CE 3372 Engineering Hydrology
Project PR1

Project Overview:

The City of Pecos, Texas, has identified a critical need to develop an alternate water supply in anticipation of the current wellfield reaching the end of its service life within the next 5-10 years. To ensure the city's long-term water security, an alternate wellfield has been identified, and property rights for its development have been secured. This wellfield is located approximately 30 miles south of the city center.

Your task is to design the components necessary to transport water from this alternate wellfield to Pecos and ensure adequate storage for future demand. This design includes:

1. Wellfield Collector Network: Design the network of wells and collection lines that will efficiently gather water from the wellfield and deliver it to a central collection point.
2. Transmission Pipeline: Design the transmission pipeline system that will carry water from the wellfield to the city's water treatment and distribution facilities. Consider hydraulic design principles to size the pipeline appropriately based on flow rates and friction losses over the 30-mile distance.
3. Storage Facilities: Design intermediate storage facilities as necessary, as well as terminal storage to ensure there is sufficient water available for city consumption during peak demand periods or in case of pipeline interruptions. Storage should accommodate both daily use and emergency reserves.

Assumptions and Constraints:

The city currently uses approximately 2.7 million gallons per day (MGD), with a peak usage of 3.9 MGD and projected growth should be accounted for over a 20-year horizon. The alternate wellfield is estimated to produce up to 3.024 MGD, with fluctuations due to seasonal variations. Transmission pipeline materials and layout should be designed considering local terrain and minimizing environmental impacts. Intermediate storage facilities may be required based on pipeline hydraulic design and system pressures. Air entry and pressure relief facilities may be required based on pipeline hydraulic design and system pressures.

Deliverables:

- Design the wellfield pipe network to the collector point. The well locations are already established from a preliminary study conducted during the water rights acquistion process.
- Size the transmission pipeline and provide justification for your selection (e.g., diam-

eter, material). The approximate alignment is attached, the design should include appropriate burial depths for the pipeline at locations along the alignment, as well as actual pipeline elevations. A topographic profile along the alignment is required as an aid to locating pressure relief facilities along the 25+ mile pipeline.

- Determine the volume of intermediate and terminal storage facilities required and provide recommendations on their placement.
- Demonstrate using a hydraulic model that the system can deliver the required raw water to replace the existing supply, under variable demand conditions. Identify using the model locations of low pressure, and high pressure. Produce plots of the energy grade line under various demsnd conditions. Identify locations where pressure relief valves, air relief valves, and flow-control valves are required.
- Determine and demonstrate an operating schedule to maintain positive pressure in the pipeline under varying flow conditions, and prevent storage tank overflows and complete tank drainage.
- Determine using water-hammer analysis the anticipated pressure changes during sudden shutdown of the transmission pipeline.

Submission Requirements:

- A detailed design report with calculations, maps, and diagrams to support your wellfield, pipeline, and storage facility designs. The report must explain the rationale behind your design decisions, including considerations of cost, energy use, and reliability.
- A final presentation summarizing your design choices, challenges, and proposed solutions.

Additional Information:

- West Pecos Water System (Proposed Alignment) (page 3)
- West Pecos Wellfield (Well Locations and Collection Network) (page 4)
- West Pecos Wellfield Pump Performance Curve (One per well) (page 5)
- West Pecos Wellfield Pump Performance Table (Tabular version of pump curve) (page 6)
- West Pecos Water System (KMZ file) `http://54.243.252.9/ce-3372-webroot/2-Exercises/PR1_PecosWater/WESTPECOSWATERSYSTEM.kmz`[1]

[1] A KMZ file is a compressed archive of multiple files, including a Keyhole Markup Language (KML) file and supporting files, that can be used to store and share geographic data


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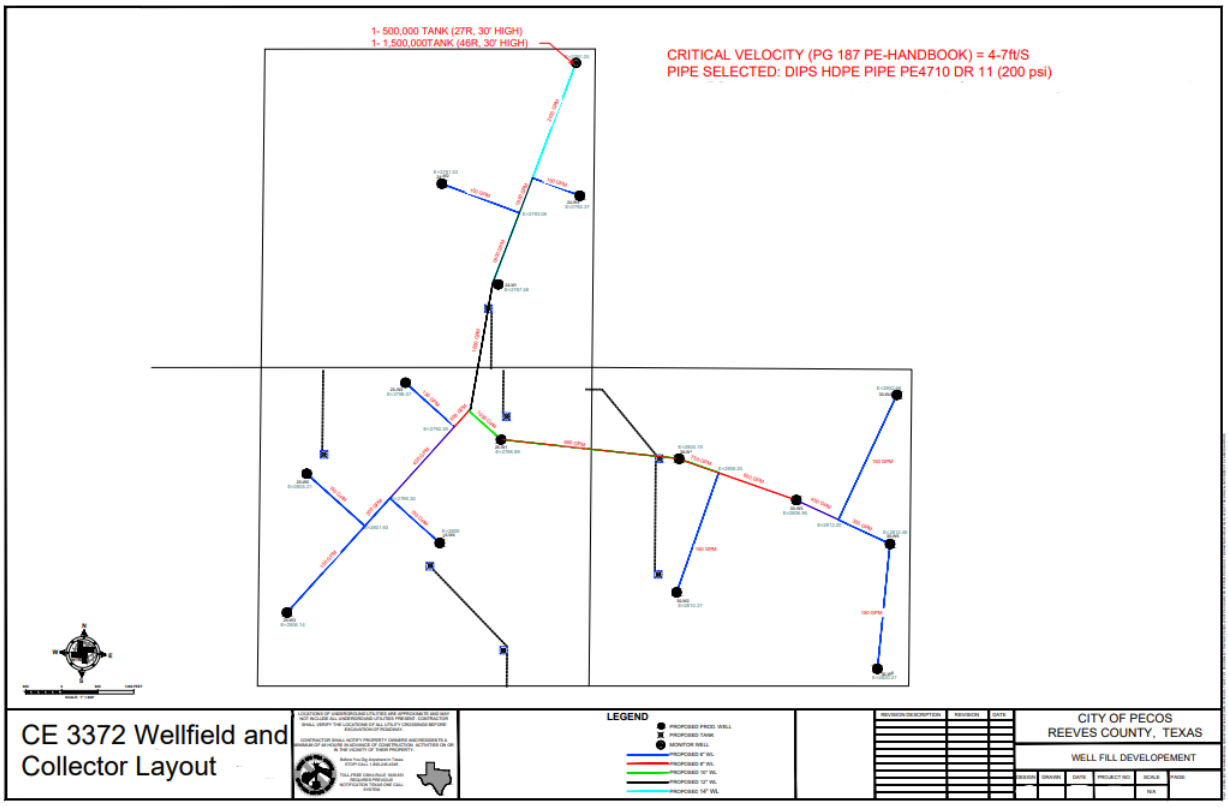

1- 500,000 TANK (27R, 30' HIGH)
1- 1,500,000TANK (46R, 30' HIGH)
CRITICAL VELOCITY (PG 187 PE-HANDBOOK) = 4-7ft/S
PIPE SELECTED: DIPS HDPE PIPE PE4710 DR 11 (200 psi)
CE 3372 Wellfield and Collector Layout
LEGEND
CITY OF PECOS
REEVES COUNTY, TEXAS
WELL FILL DEVELOPEMENT

Pump Data Sheet -

Company Name: CE 3372 Well Pump Performance @150 GPM
Date:

HEADWATER ENGINEERED SYSTEMS

Pump:

Size:	8FAHC (stages: 17)	Dimensions:	Suction: ---
Type:	Turbine		Discharge: ---
Synch Speed:	1800 rpm		
Dia:	6.1875 in		
Curve:	---		
Impeller:	8FAHC		

Fluid:

Name:	Water		
SG:	1	Vapor Pressure:	0.256 psi a
Density:	62.4 lb/ft³	Atm Pressure:	14.7 psi a
Viscosity:	1.1 cP		
Temperature:	60 °F	Margin Ratio:	1

Search Criteria:

Flow:	150 US gpm	Near Miss:	---
Head:	555 ft	Static Head:	430 ft

Pump Limits:

Temperature:	---	Sphere Size:	---
Wkg Pressure:	---		

Motor:

Standard:	NEMA	Size:	40 hp
Enclosure:	TEFC	Speed:	1800 rpm
Frame:	324T		
Sizing Criteria:	Max Power on Design Curve		

Pump Selection Warnings:
None

--- Duty Point ---

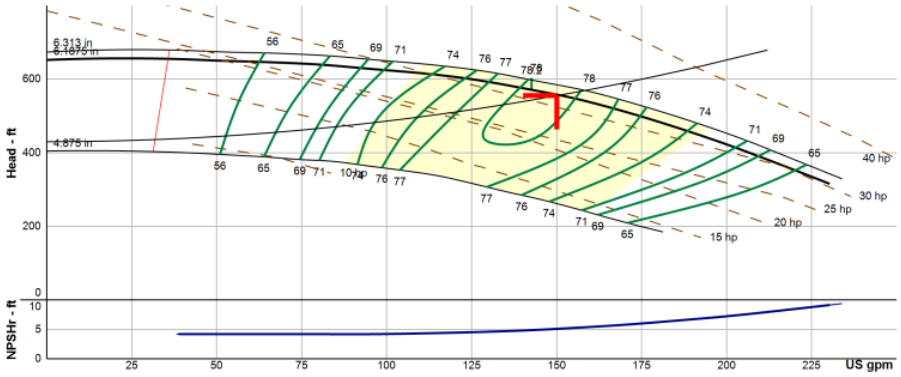
Flow:	151 US gpm
Head:	556 ft
Eff:	78%
Power:	27.1 hp
NPSHr:	5.12 ft
Speed:	1780 rpm

--- Design Curve ---

Shutoff Head:	652 ft
Shutoff dP:	282 psi
Min Flow:	35.6 US gpm
BEP:	78.2% @ 143 US gpm
NOL Power:	30.6 hp @ 230 US gpm

--- Max Curve ---

Max Power: 32.4 hp @ 234 US gpm



Selected from catalog: Headwater Engineered Systems.60, Vers

Pump Data Sheet -

Company Name:
Date:

@150 GPM

HEADWATER ENGINEERED SYSTEMS

Performance Evaluation:

Flow	Speed	Head	Efficiency	Power	NPSHr
	rpm		%		
180	1780	484	75.3	29.2	6.24
150	1780	557	78	27.1	5.1
120	1780	606	75.4	24.3	4.44
90	1780	632	68.2	21.1	4.18
60	1780	648	53.6	18.3	4.19

Selected from catalog: Headwater Engineered Systems.60, Vers