CITY OF MODESTO

JENNINGS ROAD FACILITY

TECHNICAL MEMORANDUM
CANNERY SEGREGATION PUMP STATION
OPERATIONAL EVALUATION

FINAL
MAY 2013

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CANNERY SEGREGATION PUMP STATION OPERATIONAL EVALUATION

1.0 PURPOSE

The purpose of this technical memorandum (TM) is to evaluate the Cannery Segregation ("Can Seg") pump station for the City of Modesto, California, located at the Jennings Rd. Secondary Treatment Facilities site. The TM identifies possible causes for operational problems and recommendation for improvements to the pump station.

2.0 SUMMARY OF FINDINGS AND RECOMMENDATIONS

The key findings and recommendations are summarized below:

- The Can Seg pump station consists of three equally sized pumps to achieve a firm capacity of 28 million gallons per day (mgd). Three equally sized pumps with a capacity each of 14 mgd were installed. Two pumps are designed for duty operation with one pump serving as a standby. One additional deck space is available for a future pump. The current average daily flows range between 13 to 18 mgd. As such, the installed pumps are oversized and running off their curve, causing vibrations and rough running conditions.
- The Can Seg flows have declined over recent years and have only exceed 20.3 mgd in two occasions over the last five canning seasons. As such, the firm capacity of the pump station should be reduced to from 28 mgd to 20.3 mgd. The standby pump should be programmed to switch on for additional capacity in the rare event that flows exceed 20.3 mgd.
- Many parameters in the wet well design at the Can Seg pump station differ from Hydraulic Institute (HI) standards for pump intake design. The approach flow characteristics at the pump bowls causes pump cavitation and pre-swirling of fine sand and grit at the pump intake.
- The pump bowl and impeller have been damaged both from cavitation and from abrasion and erosion caused by a high volume of fine sand and grit material present in the cannery waste.
- Long-term contact with low pH cannery waste leads to aggressive corrosion on the cast iron and steel components of the pump. The corrosion and pitting on these components is accelerated by the deterioration of the lining.
- The plant staff has been pulling the pumps out of the wet well annually to repair the pumps and to recoat the bowls and the pump columns. Pump impellers wear rings

and line shafts have been replaced and restored several times since installation in 1997.

- We recommend replacing the three existing pumps with three new vertical turbine solids handling pumps that have better flow characteristics for the current operating conditions. In addition, we recommend that the pumps be installed with open top confined inlet barrels to improve the hydraulic conditions at the pump intake. The estimated cost for the new pumps and inlets is $2.32 million.

3.0 BACKGROUND

The Can Seg pump station at Jennings Road was placed in service in 1999. It is usually operated for about four months every year during the canning season (July through October). The pump station receives food process byproducts from the pump station located at the Sutter Avenue Primary Treatment Facility, and pumps to the irrigation mixing box at the Jennings Rd. site, where the food processing water is mixed with flow from the irrigation reservoir and sent to the ranchland at the Jennings Road site. The pump station currently has three 20-inch Vertical Turbine Solids Handling (VTSH) pumps model 20QMN-A manufactured by Ingersoll-Dresser Pumps (IDP). The pumps are each rated for 14 mgd (9,722 gallons per minute[gpm]) at 55 feet of total dynamic head (TDH) at 1,190 RPM. The pumps are equipped with 200 HP motors which are speed controlled using VFDs manufactured by Allan Bradley, Model 1336 Plus.

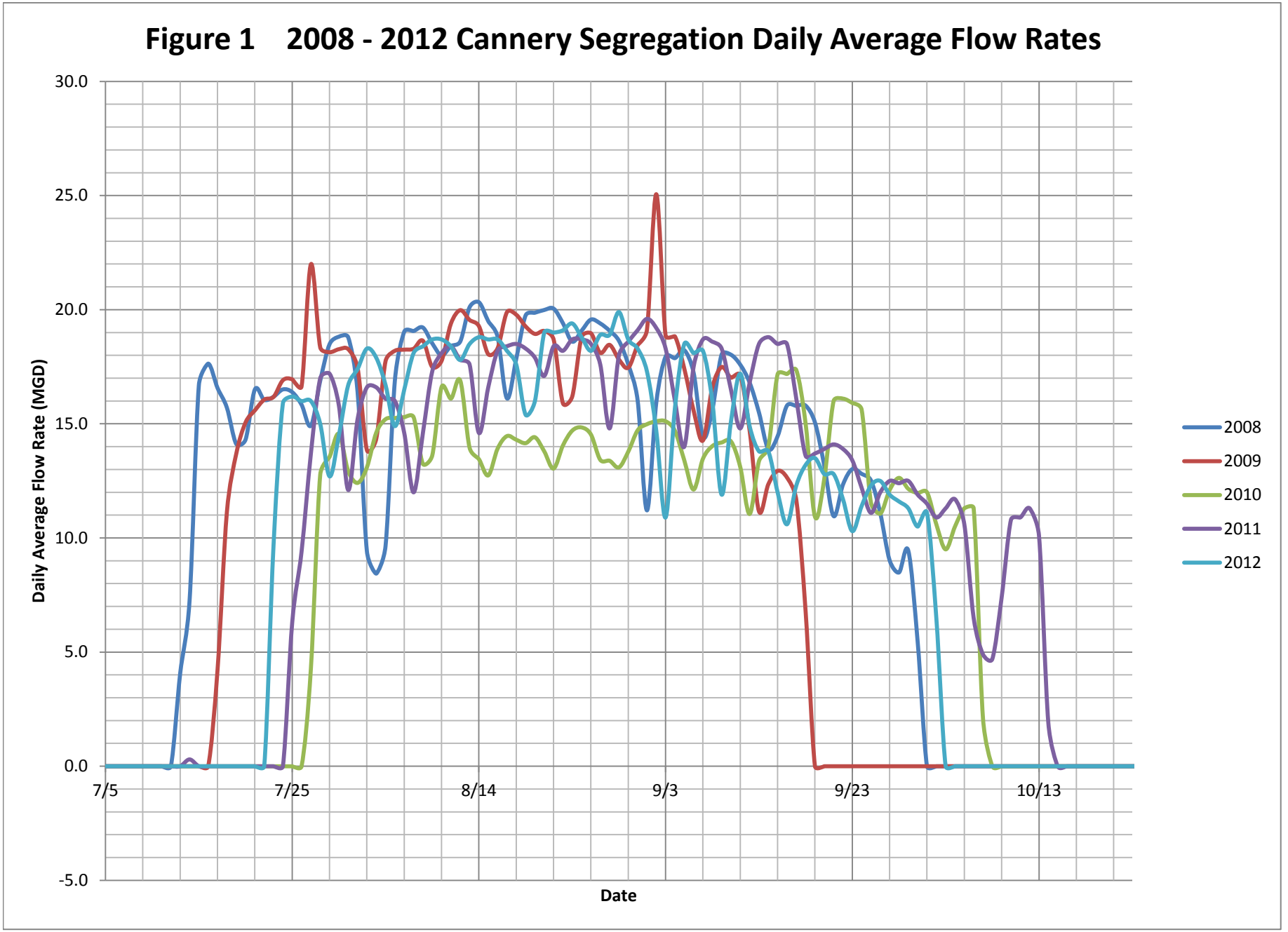
The Can Seg pump station at Jennings Road was designed in June 1998 as part of the *Ranch Cannery Pump Station and Force Main Project.* At the time of design, numerous food process facilities and two major canneries fed into the Can Seg system. The original design accommodated for a future capacity of 42 mgd, which was envisioned to be achieved by increasing the size of the pump impellers and motor, and adding an additional pump.

Since the time of design, the number of food processing plants in Modesto has decreased. One of the two major canneries that fed into the system during design is not longer in operation. As such, Can Seg flows have decreased significantly from the design firm capacity of 28 mgd to 15.2 mgd on average. Figure 1 shows the plot of daily average flow rates from the 2008 to the 2012 cannery seasons. In this time frame, the Can Seg flow rates is below 20 mgd for 98 percent of the time and have only exceeded 20.3 mgd on two days.

In recent years, the City has encountered operational challenges with the Can Seg Pump Station at Jennings Road. Plant maintenance operators have noted that the pumps are experiencing vibration and require frequent costly annual maintenance. After the cannery season each year, the pumps are the lifted out of the wet well for repairs and maintenance work. When the pumps were taken out of service and disassembled, severe damages incurred by cavitation and corrosion were observed in the inlet bell, impeller, retaining bolt,

discharge head, and other pump components. According to staff, the pumps have been rebuilt three times within 10,000 hours. The plant maintenance operators have remediated problems with the shaft and flush bearing; however, damage from cavitation and corrosion has not been addressed. In addition, the pumps were observed by the plant staff to have harmonic problems where excess vibration occurs between 31-35 Hz.

Figure 1 2008 - 2012 Cannery Segregation Daily Average Flow Rates



4.0 EVALUATION OF PUMP STATION AND OPERATIONAL CHALLENGES

This section reviews the operational challenges for the Can Seg pump station and determines possible causes for the rough running conditions at the pump station based on site visit observations, existing data, and hydraulic analyses.

4.1 Can Seg System Study

Carollo conducted a computer desk top hydraulic study of the Can Seg Pump Station. The construction drawings from Camp Dresser & McKee - CDM (*Ranch Cannery Pump Station and Force Main Project – June 1998*) were used as a basis to calculate the system head curves. The published pump curve data from the IDP shop drawings (Appendix A) were then superimposed on chart. The system TDH curves were based on cement mortar lined steel pipe, and three TDH curves were developed using three different assumptions for the friction factor "C" (Hazen-Williams equation; C=130 "smooth new pipe"; C=120 "slightly rougher pipe lining"; and C=110 "rougher pipe lining"). In addition, we simulated highest lift conditions (low wetwell and high mixing box water surface elevation) and lowest lift to create a range of operating condition requirements that a pump or combination of pumps will need to meet (See Appendix B for detailed system curve calculations).

Results are used to create the TDH curves for Figures 3 through 6. The hydraulic analysis on the existing pump station show that the existing pumps are not operating on their pump curves. A single pump operating at full speed is oversized for current conditions when the flow is between 8 and 14 mgd. When two pumps are operating in parallel, the pumps are better suited for the design firm capacity of 28 mgd at 55 feet.

4.2 Site Visit and Field Evaluations

Plant O&M staff and Carollo conducted a field visit on September 27, 2012 to collect information during cannery season operating conditions, compare field dimensions with available record and shop drawings for the pump station and IDP pumps. A field meeting was held on the same day to review operational challenges and maintenance history with the City's O&M staff. The O&M staff confirmed that the pumps have several difficulties including corrosion, cavitation, adverse inlet hydraulics, shaft misalignment, flush water quality, and vibrations.

4.2.1 Field Pump Test

A field test to confirm the results from the desk top hydraulic study was conducted during the September 27, 2012 site visit. The butterfly valve (BRV101) immediately downstream of the magnetic flow meter was incrementally closed to create an artificial resistance pressure

head and raise the system head requirement. At each interval, readings for pressure head, pump speed, wet well water level, and flow rate was recorded. Severe vibrations were observed when the valve is fully or mostly open. The vibrations diminished as the valve is incrementally closed. This test confirmed the findings of the desk top study which indicated that system head is significantly below the pump operating head and that the current pumps are oversized for current flow conditions.

4.3 Review of Existing Data

4.3.1 Review of Drawing/Layout

Design drawings for the Can Seg P.S. were reviewed for consistency and some pertinent dimensions were compared with field measurements. The drawings appear to conform to field measurements and observations with the exception of the circular concrete openings on the Can Seg pump station deck, which are shown to be 42 inches on the drawings, but were measured to be about 33-inches in the field.

4.3.2 Review of Shop Drawing

The submittal for the existing IDP pumps was reviewed to determine the material specification of the components, the coating specification, and the performance test curve. Submittal shows the components susceptible to cavitation and corrosion damage such as the impeller, diffuser bowl, and suction bell to be made of ASTM A48 cast iron. The original submitted coating is Polyamidoamine Epoxy that contains 69 percent volume solids. This solids content is less than the High Solids Epoxy that Carollo specifies for submerged pump components under similar conditions.

Performance test curves for the IDP pumps show that all three pumps deliver more than 55 ft of total dynamic head (TDH) at 10,000 GPM (14.4 mgd) at full speed. However, discussions with the plant staff and hydraulic analysis indicates that only 20-32 ft of total discharge head is needed at normal operating flow rates, suggesting that the pumps are not suitably sized for current flows.

4.3.3 Review of Training Workshop Document

The Training Workshop Document contains information about the different operating modes and the design criteria of Can Seg system. The document shows an initial station capacity of 28 mgd, which will later be expanded to an ultimate capacity of 42 mgd. However, according to staff, these predicted high flows are not seen in the recent cannery seasons and is not expected any time soon.

4.3.4 Summary of Data and Photos

The Training Workshop Document and the performance pump test in the submittal both reveal that the TDH for the IDP pumps are much higher than the actual operating pressure head needed. This discrepancy results in operation that is outside of the pump curve, which

creates adverse flow conditions that may cause cavitation. Photos (Figure 2) taken in the field when the pumps are taken out of service confirm that intake bell, impellers, discharge head, and other components of the pump been significantly impaired by corrosion and cavitation.

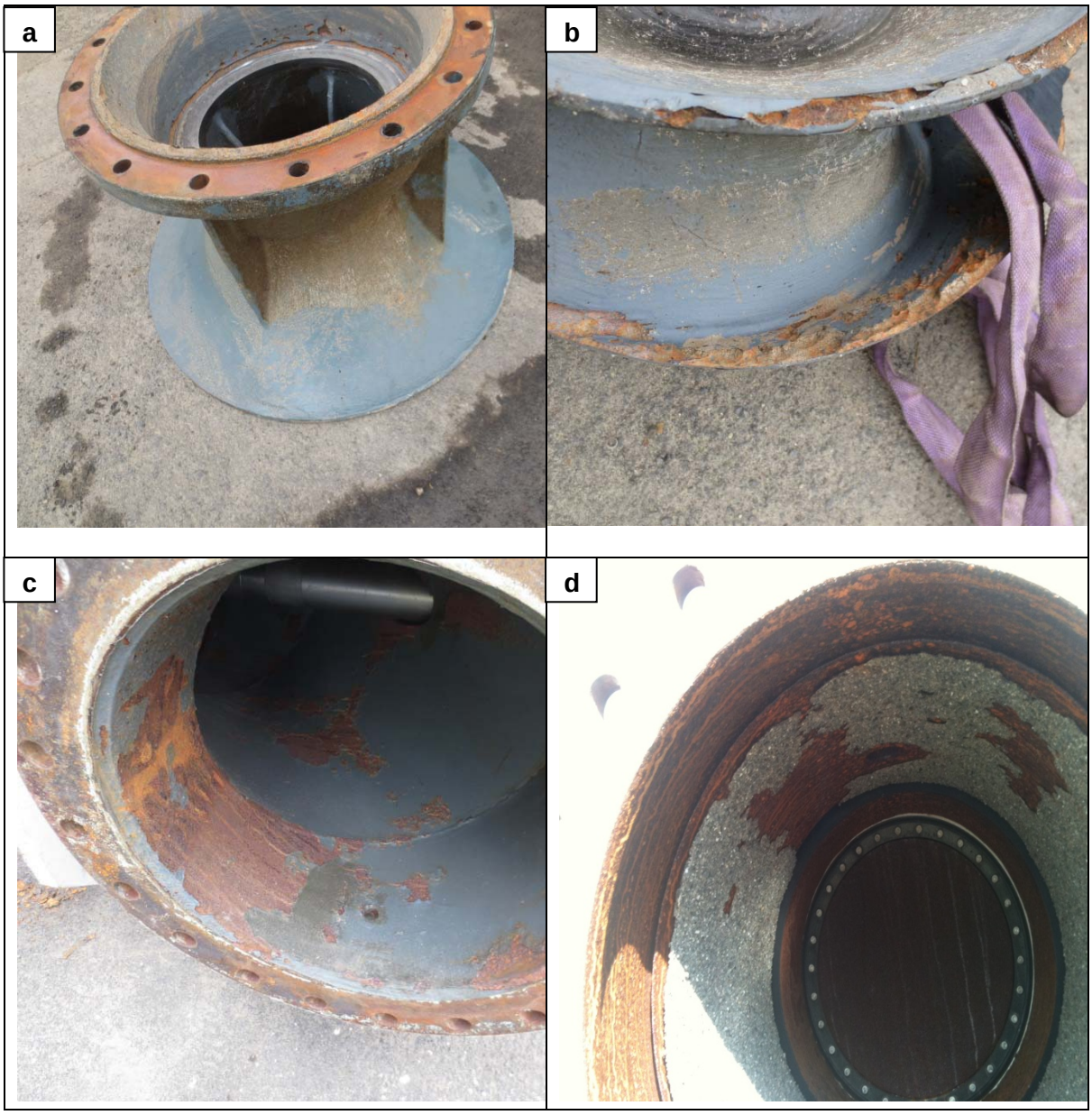


Figure 2 Cavitation and Corrosion Damage on Pump Components

a) Intake bell corrosion and abrasion, note spiraling pattern from pre-swirling; **b)** Impeller edge eroded by cavitation and corrosion; **c)** Discharge head corrosion; **d)** Disintegration of pipe lining between discharge and check valve.

4.4 Hydraulic Evaluation

4.4.1 Wet well design as compared to Hydraulic Institute standards

Hydraulic Institute Standards for pump intake (HI 9.8) contains a series of geometrical guidelines aimed to minimize adverse hydraulic phenomena such as vortices, excessive pre-swirl at intake bell, and non-uniform flow at the impeller eye. The observed vibrations, cavitation, and abrasion damage may be caused or exacerbated by these adverse hydraulic phenomena at the intake. Comparisons of dimensions shown on design drawings and HI recommended dimensions reveal salient differences in many hydraulically sensitive parameters. These comparisons are summarized in Table 1.

Table 1 Comparison of Wet Well Design with HI Standards
Cannery Segregation Pump Station Evaluation
City of Modesto

Parameter	HI Standard (1)	Actual
Approach velocity entering wet well	≤2.0 ft/s	Not measured, but calculated at 0.9 ft/s at 14 mgd.
Velocity in channel	≤1.0 ft/s	Not measured, but calculated at 1.1 ft/s at 14 mgd.
Suction bell intake velocity	3.0-8.0 ft/s	2.2 ft/s at 8 mgd 3.9 ft/s at 14 mgd
End wall clearance	24”	72”
Floor clearance	9.6” – 16”	18”
Influent Pipe	Coaxial wetwell and free of flow disruption for eight pipe diameters	Perpendicular to wetwell
Anti-rotation baffle	at the last pump	none

Note:
HI recommended dimension calculations are based on inlet bell outside diameter of 32”

The wet well geometry differs significantly from the recommended trench-type geometry in the HI standards. The HI trench-type wet well features an inlet above the suction bell and a wider section above the narrow trench, where the pump intake is situated. This layout reduces turbulence by slowing the velocity in the channel above the trench and directing flow downward into the trench. In comparison, in the existing pump station, the inlet is at the channel bottom and there is no trench to uniformly direct flow toward the suction bell. In addition, suction bell intake velocity ranges on the low side of the HI acceptable range for flows under 14 mgd, causing grit to swirl excessively at the pump intake. Furthermore, the

flow enters the wet well perpendicularly from the upstream 66-inch line and this may create additional turbulence in the wet well channel. These adverse hydraulic phenomena may be an exacerbating factor in causing cavitation and excessive vibrations.

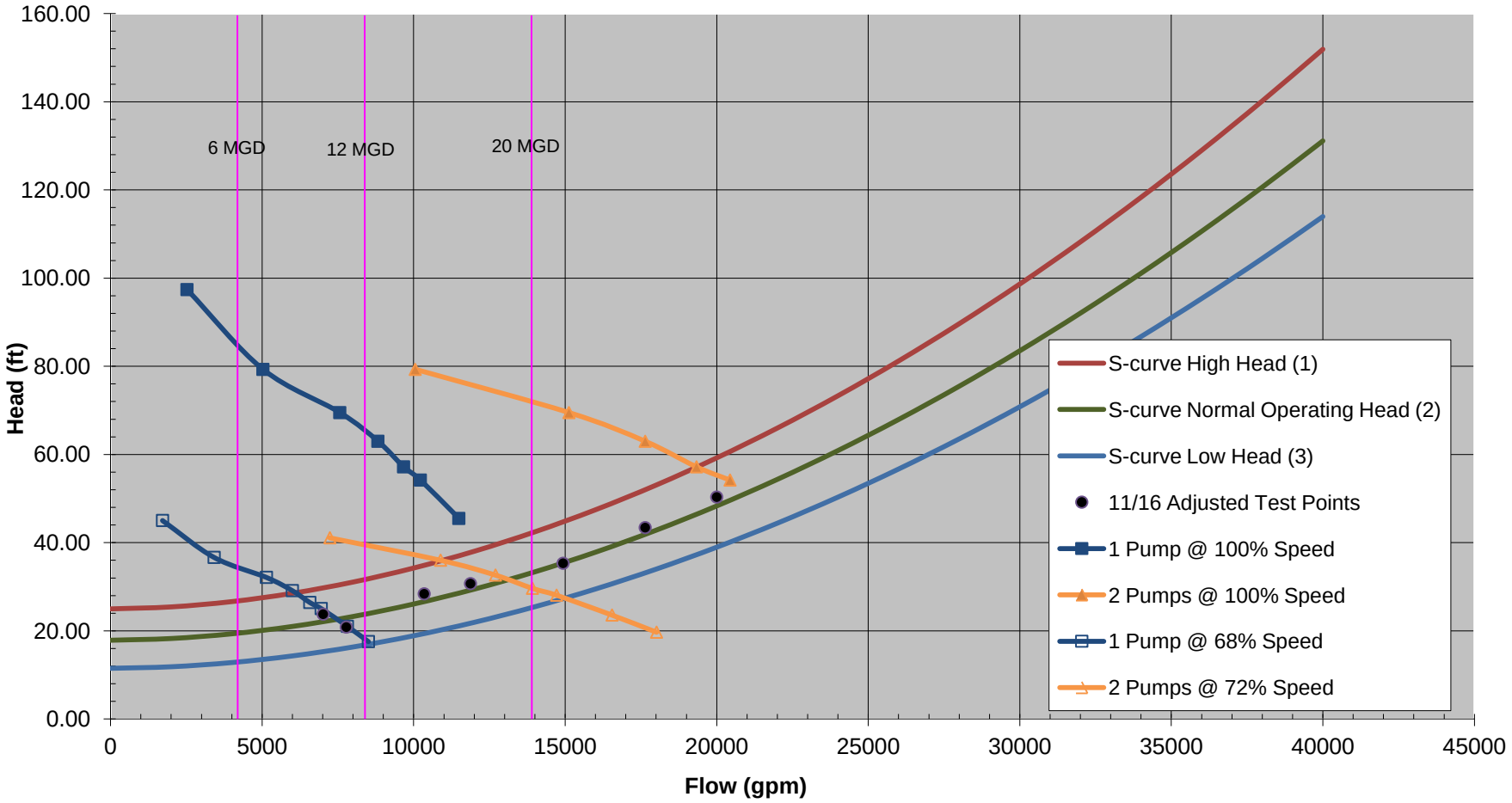
4.4.2 Hydraulic Calculations

In the desk top study, calculations were performed to evaluate a range of total dynamic head for different pipe friction factors and generate system curves. Dimensions and material specification listed in drawings were used for the friction calculations, while current alarm settings and daily average water levels in the pump station and irrigation mixing box were used to evaluate the actual static head. The performance test curves for the existing pumps are fitted on available data. The resulting analysis illustrating system and existing pump curves are shown on Figure 3. To verify the calculated system curves, additional field-testing was conducted based on two pumps operating in parallel on November 16, 2012. After calibrating for field elevations, the seven data points were then plotted against the calibrated system curves. The calibrated field data points fits closely with the average system curve (depicted by the green TDH graph on Figures 3 through 6).

Figure 3 shows that two current pumps running in parallel is capable of producing 21,000 gpm (30.2 mgd) at 52 feet, which is more than the specified designed firm capacity of 28 gpm at 55 feet TDH. This discharge head requirement in the original design appears to be based on the high friction scenario. However, available data and profile recording show that average flow rate and pressure head requirement have been much lower in the recent cannery seasons, as confirmed by the 2008 through 2012 cannery segregation flow data. Over the average range of operation, the pump curve at full speed is far above the system curve. Significant speed reduction using VFDs are required before the pump curve intersects the system curve. Furthermore, with a single pump in operation at full speed, the pump curves intersect the system curve at the tail end (right side of the curve), where NPSHr rises sharply. This creates cavitation when NPSHr exceed NPSHa.

From these hydraulic calculations, it appears that existing pumps are not well sized for operation in the 8- to 14-mgd flow range, as the flow/head characteristics for the pumps is much larger than the system requirement. The field pump test conducted on September 27, 2012 confirmed the gap between the pump curve and the TDH system curves. The pump was observed to run smoother as the butterfly valve on the discharge line was incrementally closed to provide resistance head and raise the system curve.

Figure 3 Can Seg System and Existing IDP Pump Curves



(1) Low Wet Well Level, High Mix Box Level, Hazen-Williams C = 110.
(2) Normal Operating Head, Wet Well Level and Mix Box Level from Daily Average Readings from 1-Aug-12 to 30-Sep-12, C = 120.
(3) High Wet Well Level, Low Mix Box Level, C = 130.

5.0 RECOMMENDATIONS

5.1 Alternative A - Replacement of Existing Pumps with new Vertical Turbine Solids Handling pumps

Due to poor condition of the existing pumps and the salient decrease of cannery segregation flow rates in the recent years, we recommend replacing the existing Can Seg pumps with new Vertical Turbine Solids Handling pumps (VTSH) with open top confined barrel inlet that are suitably sized for current and future cannery waste flows. The pumps should be selected such that the following parameters are met:

- Pump dimensions are compatible with existing wet well dimensions.
- Pump curve intersects systems curve for current daily average flows between 13 to 18 mgd.
- Pump is operating on or near the best efficiency point for daily average flows
- Pump impeller, line shaft, suction bell, fasteners, and other components susceptible to corrosion are made of corrosion-resistant material.

A quote for new 20-inch VTSH pumps with standard corrosion upgrade provided by JM Squared is included in Appendix C. The corrosion-resisting upgrade consists of nitronic 50 line shaft with ceramic coating on bearings, and epoxy coating and lining on pump components. In addition to these standard upgrades, we recommend that the impeller to be constructed of 316L stainless steel.

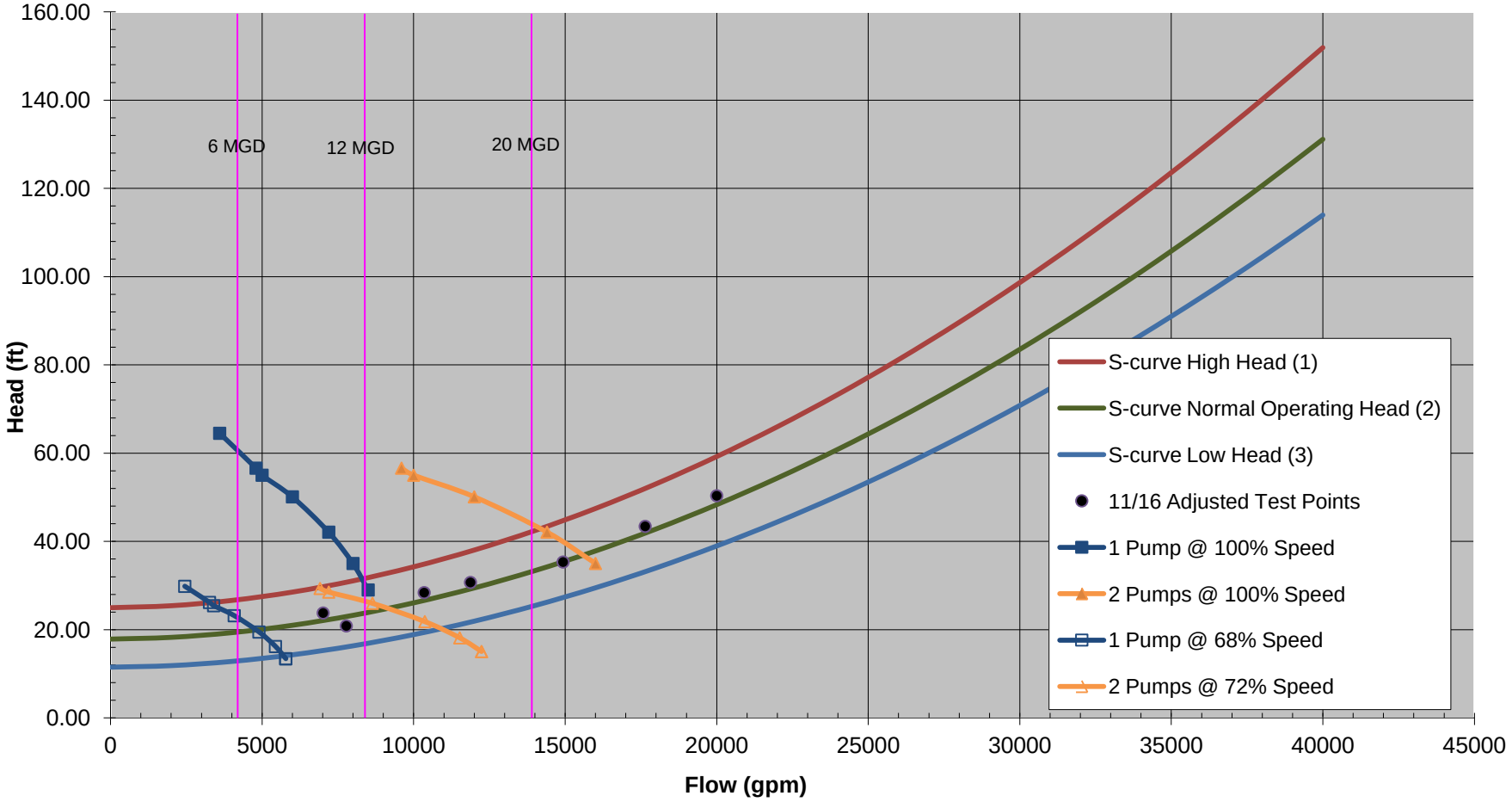
The quoted pumps operate with 100 HP high efficiency motors as opposed to the current pumps that require 200 HP motors. These proposed new pumps are sized such that a single pump is sufficient to handle flow rates up to 10 mgd and that two pumps in operation will meet the new firm capacity of 20.3 mgd. The new pump curves are plotted with the existing system curves in Figure 4, which shows that the quoted pumps are smaller and have a steeper curve than the existing IDP pumps, making than more compatible with flows between 8 to 14 mgd. Two pumps are required to meet the new firm capacity of 20.3 MGD and an additional standby pump should be provided for redundancy.

5.1.1 Open Top Confined Barrel Inlets

Carollo recommends that open top confined barrel inlets be installed around the intake of each pump to mitigate the effects of adverse hydraulic conditions such as vortices, grit-swirling, turbulence, flow rotation, and uneven flow distribution. The open top confined inlet is a hollow cylinder with flow guiding vanes that is installed around the pump intake. The confined inlets will reduce or eliminate the turbulence generated from the abrupt flow direction change at the wet well entrance. The confined inlets will also eliminate vortices,

pre-swirl at intake bell, and non-uniform flow at the impeller eye by directing flow from the top of the barrel uniformly downwards toward the suction bell of the pump.

Figure 4 Alternative A: Fairbank Morse VTSH Pump Curves



(1) Low Wet Well Level, High Mix Box Level, Hazen-Williams C = 110.
(2) Normal Operating Head, Wet Well Level and Mix Box Level from Daily Average Readings from 1-Aug-12 to 30-Sep-12, C = 120.
(3) High Wet Well Level, Low Mix Box Level, C = 130.

5.2 Alternative B - Replacement of Existing Pumps with Axial Flow Propeller Pumps from Fairbanks Morse

Axial flow propeller pumps with stainless steel propeller and bowl liner may be a suitable substitute for the existing VTSH pumps if both parameters outlined in section 5.1 for VTSH pump and the following conditions are met:

- The passing sphere size of the pump is larger than the size of the solids in the cannery and food processing water.
- There are no stringy solids in the cannery and food processing water that may clog and impair the impeller.

Single stage axial flow propeller pumps tend have lower head capacities and stricter reliable operating ranges than VTSH pumps. If this alternative is chosen, care should be given to the selection of the pump such that the pump operates at or near the max speed under normal operating conditions. One model of Fairbanks Morse axial flow pump is plotted with the existing system curves in Figure 5. However, without adjustments, this particular model does not appear to be well suited for the system. Three pumps are required to meet the new firm capacity of 20.3 MGD and additional standby pump should be provided for redundancy. Open top confined inlet barrels are also recommended on the pump intake to mitigate adverse hydraulic conditions.

5.3 Alternative C - Replacement of Existing Pumps with Axial Flow Propeller Pumps of Alternate Manufacturer

Axial flow propeller pumps from an alternate manufacturer with standard materials of construction, stainless steel propeller, and stainless steel bowl liner can be considered as a lower cost alternative than options A and B. Axial flow pumps from Prime Pump Co. is plotted with the existing system curve in Figure 6. Three pumps are required to meet the new firm capacity of 20.3 MGD and additional standby pump should be provided for redundancy. Open top confined inlet barrel is also recommended for this alternative to eliminate cavitation and abrasive erosion.

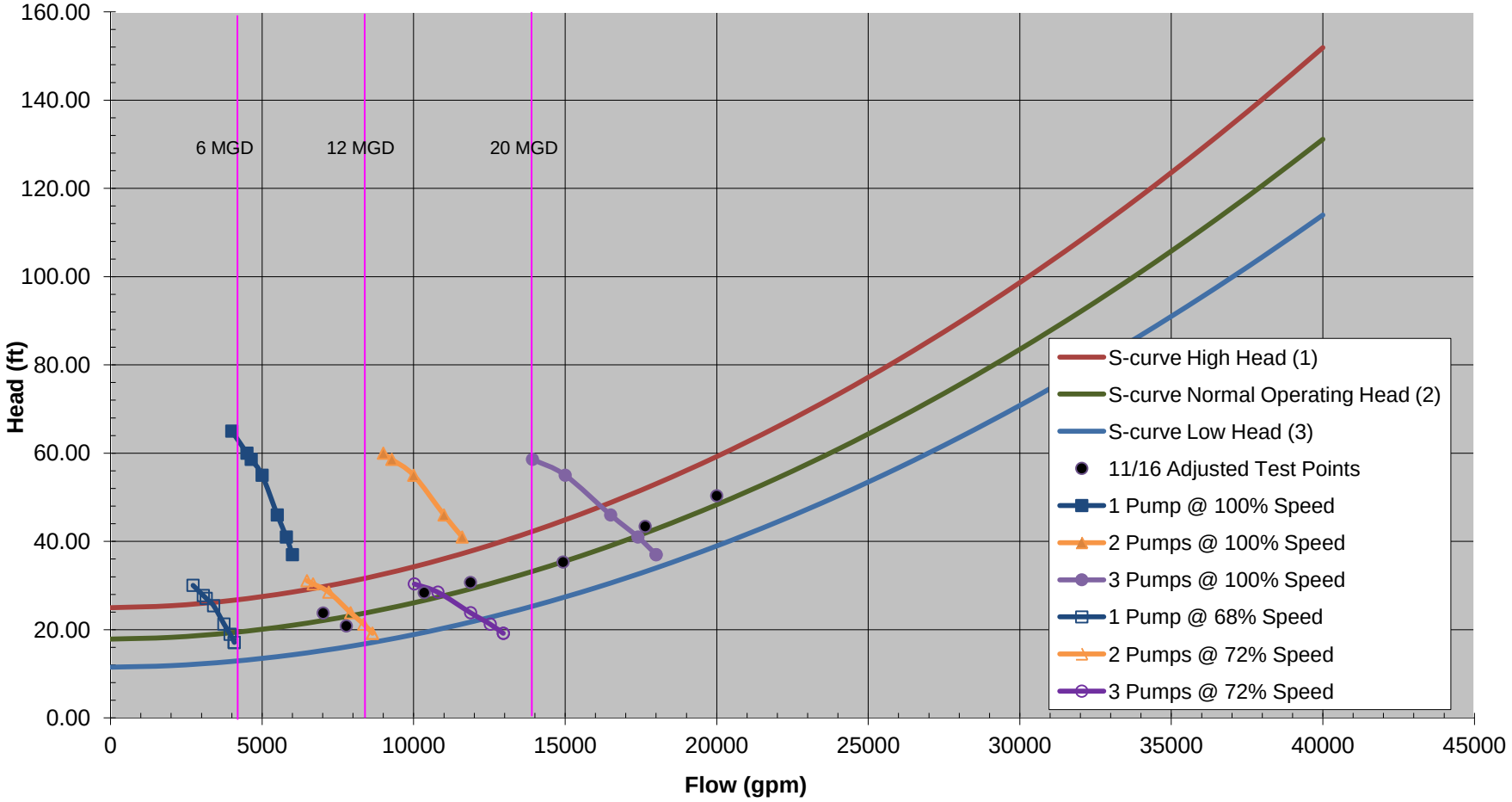
5.4 Additional Recommendations:

In addition, we recommend the following improvements to the pump station:

1. Add an open top confined inlet barrel for each pump (whether new or refurbished pumps).
2. Install concrete support below the check valve on each pump discharge, which is currently unsupported.

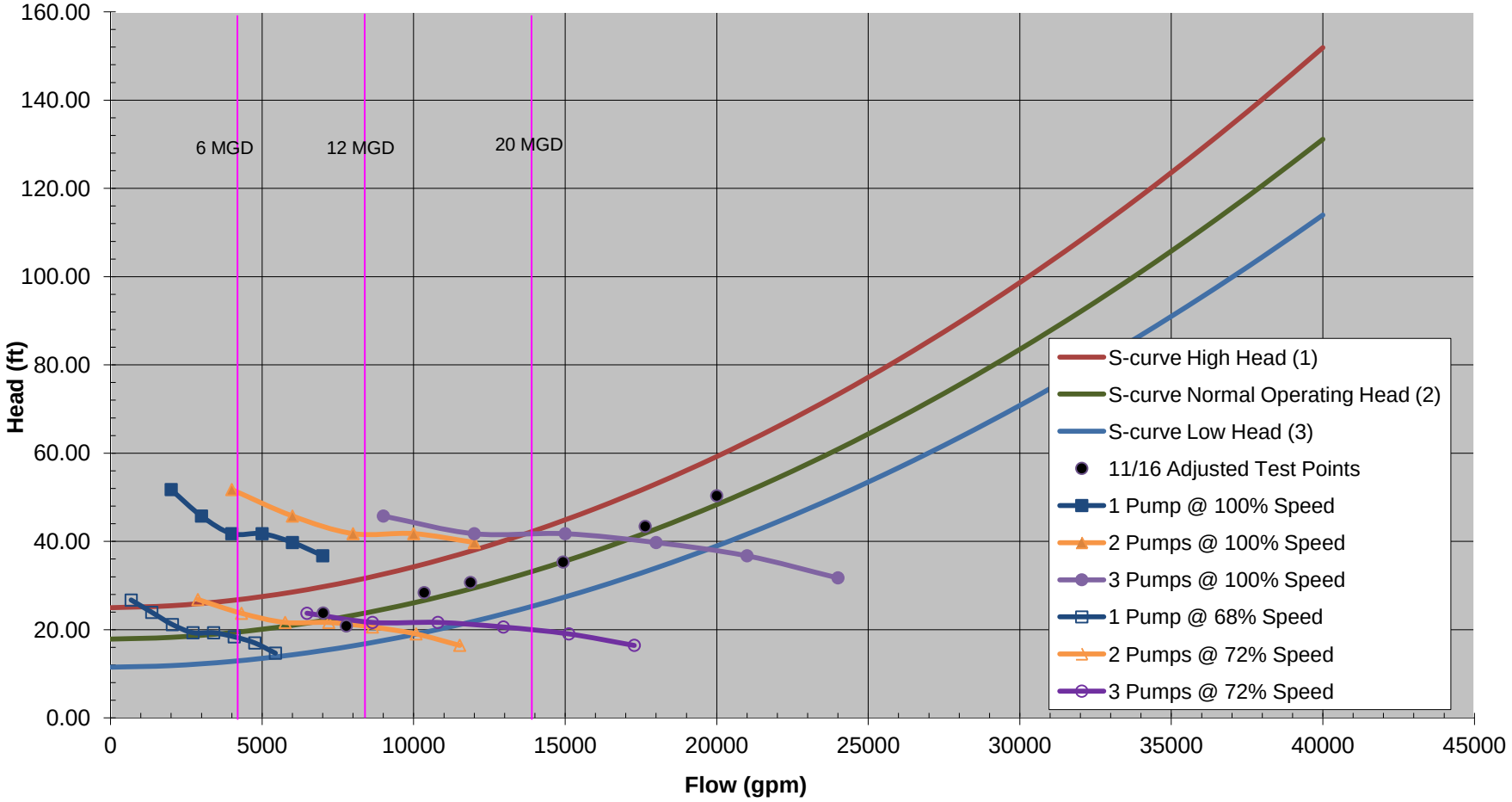
3. Coat the inside of the wet well with Enduraflex elastomeric coating to protect the concrete from corrosion.
4. Flush out wet well and replacing volume with freshwater or tertiary effluent at the end of the cannery season. Prolonged stagnant conditions with cannery waste rich in organic matter and low in pH cause corrosion.

Figure 5 Alternative B: Fairbanks Morse Axial Flow Pump Curves



(1) Low Wet Well Level, High Mix Box Level, Hazen-Williams C = 110.
(2) Normal Operating Head, Wet Well Level and Mix Box Level from Daily Average Readings from 1-Aug-12 to 30-Sep-12, C = 120.
(3) High Wet Well Level, Low Mix Box Level, C = 130.

Figure 6 Alternative C: Prime Pump Co. Axial Flow Pump Curves



(1) Low Wet Well Level, High Mix Box Level, Hazen-Williams C = 110.
(2) Normal Operating Head, Wet Well Level and Mix Box Level from Daily Average Readings from 1-Aug-12 to 30-Sep-12, C = 120.
(3) High Wet Well Level, Low Mix Box Level, C = 130.

5.5 Cost Estimate

A preliminary cost estimate based on provided quotes for the different alternative are summarized in Table 2. Two options, installation by contractor and installation by owner, are provided for each alternative. Detailed cost breakdown for each alternative and option is tabulated in Table 3 through Table 8. The cost estimates assume that the project is scheduled to be completed by mid-2014.

Table 2 Cost Estimate Summary for Each Alternative
Cannery Segregation Pump Station Evaluation
City of Modesto

Alternative	Installation By Contractor	Installation By Owner
A – Fairbanks Morse VTSH (3 pumps)	$2,325,000	$1,399,000
B – Fairbanks Morse Axial Flow Pumps (4 pumps)	$1,324,000	$797,000
C – Prime Pump Co. Axial Flow Pumps (4 pumps)	$1,208,000	$727,000

Table 3 Cost Estimate for Alternative A - VTSH Replacement and Upgrades
Cannery Segregation Pump Station Evaluation
City of Modesto

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PROJECT SUMMARY

Project:	**Can Seg P.S. Eval - ALTERNATIVE A**	**Estimate Class:**		**Class 5**
Client:	**City of Modesto**	**PIC:**		
Location:	**Modesto, CA**	**PM:**		**JMP**
Zip Code:	**95358**	**Date:**		**May 1, 2013**
Carollo Job #	**9076A.00**	**By:**		**GC**
		Reviewed:		**JMP**

NO.	DESCRIPTION	Unit Cost	Qty	TOTAL
01	Fairbanks Morse VTSH Pump & Motor	$ 250,000.00	3	$ 750,000
02	Open Top Confined Inlets (316 SST)	$ 25,000.00	3	$ 75,000
03	316L SST Impeller and Corrosion Resistance Upgrades	$ 62,000.00	3	$ 186,000
04	100-HP VFD Replacement Allowance	$ 36,250.00	3	$ 108,750
05	Check Valve	$ 39,000.00	0	$ -
06	Check Valve Support	$ 2,000.00	3	$ 6,000
07	Wet Well Enduraflex Lining Allowance	$ 40,000.00	1	$ 40,000
	TOTAL DIRECT COST			**$ 1,165,750**
	Contingency	30.0%		$ 349,725
	Subtotal			**$ 1,515,475**
	General Contractor Overhead, Profit & Risk	18.0%		$ 272,786
	Subtotal			**$ 1,788,261**
	Escalation to Mid-Point	3.0%		$ 53,648
	Subtotal			**$ 1,841,908**
	Sales Tax	8.8%		$ 162,088
	Subtotal			**$ 2,003,996**
	Bid Market Allowance	0.0%		$ -
	TOTAL ESTIMATED CONSTRUCTION COST			**$ 2,003,996**
	Engineering, Legal & Administration Fees	12.0%		$ 240,480
	Owner's Reserve for Change Orders	4.0%		$ 80,160
	TOTAL ESTIMATED PROJECT COST			**$ 2,324,636**

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

Table 4 Cost Estimate for Alternative A2 - VTSH Replacement and Upgrades – Owner Install Option
Cannery Segregation Pump Station Evaluation
City of Modesto

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PROJECT SUMMARY

		Estimate Class:		Class 5
Project:	Can Seg P.S. Eval - ALTERNATIVE A2*	PIC:		
Client:	City of Modesto	PM:		JMP
Location:	Modesto, CA	Date:		May 1, 2013
Zip Code:	95358	By:		GC
Carollo Job #	9076A.00	Reviewed:		JMP

NO.	DESCRIPTION	Unit Cost	Qty	TOTAL
01	Fairbanks Morse VTSH Pump & Motor (typ. Of 3 Pumps)	$ 250,000.00	3	$ 750,000
02	Open Top Confined Inlets (316 SST)	$ 25,000.00	3	$ 75,000
03	316L SST Impeller and Corrosion Resistance Upgrades	$ 62,000.00	3	$ 186,000
04	100 HP VFD Replacement Allowance	$ 36,250.00	3	$ 108,750
05	Check Valve	$ 39,000.00	0	$ -
06	Check Valve Support	$ 2,000.00	3	$ 6,000
07	Wet Well Enduraflex Lining Allowance	$ 40,000.00	1	$ 40,000
	TOTAL DIRECT COST			**$ 1,165,750**
	Owner's Engineering, Legal, and Adminstration Fees, and Reserve	20.0%		$ 233,150
	TOTAL ESTIMATED PROJECT COST			**$ 1,398,900**

***OWNER INSTALL OPTION**

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

Table 5 Cost Estimate for Alternative B – Fairbanks Morse Axial Flow Pumps Replacement
Cannery Segregation Pump Station Evaluation
City of Modesto

carollo Engineers...Working Wonders With Water® PROJECT SUMMARY		Estimate Class:		Class 5
Project:	Can Seg P.S. Eval - ALTERNATIVE B1	PIC:		
Client:	City of Modesto	PM:		JMP
Location:	Modesto, CA	Date:		May 1, 2013
Zip Code:	95358	By:		GC
Carollo Job #	9076A.00	Reviewed:		JMP

NO.	DESCRIPTION	Unit Cost	Qty	TOTAL
01	Fairbanks Morse Axial Flow Pump & Motor	$ 83,000.00	4	$ 332,000
02	Open Top Confined Inlets (316 SST)	$ 25,000.00	4	$ 100,000
03	316L SST Impeller and Corrosion Resistance Upgrades	$ -	4	$ -
04	100 HP -VFD Replacement Allowance	$ 36,250.00	4	$ 145,000
05	Check Valve	$ 39,000.00	1	$ 39,000
06	Check Valve Support	$ 2,000.00	4	$ 8,000
07	Wet Well Enduraflex Lining Allowance	$ 40,000.00	1	$ 40,000
	TOTAL DIRECT COST			**$ 664,000**
	Contingency	30.0%		$ 199,200
	Subtotal			**$ 863,200**
	General Contractor Overhead, Profit & Risk	18.0%		$ 155,376
	Subtotal			**$ 1,018,576**
	Escalation to Mid-Point	3.0%		$ 30,557
	Subtotal			**$ 1,049,133**
	Sales Tax	8.8%		$ 92,324
	Subtotal			**$ 1,141,457**
	Bid Market Allowance	0.0%		$ -
	TOTAL ESTIMATED CONSTRUCTION COST			**$ 1,141,457**
	Engineering, Legal & Administration Fees	12.0%		$ 136,975
	Owner's Reserve for Change Orders	4.0%		$ 45,658
	TOTAL ESTIMATED PROJECT COST			**$ 1,324,090**

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

Table 6 Cost Estimate for Alternative B2 – Fairbanks Morse Axial Flow Pumps Replacement – Owner Install Option
Cannery Segregation Pump Station Evaluation
City of Modesto

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PROJECT SUMMARY

Project:	**Can Seg P.S. Eval - ALTERNATIVE B2***	**Estimate Class:**		**Class 5**
Client:	**City of Modesto**	**PIC:**		
Location:	**Modesto, CA**	**PM:**		**JMP**
Zip Code:	**95358**	**Date:**		**May 1, 2013**
Carollo Job #	**9076A.00**	**By:**		**GC**
		Reviewed:		**JMP**

NO.	DESCRIPTION	Unit Cost	Qty	TOTAL
01	Fairbanks Morse Axial Flow Pump & Motor	$ 83,000.00	4	$ 332,000
02	Open Top Confined Inlets (316 SST)	$ 25,000.00	4	$ 100,000
03	316L SST Impeller and Corrosion Resistance Upgrades	$ -	4	$ -
04	100 HP VFD Replacement Allowance	$ 36,250.00	4	$ 145,000
05	Check Valve	$ 39,000.00	1	$ 39,000
06	Check Valve Support	$ 2,000.00	4	$ 8,000
07	Wet Well Enduraflex Lining Allowance	$ 40,000.00	1	$ 40,000
	TOTAL DIRECT COST			**$ 664,000**
	Owner's Engineering, Legal, and Adminstration Fees, and Reserve	20.0%		$ 132,800
	TOTAL ESTIMATED PROJECT COST			**$ 796,800**

***OWNER INSTALL OPTION**

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

**Table 7 Cost Estimate for Alternative C – Axial Flow Propeller Pumps and Upgrades – Alternative Manufacturer (Prime Pump Co.)
Cannery Segregation Pump Station Evaluation
City of Modesto**

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PROJECT SUMMARY

Project:	**Can Seg P.S. Eval - ALTERNATIVE C**	**Estimate Class:**		**Class 5**
Client:	**City of Modesto**	**PIC:**		
Location:	**Modesto, CA**	**PM:**		**JMP**
Zip Code:	**95358**	**Date:**		**May 1, 2013**
Carollo Job #	**9076A.00**	**By:**		**GC**
		Reviewed:		**JMP**

NO.	DESCRIPTION	Unit Cost	Qty	TOTAL
01	Prime Pump Co. Axial Flow Pump & Motor	$ 68,500.00	4	$ 274,000
02	Open Top Confined Inlets (316 SST)	$ 25,000.00	4	$ 100,000
03	316L SST Impeller and Corrosion Resistance Upgrades	$ -	4	$ -
04	100 HP -VFD Replacement Allowance	$ 36,250.00	4	$ 145,000
05	Check Valve	$ 39,000.00	1	$ 39,000
06	Check Valve Support	$ 2,000.00	4	$ 8,000
07	Wet Well Enduraflex Lining Allowance	$ 40,000.00	1	$ 40,000
	TOTAL DIRECT COST			**$ 606,000**
	Contingency	30.0%		$ 181,800
	Subtotal			**$ 787,800**
	General Contractor Overhead, Profit & Risk	18.0%		$ 141,804
	Subtotal			**$ 929,604**
	Escalation to Mid-Point	3.0%		$ 27,888
	Subtotal			**$ 957,492**
	Sales Tax	8.8%		$ 84,259
	Subtotal			**$ 1,041,751**
	Bid Market Allowance	0.0%		$ -
	TOTAL ESTIMATED CONSTRUCTION COST			**$ 1,041,751**
	Engineering, Legal & Administration Fees	12.0%		$ 125,010
	Owner's Reserve for Change Orders	4.0%		$ 41,670
	TOTAL ESTIMATED PROJECT COST			**$ 1,208,432**

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

Table 8 Cost Estimate for Alternative C2 – Axial Flow Propeller Pumps and Upgrades – Alternative Manufacturer (Prime Pump Co.) – Owner Install Option
Cannery Segregation Pump Station Evaluation
City of Modesto

carollo
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PROJECT SUMMARY

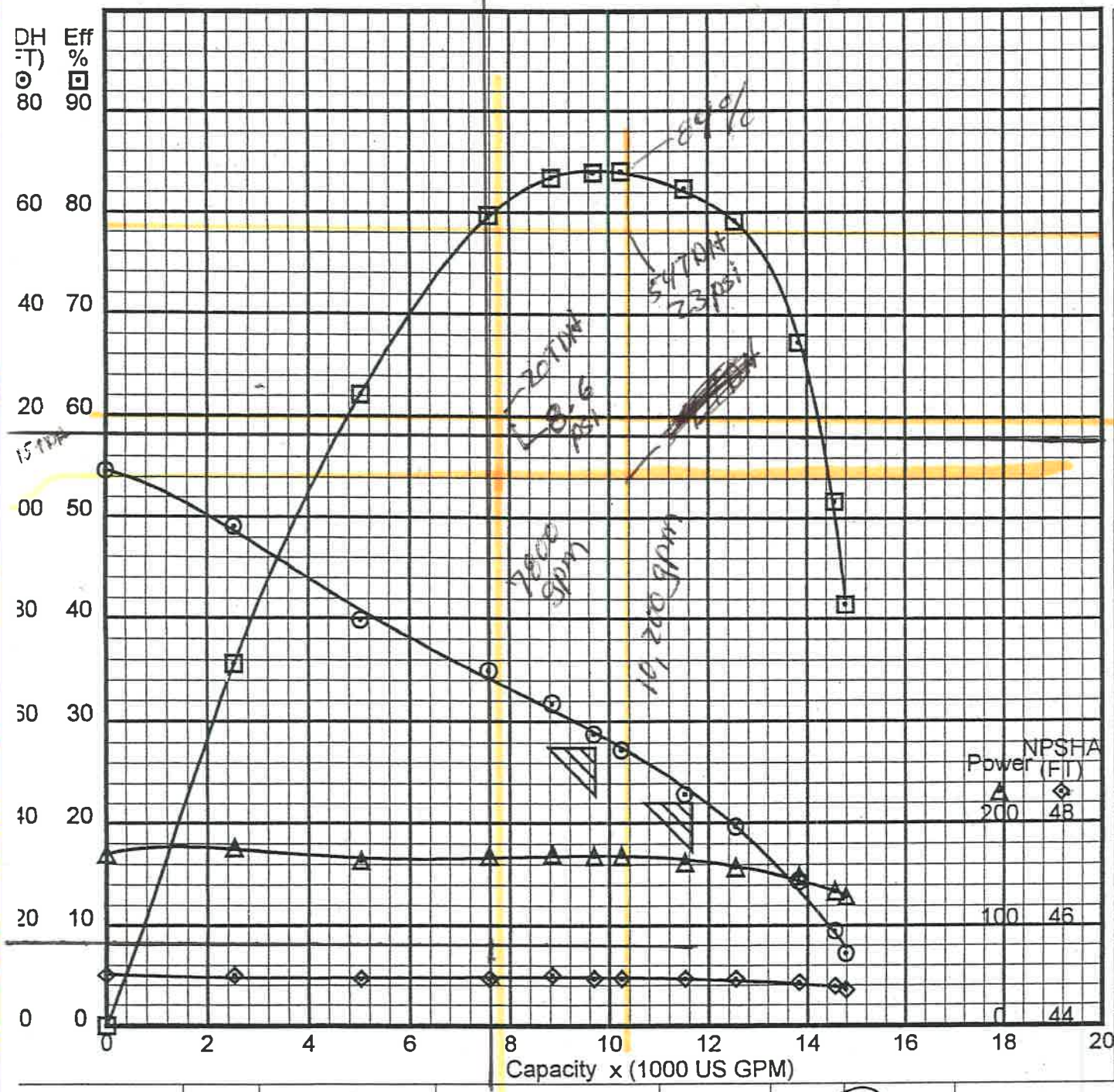
Project:	**Can Seg P.S. Eval - ALTERNATIVE C2***	**Estimate Class:**		**Class 5**
Client:	**City of Modesto**	**PIC:**		**JMP**
Location:	**Modesto, CA**	**PM:**		**May 1, 2013**
Zip Code:	**95358**	**Date:**		**GC**
Carollo Job #	**9076A.00**	**By:**		**JMP**
		Reviewed:		

NO.	DESCRIPTION	Unit Cost	Qty	TOTAL
01	Prime Pump Co. Axial Flow Pump & Motor	$ 68,500.00	4	$ 274,000
02	Open Top Confined Inlets (316 SST)	$ 25,000.00	4	$ 100,000
03	316L SST Impeller and Corrosion Resistance Upgrades	$ -	4	$ -
04	100 HP VFD Replacement Allowance	$ 36,250.00	4	$ 145,000
05	Check Valve	$ 39,000.00	1	$ 39,000
06	Check Valve Support	$ 2,000.00	4	$ 8,000
07	Wet Well Enduraflex Lining Allowance	$ 40,000.00	1	$ 40,000
	TOTAL DIRECT COST			**$ 606,000**
	Owner's Engineering, Legal, and Adminstration Fees, and Reserve	20.0%		$ 121,200
	TOTAL ESTIMATED PROJECT COST			**$ 727,200**

***OWNER INSTALL OPTION**

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

APPENDIX A - EXISTING INGERSOLL-DRESSER PUMP CURVES



INGERSOLL-DRESSER PUMP COMPANY

PUMP TEST DATA

RPM	GPM	TDH	BHP	Eff
1187	9666.5	57.2	166.5	83.9
1187	10219.8	54.2	166.5	84.0
1187	11490.3	45.5	160.3	82.3
1187	12510.4	39.0	155.6	79.2
1188	13805.9	28.6	147.8	67.4
1189	14554.5	18.8	133.6	51.7
1190	14792.1	14.3	128.8	41.5
1186	8819.9	63.0	168.1	83.4
1187	7561.8	69.5	166.5	79.7
1187	5025.8	79.3	161.9	62.2
1186	2520.6	97.4	174.3	35.6
1186	0.0	108.4	168.1	0.0

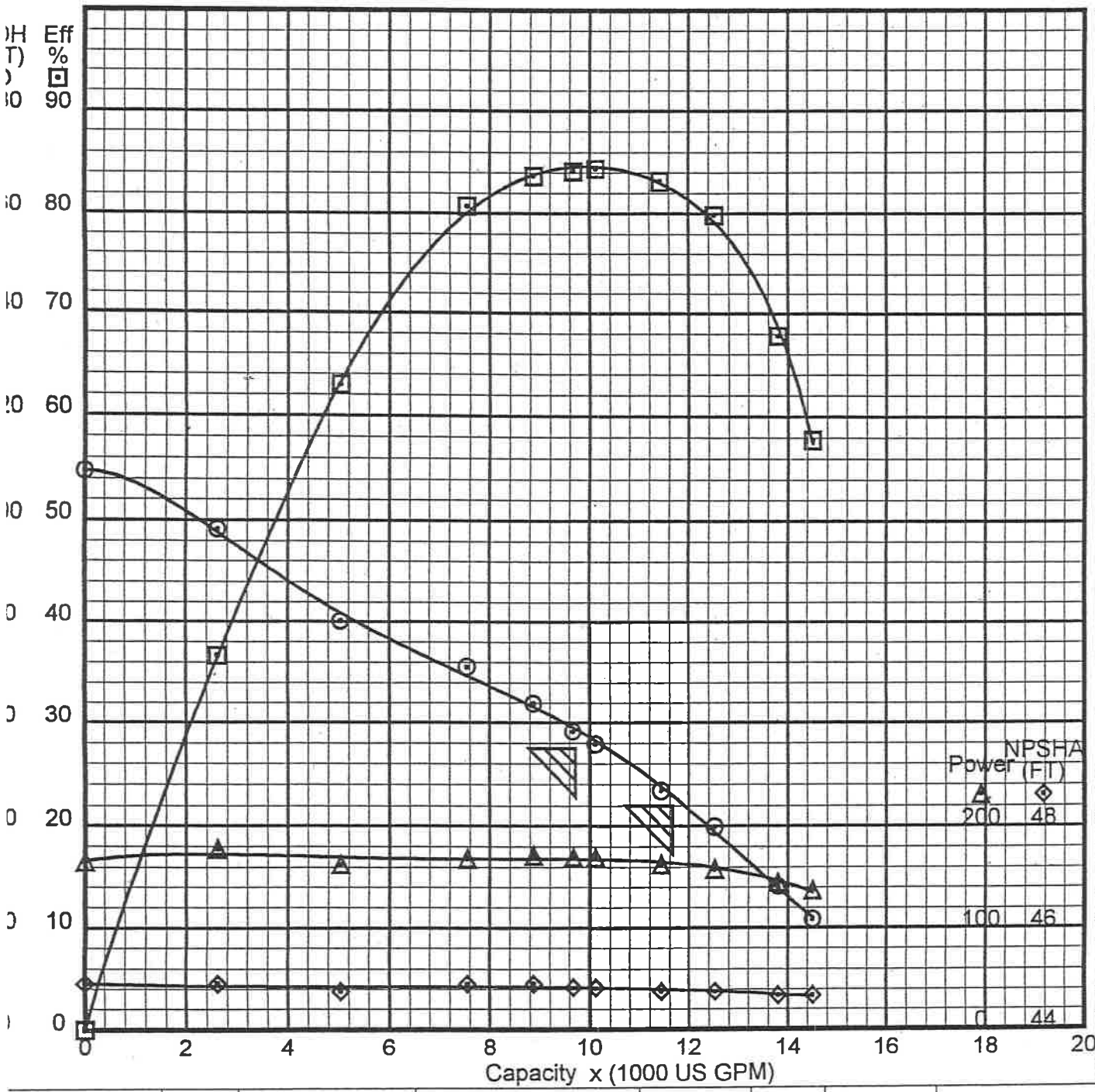
I CERTIFY THAT WITHIN THE ACCURACY OF THE TEST INSTRUMENTATION, THIS TEST REPRESENTS THE PERFORMANCE OF 20QMN PUMP 9903MS000841-3

David A. Hance

SP.GR.: 1.000 .033" RING GAP

CASING DATA		
A48 CL35	SIS-3	-
MATERIAL	FINISH	TONGUE
IMPELLER DATA		
A48 CL35	1A	.62Lx3.0B
MATERIAL	FINISH	DISC. TIPS
UB5899	A-13	18.11"
PATT. NO.	COMB. NO.	DIA

20QMN	1	S-000841	9903MS000841-3	7MAY99	SPH	DAH	200H/1200R,#53	20x14,#31	1190	T-S000841-3B
PUMP	STAGES	ORDER NO.	SERIAL NO.	DATE TESTED	TEST	APPROVED	TEST DRIVER	VENTURI	PLOTTED RPM	CURVE NO



INGERSOLL-DRESSER PUMP COMPANY

PUMP TEST DATA

RPM	GPM	TDH	BHP	Eff
1190	14505.6	21.6	136.8	57.8
1190	13805.1	28.1	144.7	67.8
1189	12509.7	39.7	157.2	79.9
1189	11422.0	46.7	161.9	83.1
1188	10097.1	55.6	168.1	84.3
1188	9657.9	58.0	168.1	84.1
1187	8854.4	63.5	169.6	83.7
1187	7530.5	70.7	166.5	80.7
1189	5040.9	80.0	161.9	62.9
1187	2611.0	97.7	175.8	36.6
1187	0.0	108.9	163.4	0.0

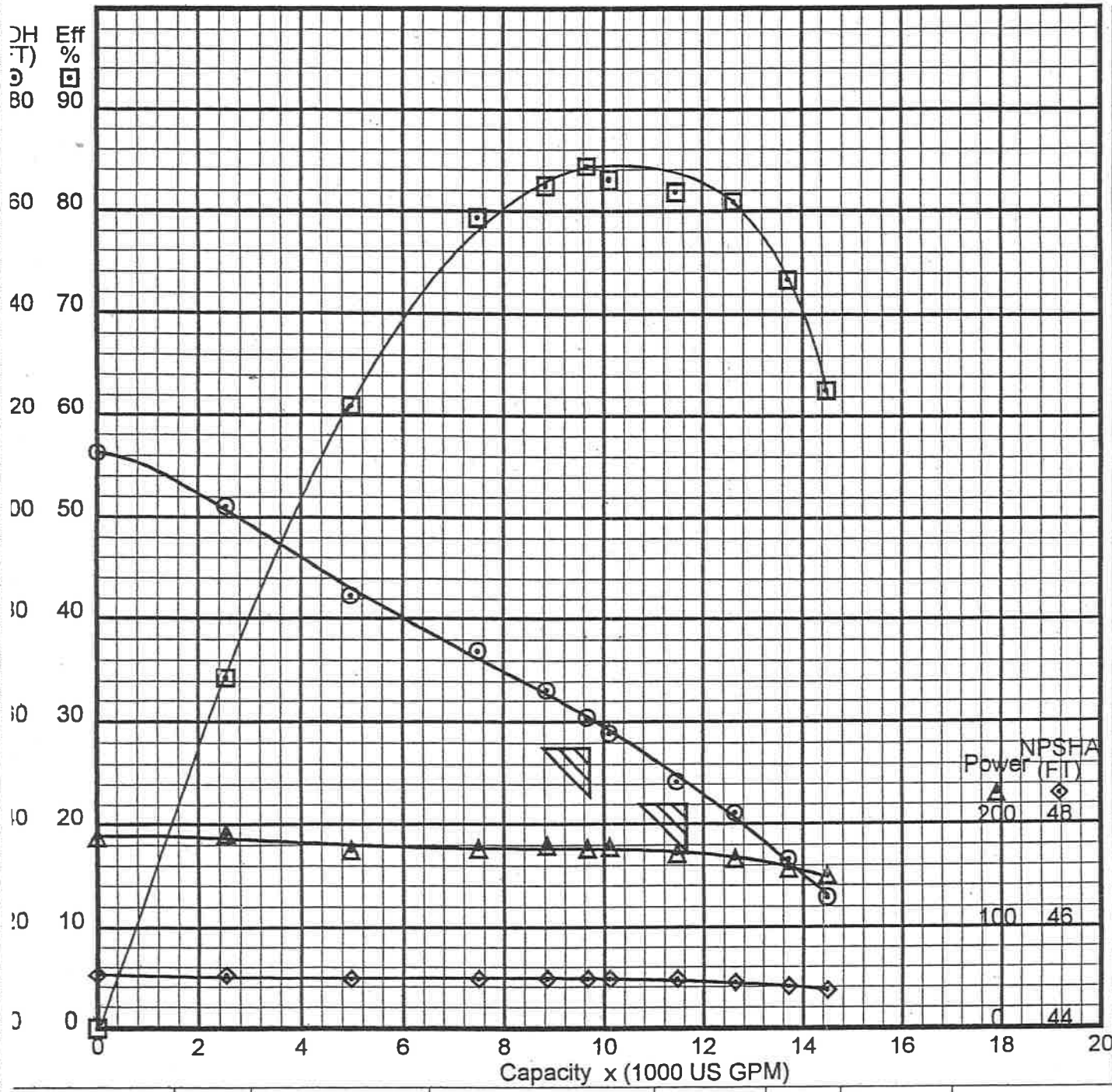
I CERTIFY THAT WITHIN THE ACCURACY OF THE TEST INSTRUMENTATION, THIS TEST REPRESENTS THE PERFORMANCE OF 20QMN PUMP 9903MS000841-2

Dennis A. Dame

SP.GR.: 1.000 .040" RING GAP

CASING DATA		
A48 CL35	SIS-3	-
MATERIAL	FINISH	TONGUE
IMPELLER DATA		
A48 CL35	1A	.62Lx3.0B
MATERIAL	FINISH	DISC. TIPS
UB5899	A-13	18.11"
PATT. NO.	COMB. NO.	DIA

20QMN	1	S-000841	9903MS000841-2	6MAY99	SSE	DAH	200H/1200R,#53	20x14,#31	1190	T-S000841-2A
PUMP	STAGES	ORDER NO.	SERIAL NO.	DATE TESTED	TEST	APPROVED	TEST DRIVER	VENTURI	PLOTTED RPM	CURVE NO



INGERSOLL-DRESSER PUMP COMPANY
PUMP TEST DATA

RPM	GPM	TDH	BHP	Eff
1186	9633.8	60.4	174.3	84.3
1186	10081.8	57.3	175.8	83.0
1186	11422.0	48.1	169.6	81.8
1187	12596.1	42.0	165.0	80.9
1188	13692.4	33.0	155.6	73.4
1189	14473.5	25.6	149.4	62.6
1186	8819.4	65.6	177.4	82.4
1186	7468.6	73.3	174.3	79.3
1186	4963.5	84.1	172.7	61.0
1185	2520.4	101.3	188.1	34.3
1185	0.0	111.6	185.0	0.0

I CERTIFY THAT WITHIN THE ACCURACY OF THE TEST INSTRUMENTATION, THIS TEST REPRESENTS THE PERFORMANCE OF 20QMN PUMP 9903MS000841-1

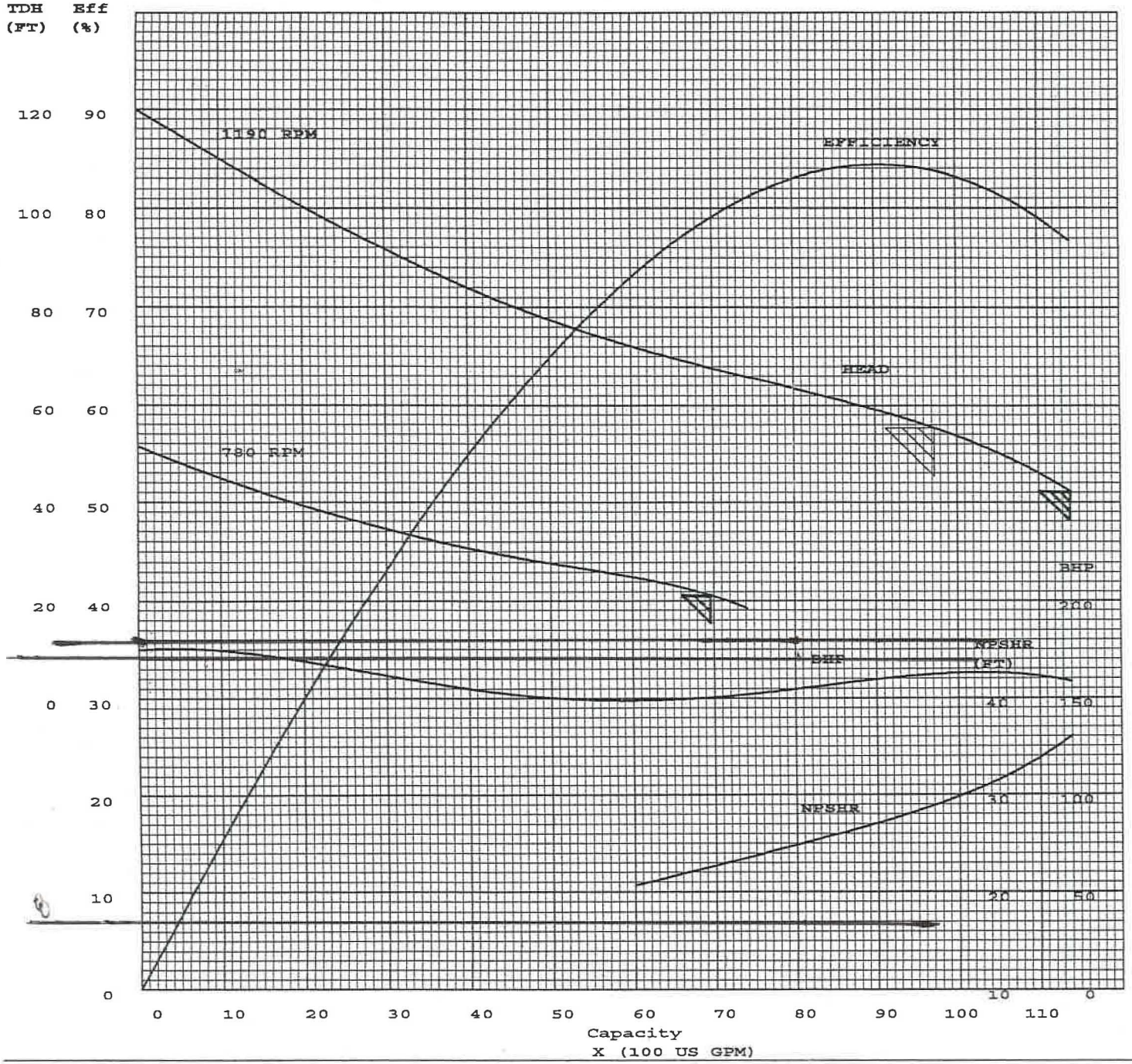
Daniel G House

SP.GR.: 1.000 .031" RING GAP

CASING DATA		
A48 CL35	SIS-3	-
MATERIAL	FINISH	TONGUE
IMPELLER DATA		
A48 CL35	1A	.62Lx2.5B
MATERIAL	FINISH	DISC. TIPS
UB5899	A-13	18.11"
PATT. NO.	COMB. NO.	DIA

20QMN	1	S-000841	9903MS000841-1	5MAY99	SSC	DAH	200H/1200R,#53	20x14,#31	1190	T-S000841-1C
PUMP	STAGES	ORDER NO.	SERIAL NO.	DATE TESTED	TEST	APPROVED	TEST DRIVER	VENTURI	PLOTTED RPM	CURVE NO

PUMP PERFORMANCE



INGERSOLL-DRESSER PUMP

This pump is designed to deliver:

US GPM	: 9722
TDH	: 55 (FT)
RPM	: 1190
Efficiency	: 84%
BHP	: 162
NPSHR	: 29 (FT)

5" Diameter Solid

2 Vane Impeller

Driver: Electric Motor

This curve shows the expected heads and efficiencies at other capacities, but this additional data is only approximate and is not guaranteed.

Certified by:

Project: RANCH CANNERY PUMP STATION

Service: RAS PUMPS P101, P102 & P104

Model No. 20QMN-A

Order No. S000841

Date: 10-9-98

E-ES000841

APPENDIX B - DESK TOP STUDY HYDRAULIC CALCULATIONS

Client: City of Modesto
Project: Can Seg Pump Station Evaluation
Job No: 9076A.00

General

1. Required Pumping Capacity

Q (min)	4	mgd	Basis: Conservative Assumption
Q (startup)	8	mgd	Basis: City Staff
Q (design)	28	mgd	Basis: CDM Training Workshop

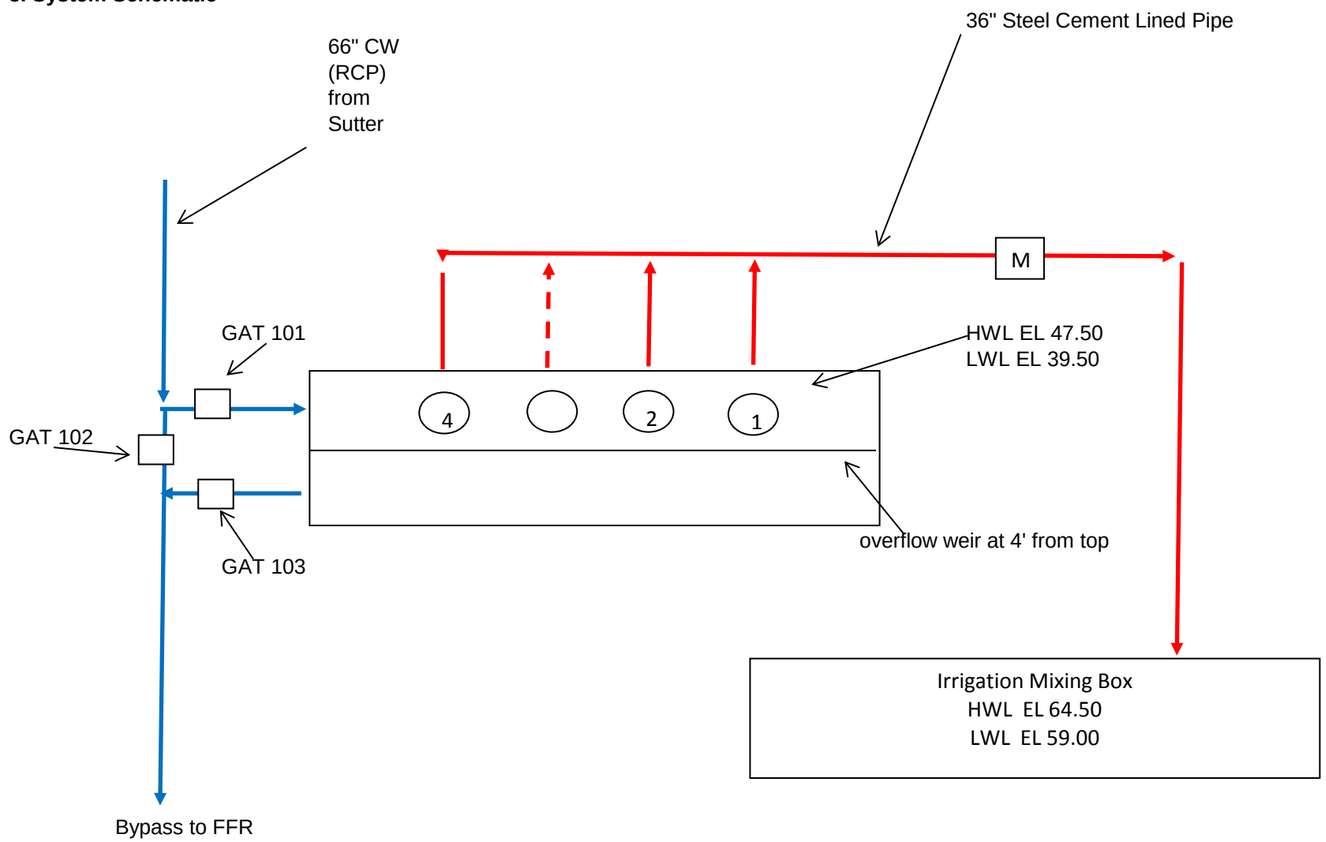
2. Process Fluid
Cannery Waste from Sutter Primary Plant

3. Operational Criteria
VFD Driven - Maintain an operator selectable flow setpoint
2 Duty / 1 Standby

4. System Background

The pump station receives cannery waste (CW) from Sutter Ave. Can Seg Pump Station, and pumps CW to the mixing box at the Jennings Rd. site, where the CW can be mixed with flow from the irrigation reservoir and sent to ranches at the Jennings Road plant site. The pump station currently has three 20” Vertical Turbine Solids Handling (VTSH) pumps model 20QMN-A manufactured by Ingersoll-Dresser Pumps (IDP). The pumps are each rated for 14 MGD (9,722 gpm) at 55’ TDH at 1,190 RPM and are equipped with 200 HP motors

5. System Schematic



Client: City of Modesto
Project: Can Seg Pump Station Evaluation
Job No: 9076A.00

Modified Curves
See System Drawings for Corresponding Segments
System Curves

Suction Elevation at CS Wet Well = 43.8 13.9' Reading from Scada
Discharge at Mixing Box
Flows from Can-Seg PS to Mixing Box

Seg A1	P104 Pump Intake to Discharge Head
Seg A2	Discharge Head to 36" FM
Seg B	36"FM wye at P104 to C-FM1
Seg C1	C-FM1
Seg C2	C-FM2
Seg C3	C-FM3
Seg C4	C-FM4
Seg C5	C-FM5
Seg D	Mixing Box M-5

		Segment A1	Segment A2	Segment B	Segment C1	Segment C2	Segment C3	Segment C4	Segment C5	Segment D	
Flow Rate	mgd	6.00	6.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	
Flow Rate	gpm	4166.67	4166.67	8333.33	8333.33	8333.33	8333.33	8333.33	8333.33	8333.33	
Flow Rate	cfs	9.28	9.28	18.56	18.56	18.56	18.56	18.56	18.56	18.56	
Pipe Diameter	inches	20.00	20.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	
Pipe Area	ft^2	2.18	2.18	7.07	7.07	7.07	7.07	7.07	7.07	7.07	
Hazen Williams (C)	--	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	Total
Pipe Length	ft		8.00	68.00	880.00	1220.00	1200.00	1200.00	810.00	58.67	5444.67
Minor Losses											
Entrance (sharp edged)	0.50									1	
Elbow, 90	0.30			2	1				1	2	
Elbow, 45	0.20								1	2	
Elbow, 22.5	0.15				1	1					
Sudden Expansion 20" to 36"	0.47		1								
Tee, line flow	0.30										
Tee, branch flow	0.75										
Decreaser	0.20										
Increaser	0.20										
Wye (thru. Straight)	0.45		1								
Magmeter	0.20			1							
Check Valve (Swing)	2.50		1								
Plug Valve	1.00										
Knife Gate Valve	0.30										
Butterfly Valve (Open)	0.50			1							
Exit	1.00										
Sum of K's		0.00	3.42	1.30	0.45	0.15	0.00	0.00	0.50	1.50	
Velocity	fps	4.25	4.25	2.63	2.63	2.63	2.63	2.63	2.63	2.63	Totals
Pipe Friction Losses	ft	0.00	0.03	0.06	0.74	1.02	1.01	1.01	0.68	0.05	4.59
Minor Losses	ft	0.00	0.96	0.14	0.05	0.02	0.00	0.00	0.05	0.16	1.38
Other Losses:											
Safety Factor 10%	ft	0.00	0.10	0.02	0.08	0.10	0.10	0.10	0.07	0.02	0.60
System Head Loss, water	ft	0.00	1.09	0.22	0.86	1.14	1.11	1.11	0.81	0.23	6.57

Input: 12.00 MGD

Segment D		
Q<6.31	FALSE	FALSE
6.3<Q<12.61	TRUE	6
12.6<Q<18.91	FALSE	FALSE
18.9<Q<25.21	FALSE	FALSE
Total Q	T or F	Value if True

Total System Head Loss ft **6.57** 27% Percent friction

Discharge Elevation 61.70 *10.7' mixing box water level reading from Scada
Suction Elevation 43.80
Static Lift ft **17.90** 73% Percent Static

Total Head ft **24.47**

C =	110.00		C =	110.00		C =	120.00		C =	130.00	
Flow Rate (gpm)	Q(MGD)	Head (Ft)	Flow Rate (gpm)	Q(MGD)	Head (Ft)	Flow Rate (gpm)	Q(MGD)	Head (Ft)	Flow Rate (gpm)	Q(MGD)	Head (Ft)
		24.47									
0	0.00	17.90	0	0.00	17.90	0	0.00	17.90	0	0.00	17.90
2000	2.88	18.35	2000	2.88	18.35	2000	2.88	18.29	2000	2.88	18.25
4000	5.76	19.55	4000	5.76	19.55	4000	5.76	19.36	4000	5.76	19.20
6000	8.64	21.44	6000	8.64	21.44	6000	8.64	21.03	6000	8.64	20.71
8000	11.52	23.98	8000	11.52	23.98	8000	11.52	23.28	8000	11.52	22.74
10000	14.40	27.16	10000	14.40	27.16	10000	14.40	26.11	10000	14.40	25.28
12000	17.28	30.96	12000	17.28	30.96	12000	17.28	29.48	12000	17.28	28.32
14000	20.16	35.37	14000	20.16	35.37	14000	20.16	33.41	14000	20.16	31.86
16000	23.04	40.37	16000	23.04	40.37	16000	23.04	37.86	16000	23.04	35.88
18000	25.92	45.97	18000	25.92	45.97	18000	25.92	42.85	18000	25.92	40.39
20000	28.80	52.14	20000	28.80	52.14	20000	28.80	48.35	20000	28.80	45.36
22000	31.68	58.90	22000	31.68	58.90	22000	31.68	54.37	22000	31.68	50.81
24000	34.56	66.22	24000	34.56	66.22	24000	34.56	60.91	24000	34.56	56.72
26000	37.44	74.11	26000	37.44	74.11	26000	37.44	67.95	26000	37.44	63.09
28000	40.32	82.56	28000	40.32	82.56	28000	40.32	75.49	28000	40.32	69.92
30000	43.20	91.56	30000	43.20	91.56	30000	43.20	83.53	30000	43.20	77.20
32000	46.08	101.12	32000	46.08	101.12	32000	46.08	92.07	32000	46.08	84.94
34000	48.96	111.22	34000	48.96	111.22	34000	48.96	101.10	34000	48.96	93.13

Simulations Under Different Friction C

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BY GC DATE 9/24/2012 SUBJECT Can-Seg Hydraulics SHEET NO. ___ OF ___
CHKD. BY ___ DATE ___ Can-Seg Pump Station JOB NO. 9076A.00

Optimal Point: $\frac{10200 gal}{min} \Big| \frac{1440 min}{d} = 14.7 MGD$ per pump

$\frac{7800 gal}{min} \Big| \frac{1440 min}{d} = 11.2 MGD$ per pump

20ft column diameter?
Need testing schematic
Pump Column Material
A1

(Est.) 8ft Dischargehead to 36" Cannery Waste Force Main

Hazen Williams (C) = 110, 120, 130
Steel cement Lined: C = 130, 110, 120
Check Valve (Swing) K=2.5
Wye (thru. Straight): 0.45
Sudden Expansion: $K_L = (1 - \frac{A_1}{A_2})^2 = (1 - \frac{\pi(\frac{20}{2})^2}{\pi(\frac{36}{2})^2})^2 = (1 - \frac{10^2}{18^2})^2$
$= 0.47$
A2

(Est.) 46' from P104 wye to ARV105
90° Elbow x2
(Est.) 10' horizontal run
(Est.) 12' vertical run
46'+10'+12' = 68'

Butterfly Valve (open) K=0.50
Mag Meter: K= 0.20
B

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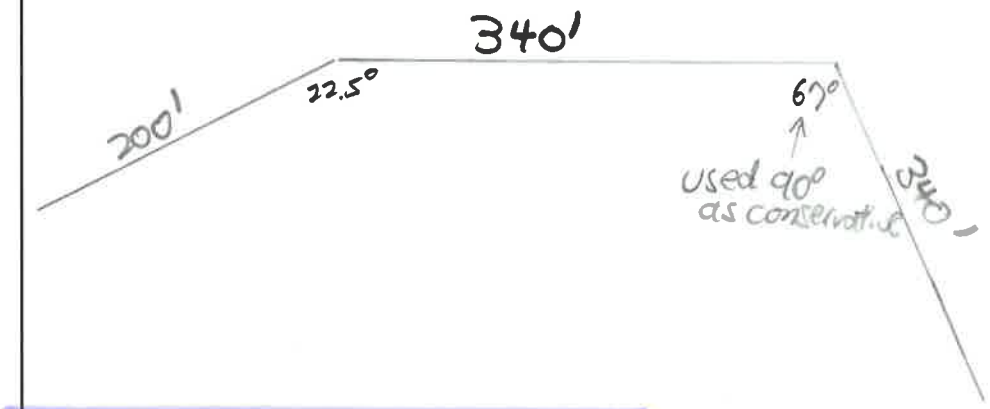
BY GC DATE 9/25/2012 SUBJECT Can Seq Hydraulics SHEET NO. ___ OF ___
CHKD. BY ___ DATE ___ CS PS to Mixing Box JOB NO. 9076A.00

C1

Sum Length: 880' C=130

C-FM1



C2

C-FM2

C3

C-FM3

1200

C4

C-FM4

1200

C5

C-FM5

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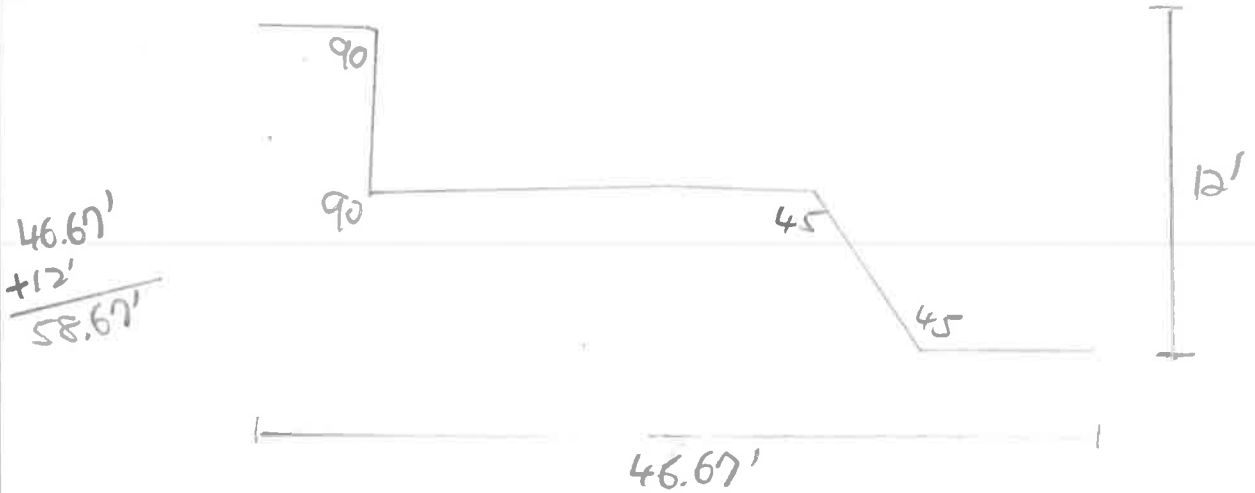
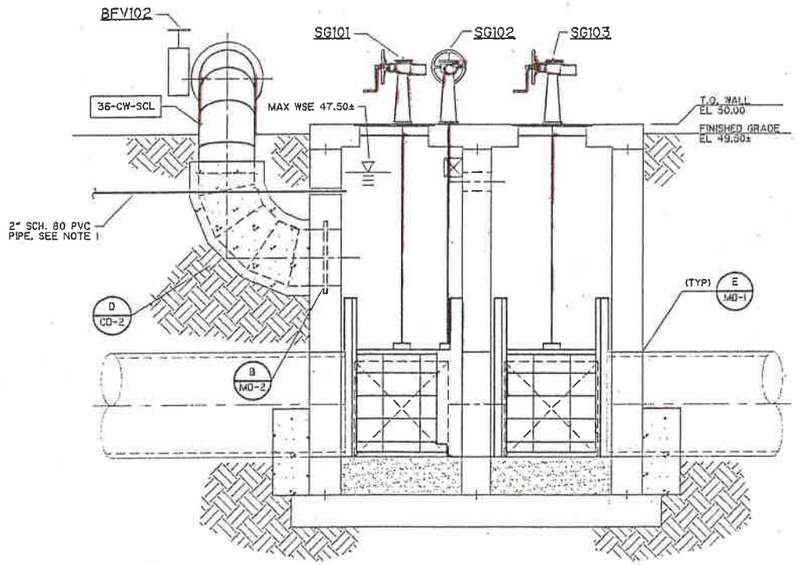
BY GC DATE 9/21/2012 SUBJECT Can-Seg Hydraulics SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ Mixing Box Entrance JOB NO. 9076A.00



46.67'
+12'
58.67'

Max : 65.50

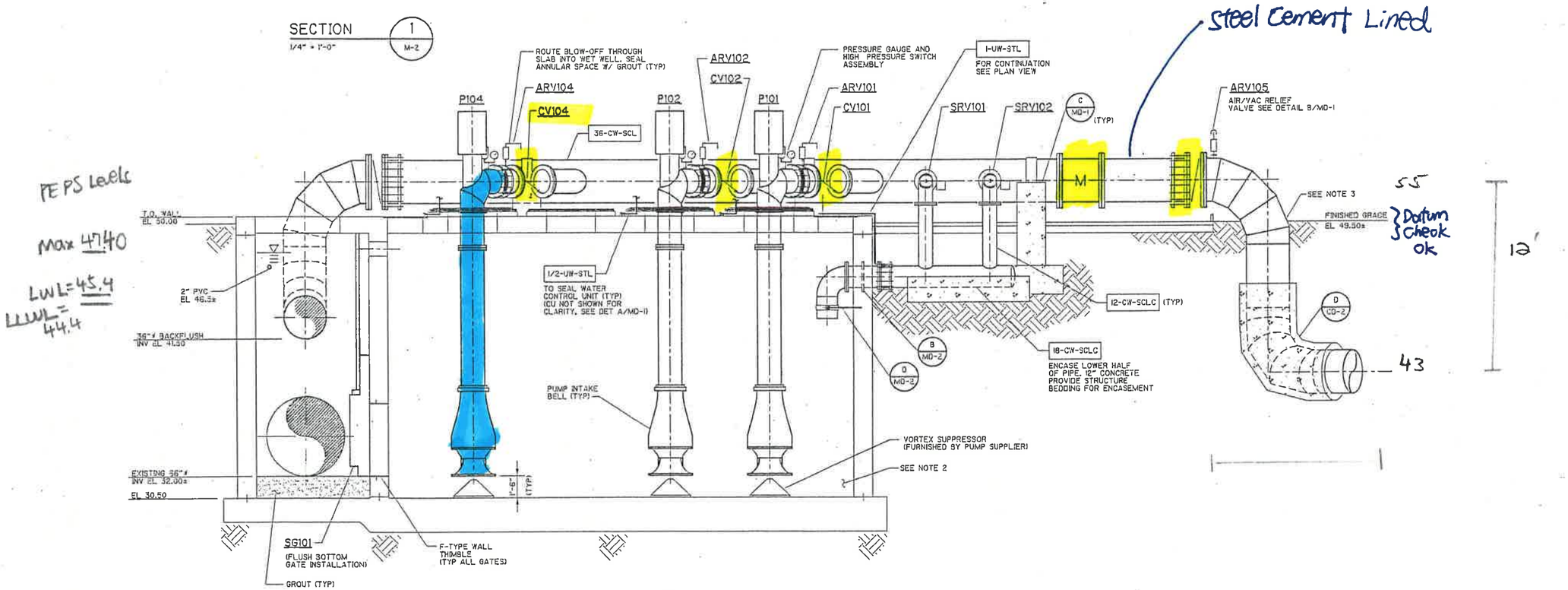


SECTION 1 — 1/4" = 1'-0" — M-2

NOTES:

1. EXTEND 2" PVC PIPE APPROX. 3" INTO STRUCTURE AND CAP. PROVIDE WATERTIGHT PENETRATION THROUGH WALL.
2. ALL INTERIOR SURFACES OF THE WET WELL, OVERFLOW CHAMBER, AND DIVERSION STRUCTURE SHALL BE EPOXY COATED IN ACCORDANCE WITH SECTION 09902.
3. TERMINATE MORTAR COATING APPROX. 6" ABOVE GRADE, TYPICAL.

Segment A1



SECTION 2 — 1/4" = 1'-0" — M-2

Steel Cement Lined

PE PS Levels

Max 47.40

LWL = 45.4

LLWL = 44.4

55

Datum check ok

43

12'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: SCW
DRAWN BY: MLM/TVN
SHEET CHK'D BY: SCW
CROSS CHK'D BY:
APPROVED BY:
SUBMITTED BY:
DATE: JUNE 1999

REGISTERED PROFESSIONAL ENGINEER — No. C042951 Exp. 9-30-00 — CIVIL — STATE OF CALIFORNIA

CDM Camp Dresser & McKee
environmental services
One Walnut Center
100 Pringle Avenue, Suite 300
Walnut Creek, CA 94596

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

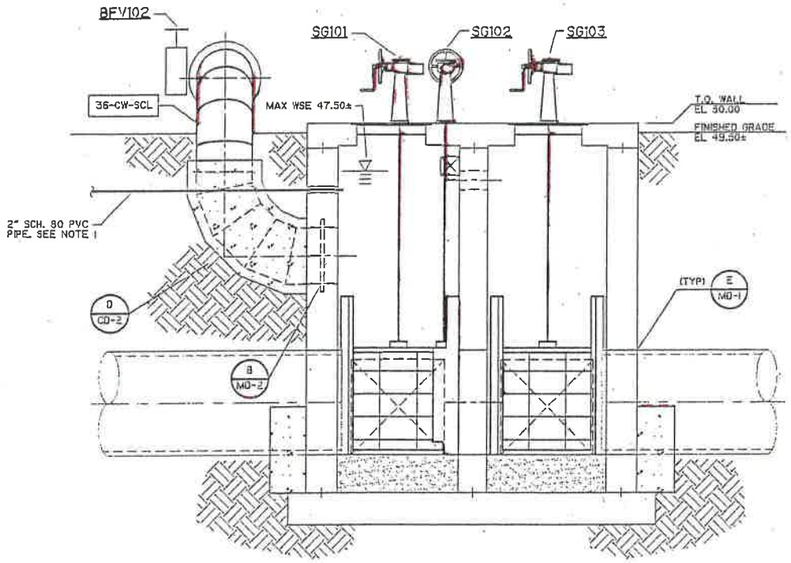
RANCH CANNERY PUMP STATION AND FORCEMAIN

PUMP STATION SECTIONS

PROJECT NO. 8390-22857
FILE NAME: 8390M-3

SHEET NO.
M-3

CDM/CAD STDTVN 22.62.30 06/18/98 10:45:01 8390M-3 I:\CAD\8390\22857\JECT\

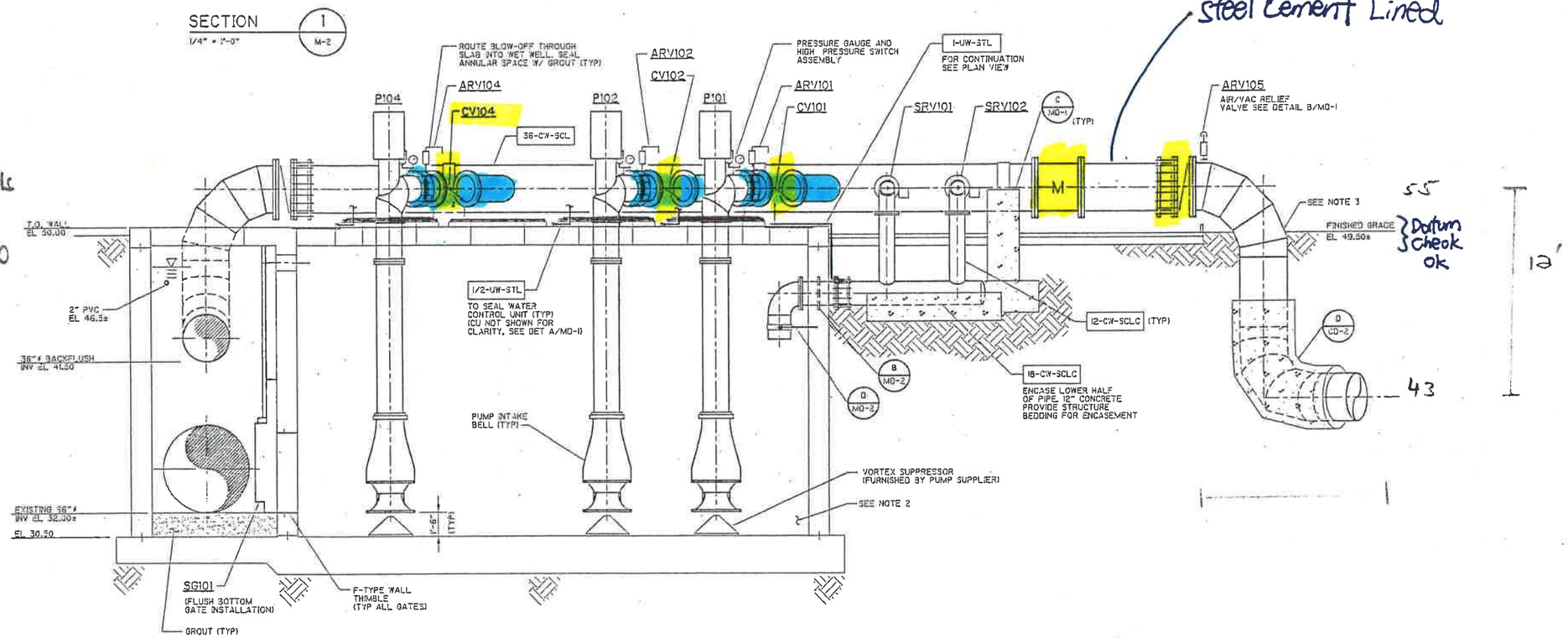


SECTION 1 — 1/4" = 1'-0" — M-2

NOTES:

1. EXTEND 2" PVC PIPE APPROX. 3" INTO STRUCTURE AND CAP. PROVIDE WATERTIGHT PENETRATION THROUGH WALL.
2. ALL INTERIOR SURFACES OF THE WET WELL, OVERFLOW CHAMBER, AND DIVERSION STRUCTURE SHALL BE EPOXY COATED IN ACCORDANCE WITH SECTION 09902.
3. TERMINATE MORTAR COATING APPROX. 6" ABOVE GRADE. TYPICAL.

Segment A2



Steel Cement Lined

PE PS Levels

Max 47.40

LWL=45.4

LLWL=44.4

Datum Check ok

SECTION 2 — 1/4" = 1'-0" — M-2

REV.	DATE	DRAWN	CHKD	REMARKS

DESIGNED BY: SCW
DRAWN BY: ML/M/TVN
SHEET CHK'D BY: SCW
CROSS CHK'D BY:
APPROVED BY:
SUBMITTED BY:
DATE: JUNE 1993

REGISTERED PROFESSIONAL ENGINEER — No. 20425 — Exp. 3-30-95 — CIVIL — STATE OF CALIFORNIA

CDM Camp Dresser & McKee
environmental engineering and construction management
One Walnut Center
100 Pringle Avenue, Suite 300
Walnut Creek, CA 94596

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

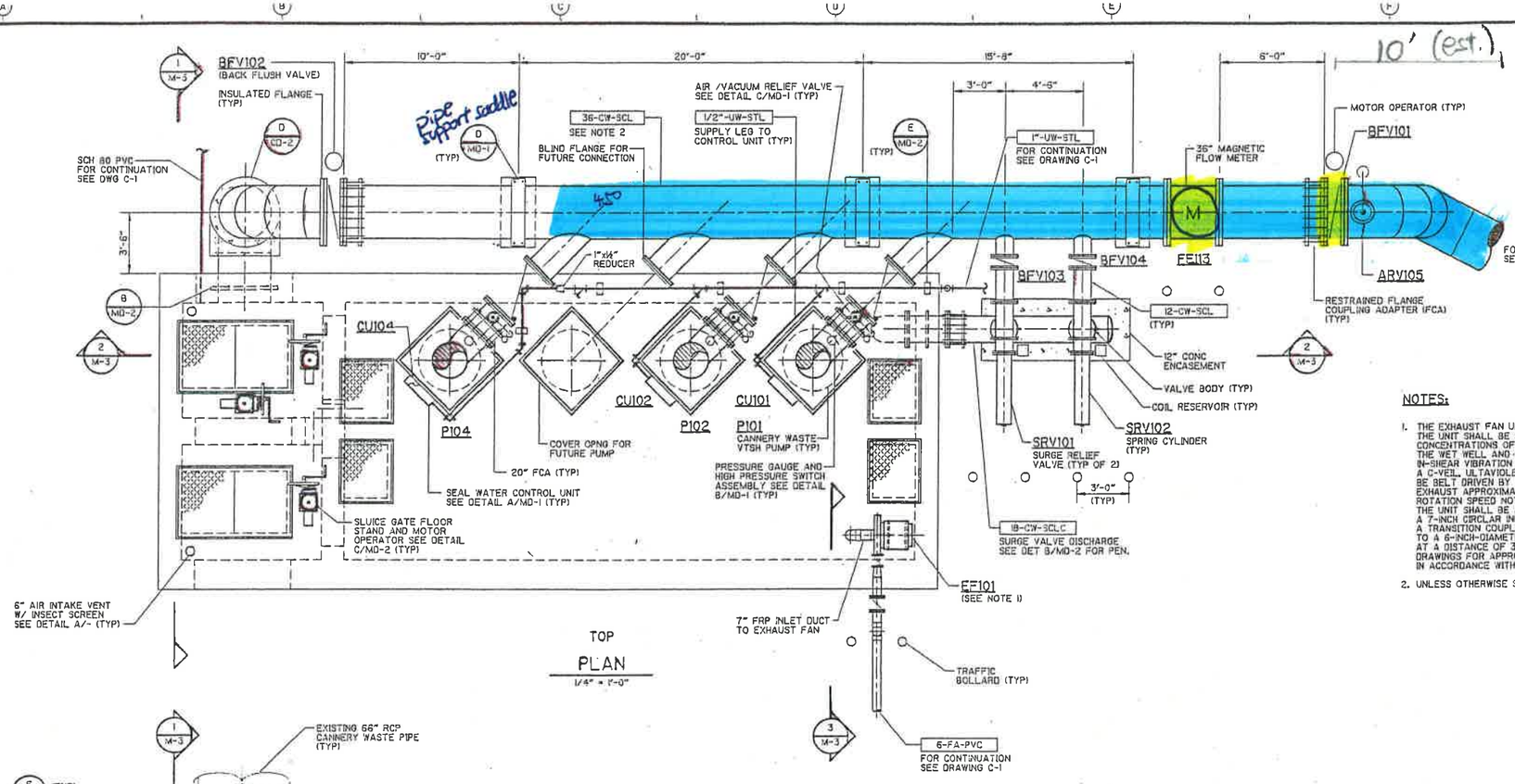
RANCH CANNERY PUMP STATION AND FORCEMAIN

PUMP STATION SECTIONS

PROJECT NO. 8390-22857
FILE NAME: 8390M-3

SHEET NO.
M-9

CDM/CADD 5T6\TYN 22:52:30 06/18/93 10:45:01 8390M-3 ACAD\8390-22857\VIEW1



NOTES:

1. THE EXHAUST FAN UNIT SHALL BE FIBERGLASS REINFORCED PLASTIC (FRP) CONSTRUCTION WITH RADIAL IMPELLER. THE UNIT SHALL BE SUITABLE FOR EXHAUSTING FOUL AIR FROM THE PUMP WET WELL WHICH MAY CONTAIN HIGH CONCENTRATIONS OF HYDROGEN SULFIDE. THE UNIT SHALL BE INSTALLED OUTDOORS ON TOP OF THE WET WELL AND SHALL BE ANCHORED TO THE CONCRETE SLAB USING EXPANSION ANCHOR BOLTS AND RUBBER-IN-SHEAR VIBRATION ISOLATION PADS. THE UNIT SHALL BE CONSTRUCTED WITH ELECTRICALLY GROUNDED FRP WITH A C-VEIL, ULTAVIOLET INHIBITOR AND SHALL HAVE A CLASS I FLAME SPREAD OF LESS THAN 25. THE FAN SHALL BE BELT DRIVEN BY A 1 HP, 1800 RPM, EXPLOSION PROOF CLASS I, DIVISION 1, GROUP B AND D MOTOR AND SHALL EXHAUST APPROXIMATELY 350 CFM AT A STATIC DISCHARGE PRESSURE OF 5-INCHES (WATER COLUMN) AT A FAN ROTATION SPEED NOT TO EXCEED 2600 RPM FAN MOTOR SHALL BE IN COMPLIANCE WITH SPECIFICATION SECTION 01170. THE UNIT SHALL BE A 12-INCH HARTZELL SERIES 42, ARRANGEMENT 10, OR EQUAL, WITH SLIP COLLAR PROVIDED FOR A 7-INCH CIRCLAR INLET FRP DUCT. FAN SUPPLIER SHALL PROVIDE FAN DISCHARGE APPURTENANCES INCLUDING A TRANSITION COUPLING, NEOPRENE FLEX CONNECTOR, ISOLATION DAMPER, AND TRANSITION COUPLING FOR CONNECTION TO A 6-INCH-DIAMETER SCHEDULE 80 PVC DISCHARGE DUCT. NOISE PRODUCED BY THE UNIT SHALL NOT EXCEED 85 DECIBELS AT A DISTANCE OF 3 FEET FROM THE UNIT WHEN OPERATING AT MAXIMUM SPEED. CONTRACTOR SHALL PROVIDE SHOP DRAWINGS FOR APPROVAL IN ACCORDANCE WITH SPECIFICATION SECTION 01300, AND OPERATION AND MAINTENANCE INFORMATION IN ACCORDANCE WITH SECTION 01730.
2. UNLESS OTHERWISE SHOWN, STEEL PIPE SHOWN ON THIS DRAWING SHALL HAVE WELDED JOINTS.

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: SCW
DRAWN BY: ML/M/TYN
SHEET CHK'D BY: SCW
CROSS CHK'D BY:
APPROVED BY:
SUBMITTED BY:
DATE: JUNE 1998

REGISTERED PROFESSIONAL ENGINEER — CHARLES S. MOORE — CIVIL — STATE OF CALIFORNIA

CDM Camp Dresser & McKee
environmental services
One Walnut Center
100 Pringle Avenue, Suite 300
Walnut Creek, CA 94596

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

RANCH CANNERY PUMP STATION AND FORCEMAIN

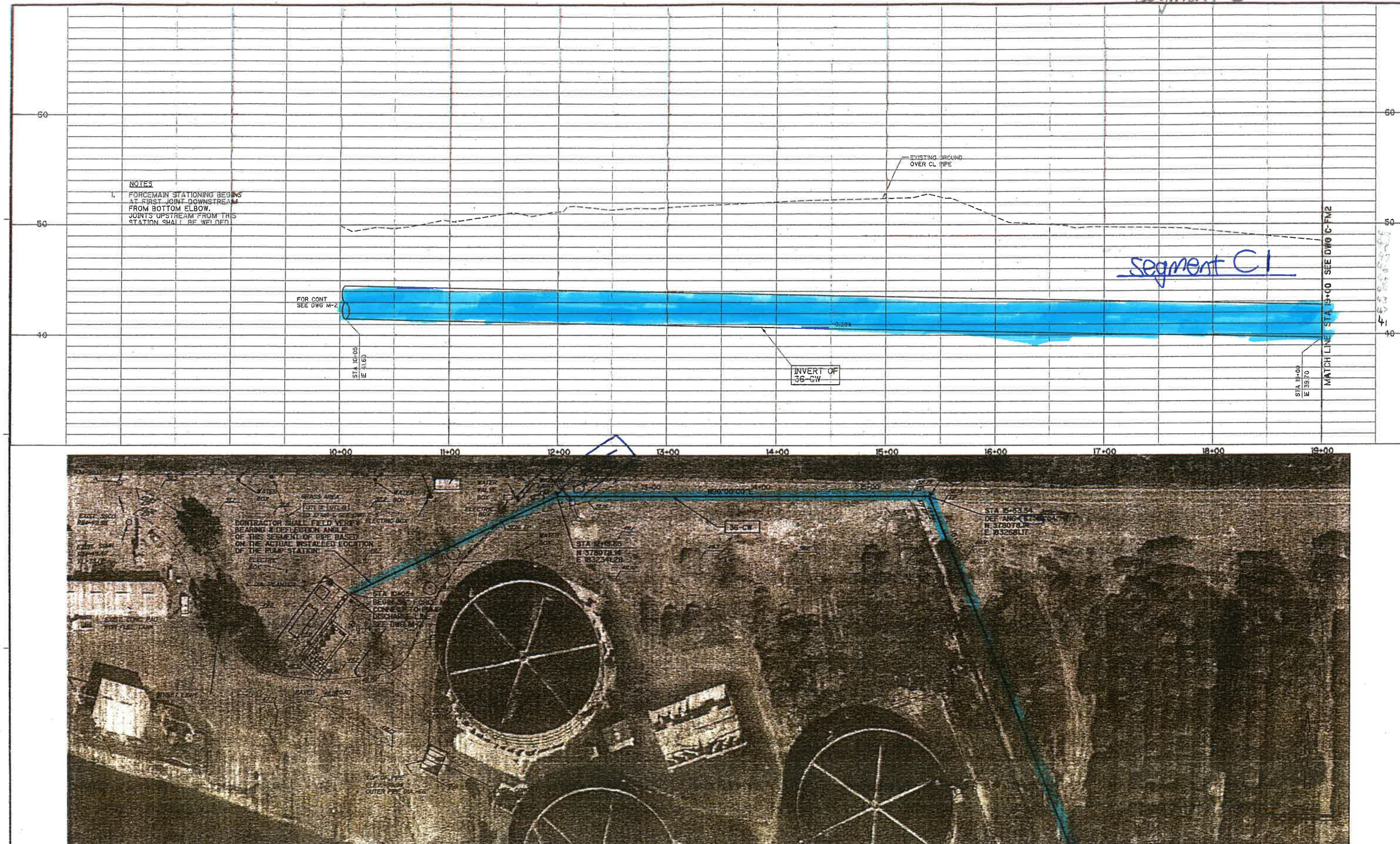
PUMP STATION PLANS

PROJECT NO. 8390-22857
FILE NAME: 8390M-2

SHEET NO.
M-2

CDM/CADD STD\TYN
17:02:24
06/8/98 10:43:53
8390M-2
Z:\ACAD\8390\22857\MEC\

Segment C



REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: RKU
DRAWN BY: RKU
SHEET CHK'D BY: SCW
CROSS CHK'D BY: -
APPROVED BY: -
SUBMITTED BY: -
DATE: JUNE 1998

REGISTERED PROFESSIONAL ENGINEER — No. C048351 — Exp. 9-30-00 — CIVIL — STATE OF CALIFORNIA

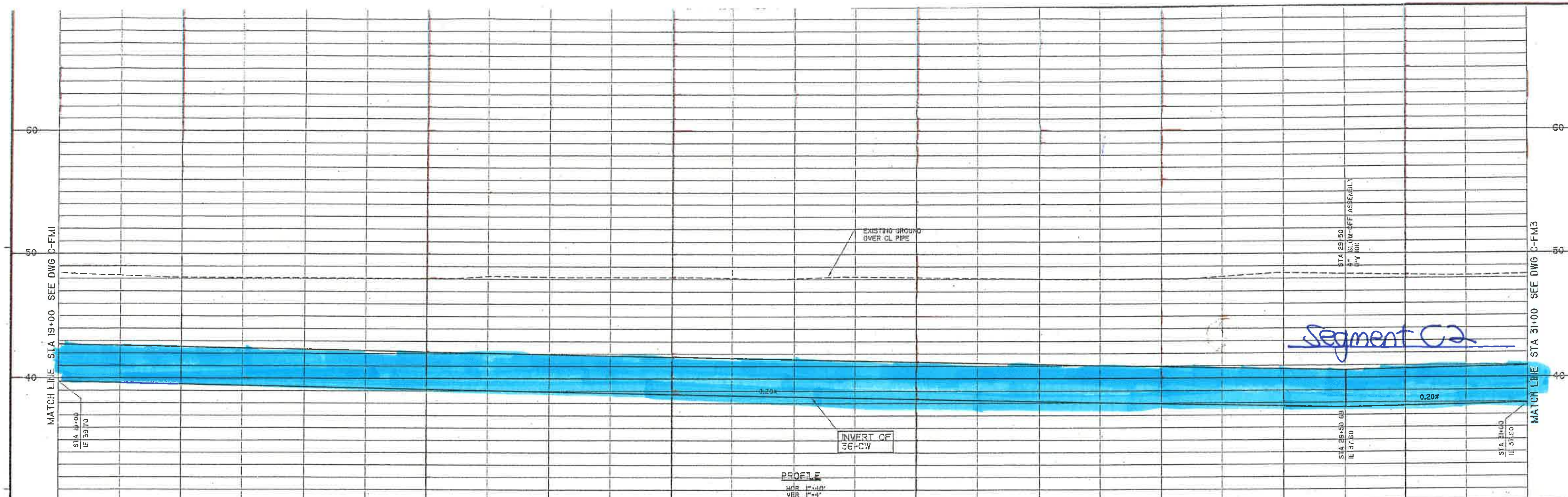
CDM Camp Dresser & McKee
environmental services
One Walnut Center
100 Pringle Avenue, Suite 300
Walnut Creek, CA 94596

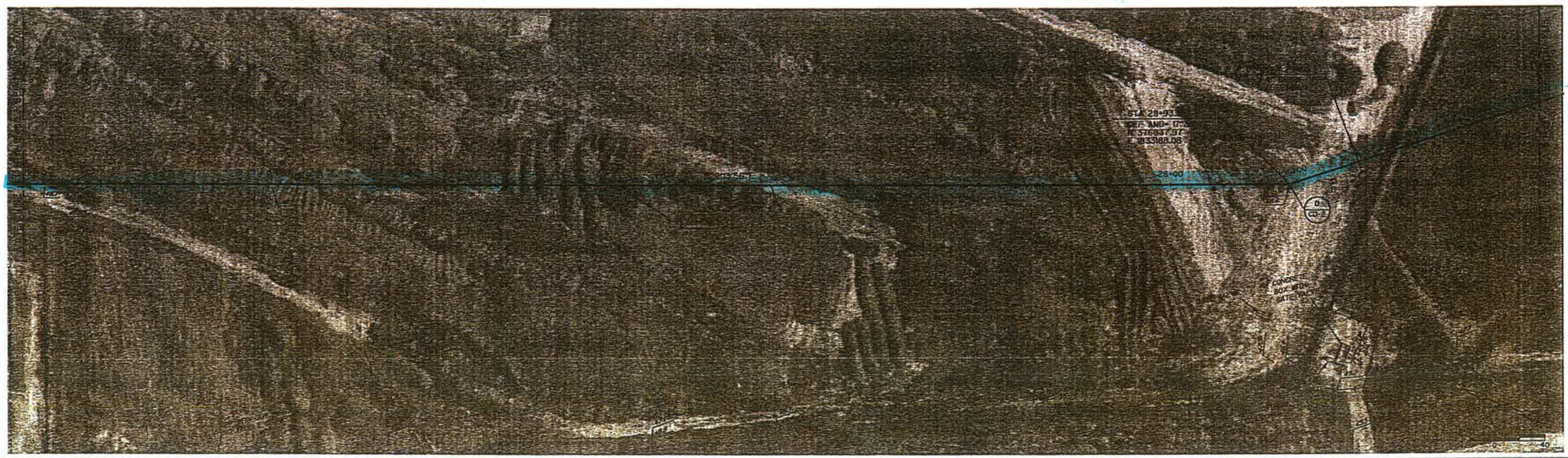
CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

RANCH CANNERY PUMP STATION AND FORCEMAIN

PLAN & PROFILE
36" FORCE MAIN
STA 10+00 TO STA 19+00

PROJECT NO. 8390-22857
FILE NAME: CFMPP001
SHEET NO. C-FM1





REV. NO.	DATE	DRWN	CKKD	REMARKS

DESIGNED BY: RKU
DRAWN BY: RKU
SHEET CHK'D BY: SCW
CROSS CHK'D BY: -
APPROVED BY: -
SUBMITTED BY: -
DATE: JUNE 1998

REGISTERED PROFESSIONAL ENGINEER · SCOTT CLARK GEDDLE · C040851 · Exp. 9-30-00 · CIVIL · STATE OF CALIFORNIA

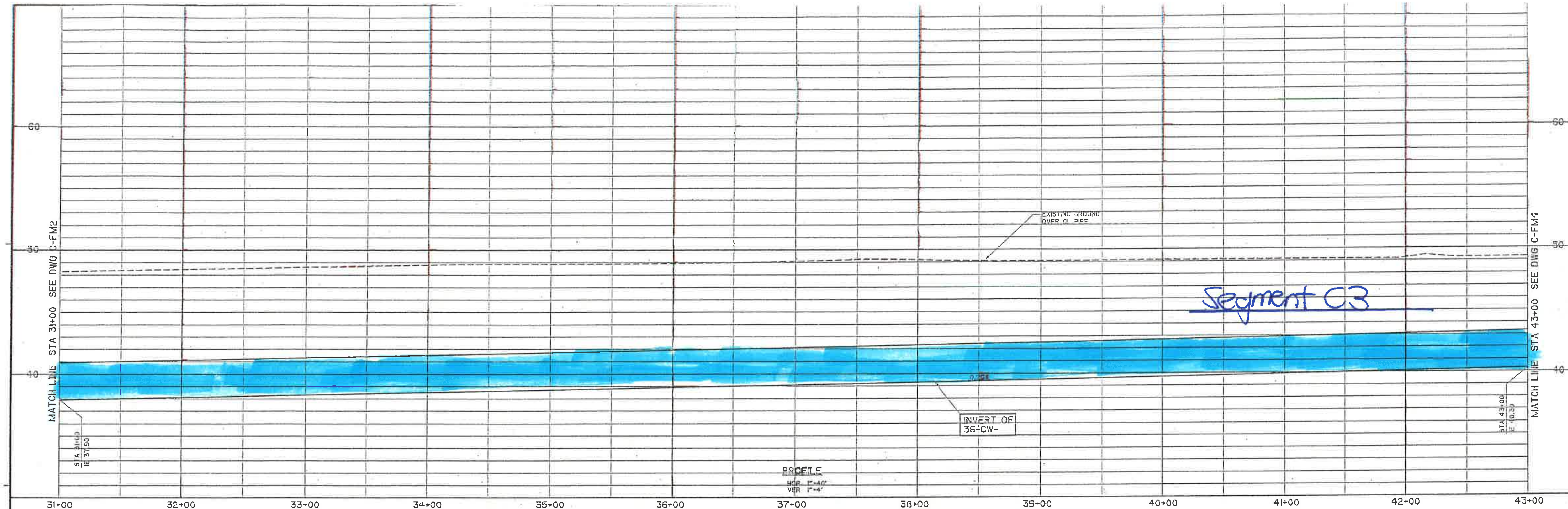
CDM Camp Dresser & McKee
One Walnut Center
100 Pringle Avenue, Suite 300
Walnut Creek, CA 94596

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

RANCH CANNERY PUMP STATION AND FORCEMAIN

PLAN & PROFILE
36" FORCE MAIN
STA 19+00 TO STA 31+00

PROJECT NO. 8390-22857
FILE NAME: CFMPP002
SHEET NO.
C-FM2



[redacted]

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: RKU
DRAWN BY: RKU
SHEET CHK'D BY: SCW
CROSS CHK'D BY: -
APPROVED BY: -
SUBMITTED BY: -
DATE: JUNE 1998

REGISTERED PROFESSIONAL ENGINEER — No. C048351 — Exp. 9-30-00 — CIVIL — STATE OF CALIFORNIA

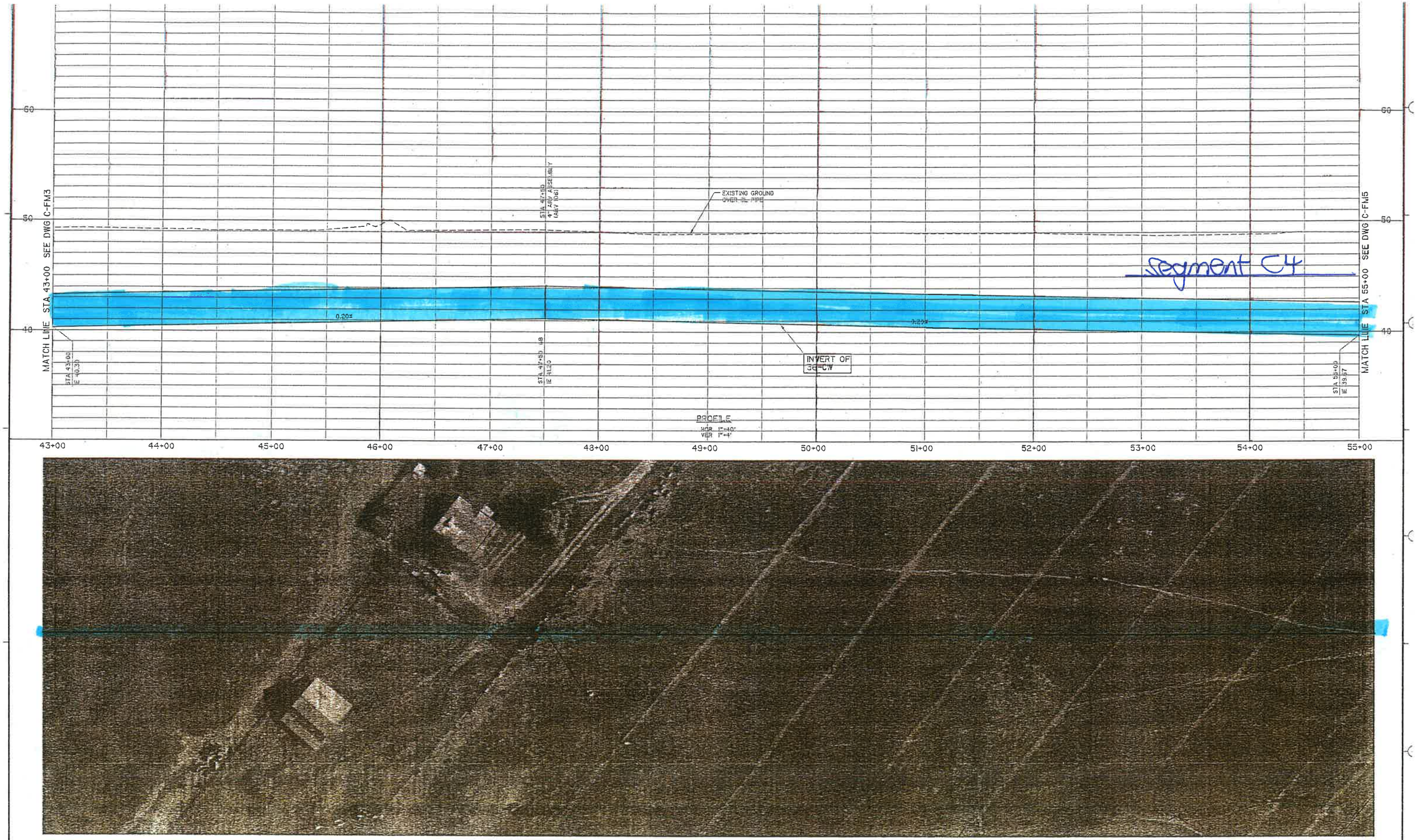
CDM Camp Dresser & McKee
environmental engineers, scientists, planners & management consultants worldwide
One Walnut Center
100 Pringle Avenue, Suite 300
Walnut Creek, CA 94596

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

RANCH CANNERY PUMP STATION AND FORCEMAIN

PLAN & PROFILE
36" FORCE MAIN
STA 31+00 TO STA 43+00

PROJECT NO. 8390-22957
FILE NAME: CFMPP003
SHEET NO.
C-FM3



REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: RKU
DRAWN BY: RKU
SHEET CHK'D BY: SCW
CROSS CHK'D BY: -
APPROVED BY: -
SUBMITTED BY: -
DATE: JUNE 1998

CDM Camp Dresser & McKee
environmental services
office worldwide
One Walnut Center
100 Pringle Avenue, Suite 300
Walnut Creek, CA 94596

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

RANCH CANNERY PUMP STATION AND FORCEMAIN

PLAN & PROFILE
36" FORCE MAIN
STA 43+00 TO STA 55+00

PROJECT NO. 8390-22857
FILE NAME: CFMP904

SHEET NO.
C-FM4

MATCH LINE STA 55+00 SEE DWG C-FM4

EXISTING GROUND OVER CL PIPE

STA 63+18 4'-1" BELOW PT ASSEMBLY @ 2.0%

PROPOSED FINISHED GRADE

Segment C5

-0.20%

FOR CONT SEE DWG C-FM4

INVERT OF 36-CW

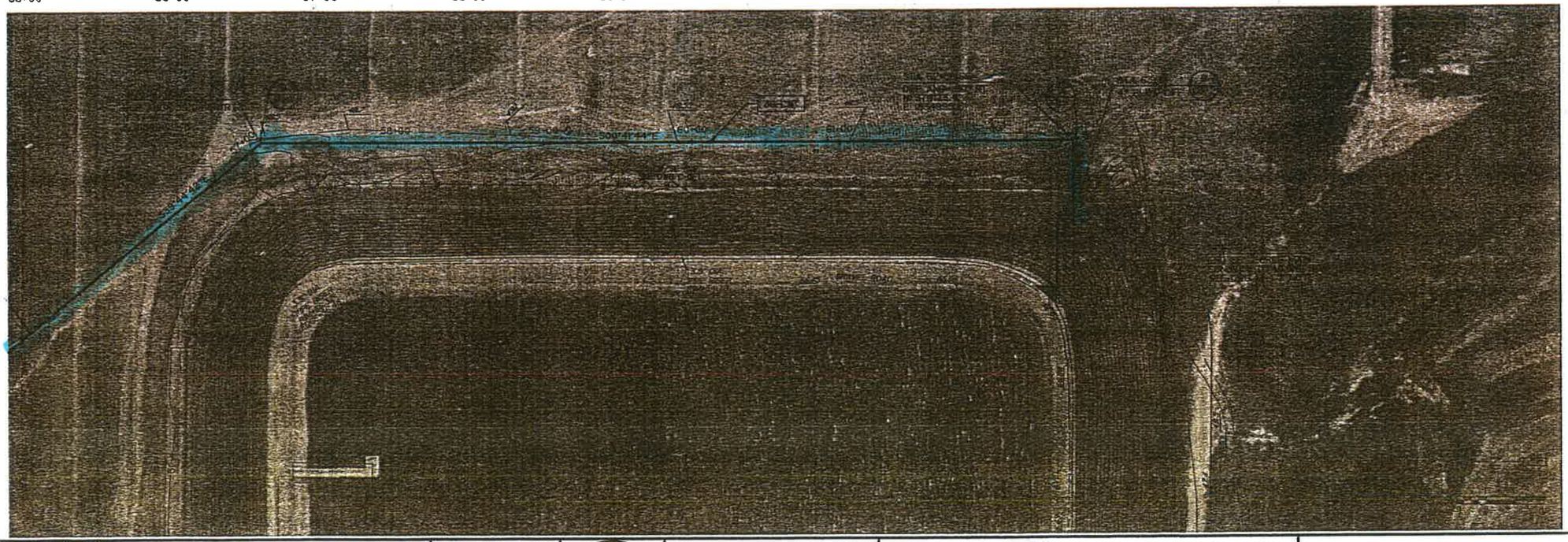
STA 55+00 IE 35.17

STA 63+12.4 IE 38.10

PROFILE
HOR 1"=40'
VER 1"=4'

60 50 40

55+00 56+00 57+00 58+00 59+00 60+00 61+00 62+00 63+00 64+00



NOTES

1. FORCEMAIN STATIONING STOPS AT THE LAST JOINT UPSTREAM FROM THE BOTTOM 45-DEG BEND. JOINTS DOWNSTREAM FROM THIS STATION SHALL BE WELDED.

222

1:23.51

06/16/98 12:43:57

C:\mgp005

D:\modules\

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: RKU
DRAWN BY: RKU
SHEET CHK'D BY: SCW
CROSS CHK'D BY: -
APPROVED BY: -
SUBMITTED BY: -
DATE: JUNE 1998

REGISTERED PROFESSIONAL ENGINEER SCOTT C. WARK No. CO15851 Exp. 3-30-00 CIVIL STATE OF CALIFORNIA

CDM Camp Dresser & McKee
environmental services
offices worldwide
One Walnut Center
100 Pringle Avenue, Suite 300
Walnut Creek, CA 94596

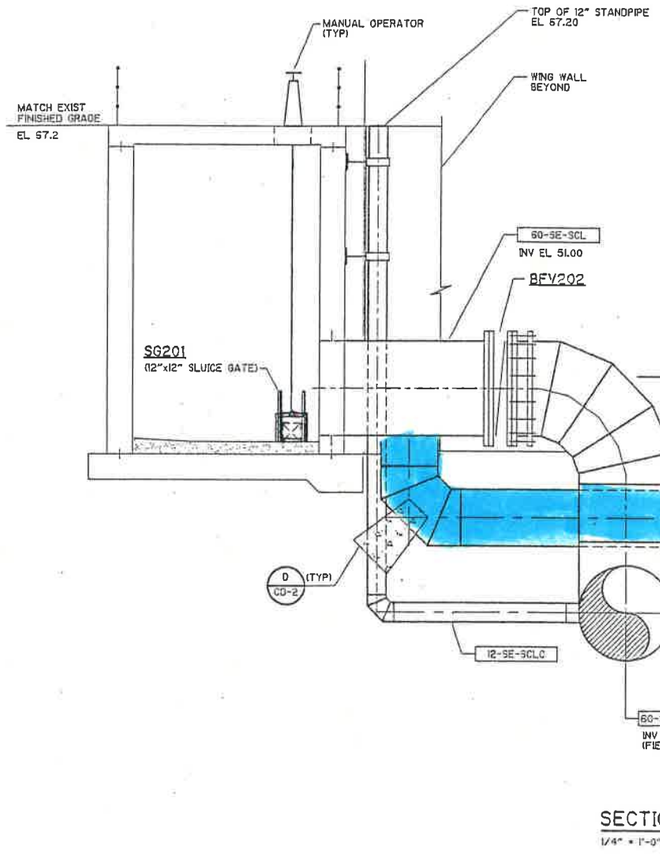
CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

RANCH CANNERY PUMP STATION AND FORCEMAIN

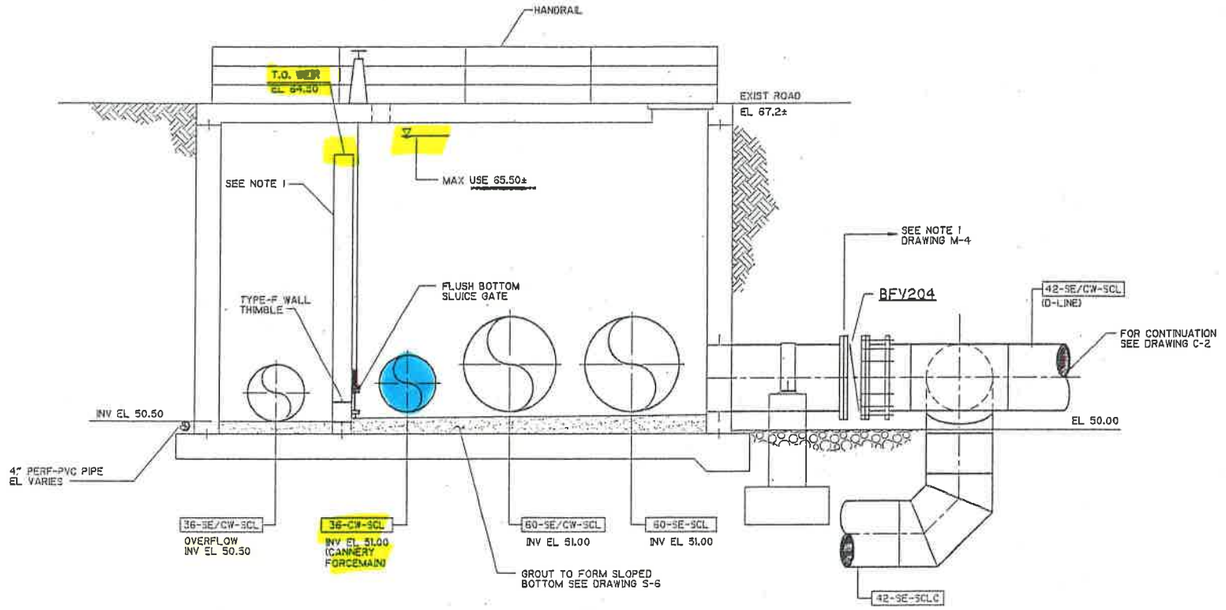
PLAN & PROFILE
36" FORCE MAIN
STA 55+00 TO STA 63+20.87

PROJECT NO. 8390-22957
FILE NAME: CFMPP005

SHEET NO.
C-FM5



SECTION 2
1/4" = 1'-0"
M-4



SECTION 1
1/4" = 1'-0"
M-4

Segment D

NOTES:

1. ALL INTERIOR SURFACES OF THE MIXING BOX AND OVERFLOW CHAMBER SHALL BE EPOXY COATED IN ACCORDANCE WIYH SECTION 09902.

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: SCW
DRAWN BY: MLM
SHEET CHK'D BY: SCW
CROSS CHK'D BY:
APPROVED BY:
SUBMITTED BY:
DATE: JUNE 1998

REGISTERED PROFESSIONAL ENGINEER 046851 EXP. 3-31-00 CIVIL STATE OF CALIFORNIA

CDM Camp Dresser & McKee
environmental services offices worldwide
One Walnut Center
100 Pringle Avenue, Suite 300
Walnut Creek, CA 94596

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

RANCH CANNERY PUMP STATION AND FORCEMAIN

MIXING BOX SECTIONS

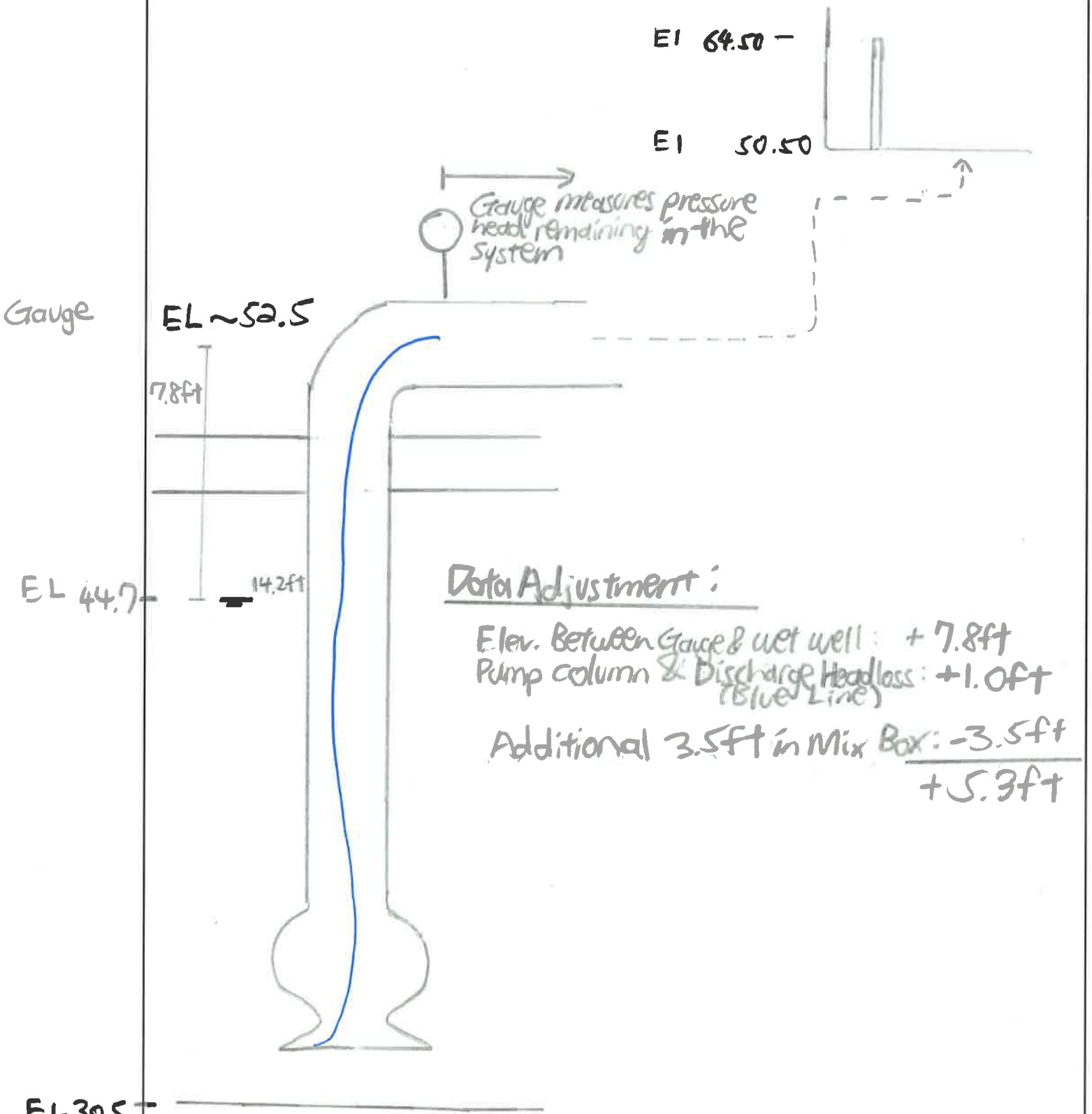
PROJECT NO. 8390-22857
FILE NAME: 8390M-5

SHEET NO.
M-5

C:\ACAD\8390\22857\MECH\
CDM/CADD STE\TWN
17:14:58
06/18/98 09:55:58
8390M-5

carollo
Engineers...Working Wonders With Water™

BY GC DATE 11/26 SUBJECT Can-Seq Pump Data Adjustment Calcs SHEET NO. 1 OF 1
CHKD. BY _____ DATE _____ JOB NO. _____



Data Adjustment:

Elev. Between Gauge & wet well: +7.8ft
Pump column & Discharge Headloss (Blue Line): +1.0ft
Additional 3.5ft in Mix Box: -3.5ft
+5.3ft

City of Modesto
Can-Seg Pump Test
11/16/2012

							Conversions			
# of Pumps	**Hz**	**Wetwell Level (ft)**	**Flow (mgd)**	**Pressure (psi)**	**Mix Box Elevation (SCADA) (ft)**	**Mix Box Elevation (Measured from top) (ft)**	**Flow (GPM)**	**Pressure head (ft)**	**Adjusted Pressure Head (ft)**	**Notes**
1	40	14.3	11.2	5	10	Not Measured	7778	11.55	20.85	(+9.3 ft)
1	40	14.4	10.1	8	14	2.33	7014	18.48	23.78	(+5.3 ft)
1	50	14.3	14.9	10	14	2	10347	23.1	28.4	(+5.3 ft)
1	55	14.3	17.1	11	14	1.88	11875	25.41	30.71	(+5.3 ft)
2	50/40	14.2	21.5	13	14	1.8	14931	30.03	35.33	(+5.3 ft)
2	50/50	14.1	25.4	16/17	14	1.57	17639	38.115	43.415	(+5.3 ft)
2	55/55	14	28.8	19/20	14	1.58	20000	45.045	50.345	(+5.3 ft)

hz of each pump (2 pumps running different pressures)

APPENDIX C – QUOTES AND MANUFACTURER CURVES

JM SQUARED ASSOCIATES, INC.

PUMPING, PROCESS AND FLOW CONTROL PRODUCTS
3975-D INDUSTRIAL WAY • CONCORD, CA 94520
TEL: (925) 798-2500 • FAX: (925) 798-7737

December 20, 2012

Jean Marc Petit
Carollo Engineers, Inc.
2700, Ygnacio Valley Rd., Suite 300
Walnut Creek, CA 945981

Reference: Modesto Cannery Segregation Pumps – VTSH Pump Estimate

Dear Jean Marc,

Per your request JM Squared is pleased to provide the following budget estimate price for complete replacement Fairbanks Morse VTSH pumps at the Modesto Cannery Segregation Pump Station.

Complete Replacement Pumps
Fairbanks Morse 20" LH Vertical Turbine Solids Handling (VTSH) pumps
Rated for 6,000 GPM @ approx. 51' TDH running at 1180 RPM
Reduced speed: approx. 7,000 GPM @ 24' TDH running at 1000 RPM
Cast Iron bowl, inlet bell & impeller, epoxy coated & lined
Steel column & discharge head, epoxy coated & lined
Nitronic 50 line shaft with ceramic coating on bearing surfaces
Stainless steel enclosing tube
Single mechanical seal
Non-witnessed performance testing included
100HP/1200RPM/3Phase/460Volt/TEFC motor
Approx. 15' pump length

Est. Price: Approx. $206,000.00 each (sales tax, installation, VFD's, accessories, etc. not included)
FOB: Kansas City, Kansas
Submittals: Approx. 6-8 weeks after acceptance of order
Delivery: Approx. 20-24 weeks for manufacture after approval

Please let me know if you need additional information.

Sincerely,

Martin Vesely

Pump Data Sheet - Fairbanks Morse Pump, 60 Hz

Company: JM Squared Associates, Inc.
Name: Martin Vesely
Date: 12/20/2012

Modesto Cannery Segregation PS - VTSH at full speed

Fairbanks Morse Pentair

Pump:

Size: 20"VTSH LH

Type: VTSH
Synch speed: 1200 rpm

Speed: 1180 rpm
Dia: 13 in

Curve:

Impeller: V20D1A

Specific Speeds:

Ns: 5526
Nss: 8131

Dimensions:

Suction: ---
Discharge: 20 in

Pump Limits:

Temperature: 160 °F
Pressure: ---
Sphere size: 5.25 in

Power: ---
Eye area: ---

Search Criteria:

Flow: 6000 US gpm

Head: 51 ft

Fluid:

Water
Density: 62.37 lb/ft³
Viscosity: 1.105 cP

Temperature: 60 °F
Vapor pressure: 0.2563 psi a
Atm pressure: 14.7 psi a

NPSHa: ---

Motor:

Standard: NEMA
Enclosure: TEFC

Size: 100 hp
Speed: 1200
Frame: 444T

Sizing criteria: Max Power on Design Curve

---- Data Point ----

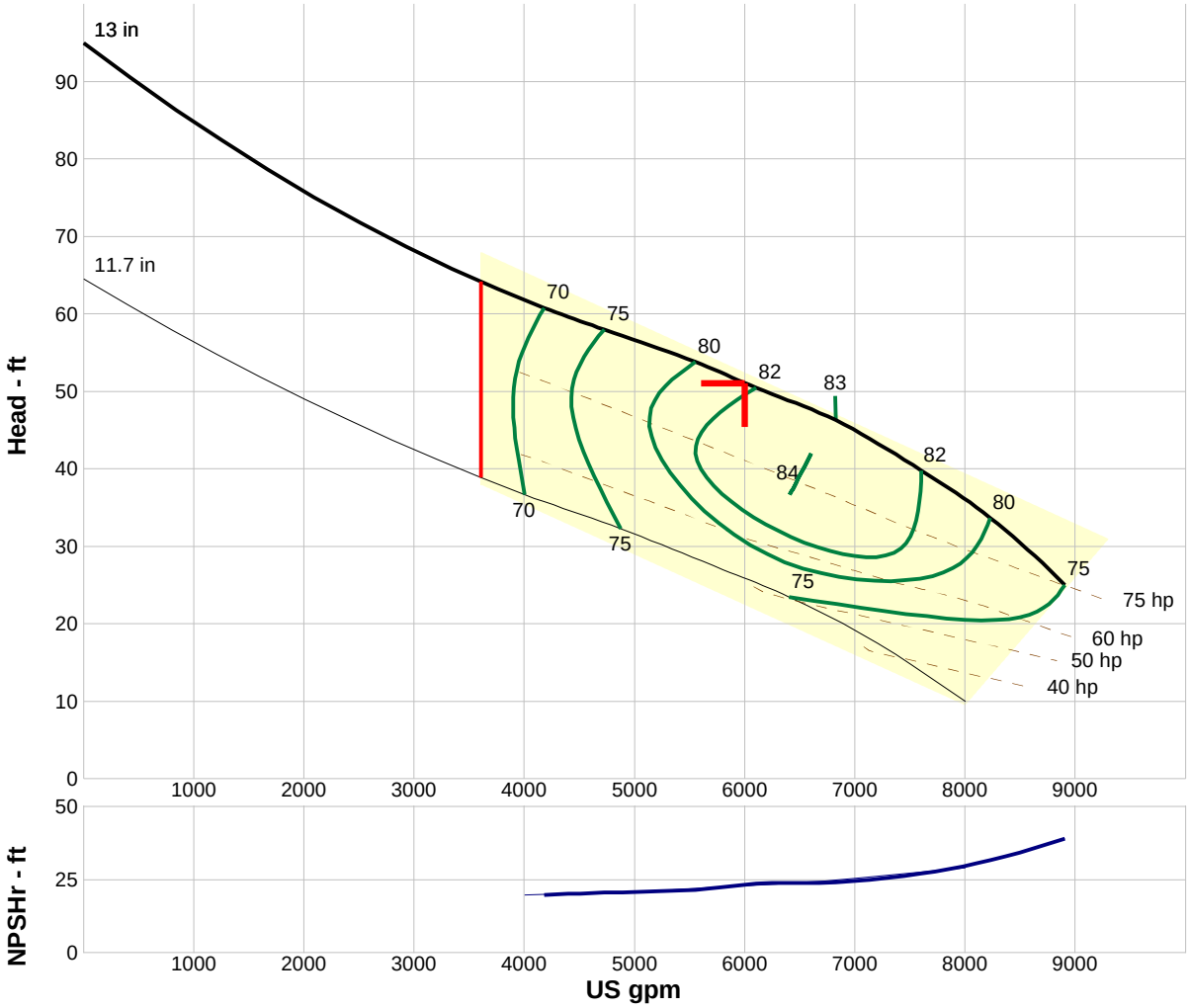
Flow:	6000 US gpm
Head:	51.1 ft
Eff:	82%
Power:	94.9 hp
NPSHr:	23.1 ft

---- Design Curve ----

Shutoff head:	95 ft
Shutoff dP:	41.1 psi
Min flow:	3600 US gpm
BEP:	83% @ 6820 US gpm
NOL power:	96.3 hp @ 6820 US gpm

-- Max Curve --

Max power: 96.3 hp @ 6820 US gpm



Curve efficiencies are typical. For guaranteed values, contact Fairbanks Morse or your local distributor. Las eficiencias en curvas son típicas. Para valores garantizados contacte a Fairbanks Morse o a su distribuidor local.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
7200	1180	43.1	83	94.8	25.5
6000	1180	51.1	82	94.9	23.1
4800	1180	57.6	75	92.6	20.6
3600	1180	65.5	65	91.1	19.1
2400	1180	---	---	---	---

Pump Data Sheet - Fairbanks Morse Pump, 60 Hz

Company: JM Squared Associates, Inc.
Name: Martin Vesely
Date: 12/20/2012

Modesto Cannery Segregation PS - VTSH at reduced speed

Fairbanks Morse Pentair

Pump:

Size: 20"VTSH LH

Type: VTSH
Synch speed: 1200 rpm

Speed: 1000 rpm
Dia: 13 in

Curve:

Impeller: V20D1A

Specific Speeds:

Ns: 5526
Nss: 8131

Dimensions:

Suction: ---
Discharge: 20 in

Pump Limits:

Temperature: 160 °F
Pressure: ---
Sphere size: 5.25 in

Power: ---
Eye area: ---

Search Criteria:

Flow: 6000 US gpm

Head: 51 ft

Fluid:

Water
Density: 62.37 lb/ft³
Viscosity: 1.105 cP

Temperature: 60 °F
Vapor pressure: 0.2563 psi a
Atm pressure: 14.7 psi a

NPSHa: ---

Motor:

Standard: NEMA
Enclosure: TEFC

Size: 60 hp
Speed: 1200
Frame: 404T

Sizing criteria: Max Power on Design Curve

---- Data Point ----

Flow:	7000 US gpm
Head:	23.9 ft
Eff:	80%
Power:	53 hp
NPSHr:	24.5 ft

---- Design Curve ----

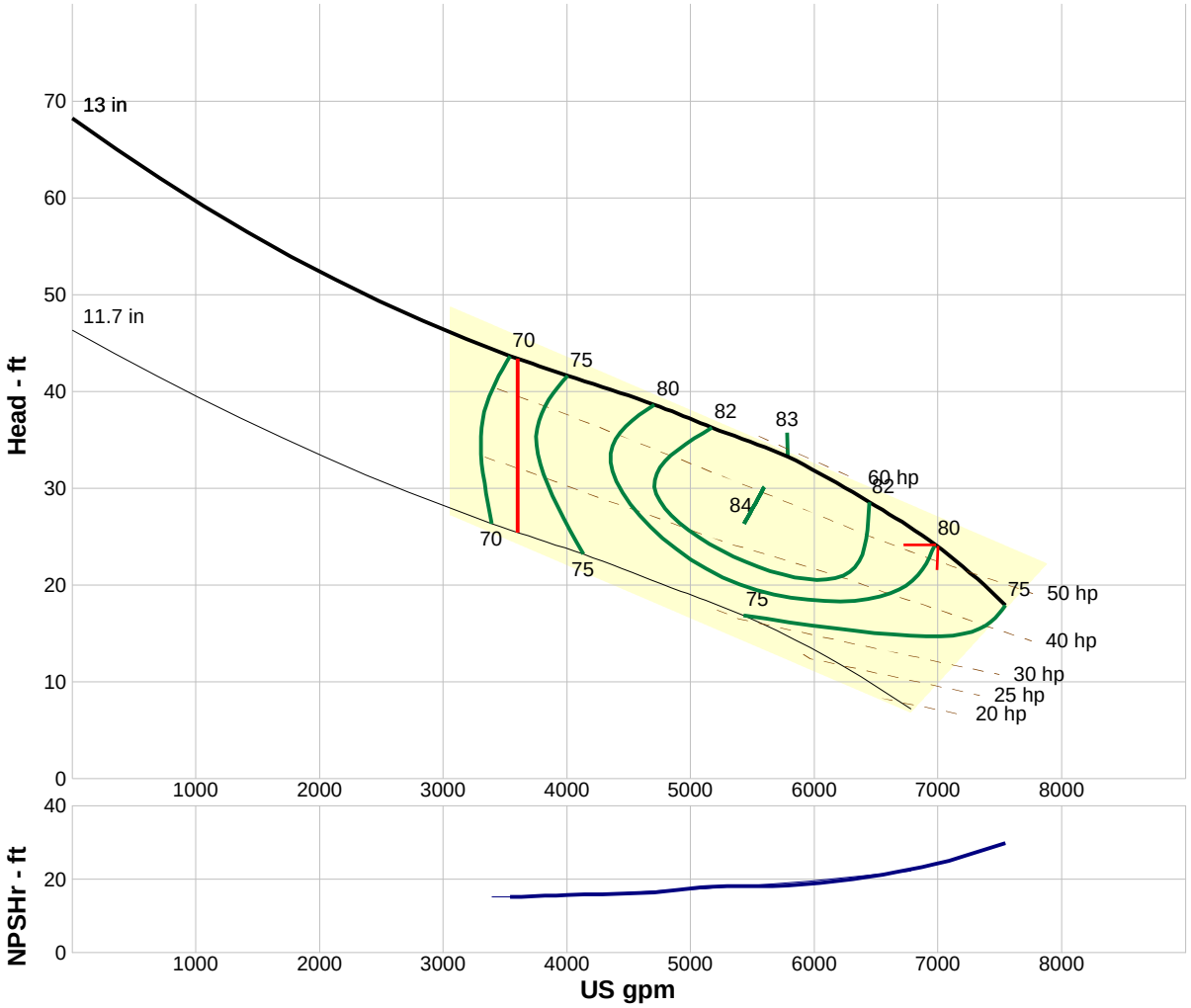
Shutoff head:	68.2 ft
Shutoff dP:	29.6 psi
Min flow:	3600 US gpm

BEP: 83% @ 5780 US gpm

NOL power:
58.6 hp @ 5780 US gpm

-- Max Curve --

Max power:
58.6 hp @ 5780 US gpm



Curve efficiencies are typical. For guaranteed values, contact Fairbanks Morse or your local distributor. Las eficiencias en curvas son típicas. Para valores garantizados contacte a Fairbanks Morse o a su distribuidor local.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
7200	1000	21.7	78	50.3	26.5
6000	1000	31.7	83	58	19.2
4800	1000	38.1	80	57.6	16.8
3600	1000	43.4	71	55.9	15.3
2400	1000	---	---	---	---

Selected from catalog: Fairbanks Morse Centrifugal.60 Vers: 3.3

Pump Data Sheet - Fairbanks Morse Pump, 60Hz

ompany: JM Squared Associates, Inc.
ame: Martin Vesely
ate: 1/28/2013

Modesto Cannery Segregation PS - 1 pump running (6 MGD @ 20' TDH)

PENTAIR

FAIRBANKS NIJHUIS

ump:

Size: 12"-8512 (1 stage)

Type: Propeller/Mixed Flow
Synch speed: 1800 rpm

Speed: 1260 rpm
Dia: 11.5 in

Curve:

Impeller: 12LM7B

Specific Speeds:

Ns: ---
Nss: ---

Dimensions:

Suction: ---
Discharge: ---

Vertical Turbine:

Bowl size: ---
Max lateral: ---
Thrust K factor: 33.1 lb/ft

ump Limits:

Temperature: ---
Pressure: ---
Sphere size: 0.9 in

Power: ---
Eye area: ---

Search Criteria:

Flow: 5800 US gpm

Head: 40 ft

Fluid:

Water
Density: 62.37 lb/ft³
Viscosity: 1.105 cP

Temperature: 60 °F
Vapor pressure: 0.2563 psi a
Atm pressure: 14.7 psi a

NPSHa: ---

Motor:

Standard: NEMA
Enclosure: TEFC

Size: 40 hp
Speed: 1800
Frame: 324T

Sizing criteria: Max Power on Design Curve

--- Data Point ---

Flow:	4200 US gpm
Head:	19.7 ft
Eff:	74.8%
Power:	28 hp
NPSHr:	28.2 ft

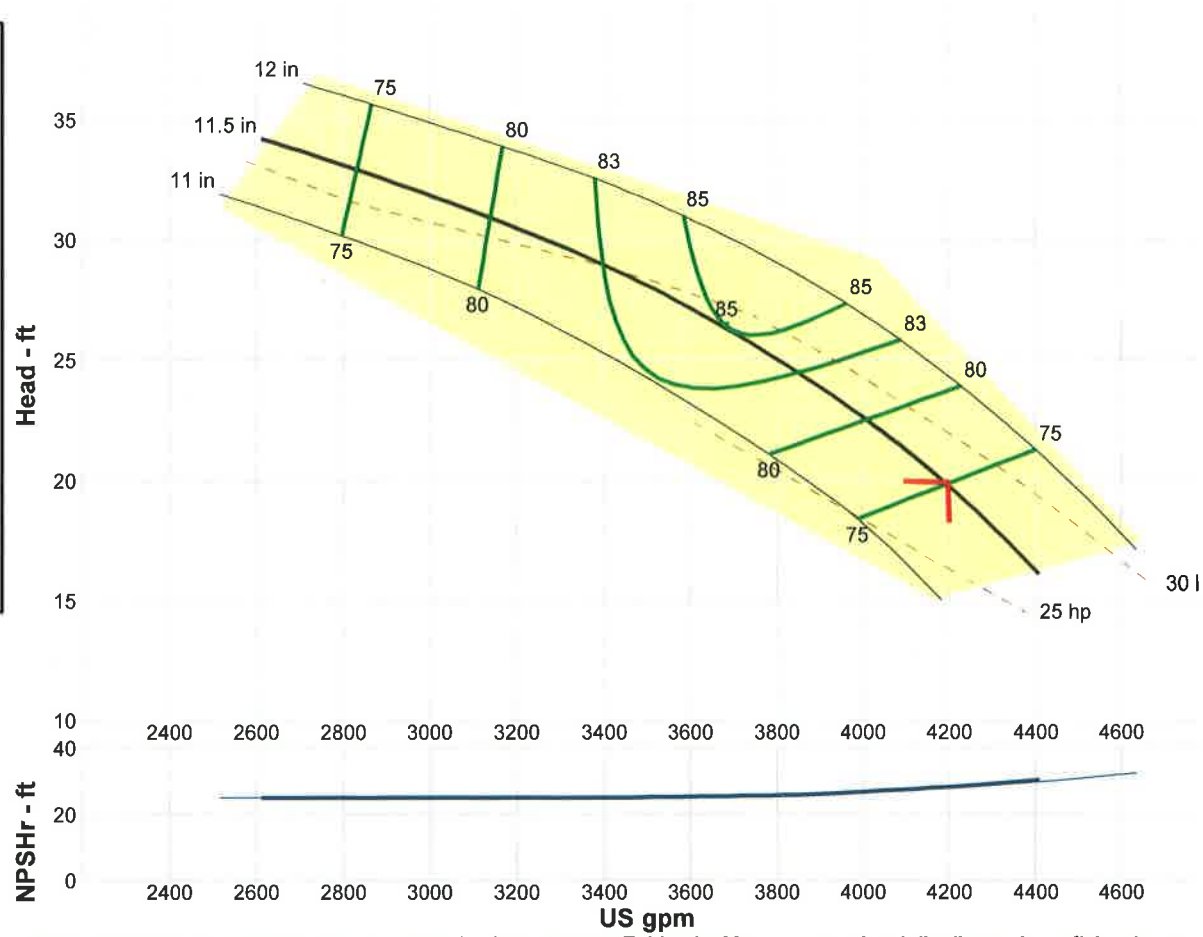
--- Design Curve ---

Shutoff head:	56.4 ft
Shutoff dP:	24.4 psi
Min flow:	---
BEP:	85% @ 3686 US gpm

NOL power:
31.4 hp @ 2830 US gpm

-- Max Curve --

Max power:
34.5 hp @ 2865 US gpm



Curve efficiencies are typical. For guaranteed values, contact Fairbanks Morse or your local distributor. Las eficiencias en curvas son típicas. Para valores garantizados contacte a Fairbanks Morse o a su distribuidor local.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
6960	1260	---	---	---	---
5800	1260	---	---	---	---
4640	1260	---	---	---	---
3480	1260	28.2	83.6	29.7	25.1
2320	1260	---	---	---	---

Pump Data Sheet - Fairbanks Morse Pump, 60Hz

Company: JM Squared Associates, Inc.
Name: Martin Vesely
Date: 1/28/2013

Modesto Cannery Segregation PS - 2 pumps running (12 MGD @ 24' TDH)

PENTAIR

FAIRBANKS NIJHUIS

Pump:

Size: 12"-8512 (1 stage)

Type: Propeller/Mixed Flow
Synch speed: 1800 rpm

Speed: 1310 rpm
Dia: 11.5 in

Curve:

Impeller: 12LM7B

Specific Speeds:

Ns: ---
Nss: ---

Dimensions:

Suction: ---
Discharge: ---

Vertical Turbine:

Bowl size: ---
Max lateral: ---
Thrust K factor: 33.1 lb/ft

Pump Limits:

Temperature: ---
Pressure: ---
Sphere size: 0.9 in

Power: ---
Eye area: ---

Search Criteria:

Flow: 5800 US gpm

Head: 40 ft

Fluid:

Water
Density: 62.37 lb/ft³
Viscosity: 1.105 cP

Temperature: 60 °F
Vapor pressure: 0.2563 psi a
Atm pressure: 14.7 psi a

NPSHa: ---

Motor:

Standard: NEMA
Enclosure: TEFC

Size: 40 hp
Speed: 1800
Frame: 324T

Sizing criteria: Max Power on Design Curve

— Data Point —

Flow:	4200 US gpm
Head:	23.9 ft
Eff:	79.2%
Power:	32 hp
NPSHr:	28.8 ft

— Design Curve —

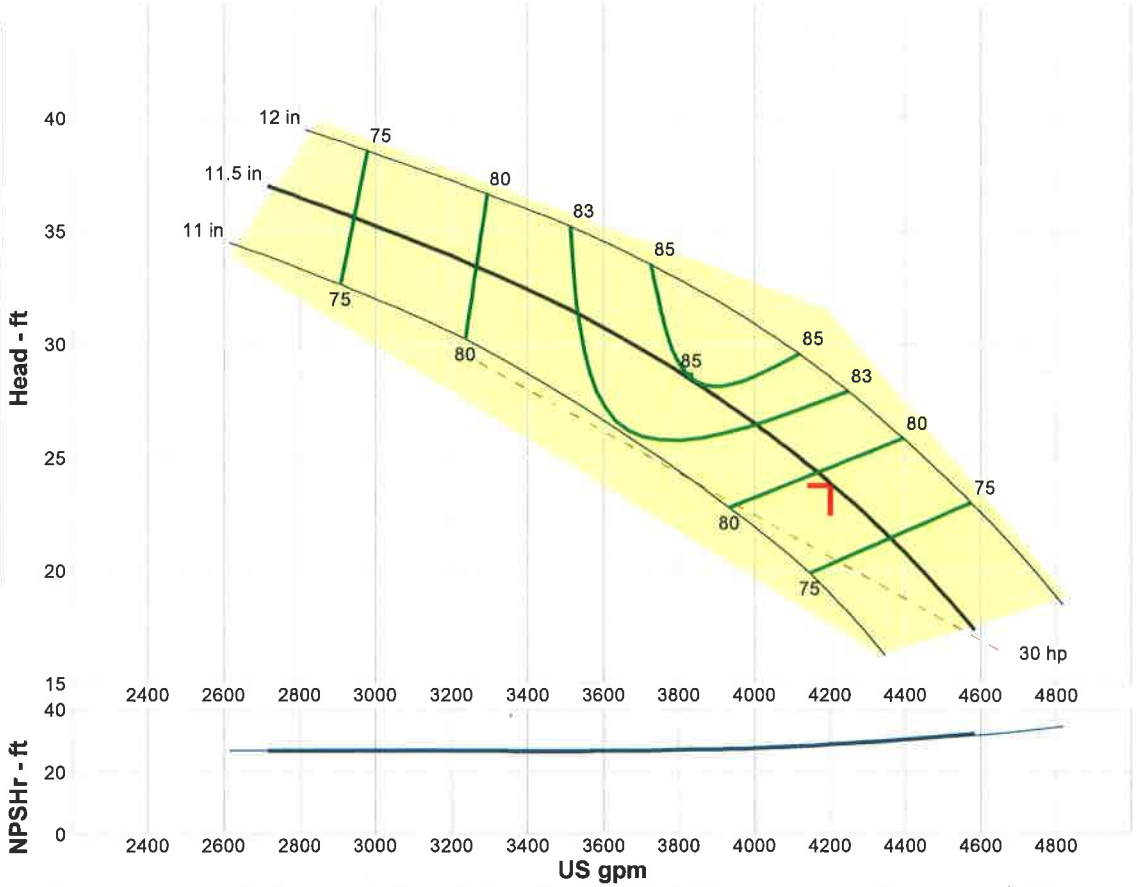
Shutoff head:	61 ft
Shutoff dP:	26.4 psi
Min flow:	---

BEP: 85% @ 3832 US gpm

NOL power:
35.3 hp @ 2942 US gpm

— Max Curve —

Max power:
38.7 hp @ 2978 US gpm



Curve efficiencies are typical. For guaranteed values, contact Fairbanks Morse or your local distributor. Las eficiencias en curvas son típicas. Para valores garantizados contacte a Fairbanks Morse o a su distribuidor local.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
6960	1310	---	---	---	---
5800	1310	---	---	---	---
4640	1310	---	---	---	---
3480	1310	31.7	82.4	33.9	26.6
2320	1310	---	---	---	---

Selected from catalog: Fairbanks Morse Propeller-MixedFlow.60 Vers: 1

Pump Data Sheet - Fairbanks Morse Pump, 60Hz

Company: JM Squared Associates, Inc.
Name: Martin Vesely
Date: 1/28/2013

Modesto Cannery Segregation PS - 3 pumps running (25 MGD @ 40' TDH)

PENTAIR

FAIRBANKS NIJHUIS

Pump:

Size: 12"-8512 (1 stage)

Type: Propeller/Mixed Flow
Synch speed: 1800 rpm

Speed: 1770 rpm
Dia: 11.5 in

Curve:

Impeller: 12LM7B

Specific Speeds:

Ns: ---
Nss: ---

Dimensions:

Suction: --
Discharge: ---

Vertical Turbine:

Bowl size: --
Max lateral: --
Thrust K factor: 33.1 lb/ft

Pump Limits:

Temperature: ---
Pressure: ---
Sphere size: 0.9 in

Power: ---
Eye area: ---

Search Criteria:

Flow: 5800 US gpm

Head: 40 ft

Fluid:

Water
Density: 62.37 lb/ft³
Viscosity: 1.105 cP

Temperature: 60 °F
Vapor pressure: 0.2563 psi a
Atm pressure: 14.7 psi a

NPSHa: ---

Motor:

Standard: NEMA
Enclosure: TEFC

Size: 100 hp
Speed: 1800
Frame: 405T

Sizing criteria: Max Power on Design Curve

--- Data Point ---

Flow:	5800 US gpm
Head:	41 ft
Eff:	76.8%
Power:	78.3 hp
NPSHr:	47.7 ft

--- Design Curve ---

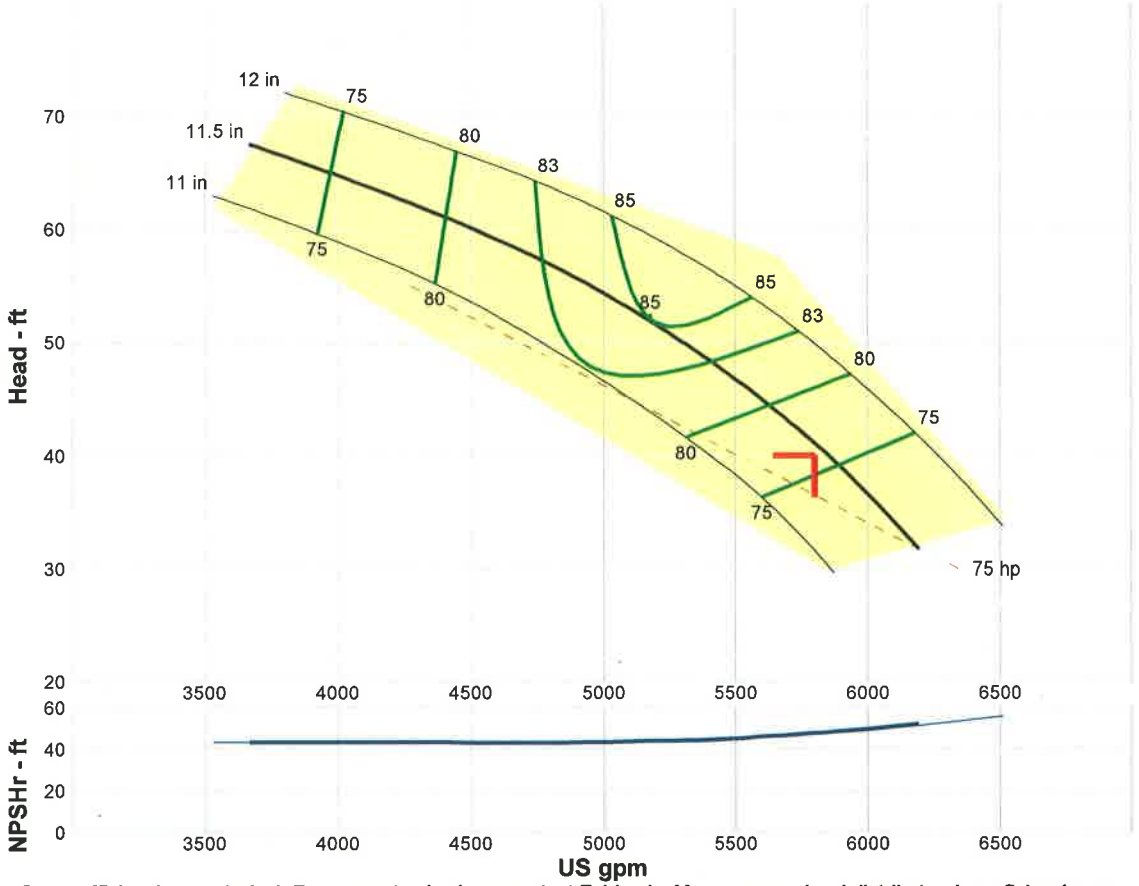
Shutoff head:	111 ft
Shutoff dP:	48.2 psi
Min flow:	---

BEP: 85% @ 5178 US gpm

NOL power:
87.2 hp @ 3976 US gpm

-- Max Curve --

Max power:
95.6 hp @ 4024 US gpm



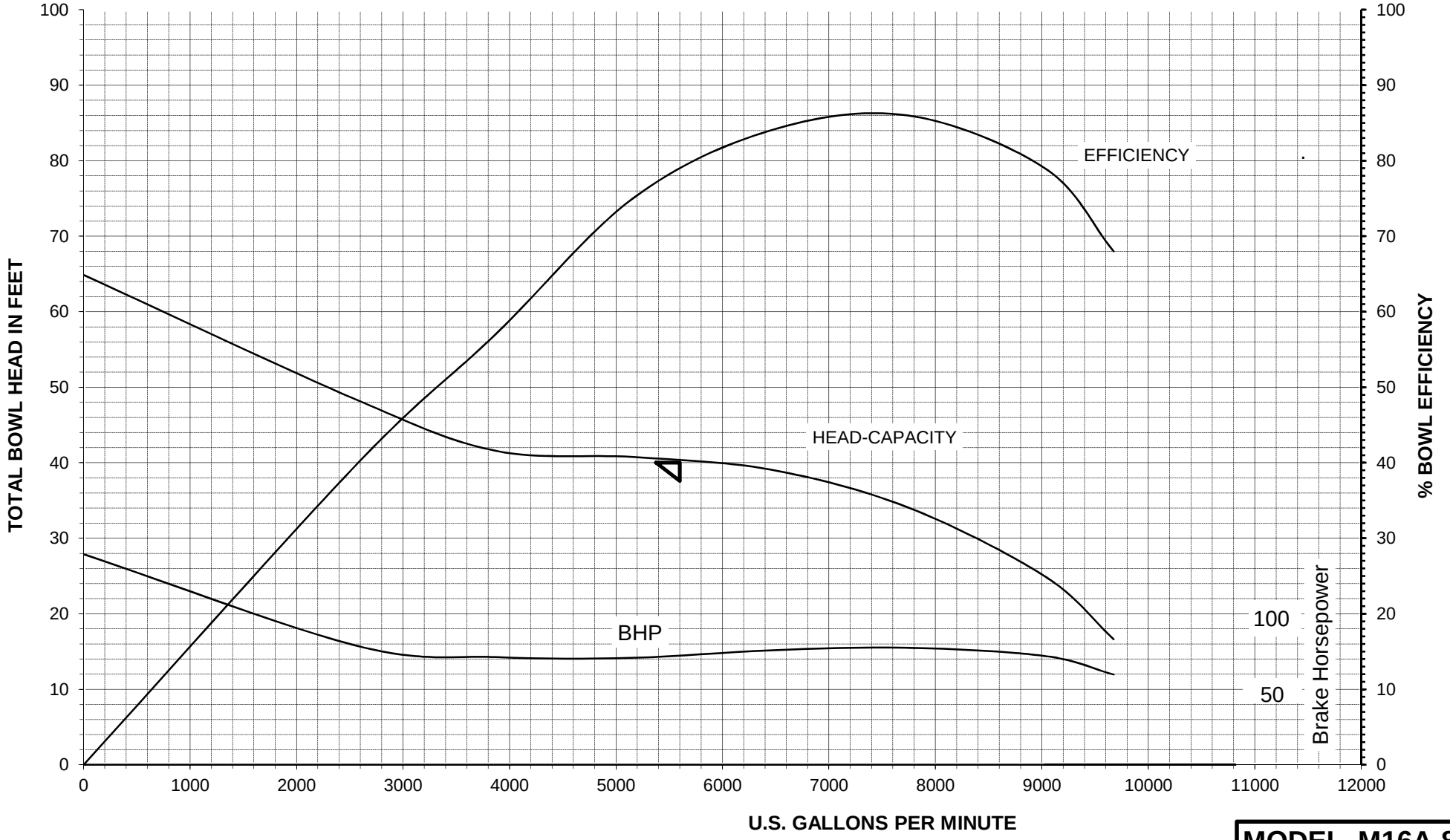
Curve efficiencies are typical. For guaranteed values, contact Fairbanks Morse or your local distributor. Las eficiencias en curvas son típicas. Para valores garantizados contacte a Fairbanks Morse o a su distribuidor local.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
6960	1770	---	---	---	---
5800	1770	41	76.8	78.3	47.7
4640	1770	58.6	81.9	83.9	43.1
3480	1770	---	---	---	---
2320	1770	---	---	---	---

Selected from catalog: Fairbanks Morse Propeller-MixedFlow.60 Vers: 1

PRIME PUMP COMPANY
M16A-8 deg
5600 GPM @ 40 ft., 1135 RPM
Min. Submergence Req'd.: 7 ft.
Imp. Dia.: 16"



MODEL M16A-8

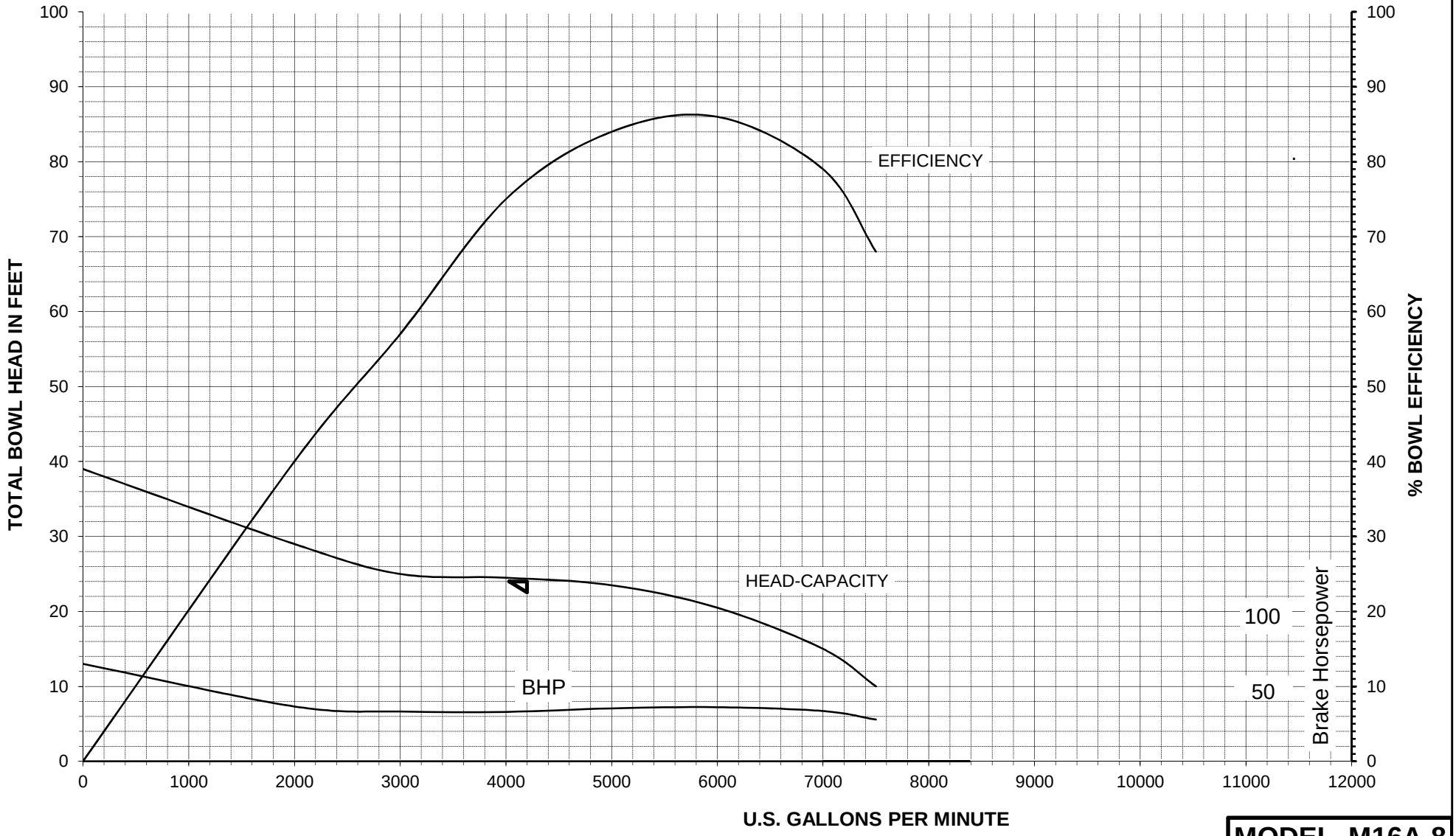
PRIME PUMP COMPANY

M16A-8 deg

4200 GPM @ 24 ft., 880 RPM

Min. Submergence Req'd.: 7 ft.

Imp. Dia.: 16"



MODEL M16A-8

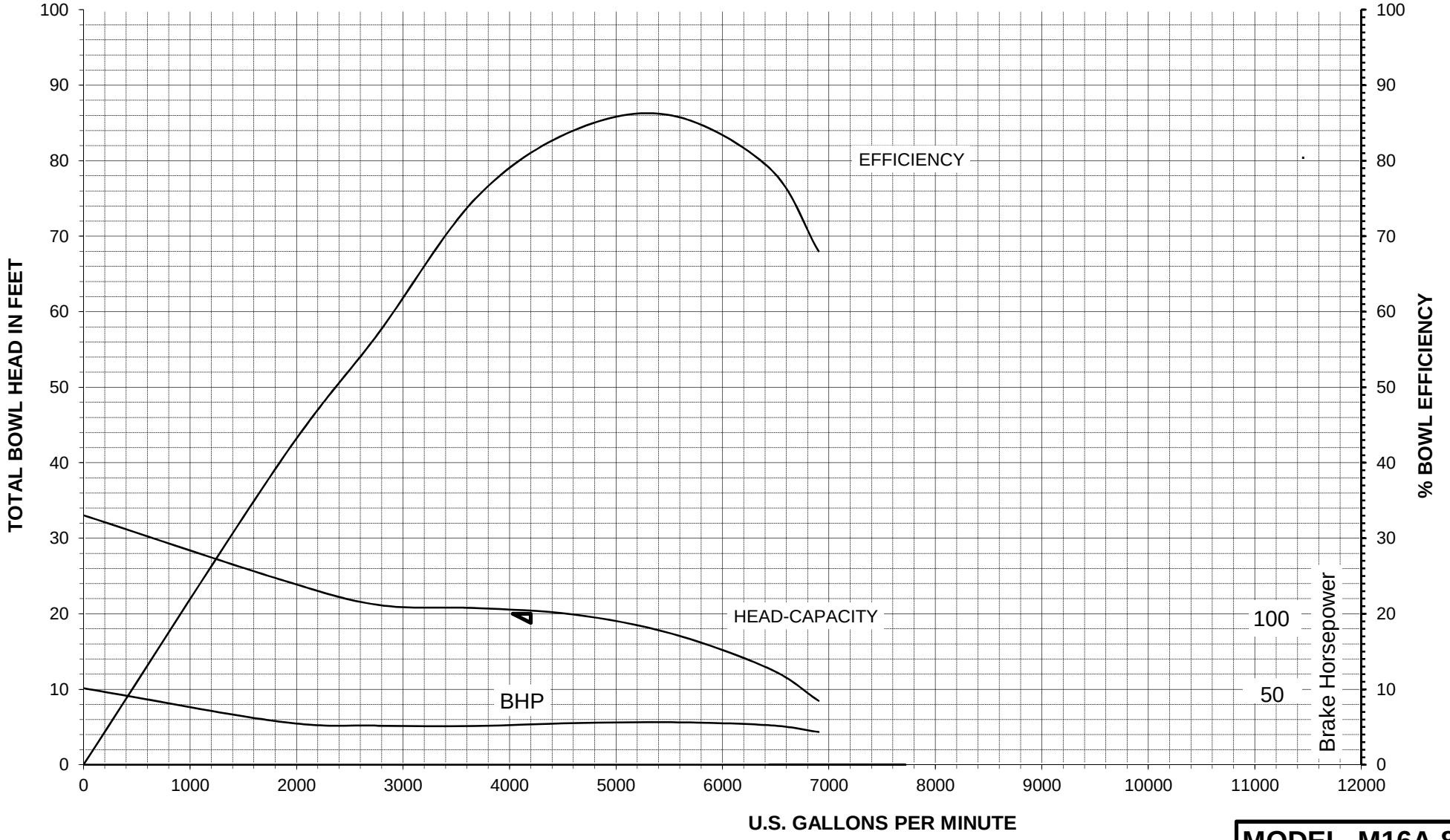
PRIME PUMP COMPANY

M16A-8 deg

4200 GPM @ 20 ft., 810 RPM

Min. Submergence Req'd.: 7 ft.

Imp. Dia.: 16"



MODEL M16A-8