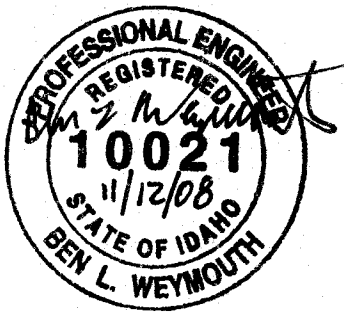
BCS-W-08-01

WATER ENGINEERING REPORT

For

BAR CIRCLE S. WATER SYSTEM
DOUBLE T ESTATES EXPANSION

KOOTENAI COUNTY, IDAHO



PREPARED FOR:

Bar Circle S Water Company
Mr. Robert Turnipseed

November 2008

PREPARED BY:

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BACKGROUND

The purpose of this report is twofold: first, it is a detailed system report that defines the current Bar Circle Water System capabilities; second, it provides details for system expansion to serve the proposed Diamond T Estates Development. A vicinity map is included in Appendix A. The proposed development will add 46 lots and increase proposed build-out to approximately 258 Equivalent Residential Units (ERU). The existing system has 154 active ERU, with 58 additional connections available.

The following sources were used to develop this report and the associated hydraulic model:

- This report replaces the "Water Engineering Report for Bar Circle S Water System, Double T Estates Expansion" prepared by Ben L. Weymouth, P.E., dated September 9, 2008.
- "Bar Circle S Water System, Water Master Plan" prepared by Jeffery D. Block, P.E., and dated August 2002.
- Monthly individual service meter readings from March 2006 to September 2008.
- Monthly production well meter readings from March 2006 to September 2008.
- Other information provided by system owner.

The current system consists of a 6-inch and a 16-inch groundwater wells, a 185,000 gallon reservoir, (4) 10 hp booster pumps and a 110 hp fire pump. Water distribution lines are currently in place to serve the Bar Circle S Developments.

A hydraulic model was used to design the new system and verify compliance with *Idaho Rules for Public Drinking Water Systems* (IDAPA58.01.08), Idaho Department of Environmental Quality (DEQ) Checklists and Design File Notes, 10-State Standards, and the requirements of the Northern Lakes Fire Protection District. The model results and the resulting system design requirements are summarized in this report.

SYSTEM OWNERSHIP

Bar Circle S Water Co. owns the existing system and Bar Circle S Water Co. will also own the proposed system expansion. The system is and will continue to be operated by Bar Circle S Water Company.

Contact: Robert Turnipseed (licensed system operator)
Bar Circle S Water Company
P.O. Box 1870
Hayden, Idaho 83835

EXISTING SYSTEM COMPONENTS

The existing supply system consists of the following components:

1. Well # 1, 16-inch minimum capacity of 483 gpm @ approx. 340 feet of head
2. Well # 2, 6-inch, minimum capacity of 55 gpm @ 170 feet of head
3. A 185,000 gallon ground-level tank (30-ft dia x 35-ft tall)
4. Three 119 gallon hydropneumatic tanks in parallel
5. Four booster pumps in parallel, minimum capacity of 180 gpm @ 170 feet of head each
6. One fire pump, minimum capacity of 1,500 gpm @ 175 feet of head
7. Backup power generator for well # 2, booster pumps, and fire pump
8. The distribution network is 4" to 12" pipe (PVC with some ductile and steel)

Tank levels control the well pumps, and system pressures control the booster pumps. Transducers located at the hydropneumatic tanks monitor the system pressures. Flow to the hydropneumatic tanks is throttled to provide additional pump run time. A summary of control settings and pump curves provided by the system operator are included in Appendix B.

PROPOSED SYSTEM EXPANSION

The existing system will be extended north to Chilco Road to serve the proposed Double T Estates. See Appendix A for a vicinity map. Phase 1 of Double T Estates will include 16 lots along Ramsey and Chilco Roads. These 16 lots represent a 7.6% increase in the number of ERUs, a 21% increase in the length of water main, and no change in unit water demands. Build-out of Double T Estates will total 46 lots (22% increase), and the length of new water main will exceed a 25% increase, and no change in unit water demands.

WATER DEMAND

The existing system provides service to the Bar Circle S Development, Country Estates Development, and Ranch Aero Development. There are 154 existing ERU connections with an additional approved 58 connections. The "existing system" is defined as all existing and approved connections, which total 212 ERU. Double T Estates Phase 1 would add 16 ERU (system total = 228 ERU) and Phase 2 would add another 30 ERU (system total = 258 ERU).

All lots in the system are and will continue to be metered. The system owner provided monthly individual service and production well meter readings from March 2006 to September 2008. A summary of the data is included in Appendix C. This data was used to determine the average day and maximum day demands. A peaking factor of 1.5 times the maximum day was used to calculate the peak hour demand.

The Northern Lakes Fire Protection District has stated that a fire flow of 1,000 gpm for a two (2) hour duration will be required for residential development, and 1,500 gpm for a two (2) hour duration will be required for commercial development.

In summary, the demands used for modeling and design purposes are:

		System gpm			
Scenario	**gpd/ERU**	**gpm/ERU**	**Existing (212 ERU)**	**Double T Phase 1 (228 ERU)**	**Double T Phase 2 (258 ERU)**
Average Day	993.60	0.69	146.28	157.32	178.02
Maximum Day	3189.05	2.21	468.52	503.88	570.18
Peak Hour (PF = 1.5)		3.32	702.78	755.82	855.27
Fire Flow, Residential	1,000 gpm for two hours				
Fire Flow, Commercial	1,500 gpm for two hours				

Individual service meter use was checked against well flow data. The amount of water unaccounted for has decreased each year for the last three years, and was significantly less in 2008. The 2008 data (January to September) shows a difference of 2,760,410 gallons. This equates to 7 gpm, which can easily be attributed to small system leaks, inaccurate readings, or use of fire hydrants. Hydrant locks were also installed on the system in 2007, which has virtually eliminated water theft.

It should also be noted that the unit flow rates are much more than is typical for a residential unit. The higher flows are due to irrigation, which is substantial since the majority of the lots are 5 acres. This is reflected in the individual meter data, which show approximately 10% of summer flow for the winter months. Implementation of alternate day sprinkling is highly recommended.

SOURCE CAPACITY

Well #1 is currently a 16-inch well with a 60-hp pump tested at 483 gpm. Well #2 is a 6-inch well with a 5-hp pump capable of discharging 55 gpm. The minimum combined source capacity is 538 gpm. Source capacity is less than peak hour flow rates at build out. Both of these wells are part of the existing water system, and discharge directly to the 185,000-gallon storage tank.

Flow testing for the existing system pumps was completed on October 17, 2008. This testing was coordinated and observed by Ben Weymouth, P.E., with Toothman-Orton Engineering Co. Flow test results are included in Appendix D. Tank levels were monitored for a measured time period to verify the flow rate for Well # 1. All other pumps were manually turned off for this test. Two different tests were run, and the calculated flows were 348 gpm and 483 gpm. The flow tests were ran for 4.25 and 7 minutes respectively before the booster pumps were turned on to maintain system pressures, so this data is subject to error given the large tank cross-section of 5,287 gallons per foot. The flow meter at the well was also monitored, and showed 400 gpm for the first test and 350 gpm for the second test. The meter has been returned to the manufacture for calibration. The pump curve indicates a flow of approximately 580 gpm (see Appendix B). For the purposes of this report, a flow of 483 gpm is conservative and was used for Well # 1. Pump performance should be verified once the flow meter is reinstalled.

The requirements of IDAPA58.01.08 section 513 for the number of groundwater sources were also reviewed. Please note that these requirements were not checked for the existing system or Double T Estates Phase 1 since the 25% threshold is not exceeded. For build-out, the peak hour flow is 855 gpm. The maximum day flow is 570 gpm, with an equalization storage flow of 98 gpm (141,147 gallons over 24 hours) for a total of 668 gpm. See Appendix F for equalization storage calculations. A third well, with a minimum capacity of 613 gpm (668 gpm less 55 gpm from Well # 2), will be required as part of Double T Estates Phase 2.

DISTRIBUTION PUMPING SYSTEM

Water is drawn from the tank to supply the system by four booster pumps and one fire pump in parallel. The pumps are sequentially turned on based on system pressure at the hydropneumatic tanks. The pumps also alternate starts. See Appendix B for pump control settings provided by the owner.

Flow testing for the existing system pumps was completed on October 17, 2008. This testing was coordinated and observed by Ben Weymouth, P.E., with Toothman-Orton Engineering Co. Flow test results are included in Appendix D. Tank levels were monitored for a measured time period to verify the flow rates. All other pumps were manually turned off for each test. Multiple tests were run, and a fire hydrant was partially opened in an effort to establish enough level change in the tank to provide reasonably accurate results. The second booster test resulted in 180 gpm at 75 psi (173-ft). This equates to 720 gpm for all four booster pumps. One of the pumps was serviced by United Pump and Drilling on October 1, 2008, and the impellor diameter was physically verified as 7.5 inches. Evaluated on the pump curve, this impellor size matches 180 gpm at 173 feet, confirming the flow test results.

The fire pump has a separate control unit, with a design capacity of 1,500 gpm @ 175 feet of head. Flow testing for the fire pump for model calibration purposes is discussed under the System Analysis section of this report.

The requirements of IDAPA58.01.08 section 541.02 for pumping units were also reviewed. Without the fire pump, the remaining four boosters can supply 720 gpm. The peak hour flow at build-out is 855 gpm. The maximum day flow is 570 gpm, with an equalization storage flow of 98 gpm (141,147 gallons over 24 hours) for a total of 668 gpm. See Appendix F for equalization storage calculations. The four booster pumps exceed the second condition, and therefore satisfy IDAPA requirements.

WATER STORAGE

The existing ground level water storage reservoir (30-ft dia. x 35-ft tall) has a total volume of approximately 185,000 gallons. A schematic of the existing tank is included in Appendix B. The operational storage (base to max in table below) for this tank is 174,481 gallons. Four booster pumps and one fire pump in parallel draw from the tank to supply the existing water system.

The following table provides a summary of the tank and its level settings as provided by the system operator:

Tank Level	
Setting	**Elevation**
Maximum (Overflow)	2331.00
Well Pumps Off	2329.00
Well #2 Pump On	2228.90
Well #1 Pump On	2227.09
Minimum	2319.00
Base (Tank Floor)	2296.00

The DEQ Design File Note titled "Reservoir Sizing – Public Water Systems" dated February 11, 1998 was used to check required reservoir capacity for the system at build-out. See Appendix F. Source capacity (538 gpm) is less than maximum day (570 gpm) and peak hour (855 gpm) at build out. Equalization storage of 141,147 gallons will be required at build-out, which is less than the 174,481 gallons of existing storage.

Emergency storage requirements were also checked, specifically IDAPA58.01.08 section 501.17, which was adopted 3-30-07. Please note that this requirement was not checked for the existing system or Double T Estates Phase 1 per paragraph "i" of the referenced section. For build-out, eight hours at an average day demand of 178 gpm equals 85,450 gallons. The required fire flow is 1,500 gpm for two hours, which is 180,000 gallons. The existing production wells provide a combined flow of 538 gpm, which is 258,240 gallons in addition to the 174,481 gallons of existing storage. Total available source capacity plus storage is 432,721 gallons, which is greater than the total emergency storage requirement of 265,450 gallons. Please note that these requirements assume backup power will be added to Well # 1 as part of Double T Estates Phase 2 improvements.

PRESSURE ZONES

The system consists of only one pressure zone with no pressure reducing valves. The total elevation change is just under 70-ft. The target zone pressures are 40 to 80 psi. Pressures under the analyzed demand scenarios are listed below.

SYSTEM ANALYSIS

The proposed system was analyzed using WaterCAD V8i by Haestad Methods to verify compliance with *Idaho Rules for Public Drinking Water Systems* (IDAPA58.01.08 section 552), 10-State Standards, and the requirements of the Northern Lakes Fire Protection District. Unit demands were distributed across the nodes in the model to accurately reflect dynamic system operation. Peak hour and max day plus fire flow were analyzed with a steady-state model. The model consists of 56 junctions, 80 pipes, two wells with pumps, four booster pumps, one fire pump, and one tank. The WaterCAD system map is in Appendix E.

Flow testing for calibrating the existing system was completed on October 17, 2008. This testing was coordinated and observed by Ben Weymouth, P.E., with Toothman-Orton Engineering Co. The fire hydrant located between junctions 48 and 49 was opened, and residual pressures were read at the hydrant at junction 54. The test data is included in Appendix D. This data was used to calibrate the model by adjusting the Hazen-Williams C-factor until the residual pressure in the model matched the observed system pressure. Average day demand, a reservoir at elevation 2502.90 (90 psi at the pump house) for system supply, and 154 ERU's was used for the calibration model. An adjusted C-factor of 142 was determined and used throughout the model for system analysis.

The following scenarios were analyzed in WaterCAD:

Demand Scenario	Required Pressure (psi)	
	Minimum	Maximum
Peak Hour	40	80
Max Day + 1000 gpm Fire Flow, Residential	20	80
Max Day + 1500 gpm Fire Flow, Commercial	20	80

SYSTEM HYDRAULIC MODEL RESULTS

The following results were obtained by use of the hydraulic model. The minimum required pressures noted above are maintained for each scenario unless otherwise noted. The existing system represents all 212 connected and approved ERUs. Phase 1 of Double T Estates is the existing system plus 16 ERUs (228 ERUs), and Phase 2 of Double T Estates is the existing plus 46 ERUs (258 ERUs).

Average Day

The average day scenario was not modeled because minimum system pressures will be experienced during either the peak hour or maximum day plus fire flow events. Pump run time is not part of the analysis.

Peak Hour

For the existing system, the minimum pressure is 52 psi, and the maximum pressure is 80 psi. Peak hour flows for Phase 1 of Double T Estates are 43 to 72 psi. Phase 2 of Double T Estates will be required to add an additional pump with a minimum capacity of 135 gpm @ 125 feet to maintain system pressures during the peak hour. With this pump, the pressures are 42 psi to 71 psi. The 135 gpm will also bring the

combined system pumping capacity to the system peak hour flow of 855 gpm with the largest pump out of service.

Max Day
The maximum day event was not modeled because the minimum system pressures will be experienced during either the peak hour or maximum day plus fire flow events.

Max Day + 1,000 gpm Fire Flow for Residential
The existing system maintains a minimum pressure of 35 psi during a residential fire flow event of 1,000 gpm for two hours. Phase 1 of Double T Estates will maintain a minimum pressure of 37 psi. Phase 2 of Double T Estates will also maintain a minimum pressure of 37 psi. Only the fire pump is used for this scenario. Note that the low pressure occurs at J-39, and pressures at this junction improve when the 10" pipe (P-85) is added with the Phase 1 improvements.

Max Day + 1,500 gpm Fire Flow for Commercial
The existing system and Phase 1 of Double T Estates will maintain a minimum pressure of 69 psi during a commercial fire flow event of 1,500 gpm for two hours. Only the fire pump is on for this scenario. At build-out Phase 2 will maintain a pressure of 68 psi. This scenario was only evaluated in the water model in areas zoned for commercial use.

SYSTEM IMPROVEMENTS

The following system improvements are necessary for compliance with *Idaho Rules for Public Drinking Water Systems* (IDAPA58.01.08 section 552), Idaho Department of Environmental Quality (DEQ) Checklists and Design File Notes, 10-State Standards, and the requirements of the Northern Lakes Fire Protection District.

Existing System
No improvements are necessary for the existing system, which includes all current and approved connections.

Double T Estates, Phase 1
Double T Estates Phase 1 consists of 16 lots along Ramsey and Chilco Roads north of the existing system. A 10-inch pipe will be required for the full length along Ramsey Road to satisfy fire flow requirements. No additional improvements are necessary for service to Phase 1. Another 10-inch pipe (P-85) will be added at the southeast corner of the existing system to provide additional system looping.

Double T Estates, Phase 2
Double T Estates Phase 2 consists of 30 lots south and east of Ramsey and Chilco Roads. Service to these lots will exceed the 25% threshold that appears in multiple sections of IDAPA58.01.08. Exceeding this threshold means that current rules adopted since the existing system was constructed are applicable to the entire water system. Service to Phase 2 will be provided by an 8-inch pipe through the development from Ramsey to Chilco. The two cul-de-sacs will have 6-inch pipes.

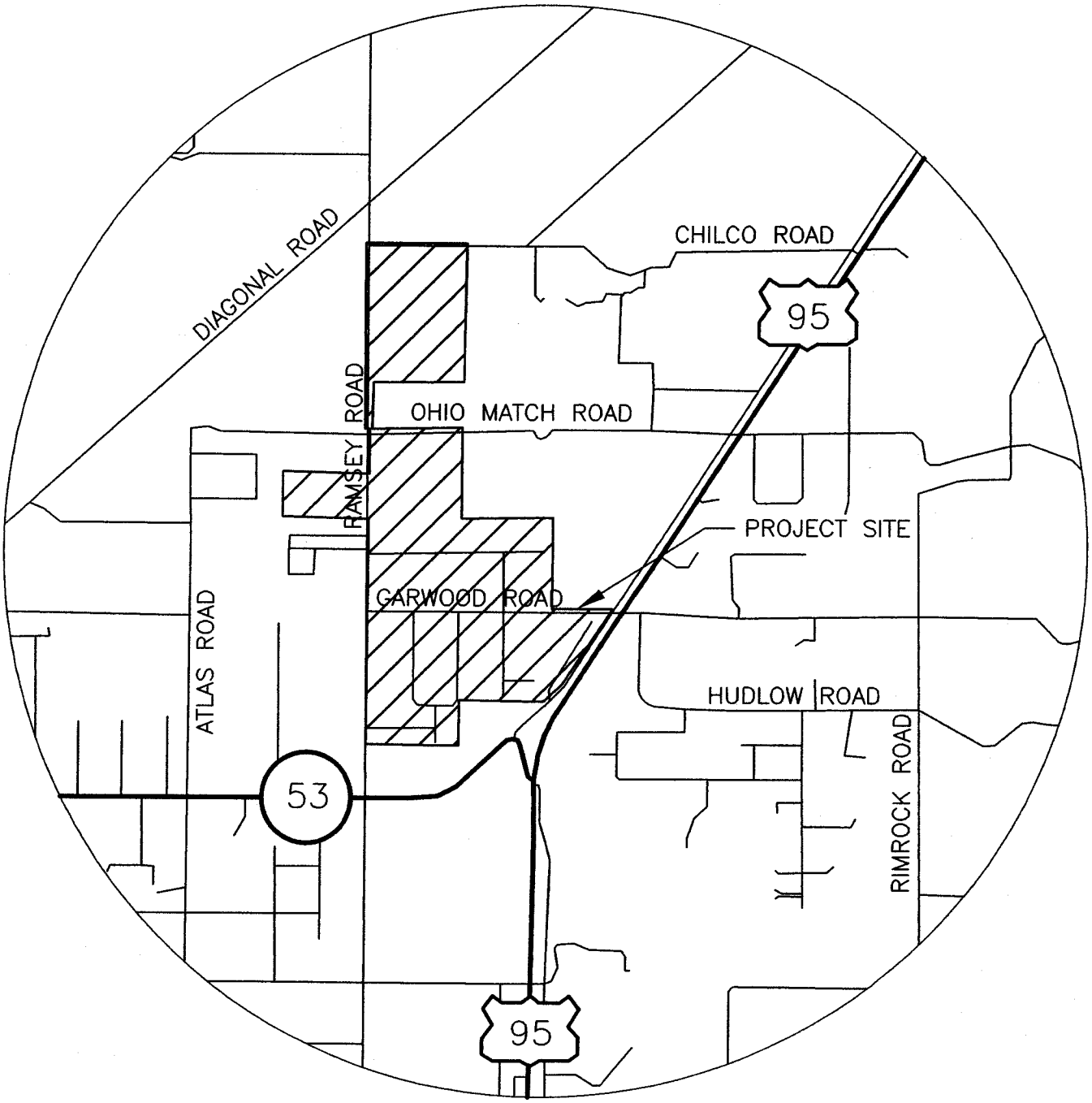
A pump will need to be added to Phase 2 to provide additional pressure to meet requirements for Peak Hour flow. The pump will need a minimum capacity of 135 gpm @ 125 feet to maintain system pressures during the peak hour. 135 gpm will also bring the combined system pumping capacity to the system peak hour flow of 855 gpm with the largest pump out of service. A small reservoir should also be installed to supply this pump. 135 gpm for one hour is 8,100 gallons of operational storage. The tank would be supplied from the existing system. An altitude valve, pressure sustaining valve, and SCADA will be required for overall system compatibility.

An additional well will be necessary per IDAPA58.01.08 section 513. The well will need a minimum flow of 613 gpm. See the "Source Capacity" section of this report for determination of the flow rate. The well can discharge to either the existing 185,000 gallon tank or the new tank in Double T Estates. The new tank would need a minimum operational storage of 18,390 gallons to provide a 30-minute chlorine contact time in anticipation of future DEQ rules.

Addition of backup power to Well # 1 will be necessary per IDAPA58.01.08 section 501.07 to meet requirements for service during a power outage.

APPENDIX A

Vicinity Map
Water System Map



VICINITY MAP

TOOTHMAN-ORTON ENGINEERING CO.
ENGINEERS • SURVEYORS • PLANNERS
WEST 280 PRAIRIE AVENUE • COEUR d'ALENE, IDAHO 83815
PHONE: 208-762-3644 • FAX: 208-762-3708

E-FILE: 08062-G-WA-VC DATE: 09/05/08 JOB: 08062

EXISTING WATER SYSTEM
BAR CIRCLE S

FUTURE WATER SYSTEM
DOUBLE T ESTATES

0 1000 2000 4000 6000

VICKI RD
CAROL RD
JAMES RD
Jamison Acres
Panhandle Acres
Panhandle Mobil Estates
JUDY K DR
CAROLINE DR
HAMPTON CT (PRIVATE)
ELMWOOD CT
POWERLINE RD (PRIVATE)
OHIO MATCH RD (PRIVATE)
RAMSEY RD
CIRCLE S TRL
LONGHORN ST
SPUR ST
DARWOOD RD
DOLAN RD
Bar Circle S Ranch
WRANGLER RD
RANCH CT
DYLAN CT (PRIVATE)
ELLA RD
AMBER CT
CHILCO RD
OHIO MATCH RD
Light Add
WELL RD
HIGHWAY 53
OLD HIGHWAY 95
HIGHWAY 95
SPOKANE INTERNATIONAL R.R.
RIMROCK DR
GRAND TOUR DR

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E-FILE: 08062-G-WA-SC DATE: 09/04/08 JOB: 08062

APPENDIX B

Existing System Information:
Pump Control Settings
Pump Curves
185k Gallon Reservoir Schematic

EXISTING PUMP CONTROLS

	185,000 GALLON RESERVOIR LEVEL (FT)	
WELL PUMP	ON	OFF
1	< 31.09	> 33.00
2	< 33.00	>33.00

	HYDROPNEUMATIC TANK PRESSURE (PSI)	
BOOSTER PUMP	ON	OFF
1	< 52	> 72
2	< 47	> 67
3	< 43	> 63
4	< 38	> 58
FIRE	20	90

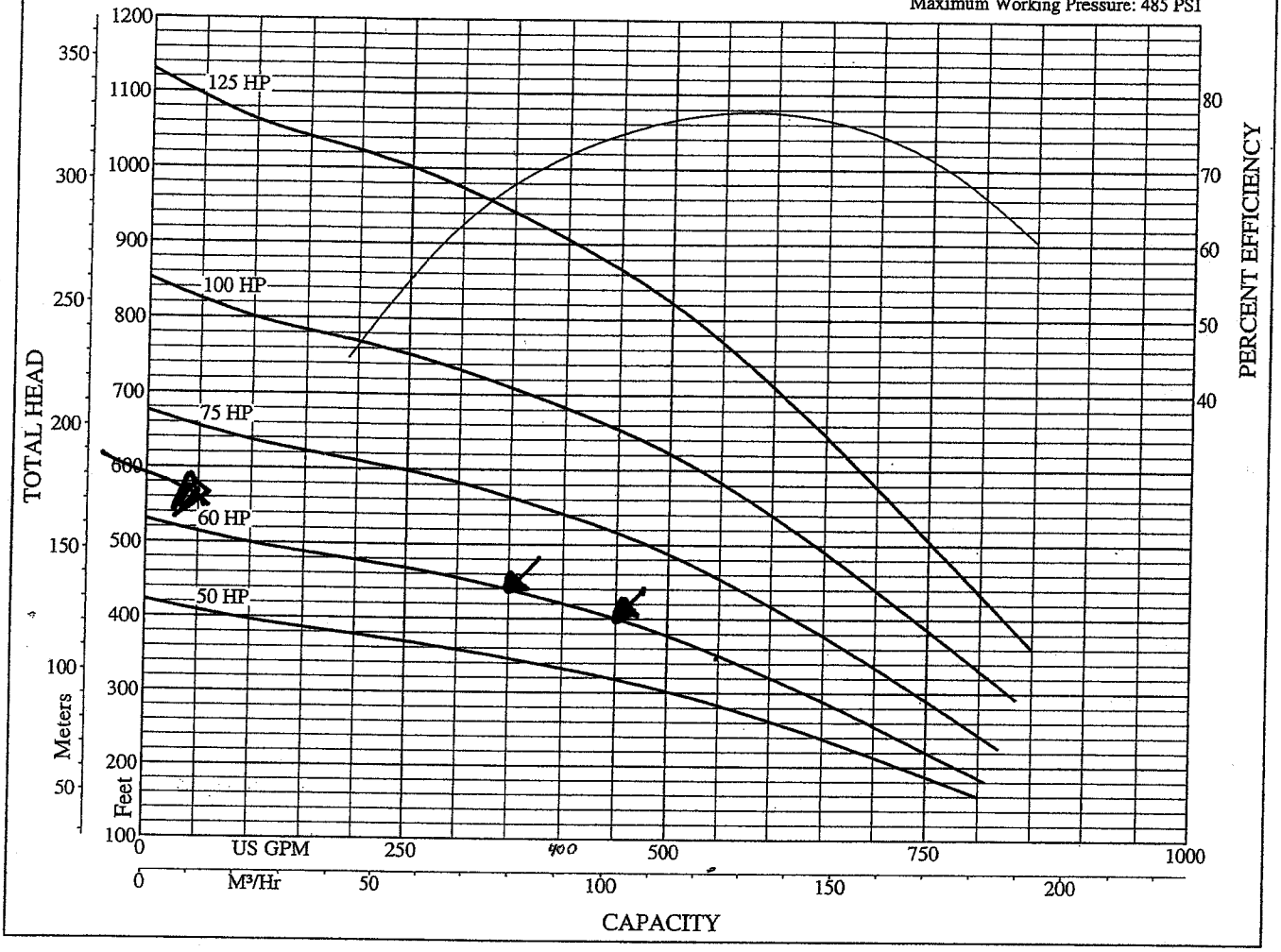
BERKELEY®

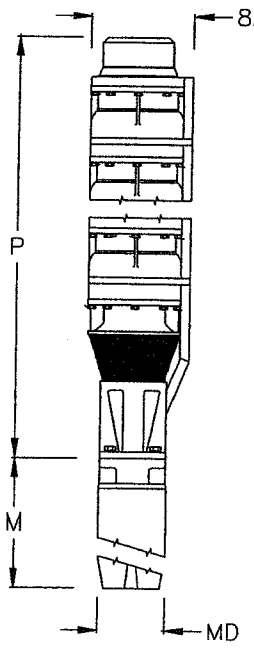
WELL PUMP

SUBMERSIBLE TURBINE

8T-500

Nominal RPM: 3450
Based on Fresh Water @ 68° F.
Maximum Working Pressure: 485 PSI





OUTLINE DIMENSIONS / WEIGHTS

HP	stages	Motor size	P length	M* length	MD* dia.	Mtr. wt.	Pump wt.
50	3	6"	45.13	55.30	5.44	304	189
60	4	6"	52.38	61.30	5.44	335	233
75	5	8"	60.25	54.90	7.50	433	280
100	6	8"	67.50	58.90	7.50	478	323
125	8	8"	82.00	68.80	7.70	709	411

Note: dimensions = inches; weight = U.S. lbs.

M* Maximum length (Franklin Electric Motor)
MD* Motor diameter (Franklin Electric Motor)

SPECIFICATIONS

Minimum Well I.D.	10.0 Inches
Minimum Submergence @ BEP (above inlet)	10.0 Feet
Capacity Range	147 – 865 GPM
Discharge	6" F NPT
See manufacturer's data for motor cooling requirements	

SUPERSEDES
All Previous

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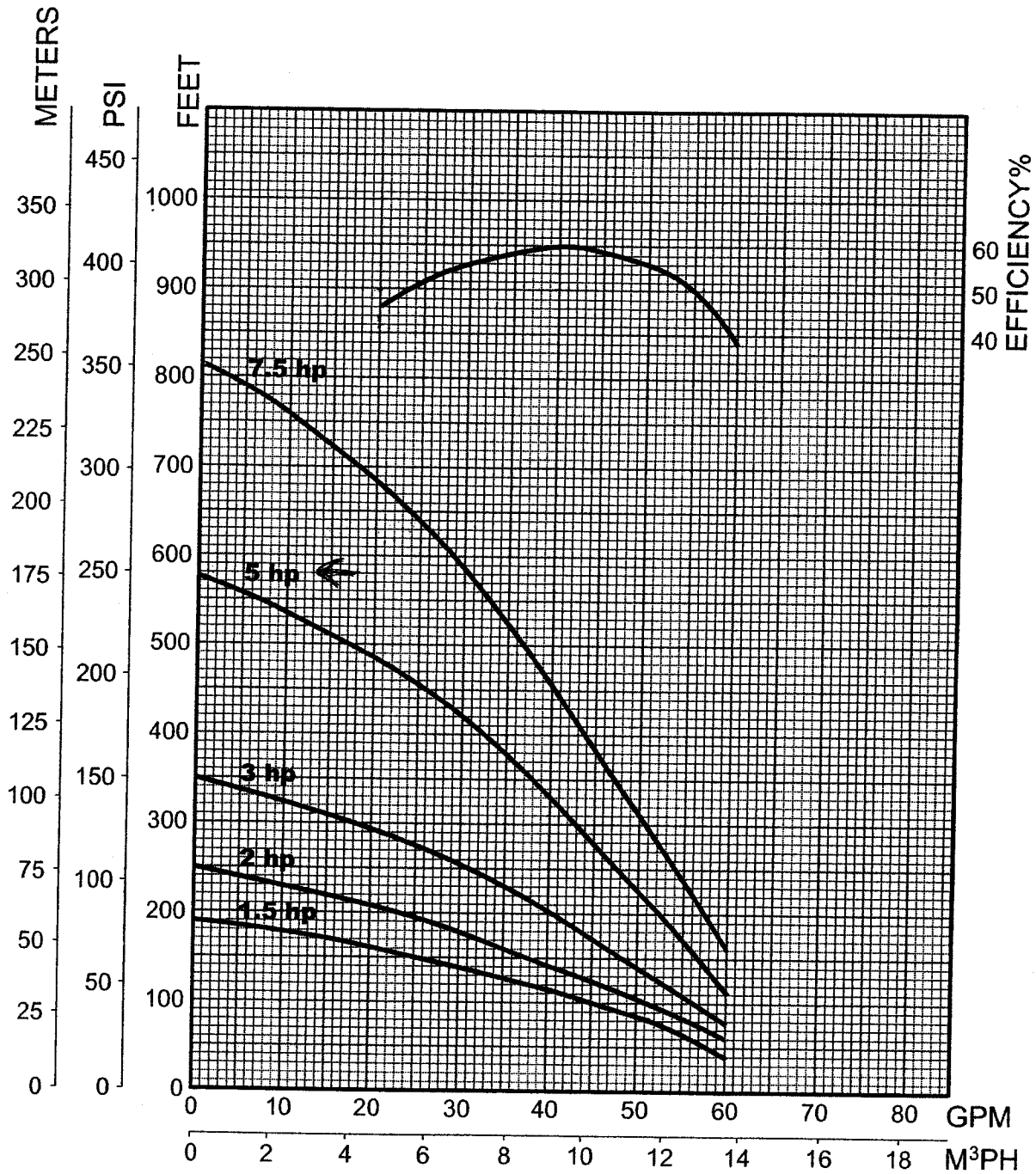
Page 24.03

small well, 5 Hp

4" Submersible Pumps

SandHandler High Capacity 45 gpm Performance Curves



Note: 1. Performance shown does not include friction loss in the drop pipe.
2. All performance data is based on rated motor nameplate voltage.
3. Performance for former XP models are the same as 45 gpm models.

800/843-9222

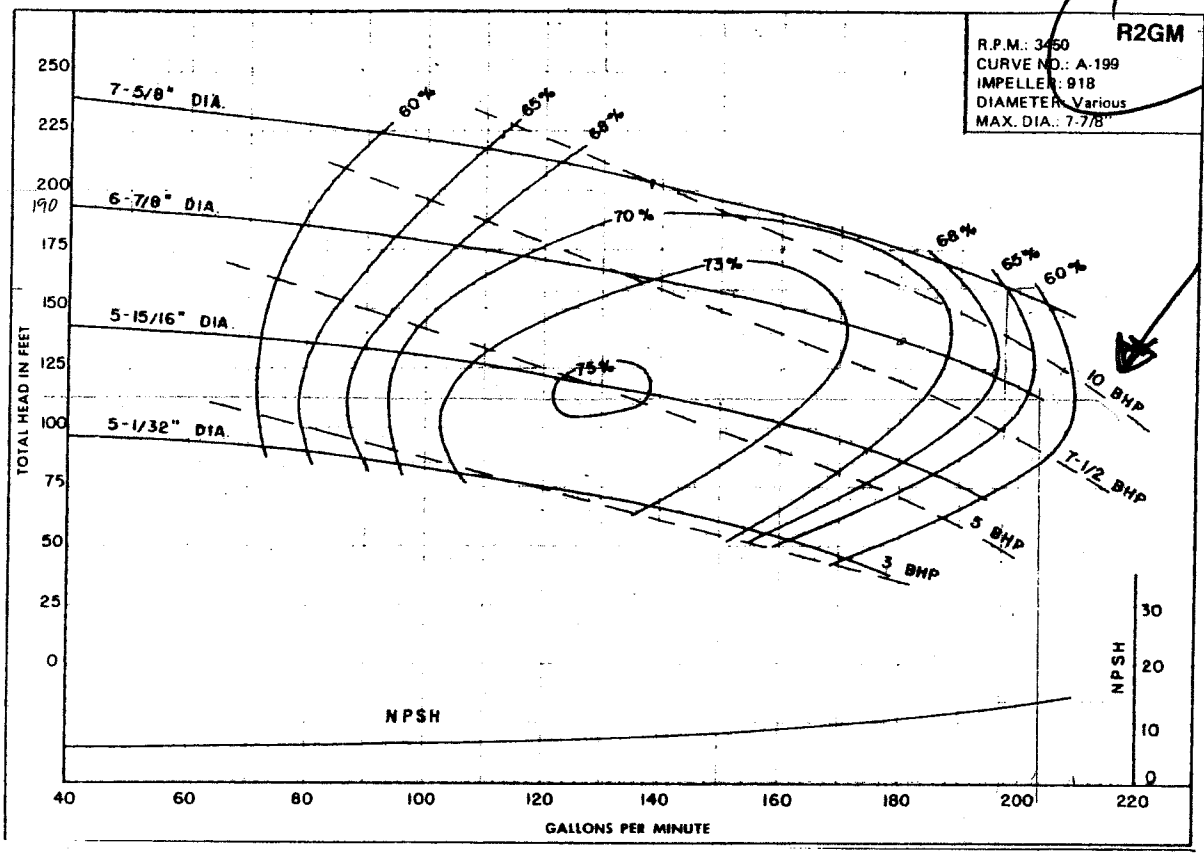
PO# 1409AB

Griswold Industrial Pumps

CENTRIFUGALS Performance Curve

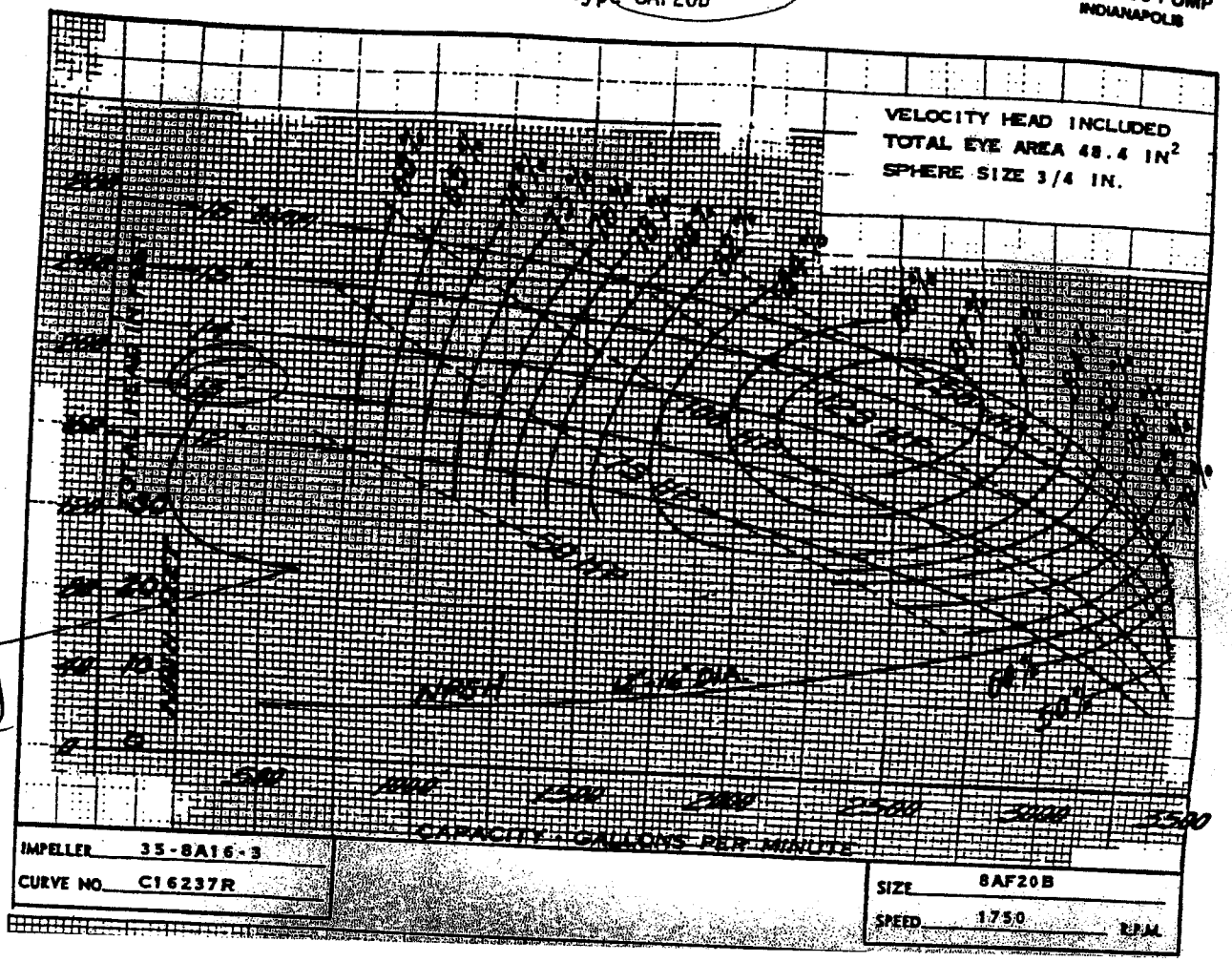
May 1, 1991

Booster Pumps **R2GM and R2GH**

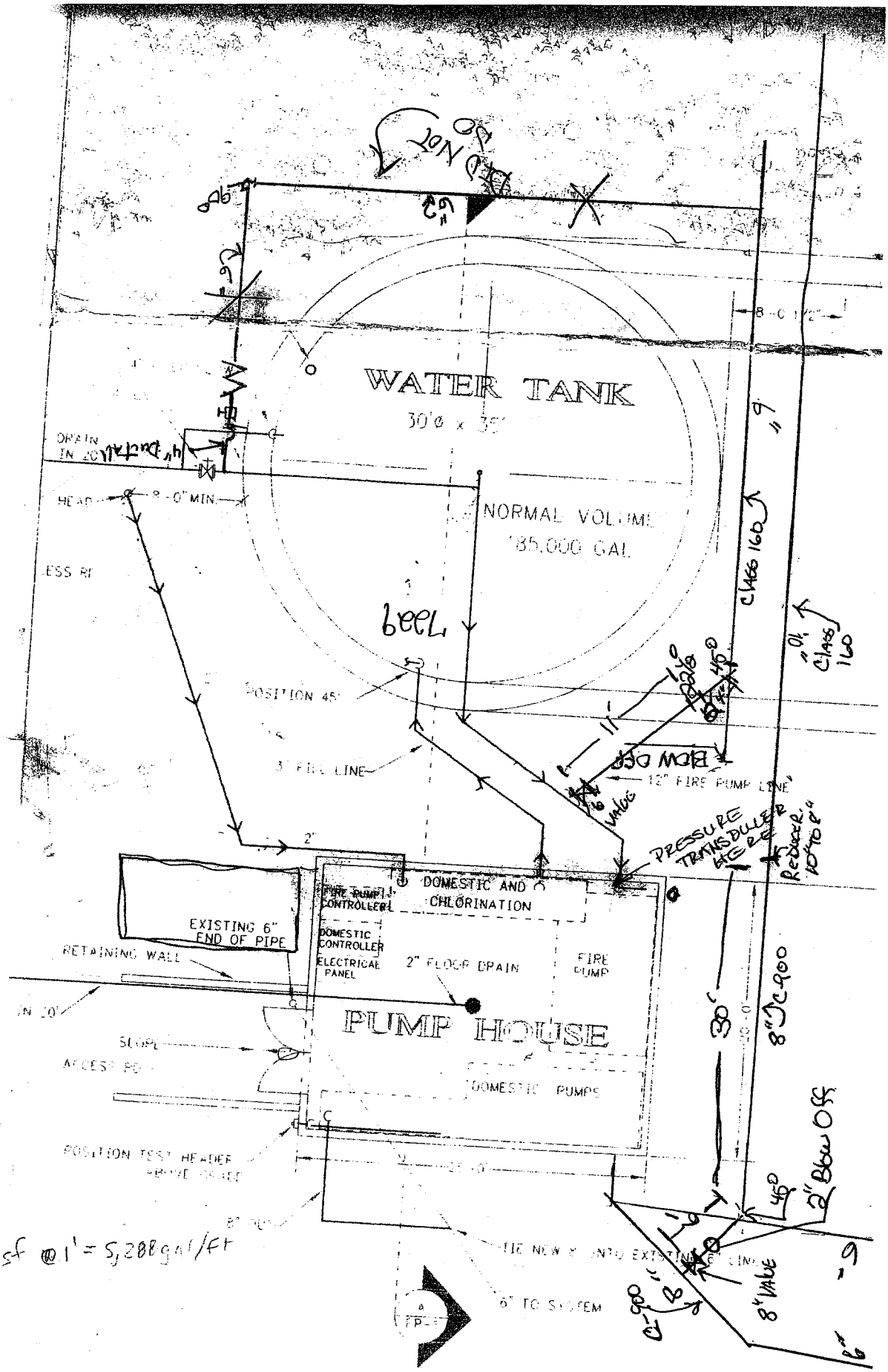


HORIZONTAL FIRE PUMPS
Type 8AF20B

PEERLESS PUMP
INDIANAPOLIS



13"
TRIM



30'Ø = 706.86sf @ 1' = 5,288 gal/ft

APPENDIX C

Water Demand Summary
Meter Data Summary

WATER DEMAND SUMMARY

	System gpm				
Scenario	**gpd/ERU**	**gpm/ERU**	**Existing (212 ERU)**	**Double T Phase 1 (228 ERU)**	**Double T Phase 2 (258 ERU)**
Average Day	993.60	0.69	146.28	157.32	178.02
Maximum Day	3189.05	2.21	468.52	503.88	570.18
Peak Hour (PF = 1.5)		3.315	702.78	755.82	855.27
Fire Flow, Residential	1,000 gpm for two hours				
Fire Flow, Commercial	1,500 gpm for two hours				

BAR CIRCEL S WATER SYSTEM
METER DATA SUMMARY

		Total Monthly Metered Usage	16" Well Monthly Metered Flows	6" Well Monthly Metered Flows	
2008	Nov. '07-April '08 (6 month Avg.)	1,449,330	700,330	1,013,983	*11 Months of records.
	May	4,353,810	3,885,700	910,100	
	June	6,067,710	5,581,300	897,300	
	July	10,786,790	10,039,800	952,900	
	August	12,411,520	11,575,700	1,125,900	
	September	7,568,560	6,531,700	858,500	
	Monthly Average	4,534,943	3,801,471	984,418	Yearly Balance
	Yearly Total(Only 10 months)	49,884,370	41,816,180	10,828,600	2,760,410
	Average Day Total	149,354	125,198	32,421	
	Avg. Day gal/D.U. (154 D.U.s)	**970**			

2007	Oct. '06-March '07 (6 month Avg.)	1,567,417	1,383,450	949,200	*13 Months of records.
	April	1,881,050	1,531,200	869,200	
	May	4,950,190	4,714,800	809,500	
	June	7,832,430	7,837,100	898,200	
	July	13,397,580	13,230,100	1,021,400	
	August	14,396,580	13,314,300	1,043,800	
	September	8,729,030	9,306,300	990,000	
	October	1,674,570	820,000	1,005,700	
	Monthly Average	4,789,687	4,542,654	948,692	Yearly Balance
	Yearly Total(Only 13 Months)	62,265,930	59,054,500	12,333,000	9,121,570
	Average Day Total	157,237	149,128	31,144	
	Avg. Day gal/D.U. (155 D.U.s)	**1,014**			

2006	Oct. '05-March '06 (6 month Avg.)	1,165,529	1,155,733	990,900	
	April	1,531,519	1,183,900	1,094,000	
	May	4,348,490	4,264,100	845,700	
	June	5,187,840	4,965,300	827,700	
	July	11,877,360	11,914,800	996,200	
	August	14,730,230	14,560,100	1,180,600	
	September	8,496,370	9,019,800	959,400	
	Monthly Average	4,430,415	4,403,533	987,417	Yearly Balance
	Yearly Total	53,164,980	52,842,400	11,849,000	11,526,420
	Average Day Total	145,657	144,774	32,463	
	Avg. Day gal/D.U. (149 D.U.s)	**978**			

		Existing System (gal/day)	3 Year Balance
			23,408,400
Average Day (gal/min./d.u.)	**0.69**	**152,041**	
Maximum Day (gal/d.u.)	**3,189.05**		
Maximum Day (gal/min./d.u.)	**2.21**	**475,169**	
*Used 154 D.U.			
Peaking Factor	**1.50**		
Peak Hour Demand (gal/min./d.u.)	**3.32**	**712,753**	

APPENDIX D

System Flow Test Results

WELL #1 PUMP TESTING

10-17-2008

Tank is 30-ft diameter by 35-ft tall
Tank Cross-Sectional Area: 706.8583 S.F.
5287.3 gal/ft

Production Well Test # 1

Time			Tank Level	Meter	Description	Calculated Flow
min	sec	minutes	(feet)	(gpm)		(gpm)
0	0	0.00	32.35	0	Pump ON	
0	38	0.63		400	Full Flow	
1	0	1.00	32.52			899
2	0	2.00	32.58	400		317
3	0	3.00	32.69			582
4	15	4.25	32.58		Pump OFF	-465
5	0	5.00	32.63		Stabilized	352

Beginning to end flow calculation: 348 gpm
*note small level change, calculations subject to error.

Production Well Test # 2

Time			Tank Level	Meter	Description	Calculated Flow
min	sec	minutes	(feet)	(gpm)		(gpm)
0	0	0.00	32.46		Pump ON	
0	8	0.13	32.52			
1	0	1.00	32.63			671
2	0	2.00	32.69			317
3	0	3.00	32.81	350		634
4	0	4.00	32.86			264
5	0	5.00	32.98	348		634
6	15	6.25	33.04			254
7	0	7.00	33.15		Pump OFF	775
8	20	8.33	33.04			-436
10	0	10.00	33.1		Stabilized	190

Beginning to end flow calculation: 483 gpm
*note small level change, calculations subject to error.

BOOSTER PUMP TESTING

10-17-2008

Booster Test # 1 All other pumps off, normal system demand

Time			Tank Level	Pressure		Description
min	sec	minutes	(feet)	at pump	at discharge	
0	0	0.00	33.04	75	45	Pump 3 ON
3	0	3.00	32.92		80	

Beginning to end flow calculation: 211 gpm

*note small level change, calculations subject to error.

Booster Test # 2 Fire hydrant partially opened

Time			Tank Level	Pressure		Description
min	sec	minutes	(feet)	at pump	at discharge	
0	0	0.00	32.69	75	45	Pump 3 ON
2	0	2.00	32.63	80	46	Pumps 3 and 4 ON
7	0	7.00	32.29	92	75	Pumps OFF

Beginning to end flow calculation:	159	gpm, one pump (0 to 2.0 minutes)
Beginning to end flow calculation:	180	gpm, each pump (2.0 to 7.0 minutes)

*note small level change, calculations subject to error.

Notes:

1. Flow tests short in duration to maintain system pressures. Longer time frames needed for accurate measurements.
2. Tank level readings from DistaView TwoView Dual Pump Controller in pump house.

CALIBRATION FLOW TEST

10-17-2008

Fire Hydrant Flow Test

Tank Cross-Sectional Area (sf): 706.8583

Time			Hydrants		Well House		
			Meter	Residual	Discharge	Tank Level	Description
min	sec	minutes	(gpm)	Pressure	Pressure	(feet)	
0	0	0.00	0	60	65	32.23	All Pumps OFF
1	5	1.08					Pump # 1 ON
1	17	1.28					Pump # 2 ON
1	23	1.38			35		Pump # 3 ON
2	6	2.10			32	31.94	Pump # 4 ON
2	49	2.82	400	23			
3	28	3.47	420				
5	0	5.00	500	24	35	31.54	
6	0	6.00	500	24	35	31.42	
7	0	7.00			83	31.31	Fire Pump ON, Pumps 1 - 4 OFF
7	43	7.72	920	70	90		
8	0	8.00	920	65	90	30.9	
8	25	8.42	920	65	90		

Flow calculation, all four boosters: 170 gpm, each pump (2.1 to 7.0 minutes)

Notes:

1. Flow measured with Pollard Water gauge, providing both flow and pressure readings on a dial guage (rated 0-1680 gpm, 0-100 psi)
2. Flow hydrant located on Ohio Match between Ramsey and Amber Ct.
3. Residual pressure measured on hydrant located on east end of pipe in Ohio Match Road.
4. Tank level readings from DistaView TwoView Dual Pump Controller in pump house.

APPENDIX E

Water Model System Map

BCS-W-08-01

SEE THE CASE FILE FOR APPENDIX E, THE WATER MODEL SYSTEM MAP, WHICH WAS TOO LARGE TO BE SCANNED

APPENDIX F

Storage Calculations

STORAGE CALCULATIONS

10-17-2008

Emergency Storage Calculations (IDAPA 58.01.08.501.07)

8 hr. @ Average Day =	(8hr * 0.69gpm * 60min/hr * 258 ERUs) =	85,450 Gal.
Fire Flow =	(1500 gpm * 60min/hr * 2 hr) =	180,000 Gal.
		265,450 Gal.
Backup Power to Well #2		
Well #2 Supply =	(55 gpm * 60min/hr * 8 hr)	26,400 Gal.
	Emergency Storage Required =	239,050 Gal.
	Existing Storage =	174,481 Gal.
	Additional Emergency Storage Req'd =	**64,569 Gal.**
With Backup Power to Well #1		
Well #1 Supply =	(483 gpm * 60min/hr * 8hr) =	231,480 Gal.
	Emergency Storage Required =	**-166,911 Gal.**

Equalization Storage Calculations (Design File Note)

Reservoir Sizing - Public Water System

DEQ Design File note dated February 11, 1998

Qmxdy =	(1.94 gpm * 258 ERUs * 60 min/hr * 24 hr/day) =	720,750 Gal.
Qpkhr =	(2.90 gpm * 258 ERUs * 60 min/hr * 1 hr) =	44,892 Gal.
Qsourcehr =	((483 gpm + 55 gpm) * 60 min/hr * 1 hr) =	32,280 Gal.
Qsourcedy =	((483 gpm + 55 gpm) * 60 min/hr * 24 hr/day) =	774,720 Gal.
Ratio =	Qsourcedy / Qmxdy =	1.07
Equation for 1.06 ratio =	4.7 * Qmxdy/24 =	141,147 Gal.
	Existing Storage =	174,481 Gal.
	Additional Equalization Storage Req'd =	**-33,334 Gal.**