharge requirements under CONTRACTOR'S or JPA'S permit (whichever permit CONTRACTOR is performing dewatering under). In addition, CONTRACTOR shall be subject to, at JPA's discretion, a fee by JPA as compensation for JPA administrative costs associated with each non-compliance occurrence. The fee shall be in an amount to pay JPA's actual costs, or $2,000, whichever is greater.

1.03 DEWATERING REPORTING

CONTRACTOR shall comply with all permit and monitoring and reporting requirements for the permit under which CONTRACTOR is operating. Specifically, CONTRACTOR shall:

A. Prepare a report which shall include the following:
   1. Characterization of the proposed wastewater discharge
   2. The estimated average and maximum daily flow rates
   3. A schedule detailing the frequency and duration of the planned discharge(s)
   4. The affected receiving water(s)
   5. A description of the proposed treatment system (if appropriate)
   6. A map showing the path from the point of initial discharge to the ultimate location of the discharge

B. Submit report from Paragraph A to: (1) the RWQCB and copy JPA five (5) days prior to the planned discharge if CONTRACTOR is operating under CONTRACTOR'S permit, or (2) JPA for submittal to the RWQCB ten (10) days prior to the planned discharge if CONTRACTOR is operating under JPA's permit.

C. Not commence work until receiving written acknowledgement on the information provided to JPA from paragraph A.

D. CONTRACTOR shall be responsible for conducting monitoring required under the permit and any additional monitoring requested by the RWQCB. All monitoring and report preparation shall be conducted as specified in the permit under which dewatering is occurring. If CONTRACTOR is operating under the JPA permit, reports shall be forwarded to JPA by the 20th of the month for submittal by JPA to the RWQCB. This report shall include a cover letter noting any violations and stating what action was taken to correct these violations. If CONTRACTOR is operating under CONTRACTOR'S

permit, copies of reports that CONTRACTOR submits to the RWQCB shall be provided to JPA.

END OF SECTION

SECTION 01200

REQUESTS FOR INFORMATION (RFI)

1.01 GENERAL

A. CONTRACTOR shall submit a Request for Instruction (RFI) to JPA if CONTRACTOR:

1. requires instruction pursuant to General Provision Article 6.15, Errors or Discrepancies Noted by CONTRACTOR,

2. raises a question requiring clarification,

3. requests product or material changes,

4. requests design changes, or

5. requires other information from JPA.

1.02 RFI SUBMITTAL PROCEDURE

All RFIs shall be submitted on JPA Forms and shall include all backup information. Backup information shall include, but not be limited to, CONTRACTOR verified field measurements, quantities, dimensions, installation requirements, materials, catalog number, and any other information that will assist the JPA in reviewing the RFI. A copy of RFI form can be found in Appendix.

1.03 JPA RESPONSE

Within seven (7) days of receipt of RFI, JPA will either return a response to the RFI or notify CONTRACTOR when a response will be issued.

1.04 COMMENCEMENT OF RFI-RELATED WORK

No portion of the work requiring instruction from JPA shall begin until RFI has been reviewed by JPA and returned to CONTRACTOR with instruction or with notation indicating JPA response is not necessary.

END OF SECTION

SECTION 01300

TRAFFIC REGULATION

1.01 GENERAL

A. Traffic shall be maintained at those locations indicated and in conformance with the plans and specifications.

B. Furnish, construct, maintain, and remove detours, road closures, lights, signs, barricades, fences, flares, miscellaneous traffic devices, flagmen, drainage facilities, paving, and such other items and services as are necessary to adequately safeguard the public from hazard and inconvenience. All such work shall comply with the ordinances, directives, permits, and regulations of authorities with jurisdiction over the public roads in which the construction takes place and over which detoured traffic is routed by the Contractor.

C. Prior to the start of construction operations, notification shall be given to the police and fire departments in whose jurisdiction the project lies, giving the expected starting date, completion date, and the name and telephone number of the responsible person who may be contacted at any hour in the event of a condition requiring immediate correction.

1.02 CONSTRUCTION SIGNING

A. Construction signing used for handling traffic and public convenience shall conform to the latest edition of the State of California, Department of Transportation, "Manual of Traffic Controls for Construction and Maintenance Work Zones" and "Work Area Traffic Control Hand-book" (WATCH) published by Buildings News Incorporated. In case of conflict between the two previously referenced manuals with regard to recommended sign spacing, the manual, which is more stringent, shall be used.

B. Signs shall be illuminated or reflectorized when they are used during hours of darkness. Cones, pylons, barricades, or posts used in the diversion of traffic shall be provided with flashers or other illumination if in place during hours of darkness.

C. A 24-hour emergency service shall be maintained to remove, install, relocate, and maintain warning devices. The names and telephone numbers of three persons responsible for this emergency service shall be furnished to the agency having jurisdiction over traffic control for the project. If any of these persons do not promptly respond or the jurisdictional agency deems it necessary to call out other forces to accomplish emergency service, the Contractor will be held responsible for the cost of such emergency service.

1.03 VEHICULAR TRAFFIC CONTROL

A. If necessary traffic control within the area along Stockdale Highway or Enos Lane shall conform to the ordinances and regulations of the California Department of Transportation (Caltrans) and the County of Kern Roads Departments.

B. The failure of the Contractor to maintain construction signing, delineators, or barricading at all times to the satisfaction of the California Department of Transportation (Caltrans) shall be sufficient cause for closing down the work until such equipment is in satisfactory condition. All costs associated with the stoppage of work, loss of production, costs of restart, etc., shall be borne by the Contractor.

C. A minimum 2-foot clearance between the curb face or edge of pavement, and a 5-foot clearance between the edge of excavation and the edge of any traffic lane shall be maintained at all times. Shoring members, beams, or other obstructions shall not be permitted within the 2-foot clearance between the edge of excavation and the edge of any traffic lane. Any projections or activity within 2 feet to 5 feet from the adjacent traffic lane must be protected by a solid concrete barrier (K-rail). "NO PARKING" signs shall be placed as necessary.

D. Work areas adjacent to the existing traffic lane shall be delineated in accordance with the requirements for the normal posted speed limit. The Contractor shall post signing, barricades, and delineators to provide clear guidance to traffic as approved by the jurisdictional agency having authority over traffic control.

1.04 PEDESTRIAN TRAFFIC CONTROL AND SAFETY

A. Fencing or other means of securement shall be provided to preclude unauthorized entry to any excavation during all nonworking hours on a 24-hour basis including weekends and holidays. Fencing shall be a minimum of 6 feet high around the entire excavation, and shall consist of a minimum 9-gage chain link type fence sturdy enough to prohibit toppling by children or adults. There shall be no openings under the wire large enough for any child to crawl through. Gates shall be locked if no adult is in attendance. Warning signs shall be placed at 50-foot centers on the outside of the fence with the statement "DEEP HOLE DANGER."

1.05 ACCESS TO ADJACENT PROPERTIES

A. Reasonable access from public streets to all adjacent properties shall be maintained at all times during construction. Prior to restricting normal access from public streets to adjacent properties, each property owner or responsible person shall be informed of the nature of the access restriction, the approximate duration of the restriction, and the best alternate access route for that particular property.

1.06 PERMANENT TRAFFIC CONTROL DEVICES

A. Existing permanent traffic control signs, barricades, and devices shall remain in effective operation unless a substitute operation is arranged for and approved as a portion of vehicular traffic control above. Replacement work shall be in accordance with the ordinances and regulations of the California Department of Transportation (Caltrans).

B. Restriping of Streets

Any permanent restriping that is required shall be done by the Contractor. The Contractor is cautioned to check with the California Department of Transportation (Caltrans) and County of Kern Roads Department to ascertain the extent and specifications for restriping. Full compensation for restriping within the right of way shall be included in the contract unit price for which such work is appurtenant thereto. Temporary striping required for traffic control during construction shall also be done by the Contractor with full compensation to be included in the contract unit price for which such work is appurtenant, and no additional allowance shall be given. Temporary striping includes any striping required on any pavement replaced prior to the final surface course. The Contractor shall remove any permanent striping that conflicts with the detour plan and all detour striping completely, prior to replacement of any final striping, by sandblasting only. Painting out existing striping shall not be permitted. Any damaged or obliterated raised pavement markers shall also be replaced in accordance with the appropriate standard with compensation for such work and materials included in the unit contract price for which such work is appurtenant.

C. Traffic Control Wire Loops

Traffic control wire loops which are cut, removed, or otherwise disturbed for construction of the pipeline shall be replaced to the exact original position. Replacement work shall be in accordance with Section 86-5.01A of the State of California, Department of Transportation, Standard Specifications. The number of turns in the loop shall be in accordance with the manufacturer's specifications for the vehicle detector.

Detector lead-in conductors, cable, inductive loop conductor, and epoxy shall conform to the provisions of Section 86 of the State of California, Department of Transportation, Standard Specifications. The cable shall not be spliced. Splices to lead-in conductors shall be made in pull boxes and soldered, wrapped, and waterproofed after sensitivity check at tuning turn on. Inductive loop wires shall be labeled in the pull box, identifying the loop and the direction of current flow. Saw cuts for inductive loop wire shall be of a width such that the loop wires will fit within the cut snugly but without need for forcing of the wire.

Damaged traffic signal conduits shall be replaced to the nearest pull box, including new wire, back to the terminal, and/or back to the signal controller to the satisfaction of the agency having jurisdiction over the equipment.

Damaged traffic loops or signal conduit shall be repaired before proceeding to the construction phase. Two traffic signal vehicle heads shall be visible at all times to vehicular traffic at signalized intersections during construction.

1.07 PAYMENT

Payment for conforming to all of the traffic control and pedestrian safety requirements of these specifications shall be considered to be included in the contract unit or lump-sum price paid for the various items of work wherein maintenance of traffic control and detours is required. No additional allowance will be given for maintenance of traffic control and detours.

END OF SECTION

SECTION 01400

PRECONSTRUCTION AND POST CONSTRUCTION CONFERENCES

1.01 PRECONSTRUCTION CONFERENCE

A. Upon issuance of Notice to Proceed, or earlier when mutually agreeable, JPA will arrange a preconstruction conference.

B. CONTRACTOR'S superintendent, JPA, Engineer/Architect representatives of utilities, major subcontractors and others involved in performance of the Work, and others necessary to agenda shall attend Preconstruction Conference.

C. JPA will preside at conference.

D. Purpose of Conference: To establish working understanding between parties and to discuss Construction Schedule, shop drawing and other submittals, cost breakdown of major lump sum items, processing of submittals and applications for payment, and other subjects pertinent to execution of the Work.

E. Agenda will include:

1. Adequacy of distribution of Contract Documents.

2. Distribution and discussion of list of major subcontractors and suppliers.

3. Proposed progress schedules and critical construction sequencing.

4. Major equipment deliveries and priorities.

5. Project coordination.

6. Permits and Permit Conditions.

7. Environmental (CEQA) Mitigation Requirements.

8. Designation of responsible personnel.

9. Procedures and Processing of:

   a. Field decisions

   b. Proposal requests

   c. Submittals
   d. Change Orders

e. Applications for Payment

f. Record Documents

10. Use of Premises:

a. Office, construction, and storage areas

b. JPA'S requirements

11. Construction facilities, controls, and construction aids

12. Coordination of construction with JPA operations and others

13. Temporary utilities

14. Safety and first aid procedures

15. Security procedures

16. Housekeeping procedures

F. JPA will record minutes of meeting and distribute copies of minutes within seven (7) days of meeting to participants and interested parties.

1.02 POST CONSTRUCTION MEETING

A. Meet with JPA and inspect the Work eleven (11) months after the date of recording by the County of the Notice of Completion of the Work.

B. Arrange meeting at least seven (7) days before meeting.

C. Meet in JPA'S office or other mutually agreed upon place.

D. Inspect the Work and draft list of items to be completed or corrected.

E. Review service and maintenance contracts, and take appropriate corrective action when necessary.

F. Complete or correct defective work and extend correction period accordingly.

G. Require attendance of Superintendent, appropriate manufacturers and installers of major units of constructions, and affected subcontractors.

END OF SECTION

SECTION 01410

CONSTRUCTION SAFETY PROCEDURES

1.01 GENERAL

A. CONTRACTOR shall assure that each employee is trained in the work practices necessary to safely perform his/her job.

B. CONTRACTOR shall assure that each employee is instructed in the known potential hazards related to his/her job and the process, and the applicable provisions of the emergency action plan for the plant or facility as covered during CONTRACTOR safety orientation.

C. CONTRACTOR shall document that each employee has received and understood the training required. The documentation shall contain the identity of the employee, the date of training, and the means used to verify that the employee understood the training. Documentation shall be submitted to JPA upon request.

D. CONTRACTOR shall advise JPA of any unique hazards presented by the CONTRACTOR'S work.

E. CONTRACTOR shall immediately notify JPA of any hazards found or discovered during the course of the work.

F. CONTRACTOR shall submit copy of OSHA T1 Annual Trench Excavation Permit upon request.

1.02 CONSTRUCTION SAFETY

A. CONTRACTOR shall submit a Construction Safety Plan detailing the methods and procedures for complying with California Labor Code Section 6401.7, Federal, and local health and safety laws, rules and requirements for the duration of the contract time. The plan shall include the following:

1. Identification of the Safety Officer (or Consultant), who will prepare, initiate, maintain and supervise safety programs, and procedures.

2. Procedures for providing workers with an awareness of safety and health hazards expected to be encountered in the course of construction.

3. Safety equipment appropriate to the safety and health hazards expected to be encountered during construction.

4. Methods for minimizing employees' exposure to safety and health hazards expected during construction.

5. Procedures for reporting safety or health hazards.

6. Procedures to follow to correct a recognized safety and health hazard.

7. Procedures for investigation of accidents, injuries, illnesses and unusual events that have occurred at the construction site.

8. Periodic and scheduled inspections of general work areas and specific workstations.

9. Training for employees and workers at the jobsite.

10. Methods of communication of safe working conditions, work practices and required personal protection equipment.

B. CONTRACTOR shall assume responsibility for every aspect of Health and Safety on the jobsite, including the health and safety of Subcontractors, suppliers, and other persons on the jobsite.

C. CONTRACTOR'S Safety Officer shall periodically review job safety information and reports and make recommendations concerning worker health and safety at the jobsite.

D. CONTRACTOR shall employ health and safety measures specified by the Safety Officer, as necessary, for workers in accordance with OSHA guidelines.

E. CONTRACTOR shall transmit to JPA copies of reports and other documents related to accidents or injuries encountered during construction.

1.03 SAFETY PROCEDURES

A. Accident Prevention:

1. Exercise precautions throughout construction for protection of persons and property.

2. Observe safety provisions of applicable Laws and Regulations.

3. Guard machinery and equipment, and eliminate other hazards.

4. Make reports required by authorities having jurisdiction, and permit safety inspections of the Work.

5. Before commencing construction Work, take necessary action to comply with provisions for safety and accident prevention.

B. Barricades:

1. Place barriers at ends of excavations and along excavations to warn pedestrian and vehicular traffic of excavations.

2. Provide barriers with flashing lights after dark.

3. Keep barriers in place until excavations are entirely backfilled and compacted.

4. Barricade excavations to prevent persons from entering excavated areas in streets, roadways, parking lots, treatment plants, or other public or private areas.

C. Warning Devices and Barricades: Adequately identify and guard hazardous areas and conditions by visual warming devices and, where necessary, physical barriers.

1. Devices shall conform to minimum requirements of OSHA and State agency which administers OSHA regulations where Project is located.

D. Hazards in Public Right-of-Way:

1. Mark at reasonable intervals, trenches and other continuous excavations in public right-of-way, running parallel to general flow of traffic, with traffic cones, barricades, or other suitable visual markers during daylight hours.

a. During hours of darkness, provide markers with torches, flashers, or other adequate lights.

2. At intersections or for pits and similar excavations, where traffic may reasonably be expected to approach head on, protect excavations by continuous barricades.

a. During hours of darkness, provide warning lights at close intervals.

E. Hazards in Protected Areas: Mark or guard excavations in areas from which public is excluded, in manner appropriate for hazard.

F. Above Grade Protection: On multi-level structures, provide safety protection that meets requirements of OSHA and State agency which administers OSHA regulations where Project is located.

G. Protect existing structures, trees, shrubs, and other items to be preserved on Project site from injury, damage or destruction by vehicles, equipment, worker or other agents with substantial barricades or other devices commensurate with hazards.

H. Fences: Enclose site of the Work with fence adequate to protect the Work against acts of theft, violence and vandalism.

END OF SECTION

SECTION 01420

CONFINED SPACES

1.01 GENERAL

A. Attention is directed to the provisions of :

1. Article 108 of the General Industry Safety Orders, Title 8, California Code of Regulations.

2. Article 4 of the Construction Safety Orders, Title 8, California Code of Regulations.

B. The General Industry Safety Orders define a confined space as a space that: (1) is large enough and so configured that a person can bodily enter and perform work, and (2) has limited or restricted means for entry and exit, and (3) is not designed for continuous occupancy.

C. Confined spaces shall be as described above, and shall include the interior of storm drains, sewers, vaults, utility pipelines, manholes, reservoirs, and any other such structure which is similarly surrounded by confining surfaces so as to permit an oxygen deficient atmosphere or the accumulation of dangerous gases or vapors.

D. A Permit Required Confined Spaces is defined as a confined space that has one or more of the following characteristics:

1. Contains a hazardous atmosphere,

2. Contains a liquid or solid materials that can engulf an entrant,

3. A configuration that can trap and suffocate an entrant,

4. Mechanical or electrical hazards, or

5. Contains any other recognized serious safety and health hazard.

6. Contains unknown atmospheric environment.

The general industry regulations define a Non-Permit Required Confined Space as a confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or physical harm.

E. Confined spaces shall be considered permit-required confined spaces (PRCS) until proven safe from atmospheric hazards by testing and ventilation; and until evaluated as safe from any other serious safety or health hazards.

1.02 CONFINED SPACE OPERATING PROCEDURES

A. CONTRACTOR shall submit confined space operating and rescue procedures to the JPA for record keeping purposes. Procedures shall conform to the applicable provisions of Article 108, General Industry Safety Orders, Title 8, California Code of Regulations.

B. CONTRACTOR shall test for the presence of combustible or dangerous gases and/or oxygen deficiency in confined spaces using an approved device immediately prior to a worker entering the confined space, and at intervals frequent enough to ensure a safe atmosphere during the time a worker is in such a structure. A record of such tests shall be kept at the jobsite.

C. Employees shall not be permitted to enter a confined space, where tests indicate the presence of a hazardous atmosphere, unless the employee is wearing suitable and approved respiratory equipment, or until such time that continuous forced air ventilation has removed the hazardous atmosphere from the confined space.

D. Confined spaces that contain or that have last been used as containers of toxic gases, light oils, hydrogen sulfide, corrosives, or poisonous substances, shall, in every case, be tested by means of approved devices or chemical analysis before being entered without wearing approved respiratory equipment.

E. Sources of ignition shall be prohibited in any confined space until after the atmosphere within the confined space has been tested and found safe.

F. Reservoirs, vessels, or other confined spaces having openings or manholes in the side as well as in the top shall be entered from the side openings or manholes when practicable.

G. CONTRACTOR shall coordinate entry operations with JPA when both CONTRACTOR personnel and JPA personnel will be working together as authorized entrants into a permit-required confined space.

H. CONTRACTOR shall submit to JPA a photocopy of the canceled permit at the conclusion of the entry operation. This information is for record-keeping purposes only, and is not intended to provide enforcement of confined space regulations.

END OF SECTION

SECTION 01430

HAZARDOUS SUBSTANCES COMMUNICATION

1.01 REFERENCE

A. General Requirements Section 01430

1.02 GENERAL

A. The following hazardous substances are known to be present or will be encountered during performance of the work.

1. None know at this time.

B. Material Safety Data Sheets (MSDS) for each known hazardous substance can be found in the Appendix.

1.03 PROCESS OVERVIEW

A. If a hazardous substance is found or identified the CONTRACTOR shall immediately stop work in the area and notify the JPA'S Representative.

B. If asbestos-containing materials are uncovered during project construction, work at the project site shall immediately halt and a qualified hazardous materials professional shall be contacted and brought to the project site to make a proper assessment of the suspect materials. All potentially friable asbestos-containing material shall be removed in accordance with Federal, State, and local laws and the National Emission Standards for Hazardous Air Pollutants guidelines prior to ground disturbance that may disturb such material. All demolition activities shall be undertaken in accordance with California Occupational Safety and Health Administration standards, as contained in Title 8 of the CCR, Section 1529, to protect workers from exposure to asbestos. Material containing more than one percent asbestos shall also be subject to San Joaquin Valley Air Pollution Control District regulations. Demolition shall be performed in conformance with Federal, State, and location laws and regulations so that construction workers and or the public avoid significant exposure to asbestos-containing materials.

END OF SECTION

SECTION 01435

HAZARDOUS SUBSTANCE PROCEDURES

1.01 REFERENCES

A. California Health and Safety Code, Section 25117.

B. United States Code of Federal Regulation (CFR), Title 29 and Title 40.

C. State of California Code of Regulations (CCR), Title 8 and Title 22.

D. Steel Structure Painting Council – PA Guide 3.

E. 29 CFR 1910.1000.

F. 29 CFR 1910.134.

G. Steel Structure Painting Council:

1. Guide 61 – Guide for Containing Debris Generated During Paint Removal Operations.

2. Guide 71 – Guide for the Disposal of Lead-Contaminated Surface Preparation Debris.

1.02 GENERAL

A. CONTRACTOR shall inform JPA and other affected persons of hazardous substances that are brought onto the jobsite or suspected hazardous substances which are encountered during performance of the work. CONTRACTOR shall notify such agencies as required to be notified by law or by regulation of the presence of hazardous substances.

B. Definitions

1. Hazardous substance: Defined as any substance included in the list (Director's List) of hazardous substances prepared by the Director, California Department of Industrial Relations, pursuant to Labor Code Section 6382. Includes hazardous waste as defined herein.

2. Hazardous waste: A waste or combination of wastes as defined in 40 CFR 261.3, or regulated as hazardous waste in California pursuant to Chapter 11, Division 4.5, Title 22, California Code of Regulations, and Chapter

6.5, Division 20, California Health and Safety Code, or those substances defined as hazardous wastes in 49 CFR 171.8.

C. CONTRACTOR shall provide plans, procedures, and controls to be used when encountering hazardous substances during performance of the work.

D. Prior to commencing work, and where it is known or suspected that hazardous substances will be encountered, CONTRACTOR shall submit a copy of its hazard communication program to JPA. Program shall describe CONTRACTOR'S communication procedures and shall give evidence of employees training for complying with procedures.

E. CONTRACTOR shall designate a Certified Industrial Hygienist to issue instructions and recommendations for worker safety in the event a hazardous substance is encountered.

F. CONTRACTOR shall file request for adjustment of Contract Price or Time due to the finding of hazardous materials at the work-site, in accordance with Article 14 of the General Provisions.

1.03 HAZARDOUS SUBSTANCE PROCEDURES

A. For work where hazardous substances will be present or encountered, CONTRACTOR shall:

1. Submit to JPA a Site Safety and Health Plan. A copy of the plan shall be made available to the jobsite while work is being performed.

2. Submit to JPA a Materials Disposal Plan.

3. Submit to JPA a Material Safety Data Sheet (MSDS) for each hazardous substance proposed to be used or encountered at the jobsite. MSDS shall be submitted prior to commencing work.

4. Exercise extreme care when handling or disposing of materials or substances that are listed as hazardous substances in Section 8-339 of California Occupational Safety and Health Regulations, Title 8, California Code of Regulations, or in Title 26 (Toxics) of the California Code of Regulations, or as evidenced by the manufacturer's MSDS.

5. Immediately notify JPA of any spill of material that is, or contains, a hazardous substance, including, but not limited to, motor oil, hydraulic fluid, or other petroleum products and hazardous materials or wastes used or generated on site. JPA personnel will notify the proper

authorities of the spill and will specify the necessary measures to be taken by the CONTRACTOR to neutralize and/or remove the hazardous substance.

B. For work where materials suspected of containing hazardous substances are encountered, CONTRACTOR shall immediately comply with the requirement set forth above in Paragraph A, as well as the following:

1. Sampling and Testing

Contractor shall sample and test all materials suspected of containing hazardous substances to determine if they are classifiable as hazardous wastes that must be disposed of at a Class I disposal site, or non-hazardous wastes that must be disposed of at a Class II or Class III disposal site. All sampling and testing shall be performed by a laboratory that complies with and is certified under the Environmental Laboratory Accreditation Program (ELAP) of the California Department of Health Services.

2. Hazardous Substances that may be Encountered

All the materials listed below that are to be disposed of from the site shall be sampled and analyzed for hazardous constituents. Analytical reports shall be submitted to the JPA prior to disposing of each material.

a. Sandblast Media, sealant, soil

b. Wastewater, sediments

c. Metals analyses will include the following 17 metals:

Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Copper, Cobalt, Lead, Mercury, Molybdenum, Nickel, Selenium, Silver, Thallium, Vanadium and Zinc

3. Handling Samples

a. Each sample shall have an identifying sample number assigned by the CONTRACTOR when the sample is taken. Sample number shall be included on the sampling chain of custody and in all reports, correspondence, and other documentation related to the sample. Each sample shall have a sampling chain of custody. Chain of custody shall show the name and organization of each person having custody of the sample, and shall also show the sample number, job name and location, time of day and date sample taken, material sampled, and tests to be performed.

JPA's Representative will witness sampling and may take samples for JPA records and for additional analyses if required. Notify the JPA at least 24 hours prior to sampling.

b. JPA's Representative will witness sampling and may take samples for JPA records and for additional analyses if required.

c. JPA's Representative will review laboratory analysis results and will obtain a Hazardous Waste Generator's EPA ID Number if required.

4. Disposal

a. JPA's Representative will give CONTRACTOR written notice to dispose of all or a portion of material at a Class I disposal site if the JPA's Representative determines that such disposal is required based on review of analytical results of samples collected in accordance with sampling plan. Non-hazardous waste shall be disposed of in either a Class II or Class III facility dependent on material composition and landfill requirements.

b. Remove and handle the material as hazardous until the JPA's Representative has reviewed the required laboratory analysis and determined the appropriate classification. Materials from different sites shall not be transported or mixed until the material is determined to be non-hazardous. Excavation materials shall be stored or stockpiled at each site until classified.

c. Transport materials in accordance with all local, state, and federal laws, rules, and regulations. Submit hazardous waste shipping manifests to the JPA'S Representative within five (5) days of offhaul. Include the name, address, EPA Identification Number and Hauler License Number of the transport company and the EPA Identification Number of the disposal site.

1.04 SUBMITTALS

A. Site Safety and Health Plan

1. Plan shall be approved by a Certified Industrial Hygienist and shall comply with all applicable requirements of the Federal Resource

Conservation and Recovery Act, Title 8, Title 22, and Title 26 of the California Code of Regulations, and all applicable regulations of all local, state, and federal agencies having jurisdiction over the safety and health hazards of all phases of the work to be performed.

2. Submit name of individual who has been designated as the site safety and health supervisor.

B. Materials Disposal Plan

1. Prepare a materials disposal plan that complies with all applicable requirements of the Federal Resource Conservation and Recovery Act, Title 8, Title 11, and Title 26 of the California Code of Regulations; and all applicable regulations of all local, state and federal agencies having jurisdiction over the disposal of removed materials, and other waste, whether hazardous or non-hazardous. Submit a copy of the plan for the JPA'S Representative prior to disposing of any material.

2. Submit permission to dispose of material from disposal site owner prior to disposing of any material. Include name, address, and telephone number of disposal site and of owner.

3. Hazardous wastes:

a. CONTRACTOR shall prepare and JPA shall accept all hazardous waste manifests prior to use.

b. Submit manifests, Bill of Lading, land disposal restriction, or other documentation required by applicable regulations governing transport and disposal of hazardous wastes for disposal of hazardous substances within five (5) days of transport. Manifests or Bill of Lading (or other listed documentation) shall identify disposed material and source, show quantity of disposed material in pounds or tons, and show method used for final disposition as buried, incinerated, chemically treated and/or other means.

c. Submit proof that the transporter and disposal site are regulated by the State to handle and dispose of hazardous wastes.

D. Sampling and Analysis, Laboratory Designation, and Test Results

1. Submit project sampling plan prior to any sampling. Include collection methods, locations, and frequencies. Include analytical methods for each material sampled.

2. Submit name and Environmental Laboratory Accreditation Program Certificate number of laboratory that will sample and test suspected hazardous substances. Include statement of laboratory's certified testing areas and analyses that laboratory is qualified to perform. Submit prior to any laboratory testing.

3. Submit laboratory analysis results of samples taken per sampling plan. Specify any deviations from original sampling plan.

END OF SECTION

SECTION 01440

TEMPORARY FACILITIES AND CONTROLS

1.01 CONSTRUCTION WATER

A. The Contractor shall be responsible for bringing construction water to the site as necessary. Water usage and location of water supply shall be coordinated with and approved by the JPA. The Contractor shall be responsible for furnishing, installing, and operating all necessary pumps, standtanks, piping, appurtenances, and necessary connections.

1.02 CONSTRUCTION POWER

A. The Contractor shall be responsible for bringing power to the site as necessary.

1.03 DUST CONTROL

A. Submit a plan detailing the means and methods for controlling dust generated by work on the site at or below ambient dust levels for the JPA'S acceptance. The plan shall also make provision for the control of paint overspray generated during painting operations. The plan shall detail equipment and methods for monitoring compliance with the plan.

B. One or more operable street sweeping machines with vacuums in combination with a water truck for dust abatement purposes shall be maintained on the jobsite.

C. All soil excavated or graded shall be sufficiently watered to prevent excessive dust. Watering shall occur as needed with complete coverage of disturbed areas. Watering shall be a minimum of twice daily on unpaved/untreated roads and on soil areas with active operations.

D. All clearing, grading, earth moving, and excavation activities shall cease during periods of high winds greater than 20 mph (averaged over one hour), if disturbed material is easily windblown, or when dust plumes of twenty percent (20%) or greater opacity impact public roads, occupied structures, or neighboring properties.

E. All fine material transported offsite shall be either sufficiently watered or securely covered to prevent excessive dust.

F. Areas disturbed by clearing, earth moving, or excavation activities shall be minimized at all times.

G. Stockpiles of soil or other fine loose material shall be stabilized by watering or other appropriate method to prevent wind-blown fugitive dust.

H. Once initial grading has ceased, all inactive soil areas within the construction site shall be treated with a dust palliative or watered twice daily until soil has sufficiently crusted to prevent fugitive dust emission.

I. All active disturbed soil areas shall be sufficiently watered to prevent excessive dust, but no less than twice a day.

J. Onsite vehicle speed shall be limited to 15 mph.

K. All areas with vehicle traffic shall be paved, treated with dust palliatives, or watered a minimum of twice daily.

L. Streets adjacent to the project site and construction activity shall be kept clean and accumulated silt removed.

M. Contractor shall properly maintain and tune all internal combustion engine powered equipment.

N. Contractor shall require employees and subcontractors to comply with California's idling restrictions for compression ignition engines.

O. Contractor shall use low sulfur (CARB) diesel fuel.

1.04 NOISE ABATEMENT

A. The CONTRACTOR shall comply with all local sound control and noise level rules, regulations, and ordinances which apply to any work pursuant to the Contract. The CONTRACTOR is responsible to provide noise abatement to limit noise levels to less than 55 dBA and is responsible for all associated costs. If surrounding land owners complain or the CONTRACTOR exceeds allowable noise levels, the CONTRACTOR shall provide a sound abatement protocol to the complete satisfaction of the JPA.

B. The CONTRACTOR shall place all stationary construction equipment so that emitted noise is directed away from sensitive receptors nearest the project site.

C. The CONTRACTOR shall locate equipment staging in areas that create the greatest possible distance between construction-related noise sources and noise-sensitive receptors nearest the project site during all project construction.

D. The Contractor shall ensure proper maintenance and working order of equipment and vehicles, and that all construction equipment is equipped with manufacturers approved mufflers and baffles.

E. The Contractor shall install sound-control devices in all construction equipment and impact equipment, no less effective than those provided on the original equipment.

1.05 DISPOSAL OF EXCESS EXCAVATED SOIL MATERIALS

A. The CONTRACTOR shall dispose of any hazardous materials, pipe, electrical, etc. that is encountered that is not to be incorporated into the project scope of work. Organic material for project clearing and grubbing shall be removed and stockpiled in a manner that it is not incorporated into the engineered fill, however it shall be spread evenly and uniformly in the basin bottoms after the completion of all work to the satisfaction of the JPA.

1.06 TEMPORARY FACILITIES

A. The CONTRACTOR shall be responsible for furnishing and installing any temporary facilities that are deemed necessary. CONTRACTOR shall be responsible for furnishing and maintaining suitable portable sanitary facilities along with sanitary hand washing facilities.

1.07 CULTURAL RESOURCES

A. In the event that prehistoric or historic subsurface cultural resources are discovered during ground-disturbing activities, all work within 50 ft of the resources shall be halted and the JPA notified. The JPA will consult with a qualified archaeologist to assess the significance of the find according to CEQA Guidelines Section 15064.5. If any find is determined to be significant, then the JPA and the archeologist will meet to determine avoidance measures or other appropriate mitigation. The JPA will make the final determination and notify the CONTRACTOR of the necessary mitigation measures.

B. In the event that paleontological resources are discovered all work in the immediate area shall be halted and the JPA notified. The JPA will notify a qualified paleontologist depending upon the project component. The paleontologist will document the discovery as needed, evaluate the potential resource, and assess the significance of the find under the criteria set forth in CEQA Guidelines Section 15064.5. If fossil or fossil bearing deposits are discovered during construction, excavation within 50 feet of the find will be temporarily halted or diverted until the discovery is examined by a qualified paleontologist. The paleontologist will notify the appropriate agencies to determine procedures that would be followed before construction is allowed to resume at the location of the find. The JPA will make the final determination and notify the CONTRACTOR of the necessary mitigation or avoidance measures.

C. If human remains are uncovered during project construction all work in the immediate area shall be halted and the JPA notified. The JPA shall immediately contact the Kern County Coroner to evaluate the remains, and follow the procedure and protocols set forth in Section 15064.4 (e) (1) of the California Environmental Quality Act Guidelines. If the Coroner determines the remains are Native American in origin, the Coroner shall contact the Native American Heritage Commission (NAHC). As provided in Public Resources Code Section 5097.98, the NAHC shall identify the person or persons believed to be most likely descended from the deceased Native American. The most likely descendent shall be

afforded the opportunity to provide recommendations concerning the future disposition of the remains and any associates grave goods as provided in PRC 5097.98.

1.08 BIOLOGICAL RESOURCES

A. (*Description of biological surveys and requirements*)

END OF SECTION

SECTION 01500

EQUIPMENT AND EQUIPMENT SYSTEMS OPERATION

1.01 GENERAL

This section describes the intended function and operation of equipment and equipment systems.

1.02 EQUIPMENT FUNCTIONS

A. (*Description of the function of key equipment*)

1.03 EQUIPMENT SYSTEM FUNCTIONS

(*Description of how the entire system being constructed works*)

END OF SECTION

SECTION 01510

TESTING, TRAINING, AND FACILITY START-UP

1.01 SUMMARY

A. Section Includes: Equipment and system testing and start-up, services of manufacturer's representatives, training of JPA'S personnel, and final testing requirements for the complete facility.

1.02 CONTRACT REQUIREMENTS

A. Testing, training, and start-up are requisite to the satisfactory completion of the Contract.

B. Complete testing, training, and start-up within the Contract Time.

C. Allow realistic durations in the Progress Schedule for testing, training, and start-up activities.

D. Furnish labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing functional testing, performance testing, and operational testing.

E. Provide competent, experienced technical representatives of equipment manufacturers for assembly, installation and testing guidance, and operator training.

1.03 START-UP/TESTING PROCESS OVERVIEW

A. This specification describes a process. The following definitions are provided for terms that are used in this specification and which describe the steps of the process.

B. Start-up Plan: A complete outline and schedule of the work that will be performed to meet the requirements of this specification.

C. Factory/Source Performance Testing: Testing which takes place at the supplier's facility to test equipment performance prior to shipment of the equipment to the job site. Factory pump test, or a control panel test, for example.

D. General Start-up and Testing: Initial adjustments, alignments, inspections, testing, etc., which are performed to confirm equipment is installed correctly and ready to be operated. Line flush, lubrication check, electrical integrity tests, instrument calibrations, for example.

E. Individual Equipment Functional Testing: Individual equipment operating tests which verify proper operation of the equipment. An individual pump functional test would include testing flow, pressure, amps, vibration, motor controls, associated instrument loops, and remote controls, for example.

F. Certification of Proper Installation: A written report from the equipment supplier and the equipment installer which certifies that the equipment tests are complete and the equipment performs satisfactorily.

G. Equipment/System Operational Testing: A test of the entire facility which demonstrates the individual equipment operates as a system and meets the operational requirements of the facility design. Operational requirements to test shall include system control features, station performance requirements such as flow and pressure for example.

1.04 START-UP PLAN

A. Submit start-up plan for each piece of equipment and each system not less than sixty (60) days prior to planned initial equipment or system start-up. Plan shall address all operating requirements set forth in Section 01500, Equipment and Equipment System Operation.

B. Provide a Schedule with the Following Activities Identified:

1. Manufacturer's services

2. Installation certifications

3. Operator training

4. Submission of Operation and Maintenance Manual

5. Performance testing

6. Functional testing

7. Operational testing

C. Provide testing plan with test logs for each item of equipment and each system when specified. Include testing of alarms, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters.

D. Provide summary of shutdown requirements for existing systems, which are necessary to complete start-up of new equipment, and systems.

E. Revise and update start-up plan based upon review comments, actual progress, or to accommodate changes in the sequence of activities.

1.05 FACTORY/SOURCE PERFORMANCE TESTING

A. Test equipment for proper performance at point of manufacture or assembly when specified.

B. Equipment that is to be tested includes, but is not limited to:

Slide gates and electrical actuator require a witnessed factor test.

1. Demonstrate equipment meets specified performance requirements.

2. Provide certified copies of test results.

3. Do not ship equipment until certified copies have received written acceptance from JPA. Written acceptance does not constitute final acceptance.

1.06 FACTORY WITNESSED PUMP TESTS

A. Pumps having a motor drive of 100 horsepower or greater shall undergo factory witnessed pump testing. Each pumping unit, complete with the actual job motor drive, shall be tested at the factory in the presence of the JPA Representative. Tests shall be performed in accordance with the applicable provisions of AWWA E101 or the standards of the Hydraulic Institute. To successfully pass a laboratory performance test, a pumping unit shall meet all performance requirements specified.

B. JPA shall pay all costs for JPA'S Representative to travel to and from the location of the laboratory performance test, and all costs incurred during testing. Should results of the tests indicate, in the opinion of the JPA's Representative that the pumps fail to meet any of the specified requirements, the JPA's Representative will notify the CONTRACTOR of such failure. The manufacturer shall thereupon, at no expense to the JPA, make such modifications and perform additional testing as may be necessary to comply with these specifications. Any additional costs for travel and subsistence shall be reimbursed to the JPA by the CONTRACTOR.

1.07 GENERAL START-UP AND TESTING

A. Mechanical Systems:

1. Remove rust preventatives and oils applied to protect equipment during construction.

2. Flush lubrication systems and dispose of flushing oils. Recharge lubrication system with lubricant recommended by manufacturer.

3. Flush fuel system and provide fuel for testing and start-up. At completion of test, fill fuel tank.

4. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.

5. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, installation and construction.

6. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.

7. Perform cold alignment and hot alignment to manufacturer's tolerances.

8. Adjust V-belt tension and variable pitch sheaves.

9. Inspect hand and motorized valves for proper adjustment. Tighten packing glands to insure no leakage, but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.

10. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.

11. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to operational testing.

B. Electrical Systems:

1. Perform insulation resistance tests on wiring except 120-volt lighting, wiring, and control wiring inside electrical panels.

2. Perform continuity tests on grounding systems.

3. Test and set switchgear and circuit breaker relays for proper operation.

4. Perform direct current high potential tests on all cables that will operate at more than 2,000 volts. Obtain services of an approved, certified independent testing lab to perform tests.

5. Check motors for actual full load amperage draw. Compare to nameplate value.

C. Instrumentation Systems:

1. Bench or field calibrate instruments and make required adjustments and control point settings. Provide data on JPA's calibration sheets.

2. Leak test pneumatic controls and instrument air piping.

3. Energize transmitting and control signal systems, verify proper operation, ranges and settings.

1.08 INDIVIDUAL EQUIPMENT FUNCTIONAL TESTING

A. Functionally test mechanical and electrical equipment for proper operation after general start-up and testing tasks have been completed.

B. Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration. Perform initial checks in the presence of and with the assistance of the manufacturer's representative.

C. Demonstrate proper operation of each instrument loop function including alarms, local and remote controls, instrumentation and other equipment functions. Generate signals with test equipment to simulate operating conditions in each control mode.

D. Conduct continuous 8-hour test under full load conditions. Replace parts which operate improperly.

1.09 CERTIFICATE OF PROPER INSTALLATION

A. At Completion of Functional Testing, Furnish Written Report Prepared and Signed by Manufacturer's Authorized Representative, Certifying Equipment:

1. Has been properly installed, adjusted, aligned, and lubricated.

2. Is free of any stresses imposed by connecting piping or anchor bolts.

3. Is suitable for satisfactory full-time operation under full load conditions.

4. Operates within the allowable limits for vibration.

5. Controls, protective devices, instrumentation, and control panels furnished as part of the equipment package are properly installed, calibrated, and functioning.

6. Control logic for start-up, shutdown, sequencing, interlocks, and emergency shutdown have been tested and are properly functioning.

B. Furnish Written Report Prepared and Signed by the Electrical and/or Instrumentation Subcontractor Certifying:

1. Motor control logic that resides in motor control centers, control panels, and circuit boards furnished by the electrical and/or instrumentation subcontractor has been calibrated and tested and is properly operating.

2. Control logic for equipment start-up, shutdown, sequencing, interlocks and emergency shutdown has been tested and is properly operating.

C. Co-sign the reports along with the manufacturer's representative and subcontractors.

1.10 TRAINING OF OWNERS PERSONNEL

A. Provide operations and maintenance training for items of mechanical, electrical and instrumentation equipment. Utilize manufacturer's representatives to conduct training sessions. Coordinate with JPA to develop content for training sessions.

B. Coordinate training sessions to prevent overlapping sessions. Arrange sessions so that individual operators and maintenance technicians do not attend more than 2 sessions per week.

C. Provide Operation and Maintenance Manual for specific pieces of equipment or systems one month prior to training session for that piece of equipment or system.

D. Satisfactorily complete functional testing before beginning operator training.

E. CONTRACTOR shall coordinate the training periods with JPA personnel and manufacturer's representatives, and shall submit a training schedule for each piece of equipment or system for which training is to be provided. Such training schedule shall be submitted not less than 21 calendar days prior to the time that the associated training is to be provided and shall be based on the current plan of operation.

1.11 EQUIPMENT/SYSTEM OPERATIONAL TESTING

A. CONTRACTOR and JPA shall jointly develop and coordinate equipment system operational testing. Operation shall comply with requirements set forth in Section 01500, Equipment and Equipment Systems Operation.

B. Conduct operational test of the entire facility after completion of operator training. Demonstrate satisfactory operation of equipment and systems in actual operation.

C. Conduct operational test for continuous 7-day period.

D. JPA will provide operations personnel, power, fuel, and other consumables for duration of operational test.

E. Immediately correct defects in material, workmanship, or equipment which became evident during operational test.

F. Repeat operational test when malfunctions or deficiencies cause shutdown or partial operation of the facility or results in performance that is less than specified.

G. In the event an item of equipment cannot be tested continuously for seven (7) days, provide information for an alternative test, or modify the seven (7) day test period. For high horsepower equipment where testing will impact Time of Use (TOU) energy limitations, describe an intermittent test procedure. Identify TOU constraints.

1.12 RECORD KEEPING

A. Maintain and Submit Following Records Generated During Start-up and Testing Phase of Project:

1. Daily logs of equipment testing identifying all tests conducted and outcome.

2. Logs of time spent by manufacturer's representatives performing services on the job site.

3. Equipment lubrication records.

4. Electrical phase, voltage, and amperage measurements.

5. Insulation resistance measurements.

6. Data sheets of control loop testing including testing and calibration of instrumentation devices and set points.

END OF SECTION

SECTION 01520

CLOSEOUT PROCEDURES

1.01 FINAL CLEANING

A. Perform final cleaning prior to inspections for Final Acceptance.

B. Use cleaning materials which are recommended by manufacturers of surfaces to be cleaned.

C. Prevent scratching, discoloring, and otherwise damaging surfaces being cleaned.

D. Clean roofs, gutters, downspouts, and drainage systems.

E. Broom clean exterior paved surfaces and rake clean other surfaces of sitework. Police yards and grounds to keep clean.

F. Remove dust, cobwebs, and traces of insects and dirt.

G. Clean grease, mastic, adhesives, dust, dirt, stains, fingerprints, paint, blemishes, sealants, plaster, concrete, and other foreign materials from sight-exposed surfaces, and fixtures and equipment.

H. Remove non-permanent protection and labels.

I. Polish glossy surfaces to clear shine.

J. Vacuum carpeted and soft surfaces.

K. Clean light fixtures and replace burned-out or dim lamps.

1.02 WASTE DISPOSAL

A. Surplus materials, waste products, and other debris shall be disposed off-site

1.03 TOUCH-UP AND REPAIR

A. Touch-up, repair, or replace finished surfaces on structures, equipment and installation that have been damaged prior to inspection for final acceptance.

1.04 CLOSEOUT DOCUMENTS

A. Submit following closeout documents upon completion of the Work, and at least 7 days prior to application for Final Payment:

1. Project Record Documents, including:

   Record drawings
   Testing reports
   Survey data
   Instrument calibration sheets

2. Operation and Maintenance Manuals

3. Warranties and Bonds.

4. Spare Parts

END OF SECTION

SECTION 01600

JPA FURNISHED EQUIPMENT

1.01 EQUIPMENT FURNISHED BY JPA

The JPA will not furnish any materials for this project.

1.02 JPA RESPONSIBILITIES

A. Arrange for and deliver necessary shop drawings, installation instructions, product data and samples to CONTRACTOR.

B. Arrange and pay for product delivery to site in accordance with construction schedule.

C. Deliver supplier's bill of materials to CONTRACTOR.

D. Inspect deliveries jointly with CONTRACTOR.

E. Submit claims for transportation damage.

F. Arrange for replacement of damaged, defective, or missing items.

G. Arrange for manufacturer's warranties, bonds, service, and inspections, as required.

1.03 CONTRACTOR RESPONSIBILITIES

A. Designating required delivery date for each JPA furnished product.

B. Reviewing shop drawings, product data and samples.

C. Submitting notification of discrepancies or anticipated problems.

D. Receiving and unloading products at site.

E. Promptly inspecting products jointly with JPA and recording shortages, damaged or defective items.

F. Handling products at site, including uncrating and storage.

G. Protecting products from damage.

H. Installing, including assembly, connections, adjustments, tests, and finish products in accordance with Contract Documents.

I. Providing operating oils, lubricants, and incidental materials required for complete installation.

J. Repairing or replacing items damaged after receipt until Date of Acceptance of the Work by JPA.

1.04 DELIVERY

A. If JPA fails to deliver products in accordance with approved Construction Schedule, adjustments will be made to Contract Time and Contract Price as stipulated in General Provisions.

END OF SECTION

SECTION 01700

EARLY OCCUPANCY OF PORTIONS OF WORK

1.01 PORTIONS OF WORK SCHEDULED FOR EARLY OCCUPANCY

A. CONTRACTOR shall complete following portions of Work for JPA'S utilization including specified testing, training of JPA'S personnel, and other preparations necessary for JPA'S occupancy or use:

No portion of the project is scheduled for early occupancy.

1.02 SUBSTANTIAL COMPLETION CERTIFICATIONS

A. Certificates of Substantial Completion will be executed for each designated portion of Work prior to JPA occupancy. Such certificate of substantial completion will describe the portion of the Work to be occupied by JPA, items that may be incomplete or defective, date of occupancy by JPA, and other information required by JPA and CONTRACTOR.

1.03 FOLLOWING OCCUPANCY

A. Occupancy by JPA will relieve CONTRACTOR of responsibility for injury or damage to the above-listed completed portions of the Work resulting from use by JPA or from the action of the elements, or from other cause, except CONTRACTOR operations or negligence.

B. After JPA occupancy, allow access for JPA'S personnel, access for others authorized by JPA, and access by JPA for operation of equipment and systems.

C. Following Occupancy, JPA will provide power to operate equipment and systems, and repair damage caused by JPA occupancy.

D. CONTRACTOR will not be required to reclean early occupied portions of Work prior to final acceptance, except for cleanup made necessary by CONTRACTOR's operations.

E. Guarantee period for portions of the Work occupied by JPA shall commence with date of Certificate of Substantial Completion of portions of Work for use by JPA. Progress payment retentions for portions of the Work occupied by JPA will be released as part of the retention for the total Work.

F. JPA'S use of occupied facilities shall not relieve CONTRACTOR from responsibility for correcting defective work or materials.

G. No partial acceptance of the Work will be made and no acceptance other than the final acceptance of the completed Work will be made except for those portions of Work designated for early occupancy by JPA.

END OF SECTION

SECTION 01800

TESTING AND LABORATORY SERVICES

1.01 GENERAL

A. Requirements:

1. The JPA shall perform all concrete and compaction testing for the project.

2. The request for compaction and concrete testing shall be made to the JPA in writing at least forty-eight (48) hours before the CONTRACTOR is ready for tests to be taken.

3. The CONTRACTOR shall make available construction equipment and materials as necessary to assist the JPA'S Representative in taking the tests.

4. If the backfill shall fail the compaction tests, the CONTRACTOR shall pay the cost of restesting. If the concrete cylinders do not reach the design 28-day compressive strength, the CONTRACTOR shall be responsible for any additional testing such as concrete cores and any remedial work.

5. If the CONTRACTOR is not ready to have compaction or concrete tests taken at the time and in the locations indicated on the written request, the CONTRACTOR shall be responsible for all standby charges and/or return visit costs to take the requested tests.

6. If the CONTRACTOR elects to use any imported materials or imported sand for backfill, a sample of the material to be used for the backfill shall be delivered to the JPA Representative for testing, prior to the commencement of backfilling. If the test fails, the CONTRACTOR shall pay the cost of retesting.

7. The JPA will witness factory testing of slide gates and actuators. The CONTRACTOR shall make arrangements for all slide gates and actuators be tested in a single location during a single visit. The CONTRACTOR shall be responsible for any cost incurred by the JPA for retesting of failed equipment or need for additional visits.

END OF SECTION

SECTION 01810

SPECIAL MEETINGS

1.01 GENERAL

A. The JPA or the JPA'S Representative may schedule a Special Meeting to discuss project related activities or issues. The CONTRACTOR shall be readily available for these meetings and ensure that any project subcontractors attend when so requested by the JPA. The time and place for such meeting will be established by the JPA or the JPA'S Representative.

B. Project Meetings: The JPA may elect to administer weekly or bi-weekly project meetings to discuss project activities, review the project schedule, and to discuss any project related issues or concerns. The CONTRACTOR shall have its Project Manager and/or Project Superintendent attend each of these meetings as well as any necessary subcontractors and provide a project look ahead schedule at each meeting. The time and place for project meetings will be established at a mutually agreeable time and place prior to the commencement of work.

END OF SECTION

SECTION 01820

SPECIAL CONTRACT CLOSE OUT

(*Description of final clean up and expected job site conditions at completion of project*)

SECTION 01840

BASIS OF MEASUREMENT FOR PAYMENT

1.01 WORK LISTED IN THE SCHEDULE OF WORK ITEMS

A. Work under this contract will be paid on a unit price or lump-sum basis as outlined on the Bid Form for the quantity of work installed.

B. The unit prices and lump-sump prices include full compensation for furnishing the labor, materials, tools, and equipment and doing all the work involved to complete the work included in the Contract Documents.

C. The application for payment will be for a specific item based on the percentage completed or quantity installed. The percentage complete will be based on the value of the partially completed work relative to the value of the item when entirely completed and ready for service.

1.02 BID ITEMS

(Provide Description of each bid item)

1. ITEM NO. 1 – MOBILIZATION, DEMOBLIZATION, AND CLEANUP

Work under this item shall include all labor, tools, equipment and transportation of personnel, equipment, and operating supplies to and from the site, establishment of portable sanitary facilities, site electrical, and site communications, obtaining an adequate supply of fresh water if necessary, trench safety measures, SWPPP, Dust Control Plan, final cleanup work and all bonds, insurance, overhead, permits, shop drawings, close-out documents, and costs of work not specifically included in any other contract item.

During the progress of the work, the Contractor shall maintain the site and related equipment in a clean, orderly condition, free from unsightly accumulation of rubbish. Upon completion of the work and before the final estimate is submitted, the Contractor shall at his own expense remove from the vicinity of the work all weeds, rubbish, uninstalled materials and other like materials, belonging to him or used under his direction during construction. In the event of his failure to do so, the same may be removed by the JPA after ten days written notice to the Contractor. Such removal shall be at the expense of the Contractor and will be deducted from the final payment due him. Where construction crosses public or private property, it shall be restored by the Contractor to the complete satisfaction of the JPA, at the Contractor's expense.

1.02 WORK NOT LISTED IN THE SCHEDULE OF WORK ITEMS

A. The General Provisions and items in the Special Provisions, general requirements, and specifications which are not listed in the schedule of work items of the Bid Form are, in general, applicable to more than one listed work item, and no separate work item is provided therefore. Include the cost of work not listed but necessary to complete the project designated in the Contract Documents in the various listed work items of the Bid Form.

B. The bids for the work are intended to establish at total cost for the work in its entirety. Should the CONTRACTOR feel that the cost for the work has not been established by specific items in the Bid Form, include the cost for that work in some related bid item so that the Proposal for the project reflects the total cost for completing the work in its entirety.

1.03 MOBILIZATION

Payment for mobilization shall be made at the time of the first progress payment after the CONTRACTOR has purchased bonds and insurance and established a Contractor's site office with telephone service and a temporary field office for the JPA'S Representative.

1.04 TRENCH SAFETY MEASURES

Payment for sheeting, shoring, and bracing for the protection of life and limb, in conformance with all applicable safety orders, shall be provided for in the applicable bid items and will be paid for in accordance with the provisions outlined herein.

1.05 STORM WATER POLLUTION CONTROL / DUST CONTROL PLAN

Payment for storm water pollution control and air quality control shall be provided for in the applicable bid items and will be paid for in accordance with the provisions outlined herein.

END OF SECTION

SECTION 01900

GENERAL DESIGN REQUIREMENTS

1.01 GENERAL

(*Description of permits to be obtained, requirement to comply with all permit requirements, necessary notifications when working on other person's land, identification of time sensitive work and allowable time to complete work, etc.*)

1.02 EXISTING UTILITIES / STRUCTURES

Prior to construction, the CONTRACTOR shall perform a U.S.A. Locate and shall expose all known utility crossings and facilities in order to construct the project without damaging existing facilities or encountering a conflict with said facilities. CONTRACTOR shall be responsible for all associated costs with identifying and exposing existing utilities.

1.03 PERMITS

The JPA will submit a Notice of Intent to Discharge, along with appurtenant fee, under the Construction Activities Storm Water General Permit (99-08-DWQ). Under this permit the CONTRACTOR must prepare and submit a Storm Water Pollution Prevention Plan. CONTRACTOR shall be responsible for operating in accordance with the SWPPP.

The CONTRACTOR shall be responsible for preparing, obtaining, and complying with a SJVAPCD Dust Control Plan and Permit and be responsible for all associated costs.
See also Section 00600 herein.

END OF SECTION

SECTION 02000

MITIGATION MEASURES

1.01 GENERAL

The CONTRACTOR shall be responsible for complying with mitigation measurements listed in Table S-1 herein. Below is a summary list of items that pertain to the CONTRACTOR:

- (*List of required mitigation measure for this specific project*)

END OF SECTION

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KERN FAN GROUNDWATER STORAGE PROJECT

TECHNICAL MEMORANDUM NO. 2
(*Conveyance Capacity Requirements)*

PREPARED FOR: Groundwater Banking Joint Powers Authority (JPA)
PREPARED BY: Curtis Skaggs, P.E., Dee Jaspar & Associates, Inc.
DATE: September 23, 2020

SUBJECT: ***Conveyance Capacity Requirements***
(90% Draft)

I. Executive Summary

This technical memorandum serves to evaluate the potential project water demands and identify the capacity requirements for the Conveyance Canal and the associated Pump Stations.

The memorandum addresses these primary questions:

1. What demand estimates should be utilized for project recharge areas?

2. What is the proper application of these demands in order to size the conveyance facilities?

Appendix A provides a brief project description for reference. This project description was used throughout the grant application process and is based upon the thirty-percent (30%) design. Therefore, the capacities, recharge rates, acreages, etc. may be outdated. It anticipated the recharge rates for the Phase I and Phase II properties at approximately 0.35 feet per day to 0.70 feet per day. The purpose of this memorandum is to more closely evaluate the Phase I and Phase II property locations and estimated recharge rates in an effort to design more closely to actual conditions.

The recharge areas have been evaluated based on soil survey maps, available tTEM geophysical survey information, and historical recharge rates for existing nearby recharge basins. An average recharge rate of 0.6 feet per day has been utilized for the Phase I Recharge Property and an average recharge rate of 0.5 feet per day has been utilized for the Phase II Recharge Property. The initial fill rate for these facilities is estimated at

1.5 times the average recharge rate. This affords the most aggressive filling rate for ponds of three (3) to seven (7) days and is still manageable by system operators. A 1.25 fill rate factor would be considered adequate and reduces the conveyance capacity requirement by 72 cfs. The 1.5 versus the 1.25 factor would provide approximately 1,000 AF additional recharge per Article 21 startup (72 cfs x 7 days). The 1.5 fill rate factor would also provide redundant conveyance capacity in terms of pump outages, aquatic restrictions, and subsidence.

The demands that will be served by the Conveyance Canal consist primarily of the Phase II Property and the West Basins Property. The canal diversion points include:

- In-Lieu Agricultural Demands

  The "in-lieu" agricultural lands include areas west of the I-5 Freeway and north of Stockdale Highway within the service area of the Rosedale-Rio Bravo Water Storage District. In addition, there are "in-lieu" agricultural lands adjacent to the conveyance canal that are east of the I-5 Freeway as well as surrounding the existing West Basins property.

  These demands are for lands that are considered adjacent to the conveyance canal and require relatively little infrastructure to be served.

  In addition, the peak "in-lieu" agricultural demand (June, July, August) is not anticipated to overlap with the peak recharge events (December, January, February, March) which will likely occur in the winter or early spring. An analysis of the Kern Fan Groundwater Storage Project for the Water Storage Investment Program by MBK Engineers dated February 23, 2018 evaluated the availability of Article 21 supply. In wet years and above normal water years, Article 21 supply has been available during the months of December, January, February, March, April, and May. In below normal water years, Article 21 supply has been available in the month of March.

  However, while a small portion of Article 21 supply may be utilized for "in-lieu" during recharge events, the canal will be capable of supplying one-hundred percent (100%) of the average "in-lieu" agricultural demand. The canal capacity is based upon the average "in-lieu" agricultural demand plus the recharge basin fill rate of 1.5 times the average recharge rate. In the event the peaking demand for "in-lieu" agricultural demand plus the fill rates of the recharge basins exceeds the canal capacity, the "in-lieu" water will be prioritized above recharge water.

- Phase II Recharge Property. Location of this property has been assumed at this time and is estimated as approximately 640 gross acres with approximately 508 wetted acres.

- West Basins Recharge Property. This is an existing recharge facility with approximately 388 gross acres and approximately 280 wetted acres. This property will be supplied water from the California Aqueduct in return for freeing up capacity from the east (Kern River or CVC) to supply the Phase I Recharge Property.

- West Basins Pipeline Intertie to Enns Basins. There is an existing 27-inch pipeline that can be utilized to convey water from the canal to the existing Enns Basins in order to free up additional capacity from the east (Kern River or CVC) to supply the Phase I Recharge Property. This will require a small pump station to convey the water through the 27-inch pipeline to the Enns Basins. If a Reach 5 is constructed to convey water to the Phase I Recharge Property (105 cfs Exchange Capacity) it may make more sense to deliver water to the Enns Basins from Reach 5 and forego the use of the existing 27-inch pipeline (24 cfs capacity). Rather than construct two small pump stations (Pump Station No. 4 and 27-inch Pipeline Pump Station) it may make more sense to simply construct Pump Station No. 4 and increase the amount of water to the Phase I Recharge Property through Reach 5 to 130 cfs.

- Phase I Recharge Property. Location of this property has been assumed at this time and is estimated as approximately 640 gross acres with approximately 530 wetted acres. This property has originally been assumed to not be served by the new conveyance canal, however this property could ultimately be acquired in close proximity to the conveyance canal or there is a disparity in the water exchange between the West Basins and the Phase I property that must be accounted for. The West Basins exchange currently estimates 135 cfs that can be supplied from the east via the Kern River and Goose Lake Channel (105 cfs + 24 cfs in WB Pipe Intertie + 6 cfs In-Lieu). The Phase I Property initial fill rate demand is approximately 240 cfs. This is a disparity of approximately 105 cfs that may need to be supplied by the conveyance canal from the California Aqueduct.

The table below summarizes the design criteria for flow capacities.

Capacity may also be considered for future projects such as supply for future recharge basins, Stockdale West, and Strand Ranch, however the scope of this memorandum does not evaluate future projects.

Table 1

Kern Fan Groundwater Banking Project

		Reach 1	Reach 2		Reach 3			Reach 4						
Conveyance Canal	Maximum Aqueduct Capacity	Aqueduct To Stockdale Hwy	Pump Station No. 1	Divert to In-Lieu Adjacent to Canal	Pump Station No. 2	Divert to In-Lieu Adjacent to Canal	Divert to Phase II	Pump Station No. 3	Divert to In-Lieu Adjacent to West Basins	Divert to WB Pipe Intertie with Enns	Divert to West Basins	Phase I Exchange Capacity[1]	Divert to Phase I	Balance
Conveyance Canal Demand Summary	500 cfs	443	443	8	435	3	192	240	6	24	105	105	105	57 cfs

[1]Water to Phase I is by an exchange with the West Basins and In-Lieu properties. However a disparity in demand exists whereby the demand for the West Basins, In-Lieu, and the WB Pipeline Intertie to the Enns Basins is 135 cfs (105 cfs + 6 cfs + 24 cfs Demand) and the Phase I Property is 240 cfs (240 cfs Initial Fill Rate). This is a disparity of 105 cfs to be accounted for by the Phase II conveyance canal.

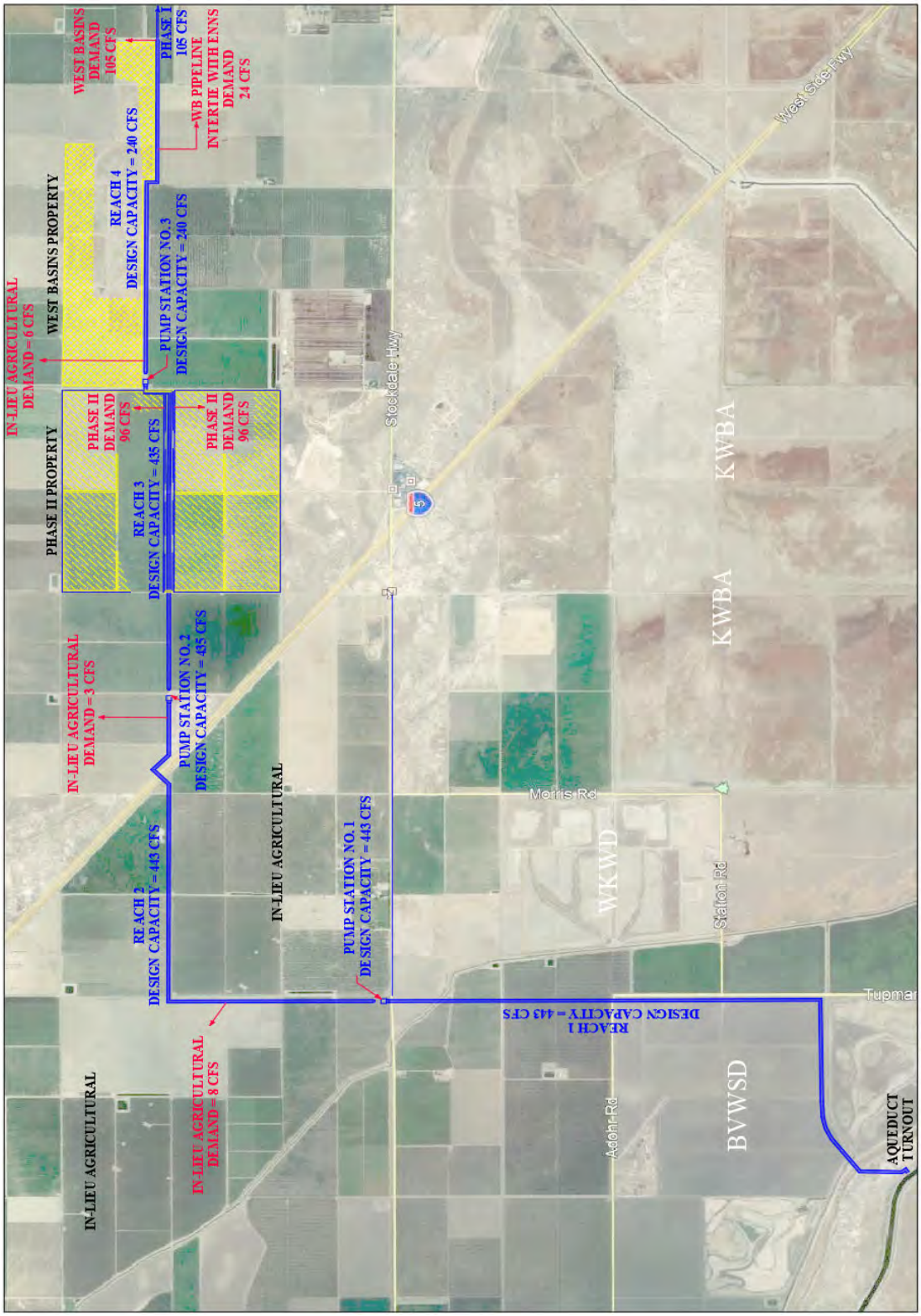

Figure 1: Conveyance Canal Demands and Capacities

It should be noted that the estimates herein are preliminary and subject to change in the event that the actual Phase I and Phase II recharge locations change or the conveyance canal alignment changes. In addition, physical geotechnical work, and perhaps tTEM geophysical work, will need to be performed at the Phase I and Phase II recharge locations during the engineering design to confirm the soil types and permeabilities.

I. Recharge Pond Infiltration and Filling Rates

A. Phase I Recharge Property

The proposed Phase I property is located west of Enos Lane and north of Stockdale Highway in Sections 26 and 27 of T29S, R25E, M.D.B.&M.

The property consists of approximately 630 acres as illustrated in Figure 2 below.

Figure 2: Phase I Property

The United States Department of Agriculture Soil Conservation Service Soil Survey Maps for the northwestern part of Kern County were reviewed in the area of the proposed Phase I property. The proposed property consists of the following soil types, generally speaking, in the top five-feet of the soil:

- Garces Silt Loam (SCS-156) +/- 20 acres
- Wasco Sandy Loam (SCS-243) +/- 30 acres
- Wasco Fine Sandy Loam (SCS-244) +/- 210 acres

- Westhaven Fine Sandy Loam (SCS-245) +/- 200 acres
- Cajon Loamy Sand (SCS-125) +/- 170 acres

The acreages noted above are estimates of the soil type across the property. The majority of the soil is:

- Wasco Fine Sandy Loam (+/- 33% of Property)
  Moderately Rapid Permeability

- Westhaven Fine Sandy Loam (+/- 33% of Property)
  Moderately Slow Permeability

- Cajon Loamy Sand (+/- 27% of Property)
  Rapid Permeability

The Rosedale-Rio Bravo Water District existing Enns Basins are located in the closest proximity to this property. The soil types for that area are predominantly:

- Cajon Loamy Sand (+/- 50% of Property)
  Rapid Permeability

- Wasco Fine Sandy Loam (+/- 45% of Property)
  Moderately Rapid Permeability

- Westhaven Fine Sandy Loam (+/- 5% of Property)
  Moderately Slow Permeability

The soil types for the Enns Basins are very similar to the soil types for the proposed Phase I property. The historic recharge rates for the Enns Basins were reviewed. An average recharge capacity for the Enns Basins is approximately 0.6 feet per day.

In addition, Rosedale-Rio Bravo Water Storage District had Ramboll, an engineering firm out of Emeryville, California, perform a tTEM geophysical survey of a portion of the proposed Phase I property. The transient electromagnetic (tTEM) method is a geophysical exploration technique in which electric and magnetic fields are induced by transient pulses of electric current and the subsequent decay response measured. This allows for a non-intrusive method of obtaining subsurface resistivity-conductivity data in an effort to identify the subsurface lithology.

The tTEM method measures the electrical resistivity of the earth. To assess the lithology below the ground surface, the resistivities measured by the receivers must be translated to lithologies. Translating resistivities to lithology is based on a general correlation between resistivity and type of sediments. Impermeable clay has a low resistivity. Sandy clay typically results in a resistivity ranging from 30 to 100 ohm-m, while sand to coarse sand has a resistivity above 50 ohm-m.

The average resistivity to an approximate depth of 200-feet for the southern half of Section 27 is approximately 25.1 ohm-m. This is illustrated in Figure 3 below. The average resistivity is comparable to the Stockdale East Recharge Facility property.

Figure 3: Average Resistivity for McCaslin Property (Portion of Phase I)

Figure 4 below illustrates the lithology vertically based on elevation and shows how the top 90-feet to 100-feet has coarser material (purple) well suited for groundwater recharge. A more detailed analysis of the tTEM survey in the area of the Phase I property is attached in Appendix B.

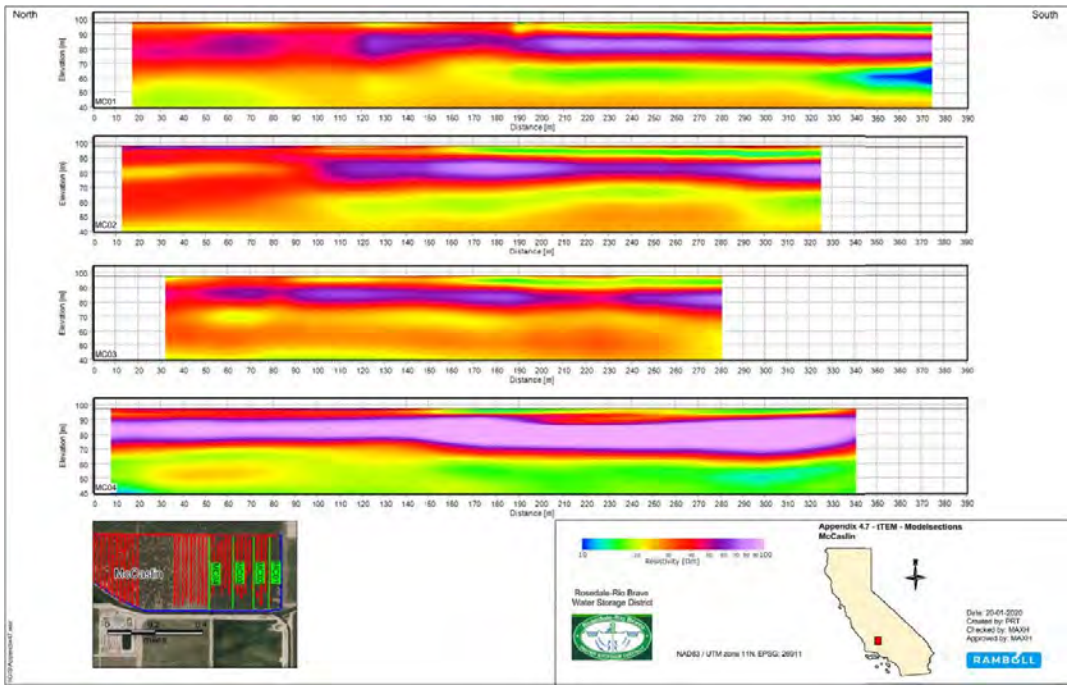

Figure 4: Model Sections of Southern Half of Section 27

The proposed Phase I Recharge property is anticipated to encompass approximately 630 acres. This may result in approximately 530 wetted acres of recharge basins. Based on the information above it is recommended that an average recharge rate of 0.6 feet per day be utilized for the proposed Phase I Recharge Basins. At the above described recharge rates, the following capacities will be required:

Average Maintenance Rate = 530 acres * 0.6 ft/day = 318 ac-ft/d = 160 cfs

Initial Fill Rate = 1.5 * 160 cfs = 240 cfs

This results in a flowrate of approximately 160 cfs. The initial fill rate is estimated as 1.5 * average flow rate which equates to a fill rate of approximately 240 cfs.

B. Phase II Recharge Property

The proposed Phase II property is located west of Bussell Road and north of Stockdale Highway in Sections 30 and 31, T29S, R25E, M.D.B.&M.

The property consists of approximately 640 acres as illustrated in Figure 5 below.

Figure 5: Phase II Property

The United States Department of Agriculture Soil Conservation Service Soil Survey Maps for the northwestern part of Kern County were reviewed in the area of the proposed Phase II property and the proposed property consists of the following soil types:

- Garces Silt Loam (SCS 156) +/- 20 acres
- Kimberlina Fine Sandy Loam (SCS 174) +/- 190 acres
- Westhaven Fine Sandy Loam (SCS 245) +/- 380 acres
- Cajon Loamy Sand (SCS 125) +/- 50 acres

The acreages noted above are estimates of the soil type across the property. The majority of the soil is:

- Kimberlina Fine Sandy Loam (+/- 30% of Property)
  Moderately Rapid Permeability

- Westhaven Fine Sandy Loam (+/- 60% of Property)
  Moderately Slow Permeability

The tTEM information did not exist for any properties in the vicinity of the Phase II property. It is recommended that this work be performed for the Enns Basins and the West Basins in an effort to correlate with actual average recharge rates and for comparison with the proposed Phase II property. The cost for these tTEM surveys is approximately $30,000 to $35,000. It is also recommended that tTEM surveys be performed on the eventual Phase I and Phase II recharge properties. The estimated cost for those surveys is approximately $60,000 to $65,000.

The Rosedale-Rio Bravo Water District existing West Basins are located in the closest proximity to this property. The historic recharge rates for the West Basins were reviewed. An average recharge capacity for the West Basins is approximately 0.5 feet per day.

Based on the information above it is recommended that an average recharge rate of 0.5 feet per day be utilized for the proposed Phase II Recharge Basins similar to that of the West Basins.

The proposed Phase II Recharge property is anticipated to encompass approximately 640 acres. This may result in approximately 508 wetted acres of recharge basins. At the above described recharge rates, the following capacities will be required:

Average Maintenance Rate = 508 acres * 0.5 ft/day = 254 ac-ft/d = 128 cfs

Initial Fill Rate = 1.5 * 128 cfs = 192 cfs

This results in a flowrate of approximately 128 cfs. The initial fill rate is estimated as 1.5 * average flow rate which equates to a fill rate of approximately 192 cfs.

C. West Basin Property

The West Basin property is already developed and utilized by the Rosedale-Rio Bravo Water Storage District. However, it is planned to provide recharge capacity for this property from the California Aqueduct and thus this recharge capacity must be accounted for in the conveyance facilities. The proposed West Basin property is located north of Stockdale Highway and is bisected by Bussell Road in Sections 28 and 29, T29S, R25E, M.D.B.&M.

The property consists of approximately 388 acres as illustrated in Figure 6 below.

Figure 6: West Basins Property

The United States Department of Agriculture Soil Conservation Service Soil Survey Maps for the northwestern part of Kern County were reviewed in the area of the West Basin property and the property consists of the following soil type:

- Westhaven Fine Sandy Loam (SCS 245) +/- 388 acres

The acreages noted above are estimates of the soil type across the property. The majority of the soil is:

- Westhaven Fine Sandy Loam (+/- 100% of Property)
  Moderately Slow Permeability

The historic recharge rates for the West Basins were reviewed. An average recharge capacity for the West Basins is approximately 0.5 feet per day.

The existing West Basins Recharge property encompasses approximately 388 acres. It is estimated that there are approximately 280 wetted acres of recharge basins.

It has been demonstrated for the West Basins that an average recharge rate of 0.5 feet per day can be achieved. At the above described recharge rates, the following capacities will be required:

Average Maintenance Rate = 280 acres * 0.5 ft/day = 140 ac-ft/d = 70 cfs

Initial Fill Rate = 1.5 * 70 cfs = 105 cfs

This results in a flowrate of approximately 70 cfs. The initial fill rate is estimated as 1.5 * average flow rate which equates to a fill rate of approximately 105 cfs.

II. In-Lieu (Agricultural) Demands

The Rosedale-Rio Bravo Water Storage District boundary is illustrated in Figure 7 below.

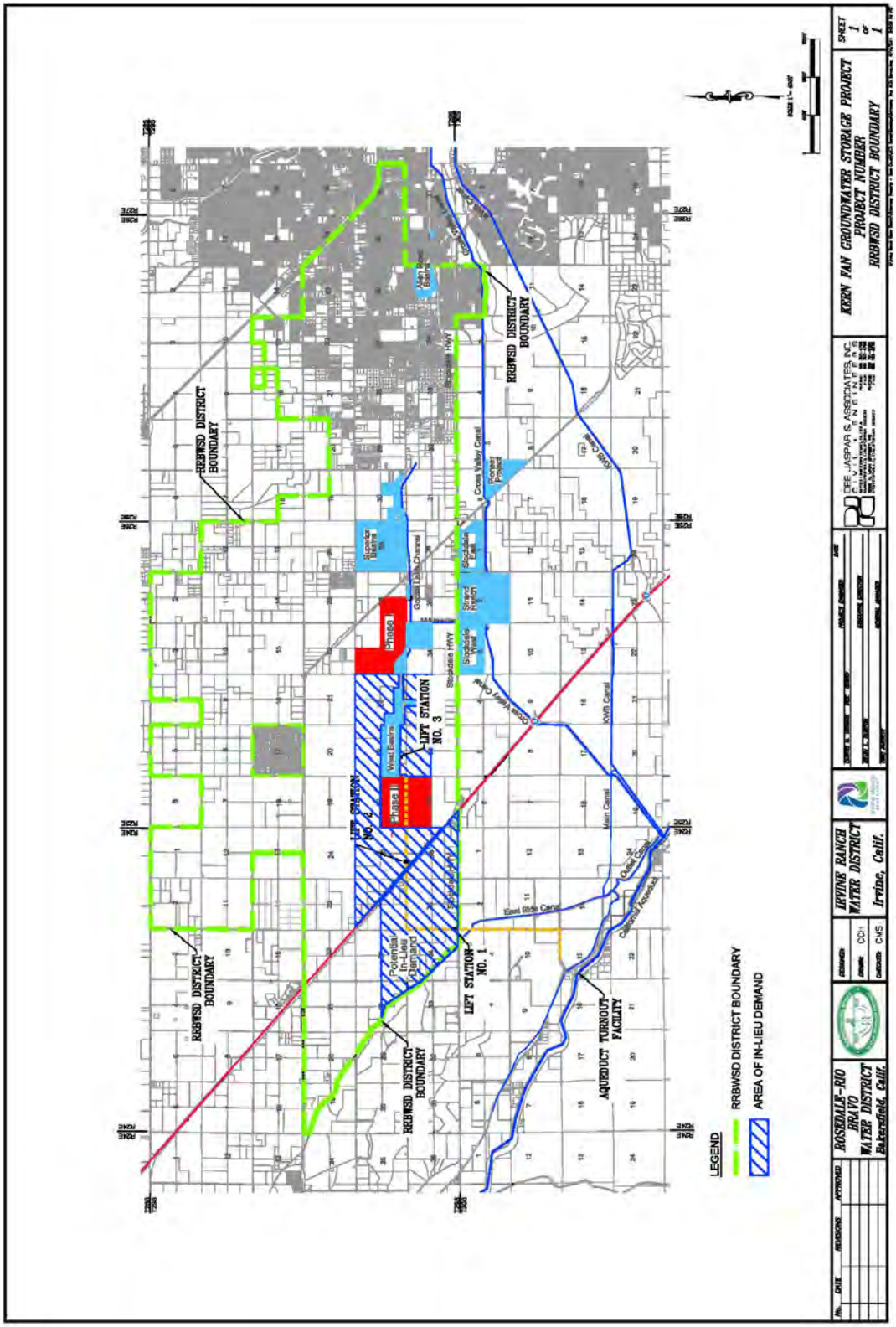

Figure 7: Potential In-Lieu Area

There are approximately 4,889 acres of farmland in the western region of the District, on the west and east sides of Interstate 5, that currently have limited access to surface water.

Due to this lack of infrastructure, these properties rely heavily on groundwater pumping. Implementing in-lieu service areas would enable the District to expand its area of surface water supply. This would achieve the following objectives:

- Allow the District to make greater use of high flow water supplies
- Reduce groundwater pumping
- Improve groundwater levels in the western region of the District

The lands identified herein for in-lieu water are considered adjacent to the proposed conveyance canal and are illustrated in Figure 7 above. The properties west of the I-5 Freeway considered adjacent to the conveyance canal consist of portions of Sections 26, 27, 28, 34, 35, and 36 in T29S, R24E. In addition, the cropping pattern has been estimated as of July 2020, see Table 2 below.

Table 2
Cropping Pattern Adjacent to Canal

Lands West of I-5 Freeway			
Crop	Acreage (acres)	Annual Demand (ac-ft)	Peak Demand (cfs)
Alfalfa	263.2	1174	5.86
Almonds	482.1	1745	10.74
Grape	64.8	172	1.44
Fallow	6.7	24	0.15
Pistachio	1400.1	4746	31.20
Totals:	2216.9	7862	49.39

[1]Water Demand for fallow lands estimated at 3.61 ac-ft/ac to account for development of these lands with surface water supply in future.
[2]Peak demand estimated as 10 gpm/acre.

There are also agricultural properties east of the I-5 Freeway and surrounding the existing West Basins that would likely receive water from the conveyance canal for in-lieu recharge. These lands are in portions of Sections 28, 29, 30, 31, 32, and 33 in T28S, R25E and are shown in Table 3 below.

Table 3
Cropping Pattern Adjacent to Canal

Lands East of I-5 Freeway			
Crop	Acreage (acres)	Annual Demand (ac-ft)	Peak Demand (cfs)
Alfalfa	258.4	1152.2	5.76
Almonds	814.1	2947.0	18.14
Carrots	280.0	700.0	6.24
Corn	600.6	1681.5	13.38
Cotton	249.6	773.6	5.56
Grape	360.0	957.6	8.02
Fallow	109.6	395.7	2.44
Totals:	2672.2	8608	59.54

[1]Water Demand for fallow lands estimated at 3.61 ac-ft/ac to account for development of these lands with surface water supply in future.
[2]Peak demand estimated as 10 gpm/acre.

This is a total in-lieu demand of 109 cfs (49.39 cfs + 59.54 cfs) for lands adjacent to the canal. However, high flow water supplies such as Article 21 water are typically available in wet years around the months of December through May. There is some overlap with the irrigation season noted above, however it avoids overlap with the peak irrigation months of June, July, August, and September as shown below in Table 4. Table 4 has been included to estimate the water demand for agriculture throughout the course of the year and demonstrates how the water demand drops off in the months of November through April.

During the months of January, February, March, and April when the Kern Fan Project would be receiving high flow water supplies and recharging under initial recharge rates, the in-lieu water demand would be a fraction (14% to 41%) of the peak month demands of July and August. Accounting for this limited irrigation demand equates to the need for additional conveyance capacity of approximately 17 cfs (109 cfs x 16%).

Table 4

Estimate of Seasonal Irrigation Demand

Month	Alfalfa		Almonds		Carrots		Corn		Cotton		Grapes		Pistachios		Totals		Estimate of Peak Water Demand Based on 10 gpm/ac
	ETc (in)	Water Use (ac-ft)	ETc (in)	Water Use (ac-ft)	ETc (in)	Water Use (ac-ft)	ETc (in)	Water Use (ac-ft)	ETc (in)	Water Use (ac-ft)	ETc (in)	Water Use (ac-ft)	ETc (in)	Water Use (ac-ft)	Water Use (ac-ft)	% of Peak Month	
Jan	1.11	48.25	1.05	113.42	1.11	25.90	1.11	55.56	1.11	23.09	1.06	37.52	1.05	122.51	400.34	14%	16 cfs
Feb	2.45	106.49	1.15	124.22	0.92	21.47	0.92	46.05	0.92	19.14	0.94	33.28	0.95	110.84	440.01	16%	17 cfs
Mar	4.32	187.78	1.30	140.42	1.20	28.00	1.20	60.06	0.12	2.50	0.52	18.41	0.12	14.00	423.16	15%	17 cfs
Apr	6.19	269.06	4.41	476.35	1.84	42.93	1.83	91.59	1.39	28.91	1.94	68.68	1.69	197.18	1131.77	41%	44 cfs
May	7.55	328.17	6.78	732.35	2.82	65.80	2.84	142.14	1.68	34.94	4.52	160.01	2.75	320.86	1718.48	62%	67 cfs
Jun	7.86	341.65	7.00	756.12	7.94	185.27	7.68	384.38	5.26	109.41	6.46	228.68	6.59	768.89	2589.13	93%	101 cfs
Jul	7.53	327.30	7.32	790.68	8.15	190.17	8.83	441.94	8.92	185.54	6.35	224.79	8.95	1044.24	3014.49	108%	109 cfs
Aug	6.57	285.58	6.00	648.10	2.76	64.40	5.96	298.30	8.10	168.48	5.06	179.12	7.75	904.23	2483.81	89%	97 cfs
Sept	5.13	222.98	4.45	480.67	0.02	0.47	0.46	23.02	5.74	119.39	2.58	91.33	5.73	668.55	1605.95	58%	63 cfs
Oct	2.10	91.28	2.03	219.27	0.33	7.70	0.33	16.52	1.57	32.66	0.51	18.05	3.10	361.69	739.47	27%	29 cfs
Nov	1.40	60.85	0.82	88.57	0.86	20.07	0.86	43.04	0.86	17.89	0.83	29.38	0.87	101.51	341.25	12%	13 cfs
Dec	1.27	55.20	1.10	118.82	1.14	26.60	1.14	57.06	1.14	23.71	1.11	39.29	1.10	128.34	422.43	15%	17 cfs
Totals:	53.48	2324.60	43.41	4689.00	29.09	678.77	33.16	1659.66	36.81	765.65	31.88	1128.55	40.65	4742.84	15310.30		
Average (AC-FT/AC):		4.46		3.62		2.42		2.76		3.07		2.66		3.39			

[1]ETc values used from Table 11 for Zone 15 in a Typical Year from the ITRC California Crop and Soil Evapotranspiration Report

The peak irrigation demand has been estimated as 109 cfs during the month of July. As stated above it is anticipated that high flow supplies will be available beginning around the months of December, January, February, or March. Therefore, an estimated irrigation demand of 17 cfs (Month of February) has been added to the conveyance canal capacity. It is assumed that even if the District is still recharging water through the summer months, that the average maintenance rates will be more appropriate than the fill rates, therefore there will be capacity in the canal for in-lieu recharge.

III. Enns Basins utilizing WB Pipeline Intertie

There is also an existing 27-inch well lateral that connects the West Basin wells to the RRBWSD Intake Canal directly adjacent to the Enns Basins. This pipeline could be utilized during recharge events to convey water to the Enns Basins via pumping from the conveyance canal. The Enns Basins include approximately 175 wetted acres of recharge area. The historic average recharge rate for these basins is 0.62 feet per day which results in a recharge flow rate of 55 cfs. The initial fill rate is estimated as 1.5 * average flow rate which equates to a fill rate of approximately 83 cfs.

Average Maintenance Rate = 175 acres * 0.62 ft/day = 109 ac-ft/d = 55 cfs

Initial Fill Rate = 1.5 * 55 cfs = 83 cfs

However, this conveyance is limited by the carrying capacity of the existing 27-inch well lateral or pipeline intertie. Since a pump station will be required at the conveyance canal, pipeline velocities could be designed to exceed 5 fps in an effort to increase the capacity of the pipeline.

WB Pipeline Capacity = at 5 fps = 20 cfs

WB Pipeline Capacity = at 6 fps = 24 cfs

WB Pipeline Capacity = at 7 fps = 28 cfs

WB Pipeline Capacity = at 8 fps = 32 cfs

In the event a Reach 5 is constructed to supply the Phase I Recharge Property, then it may make more sense to forego the use of the existing 27-inch pipeline and simply supply the Enns Basins from the Reach 5 Facilities or increase the overall reach capacity to the Phase I Property from 105 cfs to 129 cfs so that there is only one additional pump station.

IV. Other Potential Opportunities

There is the potential for other cooperative projects or future projects that could benefit RRBWSD and IRWD, however these have not been evaluated herein. Potential projects could include, but are not limited too:

- Recharge Area Expansion within RRBWSD District Boundary
- Cooperative Projects with the Buena Vista Water Storage District, the Kern Water Bank Authority, or the West Kern Water District

- Conveyance of Aqueduct Water to Stockdale West
- Conveyance of Aqueduct Water to Strand Ranch

V. Pump Stations and Reach Capacities

Three pump stations are currently planned for the conveyance canal which would divide the canal into four reaches.

- Reach One (1) of the conveyance canal begins at the California Aqueduct and ends at Pump Station No. 1 located just north of Stockdale Highway.

  Reach One Capacity is approximately 443 cfs which accounts for the following demands.

  - Phase II Property Initial Fill Rate 192 cfs
  - West Basins Initial Fill Rate 105 cfs
  - In-Lieu Agricultural Recharge 17 cfs
  - Enns Basins -WB Pipeline Intertie 24 cfs
  - Phase I Exchange Capacity 105 cfs

- Reach Two (2) of the conveyance canal begins at Pump Station No. 1 on the north side of Stockdale Highway and ends at Pump Station No. 2 on the east side of the Interstate 5 Freeway.

  Reach Two Capacity and Pump Station No. 1 Capacity is approximately 443 cfs which accounts for the following demands.

  - Phase II Property Initial Fill Rate 192 cfs
  - West Basins Initial Fill Rate 105 cfs
  - In-Lieu Agricultural Recharge 17 cfs
  - Enns Basins -WB Pipeline Intertie 24 cfs
  - Phase I Exchange Capacity 105 cfs

- Reach Three (3) of the conveyance canal begins at Pump Station No. 2 located on the east side of the Interstate 5 Freeway and ends at Pump Station No. 3 near the west end of the West Basins.

  Reach Three Capacity and Pump Station No. 2 Capacity is approximately 435 cfs which accounts for the following demands:

  - Phase II Property Initial Fill Rate 192 cfs
  - West Basins Initial Fill Rate 105 cfs
  - In-Lieu Agricultural Recharge 9 cfs
  - Enns Basins -WB Pipeline Intertie 24 cfs
  - Phase I Exchange Capacity 105 cfs

- Reach Four (4) of the conveyance canal begins at Pump Station No. 3 located near the west end of the West Basins and ends at the West Basins Turnout at the east end of the West Basins.

  Reach Four Capacity and Pump Station No. 3 Capacity is approximately 240 cfs which accounts for the following demands:

  - West Basins Initial Fill Rate 105 cfs
  - In-Lieu Agricultural Recharge 6 cfs
  - Enns Basins -WB Pipeline Intertie 24 cfs
  - Phase I Exchange Capacity 105 cfs

VI. Summary

The conveyance canal will need to provide capacity for the following uses:

- In-Lieu Agricultural Demand 17 cfs
- Phase II Property Recharge 192 cfs
- West Basins Property Recharge 105 cfs
- Enns Basins – WB Pipeline Intertie 24 cfs
- Phase I Exchange Capacity (Potential Reach 5) 105 cfs

The conveyance capacity and associated pump station capacity would decrease as these demands are accounted for. These reach capacities are summarized in Table 5 and illustrated in Figure 11.

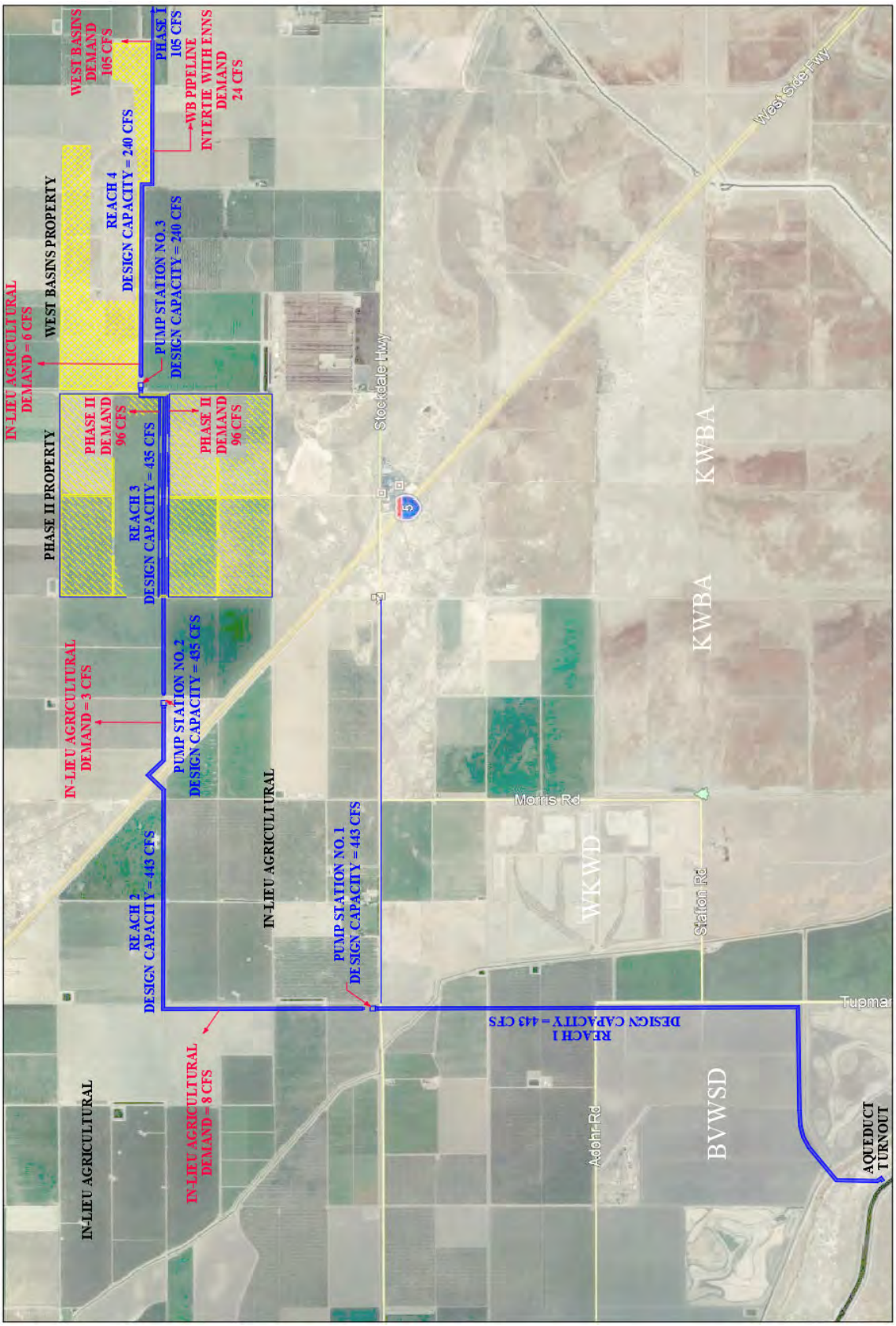

Figure 8: Conveyance Canal Demands and Capacities

A summary of the conveyance capacities is shown below in Table 5:

Table 5
Conveyance Canal Design Capacity

Conveyance Canal Facility	Design Canal Capacity	Design Pump Station Capacity
Reach 1	443 cfs	
Reach 2	443 cfs	443 cfs
Reach 3	435 cfs	435 cfs
Reach 4	240 cfs	240 cfs
Reach 5, if necessary	129 cfs	129 cfs

As described herein, Article 21 water supply is typically available in the months of December, January, February, March, April and May. Beyond these months of the year it is anticipated that the recharge areas would be at the maintenance rates rather than the initial fill rates.

The agricultural demands are typically the highest during the months of June, July, August, and September.

Table 6 illustrates the conveyance canal demands throughout the year for a 1) wet year or above normal year, 2) below normal wet year, and 3) for a dry or critical year. The anticipated peak flow of the conveyance canal is 443 cfs.

In wet years and above normal years, the conveyance canal is able to supply 100% of the average "in-lieu" agricultural demand as the recharge decreases to the estimated maintenance rates. While in below normal years and dry or critical years, the conveyance canal is able to supply 100% of the average "in-lieu" agricultural demand as water is available.

Table 6

Estimated Maximum Conveyance Canal Capacity by Month

Demand Description	January	February	March	April [2]	May	June	July	August	September	October	November	December
Recharge Operations (Wet Year or Above Normal Year)[3]	426	426	426	354	282	282	282	282	282	282	282	426
In-Lieu Agricultural[1]	16	17	17	44	67	101	109	97	63	29	13	17
Monthly Totals (Wet Year or Above Normal Year):	**442**	**443**	**443**	**398**	**349**	**383**	**391**	**379**	**345**	**311**	**295**	**443**
Recharge Operations (Below Normal Year)[3]	0	0	426	0	0	0	0	0	0	0	0	0
In-Lieu Agricultural[1]	16	17	17	44	67	101	109	97	63	29	13	17
Monthly Totals (Below Normal Year):	**16**	**17**	**443**	**44**	**67**	**101**	**109**	**97**	**63**	**29**	**13**	**17**
Recharge Operations (Dry or Critical Year)	0	0	0	0	0	0	0	0	0	0	0	0
In-Lieu Agricultural[1]	16	17	17	44	67	101	109	97	63	29	13	17
Monthly Totals (Dry or Critical Year):	**16**	**17**	**17**	**44**	**67**	**101**	**109**	**97**	**63**	**29**	**13**	**17**

[1]The "In-Lieu" agricultural demand is the average demand based upon land area, cropping pattern, and monthly Et_c.

[2]The recharge demand for the month of April is an interpolation between the fill rate of 426 cfs in March and the maintenance rate of 282 cfs in May.

[3]The months of December through April are based upon Article 21 supplies being available for recharge up to the estimated filling rate. The months of May through November are the maintenance rates and are based on other water supplies besides Article 21 water.

VII. Related Work Specified Elsewhere

A. TM 3 – Pipeline Requirements
B. TM 4 – Pump Station Requirements
C. TM 5 – Geotechnical Investigation
D. TM 6 - Canal Liner and Turnout Requirements
E. TM 8 - ROW Acquisitions
F. TM 11 – Facility Operation and SCADA Requirements
G. TM 12- Engineer's Estimates

Appendices

Appendix A – Original Project Description
Appendix B - tTEM Results on portion of Phase I Property

Appendix A
Project Description

The Kern Fan Groundwater Storage Project (Project) consists of a regional water bank in the Kern County Groundwater Sub-basin of the San Joaquin Groundwater Basin in Kern County, California that will provide water supply, groundwater and ecosystem benefits. Project facilities will be planned, designed, constructed, owned, and operated by the Kern Fan Joint Powers Authority (JPA) that consists of representatives from the Irvine Ranch Water District (IRWD) and the Rosedale-Rio Bravo Water Storage District (RRBWSD). IRWD and RRBWSD share a ten-year history of implementing successful water banking projects in Kern County. The Project concept, sizing, location, features and operations are based on the experience and knowledge gained from IRWD's and RRBWSD's existing water banking projects.

The total storage capacity to be developed by the Project is anticipated to be 100,000 acre-feet. The Project will be supplied primarily by the State Water Project's supplies that exceed the SWP Contractors allocation during a wet year (Article 21 supplies) and also by other wet-year water supplies as available, including Kern River water. In wet years, when it is declared available by the California Department of Water Resources (DWR), the JPA will take delivery of Article 21 supplies to store in the Project. IRWD and RRBWSD will equally share 75 percent of the Article 21 water delivered into storage for water supply and groundwater benefits. The remaining 25 percent of the stored Article 21 water will be held as State Water Project (SWP) system water that will be used for ecosystem benefit purposes. The ecosystem benefits will be derived by exchanging water from the Kern Fan Project to Oroville Reservoir where they will be released as needed for short term pulse flows. This exchange will be coordinated through a separate agreement.

Other water supplies that could be available for the Project include other SWP supplies diverted from the California Aqueduct, as well as other supply sources including Central Valley Project Section 215 flood water and high-flow Kern River water.

The Project objectives are to cost-efficiently recharge and store groundwater for subsequent recovery to address the following:

- Enhance water supply reliability;
- Reduce imported water demands on the San Francisco Bay/Sacramento –San Joaquin Delta Estuary (Delta) to benefit spring and winter-run Chinook salmon;
- Provide water supply during drought conditions;
- Provide water supply for emergency response benefits;
- Establish temporary wetlands through intermittent recharge events that will attract migratory and other water fowl in Kern County;
- Benefit the water levels in the Kern County Groundwater Sub-basin;
- Provide sustainable water supply for local agricultural use; and
- Be integrated into other water storage projects and storage reservoirs to provide greater statewide benefits.

The Project involves purchasing approximately 640 acres of land mostly within the Rosedale Rio Bravo Water Storage District (RRBWSD) boundary and within the limits of the Stockdale Integrated Banking Project Environmental Impact Report (EIR). Water will be conveyed to this property for recharge from the Friant-Kern Canal or the Kern River by exchange via the Goose Lake Channel or from the Cross Valley Canal (CVC) via the RRBWSD Intake Canal. An interconnection pipeline will be constructed from the RRBWSD Intake Canal to the proposed property to connect the two. A new check structure will be required in the Goose Lake Channel with a reinforced concrete turnout structure constructed behind it to convey water from the Goose Lake Channel to the Phase I property. This turnout structure will include a lift station with four 60 cfs pumps each equipped with 200 hp vertical motors to lift the water up to the Phase I property for recharge and include discharge piping, metering, appurtenances, lighting, electrical, controls, and SCADA communication. The anticipated recharge at this proposed property will initially be 230 cfs (0.7 ft/d of recharge) and then drop to an approximate maintenance rate of 115 cfs (0.35 ft/d of recharge).

The Phase I property will be developed for recharging ground water and the construction work will include site clearing and grubbing, installation of site fencing and gates, construction of earthen levees, construction of inter-basin structures and conveyance facilities, rip-rap, and existing well abandonments. In addition the property will be equipped with up to six recovery wells with an approximate capacity of 5 to 6 cfs each. These will be 20-inch diameter wells cased to approximately 930-ft. The wells will be equipped with vertical turbine pumps, 400 hp vertical hollowshaft motors, discharge piping, appurtenances, electrical and controls, and site improvements. The underground well conveyance piping will be PVC pipe ranging in size from 12-inch to 30-inch diameter. The recovery wells will return water through a conveyance pipeline that crosses the Goose Lake Channel and discharges into the RRBWSD Intake Canal whereby the water is returned to the Cross Valley Canal (CVC) for delivery or exchange to the California Aqueduct.

In order to have capacity in the Goose Lake Channel to recharge water to the Phase I property it is proposed to supply water to the existing RRBWSD West Basins by an alternate means. Due to limited capacity in the Goose Lake Channel and the CVC it is planned to construct a new reinforced concrete turnout at the California Aqueduct and convey 500 cfs approximately 9.0 miles to the easterly end of the RRBWSD West Basins. The 500 cfs capacity will account for initial recharge to the West Basins of approximately 120 cfs, initial recharge to the Phase II Property of approximately 230 cfs, and potential in lieu recharge water to District farmlands. The approximate water surface elevation at the California Aqueduct is 305-ft. The approximate elevation at the east end of the West Basins is 315-ft therefore requiring an approximate static lift of 10-feet. This water supply will be conveyed in a new canal with the approximate dimensions of a 20-ft wide bottom, 8-ft depth, and 1.5:1 side slopes. A habitat conservation plan (HCP) and mitigation credit for the conveyance easement equal to approximately 100 acres is included. The canal will be concrete lined and have siphon crossings at the following major locations:

- Outlet Canal & West Side Canal
- Adohr Road
- East Side Canal
- Stockdale Highway
- Interstate 5 Freeway
- Miscellaneous Levee Roads and Farm Roads

The canal is planned to be concrete lined in an effort to minimize weeds, debris, and sediment in the siphon crossings and the lift station forebays. Furthermore the concrete lining has the longest useful life. The canal will have three lift stations along the alignment to lift water to the recharge basins. It is estimated that the first lift station will consist of a reinforced concrete pump station with two 30 cfs low lift pumps with 100 hp motors, two 60 cfs low lift pumps with 200 hp motors, and four 80 cfs low lift pumps with 300 hp vertical motors, discharge piping and appurtenances, electrical and controls in order to convey 500 cfs to the east side of the I-5 Freeway. The second lift station will consist of a reinforced concrete pump station with two 30 cfs low lift pumps with 100 hp motors, two 60 cfs low lift pumps with 200 hp motors, and four 80 cfs low lift pumps with 300 hp vertical motors, discharge piping and appurtenances, electrical and controls in order to convey 500 cfs to the west end of the West Basins and to the Phase II Recharge Property. The third lift station will consist of a reinforced concrete pump station with two 30 cfs low lift pumps with 100 hp motors, two 60 cfs low lift pumps with 200 hp motors, and four 80 cfs low lift pumps with 300 hp vertical motors, discharge piping and appurtenances, electrical and controls in order to convey 500 cfs to the east end of the West Basins and the Goose Lake Channel. Each lift station will also include a gravity bypass line with slide gate into the lift station structure for the reverse flow of recovered water back to the California Aqueduct.

A reinforced concrete turnout structure for approximately 420 cfs will be constructed at the east end of the West Basins to convey recharge water to the West Basins and to the Goose Lake Channel if necessary. This structure will be equipped such that recovered water from the WB wells can be returned through the canal conveyance facility to the California Aqueduct.

In addition, the Project involves purchasing approximately 640 acres of Phase II land located within the Rosedale Rio Bravo Water Storage District boundary but outside of the limits of the Stockdale Integrated Banking Project EIR. Water will then be conveyed to this property from the California Aqueduct via the new canal.

The Phase II property will be developed for the recharge and recovery of ground water. The anticipated recharge at this property will initially be approximately 230 cfs (0.7 ac-ft/d) and then drop to an approximate maintenance rate of 115 cfs (0.35 ac-ft/d). The scope of work for construction will include site clearing and grubbing, installation of site fencing and gates, construction of earthen levees, construction of inter-basin structures and conveyance facilities, rip-rap, and existing well abandonments. In addition the property will be equipped with six recovery wells with an approximate capacity of 5 to 6

cfs each. These will be 20-inch diameter wells cased to approximately 930-ft. The wells will be equipped with vertical turbine pumps, 400 hp vertical hollowshaft motors, discharge piping, appurtenances, electrical and controls, and site improvements. The underground well conveyance piping will be PVC pipe ranging in size from 12-inch to 30-inch diameter. The recovery wells will pump water through conveyance pipelines back to the new canal and reverse flow water in the canal by gravity to return water to the California Aqueduct. At the California Aqueduct turnout afterbay facility, a small lift station will be constructed to lift water into the turnout pipeline and convey the water back to the California Aqueduct.

The proposed Project will also include the construction of a SCADA system to aid in the operations of the Aqueduct turnout, the canal lift stations, the turnout facilities to the groundwater banking properties, and the recovery water well facilities. This will include PLC's, radio communication, computer station at a central headquarters, and control programming.

Appendix B
tTEM Results on portion of Phase I Property

The tTEM method measures the electrical resistivity of the earth. To assess the lithology below the ground surface, the resistivities measured by the receivers must be translated to lithologies. Translating resistivities to lithology is based on a general correlation between resistivity and type of sediments. Impermeable clay has a low resistivity. Sandy clay typically results in a resistivity ranging from 30 to 100 ohm-m, while sand to coarse sand has a resistivity above 50 ohm-m. This correlation is a general assumption and can vary between locations. For purposes of the figures below, from the Ramboll study, the resistivities are color coded, see Figure 2.

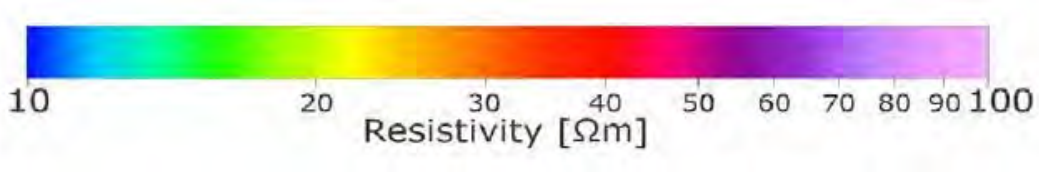

Figure 1: Resistivity Color Scale

It is estimated that clays are typically below 15 ohm-m (blue, light blue), silt layers are found to vary significantly from 10 – 40 ohm-m (green, yellow, orange, red), and sands and/or gravels are typically above 40 ohm-m (pink, purple). The large variations for the silt layers are interpreted to reflect the clay content, either as thin interbedded clay sequences or as a mixture of silt and clay.

The data surveyed indicates the southern half of Section 27 is interpreted mostly as clay and silts at depths to 13-feet below ground surface. See figures 2 and 3 below.

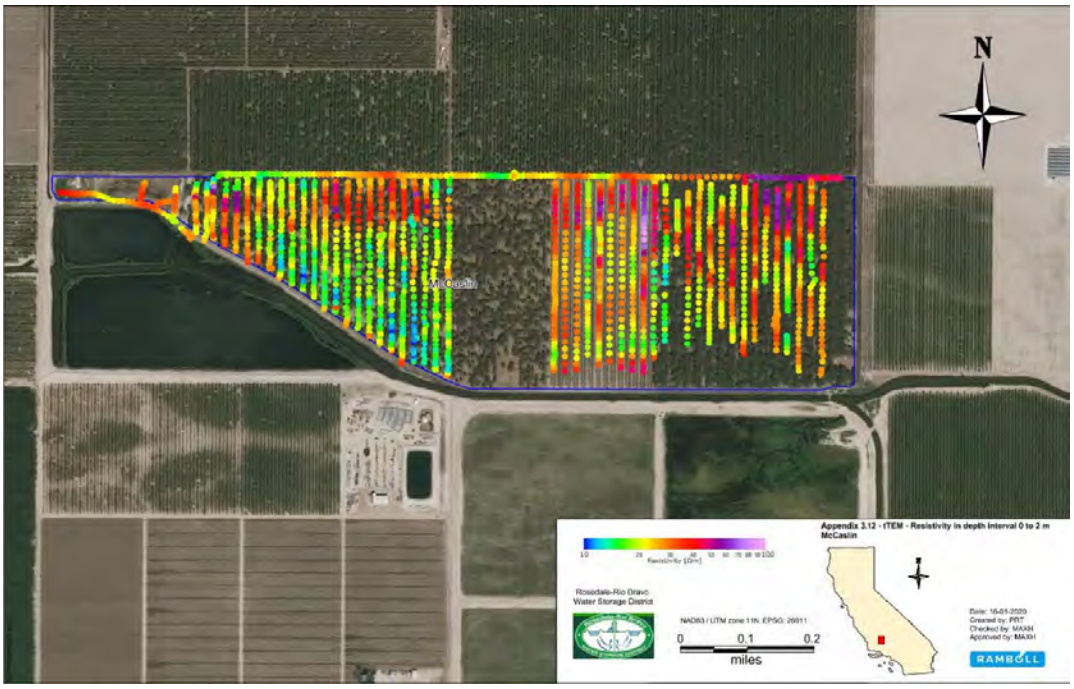

Figure 2: Depths of 0-feet to 6.5-feet

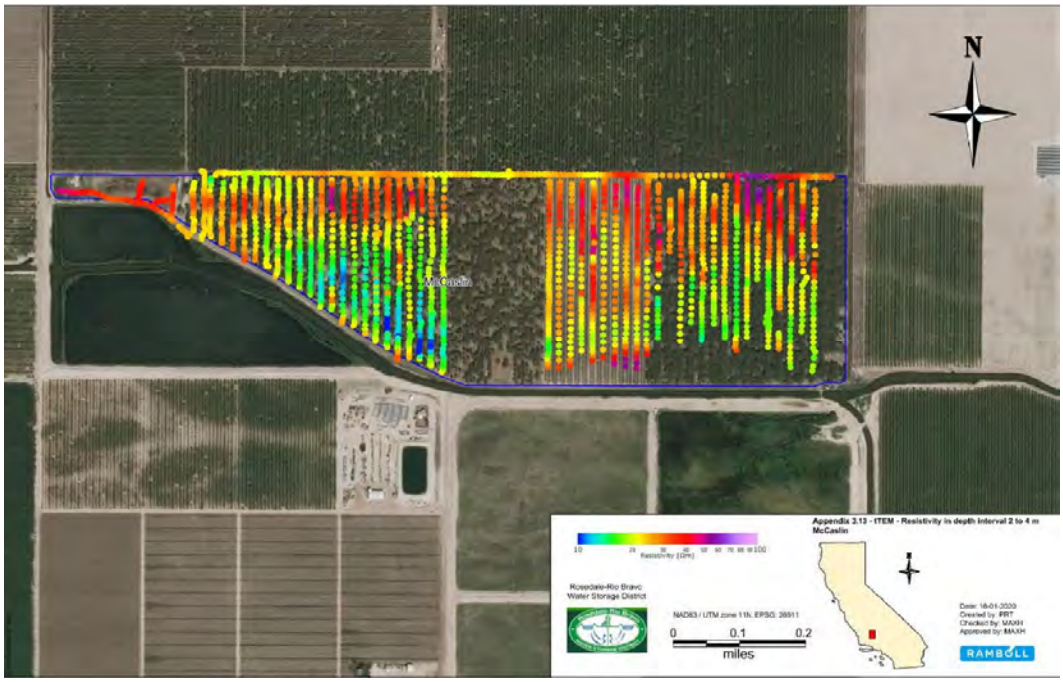

Figure 3: Depths of 6.5-feet to 13-feet

The depth interval from 13-feet to approximately 32-feet begins to transition from the silt and clays to coarser material, see Figures 4 and 5.

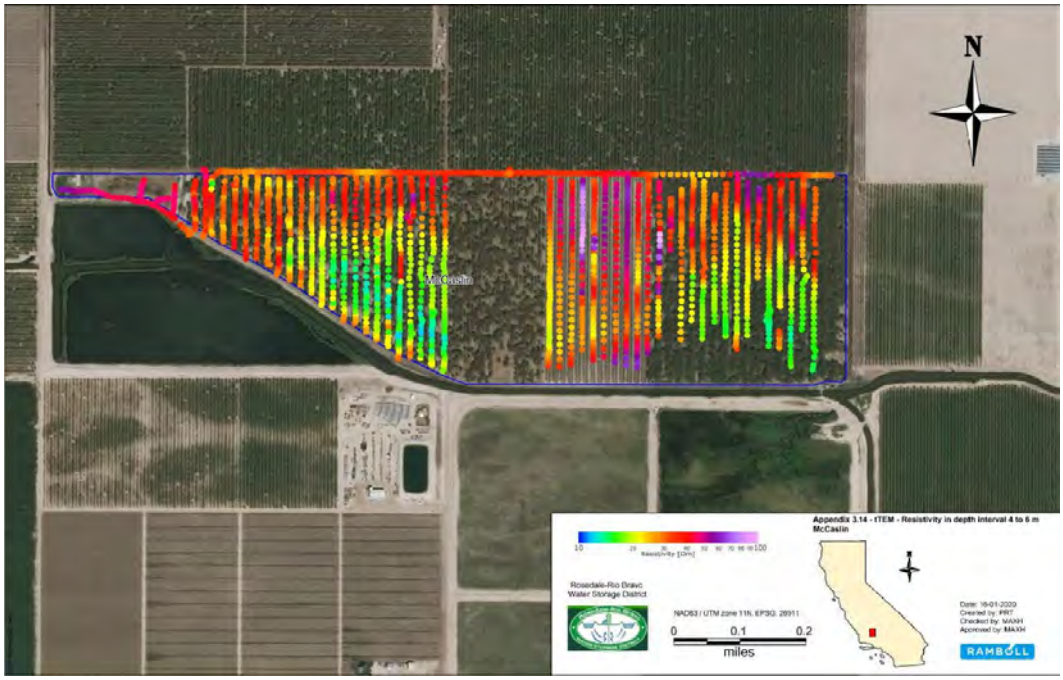

Figure 4: Depths of 13-feet to 20-feet

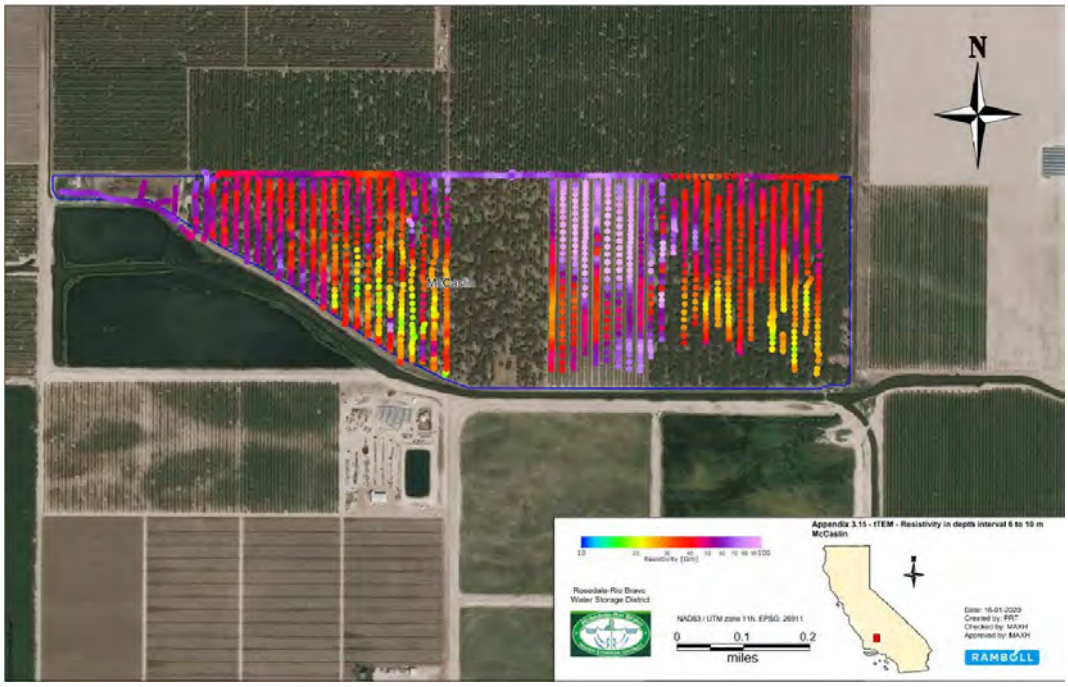

Figure 5: Depths of 20-feet to 32-feet

The depth interval from 32-feet to 65-feet illustrates coarse sands and gravels throughout the majority of the southern half of Section 27 as shown in Figures 6 and 7.

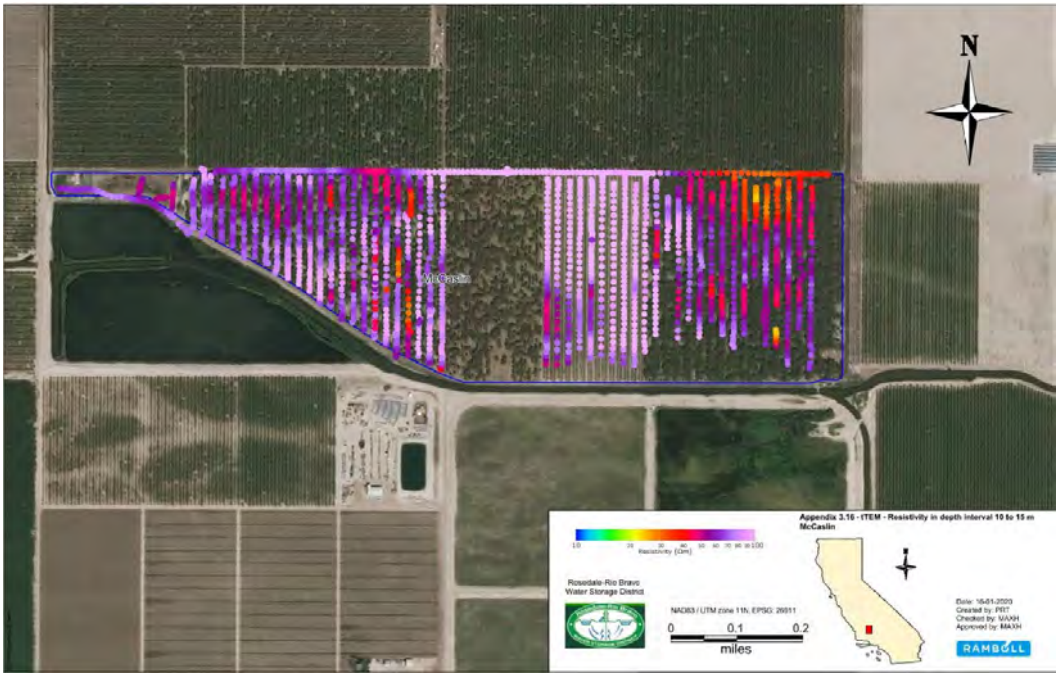

Figure 6: Depths of 32-feet to 49-feet

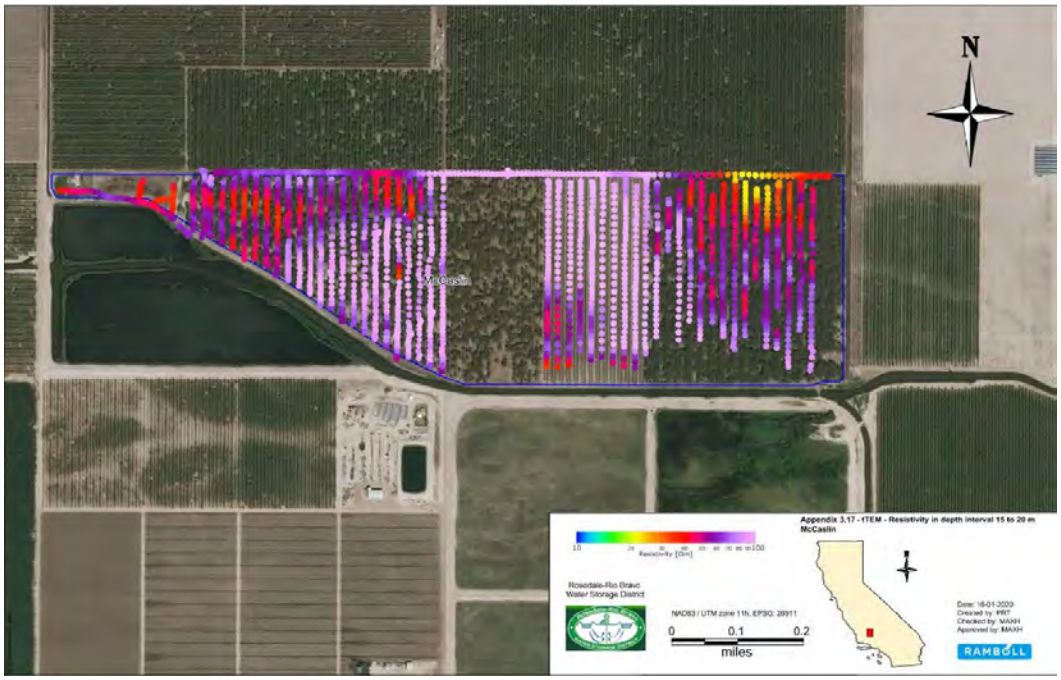

Figure 7: Depths of 49-feet to 65-feet

The depth interval from 65-feet to 82-feet below ground surface shows a large area in the central part as being coarse sand material. To the northwest and eastern parts of the south half of Section 27, the resistivities tend to be slightly lower, indicating finer material, see Figure 8.

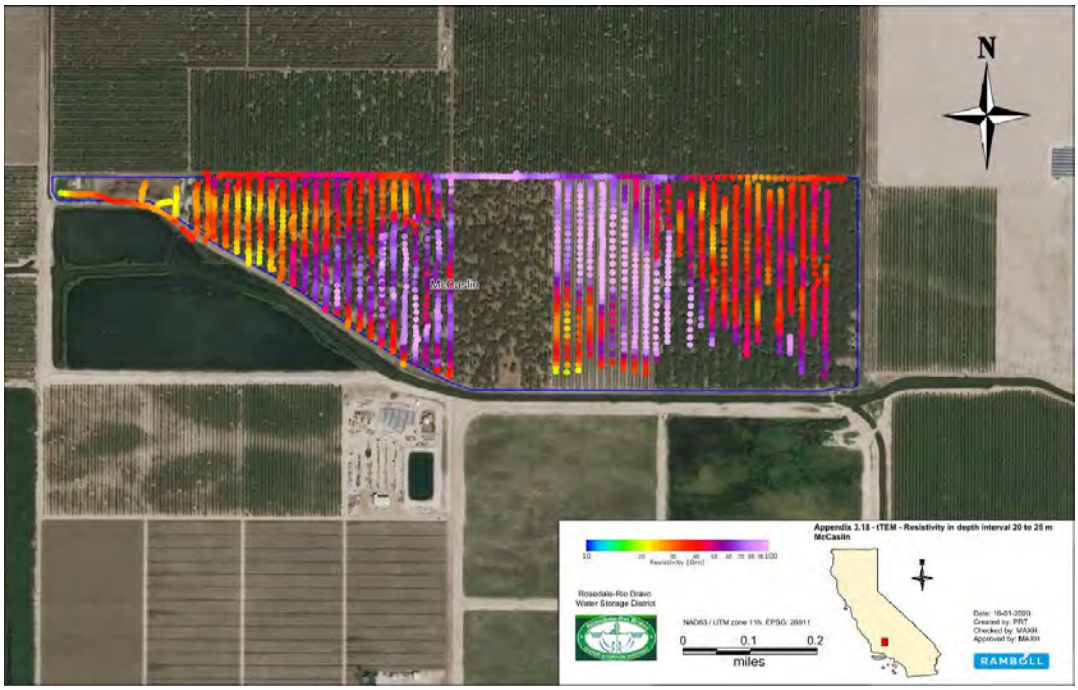

Figure 8: Depths of 65-feet to 82-feet

Beyond a depth of approximately 82-feet the material begins to transition back to a finer, siltier material with some clay, see Figures 9 through 12.

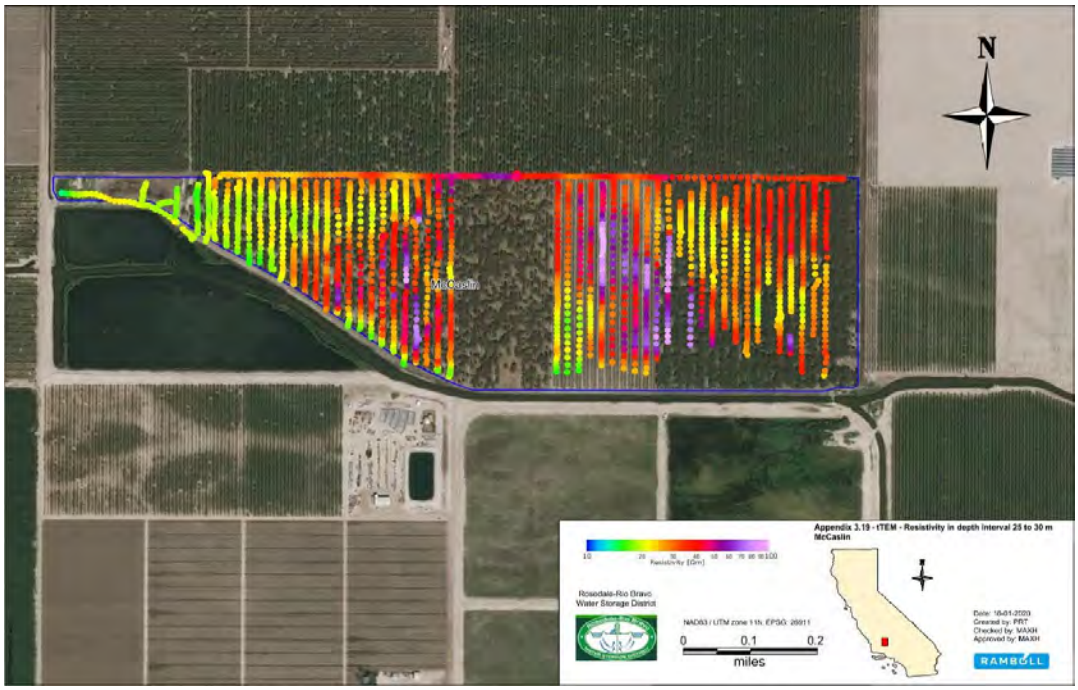

Figure 9: Depths of 82-feet to 98-feet

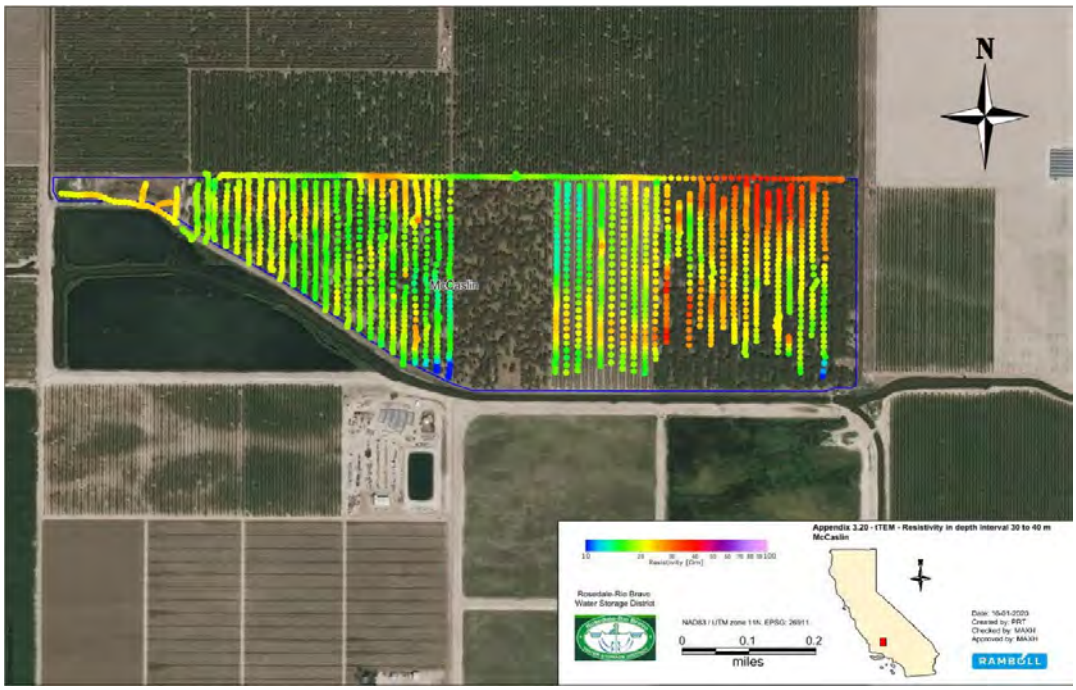

Figure 10: Depths of 98-feet to 131-feet

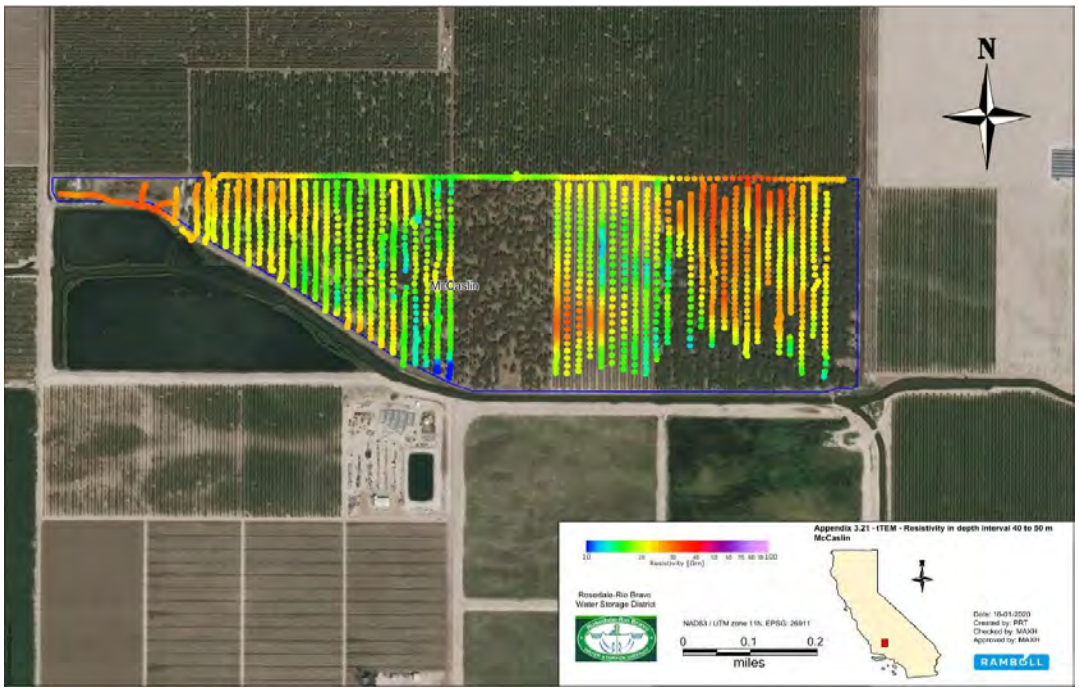

Figure 11: Depths of 131-feet to 164-feet

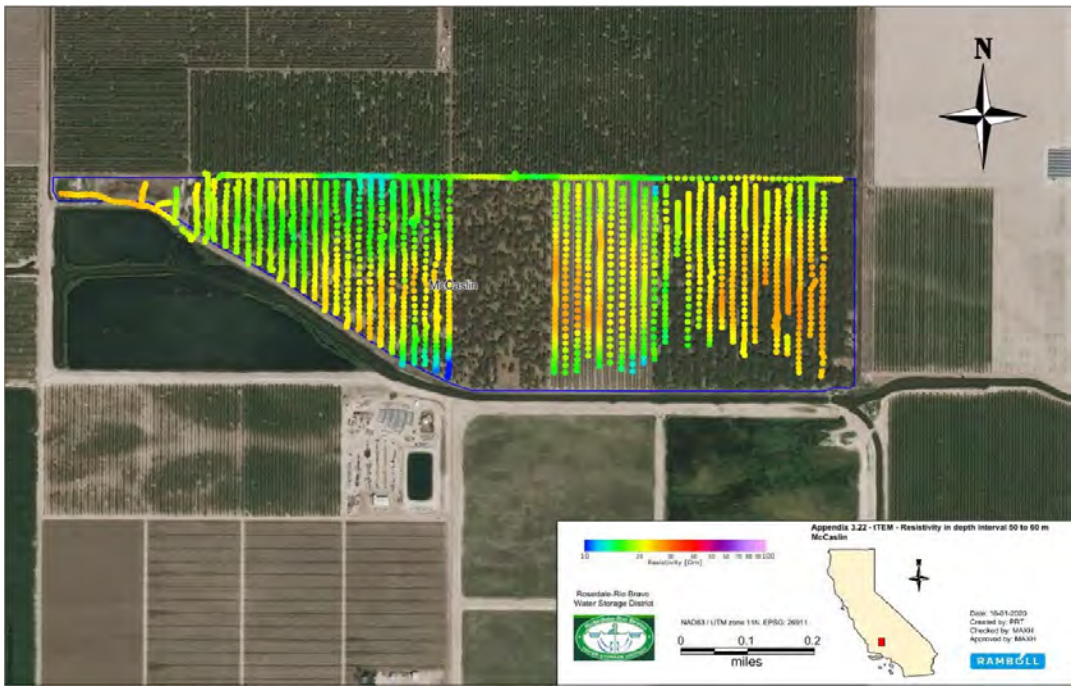

Figure 12: Depths of 164-feet to 197-feet

The average resistivity for the southern half of Section 27 is approximately 25.1 ohm-m. Figure 13 below illustrates the lithology vertically based on elevation and shows how the top 90-feet to 100-feet has coarser material well suited for groundwater recharge.

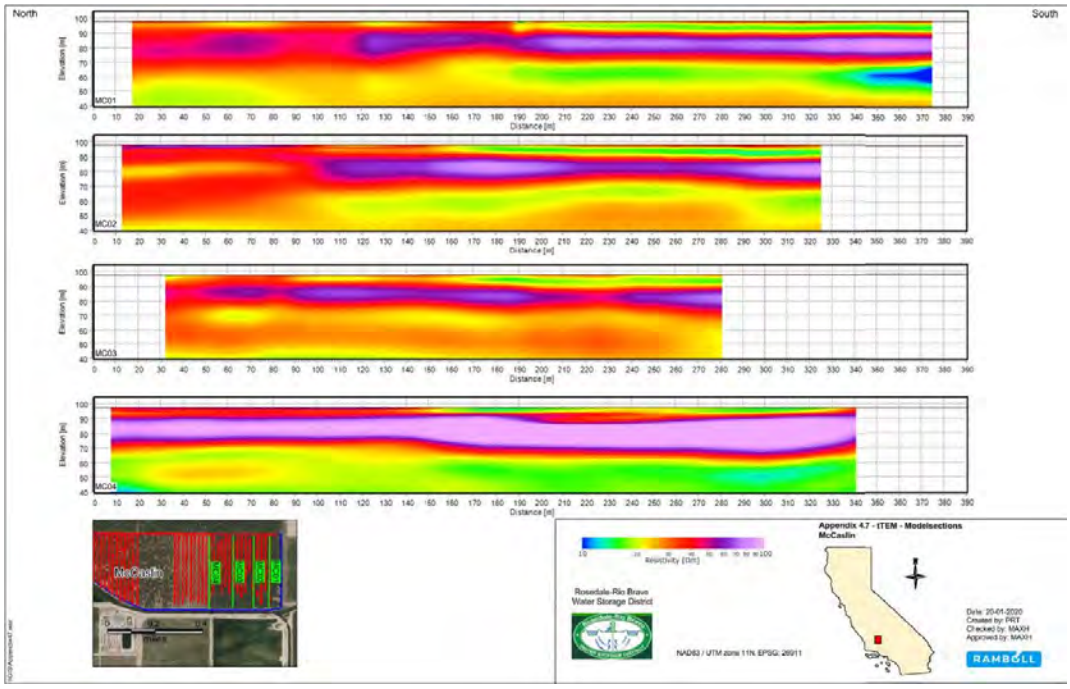

Figure 13: Model Sections of Southern Half of Section 27

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KERN FAN GROUNDWATER STORAGE PROJECT

TECHNICAL MEMORANDUM NO. 3
(Pipeline Requirements)

PREPARED FOR: Groundwater Banking Joint Powers Authority (JPA)
PREPARED BY: Curtis Skaggs, P.E.
DATE: November 23, 2020

SUBJECT: ***Pipeline Requirements***

I. Executive Summary

The successful performance of any pipe generally depends on:

1) proper selection of the type of pipe and class of pipe for the application
2) proper sizing of the pipeline for the hydraulic conditions
3) type of bedding and backfill material
4) proper installation and care of bedding, backfill, and compaction
5) pipeline venting to protect the pipeline system and maintain its efficiency
6) corrosion implications and protection

This memorandum serves to address some of the items above and provide the basis for the pipeline design and the preliminary Engineer's Estimate. The type of pipe and sizes of pipe recommended herein are preliminary and subject to change. The project designer shall review and evaluate the findings herein and will ultimately be responsible for the final design thereof.

The table below summarizes the project facility, the type of pipe recommended, and the estimated pipe size. The pipeline installation, bedding, backfill, and compaction will be addressed during the engineering design phase as part of the detailed project technical specifications.

Project Facility	Nominal Pipe Size	Pipe Type
Aqueduct Turnout	108-inch	D50 Dry Cast RCP
Adohr Road Siphon	120-inch	C25 Dry Cast RCP
East Side Canal Siphon	120-inch	C25 Dry Cast RCP
Reach 2 Farm Road Siphon	120-inch	C25 Dry Cast RCP
Reach 3 Farm Road Siphon	120-inch	C25 Dry Cast RCP
Reach 4 Farm Road Siphon	90-inch	C25 Dry Cast RCP
Stockdale Hwy Cased Crossing Carrier Pipe	120-inch	D25 Dry Cast RCP
I-5 Fwy Cased Crossing Carrier Pipe	120-inch	D25 Dry Cast RCP
Reach 4 Conveyance Piping	63-inch and 54-inch	DR41 HDPE
Phase II Turnout	48-inch	ADS N12 WT HDPE
West Basins Turnout (Open Channel Design)	48-inch (2 Barrels)	ADS N12 WT HDPE
West Basins Turnout (Closed Conduit Design)	36-inch	DR41 HDPE
Phase I Turnout (Open Channel Design)	48-inch (2 Barrels)	ADS N12 WT HDPE
Phase I Turnout (Closed Conduit Design)	54-inch	DR41 HDPE
Well Conveyance Pipelines	15-inch to 27-inch	SDR51 PIP PVC
Well Conveyance Pipelines	30-inch to 36-inch	DR51 C900 PVC or DR41 HDPE
Interbasin Piping	36-inch and 48-inch	ADS N12 WT HDPE
In-Lieu Turnout Piping	24-inch	ADS N12 WT HDPE

1. *The "D" class of pipe is a conservative assumption at this stage in the design. The RCP pipe classification shall be re-evaluated during detailed design and be based on actual design elevations, earth cover, and operating conditions.*
2. *The project shall prepare for bid alternatives for pipe sizes and structures where more than one alternative is an option and close in pricing such as for the Reach 4 Conveyance Canal Piping, the Well Conveyance Pipelines, and Road Crossings and Bridges or Box Culverts.*

Pipeline venting is not addressed herein, however it will need to be considered during the engineering design. The pipeline must have the ability to vent large volumes of air during filling or startup, release accumulations of air during operation, and allow air back into the pipeline at times to prevent negative pressures. Similarly, corrosion protection is not addressed in detail herein, but shall be considered during the engineering design where steel pipelines and appurtenances are installed below ground.

Section II of this memorandum discusses the different types of pipe materials:

Section III then briefly discusses the types of crossings such as trenchless pipe installations, siphon or road pipe crossings, box culverts, or bridges

Section IV evaluates the pipe types and pipe sizes for the primary project components as outlined below:

Cost estimates utilized herein are preliminary and only for purposes of the preliminary engineering work. Budgetary pipe material costs have been obtained as of September and October 2020 and installation cost estimates utilized from previous projects similar in nature. It is understood that these costs are subject to change based on the actual project conditions and engineering design, actual quantities to be installed, external global impacts to material pricing, and other unforeseen circumstances. Therefore, it is recommended to verify pipeline material costs in the design phase and to consider bidding multiple pipe material options for those close in cost.

II. PIPE MATERIALS

A. PVC Pipe

PVC pipe is an ideal pipe material for certain aspects of this project as it is a corrosion resistant material, is suitable for these water temperatures and water quality parameters, and is easy to install.

There are many types of PVC pipe, however for water pressure pipe the most common types of pipe are AWWA pressure pipe and ASTM pressure pipe. A roughness coefficient of 0.010 and a Hazen-Williams coefficient of 150 was used for PVC pipe per the McGraw-Hill Hydraulic Design Handbook.

AWWA pressure pipe is governed by the standards, AWWA C900 and C909, and use cast-iron pipe size outside diameters. This diameter regimen is compatible with both cast-iron pipe and ductile-iron pipe.

ASTM pressure pipe is governed by the standard, ASTM D2241, and is also referred to as plastic irrigation pipe (PIP). This diameter regimen is compatible with iron pipe sizes or steel pipe.

The above noted types of pipe have varying pressure classes, pipe wall thicknesses, and available diameters. For purposes of cost comparison, it has been assumed that a pressure class of 80 psi will be adequate for the applications that PVC pipe would be installed in, i.e. turnouts, well conveyance pipelines, etc. Specific pipe classes and costs however, are discussed in greater detail under Section IV Facility Piping.

a) Size Ranges and Availability

Plastic Irrigation Pipe (PIP)

Plastic Irrigation Pipe (PIP) is available in size ranges from 12-inch diameter to 27-inch diameter. The size chart below is for a standard dimension ratio (SDR) of 51. The dimension ratio defines a constant ratio between the outer pipe diameter and the pipe wall thickness thus providing a simple means of specifying product dimensions to maintain constant mechanical properties regardless of pipe size. The pressure class for ASTM D2241 SDR51 pipe is 80 psig.

Table 1

Kern Fan Project PIP Pipe Data (SDR51 PC 80)				
Nominal Diameter (in)	O.D.	I.D.	Capacity at Velocity = 5 fps	Capacity at Velocity = 6 fps
12	12.24	11.73	3.8	4.5
15	15.30	14.66	5.9	7.0
18	18.70	17.92	8.8	10.5
21	22.05	21.13	12.2	14.6
24	24.80	23.77	15.4	18.5
27	27.95	26.79	19.6	23.5
30	NA	NA	NA	NA
36	NA	NA	NA	NA
42	NA	NA	NA	NA
48	NA	NA	NA	NA

The PIP pipe size availability will likely mean that this pipe is not a suitable alternative for turnout piping. However, it would work for the well conveyance pipelines that are 27-inch diameter and smaller. Assuming, 6 cfs per well, it is likely that this pipe would work for connecting up to 3 wells maximum.

The PIP pipe is also advantageous as it is readily available locally since it is the typical pipe used by agricultural contractors in the area and most contractors are experienced with its installation.

The PIP pipe fittings used by the District are typically Gheen or Morrill stainless steel fittings, or equivalent. This is a result of past experience with coating issues on the Gheen fittings.

C900 PVC Pipe

AWWA C900 PVC pipe is available in size ranges from 12-inch diameter to 60-inch diameter. The largest size available in the previous C905-10 standard was 48-inch, however the revised C900-16 standard added two larger pipe sizes – 54-inch and 60-inch. The size chart below is for a dimension ratio (DR) of 41 and 51. The dimension ratio defines a constant ratio between the outer pipe diameter and the pipe wall thickness thus providing a simple means of specifying product dimensions to maintain constant mechanical properties regardless of pipe size. The pressure class for AWWA C900 DR41 pipe is 100 psig and is for the 54-inch and 60-inch pipe. The AWWA C900 DR51 pipe is 80 psig and is for the 30-inch through 48-inch pipe.

Table 2

Kern Fan Project PVC Pipe Data (DR51 PC 80)				
Nominal Diameter (in)	O.D.	I.D.	Capacity at Velocity = 5 fps	Capacity at Velocity = 6 fps
30	32.00	30.67	25.6	30.8
36	38.30	36.71	36.7	44.1
42	44.50	42.65	49.6	59.5
48	50.80	49.69	67.3	80.8

Table 2A

Kern Fan Project PVC Pipe Data (DR41 PC 100)				
Nominal Diameter (in)	O.D.	I.D.	Capacity at Velocity = 5 fps	Capacity at Velocity = 6 fps
54	57.56	54.02	79.6	95.5
60	61.61	57.82	91.2	109.4

The C900 PVC pipe availability allows for capacities upwards of 90 to 110 cfs. This piping is an option for recharge facility turnouts, interbasin structures, "in-lieu" turnouts, and well conveyance pipelines.

The C900 PVC pipe fittings are typically ductile iron fittings and film wrapped below grade to prevent corrosion.

b) Limitations/Concerns

PVC pipe is often a cost effective, corrosion resistant, and trouble-free option for pipeline projects. Limitations or concerns for the use of PVC pipe would include:

- Water temperatures greater than 73°F require the pressure de-rating of the pipe.
- Pipe installation requires adequate compaction and support around the pipe haunches and springline.
- Heavy equipment shall not be placed over the pipe until the pipe zone is backfilled and compacted to specifications.
- Pipe not recommended to be exposed to the environment due to concerns with damage from impact or UV exposure.

c) Capital Cost Estimate

As demonstrated in Tables 3 and 4 below, ASTM D2241 PIP PVC pipe is the most economical pipe material in the available pipe sizes of 27-inches and smaller.

Plastic Irrigation Pipe (PIP)

Table 3

Kern Fan Project PIP Pipe Data (SDR51 PC 80) - Cost Estimate		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Material + Install Pipe Cost ($/LF)
12	$14.64	$54.64
15	$18.17	$62.17
18	$19.98	$77.98
21	$28.76	$89.76
24	$36.53	$95.53
27	$50.56	$111.56
30	NA	NA
36	NA	NA
42	NA	NA
48	NA	NA

C900 PVC Pipe

Table 4

Kern Fan Project PVC Pipe Data (DR51 PC 80) - Cost Estimate		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Material + Install Pipe Cost ($/LF)
30	$68.31	$132.31
36	$99.14	$187.14
42	$131.23	$223.73
48	$165.80	$263.80

Table 4A

Kern Fan Project PVC Pipe Data (DR41 PC 100) - Cost Estimate		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Material + Install Pipe Cost ($/LF)
14	$19.42	$77.42
16	$20.04	$78.04
18	$21.92	$79.92
20	$37.80	$98.80
24	$49.68	$110.68
30	$70.45	$134.45
36	$106.89	$194.89
42	$144.54	$237.04
48	$200.18	$298.18
54	$266.35	$390.35
60	$316.45	$448.45

Pipe cost estimates based on approximately 1,200-ft of pipe.
Increases in quantity may affect pricing.

B. HDPE Pipe

HDPE pipe is an ideal pipe material for certain aspects of this project as it is a corrosion resistant material, is suitable for these water temperatures and water quality parameters, and is easy to install. A roughness coefficient of 0.009 and a Hazen-Williams coefficient of 160 was used for HDPE pipe per the McGraw-Hill Hydraulic Design Handbook.

HDPE is a high-density polyethylene structure wall thermal winding pipe. It is made from high-density polyethylene resin. HDPE pipe can be joined by butt welding, electrofusion welding, socket welding, or extrusion welding. These joints heat the pipe during the joining process, creating a completely homogenous joint so the weld becomes as strong, or stronger, than the existing pipe on either side of the weld.

HDPE pipe can be manufactured to AWWA C906, ASTM F714, and ASTM D3035 standards for use with cast-iron or iron pipe size outside diameters. This diameter regimen is compatible with both cast-iron pipe and ductile-iron pipe or with iron pipe sizes and steel pipe sizes.

Corrugated dual wall HDPE pipe with a smooth wall interior is also an option for the recharge basin interbasin structures and turnouts. This pipe can be provided with a water-tight joint per ASTM D3212 and has a roughness coefficient of 0.012 per the published Advanced Drainage Systems, Inc. (ADS) data.

a) Size Ranges and Availability

AWWA C906 HDPE pipe is available in size ranges from 12-inch diameter to 63-inch diameter. The size chart below is for a dimension ratio (DR) of 32.5 and of 41. The dimension ratio defines a constant ratio between the outer pipe diameter and the pipe wall thickness thus providing a simple means of specifying product dimensions to maintain constant mechanical properties regardless of pipe size. The pressure class for AWWA C906 DR32.5 pipe is 63 psig and is suitable for pipe diameters from 14-inches to 63-inches. The DR41 pipe is rated for 50 psig and is suitable for pipe diameters from 36-inches to 63-inches.

Table 5

Kern Fan Project HDPE Pipe Data (DR32.5 PC 63)				
Nominal Diameter (in)	O.D.	I.D.	Capacity at Velocity = 5 fps	Capacity at Velocity = 6 fps
14	14.00	13.09	4.7	5.6
16	16.00	14.96	6.1	7.3
18	18.00	16.83	7.7	9.3
20	20.00	18.70	9.5	11.4
22	22.00	20.57	11.5	13.8
24	24.00	22.44	13.7	16.5
26	26.00	24.30	16.1	19.3
28	28.00	26.17	18.7	22.4
30	30.00	28.04	21.4	25.7
32	32.00	29.91	24.4	29.3
34	34.00	31.78	27.5	33.0
36	36.00	33.65	30.9	37.0
42	42.00	39.26	42.0	50.4
48	48.00	44.87	54.9	65.9
54	54.00	50.48	69.5	83.3
63	63.00	58.89	94.5	113.4

Table 5A

Kern Fan Project HDPE Pipe Data (DR41 PC 50)				
Nominal Diameter (in)	O.D.	I.D.	Capacity at Velocity = 5 fps	Capacity at Velocity = 6 fps
36	36.00	34.14	31.8	38.1
42	42.00	39.83	43.2	51.9
48	48.00	45.52	56.5	67.8
54	54.00	51.21	71.5	85.8
63	63.00	59.74	97.3	116.7

The HDPE pipe availability allows for capacities upwards of 95 to 116 cfs. This piping is an option for recharge facility turnouts, interbasin structures, “in-lieu” turnouts, and well conveyance pipelines.

It is also possible that a combination of PVC pipe and HDPE pipe could be installed together such as for the well conveyance pipelines. However, consideration will need to be given to the amount of HDPE pipe to be installed and the cost to mobilize and demobilize pipe fusing equipment.

The ADS N-12 Dual Wall HDPE is anticipated to be used for recharge basin turnouts, farmer or “in-lieu” turnouts, and interbasin structures. This pipe is available in pipe diameters from 4-inches to 60 inches. The pipe is a watertight joint per ASTM D3212.

Table 6

Kern Fan Project ADS N-12 Pipe Data (WT IB)				
Nominal Diameter (in)	O.D.	I.D.	Capacity at Velocity = 5 fps	Capacity at Velocity = 6 fps
24	28.00	24.00	15.7	18.8
30	36.00	30.00	24.5	29.4
36	42.00	36.00	35.3	42.4
42	48.00	42.00	48.1	57.7
48	54.00	48.00	62.8	75.4
60	67.00	60.00	98.1	117.8

b) Limitations/Concerns

HDPE pipe is often a cost effective, corrosion resistant, and trouble-free option for irrigation pipeline projects. Limitations or concerns for the use of HDPE pipe would include:

- Water temperatures greater than 73°F require the pressure de-rating of the pipe.
- Pipe installation and repairs require special equipment and specialized contractors.
- Pipe subject to greater temperature expansion and contraction during installation.
- Pipe installation, in larger sizes, typically needs to be filled with water prior to performing backfill and compaction.
- Pipe installation requires adequate compaction and support around the pipe haunches and springline.

c) Capital Cost Estimate

Table 7

Kern Fan Project HDPE Pipe Data (DR32.5 PC 63) - Cost Estimate		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Material + Install Pipe Cost ($/LF)
14	$14.58	$64.58
16	$17.24	$67.24
18	$19.92	$71.92
20	$24.03	$82.03
22	$28.60	$86.60
24	$34.34	$96.34
26	$42.61	$113.61
28	$49.84	$127.84
30	$54.35	$142.35
32	$63.11	$159.11
34	$72.77	$178.77
36	$78.30	$204.30
42	$92.40	$230.40
48	$108.00	$260.00
54	$124.20	$297.20
63	$148.37	$352.37

Table 7A

Kern Fan Project HDPE Pipe Data (DR41 PC 50) - Cost Estimate		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Material + Install Pipe Cost ($/LF)
36	$58.30	$184.30
42	$72.40	$210.40
48	$88.00	$240.00
54	$104.20	$277.20
63	$128.37	$332.37

Pipe cost estimates based on approximately 1,200-ft of pipe.
Increases in quantity may affect pricing.

The costs for the ADS N-12 Dual Wall HDPE pipe are shown below.

Table 8

Kern Fan Project ADS N-12 Pipe Data (WT IB) - Cost Estimate		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Material + Install Pipe Cost ($/LF)
24	$28.57	$89.57
30	$41.04	$105.04
36	$56.50	$144.50
42	$70.18	$162.68
48	$93.15	$191.15
60	$130.41	$262.41

C. Wet Cast RCP

Wet or centrifugally cast RCP shall be manufactured in accordance with ASTM C361 for water-tight pressure joints. A roughness coefficient of 0.013 and a Hazen-Williams coefficient of 130 was used for concrete pipe per the McGraw-Hill Hydraulic Design Handbook.

The wet cast process is a flowable form of concrete which may be poured from a mixer, hopper, or truck and cast into forms where it is then stripped, finished, and marked prior to shipping. This process normally contains concrete with a slump less than 4-inches and is used on the production of large diameter pipe.

Wet cast is also used for non-standard joints and custom pipe or fittings.

RCP pipe shall have a watertight joint utilizing a confined gasket of the O-ring type.

a) Size Ranges and Availability

Table 9

Kern Fan Project RCP Pipe Data (ASTM C361) - Wet Cast				
Nominal Diameter (in)	O.D.	I.D.	Capacity at Velocity = 5 fps	Capacity at Velocity = 6 fps
36	44.00	36.00	35.3	42.4
42	51.00	42.00	48.1	57.7
48	58.00	48.00	62.8	75.4
54	65.00	54.00	79.5	95.4
60	72.00	60.00	98.2	117.8
66	80.50	66.00	118.8	142.5
72	87.50	72.00	141.4	169.6
78	94.50	78.00	165.9	199.1
84	101.50	84.00	192.4	230.9
90	108.50	90.00	220.9	265.1
96	115.50	96.00	251.3	301.6
102	121.00	102.00	283.7	340.5
108	128.00	108.00	318.1	381.7
114	133.00	114.00	354.4	425.3
120	140.00	120.00	392.7	471.2
126	147.00	126.00	433.0	519.5
132	157.50	132.00	475.2	570.2
144	168.00	144.00	565.5	678.6

b) Limitations/Concerns

- Lower compressive strength than dry cast pipe.
- Typically takes longer to manufacturer than dry cast pipe (approximately 12-14 joints/day).
- Higher cost (higher labor costs in manufacturing)

c) Capital Cost Estimate

Table 10

Kern Fan Project D50 RCP Pipe Data (ASTM C361) - Cost Estimate (Wet Cast)		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Material + Install Pipe Cost ($/LF)
36	$300.00	$386.60
42	$390.00	$480.00
48	$486.18	$580.62
54	$617.90	$717.90
60	$749.61	$857.55
66	$896.42	$1,036.42
72	$1,043.22	$1,225.47
78	$1,184.25	$1,414.25
84	$1,327.25	$1,612.00
90	$1,470.36	$1,805.36
96	$1,608.89	$2,002.58
102	$1,808.95	$2,263.95
108	$2,009.00	$2,531.57
114	$2,231.16	$2,901.16
120	$2,453.32	$3,271.02
126	$2,565.69	$3,535.69
132	$2,678.06	$3,775.23
144	$2,775.00	$4,141.46

Pipe cost estimates based on approximately 1,200-ft of pipe.
Increases in quantity may affect pricing.

D. Dry Cast RCP

Dry cast RCP shall be manufactured in accordance with ASTM C361 for water-tight pressure joints. A roughness coefficient of 0.013 and a Hazen-Williams coefficient of 130 was used for concrete pipe per the McGraw-Hill Hydraulic Design Handbook.

The dry cast process has a low water to cement ratio and a zero slump. This method uses low frequency-high amplitude vibration to distribute and densely compact the dry mix in the form. This process allows for the concrete to be stripped sooner and for the forms to be re-used.

Dry cast pipe is poured with a drier mix than wet cast pipe and the barrel of the joint can be stripped immediately after pouring. The bell and spigot ends remain in the forms for 24 hours while a plastic bag is normally placed over the barrel immediately after stripping the forms.

a) Size Ranges and Availability

Table 11

Kern Fan Project RCP Pipe Data (ASTM C361) - Dry Cast				
Nominal Diameter (in)	O.D.	I.D.	Capacity at Velocity = 5 fps	Capacity at Velocity = 6 fps
36	44.00	36.00	35.3	42.4
42	51.00	42.00	48.1	57.7
48	58.00	48.00	62.8	75.4
54	65.00	54.00	79.5	95.4
60	72.00	60.00	98.2	117.8
66	80.50	66.00	118.8	142.5
72	87.50	72.00	141.4	169.6
78	94.50	78.00	165.9	199.1
84	101.50	84.00	192.4	230.9
90	108.50	90.00	220.9	265.1
96	115.50	96.00	251.3	301.6
102	121.00	102.00	283.7	340.5
108	128.00	108.00	318.1	381.7
114	133.00	114.00	354.4	425.3
120	140.00	120.00	392.7	471.2
126	147.00	126.00	433.0	519.5
132	157.50	132.00	475.2	570.2
144	168.00	144.00	565.5	678.6

b) Limitations/Concerns

- Surface of pipe may be a little rougher due to the manufacturing process.
- Important to ensure form vibrators are effectively imparting energy to the concrete and not just the forms.
- Dry cast RCP can have difficulty meeting watertight requirements at joint when pressure tested. Testing needs to be implemented to confirm ability of manufacturer to meet this requirement and joints shall be of double gasket construction.

c) Capital Cost Estimate

Costs are estimated below in Table 12 for D25 Dry Cast RCP as well as D50 Dry Cast RCP.

Table 12

Kern Fan Project D25 RCP Pipe Data (ASTM C361) - Cost Estimate (Dry Cast)		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Material + Install Pipe Cost ($/LF)
36	$111.78	$198.38
42	$142.83	$232.83
48	$173.88	$268.32
54	$204.93	$304.93
60	$235.98	$343.92
66	$267.03	$407.03
72	$298.08	$480.33
78	$329.13	$559.13
84	$360.18	$644.93
90	$391.23	$726.23
96	$422.28	$815.97
102	$453.33	$908.33
108	$484.38	$1,006.95
114	$515.43	$1,185.43
120	$546.48	$1,364.18
126	$577.53	$1,547.53
132	$608.58	$1,705.75
144	$639.63	$2,006.09

Table 12A

Kern Fan Project D50 RCP Pipe Data (ASTM C361) - Cost Estimate (Dry Cast)		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Material + Install Pipe Cost ($/LF)
36	$175.12	$261.72
42	$202.45	$292.45
48	$229.77	$324.21
54	$257.72	$357.72
60	$285.66	$393.60
66	$312.98	$452.98
72	$340.31	$522.56
78	$367.63	$597.63
84	$394.96	$679.71
90	$422.28	$757.28
96	$450.85	$844.54
102	$479.41	$934.41
108	$509.22	$1,031.79
114	$540.27	$1,210.27
120	$571.32	$1,389.02
126	$602.37	$1,572.37
132	$639.63	$1,736.80
144	$683.10	$2,049.56

Pipe cost estimates based on approximately 1,200-ft of pipe.
Increases in quantity may affect pricing.

E. Fusion Bonded Epoxy Lined and Coated Steel Pipe (FBEL&C)

Fusion Bonded Epoxy Lined and Coated Steel Pipe (FBEL&C) is a steel cylinder pipe per AWWA C200 that is internally and externally lined with a fusion bonded epoxy. A roughness coefficient of 0.011 and a Hazen-Williams coefficient of 145 was used for epoxy lined pipe per the McGraw-Hill Hydraulic Design Handbook.

a) Size Ranges and Availability

The fusion bonded epoxy lined and coated steel pipe comes in a wide range of pipe sizes, however it is typically more competitive price wise with plastic pipes and other pipe types in pipe sizes greater than 42-inch diameter.

Table 13

Kern Fan Project FBEL Steel Pipe Data (1/4" Wall)				
Nominal Diameter (in)	O.D.	I.D.	Capacity at Velocity = 5 fps	Capacity at Velocity = 6 fps
36	36.00	35.50	34.4	41.2
42	42.00	41.50	46.9	56.3
48	48.00	47.50	61.5	73.8
54	54.00	53.50	78.0	93.6
60	60.00	59.50	96.5	115.8
66	66.00	65.50	116.9	140.3
72	72.00	71.50	139.3	167.2
84	84.00	83.50	190.0	228.1
90	90.00	89.50	218.3	262.0
96	96.00	95.50	248.6	298.3
102	102.00	101.50	280.8	337.0
108	108.00	107.50	315.0	378.0
114	114.00	113.50	351.1	421.4
120	120.00	119.50	389.2	467.1
126	126.00	125.50	429.3	515.2
132	132.00	131.50	471.3	565.6
138	138.00	137.50	515.3	618.4
144	144.00	143.50	561.3	673.5

b) Limitation/Concerns

Fusion bonded epoxy steel pipe is often a cost effective and trouble-free option for pipeline projects and is preferred in above ground installations where it is subject to inclement weather, UV exposure, seismic events, or nearby to traffic and vehicular access. Limitations or concerns for the use of FBE pipe would include:

- Corrosion protection required typically in order to prevent corrosion in the event of coating holidays. Typically a sacrificial or passive system is adequate for cathodic protection and an impressed current system can be added in the future if necessary.
- Pipe installation requires adequate compaction and support around the pipe haunches and springline.
- Installation requires inspection of fusion bonded epoxy lining and coating for damage and holidays. Surface preparation and application need to be inspected to prevent delamination and other coating defects.
- Cutting or welding of the pipe will damage the epoxy lining and coating. Repairs typically made with a two-part epoxy repair kit.

c) Capital Cost Estimate

Table 14

Kern Fan Project FBEL Steel Pipe (AWWA C200) - Cost Estimate		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Matrial + Install Pipe Cost ($/LF)
36	$161.00	$287.83
42	$190.00	$321.00
48	$220.00	$356.38
54	$255.00	$431.00
60	$330.00	$524.24
66	$400.00	$620.00
72	$500.00	$767.86
78	$550.00	$880.00
84	$600.00	$997.09
90	$650.00	$1,110.00
96	$700.00	$1,303.36
102	$750.00	$1,450.00
108	$810.00	$1,612.71
114	$1,007.37	$1,877.37
120	$1,205.00	$2,197.48
126	$1,320.00	$2,470.00
132	$1,570.00	$2,856.00
144	$1,710.00	$3,282.00

Pipe cost estimates based on approximately 1,200-ft of pipe.
Increases in quantity may affect pricing.

F. Cement Mortar Lined and Coated Steel Pipe (CMLC)

Cement Mortar Lined and Coated (CMLC) Steel pipe is a steel cylinder pipe per AWWA C200 that is internally lined with a cement mortar lining that is centrifugally spun and a brush or spray applied cement mortar coating exterior in accordance with AWWA C205. A roughness coefficient of 0.013 and a Hazen-Williams coefficient of

130 was used for cement mortar lined pipe per the McGraw-Hill Hydraulic Design Handbook.

a) Size Ranges and Availability

The cement mortar lined and coated steel pipe comes in a wide range of pipe sizes, however it is typically more competitive price wise with plastic pipes and other pipe types in pipe sizes greater than 42-inch diameter.

Table 15

Kern Fan Project CMLC Steel Pipe Data (1/4" Wall, 1/2" Lining, 3/4" Coating)				
Nominal Diameter (in)	O.D.	I.D.	Capacity at Velocity = 5 fps	Capacity at Velocity = 6 fps
36	37.50	34.50	32.5	39.0
42	43.50	40.50	44.7	53.7
48	49.50	46.50	59.0	70.8
54	55.50	52.50	75.2	90.2
60	61.50	58.50	93.3	112.0
66	67.50	64.50	113.5	136.1
72	73.50	70.50	135.5	162.7
84	85.50	82.50	185.6	222.7
90	91.50	88.50	213.6	256.3
96	97.50	94.50	243.5	292.2
102	103.50	100.50	275.4	330.5
108	109.50	106.50	309.3	371.2
114	115.50	112.50	345.1	414.2
120	121.50	118.50	382.9	459.5
126	127.50	124.50	422.7	507.2
132	133.50	130.50	464.4	557.3
138	139.50	136.50	508.1	609.7
144	145.50	142.50	553.8	664.5

b) Limitations/Concerns

CMLC steel pipe is often a cost effective and trouble-free option for pipeline projects. Limitations or concerns for the use of CMLC pipe would include:

- Corrosion protection required. Typically a sacrificial or passive system is adequate for cathodic protection and an impressed current system can be added in the future if necessary.
- Pipe installation requires adequate compaction and support around the pipe haunches and springline.
- Installation requires inspection of cement mortar lining and coating for damage and cracks.
- Personnel must have confined space training to repair & inspect interior joint lining repairs.

c) Capital Cost Estimate

Table 16

Kern Fan Project CMLC Steel Pipe (AWWA C200) - Cost Estimate		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Matrial + Install Pipe Cost ($/LF)
36	$171.00	$257.83
42	$194.00	$305.00
48	$220.00	$336.38
54	$255.00	$411.00
60	$340.00	$514.24
66	$450.00	$650.00
72	$550.00	$797.86
78	$600.00	$910.00
84	$650.00	$1,027.09
90	$700.00	$1,160.00
96	$810.00	$1,363.36
102	$936.00	$1,586.00
108	$1,070.00	$1,872.71
114	$1,152.00	$2,022.00
120	$1,205.00	$2,197.48
126	$1,320.00	$2,470.00
132	$1,580.00	$2,866.00
144	$1,760.00	$3,332.00

Pipe cost estimates based on approximately 1,200-ft of pipe.
Increases in quantity may affect pricing.

G. Cost Summary

The Table 17 below summarizes the costs of the different pipe materials and highlights the pipe sizes that are the most economical.

Table 17

Kern Fan Project

Linear Pipeline Material and Cost Summary - Recommended

Pipe Capacity at 5-6 fps	SDR51 PIP PVC Pipe			DR41 & DR51 C900 PVC Pipe			DR32.5 & DR41 HDPE Pipe			ADS N-12 HDPE Pipe[1]			CMLC Pipe			FBEL&C Pipe			D50 Wet Cast RCP Pipe			D25 Dry Cast RCP Pipe		
	Pipe Size	Material Cost ($/LF)	Material + Install Cost ($/LF)	Pipe Size	Material Cost ($/LF)	Material + Install Cost ($/LF)	Pipe Size	Material Cost ($/LF)	Material + Install Cost ($/LF)	Pipe Size	Material Cost ($/LF)	Material + Install Cost ($/LF)	Pipe Size	Material Cost ($/LF)	Material + Install Cost ($/LF)	Pipe Size	Material Cost ($/LF)	Material + Install Cost ($/LF)	Pipe Size	Material Cost ($/LF)	Material + Install Cost ($/LF)	Pipe Size	Material Cost ($/LF)	Material + Install Cost ($/LF)
5 cfs	15	$18.17	$62.17	14	$19.42	$77.42	14	$14.58	$64.58														
10 cfs	18	$19.98	$77.98	18	$21.92	$79.92	20	$24.03	$82.03														
15 cfs	24	$36.53	$95.53	24	$49.68	$110.68	24	$34.34	$96.34														
20 cfs	27	$50.56	$111.56	24	$49.68	$110.68	28	$49.84	$127.84														
25 cfs				30	$68.31	$132.31	30	$54.35	$142.35														
30 cfs				30	$68.31	$132.31	34	$72.77	$178.77														
35 cfs				36	$99.14	$187.14	36	$58.30	$184.30	36	$56.50	$116.53	36	$171.00	$257.83	36	$161.00	$287.83	36	$300.00	$386.60	36	$111.78	$198.38
40 cfs				36	$99.14	$187.14	42	$72.40	$210.40	36	$56.50	$116.53	42	$194.00	$305.00	42	$190.00	$321.00	36	$300.00	$386.60	36	$111.78	$198.38
45 cfs				42	$131.23	$223.73	42	$72.40	$210.40	42	$70.18	$133.85	42	$194.00	$305.00	42	$190.00	$321.00	42	$390.00	$480.00	42	$142.83	$232.83
50 cfs				42	$131.23	$223.73	42	$72.40	$210.40	42	$70.18	$133.85	42	$194.00	$305.00	42	$190.00	$321.00	42	$390.00	$480.00	42	$142.83	$232.83
55 cfs				42	$131.23	$223.73	48	$88.00	$240.00	42	$70.18	$133.85	48	$220.00	$336.38	48	$220.00	$356.38	42	$390.00	$480.00	42	$142.83	$232.83
60 cfs				48	$165.80	$263.80	48	$88.00	$240.00	48	$93.15	$161.19	48	$220.00	$336.38	48	$220.00	$356.38	48	$486.18	$580.62	48	$173.88	$268.32
70 cfs				48	$165.80	$263.80	54	$104.20	$277.20	48	$93.15	$161.19	48	$220.00	$336.38	48	$220.00	$356.38	48	$486.18	$580.62	48	$173.88	$268.32
80 cfs				48	$165.80	$263.80	54	$104.20	$277.20	48	$93.15	$161.19	54	$255.00	$411.00	54	$255.00	$431.00	54	$617.90	$717.90	54	$204.93	$304.93
90 cfs				54	$266.35	$390.35	63	$128.37	$332.37	60	$130.41	$203.78	54	$255.00	$411.00	54	$255.00	$431.00	54	$617.90	$717.90	54	$204.93	$304.93
100 cfs				60	$316.45	$448.45	63	$128.37	$332.37	60	$130.41	$210.46	60	$340.00	$514.24	60	$330.00	$524.24	60	$749.61	$857.55	60	$235.98	$343.92
150 cfs													72	$550.00	$797.86	72	$500.00	$767.86	72	$1,043.22	$1,225.47	72	$298.08	$480.33
200 cfs													84	$650.00	$1,027.09	84	$600.00	$997.09	84	$1,327.25	$1,612.00	84	$360.18	$644.93
250 cfs													90	$700.00	$1,160.00	90	$650.00	$1,110.00	90	$1,470.36	$1,805.36	90	$391.23	$726.23
300 cfs													102	$936.00	$1,586.00	102	$750.00	$1,450.00	96	$1,608.89	$2,002.58	96	$422.28	$815.97
350 cfs													108	$1,070.00	$1,872.71	108	$810.00	$1,612.71	108	$2,009.00	$2,531.57	108	$484.38	$1,006.95
400 cfs													114	$1,152.00	$2,022.00	114	$1,007.37	$1,877.37	114	$2,231.16	$2,901.16	114	$515.43	$1,185.43
450 cfs													120	$1,205.00	$2,197.48	120	$1,205.00	$2,197.48	120	$2,453.32	$3,271.02	120	$546.48	$1,364.18
500 cfs													126	$1,320.00	$2,470.00	126	$1,320.00	$2,470.00	126	$2,565.69	$3,535.69	126	$577.53	$1,547.53

Represents most economical pipe material based upon costs estimates and information available in October 2020.

Represents secondary pipe material alternatives that may be more economical depending on actual design and project timing.

[1]The ADS N-12 HDPE pipe is not applicable to a linear, pressurized pipeline design, but is anticipated to be used at recharge facility turnouts, "in-lieu" turnouts, and interbasin structures.

III. Crossings

The conveyance canal will involve crossings at the following locations, at a minimum:

- Adhor Road (County Road)
- East Side Canal
- Stockdale Highway (Caltrans R/W)
- Interstate 5 Freeway (Caltrans R/W)
- Farm Roads/Dirt Roads

These crossings may be completed by a bore and jack operation, micro-tunnel operation, open cut, or remain an open channel utilizing a bridge crossing to maintain farm road access. These are discussed in greater detail below.

The trenchless pipe installation will require specific soils investigation to be performed at each of the proposed crossings. The soils work will need to identify depth to groundwater, type of soils, ability of soil to maintain arching until grouting, need for soil stabilization, and potential settlement.

Siphon or road crossings may be a siphon pipe, box culvert, or open channel with a bridge crossing.

The casing pipes at Stockdale Highway and the I-5 Freeway shall be designed for H20 traffic loadings and conform to the minimum wall thicknesses as required by the California Department of Transportation (Caltrans). The casing pipe shall be sloped to one end to drain, shall have end seals, and shall have a minimum diameter of the carrier pipe outside diameter plus 12-inches. The casing shall extend a minimum of three-feet (3-ft) outside the Caltrans right-of-way plus the distance from the bottom of casing to the finish grade. The minimum cover above the casing pipe shall be 3.5-feet. All casing joints shall be butt welded and watertight and shall be welded by welder's qualified per ANSI/AWS D1.1. All welds shall be visually and radiographically tested per ANSI/AWS D1.1. The carrier pipe shall have casing spacers installed at the appropriate frequency and be the bolt-on type. It is anticipated that the annulus between the casing pipe and carrier pipe will be filled with a two-sack cement slurry.

a) Bore and Jack

The trenchless installation using the bore and jack is a method for installing a steel casing or liner plate that will be used to install a carrier pipe. It is a multi-stage process consisting of constructing a temporary horizontal jacking platform and a starting alignment track in an entrance pit (boring pit) at a desired elevation. The casing pipe is then jacked by manual control along the starting alignment track with simultaneous excavation of the soil being accomplished by a rotating cutting head in the leading edge of the product's annular space. The ground up soil (spoil) is transported back to the entrance pit by helical wound auger flights rotating inside the casing pipe.

The jack and bore method typically provides limited tracking and steering as well as limited support to the excavation face.

The jack and bore method is suitable for steel casing pipes or liner plates.

b) Micro tunnel

The trenchless installation using the micro tunneling method is conducted similar to the above described jack and bore method with the exception that it is remotely controlled, guided pipe jacking process that provides continuous support to the excavation face.

The guidance system usually consists of a laser mounted in the tunneling drive shaft which communicates a reference line to a target mounted inside the micro tunneling machine's articulated steering head. The micro tunneling process provides the ability to control the excavation face stability by applying mechanical or fluid pressure to counterbalance the earth and hydrostatic pressures.

The micro tunneling method is suitable for casing pipes that are steel, ductile iron, reinforced concrete cylinder pipe, or RCP.

c) Bridges

Bridges allow for the conveyance channel to be installed across farm roads or dirt roads without alteration or disturbance necessarily to the road grade. In addition, the elimination of a siphon crossing or box culvert eliminates headlosses and improves the hydraulic conditions of the conveyance canal.

The bridges shall be clear-span bridges that do not require infilling or restrict the area of water flow within the conveyance canal.

The bridges shall include guardrailing and/or fencing to protect against the entrance of vehicles or equipment into the canal.

IV. Facility Piping

This analysis serves to evaluate turnout pipes, siphon pipes, interbasin pipes, pump station discharge pipes, well pipes, and conveyance pipelines. These include the following:

- Aqueduct Turnout
- Adohr Road Siphon
- East Side Canal Siphon
- Farm Road Siphons
- Cased Crossings – Stockdale Hwy and I-5 Fwy
- Canal Conveyance Piping
- Pump Station Discharge Piping
- Phase II Turnout
- West Basins Turnout
- Phase I Turnout
- Well Discharge Piping
- Well Conveyance Piping
- Interbasin Piping

Figure 1 illustrates the approximate locations of the above described facilities.

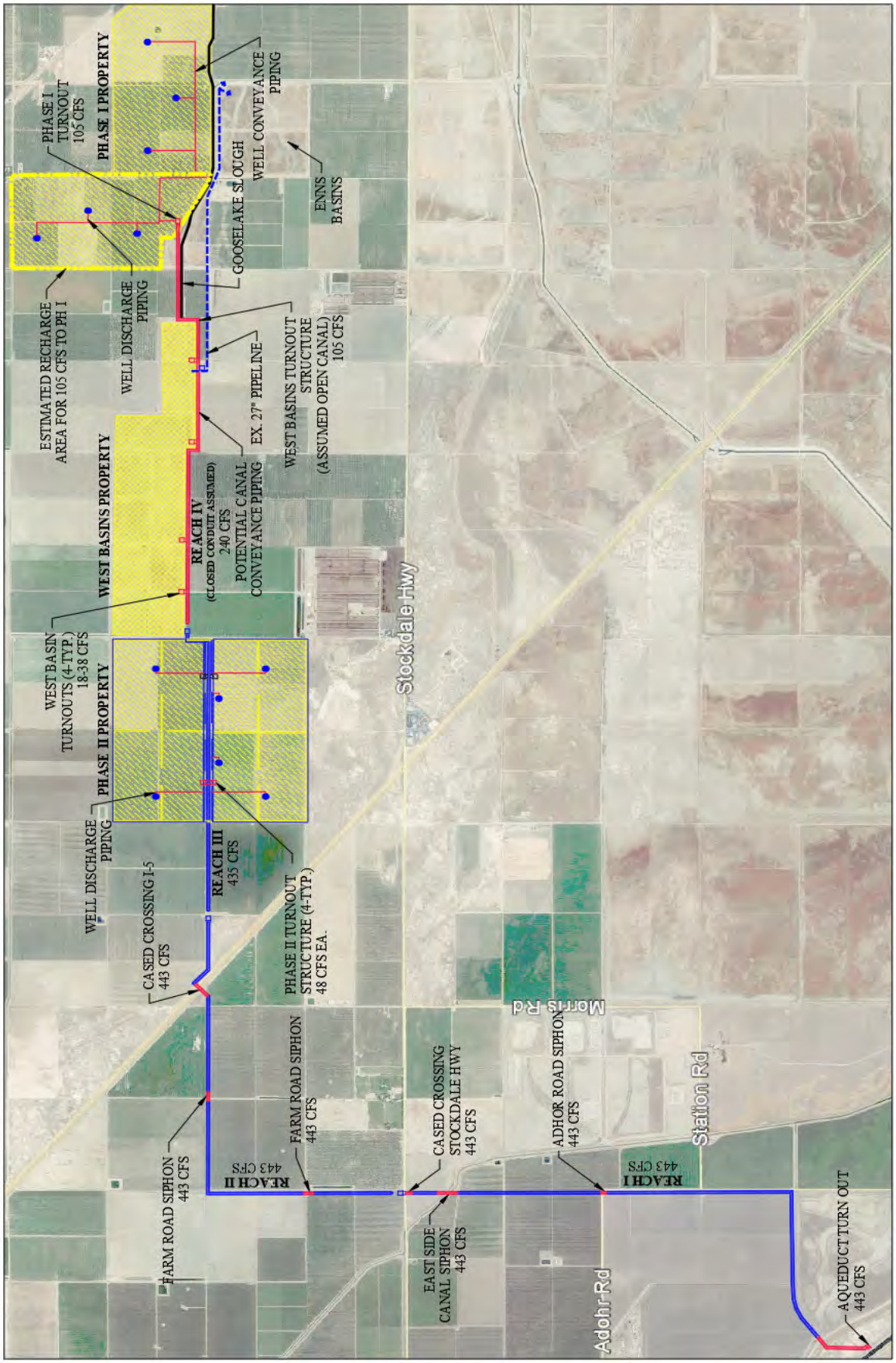

Figure 1: Project Map

The sizing and headloss calculations herein are based upon conceptual layouts and design and are subject to change during the detailed engineering design phase. However, this analysis shall provide a basis for the pipe sizes, materials, and value engineering.

A. Aqueduct Turnout

a) Sizing Criteria

The design flow for the conveyance canal from the California Aqueduct is 443 cfs.

- Flowrate = 443 cfs
- Maximum Velocity = 5 fps. This is typical for pipe turnouts, however Reach 1 of the canal is well below the Aqueduct in this location and there is excess head, therefore a higher velocity has been considered.
- Recommended Maximum Velocity = 7 fps
- Pipe Diameter = Approximate 108-in (9.0-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the turnout piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the Manning's Equation for the friction loss through the pipe. In addition, the turnout piping will be installed well below the canal operating surface and will be submerged at all times, therefore the hydraulic calculations were also reviewed using the Hazen-Williams Equation.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Hazen-Williams Equation: $h_f = (3.022 * V^{1.85} * L) / (C^{1.85} * D^{1.17})$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
n = Material Coefficient (Used 0.013 for new concrete pipe)
C = Roughness Coefficient (Used 130 for new concrete pipe)
L = Pipe Length (Estimated as 2,100-ft)

Results:

A = 443 cfs / 7 fps = 63.3 sf
D = 8.98 ft < 9.0 ft (108-in)

$A = (3.14*D^2)/4 = 63.59$ sf
V = 443 cfs / 63.59 sf = 6.97 fps
Velocity Head = $h_v = v^2/2g = 0.75$ ft

Wetted Perimeter = P = 34.54 ft
Hydraulic Radius = R = A/P = 94.99 sf / 34.54 ft = 2.75 ft
Entrance Loss = 0.5 * $v^2/2g$ = 0.38 ft
H_L= 0.95 ft / 1,000 ft
Exit Loss = 1.0 * $v^2/2g$ = 0.75 ft

Total Estimated Headloss = 3.13-ft

Design the turnout piping so that the control water surface submerges the pipe at the headwall structure a minimum 1.78 times h_v plus 3-inches or approximately 20-inches.

b) Pipe Materials

The Aqueduct Turnout piping is large diameter pipe in the approximate size of 9-ft diameter. The pipe material options consist of FBE steel pipe, CMLC steel pipe, wet cast RCP, and dry cast RCP. It is standard practice for the pipe deflection to be limited to 2% for CMLC steel pipe and 5% for FBE steel pipe. Assuming an earth cover of 15-ft, the deflection for a 5/8" wall FBE steel pipe is approximately 4.5%. However, the use of CMLC in this application with such a large diameter and a significant earth cover while maintaining pipe wall deflections of less than 2% is difficult. The wet cast and dry cast RCP pipe would be ASTM C361 pipe, D50 double gasketed pipe. The "D" designation signifies that the pipe is suitable for earth cover over the top of the pipe up to 20-ft. The "50" designation signifies that the pipe can handle hydrostatic heads up to 50-ft above the centerline of the pipe. The hydrostatic head under normal gravity flow operations will likely be approximately 35-ft to 40-ft and potentially a little higher when pumping in a return water condition back to the Aqueduct.

c) Material Recommendations

The Aqueduct Turnout piping is estimated to be approximately 2,100-ft in length. The FBE steel pipe is estimated as $810 per lineal foot for material cost and $1,613 per lineal foot for material and installation. The wet cast RCP is estimated as $2,009 per lineal foot for material cost and $2,532 per lineal foot for material and installation while the dry cast D50 RCP is estimated as $585 per lineal foot for material cost and $1,400 per lineal foot for material and installation.

Steel pipe is not recommended in this application due to excessive pipe deflections of 4-inches to 5-inches even if it is within acceptable percentages. The dry cast RCP is the most economical pipe in this pipe diameter. Provided DWR does not require wet cast RCP, it is recommended that dry cast RCP pipe be used for the Aqueduct Turnout piping. In addition, RCP is a preferred pipe material for this application since it is corrosion resistant, more suitable to resist flotation, and a rigid pipe.

If DWR does require the use of wet cast RCP, then it is anticipated that the District will install wet cast RCP within the Aqueduct right-of-way and then utilize dry cast RCP outside of the right-of-way.

B. Road Crossings

Adhor Road

a) Sizing Criteria

The design flow for the road crossing at Adohr Road is 443 cfs.

- Flowrate = 443 cfs
- Maximum Velocity = 6 fps
- Pipe Diameter = Approximate 120-in (10-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the crossing piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the Manning's Equation for the friction loss through the pipe.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
n = Material Coefficient (Used 0.013 for new concrete pipe)
L = Pipe Length (Estimated as 100-ft)

Results:

A = 443 cfs / 6 fps = 73.8 sf
D = 9.70 ft < 10.0 ft (120-in)

$A = (3.14*D^2)/4 = 78.5$ sf
V = 443 cfs / 78.5 sf = 5.64 fps
Velocity Head = $h_v = v^2/2g = 0.49$ ft
Wetted Perimeter = P = 31.4 ft
Hydraulic Radius = R = A/P = 78.5 sf / 31.4 ft = 2.50 ft
Entrance Loss = $0.5 * v^2/2g = 0.25$ ft
H_L= 0.71 ft / 1,000 ft
Exit Loss = $1.0 * v^2/2g = 0.49$ ft

Total Estimated Headloss = 0.81-ft

Design the road crossing piping so that the control water surface submerges the pipe at the headwall structure a minimum 1.78 times h_v plus 3-inches or approximately 14-inches.

Another option for the Adohr Road crossing is a box culvert if the grade allows for it. The hydraulic properties for a 8' x 12' box culvert are noted below:

The continuity equation was used to solve for the cross-sectional area of the box culvert and the culvert dimensions given the design flow and maximum velocity.

$A = Q/V$

The headloss through the box culvert was calculated using the velocity head of the culvert for minor entrance and exit losses and the Manning's Equation for the friction loss through the culvert.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Culvert Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
n = Material Coefficient (Used 0.013 for precast concrete)
L = Culvert Length (Estimated as 100-ft)

Results:

A = 443 cfs / 6 fps = 73.8 sf
D = 9.7 ft < 10.0 ft (120-in)

A = 8' x 12' = 96.0 sf
V = 443 cfs / 96 sf = 4.61 fps
Velocity Head = $h_v = v^2/2g = 0.33$ ft
Wetted Perimeter = P = 40.0 ft
Hydraulic Radius = R = A/P = 96 sf / 40 ft = 2.40 ft
Entrance Loss = $0.5 * v^2/2g = 0.17$ ft
H_L = 0.50 ft / 1,000 ft
Exit Loss = $1.0 * v^2/2g = 0.33$ ft

Total Estimated Headloss = 0.55-ft

Design structure to minimize headloss at maximum flow and closely match culvert invert with canal invert to avoid material buildup in the box culvert during low flow conditions.

b) Pipe Materials

The Adohr Road crossing piping is large diameter pipe in the approximate size of 10-ft diameter. The pipe material options consist of FBE steel pipe, CMLC steel pipe, wet cast RCP, and dry cast RCP. It is standard practice for the pipe deflection to be limited to 2% for CMLC steel pipe and 5% for FBE steel pipe. Assuming an earth cover of 10-ft, the deflection for a 3/8" wall FBE steel pipe is approximately 3%. However, the use of CMLC in this application with such a large diameter and a significant earth cover while maintaining pipe wall deflections of less than 2% is difficult. The wet cast and dry cast RCP pipe would be ASTM C361 pipe, C25 double gasketed pipe. The "C" designation signifies that the pipe is suitable for earth cover over the top of the pipe up to 15-ft. The "25" designation signifies that the pipe can handle hydrostatic heads up to 25-ft

above the centerline of the pipe. The hydrostatic head under normal gravity flow operations will likely be less than 10-ft.

c) Material Recommendations

The Adohr Road crossing piping is estimated to be approximately 100-ft in length. The FBE steel pipe is estimated as $1,205 per lineal foot for material cost and $2,197 per lineal foot for material and installation. The wet cast RCP is estimated as $2,453 per lineal foot for material cost and $3,271 per lineal foot for material and installation while the dry cast RCP is estimated as $546 per lineal foot for material cost and $1,364 per lineal foot for material and installation.

Steel pipe is not recommended in this application due to excessive pipe deflections of 3-inches to 4-inches even if it is within acceptable percentages. The dry cast RCP is the most economical pipe in this pipe diameter. Therefore, it is recommended that dry cast RCP pipe be used for the Adhor Road siphon piping. In addition, RCP is a preferred pipe material for this application since it is corrosion resistant, more suitable to resist flotation, and a rigid pipe.

The box culvert is also an economical alternative provided the grades work and do not require an inverted siphon.

East Side Canal

a) Sizing Criteria

The design flow for the siphon crossing at the East Side Canal is 443 cfs. This crossing is anticipated to be an inverted siphon due to dropping down to cross beneath the East Side Canal prism and provide proper clearances. Therefore, a box culvert is not anticipated as an option at this location.

- Flowrate = 443 cfs
- Maximum Velocity = 6 fps
- Pipe Diameter = Approximate 120-in (10-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the inverted siphon piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the Manning's Equation for the friction loss through the pipe.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Where:

Q = Flow (cfs)

V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
n = Material Coefficient (Used 0.013 for new concrete pipe)
C = Roughness Coefficient (Used 130 for new concrete pipe)
L = Pipe Length (Estimated as 250-ft)

Results:

A = 443 cfs / 6 fps = 73.8 sf
D = 9.70 ft < 10.0 ft (120-in)

$A = (3.14*D^2)/4 = 78.5$ sf
V = 443 cfs / 78.5 sf = 5.64 fps
Velocity Head = $h_v = v^2/2g = 0.49$ ft
Wetted Perimeter = P = 31.4 ft
Hydraulic Radius = R = A/P = 78.5 sf / 31.4 ft = 2.50 ft
Entrance Loss = $0.5 * v^2/2g = 0.25$ ft
H_L= 0.71 ft / 1,000 ft
Exit Loss = $1.0 * v^2/2g = 0.49$ ft

Total Estimated Headloss = 0.92-ft

Design the siphon piping so that the control water surface submerges the pipe at the headwall structure a minimum 1.78 times h_v plus 3-inches or approximately 14-inches.

b) Pipe Materials

The East Side Canal crossing piping is large diameter pipe in the approximate size of 10-ft diameter. The pipe material options consist of FBE steel pipe, CMLC steel pipe, wet cast RCP, and dry cast RCP. It is standard practice for the pipe deflection to be limited to 2% for CMLC steel pipe and 5% for FBE steel pipe. Assuming a maximum earth cover of 10-ft, the deflection for a 3/8" wall FBE steel pipe is approximately 3%. However, the use of CMLC in this application with such a large diameter and a significant earth cover while maintaining pipe wall deflections of less than 2% is difficult. The wet cast and dry cast RCP pipe would be ASTM C361 pipe, C25 double gasketed pipe. The "C" designation signifies that the pipe is suitable for earth cover over the top of the pipe up to 15-ft. The "25" designation signifies that the pipe can handle hydrostatic heads up to 25-ft above the centerline of the pipe. The hydrostatic head under normal gravity flow operations will likely be less than 10-ft.

c) Material Recommendations

The East Side Canal crossing piping is estimated to be approximately 250-ft in length. The FBE steel pipe is estimated as $1,205 per lineal foot for material cost and $2,197 per lineal foot for material and installation. The wet cast RCP is estimated as $2,453 per lineal foot for material cost and $3,271 per lineal foot for material and installation while the dry cast RCP is estimated as $546 per lineal foot for material cost and $1,364 per lineal foot for material and installation.

Steel pipe is not recommended in this application due to excessive pipe deflections of 3-inches to 4-inches even if it is within acceptable percentages.

The dry cast RCP is the most economical pipe in this pipe diameter. Therefore, it is recommended that dry cast RCP pipe be used for the East Side Canal siphon piping. In addition, RCP is a preferred pipe material for this application since it is corrosion resistant, more suitable to resist flotation, and a rigid pipe.

Reach 2 Farm Road

a) Sizing Criteria

The design flow for the crossing at a Reach 2 Farm Road crossing is 443 cfs.

- Flowrate = 443 cfs
- Maximum Velocity = 6 fps
- Pipe Diameter = Approximate 120-in (10-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the crossing piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the Manning's Equation for the friction loss through the pipe.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
n = Material Coefficient (Used 0.013 for new concrete pipe)
L = Pipe Length (Estimated as 60-ft)

Results:

A = 443 cfs / 6 fps = 73.8 sf
D = 9.70 ft < 10.0 ft (120-in)

$A = (3.14*D^2)/4 = 78.5$ sf
V = 442 cfs / 78.5 sf = 5.64 fps
Velocity Head = $h_v = v^2/2g = 0.49$ ft
Wetted Perimeter = P = 31.4 ft
Hydraulic Radius = R = A/P = 78.5 sf / 31.4 ft = 2.50 ft
Entrance Loss = $0.5 * v^2/2g = 0.25$ ft
H_L= 0.71 ft / 1,000 ft
Exit Loss = $1.0 * v^2/2g = 0.49$ ft

Total Estimated Headloss = 0.78-ft

Design the road crossing piping so that the control water surface submerges the pipe at the headwall structure a minimum 1.78 times h_v plus 3-inches or approximately 14-inches.

Other options for the Farm Road crossing include a pre-cast box culvert or a precast bridge. The hydraulic properties for a 8' x 12' box culvert are noted below:

The continuity equation was used to solve for the cross-sectional area of the box culvert and the culvert dimensions given the design flow and maximum velocity.

$A = Q/V$

The headloss through the box culvert was calculated using the velocity head of the culvert for minor entrance and exit losses and the Manning's Equation for the friction loss through the culvert.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Culvert Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
n = Material Coefficient (Used 0.013 for precast concrete)
L = Culvert Length (Estimated as 60-ft)

Results:

A = 443 cfs / 6 fps = 73.8 sf
D = 9.7 ft < 10.0 ft (120-in)

A = 8' x 12' = 96.0 sf
V = 443 cfs / 96 sf = 4.61 fps
Velocity Head = $h_v = v^2/2g = 0.33$ ft
Wetted Perimeter = P = 40.0 ft
Hydraulic Radius = R = A/P = 96 sf / 40 ft = 2.40 ft
Entrance Loss = $0.5 * v^2/2g = 0.17$ ft
H_L = 0.50 ft / 1,000 ft
Exit Loss = $1.0 * v^2/2g = 0.33$ ft

Total Estimated Headloss = 0.53-ft

Design structure to minimize headloss at maximum flow and closely match culvert invert with canal invert to avoid material buildup in the box culvert during low flow conditions.

b) Pipe Materials

The Farm Road crossing piping is large diameter pipe in the approximate size of 10-ft diameter. The pipe material options consist of FBE steel pipe, CMLC steel pipe, wet cast RCP, and dry cast RCP. It is standard practice for the pipe

deflection to be limited to 2% for CMLC steel pipe and 5% for FBE steel pipe. Assuming an earth cover of 10-ft, the deflection for a 3/8" wall FBE steel pipe is approximately 3%. However, the use of CMLC in this application with such a large diameter and a significant earth cover while maintaining pipe wall deflections of less than 2% is difficult. The wet cast and dry cast RCP pipe would be ASTM C361 pipe, C25 double gasketed pipe. The "C" designation signifies that the pipe is suitable for earth cover over the top of the pipe up to 15-ft. The "25" designation signifies that the pipe can handle hydrostatic heads up to 25-ft above the centerline of the pipe. The hydrostatic head under normal gravity flow operations will likely be less than 10-ft.

c) Material Recommendations

The Farm Road crossing piping is estimated to be approximately 60-ft in length. The FBE steel pipe is estimated as $1,205 per lineal foot for material cost and $2,197 per lineal foot for material and installation. The wet cast RCP is estimated as $2,453 per lineal foot for material cost and $3,271 per lineal foot for material and installation while the dry cast RCP is estimated as $546 per lineal foot for material cost and $1,364 per lineal foot for material and installation.

Steel pipe is not recommended in this application due to excessive pipe deflections of 3-inches to 4-inches even if it is within acceptable percentages. The dry cast RCP is the most economical pipe in this pipe diameter. Therefore, it is recommended that dry cast RCP pipe be used for the Farm Road crossing piping. In addition, RCP is a preferred pipe material for this application since it is corrosion resistant, more suitable to resist flotation, and a rigid pipe.

The box culvert is also an economical alternative provided the grades work and do not require an inverted siphon. It is envisioned that a 8' x 12' box culvert could be installed and the farm road built up over the box culvert so that it did not require an inverted siphon.

Reach 3 Farm Road

a) Sizing Criteria

The design flow for the crossing at a Reach 3 Farm Road crossing is 435 cfs.

- Flowrate = 435 cfs
- Maximum Velocity = 6 fps
- Pipe Diameter = Approximate 120-in (10-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the crossing piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the

Manning's Equation for the friction loss through the pipe.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
n = Material Coefficient (Used 0.013 for new concrete pipe)
L = Pipe Length (Estimated as 60-ft)

Results:

A = 435 cfs / 6 fps = 72.5 sf
D = 9.61 ft < 10.0 ft (120-in)

$A = (3.14*D^2)/4 = 78.5$ sf
V = 435 cfs / 78.5 sf = 5.54 fps
Velocity Head = $h_v = v^2/2g = 0.48$ ft
Wetted Perimeter = P = 31.4 ft
Hydraulic Radius = R = A/P = 78.5 sf / 31.4 ft = 2.50 ft
Entrance Loss = $0.5 * v^2/2g = 0.24$ ft
H_L = 0.68 ft / 1,000 ft
Exit Loss = $1.0 * v^2/2g = 0.48$ ft

Total Estimated Headloss = 0.78-ft

Design the road crossing piping so that the control water surface submerges the pipe at the headwall structure a minimum 1.78 times h_v plus 3-inches or approximately 14-inches.

Other options for the Farm Road crossing include a pre-cast box culvert or a precast bridge. The hydraulic properties for a 8' x 12' box culvert are noted below:

The continuity equation was used to solve for the cross-sectional area of the box culvert and the culvert dimensions given the design flow and maximum velocity.

$A = Q/V$

The headloss through the box culvert was calculated using the velocity head of the culvert for minor entrance and exit losses and the Manning's Equation for the friction loss through the culvert.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Culvert Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope

n = Material Coefficient (Used 0.013 for precast concrete)
L = Culvert Length (Estimated as 60-ft)

Results:

A = 435 cfs / 6 fps = 72.5 sf
D = 9.6 ft < 10.0 ft (120-in)

A = 8' x 12' = 96.0 sf
V = 435 cfs / 96 sf = 4.53 fps
Velocity Head = $h_v = v^2/2g$ = 0.32 ft
Wetted Perimeter = P = 40.0 ft
Hydraulic Radius = R = A/P = 96 sf / 40 ft = 2.40 ft
Entrance Loss = 0.5 * $v^2/2g$ = 0.16 ft
H_L = 0.48 ft / 1,000 ft
Exit Loss = 1.0 * $v^2/2g$ = 0.32 ft

Total Estimated Headloss = 0.51-ft

Design structure to minimize headloss at maximum flow and closely match culvert invert with canal invert to avoid material buildup in the box culvert during low flow conditions.

b) Pipe Materials

The Farm Road crossing piping is large diameter pipe in the approximate size of 10-ft diameter. The pipe material options consist of FBE steel pipe, CMLC steel pipe, wet cast RCP, and dry cast RCP. It is standard practice for the pipe deflection to be limited to 2% for CMLC steel pipe and 5% for FBE steel pipe. Assuming an earth cover of 10-ft, the deflection for a 3/8" wall FBE steel pipe is approximately 3%. However, the use of CMLC in this application with such a large diameter and a significant earth cover while maintaining pipe wall deflections of less than 2% is difficult. The wet cast and dry cast RCP pipe would be ASTM C361 pipe, C25 double gasketed pipe. The "C" designation signifies that the pipe is suitable for earth cover over the top of the pipe up to 15-ft. The "25" designation signifies that the pipe can handle hydrostatic heads up to 25-ft above the centerline of the pipe. The hydrostatic head under normal gravity flow operations will likely be less than 10-ft.

c) Material Recommendations

The Farm Road crossing piping is estimated to be approximately 60-ft in length. The FBE steel pipe is estimated as $1,205 per lineal foot for material cost and $2,197 per lineal foot for material and installation. The wet cast RCP is estimated as $2,453 per lineal foot for material cost and $3,271 per lineal foot for material and installation while the dry cast RCP is estimated as $546 per lineal foot for material cost and $1,364 per lineal foot for material and installation.

Steel pipe is not recommended in this application due to excessive pipe deflections of 3-inches to 4-inches even if it is within acceptable percentages. The dry cast RCP is the most economical pipe in this pipe diameter. Therefore, it is recommended that dry cast RCP pipe be used for the Farm Road crossing piping. In addition, RCP is a preferred pipe material for this application since it is corrosion resistant, more suitable to resist flotation, and a rigid pipe.

The box culvert is also an economical alternative provided the grades work and do not require an inverted siphon. It is envisioned that a 8' x 12' box culvert could be installed and the farm road built up over the box culvert so that it did not require an inverted siphon.

Reach 4 Farm Road

a) Sizing Criteria

The design flow for the crossing at a Reach 4 Farm Road crossing is 240 cfs.

- Flowrate = 240 cfs
- Maximum Velocity = 6 fps
- Pipe Diameter = Approximate 90-in (7.5-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the crossing piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the Manning's Equation for the friction loss through the pipe.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
n = Material Coefficient (Used 0.013 for new concrete pipe)
L = Pipe Length (Estimated as 60-ft)

Results:

A = 240 cfs / 6 fps = 40.0 sf
D = 7.14 ft < 7.5 ft (90-in)

$A = (3.14*D^2)/4 = 44.2$ sf
V = 240 cfs / 44.2 sf = 5.43 fps
Velocity Head = $h_v = v^2/2g = 0.46$ ft
Wetted Perimeter = P = 23.6 ft
Hydraulic Radius = R = A/P = 44.2 sf / 23.6 ft = 1.87 ft
Entrance Loss = $0.5 * v^2/2g = 0.23$ ft
H_L= 0.97 ft / 1,000 ft
Exit Loss = $1.0 * v^2/2g = 0.46$ ft

Total Estimated Headloss = 0.75-ft

Design the road crossing piping so that the control water surface submerges the pipe at the headwall structure a minimum 1.78 times h_v plus 3-inches or approximately 13-inches.

Other options for the Farm Road crossing include a pre-cast box culvert or a precast bridge. The hydraulic properties for a 8' x 8' box culvert are noted below:

The continuity equation was used to solve for the cross-sectional area of the box culvert and the culvert dimensions given the design flow and maximum velocity.

$A = Q/V$

The headloss through the box culvert was calculated using the velocity head of the culvert for minor entrance and exit losses and the Manning's Equation for the friction loss through the culvert.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Culvert Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
n = Material Coefficient (Used 0.013 for precast concrete)
L = Culvert Length (Estimated as 60-ft)

Results:

A = 240 cfs / 6 fps = 40.0 sf

A = 8' x 8' = 64.0 sf
V = 240 cfs / 64 sf = 3.75 fps
Velocity Head = $h_v = v^2/2g$ = 0.22 ft
Wetted Perimeter = P = 32.0 ft
Hydraulic Radius = R = A/P = 64 sf / 32 ft = 2.00 ft
Entrance Loss = $0.5 * v^2/2g$ = 0.11 ft
H_L = 0.42 ft / 1,000 ft
Exit Loss = $1.0 * v^2/2g$ = 0.22 ft

Total Estimated Headloss = 0.36-ft

Design structure to minimize headloss at maximum flow and closely match culvert invert with canal invert to avoid material buildup in the box culvert during low flow conditions.

b) Pipe Materials

The Farm Road crossing piping is large diameter pipe in the approximate size of 7.5-ft diameter. The pipe material options consist of FBE steel pipe, CMLC steel pipe, wet cast RCP, and dry cast RCP. It is standard practice for the pipe deflection to be limited to 2% for CMLC steel pipe and 5% for FBE steel pipe. Assuming an earth cover of 10-ft, the deflection for a 3/8" wall FBE steel pipe is approximately 3%. However, the use of CMLC in this application with such a

large diameter and a significant earth cover while maintaining pipe wall deflections of less than 2% is difficult. The wet cast and dry cast RCP pipe would be ASTM C361 pipe, C25 double gasketed pipe. The "C" designation signifies that the pipe is suitable for earth cover over the top of the pipe up to 15-ft. The "25" designation signifies that the pipe can handle hydrostatic heads up to 25-ft above the centerline of the pipe. The hydrostatic head under normal gravity flow operations will likely be less than 10-ft.

c) Material Recommendations

The Farm Road crossing piping is estimated to be approximately 60-ft in length. The FBE steel pipe is estimated as $650 per lineal foot for material cost and $1,110 per lineal foot for material and installation. The wet cast RCP is estimated as $1,470 per lineal foot for material cost and $1,805 per lineal foot for material and installation while the dry cast RCP is estimated as $391 per lineal foot for material cost and $726 per lineal foot for material and installation.

Steel pipe is not recommended in this application due to excessive pipe deflections of 3-inches to 4-inches even if it is within acceptable percentages. The dry cast RCP is the most economical pipe in this pipe diameter. Therefore, it is recommended that dry cast RCP pipe be used for the Farm Road crossing piping. In addition, RCP is a preferred pipe material for this application since it is corrosion resistant, more suitable to resist flotation, and a rigid pipe.

The box culvert is also an economical alternative provided the grades work and do not require an inverted siphon. It is envisioned that a 8' x 8' box culvert could be installed and the farm road built up over the box culvert so that it did not require an inverted siphon.

C. Highway Cased Crossings

a) Sizing Criteria

The design flow for the cased crossing at Stockdale Highway in Reach 1 and the cased crossing at the Interstate 5 Freeway in Reach 2 is 443 cfs.

- Flowrate = 443 cfs
- Maximum Velocity = 6 fps
- Pipe Diameter = Approximate 120-in (10-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the carrier piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the Manning's Equation for the friction loss through the pipe.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
n = Material Coefficient (Used 0.013 for new concrete pipe)
L = Pipe Length (Stockdale Hwy estimated as 150-ft)
(I-5 Fwy estimated as 280-ft)

Results:

A = 443 cfs / 6 fps = 73.8 sf
D = 9.70 ft < 10.0 ft (120-in)

$A = (3.14*D^2)/4 = 78.5$ sf
V = 442 cfs / 78.5 sf = 5.64 fps
Velocity Head = $h_v = v^2/2g = 0.49$ ft
Wetted Perimeter = P = 31.4 ft
Hydraulic Radius = R = A/P = 78.5 sf / 31.4 ft = 2.50 ft
Entrance Loss = $0.5 * v^2/2g = 0.25$ ft
H_L= 0.71 ft / 1,000 ft
Exit Loss = $1.0 * v^2/2g = 0.49$ ft

Total Estimated Headloss = 0.85-ft for Stockdale Hwy
0.94-ft for I-5 Fwy

Design the cased crossing piping so that the control water surface submerges the pipe at the headwall structure a minimum 1.78 times h_v plus 3-inches or approximately 14-inches.

b) Pipe Materials

The casing pipe material for these crossings is estimated to be a minimum of 168" diameter bare steel pipe or steel liner plate with an approximate wall thickness of 3/4" per the requirements of the California Department of Transportation.

The cased crossing carrier piping is large diameter pipe in the approximate size of 10-ft diameter. The annulus between the casing pipe and the carrier pipe will be filled with a cement slurry. For this reason, RCP pipe is recommended for the carrier piping. The wet cast and dry cast RCP pipe would be ASTM C361 pipe, D25 double gasketed pipe with an approximate O.D. of 142".

c) Material Recommendations

The estimated cost for the cased crossings includes installation of the 168" diameter liner plate by the tunnel boring machine method and soil stabilization and is approximately $2,000 per lineal foot material cost and approximately $4,000 per lineal foot for material and installation. The carrier pipe is estimated as 10-ft diameter ASTM C361 D25 double gasketed RCP and the annulus filled with a cement slurry. The estimated cost to install the carrier piping is approximately $585 per lineal foot material cost and $2,500 per lineal foot for material and installation.

D. Reach 4 Conveyance Piping

a) Sizing Criteria

The Reach 4 of the conveyance canal may be an open channel or a closed conduit design. The design flow for a closed conduit in Reach 4 is 240 cfs. However, this 240 cfs demand is for the initial filling of the recharge basins and is expected to be a short-term event. Therefore, it is more desirable to design the closed conduit system for the average rates (approximately 160 cfs) rather than the short-term peak fill rates. Furthermore, it is anticipated that a closed conduit design could reduce in pipeline size as water is conveyed through turnouts along the pipeline to the West Basins, see Figure 2.

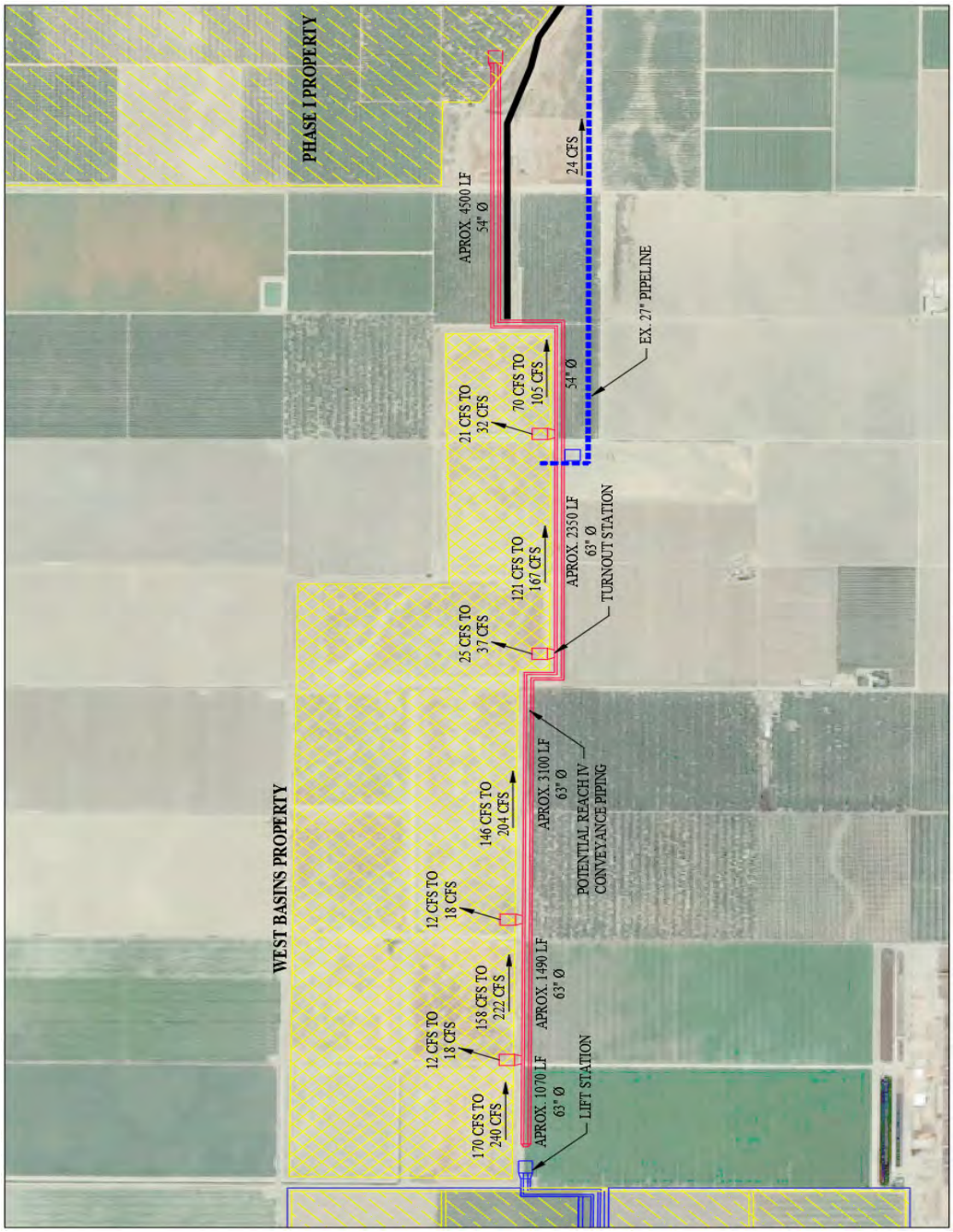

Figure 2: West Basin Turnouts

Alternative 1a: Fill Rate – Max Velocity 7 fps

The first alternative targets maintaining pipeline velocities below 7 fps during the initial filling operations and below 5 fps during average recharge conditions.

- Flowrate = 240 cfs
- Maximum Velocity at Initial Fill = 7.0 fps
- Pipe Diameter = Approximate 84-in (7-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the conveyance piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the Hazen-Williams Equation for the friction loss through the pipe.

Hazen-Williams Equation: $h_f = (3.022 * V^{1.85} * L) / (C^{1.85} * D^{1.17})$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Material Coefficient (Used 130 for Dry Cast RCP pipe)
L = Pipe Length (Estimated as 1,070-ft)

Results:

A = 240 cfs / 7.0 fps = 34.3 sf
D = 6.6 ft < 7.0 ft (84-in)

$A = (3.14*D^2)/4 = 38.47$ sf
V = 240 cfs / 38.47 sf = 6.24 fps
Velocity Head = $h_v = v^2/2g = .60$ ft
Wetted Perimeter = P = 22.0 ft
Hydraulic Radius = R = A/P = 38.5 sf / 22.0 ft = 1.75 ft
Entrance Loss = $0.5 * v^2/2g = 0.30$ ft
H_L= 1.21 ft
Minor Loss = $0.2 * v^2/2g = 0.60$ ft

Total Estimated Headloss = 2.11-ft

The flow then decreases to approximately 222 cfs after the first turnout to the West Basins. The pipeline remains a 84" Dry Cast RCP pipe with an approximate 84" I.D.

Where:

Q = Flow (cfs)
V = Velocity (fps)

D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Material Coefficient (Used 130 for Dry Cast RCP pipe)
L = Pipe Length (Estimated as 1,490-ft)

Results:

A = 222 cfs / 7.0 fps = 31.71 sf
D = 6.4 ft < 7.0 ft (84-in)

$A = (3.14*D^2)/4 = 38.47$ sf
V = 222 cfs / 38.47 sf = 5.77 fps
Velocity Head = $h_v = v^2/2g = 0.52$ ft
Wetted Perimeter = P = 22.0 ft
Hydraulic Radius = R = A/P = 38.5 sf / 22.0 ft = 1.75 ft
H_L= 1.45 ft
Minor Loss = $0.2 * v^2/2g = 0.10$ ft

Total Estimated Headloss = 1.55-ft

The flow then decreases to approximately 204 cfs after the first and second turnouts to the West Basins. The pipeline then reduces to a 72" Dry Cast RCP pipe with an approximate 72" I.D.

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Material Coefficient (Used 130 for Dry Cast RCP pipe)
L = Pipe Length (Estimated as 3,100-ft)

Results:

A = 204 cfs / 7.0 fps = 29.1 sf
D = 6.1 ft $\leq$ 6 ft (72-in)

$A = (3.14*D^2)/4 = 28.3$ sf
V = 204 cfs / 28.3 sf = 7.2 fps
Velocity Head = $h_v = v^2/2g = 0.81$ ft
Wetted Perimeter = P = 18.8 ft
Hydraulic Radius = R = A/P = 28.3 sf / 18.8 ft = 1.51 ft
H_L= 5.45 ft
Minor Loss = $0.2 * v^2/2g = 0.16$ ft

Total Estimated Headloss = 5.61-ft

The flow then decreases to approximately 167 cfs after the first, second, and third turnouts to the West Basins. The pipeline then reduces to a 66" Dry Cast RCP pipe with an approximate 66" I.D.

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)

A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Material Coefficient (Used 130 for Dry Cast RCP pipe)
L = Pipe Length (Estimated as 2,350-ft)

Results:

A = 167 cfs / 7.0 fps = 23.9 sf
D = 5.5 ft $\leq$ 5.5 ft (66-in)

$A = (3.14*D^2)/4 = 23.7$ sf
V = 167 cfs / 23.7 sf = 7.05 fps
Velocity Head = $h_v = v^2/2g = 0.77$ ft
Wetted Perimeter = P = 17.3 ft
Hydraulic Radius = R = A/P = 23.7 sf / 17.3 ft = 1.37 ft
H_L= 4.40 ft
Minor Loss = $0.2 * v^2/2g = 0.15$ ft

Total Estimated Headloss = 4.55-ft

The flow then decreases to approximately 135 cfs after the fourth and final turnout to the West Basins. In addition, approximately 24 cfs is conveyed to the existing 27-inch West Basin pipeline and 6 cfs to "in-lieu" turnout demands leaving approximately 105 cfs to be conveyed to the Phase I Property. The pipeline reduces to a 54" Dry Cast RCP pipe with an approximate 54" I.D.

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Material Coefficient (Used 130 for Dry Cast RCP pipe)
L = Pipe Length (Estimated as 4,500-ft)

Results:

A = 105 cfs / 7.0 fps = 15.0 sf
D = 4.37 ft < 4.5 ft (54-in)

$A = (3.14*D^2)/4 = 15.9$ sf
V = 105 cfs / 15.9 sf = 6.6 fps
Velocity Head = $h_v = v^2/2g = 0.68$ ft
Wetted Perimeter = P = 14.1 ft
Hydraulic Radius = R = A/P = 15.9 sf / 14.1 ft = 1.13 ft
H_L= 9.43 ft
Exit Loss = $1.0 * v^2/2g = 0.68$ ft

Total Estimated Headloss = 10.11-ft

The estimated headloss above (23.93-ft) would need to be added to the static lift which is estimated as 13-ft for a total TDH (excluding Pump Station losses for sake of comparison) of approximately 36.93-ft. The total dynamic head (TDH) for the Pump Station No. 3 under the open channel design is approximately 13-ft (excluding Pump Station losses for sake of comparison). The closed conduit design results in an approximate increase of 1,000 bhp to convey the water

through Reach 4. This results in cost increases to the pumps, motors, VFD's, and electrical equipment.

This also results in higher operational costs. The higher pump station lift is approximately 23.93-ft than an open channel design. This equates to approximately 37.70 kwh/ac-ft. In a wet year it is estimated that approximately 7,140 ac-ft could be pumped through this reach during the initial fill over an approximate two-week duration. This equates to approximately 269,170 kwh per year. Assuming an average energy rate of $0.14/kwh equates to an increased operational cost in wet years of approximately $37,684.00.

Alternative 1b: Avg. Recharge Rate – Max Velocity 7 fps

The same calculations as above were performed accounting for the average recharge rates:

- Flowrate = 170 cfs
- Maximum Velocity = 7.0 fps
- Pipe Diameter = Approximate 84-in (7-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the conveyance piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the Hazen-Williams Equation for the friction loss through the pipe.

Hazen-Williams Equation: $h_f = (3.022 * V^{1.85} * L) / (C^{1.85} * D^{1.17})$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Material Coefficient (Used 130 for Dry Cast RCP pipe)
L = Pipe Length (Estimated as 1,070-ft)

Results:

A = 170 cfs / 7.0 fps = 24.3 sf
D = 5.6 ft < 7 ft (84-in)

$A = (3.14*D^2)/4 = 38.47$ sf
V = 170 cfs / 38.47 sf = 4.42 fps
Velocity Head = $h_v = v^2/2g = 0.30$ ft
Wetted Perimeter = P = 22.0 ft
Hydraulic Radius = R = A/P = 38.5 sf / 22.0 ft = 1.75 ft
Entrance Loss = $0.5 * v^2/2g = 0.15$ ft
H_L = 0.64 ft

Minor Loss = 0.2 * $v^2/2g$ = 0.06 ft

Total Estimated Headloss = 0.85-ft

The flow then decreases to approximately 158 cfs after the first turnout to the West Basins. The pipeline remains a 84" Dry Cast RCP pipe with an approximate 84" I.D.

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Material Coefficient (Used 130 for Dry Cast RCP pipe)
L = Pipe Length (Estimated as 1,490-ft)

Results:

A = 158 cfs / 7.0 fps = 22.6 sf
D = 5.36 ft < 7.0 ft (84-in)

A = $(3.14*D^2)/4$ = 38.47 sf
V = 158 cfs / 38.47 sf = 4.11 fps
Velocity Head = $h_v = v^2/2g$ = 0.26 ft
Wetted Perimeter = P = 22.0 ft
Hydraulic Radius = R = A/P = 38.5 sf / 22.0 ft = 1.75 ft
H_L= 0.78 ft
Minor Loss = 0.2 * $v^2/2g$ = 0.05 ft

Total Estimated Headloss = 0.83-ft

The flow then decreases to approximately 146 cfs after the first and second turnouts to the West Basins. The pipeline reduces to a 72" Dry Cast RCP pipe with an approximately 72" I.D.

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Material Coefficient (Used 130 for Dry Cast RCP pipe)
L = Pipe Length (Estimated as 3,100-ft)

Results:

A = 146 cfs / 7.0 fps = 20.9 sf
D = 5.15 ft < 6.0 ft (72-in)

A = $(3.14*D^2)/4$ = 28.26 sf
V = 146 cfs / 28.26 sf = 5.17 fps
Velocity Head = $h_v = v^2/2g$ = 0.41 ft
Wetted Perimeter = P = 18.8 ft
Hydraulic Radius = R = A/P = 28.3 sf / 18.8 ft = 1.51 ft
H_L= 2.95 ft
Minor Loss = 0.2 * $v^2/2g$ = 0.08 ft

Total Estimated Headloss = 3.04-ft

The flow then decreases to approximately 121 cfs after the first, second, and third turnouts to the West Basins. The pipeline further reduces to a 66" Dry Cast RCP pipe with an approximate 66" I.D.

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Material Coefficient (Used 130 for Dry Cast RCP pipe)
L = Pipe Length (Estimated as 2,350-ft)

Results:

A = 121 cfs / 7.0 fps = 17.29 sf
D = 4.69 ft < 5.5 ft (66-in)

$A = (3.14*D^2)/4 = 23.75$ sf
V = 121 cfs / 23.75 sf = 5.09 fps
Velocity Head = $h_v = v^2/2g = 0.40$ ft
Wetted Perimeter = P = 17.3 ft
Hydraulic Radius = R = A/P = 23.8 sf / 17.3 ft = 1.38 ft
H_L= 2.41 ft
Minor Loss = $0.2 * v^2/2g = 0.08$ ft

Total Estimated Headloss = 2.49-ft

The flow then decreases to approximately 100 cfs after the fourth and final turnout to the West Basins. In addition, approximately 24 cfs is conveyed to the existing 27-inch West Basin pipeline and 6 cfs to "in-lieu" turnout demands leaving approximately 70 cfs to be conveyed to the Phase I Property. The pipeline reduces to a 54" Dry Cast RCP pipe with an approximate 54" I.D.

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Material Coefficient (Used 130 for Dry Cast RCP pipe)
L = Pipe Length (Estimated as 4,500-ft)

Results:

A = 70 cfs / 7.0 fps = 10.0 sf
D = 3.57 ft < 4.5 ft (54-in)

$A = (3.14*D^2)/4 = 15.9$ sf
V = 70 cfs / 15.9 sf = 4.40 fps
Velocity Head = $h_v = v^2/2g = 0.30$ ft
Wetted Perimeter = P = 14.1 ft
Hydraulic Radius = R = A/P = 15.9 sf / 14.1 ft = 1.13 ft
H_L= 4.46 ft

Exit Loss = 1.0 * $v^2/2g$ = 0.30 ft

Total Estimated Headloss = 4.76-ft

The estimated headloss above (11.97-ft) would need to be added to the static lift which is estimated as 13-ft for a total TDH (excluding Pump Station losses for sake of comparison) of approximately 24.97-ft.

This also results in higher operational costs that must be considered. The higher pump station lift is approximately 11.97-ft. This equates to approximately 18.86 kwh/ac-ft. In a wet year it is estimated that approximately 42,860 ac-ft could be pumped through this reach during the average recharge operations to bank the total 50,000 ac-ft goal. This equates to approximately 808,226 kwh per year. Assuming an average energy rate of $0.14/kwh equates to an increased operational cost in wet years of approximately $113,152.00.

This equates to a total operating cost in a wet year of approximately $150,836.00 more than would be experienced with an open channel facility. The approximate capital cost for the 84" Dry Cast RCP closed conduit design would be roughly $5.5M. In addition, the increased pump station horsepower is anticipated to add approximately $800,000 in cost for a total capital cost of approximately $6.3M.

Alternative 2a: Fill Rate – Max Velocity 12.5 fps

The second alternative evaluates using HDPE pipe and pushing the velocities higher during the initial filling period with the understanding that the majority of the time the system will be operating under average recharge rates and lower pipeline velocities.

- Flowrate = 240 cfs
- Maximum Velocity at Initial Fill = 12.5 fps
- Pipe Diameter = Approximate 60-in (5-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the conveyance piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the Hazen-Williams Equation for the friction loss through the pipe.

Hazen-Williams Equation: $h_f = (3.022 * V^{1.85} * L) / (C^{1.85} * D^{1.17})$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope

C = Material Coefficient (Used 160 for HDPE pipe)
L = Pipe Length (Estimated as 1,070-ft)

Results:

A = 240 cfs / 12.5 fps = 19.2 sf
D = 4.95 ft < 5 ft (60-in)

$A = (3.14*D^2)/4 = 19.46$ sf
V = 240 cfs / 19.46 sf = 12.34 fps
Velocity Head = $h_v = v^2/2g = 2.36$ ft
Wetted Perimeter = P = 15.6 ft
Hydraulic Radius = R = A/P = 19.5 sf / 15.6 ft = 1.25 ft
Entrance Loss = $0.5 * v^2/2g = 1.18$ ft
H_L= 4.32 ft
Minor Loss = $0.2 * v^2/2g = 0.47$ ft

Total Estimated Headloss = 5.97-ft

The flow then decreases to approximately 222 cfs after the first turnout to the West Basins. The pipeline remains a 63" HDPE pipe with an approximately 60" I.D.

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Material Coefficient (Used 160 for HDPE pipe)
L = Pipe Length (Estimated as 1,490-ft)

Results:

A = 222 cfs / 12.5 fps = 17.8 sf
D = 4.76 ft < 5 ft (60-in)

$A = (3.14*D^2)/4 = 19.46$ sf
V = 222 cfs / 19.46 sf = 11.41 fps
Velocity Head = $h_v = v^2/2g = 2.02$ ft
Wetted Perimeter = P = 15.6 ft
Hydraulic Radius = R = A/P = 19.5 sf / 15.6 ft = 1.25 ft
H_L= 5.20 ft
Minor Loss = $0.2 * v^2/2g = 0.40$ ft

Total Estimated Headloss = 5.60-ft

The flow then decreases to approximately 204 cfs after the first and second turnouts to the West Basins. The pipeline remains a 63" HDPE pipe with an approximately 60" I.D.

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope

C = Material Coefficient (Used 160 for HDPE pipe)
L = Pipe Length (Estimated as 3,100-ft)

Results:

A = 204 cfs / 12.5 fps = 16.3 sf
D = 4.56 ft < 5 ft (60-in)

$A = (3.14*D^2)/4 = 19.46$ sf
V = 204 cfs / 19.46 sf = 10.48 fps
Velocity Head = $h_v = v^2/2g = 1.71$ ft
Wetted Perimeter = P = 15.6 ft
Hydraulic Radius = R = A/P = 19.5 sf / 15.6 ft = 1.25 ft
H_L= 9.26 ft
Minor Loss = $0.2 * v^2/2g = 0.34$ ft

Total Estimated Headloss = 9.60-ft

The flow then decreases to approximately 167 cfs after the first, second, and third turnouts to the West Basins. The pipeline remains a 63" HDPE pipe with an approximately 60" I.D.

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Material Coefficient (Used 160 for HDPE pipe)
L = Pipe Length (Estimated as 2,350-ft)

Results:

A = 167 cfs / 12.5 fps = 13.4 sf
D = 4.13 ft < 5 ft (60-in)

$A = (3.14*D^2)/4 = 19.46$ sf
V = 167 cfs / 19.46 sf = 8.58 fps
Velocity Head = $h_v = v^2/2g = 1.14$ ft
Wetted Perimeter = P = 15.6 ft
Hydraulic Radius = R = A/P = 19.5 sf / 15.6 ft = 1.25 ft
H_L= 4.82 ft
Minor Loss = $0.2 * v^2/2g = 0.23$ ft

Total Estimated Headloss = 5.05-ft

The flow then decreases to approximately 135 cfs after the fourth and final turnout to the West Basins. In addition, approximately 24 cfs is conveyed to the existing 27-inch West Basin pipeline and 6 cfs to "in-lieu" turnout demands leaving approximately 105 cfs to be conveyed to the Phase I Property. The pipeline reduces to a 54" HDPE pipe with an approximately 51" I.D.

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius

S = Slope
C = Material Coefficient (Used 160 for HDPE pipe)
L = Pipe Length (Estimated as 4,500-ft)

Results:

A = 105 cfs / 12.5 fps = 8.4 sf
D = 3.27 ft < 4.5 ft (54-in)

$A = (3.14*D^2)/4 = 14.30$ sf
V = 105 cfs / 14.30 sf = 7.34 fps
Velocity Head = $h_v = v^2/2g = .84$ ft
Wetted Perimeter = P = 13.4 ft
Hydraulic Radius = R = A/P = 14.3 sf / 13.4 ft = 1.07 ft
H_L= 8.32 ft
Exit Loss = $1.0 * v^2/2g = 0.84$ ft

Total Estimated Headloss = 9.16-ft

The estimated headloss above (35.38-ft) would need to be added to the static lift which is estimated as 13-ft for a total TDH (excluding Pump Station losses for sake of comparison) of approximately 48.38-ft. The total dynamic head (TDH) for the Pump Station No. 3 under the open channel design is approximately 13-ft (excluding Pump Station losses for sake of comparison). The closed conduit design results in an approximate increase of 1,480 bhp to convey the water through Reach 4. This results in cost increases to the pumps, motors, VFD's, and electrical equipment.

This also results in higher operational costs. The higher pump station lift is approximately 35.38-ft more than an open channel design. This equates to approximately 55.74 kwh/ac-ft. In a wet year it is estimated that approximately 7,140 ac-ft could be pumped through this reach during the initial fill over an approximate two-week duration. This equates to approximately 397,963 kwh per year. Assuming an average energy rate of $0.14/kwh equates to an increased operational cost in wet years of approximately $55,715.00.

Alternative 2b: Avg. Recharge Rate – Max Velocity 12.5 fps

The same calculations as above were performed accounting for the average recharge rates:

- Flowrate = 170 cfs
- Maximum Velocity = 12.5 fps
- Pipe Diameter = Approximate 60-in (5-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the conveyance piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the Hazen-Williams Equation for the friction loss through the pipe.

Hazen-Williams Equation: $h_f = (3.022 * V^{1.85} * L) / (C^{1.85} * D^{1.17})$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Material Coefficient (Used 160 for HDPE pipe)
L = Pipe Length (Estimated as 1,070-ft)

Results:

A = 170 cfs / 12.5 fps = 13.6 sf
D = 4.16 ft < 5 ft (60-in)

$A = (3.14*D^2)/4 = 19.46$ sf
V = 170 cfs / 19.46 sf = 8.74 fps
Velocity Head = $h_v = v^2/2g = 1.19$ ft
Wetted Perimeter = P = 15.6 ft
Hydraulic Radius = R = A/P = 19.5 sf / 15.6 ft = 1.25 ft
Entrance Loss = $0.5 * v^2/2g = 0.59$ ft
H_L= 2.28 ft
Minor Loss = $0.2 * v^2/2g = 0.24$ ft

Total Estimated Headloss = 3.11-ft

The flow then decreases to approximately 158 cfs after the first turnout to the West Basins. The pipeline remains a 63" HDPE pipe with an approximately 60" I.D.

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Material Coefficient (Used 160 for HDPE pipe)
L = Pipe Length (Estimated as 1,490-ft)

Results:

A = 158 cfs / 12.5 fps = 12.6 sf
D = 4.01 ft < 5 ft (60-in)

$A = (3.14*D^2)/4 = 19.46$ sf
V = 158 cfs / 19.46 sf = 8.12 fps
Velocity Head = $h_v = v^2/2g = 1.02$ ft
Wetted Perimeter = P = 15.6 ft
Hydraulic Radius = R = A/P = 19.5 sf / 15.6 ft = 1.25 ft
H_L= 2.77 ft
Minor Loss = $0.2 * v^2/2g = 0.20$ ft

Total Estimated Headloss = 2.97-ft

The flow then decreases to approximately 146 cfs after the first and second turnouts to the West Basins. The pipeline remains a 63" HDPE pipe with an approximately 60" I.D.

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Material Coefficient (Used 160 for HDPE pipe)
L = Pipe Length (Estimated as 3,100-ft)

Results:

A = 146 cfs / 12.5 fps = 11.7 sf
D = 3.86 ft < 5 ft (60-in)

$A = (3.14*D^2)/4 = 19.46$ sf
V = 146 cfs / 19.46 sf = 7.50 fps
Velocity Head = $h_v = v^2/2g = 0.87$ ft
Wetted Perimeter = P = 15.6 ft
Hydraulic Radius = R = A/P = 19.5 sf / 15.6 ft = 1.25 ft
H_L= 4.99 ft
Minor Loss = $0.2 * v^2/2g = 0.17$ ft

Total Estimated Headloss = 5.16-ft

The flow then decreases to approximately 121 cfs after the first, second, and third turnouts to the West Basins. The pipeline remains a 63" HDPE pipe with an approximately 60" I.D.

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Material Coefficient (Used 160 for HDPE pipe)
L = Pipe Length (Estimated as 2,350-ft)

Results:

A = 121 cfs / 12.5 fps = 9.7 sf
D = 3.51 ft < 5 ft (60-in)

$A = (3.14*D^2)/4 = 19.46$ sf
V = 121 cfs / 19.46 sf = 6.22 fps
Velocity Head = $h_v = v^2/2g = .60$ ft
Wetted Perimeter = P = 15.6 ft
Hydraulic Radius = R = A/P = 19.5 sf / 15.6 ft = 1.25 ft
H_L= 2.67 ft
Minor Loss = $0.2 * v^2/2g = 0.12$ ft

Total Estimated Headloss = 2.79-ft

The flow then decreases to approximately 100 cfs after the fourth and final turnout to the West Basins. In addition, approximately 24 cfs is conveyed to the existing 27-inch West Basin pipeline and 6 cfs to "in-lieu" turnout demands leaving approximately 70 cfs to be conveyed to the Phase I Property. The pipeline reduces to a 54" HDPE pipe with an approximately 51" I.D.

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Material Coefficient (Used 160 for HDPE pipe)
L = Pipe Length (Estimated as 4,500-ft)

Results:

A = 70 cfs / 12.5 fps = 5.6 sf
D = 2.67 ft < 4.5 ft (54-in)

$A = (3.14*D^2)/4 = 14.30$ sf
V = 70 cfs / 14.30 sf = 6.99 fps
Velocity Head = $h_v = v^2/2g = .76$ ft
Wetted Perimeter = P = 13.4 ft
Hydraulic Radius = R = A/P = 14.3 sf / 13.4 ft = 1.07 ft
H_L= 3.93 ft
Exit Loss = $1.0 * v^2/2g = 0.76$ ft

Total Estimated Headloss = 4.69-ft

The estimated headloss above (18.72-ft) would need to be added to the static lift which is estimated as 13-ft for a total TDH (excluding Pump Station losses for sake of comparison) of approximately 31.72-ft.

This also results in higher operational costs that must be considered. The higher pump station lift is approximately 18.72-ft. This equates to approximately 29.49 kwh/ac-ft. In a wet year it is estimated that approximately 42,860 ac-ft could be pumped through this reach during the average recharge operations to bank the total 50,000 ac-ft goal. This equates to approximately 1,263,905 kwh per year. Assuming an average energy rate of $0.14/kwh equates to an increased operational cost in wet years of approximately $176,947.00.

This equates to a total operating cost in a wet year of approximately $232,662.00 as opposed to designing the closed conduit piping system closer to a more conventional velocity of 5 to 7 fps. This is an approximate increase of $81,826.00 in operating expenses per wet year as a result of utilizing a smaller diameter piping system. The approximate capital cost for the 63" HDPE closed conduit design would be roughly $4.0M. In addition, the increased pump station horsepower is anticipated to add approximately $1.5M in cost for a total capital cost of approximately $5.5M. Therefore, the increased capital cost for the difference between 63" HDPE and 84" Dry Cast RCP in a closed conduit design would be approximately $0.8M ($6.3M - $5.5M). However, the increased pipe size saves approximately $81,826.00 annually in wet years ($232,662 - $150,836). This requires approximately 10 wet years to pay for the increased

capital cost which is a great deal of time when considering that wet years typically occur only about two years out of every ten which would equate to an approximate payback period of 50 years.

Value engineering during the design phase may also consider possible parallel pipelines, more detailed pump station costs, rights-of-way and crop take, etc. when evaluating the Reach 4 design.

b) Pipe Materials

The conveyance piping is large diameter pipe in the approximate size of 5-ft diameter. The pipe material options consist of PVC, HDPE, FBE steel pipe, CMLC steel pipe, wet cast RCP, and dry cast RCP. The PVC pipe would be DR41 pipe and the HDPE would be 63" DR41 pipe. It is anticipated that a 3/8-inch steel pipe wall thickness would be utilized for the FBE steel pipe and CMLC steel pipe. The wet cast and dry cast RCP pipe would be ASTM C361 pipe, C50 double gasketed pipe. The "C" designation signifies that the pipe is suitable for earth cover over the top of the pipe up to 15-ft which is anticipated when crossing levee embankments. The "50" designation signifies that the pipe can handle hydrostatic heads up to 50-ft above the centerline of the pipe.

c) Material Recommendations

The conveyance piping is estimated to be approximately 12,510-ft in length. The PVC pipe is estimated as $316 per lineal foot for material cost and $448 per lineal foot for material and installation. The HDPE pipe is estimated as $128 per lineal foot for material cost and $332 per lineal foot for material and installation. The FBE steel pipe is estimated as $330 per lineal foot for material cost and $524 for material and installation. The CMLC steel pipe is estimated as $340 per lineal foot for material cost and $514 per lineal foot for material and installation. The wet cast RCP is estimated as $750 per lineal foot for material cost and $858 per lineal foot for material and installation while the dry cast RCP is estimated as $236 per lineal foot for material cost and $344 per lineal foot for material and installation.

The DR41 HDPE pipe is the most economical pipe in this pipe diameter. Therefore, 63" DR41 HDPE pipe is the recommended pipe material for the Reach 4 canal conveyance piping if a closed conduit design is selected. The pipe size could also be reduced as the closed conduit system turns out water to each recharge basin.

The pipe pressure class will need to be re-evaluated upon completion of the pump station design to ensure the pipe is designed for the appropriate working pressures, potential surge pressures, and pump shut-off head, if applicable.

E. Pump Station Discharge Piping

a) Sizing Criteria

The design flow for Pump Station No. 1 located near Stockdale Highway is 443 cfs. The design flow for Pump Station No. 2 located near the Interstate 5 Freeway is 435 cfs. The design flow for Pump Station No. 3 near the West Basins is 240 cfs. Each of these pump stations will consist of multiple pumps. The calculations below are for various sizes of pump discharge piping. Technical Memorandum No. 4 (Pump Station Requirements) will evaluate the different combinations of pumps.

- Flowrate = 240 cfs to 443 cfs
- Flowrate varies for each pump discharge line
- Maximum Velocity = 10 fps

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the discharge piping was calculated using the velocity head of the pipe for minor losses and the Hazen-Williams Equation for the friction loss through the pipe.

Hazen-Williams Equation: $h_f = (3.022 * V^{1.85} * L) / (C^{1.85} * D^{1.17})$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
C = Roughness Coefficient (Used 145 for lined steel pipe)
L = Pipe Length (Estimated as 150-ft)

Results:

125 cfs Pumps

A = 125 cfs / 10 fps = 12.5 sf
D = 3.99 ft < 4.0 ft (48-in)

$A = (3.14*D^2)/4 = 12.6$ sf
V = 125 cfs / 12.6 sf = 9.92 fps
Velocity Head = $h_v = v^2/2g = 1.53$ ft
Wetted Perimeter = P = 12.6 ft
Hydraulic Radius = R = A/P = 12.6 sf / 12.6 ft = 1.0 ft
Entrance Loss = $0.5 * v^2/2g = .77$ ft
H_L= 0.63 ft
Check Valve = 0.50-ft
Flow Meter = 0.01-ft
Butterfly Valve = 0.55-ft
Exit Loss = $1.0 * v^2/2g = 1.53$ ft

Total Estimated Headloss = 3.99-ft

100 cfs Pumps

A = 100 cfs / 10 fps =10.00 sf
D = 3.56 ft < 4.0 ft (48-in)

$A = (3.14*D^2)/4 = 12.6$ sf
V = 100 cfs / 12.6 sf = 7.94 fps
Velocity Head = $h_v = v^2/2g = 0.98$ ft
Wetted Perimeter = P = 12.6 ft
Hydraulic Radius = R = A/P = 12.6 sf / 12.6 ft = 1.0 ft
Entrance Loss = $0.5 * v^2/2g = 0.49$ ft
H_L= 0.51 ft
Check Valve = 0.35-ft
Flow Meter = 0.01-ft
Butterfly Valve = 0.35-ft
Exit Loss = $1.0 * v^2/2g = 0.98$ ft

Total Estimated Headloss = 2.69-ft

90 cfs Pumps

A = 90 cfs / 10 fps = 9.00 sf
D = 3.39 ft < 3.5 ft (42-in)

$A = (3.14*D^2)/4 = 9.62$ sf
V = 90 cfs / 9.6 sf = 9.38 fps
Velocity Head = $h_v = v^2/2g = 1.36$ ft
Wetted Perimeter = P = 11.0 ft
Hydraulic Radius = R = A/P = 9.6 sf / 11.0 ft = 0.87 ft
Entrance Loss = $0.5 * v^2/2g = 0.68$ ft
H_L= 0.66 ft
Check Valve = 0.45-ft
Flow Meter = 0.01-ft
Butterfly Valve = 0.50-ft
Exit Loss = $1.0 * v^2/2g = 1.36$ ft

Total Estimated Headloss = 3.66-ft

80 cfs Pumps

A = 80 cfs / 10 fps = 8.0 sf
D = 3.19 ft < 3.5 ft (42-in)

$A = (3.14*D^2)/4 = 9.62$ sf
V = 80 cfs / 9.6 sf = 8.33 fps
Velocity Head = $h_v = v^2/2g = 1.08$ ft
Wetted Perimeter = P = 11.0 ft
Hydraulic Radius = R = A/P = 9.6 sf / 11.0 ft = 0.875 ft
Entrance Loss = $0.5 * v^2/2g = 0.54$ ft
H_L= 0.53 ft
Check Valve = 0.35-ft
Flow Meter = 0.01-ft
Butterfly Valve = 0.40-ft
Exit Loss = $1.0 * v^2/2g = 1.08$ ft

Total Estimated Headloss = 2.91-ft

65 cfs Pumps

A = 65 cfs / 10 fps = 6.5 sf
D = 2.88 ft < 3.0 ft (36-in)

$A = (3.14*D^2)/4 = 7.07$ sf
V = 65 cfs / 7.07 sf = 9.19 fps
Velocity Head = $h_v = v^2/2g = 1.31$ ft
Wetted Perimeter = P = 9.42 ft
Hydraulic Radius = R = A/P = 7.1 sf / 9.4 ft = 0.75 ft
Entrance Loss = $0.5 * v^2/2g = 0.66$ ft
H_L= 0.76 ft
Check Valve = 0.55-ft
Flow Meter = 0.01-ft
Butterfly Valve = 0.50-ft
Exit Loss = $1.0 * v^2/2g = 1.31$ ft

Total Estimated Headloss = 3.79-ft

60 cfs Pumps

A = 60 cfs / 10 fps = 6.0 sf
D = 2.76 ft < 3.0 ft (36-in)

$A = (3.14*D^2)/4 = 7.07$ sf
V = 60 cfs / 7.07 sf = 8.49 fps
Velocity Head = $h_v = v^2/2g = 1.12$ ft
Wetted Perimeter = P = 9.42 ft
Hydraulic Radius = R = A/P = 7.1 sf / 9.4 ft = 0.75 ft
Entrance Loss = $0.5 * v^2/2g = 0.56$ ft
H_L= 0.66 ft
Check Valve = 0.45-ft
Flow Meter = 0.01-ft
Butterfly Valve = 0.45-ft
Exit Loss = $1.0 * v^2/2g = 1.12$ ft

Total Estimated Headloss = 3.25-ft

50 cfs Pumps

A = 50 cfs / 10 fps = 5.0 sf
D = 2.52 ft < 3.0 ft (36-in)

$A = (3.14*D^2)/4 = 7.07$ sf
V = 50 cfs / 7.07 sf = 7.07 fps
Velocity Head = $h_v = v^2/2g = 0.78$ ft
Wetted Perimeter = P = 9.42 ft
Hydraulic Radius = R = A/P = 7.07 sf / 9.42 ft = 0.75 ft
Entrance Loss = $0.5 * v^2/2g = 0.39$ ft
H_L= 0.57 ft
Check Valve = 0.32-ft
Flow Meter = 0.01-ft
Butterfly Valve = 0.26-ft
Exit Loss = $1.0 * v^2/2g = 0.78$ ft

Total Estimated Headloss = 2.33-ft

40 cfs Pumps

A = 40 cfs / 10 fps = 4.00 sf
D = 2.26 ft < 2.5 ft (30-in)

$A = (3.14*D^2)/4 = 4.91$ sf

V = 40 cfs / 4.91 sf = 8.15 fps
Velocity Head = $h_v = v^2/2g$ = 1.03 ft
Wetted Perimeter = P = 7.85 ft
Hydraulic Radius = R = A/P = 4.91 sf / 7.85 ft = 0.63 ft
Entrance Loss = 0.5 * $v^2/2g$ = 0.52 ft
H_L= 0.76 ft
Check Valve = 0.45-ft
Flow Meter = 0.01-ft
Butterfly Valve = 0.45-ft
Exit Loss = 1.0 * $v^2/2g$ = 1.03 ft

Total Estimated Headloss = 3.22-ft

30 cfs Pumps
A = 30 cfs / 10 fps = 3.00 sf
D = 1.95 ft < 2.0 ft (24-in)

A = (3.14*D^2)/4 = 3.14 sf
V = 30 cfs / 3.14 sf = 9.55 fps
Velocity Head = $h_v = v^2/2g$ = 1.42 ft
Wetted Perimeter = P = 6.28 ft
Hydraulic Radius = R = A/P = 3.14 sf / 6.28 ft = 0.50 ft
Entrance Loss = 0.5 * $v^2/2g$ = 0.71 ft
H_L= 1.31 ft
Check Valve = 0.50-ft
Flow Meter = 0.01-ft
Butterfly Valve = 0.50-ft
Exit Loss = 1.0 * $v^2/2g$ = 1.42 ft

Total Estimated Headloss = 4.45 ft

Table 18

Pump Station Discharge Pipe Size Summary			
Pump Capacity (cfs)	Pipe Size (in)	Velocity (fps)	Estimated Headloss (ft)
125	48	9.92	3.99
100	48	7.94	2.69
90	42	9.38	3.66
80	42	8.33	2.91
65	36	9.19	3.79
60	36	8.49	3.25
50	36	7.07	2.33
40	30	8.15	3.22
30	24	9.55	4.45

1. Pump discharge piping does not take into consideration the pump column pipe size or valve/meter sizes at this time. Size recommendations solely based on pipe velocity.

b) Pipe Materials

The pump station discharge piping configuration is evaluated and discussed in the Technical Memorandum No. 4. The selected configuration will dictate what the flow capacities are for each discharge pipeline. However, generally speaking, Table 18 above, estimates the discharge pipe size for the given flows.

It is anticipated that the above ground discharge piping will be either fusion bonded epoxy lined and coated steel pipe or cement mortar lined and exterior painted steel pipe. Fusion bonded epoxy lined or cement mortar lined steel pipe is preferred in above ground installations where it is subject to inclement weather, UV exposure, seismic events, or nearby to traffic and vehicular access. The underground piping could be PVC pipe, HDPE pipe, FBE steel pipe, or CMLC steel pipe. The pipe class or pressure rating will depend on the pump selection and the associated shutoff head of each pump. However, for purposes of this evaluation a minimum pressure class of 50 psi has been estimated and is figured to be conservative.

c) Material Recommendations

The pump station discharge piping is estimated to be approximately 150-ft in length. The FBE lined steel pipe is estimated as the following costs per foot:

Table 19

Pump Station Discharge Piping Fusion Bonded Epoxy Lined Steel Pipe		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Material + Install Pipe Cost ($/LF)
24	$120.00	$210.00
30	$148.20	$238.50
36	$161.20	$287.83
42	$190.80	$321.00
48	$220.00	$356.38

The CML steel pipe is estimated as the following cost per foot:

Table 20

Pump Station Discharge Piping Cement Mortar Lined Steel Pipe		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Material + Install Pipe Cost ($/LF)
24	$100.00	$190.00
30	$123.50	$213.50
36	$171.00	$257.83
42	$194.00	$305.00
48	$220.00	$336.38

The underground piping may be plastic rather than FBE or CMLC steel pipe.

The SDR51 and DR51 PVC pipe is estimated as the following cost per foot:

Table 21

Pump Station Discharge Piping PVC Pipe (DR51 and SDR51)		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Material + Install Pipe Cost ($/LF)
24	$36.53	$95.53
27	$50.56	$111.56
30	$68.31	$132.31
36	$99.14	$187.14
42	$131.23	$223.73
48	$165.80	$263.80

The DR32.5 HDPE pipe is estimated as the following cost per foot:

Table 22

Pump Station Discharge Piping HDPE Pipe (DR32.5 and DR41)		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Material + Install Pipe Cost ($/LF)
24	$34.34	$96.34
30	$54.35	$142.35
36	$58.30	$184.30
42	$72.40	$210.40
48	$88.00	$240.00

F. Phase II Turnout

a) Sizing Criteria

The Phase II Turnout is currently illustrated with two turnouts – one on the north side of the conveyance canal and one on the south side of the conveyance canal. This results in a turnout capacity of 96 cfs each. However, this is subject to change based on the actual location of the Phase II Property and the canal alignment. In addition, it may be more cost efficient to install multiple turnouts such that there is a canal turnout to each recharge basin. This could result in four turnouts (2 each side) and reduce the capacity of the turnouts to approximately 48 cfs each.

The design flow per turnout for four turnouts to the Phase II Property is 48 cfs each.

- Flowrate = 48 cfs
- Maximum Velocity = 5 fps
- Pipe Diameter = Approximate 48-in (4.0-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the turnout piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the Manning's Equation for the friction loss through the pipe.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
n = Material Coefficient (Used 0.012 for ADS HDPE pipe)
L = Pipe Length (Estimated as 150-ft)

Results:

A = 48 cfs / 5 fps = 9.6 sf
D = 3.49 ft < 4.0 ft (48-in)
D = 47.24" I.D.

$A = (3.14*D^2)/4 = 12.2$ sf
V = 48 cfs / 12.6 sf = 3.93 fps
Velocity Head = $h_v = v^2/2g = 0.24$ ft
Wetted Perimeter = P = 12.4 ft
Hydraulic Radius = R = A/P = 12.2 sf / 12.4 ft = 0.98 ft
Entrance Loss = $0.5 * v^2/2g = 0.12$ ft
H_L= 1.02 ft / 1,000 ft
Exit Loss = $1.0 * v^2/2g = 0.24$ ft

Total Estimated Headloss = 0.51-ft

Design the turnout piping so that the control water surface submerges the pipe at the headwall structure a minimum 1.78 times h_v plus 3-inches or approximately 8-inches.

b) Pipe Materials

The District desires to standardize the turnout piping to be 48-inch diameter. This will allow them to have uniform sizes for precast structures, slide gates, and stop log slots or weir boards.

The 48-inch diameter turnout piping is a size which falls within the availability of PVC, HDPE, CMLC, or RCP. The PVC pipe would be a pressure class 80 psi (DR51) pipe with a nominal interior diameter of 49.69-inches and an outside diameter of 50.80 inches. The HDPE pipe would be a pressure class of 50 psi (DR41) pipe with a nominal interior diameter of 45.52-inches and an outside diameter of 48.00-inches. The ADS N-12 corrugated HDPE pipe is also an alternative and has an O.D. of 54-inches and an I.D. of 47.24-inches. The cement

mortar lined and coated steel pipe would have a ¼-inch wall thickness, ½-inch thick lining, and ¾-inch thick coating. The wet cast and dry cast RCP pipe would be ASTM C361 pipe, C25 double gasketed pipe. The "C" designation signifies that the pipe is suitable for earth cover over the top of the pipe up to 15-ft. The "25" designation signifies that the pipe can handle hydrostatic heads up to 25-ft above the centerline of the pipe.

c) Material Recommendations

The turnout piping is estimated to be approximately 150-ft in length. The PVC pipe is estimated as $166 per lineal foot material cost and $264 per lineal foot material and installation. The HDPE pipe is estimated as $88 per lineal foot material cost and $240 per lineal foot for material and installation. The ADS N-12 pipe is estimated as $93 per lineal foot material cost and $161 per lineal foot material and installation. The CMLC steel pipe is estimated as $220 per lineal foot material cost and $336 per lineal foot for material and installation. The wet cast RCP is estimated as $486 per lineal foot material cost and $581 per lineal foot for material and installation while the dry cast RCP is estimated as $174 per lineal foot material cost and $268 per lineal foot for material and installation.

The ADS N-12 HDPE pipe is the most economical pipe material for the turnout piping and is a preferred material by the District. Therefore, it is recommended that ADS N-12 HDPE pipe be utilized at the Phase II turnouts.

G. West Basins Turnout

a) Sizing Criteria

Alternative 1: Reach 4 Open Channel Design

The West Basins Turnout is illustrated in the 30% Preliminary Design Report as one turnout with four barrels discharging water into the canal that supplies the easterly boundary of the West Basins. However, if Reach 4 is an open channel then a single turnout at the end of Reach 4 to the West Basins could be two barrels each 48" diameter in size.

The design flow for a two barrel design to the West Basins Property is 52.5 cfs per barrel.

- Flowrate = 52.5 cfs
- Maximum Velocity = 5 fps
- Pipe Diameter = Approximate 48-in (4.0-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the turnout piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the Manning's Equation for the friction loss through the pipe.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
n = Material Coefficient (Used 0.012 for ADS HDPE pipe)
L = Pipe Length (Estimated as 200-ft)

Results:

A = 52.5 cfs / 5 fps = 10.5 sf
D = 3.65 ft < 4.0 ft (48-in)
D = 47.24" I.D.

$A = (3.14*D^2)/4 = 12.2$ sf
V = 52.5 cfs / 12.6 sf = 4.30 fps
Velocity Head = $h_v = v^2/2g = 0.29$ ft
Wetted Perimeter = P = 12.4 ft
Hydraulic Radius = R = A/P = 12.2 sf / 12.4 ft = 0.98 ft
Entrance Loss = $0.5 * v^2/2g = 0.15$ ft
H_L= 1.23 ft / 1,000 ft
Exit Loss = $1.0 * v^2/2g = 0.29$ ft

Total Estimated Headloss = 0.69-ft

Design the turnout piping so that the control water surface submerges the pipe at the headwall structure a minimum 1.78 times h_v plus 3-inches or approximately 10-inches.

Alternative 2: Reach 4 Closed Conduit Design

If multiple turnouts are constructed along a closed conduit design then it is anticipated that there may be four turnouts ranging in capacity from 18 cfs to 37.5 cfs.

The turnout piping is anticipated to be 36-inch diameter HDPE piping.

- Flowrate = 18 cfs
- Maximum Velocity = 5 fps
- Pipe Diameter = Approximate 36-in (3.0-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the turnout piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the Manning's Equation for the friction loss through the pipe.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
n = Material Coefficient (Used 0.009 for HDPE pipe)
L = Pipe Length (Estimated as 200-ft)

Results:

A = 18 cfs / 5 fps = 3.6 sf
D = 2.14 ft < 3.0 ft (36-in)
D = 34.14" I.D.

$A = (3.14*D^2)/4 = 6.4$ sf
V = 18 cfs / 6.4 sf = 2.81 fps
Velocity Head = $h_v = v^2/2g = 0.12$ ft
Wetted Perimeter = P = 8.9 ft
Hydraulic Radius = R = A/P = 6.4 sf / 8.9 ft = 0.72 ft
Entrance Loss = $0.5 * v^2/2g = 0.06$ ft
H_L= 0.45 ft / 1,000 ft
Exit Loss = $1.0 * v^2/2g = 0.12$ ft

Total Estimated Headloss = 0.27-ft

Design the turnout piping so that the control water surface submerges the pipe at the headwall structure a minimum 1.78 times h_v plus 3-inches or approximately 6-inches.

- Flowrate = 37.5 cfs
- Maximum Velocity = 5 fps
- Pipe Diameter = Approximate 36-in (3.0-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the turnout piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the Manning's Equation for the friction loss through the pipe.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Where:

Q = Flow (cfs)
V = Velocity (fps)

D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
n = Material Coefficient (Used 0.009 for HDPE pipe)
L = Pipe Length (Estimated as 200-ft)

Results:

A = 37.5 cfs / 5 fps = 7.5 sf
D = 3.1 ft $\leq$ 3.0 ft (36-in)
D = 34.14" I.D.

$A = (3.14*D^2)/4 = 6.4$ sf
V = 37.5 cfs / 6.4 sf = 5.86 fps
Velocity Head = $h_v = v^2/2g = 0.53$ ft
Wetted Perimeter = P = 8.9 ft
Hydraulic Radius = R = A/P = 6.4 sf / 8.9 ft = 0.72 ft
Entrance Loss = $0.5 * v^2/2g = 0.27$ ft
H_L= 1.95 ft / 1,000 ft
Exit Loss = $1.0 * v^2/2g = 0.53$ ft

Total Estimated Headloss = 1.19-ft

Design the turnout piping so that the control water surface submerges the pipe at the headwall structure a minimum 1.78 times h_v plus 3-inches or approximately 15-inches.

b) Pipe Materials

The District desires to standardize the turnout piping to be 36-in or 48-inch diameter. This will allow them to have uniform sizes for precast structures, slide gates, and stop log slots or weir boards. A single turnout to the West Basins at the end of an open channel design in Reach 4 is anticipated to be two 48-inch barrels. If Reach 4 is a closed conduit design with four turnouts to the West Basins along the pipeline, then it is anticipated that each turnout will be a 36-inch diameter branch from the DR41 HDPE pipeline and controlled by a 36-inch diameter butterfly valve. The material recommendations below are for a single turnout to the West Basins at the end of an open channel design.

The 48-inch diameter turnout piping is a size which falls within the availability of PVC, HDPE, CMLC, or RCP. The PVC pipe would be a pressure class 80 psi (DR51) pipe with a nominal interior diameter of 49.69-inches and an outside diameter of 50.80 inches. The HDPE pipe would be a pressure class of 50 psi (DR41) pipe with a nominal interior diameter of 45.52-inches and an outside diameter of 48.00-inches. The ADS N-12 corrugated HDPE pipe is also an alternative and has an O.D. of 54-inches and an I.D. of 47.24-inches. The cement mortar lined and coated steel pipe would have a ¼-inch wall thickness, ½-inch thick lining, and ¾-inch thick coating. The wet cast and dry cast RCP pipe would be ASTM C361 pipe, C25 double gasketed pipe. The "C" designation signifies that the pipe is suitable for earth cover over the top of the pipe up to 15-ft. The "25" designation signifies that the pipe can handle hydrostatic heads up to 25-ft above the centerline of the pipe.

c) Material Recommendations

The turnout piping is estimated to be approximately 200-ft in length. The PVC pipe is estimated as $166 per lineal foot material cost and $264 per lineal foot material and installation. The HDPE pipe is estimated as $88 per lineal foot material cost and $240 per lineal foot for material and installation. The ADS N-12 pipe is estimated as $93 per lineal foot material cost and $161 per lineal foot material and installation. The CMLC steel pipe is estimated as $220 per lineal foot material cost and $336 per lineal foot for material and installation. The wet cast RCP is estimated as $486 per lineal foot material cost and $581 per lineal foot for material and installation while the dry cast RCP is estimated as $174 per lineal foot material cost and $268 per lineal foot for material and installation.

The ADS N-12 HDPE pipe is the most economical pipe material for the turnout piping and is a preferred material by the District. Therefore, it is recommended that ADS N-12 HDPE pipe be utilized at the West Basin turnouts. However, if a closed conduit system is utilized using DR41 HDPE then it is likely that the turnouts will also be DR41 HDPE pipe.

H. Phase I Turnout

a) Sizing Criteria

The Phase I Turnout is currently illustrated as one turnout with two barrels discharging into the Phase I property.

The design flow for a two barrel design to the Phase I Property is 52.5 cfs per barrel.

- Flowrate = 52.5 cfs
- Maximum Velocity = 5 fps
- Pipe Diameter = Approximate 48-in (4.0-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the turnout piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the Manning's Equation for the friction loss through the pipe.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area

R = Hydraulic Radius
S = Slope
n = Material Coefficient (Used 0.012 for ADS HDPE pipe)
L = Pipe Length (Estimated as 200-ft)

Results:

A = 52.5 cfs / 5 fps = 10.5 sf
D = 3.65 ft < 4.0 ft (48-in)
D = 47.24" I.D.

$A = (3.14*D^2)/4 = 12.2$ sf
V = 52.5 cfs / 12.6 sf = 4.30 fps
Velocity Head = $h_v = v^2/2g = 0.29$ ft
Wetted Perimeter = P = 12.4 ft
Hydraulic Radius = R = A/P = 12.2 sf / 12.4 ft = 0.98 ft
Entrance Loss = $0.5 * v^2/2g = 0.15$ ft
H_L= 1.23 ft / 1,000 ft
Exit Loss = $1.0 * v^2/2g = 0.29$ ft

Total Estimated Headloss = 0.69-ft

Design the turnout piping so that the control water surface submerges the pipe at the headwall structure a minimum 1.78 times h_v plus 3-inches or approximately 10-inches.

b) Pipe Materials

The District desires to standardize the turnout piping to be 48-inch diameter. This will allow them to have uniform sizes for precast structures, slide gates, and stop log slots or weir boards. A single turnout to the Phase I Property at the end of an open channel design is anticipated to be two 48-inch barrels. If Reach 4 is a closed conduit design that continues all the way to the Phase I Property, then it is anticipated that the pipeline and the discharge to the Phase I property will be a 54-inch DR41 HDPE pipeline. The material recommendations below are for a single turnout to the Phase I Property at the end of an open channel design.

The 48-inch diameter turnout piping is a size which falls within the availability of PVC, HDPE, CMLC, or RCP. The PVC pipe would be a pressure class 80 psi (DR51) pipe with a nominal interior diameter of 49.69-inches and an outside diameter of 50.80 inches. The HDPE pipe would be a pressure class of 50 psi (DR41) pipe with a nominal interior diameter of 45.52-inches and an outside diameter of 48.00-inches. The ADS N-12 corrugated HDPE pipe is also an alternative and has an O.D. of 54-inches and an I.D. of 47.24-inches. The cement mortar lined and coated steel pipe would have a ¼-inch wall thickness, ½-inch thick lining, and ¾-inch thick coating. The wet cast and dry cast RCP pipe would be ASTM C361 pipe, C25 double gasketed pipe. The "C" designation signifies that the pipe is suitable for earth cover over the top of the pipe up to 15-ft. The "25" designation signifies that the pipe can handle hydrostatic heads up to 25-ft above the centerline of the pipe.

c) Material Recommendations

The turnout piping is estimated to be approximately 200-ft in length. The PVC pipe is estimated as $166 per lineal foot material cost and $264 per lineal foot

material and installation. The HDPE pipe is estimated as $88 per lineal foot material cost and $240 per lineal foot for material and installation. The ADS N-12 pipe is estimated as $93 per lineal foot material cost and $161 per lineal foot material and installation. The CMLC steel pipe is estimated as $220 per lineal foot material cost and $336 per lineal foot for material and installation. The wet cast RCP is estimated as $486 per lineal foot material cost and $581 per lineal foot for material and installation while the dry cast RCP is estimated as $174 per lineal foot material cost and $268 per lineal foot for material and installation.

The ADS N-12 HDPE pipe is the most economical pipe material for the turnout piping and is a preferred material by the District. Therefore, it is recommended that ADS N-12 HDPE pipe be utilized at the Phase I turnout. However, if a closed conduit system is utilized using DR41 HDPE then it is likely that the turnout will remain DR41 HDPE pipe.

I. Well Discharge Piping

a) Sizing Criteria

The Well Discharge Piping is the above ground piping and appurtenances from the well pump head to the transition below grade to the underground well conveyance piping.

The design flow for a well is 5 to 6 cfs.

- Flowrate = 6 cfs
- Maximum Velocity = 8 fps
- Pipe Diameter = Approximate 12-in (1-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$$A = Q/V$$

The headloss through the well discharge piping was calculated using the velocity head of the pipe for minor losses and the Hazen-Williams Equation for the friction loss through the pipe.

Hazen-Williams Equation: $h_f = (3.022 * V^{1.85} * L) / (C^{1.85} * D^{1.17})$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Roughness Coefficient (Used 145 for lined steel pipe)

L = Pipe Length (Estimated as 40-ft)

Results:

A = 6 cfs / 8 fps = 0.75 sf
D = 0.98 ft < 1.0 ft (12-in)

$A = (3.14*D^2)/4 = 0.78$ sf
V = 6 cfs / 0.78 sf = 7.64 fps
Velocity Head = $h_v = v^2/2g = 0.91$ ft
Wetted Perimeter = P = 3.1 ft
Hydraulic Radius = R = A/P = 0.78 sf / 3.1 ft = 0.25 ft
Entrance Loss = $0.5 * v^2/2g = 0.46$ ft
H_L= 0.52 ft
Check Valve = 2.7 ft
Flow Meter = 0.25 ft
Butterfly Valve = 0.40 ft
Minor Loss (90° Bend) = 0.18 ft
Exit Loss = $1.0 * v^2/2g = 0.91$ ft

Total Estimated Headloss = 5.42-ft

b) Pipe Materials

The well discharge piping will be fusion bonded epoxy lined and coated steel pipe. This is common for all the District wells. Fusion bonded epoxy steel pipe is preferred in above ground installations where it is subject to inclement weather, UV exposure, seismic events, or nearby to traffic and vehicular access.

c) Material Recommendations

The well discharge piping will be fusion bonded epoxy lined and coated steel pipe. The size is estimated as 12-inch diameter, however this is subject to change based on the actual well capacity at the time of design.

J. Well Conveyance Pipelines

a) Sizing Criteria

The Well Conveyance Piping is the below ground piping from the well discharge piping to the point of discharge typically at a canal. The pipeline lengths are subject to change, but have been estimated based on the feasibility study drawings for purposes of this analysis.

The design flow for the well conveyance piping from a single well is 6 cfs.

- Flowrate = 6 cfs
- Maximum Velocity = 5 fps
- Pipe Diameter = Approximate 15-in (1.25-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the well conveyance piping was calculated using the velocity head of the pipe for minor losses and the Hazen-Williams Equation for the friction loss through the pipe.

Hazen-Williams Equation: $h_f = (3.022 * V^{1.85} * L) / (C^{1.85} * D^{1.17})$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Roughness Coefficient (Used 150 for PVC pipe)
L = Pipe Length (Estimated as 1,830-ft)

Results:

A = 6 cfs / 5 fps = 1.2 sf
D = 1.22 ft < 1.25 ft (15-in)

$A = (3.14*D^2)/4 = 1.17$ sf
V = 6 cfs / 1.17 sf = 5.13 fps
Velocity Head = $h_v = v^2/2g = 0.41$ ft
Wetted Perimeter = P = 3.8 ft
Hydraulic Radius = R = A/P = 1.17 sf / 3.8 ft = 0.31 ft
Entrance Loss = $0.5 * v^2/2g = 0.22$ ft
H_L= 8.52 ft
Minor Losses (Bends) = 1.23 ft
Exit Loss = $1.0 * v^2/2g = 0.41$ ft

Total Estimated Headloss = 10.38-ft

The design flow for the well conveyance piping from two wells is 12 cfs.

- Flowrate = 12 cfs
- Maximum Velocity = 5 fps
- Pipe Diameter = Approximate 21-in (1.75-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the well conveyance piping was calculated using the velocity head of the pipe for minor losses and the Hazen-Williams Equation for the friction loss through the pipe.

Hazen-Williams Equation: $h_f = (3.022 * V^{1.85} * L) / (C^{1.85} * D^{1.17})$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Roughness Coefficient (Used 150 for PVC pipe)
L = Pipe Length (Estimated as 1,300-ft)

Results:

A = 12 cfs / 5 fps = 2.4 sf
D = 1.75 ft $\leq$ 1.75 ft (21-in)

A = $(3.14*D^2)/4$ = 2.43 sf
V = 12 cfs / 2.43 sf = 4.94 fps
Velocity Head = $h_v = v^2/2g$ = 0.38 ft
Wetted Perimeter = P = 5.5 ft
Hydraulic Radius = R = A/P = 2.43 sf / 5.5 ft = 0.44 ft
Entrance Loss = $0.5 * v^2/2g$ = 0.19 ft
H_L= 3.67 ft
Minor Losses (Bends) = 1.14 ft
Exit Loss = $1.0 * v^2/2g$ = 0.38 ft

Total Estimated Headloss = 5.38-ft

The design flow for the well conveyance piping from three wells is 18 cfs.

- Flowrate = 18 cfs
- Maximum Velocity = 5 fps
- Pipe Diameter = Approximate 27-in (2.25-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the well conveyance piping was calculated using the velocity head of the pipe for minor losses and the Hazen-Williams Equation for the friction loss through the pipe.

Hazen-Williams Equation: $h_f = (3.022 * V^{1.85} * L) / (C^{1.85} * D^{1.17})$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Roughness Coefficient (Used 150 for PVC pipe)
L = Pipe Length (Estimated as 3,670-ft)

Results:

A = 18 cfs / 5 fps = 3.6 sf
D = 2.14 ft < 2.25 ft (27-in)

$A = (3.14*D^2)/4 = 3.97$ sf
V = 18 cfs / 3.97 sf = 4.53 fps
Velocity Head = $h_v = v^2/2g = 0.32$ ft
Wetted Perimeter = P = 7.1 ft
Hydraulic Radius = R = A/P = 3.97 sf / 7.1 ft = 0.56 ft
Entrance Loss = $0.5 * v^2/2g = 0.16$ ft
H_L= 6.62 ft
Minor Losses (Bends) = 0.96 ft
Exit Loss = $1.0 * v^2/2g = 0.32$ ft

Total Estimated Headloss = 8.06-ft

The design flow for the well conveyance piping from four wells is 24 cfs.

- Flowrate = 24 cfs
- Maximum Velocity = 5 fps
- Pipe Diameter = Approximate 30-in (2.5-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the well conveyance piping was calculated using the velocity head of the pipe for minor losses and the Hazen-Williams Equation for the friction loss through the pipe.

Hazen-Williams Equation: $h_f = (3.022 * V^{1.85} * L) / (C^{1.85} * D^{1.17})$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Roughness Coefficient (Used 150 for PVC pipe)
L = Pipe Length (Estimated as 1,500-ft)

Results:

A = 24 cfs / 5 fps = 4.8 sf
D = 2.47 ft < 2.5 ft (30-in)

$A = (3.14*D^2)/4 = 4.91$ sf
V = 24 cfs / 4.91 sf = 4.89 fps
Velocity Head = $h_v = v^2/2g = 0.37$ ft
Wetted Perimeter = P = 7.85 ft
Hydraulic Radius = R = A/P = 4.91 sf / 7.85 ft = 0.63 ft
Entrance Loss = $0.5 * v^2/2g = 0.19$ ft

H_L= 2.76 ft
Minor Losses (Bends) = 1.11 ft
Exit Loss = 1.0 * $v^2/2g$ = 0.37 ft

Total Estimated Headloss = 4.43-ft

The design flow for the well conveyance piping from six wells is 36 cfs.

- Flowrate = 36 cfs
- Maximum Velocity = 5 fps
- Pipe Diameter = Approximate 36-in (3.0-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the well conveyance piping was calculated using the velocity head of the pipe for minor losses and the Hazen-Williams Equation for the friction loss through the pipe.

Hazen-Williams Equation: $h_f = (3.022 * V^{1.85} * L) / (C^{1.85} * D^{1.17})$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
C = Roughness Coefficient (Used 150 for PVC pipe)
L = Pipe Length (Estimated as 1,500-ft)

Results:

A = 36 cfs / 5 fps = 7.2 sf
D = 3.03 ft $\leq$ 3.0 ft (36-in)

A = $(3.14*D^2)/4$ = 7.07 sf
V = 36 cfs / 7.1 sf = 5.07 fps
Velocity Head = $h_v = v^2/2g$ = 0.40 ft
Wetted Perimeter = P = 9.42 ft
Hydraulic Radius = R = A/P = 7.07 sf / 9.42 ft = 0.75 ft
Entrance Loss = 0.5 * $v^2/2g$ = 0.20 ft
H_L= 2.38 ft
Minor Losses (Bends) = 1.20 ft
Exit Loss = 1.0 * $v^2/2g$ = 0.40 ft

Total Estimated Headloss = 4.18-ft

Table 23

Well Conveyance Pipe Sizing Summary			
Turnout Capacity (cfs)	Number of Wells	Pipe Size (in)	Estimated Headloss (ft)
6	1	15	10.38
12	2	21	5.38
18	3	27	8.06
24	4	30	4.43
36	6	36	4.18

b) Pipe Materials

The 16-inch to 36-inch diameter well conveyance piping is a size which falls within the availability of PVC, HDPE, or CMLC, however plastic pipe would be the preferred material.

The ASTM D2241 PIP PVC pipe would be a pressure class 80 psi (SDR 51) pipe with the following nominal diameters:

- 15" 15.30" O.D. and 14.66" I.D.
- 18" 18.70" O.D. and 17.92" I.D.
- 21" 22.05" O.D. and 21.13" I.D.
- 24" 24.80" O.D. and 23.77" I.D.
- 27" 27.95" O.D. and 26.79" I.D.

The AWWA C905 PVC pipe would be a pressure class 80 psi (DR 51) with the following nominal pipe diameters:

- 30" 32.00" O.D. and 30.67" I.D.
- 36" 38.30" O.D. and 36.71" I.D.

The HDPE pipe would be a pressure class of 63 psi (DR32.5) and 50 psi (DR41) pipe with the following nominal pipe diameters:

- 16" 16.00" O.D. and 14.96" I.D.
- 24" 24.00" O.D. and 22.44" I.D.
- 30" 30.00" O.D. and 28.04" I.D.
- 36" 36.00" O.D. and 34.14" I.D.

c) Material Recommendations

The well conveyance piping is estimated to be approximately 1,300-ft to 3,600-ft in length for each pipe size. The ASTM D2241 SDR51 PIP PVC pipe is estimated as the following cost per foot:

Table 24

Well Conveyance Piping SDR51 PIP PVC Pipe		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Material + Install Pipe Cost ($/LF)
15	$18.17	$62.17
18	$19.98	$77.98
21	$28.76	$89.76
24	$36.53	$95.53
27	$50.56	$111.56

The AWWA C905 DR51 PVC pipe is estimated as the following cost per foot:

Table 25

Well Conveyance Piping C905 DR51 PVC Pipe		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Material + Install Pipe Cost ($/LF)
30	$68.31	$132.31
36	$99.14	$187.14

The DR32.5 and DR41 HDPE pipe is estimated as the following cost per foot:

Table 26

Well Conveyance Piping DR32.5 HDPE Pipe		
Nominal Diameter (in)	Material Pipe Cost ($/LF)	Material + Install Pipe Cost ($/LF)
16	$17.24	$67.24
24	$34.34	$96.34
30	$54.35	$142.35
36	$58.30	$184.30

Based on the costs above it is recommended that PVC pipe be installed for the well conveyance pipelines utilizing ASTM D2241 PIP PVC pipe in sizes 27-inches and smaller and AWWA C905 PVC pipe or HDPE pipe for sizes 30-inches and larger.

The size and pressure class of pipe are estimated, however this is subject to change based on the actual well capacity and conveyance pipeline configuration at the time of design. In addition, it is recommended that multiple pipe options such as PVC and HDPE be included in the bid to identify the most economical pipe between PVC and HDPE.

K. Interbasin Piping

a) Sizing Criteria

The Interbasin piping is the piping in between recharge basins that are used for the conveyance of water between basins. These are anticipated to be precast structures with weir boards for regulating flow and water level and the piping installed beneath the levee to a discharge point in the downstream basin. The District would like to standardize the size of the interbasin piping to be 36-inch or 48-inch diameter.

The design flow for a 36" single barrel design is 24 to 30 cfs.

- Flowrate = 30 cfs
- Maximum Velocity = 5 fps
- Pipe Diameter = Approximate 36-in (3.0-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the turnout piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the Manning's Equation for the friction loss through the pipe.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
n = Material Coefficient (Used 0.012 for ADS HDPE pipe)
L = Pipe Length (Estimated as 60-ft)

Results:

A = 30 cfs / 5 fps = 6.0 sf
D = 2.76 ft < 3.0 ft (36-in)
D = 35.43" I.D.

$A = (3.14*D^2)/4 = 6.8$ sf
V = 30 cfs / 6.8 sf = 4.41 fps
Velocity Head = $h_v = v^2/2g = 0.30$ ft
Wetted Perimeter = P = 9.3 ft
Hydraulic Radius = R = A/P = 6.8 sf / 9.3 ft = 0.73 ft
Entrance Loss = $0.5 * v^2/2g = 0.15$ ft
H_L= 1.91 ft / 1,000 ft
Exit Loss = $1.0 * v^2/2g = 0.30$ ft

Total Estimated Headloss = 0.56-ft

Design the interbasin piping so that the control water surface submerges the pipe at the headwall structure a minimum 1.78 times h_v plus 3-inches or approximately 10-inches.

The design flow for a 48" single barrel design is 55 to 60 cfs.

- Flowrate = 60 cfs
- Maximum Velocity = 5 fps
- Pipe Diameter = Approximate 48-in (4.0-ft) Internal Diameter

The continuity equation was used to solve for the cross-sectional area of the pipe and the pipe diameter given the design flow and maximum velocity.

$A = Q/V$

The headloss through the turnout piping was calculated using the velocity head of the pipe for minor entrance and exit losses and the Manning's Equation for the friction loss through the pipe.

Manning's Equation: $V = (1.49/n)*R^{2/3}*S^{1/2}$

Where:

Q = Flow (cfs)
V = Velocity (fps)
D = Diameter (ft)
A = Pipe Internal Cross-Sectional Area
R = Hydraulic Radius
S = Slope
n = Material Coefficient (Used 0.012 for ADS HDPE pipe)
L = Pipe Length (Estimated as 60-ft)

Results:

A = 60 cfs / 5 fps = 12.0 sf
D = 3.91 ft < 4.0 ft (48-in)
D = 47.24" I.D.

$A = (3.14*D^2)/4 = 12.18$ sf
V = 60 cfs / 12.18 sf = 4.93 fps
Velocity Head = $h_v = v^2/2g = 0.38$ ft
Wetted Perimeter = P = 12.4 ft
Hydraulic Radius = R = A/P = 12.2 sf / 12.4 ft = 0.98 ft
Entrance Loss = $0.5 * v^2/2g = 0.19$ ft
H_L= 1.61 ft / 1,000 ft
Exit Loss = $1.0 * v^2/2g = 0.38$ ft

Total Estimated Headloss = 0.67-ft

Design the interbasin piping so that the control water surface submerges the pipe at the headwall structure a minimum 1.78 times h_v plus 3-inches or approximately 12-inches.

b) Pipe Materials

The District desires to standardize the interbasin piping to be 36-inch or 48-inch diameter piping. This will allow them to have uniform sizes for precast structures and stop log slots or weir boards.

The 36-inch and 48-inch diameter turnout piping is a size which falls within the availability of PVC, HDPE, CMLC, or RCP.

The AWWA C905 DR51 PVC pipe would be a pressure class 80 psi. The 36" PVC pipe has a 38.30" O.D. and a 36.71" I.D. The 48" PVC pipe has a 50.80" O.D. and a 49.69" I.D.

The HDPE pipe would be a pressure class 50 psi (DR 41). The 36" HDPE pipe has a 36.00" O.D. and a 34.14" I.D or the pipe could be a ADS Dual Wall HDPE Pipe, corrugated with a smooth interior wall and watertight joint. The ADS Dual Wall HDPE has an O.D. of 42.00" and an I.D. of 36.00". The 48" HDPE pipe has a 48.00" O.D. and a 45.52" I.D or the pipe could be a ADS Dual Wall HDPE Pipe, corrugated with a smooth interior wall and watertight joint. The ADS Dual Wall HDPE has an O.D. of 54.00" and an I.D. of 48.00".

The cement mortar lined and coated steel pipe would have a ¼-inch wall thickness, ½-inch thick lining, and ¾-inch thick coating. The 36" pipe has a 37.50" O.D. and a 34.50" I.D.

The ASTM C361 C25 double gasketed RCP would be suitable for hydrostatic heads up to 25-ft from the centerline of the pipe. The 36" RCP has a bell outside diameter of 50.25" O.D. and a 36" I.D.

c) Material Recommendations

The 36" interbasin piping is estimated to be approximately 60-ft in length. The PVC pipe is estimated as $99 per lineal foot material cost and $187 per lineal foot for material and installation. The HDPE pipe is estimated as $58 per lineal foot material cost and $184 per lineal foot for material and installation while the ADS pipe is estimated as $57 per lineal foot material cost and $117 per lineal foot for material and installation.

The 48" interbasin piping is estimated to be approximately 60-ft in length. The PVC pipe is estimated as $166 per lineal foot material cost and $264 per lineal foot for material and installation. The HDPE pipe is estimated as $88 per lineal foot material cost and $240 per lineal foot for material and installation while the ADS pipe is estimated as $93 per lineal foot material cost and $161 per lineal foot for material and installation.

The ADS Dual-Wall HDPE pipe is the most economical pipe material for the interbasin piping. This pipe material is preferred for this application as it is corrosion resistant, has good strength, and the corrugations help extend the seepage path.

V. Summary

The type and size of piping has been evaluated for each of the major project components. These are summarized below in Table 27.

Table 27

Project Facility	Nominal Pipe Size	Pipe Type
Aqueduct Turnout	108-inch	D50 Dry Cast RCP
Adohr Road Siphon	120-inch	C25 Dry Cast RCP
East Side Canal Siphon	120-inch	C25 Dry Cast RCP
Reach 2 Farm Road Siphon	120-inch	C25 Dry Cast RCP
Reach 3 Farm Road Siphon	120-inch	C25 Dry Cast RCP
Reach 4 Farm Road Siphon	90-inch	C25 Dry Cast RCP
Stockdale Hwy Cased Crossing Carrier Pipe	120-inch	D25 Dry Cast RCP
I-5 Fwy Cased Crossing Carrier Pipe	120-inch	D25 Dry Cast RCP
Reach 4 Conveyance Piping	63-inch and 54-inch	DR41 HDPE
Phase II Turnout	48-inch	ADS N12 WT HDPE
West Basins Turnout (Open Channel Design)	48-inch (2 Barrels)	ADS N12 WT HDPE
West Basins Turnout (Closed Conduit Design)	36-inch	DR41 HDPE
Phase I Turnout (Open Channel Design)	48-inch (2 Barrels)	ADS N12 WT HDPE
Phase I Turnout (Closed Conduit Design)	54-inch	DR41 HDPE
Well Conveyance Pipelines	15-inch to 27-inch	SDR51 PIP PVC
Well Conveyance Pipelines	30-inch to 36-inch	DR51 C900 PVC or DR41 HDPE
Interbasin Piping	36-inch and 48-inch	ADS N12 WT HDPE
In-Lieu Turnout Piping	24-inch	ADS N12 WT HDPE

1. *The "D" class of pipe is a conservative assumption at this stage in the design. The RCP pipe classification shall be re-evaluated during detailed design and be based on actual design elevations, earth cover, and operating conditions.*
2. *The project shall prepare for bid alternatives for pipe sizes and structures where more than one alternative is an option and close in pricing such as for the Reach 4 Conveyance Canal Piping, the Well Conveyance Pipelines, and Road Crossings and Bridges or Box Culverts.*

In addition, Table 28 summarizes the estimated material costs and installation costs (material + installation) for the various pipe sizes and capacities and highlights the most economical options.

Table 28

Kern Fan Project

Linear Pipeline Material and Cost Summary - Recommended

Pipe Capacity at 5-6 fps	SDR51 PIP PVC Pipe			DR41 & DR51 C900 PVC Pipe			DR32.5 & DR41 HDPE Pipe			ADS N-12 HDPE Pipe[1]			CMLC Pipe			FBE&C Pipe			D50 Wet Cast RCP Pipe			D25 Dry Cast RCP Pipe		
	Pipe Size	Material Cost ($/LF)	Material + Install Cost ($/LF)	Pipe Size	Material Cost ($/LF)	Material + Install Cost ($/LF)	Pipe Size	Material Cost ($/LF)	Material + Install Cost ($/LF)	Pipe Size	Material Cost ($/LF)	Material + Install Cost ($/LF)	Pipe Size	Material Cost ($/LF)	Material + Install Cost ($/LF)	Pipe Size	Material Cost ($/LF)	Material + Install Cost ($/LF)	Pipe Size	Material Cost ($/LF)	Material + Install Cost ($/LF)	Pipe Size	Material Cost ($/LF)	Material + Install Cost ($/LF)
5 cfs	15	$18.17	$62.17	14	$19.42	$77.42	14	$14.58	$64.58																
10 cfs	18	$19.98	$77.98	18	$21.92	$79.92	20	$24.03	$82.03																
15 cfs	24	$36.53	$95.53	24	$49.68	$110.68	24	$34.34	$96.34																
20 cfs	27	$50.56	$111.56	24	$49.68	$110.68	28	$49.84	$127.84																
25 cfs				30	$68.31	$132.31	30	$54.35	$142.35																
30 cfs				30	$68.31	$132.31	34	$72.77	$178.77																
35 cfs				36	$99.14	$187.14	36	$58.30	$184.30	36	$56.50	$116.53	36	$171.00	$257.83	36	$161.00	$287.83	36	$300.00	$386.60	36	$111.78	$198.38
40 cfs				36	$99.14	$187.14	42	$72.40	$210.40	36	$56.50	$116.53	42	$194.00	$305.00	42	$190.00	$321.00	36	$300.00	$386.60	36	$111.78	$198.38
45 cfs				42	$131.23	$223.73	42	$72.40	$210.40	42	$70.18	$133.85	42	$194.00	$305.00	42	$190.00	$321.00	42	$390.00	$480.00	42	$142.83	$232.83
50 cfs				42	$131.23	$223.73	42	$72.40	$210.40	42	$70.18	$133.85	42	$194.00	$305.00	42	$190.00	$321.00	42	$390.00	$480.00	42	$142.83	$232.83
55 cfs				42	$131.23	$223.73	48	$88.00	$240.00	42	$70.18	$133.85	48	$220.00	$336.38	48	$220.00	$356.38	42	$390.00	$480.00	42	$142.83	$232.83
60 cfs				48	$165.80	$263.80	48	$88.00	$240.00	48	$93.15	$161.19	48	$220.00	$336.38	48	$220.00	$356.38	48	$486.18	$580.62	48	$173.88	$268.32
70 cfs				48	$165.80	$263.80	54	$104.20	$277.20	48	$93.15	$161.19	48	$220.00	$336.38	48	$220.00	$356.38	48	$486.18	$580.62	48	$173.88	$268.32
80 cfs				48	$165.80	$263.80	54	$104.20	$277.20	48	$93.15	$161.19	54	$255.00	$411.00	54	$255.00	$431.00	54	$617.90	$717.90	54	$204.93	$304.93
90 cfs				54	$266.35	$390.35	63	$128.37	$332.37	60	$130.41	$203.78	54	$255.00	$411.00	54	$255.00	$431.00	54	$617.90	$717.90	54	$204.93	$304.93
100 cfs				60	$316.45	$448.45	63	$128.37	$332.37	60	$130.41	$210.46	60	$340.00	$514.24	60	$330.00	$524.24	60	$749.61	$857.55	60	$235.98	$343.92
150 cfs													72	$550.00	$797.86	72	$500.00	$767.86	72	$1,043.22	$1,225.47	72	$298.08	$480.33
200 cfs													84	$650.00	$1,027.09	84	$600.00	$997.09	84	$1,327.25	$1,612.00	84	$360.18	$644.93
250 cfs													90	$700.00	$1,160.00	90	$650.00	$1,110.00	90	$1,470.36	$1,805.36	90	$391.23	$726.23
300 cfs													102	$936.00	$1,586.00	102	$750.00	$1,450.00	96	$1,608.89	$2,002.58	96	$422.28	$815.97
350 cfs													108	$1,070.00	$1,872.71	108	$810.00	$1,612.71	108	$2,009.00	$2,531.57	108	$484.38	$1,006.95
400 cfs													114	$1,152.00	$2,022.00	114	$1,007.37	$1,877.37	114	$2,231.16	$2,901.16	114	$515.43	$1,185.43
450 cfs													120	$1,205.00	$2,197.48	120	$1,205.00	$2,197.48	120	$2,453.32	$3,271.02	120	$546.48	$1,364.18
500 cfs													126	$1,320.00	$2,470.00	126	$1,320.00	$2,470.00	126	$2,565.69	$3,535.69	126	$577.53	$1,547.53

Represents most economical pipe material based upon costs estimates and information available in October 2020.

Represents secondary pipe material alternatives that may be more economical depending on actual design and project timing.

[1]The ADS N-12 HDPE pipe is not applicable to a linear, pressurized pipeline design, but is anticipated to be used at recharge facility turnouts, "in-lieu" turnouts, and interbasin structures.

VI. Related Work Specified Elsewhere

A. TM 2 – Conveyance Capacity
B. TM 4 – Pump Station Requirements
C. TM 5 – Geotechnical Requirements
D. TM 6 – Canal Liner and Turnout Requirements
E. TM 7 – Well Drilling and Equipping Requirements
F. TM 11- Engineer's Estimates