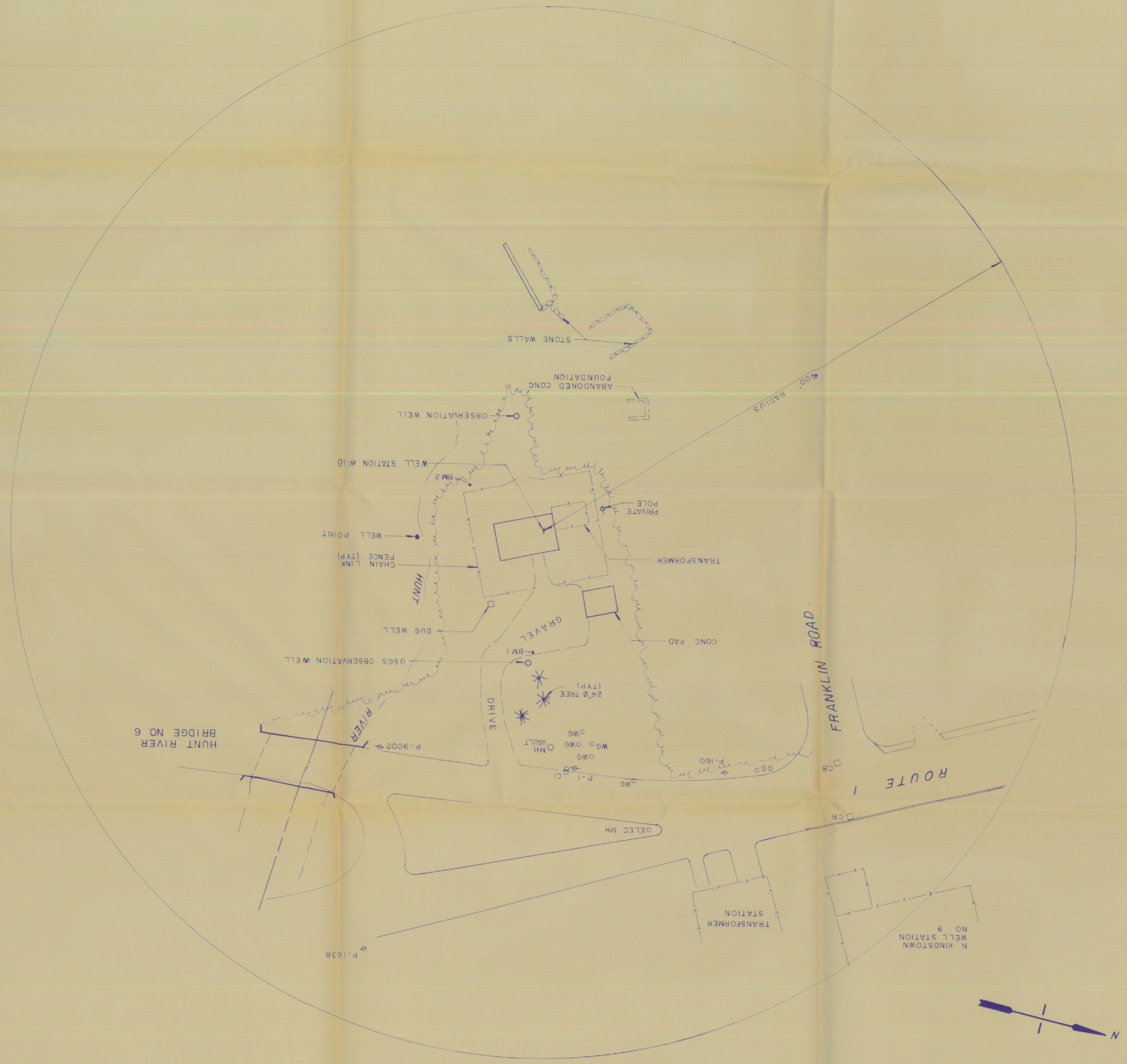
SIGN IN SHEET
Pre Conference RFQ Replacement of Well #10
Thursday February 20, 2014 @ 11 am with Site Visit to follow

Name	Company	Email	Phone
Anthony Urbano	GZA GeoEnvironmental, Inc	anthony.urbano@gza.com	(401) 421-4140
Robert P. Sims	CDR Maguire, Inc	robert.sims@cdrmaguire.com	(401) 272-6000
William Nunnery	Weston & Sampson	nunneryw@wseinc.com	(978) 532-1900
Peter Calderazzo	Dewberry Engineers	pcalderazzo@dewberry.com	(617) 531-0748
Joel Frisch	Northeast Geoscience Inc	jfrisch@ngeo.net	(978) 365-9045
Michael Ohl	Comprehensive Environmental	mohl@ceiengineers.com	(508) 281-5160
Greg Smith	Wright-Pierce Engineering	greg.smith@wright-pierce.com	(603) 748-6390
Tom Simbro	Wright-Pierce Engineering	tom.simbro@wright-pierce.com	(401) 383-2276
Tim Thies	Pare Corporation	tthies@parecorp.com	(401) 334-4100
George Palmisciano	Pare Corporation	gpalmisciano@parcorp.com	(401) 334-4100
Tom Nicholson	C & E Engineering	tnicholson@ceengineer.com	(401) 762-1711
Bob Ferrari	NWSI - Northeast Water Solutions, Inc	rferrari@nwsi.net	(401) 667-7463
Larry Anderson	NWSI - Northeast Water Solutions, Inc	landerson@nwsi.net	(401) 667-7463
Chris Cabral	Crossman Engineering	chris.cabral@crossmaneng.com	(401) 738-5660
Jim Vernon	Nobis Engineering	jvernon@nobiseng.com	(603) 224-4182



ELEVATION	DESCRIPTION
100.0*	BM1 - STAKE
100.8	USGS OBSERVATION WELL - CASING ELEVATION
100.5	DUGWELL - BUILDING SILL ELEVATION
95.7	TOP OF WELL POINT AT RIVER EDGE
100.3	MANHOLE COVER AT INTERSECTION OF RT. 1 AND GRAVEL DRIVE
99.9	OBSERVATION WELL (GROUND ELEVATION AT WELL WEST OF STATION)
101.9	WELL STATION #10 FLOOR ELEVATION
97.8	BM1 - STAKE

*NOTE: ASSUMED DATUM ELEVATION AT BM1 = 100.0 FT.

REVISIONS			
NO	DATE	BY	REMARKS

LEGEND

GG	GAS GATE
CI	CURB INLET
WG	WATER GATE
MH	MAN HOLE
P-	POWER POLE
BM	BENCH MARK
CB	CATCH BASIN
	RIVER EDGE

PRELIMINARY

SEP - 9 1992

DESIGNED BY	DATE
DRAWN BY	DATE
KRPdeZa	9-04-92
CHECKED BY	DATE
CHECKED BY	DATE
CONSTR REV	DATE

PARE ENGINEERING CORPORATION

Engineers — Planners — Consultants
8 Blackstone Valley Place, Lincoln, RI 02865
401/334/4100

TOWN OF NORTH KINGSTOWN

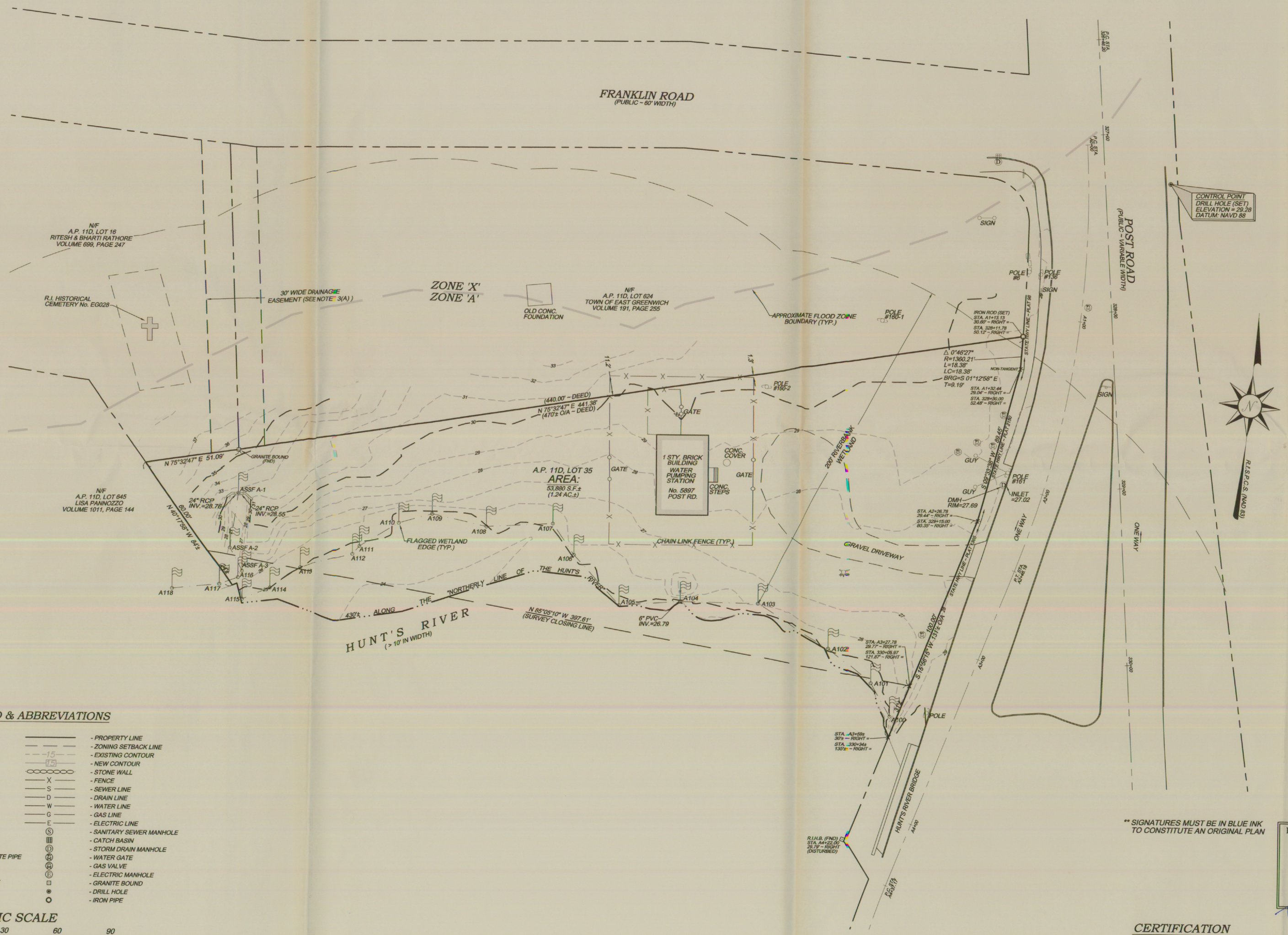
NORTH KINGSTOWN WATER DIST. SYSTEM

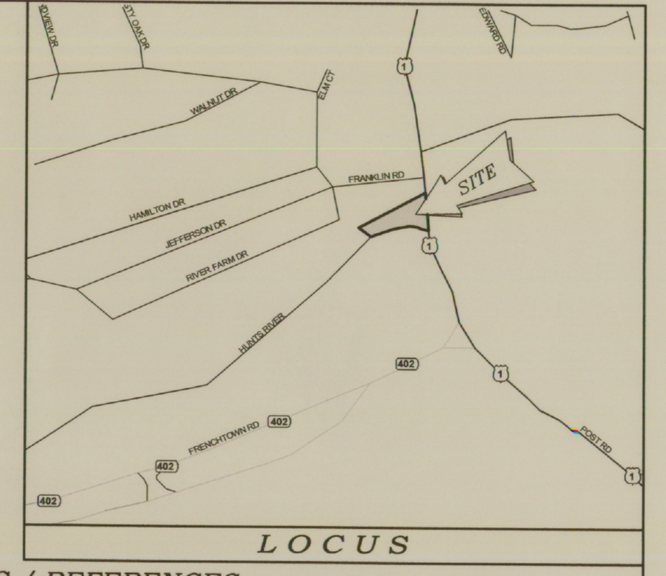
WELL STATION #10

400' RADIUS PLAN

JOB No. 92034.00 SCALE: 1"=40' SHT. 1 of 1

PRINTED ON DAVID 2000 INCHES





LOCUS

NOTES / REFERENCES

1. REFERENCE IS MADE TO THE FOLLOWING MAPS AND PLANS OF RECORD;

   A.) R.I. HIGHWAY PLAT No.'s 98, 259, 466, 1365, 2150 & 2150B.

   B.) PLAN ENTITLED "DIVISION OF LAND FRANKLIN ROAD A.P. 11-D, PORTION LOT 16 EAST GREENWICH, R.I. PREPARED BY DIPRETE ENGINEERING ASSOC., INC. PREPARED FOR: CRANSTON BUILDERS, INC. FEBRUARY, 1994."

   C.) PLAN ENTITLED "RIVERFARM SUBDIVISION No. 2 EAST GREENWICH, R.I. BELONGING TO PILGRIM LAND DEVELOPERS, INC. BY VICTOR J. MINARDI, P.E. JANUARY, 1970."

   D.) PLAN ENTITLED "RIVERFARM SUBDIVISION No. 1 EAST GREENWICH, R.I. BELONGING TO PILGRIM LAND DEVELOPERS, INC. BY VICTOR J. MINARDI, P.E. SEPTEMBER, 1967."

2. REFERENCE IS MADE TO THE FOLLOWING TOWN OF EAST GREENWICH LAND EVIDENCE RECORDS REGARDING RECORDED TITLE TO THE PREMISES SURVEYED;

   A.) A.P. 11D, LOT 35 ~ TOWN OF NORTH KINGSTOWN ~ VOLUME 381, PAGE 282

3. THESE PREMISES MAY BE SUBJECT TO / BENEFITED BY THE FOLLOWING EASEMENTS, RIGHTS OF WAY OR AGREEMENTS OF RECORD:

   A.) 30' WIDE DRAINAGE EASEMENT AS DESCRIBED IN VOLUME 41, PAGE 249

   B.) POSSIBLE EASEMENT FOR ELECTRIC GUY WIRES AS THEY CURRENTLY EXIST (NO RECORDS FOUND)

4. THESE PREMISES ARE SITUATED IN AN 'CH ZONE' (COMMERCIAL ZONE).

   DIMENSIONAL REQUIREMENTS

MIN. LOT AREA	= 30,000 SQ.FT.
MIN. FRONTAGE	= 150 FT.
MIN. S/B FRONT YARD	= 50 FT.
MIN. S/B REAR YARD	= 40 FT.
MIN. S/B SIDE YARD	= 40 FT.
MAX. STRUCTURE HEIGHT	= 35 FT.
MAX. LOT COVERAGE	= 25% (STRUCTURE)

   NOTE - ZONING INFORMATION IS FROM CURRENT ZONING AND MAY NOT REFLECT THE CONDITIONS AT THE TIME OF CONSTRUCTION OR ANY VARIANCES GRANTED.

5. THESE PREMISES ARE SITUATED IN A ZONE 'A' (AREAS OF 1% ANNUAL CHANCE FLOOD...) AS DESIGNATED ON THE "NATIONAL FLOOD INSURANCE PROGRAM, FIRM FLOOD INSURANCE RATE MAP KENT COUNTY, RHODE ISLAND (ALL JURISDICTIONS) PANEL 139 OF 251 TOWN OF EAST GREENWICH MAP NUMBER 44003C0139G: EFFECTIVE DATE: DECEMBER 3, 2010. FEDERAL EMERGENCY MANAGEMENT AGENCY".

6. ANY UTILITIES SHOWN ON THIS PLAN HAVE BEEN LOCATED FROM FIELD SURVEY INFORMATION AND EXISTING PLANS. THE SURVEYOR MAKES NO GUARANTEE THAT THE UTILITIES SHOWN COMPRISE ALL SUCH OR ABANDONED. THE SURVEYOR DOES NOT WARRANT THAT THE UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED ALTHOUGH THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM ALL AVAILABLE INFORMATION. (PLEASE CONTACT DIG SAFE 72 HOURS PRIOR TO CONSTRUCTION AT PHONE NO. 1-888-DIG-SAFE AND/OR ALL LOCAL UTILITY COMPANIES.)

7. THE HORIZONTAL DATUM FOR THIS PROJECT IS THE R.I.S.P.C.S. (NAD 83) AND THE VERTICAL DATUM FOR THIS PROJECT IS NAVD 88. THE PROJECT DATUMS WERE ESTABLISHED FROM DATA TRANSMITTED FROM MTS REFERENCE STATIONS USING THE MTS RTK NETWORK VIA LEICA GPS1200 SERIES ANTENNAS / RECEIVERS.

8. WETLAND DELINEATION BY ECOTONES, INC., P.O. BOX 1131, EAST GREENWICH, R.I. 02818 AND FIELD LOCATED BY WATERMAN ENGINEERING COMPANY.

LEGEND & ABBREVIATIONS

N/F	- NOW OR FORMERLY	- PROPERTY LINE
A.P.	- ASSESSORS PLAT	- ZONING SETBACK LINE
S.F.	- SQUARE FEET	- EXISTING CONTOUR
AC.	- ACRES	- NEW CONTOUR
±	- PLUS OR MINUS	- STONE WALL
STY	- STORY	- FENCE
W/F	- WOOD FRAMED	- SEWER LINE
SHP	- STATE HIGHWAY PLAT	- DRAIN LINE
RET.	- RETAINING WALL	- WATER LINE
PED.	- PEDESTRIAN	- GAS LINE
(FND.)	- FOUND	- ELECTRIC LINE
RIHB	- RI HIGHWAY BOUND	- SANITARY SEWER MANHOLE
PK NAIL	- MASONRY NAIL	- CATCH BASIN
FE.	- FLARED END	- STORM DRAIN MANHOLE
RCP	- REINFORCED CONCRETE PIPE	- WATER GATE
CLF	- CHAIN LINK FENCE	- GAS VALVE
INV.	- INVERT	- ELECTRIC MANHOLE
x 10.80	- EXISTING SPOT GRADE	- GRANITE BOUND
+ 10.80	- NEW SPOT GRADE	- DRILL HOLE
		- IRON PIPE

GRAPHIC SCALE

30 0 15 30 60 90

(in feet)

1 INCH EQUALS 30 FEET

COPYRIGHT

WATERMAN ENGINEERING CO.
CIVIL ENGINEERS & SURVEYORS
80 BOSTON NECK ROAD
EAST PROVIDENCE, RI 02914-2004

THESE DRAWINGS ARE THE PROPERTY OF THE ENGINEER/SURVEYOR AND HAVE BEEN PREPARED FOR THE OWNER, FOR THIS PROJECT AT THIS SITE AND ARE NOT TO BE USED FOR ANY OTHER PURPOSE, LOCATION OR OWNER WITHOUT WRITTEN CONSENT OF THIS OWNER OR ONE OF IT'S DIRECTORS'

** SIGNATURES MUST BE IN BLUE INK TO CONSTITUTE AN ORIGINAL PLAN

RICHARD S. LIPSITZ
No. 1837
PROFESSIONAL LAND SURVEYOR

CERTIFICATION

THIS SURVEY AND PLAN CONFORM TO THE FOLLOWING CLASS STANDARDS AS ADOPTED BY THE RHODE ISLAND BOARD OF REGISTRATION FOR PROFESSIONAL LAND SURVEYORS, EFFECTIVE APRIL 1, 1994.

BOUNDARY SURVEY - CLASS I

TOPOGRAPHIC SURVEY - CLASS III

RICHARD S. LIPSITZ — 1837 — 7-19-13

WATERMAN ENGINEERING COMPANY — REG. NO. — DATE

NO.	DATE	REVISION	CHECKED BY
1	7/19/13	BUILDING CALLOUT CHANGED	RSL

BOUNDARY & TOPOGRAPHIC SURVEY PLAN
WATER PUMPING STATION ~ A.P. 11D, LOT 35
5897 POST ROAD (U.S. ROUTE 1)
EAST GREENWICH, RHODE ISLAND

TOWN OF NORTH KINGSTOWN
80 BOSTON NECK ROAD
NORTH KINGSTOWN, RHODE ISLAND 02852

PROJECT NO.	13-011
SCALE:	1" = 30'
DATE:	04/25/13
DRAWN BY:	BJT
CHECKED BY:	RSL
FILENAME:	13-011_SU1
	1 of 1 SHTS
DRAWING #:	SU1

Waterman ENGINEERING COMPANY
Engineers & Surveyors ~ Est. 1894
46 Sutton Avenue
East Providence, RI
Phone: (401) - 438 - 5775
Fax: (401) - 438 - 5773
www.watermanengineering.net

ECOTONES, INC.
ENVIRONMENTAL CONSULTANTS

PO BOX 1131
EAST GREENWICH, RI 02818
PHONE 401-256-5199
FAX 401-256-5191

Bradford J. Travers, Senior Project Surveyor
Waterman Engineering Co.
46 Sutton Avenue
East Providence, RI 02914

April 18, 2013
Project 13020

Brad@watermanengineering.net

RE: Freshwater Wetland Letter of Findings
Town of North Kingstown Pump Station Post Road, AP 11-D Lot 35, East Greenwich, RI

Mr. Travers:

Ecotones, Inc. has completed the freshwater wetland delineation for the above referenced property. The inspection was performed in accordance with the State of Rhode Island Department of Environmental Management (RIDEM) Rules and Regulations Governing the Administration and Enforcement of the Freshwater Wetlands Act, December 2010 (Rules).

Inspection and delineation of wetlands on the property occurred on April 1, 2013 under partly cloudy conditions. A river as defined in the Rules was identified and delineated as the A-Series (flags A-100 to A-118). A 200-foot riverbank wetland extends from the edge of this blue-line river, Hunt River. An Area Subject to Storm Flowage (ASSF) enters the river in the vicinity of wetland flag A-116. This ASSF has been delineated as ASSF-A1 through ASSF –A3. There is no riverbank associated with this ASSF as it originates as road runoff and enters the property via concrete culverts.

The subject property is located within a Special Flood Hazard Area (SFHA) Subject to Inundation by the 1% Annual Chance Flood - FEMA Zone A (FEMA, 2010). FEMA Zone A is defined as no base flood elevations determined (FEMA, 2010).

Vegetation observed within the wetland was limited to shrub vegetation growing on sediment deposits (sand bars) within the river. This vegetation was dominated by red maple (*Acer rubrum*) red-osier dogwood (*Cornus stolonifera*) and winterberry (*Ilex verticillata*). Upland vegetation was a mix of hardwood species and included, but was not limited to, the species listed in Table 1. The expected frequency of occurrence (Indicator Status) of each species in wetlands is also provided (Reed, 1988 and US F&W, 1997).

Table 1. Species observed in upland.

Strata	Common Name	Scientific Name	Indicator Status
Tree	Fraxinus americana	white ash	FACU
Tree	Acer rubrum	red maple	FAC
Sapling/Shrub	Lonicera tatarica	honeysuckle	FACU
Sapling/Shrub	Rosa multiflora	multiflora rose	FACU

The soil on site is classified in the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) Database for the State of Rhode Island: Bristol, Kent, Newport, Providence, and Washington County (2010) as Urban Land (UD). Urban Land is not listed as a hydric soil in the hydric soil database.

Wetlands and their positions can vary through time as a result of changes in hydrology, seasonal variations, and/or site alterations. No long-term monitoring or lab analyses have been conducted. Accordingly, the results are limited to the observations on and valid for the specific date of the evaluation only. All evaluations and delineations are subject to review and/or verification by the RIDEM and Federal agencies. The edge was delineated along the apparent high-water mark of the river, which at times may vary.

If you have any questions regarding this letter or require additional information, please contact us at your convenience.

Sincerely,

Kevin Fetzer, PWS, Principal Biologist/Soil Scientist
kfetzer@ecotonesinc.com

13020_FW_LOF.doc.docx

REFERENCES CITED:

Federal Emergency Management Agency (FEMA). 2010. Flood Insurance Rate Map, Kent County, Rhode Island, (all Jurisdictions). Panel 138 of 251. Map Number 44003C0138G. Effective Date December 3, 2010.

Reed, P.B. 1988. National list of plant species that occur in wetlands: Northeast (Region 1). U.S. Fish and Wildlife Service Biological Report 88(26.1). 111 pp.

United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). 2010. Web Soil Survey. National Cooperative Soil Survey. Soil Survey Area: State of Rhode Island: Bristol, Kent, Newport, Providence, and Washington Counties Survey Area Data: Version 7, Dec 8, 2010. http://websoilsurvey.nrcs.usda.gov. Last accessed: March 20, 2011.

	MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL
2004	PS 10		1,918,200	1,658,000	7,376,100	7,487,700	9,714,200	50,741,100
2005	PS 10	287,000	17,859,000	13,379,700	41,409,600	26,108,100	49,786,000	55,386,900
2006	PS 10	13,951,000	12,046,800	6,916,200	0	15,319,500	17,845,500	20,559,000
2007	PS 10	16,254,000	429,000	19,387,000	12,660,000	73,000	457,000	35,886,000
2008	PS 10	17,539,300	1,026,900	113,000	0	0	0	14,700,600
2009	PS 10	0	0	0	11,305,900	19,073,600	18,030,000	9,900,000
2010	PS 10	16,540,000	12,569,300	13,559,900	19,970,000	36,430,000	39,709,900	48,220,100
2011	PS 10	24,380,000	17,913,400	7,900,000	6,831,300	0	0	0
2012	PS 10	730,000	640,000	885,900	415,700	544,800	586,400	458,800
2013	PS 10	0	0	0	119,700	2,560,000	206,700	0

AUG	SEP	OCT	NOV	DEC
4,339,000	33,643,800	25,345,300	23,879,100	20,304,700
61,568,900	51,566,100	2,696,000	0	0
24,717,600	7,791,800	18,941,600	19,459,800	19,256,200
33,701,000	27,389,000	29,447,400	22,227,400	11,100,900
24,192,400	3,050,000	16,226,000	15,864,000	5,967,700
23,140,000	27,167,300	12,129,100	12,936,900	7,139,100
42,472,000	33,012,300	26,275,700	23,297,500	24,530,900
0	1,061,700	7,511,400	11,923,500	4,084,300
30,300	0	0	0	0
0	0	0	0	0

Layne Christensen Company

16 Commercial Drive, P.O. Box 309 • Dracut, Massachusetts 01826 • Phone: (978) 937-2242 • Fax: (978) 937-2252

September 4, 2001

Mr. Bob Silvia
Process Engineers & Constructors, Inc.
159 Knight Street
Warwick, RI 02886

Re: Well Redevelopment Report – North Kingstown, RI Well #10

Dear Mr. Silvia,

We have completed the chemical treatment and redevelopment of the North Kingstown Water Department's Well #10 and offer the following report for your review.

Redevelopment Procedures
The redevelopment of Well No. 10 included a combination of conventional chemical treatments and mechanical surging and pumping. Chemical solutions including Muriatic Acid/QC-21 Well Cleaner, Sodium Hexametaphosphate, and Calcium Hypochlorite were used in the redevelopment process. Each solution was injected into the screened area of the well, forced into the formation by the addition of water and surged for several hours prior to being pumped from the well while surging. All chemicals were pumped to a temporary holding tank and neutralized prior to discharge on site. Copies of the neutralization records are attached for your reference. Upon completion of each chemical treatment a brief capacity test was completed to monitor the progress of the rehabilitation. The results of this testing are presented below:

2001 Redevelopment Data – North Kingstown, RI Well No. 10

EVENT	STATIC (feet)	FLOW RATE (gpm)	PUMPING LEVEL (feet)	DRAW DOWN (feet)	SPECIFIC CAPACITY (gpm/ft)	% INCREASE
Pre-Cleaning	9.46	1,056	19.68	10.23	103.23	–
Acid/QC-21	12.20	399	19.15	3.95	101.01	- 2.15%
Phosphates	12.20	412	15.40	3.20	128.75	+ 24.72%
Chlorine	12.60	409	15.70	3.10	131.93	+ 27.80%

The Pre-Cleaning Data was taken from a December 5, 2000 flow test conducted on the well by LCC as part of the Town's annual maintenance and inspection service. While the well was in relatively good condition prior to the redevelopment, the cleaning process increased the overall production capacity of the well by approximately 27.80% from 101.01gpm/ft @ 399gpm to a final level of 131.93gpm/ft @ 409gpm.

TV Inspection Services
Once the pumping equipment was removed from the well a closed circuit TV inspection was conducted to evaluate the condition of the well screen and casing. This pre-cleaning inspection found the well to be encrusted with mineral deposits throughout the entire length of the well. Although the amount of deposition made a complete visual inspection of the screen and casing difficult, it was evident that there were no structural defects in the setting.

After the redevelopment procedures were completed a post-cleaning inspection was conducted. This inspection clearly showed the effectiveness of the cleaning effort as a substantial amount of the build up noted during the pre-cleaning inspection had been removed. All components of the screen and casing appeared to be intact and structurally sound. Through the inspections we were able to verify the construction of the well as a 12" x 107.5' deep well equipped with 38' of 8" diameter stainless steel wire wrap screen.

A VHS copy of the inspections is included with this report for your records.

Pumping Equipment

As stated in the previously submitted Pump Inspection Report the existing equipment was found to be in relatively good condition with the exception of the pump bowl assembly. The 12", 9-stage Deming Bowl showed signs of wear on all surfaces. The recommendation offered was to overhaul the existing bowl, including new bowl bushings, collet assemblies, impeller shat and machine work on the cast iron bowls, or simply replace the unit complete. At the time of this report we understand that the Town is working with their engineering consultents to determine the final design conditions for the proposed new bowl assembly.

We trust that you will find this report complete, however, if you have any questions or require additional information, please contact our office at (978)-937-2242.

Thank you for your consideration.

Sincerely,
Layne Christensen Company

Thomas S. Hydro

Thomas S. Hydro
District Manager

Layne Christensen Company

Subject North Kingstown, RI Date 11/29/01

Based on past inspection data we have approximated the average specific capacity for Wells #9 and #10.

Well #9 - 133.34 gpm/ft @ 1,200 gpm
Well #10 - 104.98 gpm/ft @ 1,026 gpm
} ave of 5 years of test data

Pare Eng has proposed that new pumps for these wells should be designed to deliver 1,600 gpm and 2,100 gpm respectively.

Even if we assume a 50% decrease in specific capacity resulting from the increased flow rates it would appear as though both wells should be able to deliver the desired flow rates.

Well #9 133.34 gpm/ft x .5 = 66.67 gpm/ft - reduced Spec Cap
1,600 gpm / 66.67 gpm/ft = 24 ft of Drawdown @ design rate
Max Available DD = Pump Setting (68') - Static (4') - 5' Safety factor
= 59 ft

Well #10 104.98 gpm/ft x .5 = 52.49 gpm/ft - reduced Spec Cap
2,100 gpm / 52.49 gpm/ft = 40 ft of Drawdown @ design rate
Max Available DD = Pump Setting (70') - Static (10') - 5' Safety Factor
= 55 ft.

Layne Christensen Company

Well and Pump Inspection Data Sheet

Owner: NORTH KINGSTOWN **Well / Pump No.:** WELL # 10 **Inspection Date:** April 6, 2007

Well Information

Casing Diameter:	12"
Total Depth:	104.50'
Screen Diameter:	8"
Screen Length:	30'
Slot Size:	?
Year Installed:	?
Last Serviced:	Aug 2001
Rated Capacity:	2,100

Pump Information

Serial Number:	400378
Make:	Christensen
Model:	12DHHO-5
Design Point:	2,100 @ 250'
Column Size:	8"
Shaft Size:	1-11/16/1-13/16
Depth to Suction:	60.95'
Airline:	54.95'
Year Installed:	Dec 2002

Motor Information

Make:	U.S.
Hp:	200
Voltage:	460
Amperage:	228
RPM:	1785
Frame:	445TPH
Type:	RUS
MegOhms:	
Year Installed:	1999

Pump Performance

	gpm	design	test	% off
Original:	2,100	250	--	--
Last Test:	1,971	266	256.86	-3.44%
Current Test:	1,525	300	248.52	-17.16%

Well Performance

	year	gpm	gpm/ft	% off
Original:	1975	1,500	139.53	--
Previous Test:	2001	409	131.93	-5.45%
Previous Test:	4/8/03	1,506	98.75	-29.23%
Current Test:	4/6/2007	1,525	101.00	-27.62%

Static Water Level	15.00			Pressure Gage Ht		6.00										
Pumping Level	Draw Down	Flow Meter	Pitot or Orifice	Specific Capacity	Discharge Pressure	TDH	Amperages L1	L2	L3	Kilowatts L1-L2	L2-L3	Total		Horsepower Elec.	Water	Eff.
15.00	0.00	0	--	n/a	170	413.70	--	--	--	--	--	--		--	--	--
22.00	7.00	965	--	137.86	116	295.96	164.80	160.40	155.00	77.5	30.7	108.2		145.04	70.40	48.54%
30.00	15.00	1,525	--	101.67	92	248.52	169.10	155.40	159.30	80.5	32.7	113.2		151.74	93.42	61.57%

Comments: **Maintenance Services:** Change Motor Oil: -- Grease Bearings: -- Replace Packing Material: Yes

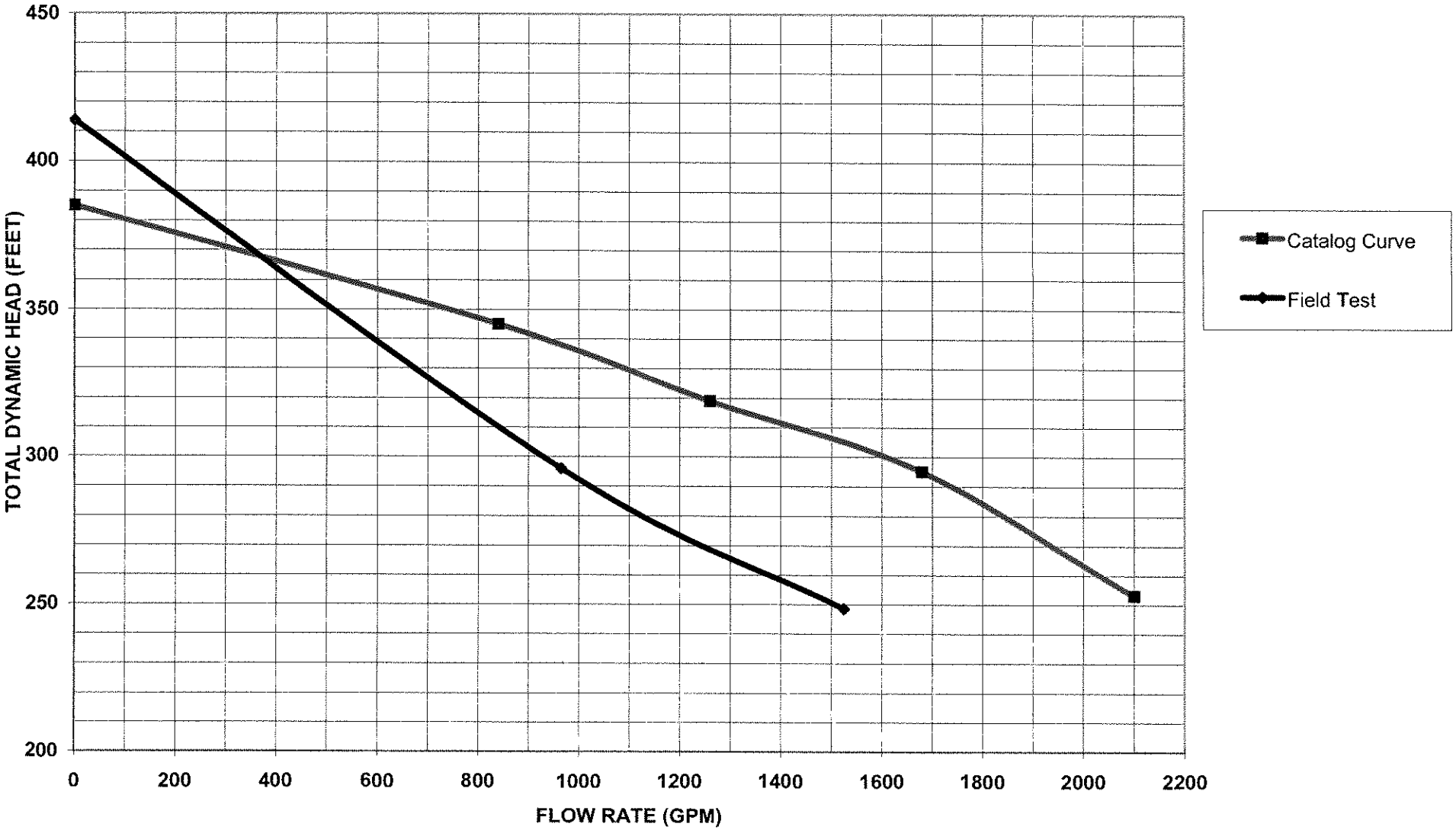
WELL PERFORMANCE IS DOWN 27.62%.

PUMP PERFROMANCE IS 17% BELOW DESIGN CURVE.

Layne Christensen Company 16 Commercial Drive P.O. Box 309 Dracut, MA 01826 ph:978-937-2242 fax:978-937-2252

Layne Christensen Company

NORTH KINGSTOWN WATER DEPARTMENT
WELL #10
CHRISTENSEN 12DHHO, 5-STAGE
FIELD TEST DATA - APRIL 6, 2007



Layne Christensen Company

16 Commercial Drive, P.O. Box 309 • Dracut, Massachusetts 01826 • Phone: (978) 937-2242 • Fax: (978) 937-2252

November 10, 2003

Mr. Robert Silvia
Process Engineers & Constructors, Inc.
159 Knight Street
Warwick, RI 02886

Re: North Kingstown, RI Well #10 Pumping Equipment

Dear Mr. Silvia,

We have received and reviewed Fay, Spofford and Thorndike's response letter dated October 28, 2003. While we disagree with their determination that Layne bears full responsibility for the current situation at the Well No. 10 station, we are prepared to work with the Town of North Kingstown, as we have many times previously, to remedy the problem to their satisfaction.

Recommended Solution

Upon further review of the pump performance data and a consultation with the pump manufacturer, we do not believe that replacement of the column shafting is the solution to the problem. The existing shaft is 1-13/16-inch diameter within the 8-inch diameter column pipe. As the current configuration results in a friction loss of over 10-feet over the length of the column assembly, installation of a larger diameter shaft would only result in additional losses. Instead of concentrating on the shafting we propose to remove and modify the existing pump to enable the unit to perform befter under actuel system conditions. The modification to be completed includes replacing the stainless steel impeller shaft and adding a sixth stage to the pump assembly. The addition of the sixth stage will provide sufficient additional head, approximately 40-feet, while remaining within the 200Hp rating of the existing motor, to allow for a more liberal adjustment of the impeller height, thereby negating the affects of the suspected shaft stretch. Upon installation of the modified pump, field testing will be completed to verify performance.

At this time Layne is prepared to provide the labor required to remove, modify, reset and test the pump at no additional charge to the Town. The only additional cost to the Town would be the cost of the additional stage, $930.88. We believe this to be a reasonable request as it can be argued that the original replacement pump bowl design should have included six stages to satisfy the updated system design requirements.

Once we receive written notification that the proposed modifications have been accepted by Fay, Spofford and Thorndike, the materials will be ordered and a schedule for completion of the work discussed. We anticipate that delivery of the materials from the factory will take 1 to 2 weeks from the date of order.

We trust that you will find this report complete, however, if you have any questions or require additional information please contact our office at (978)-937-2242.

Sincerely,
Layne Christensen Company

Thomas S. Hydro

Thomas S. Hydro
District Manager

Layne Christensen Company
Thomas Hydro
North Kingstown Well No. 10

Goulds Turbine Pump Selection ver: 8.043
11/08/01

PUMP DATA SHEET

Goulds Turbine 60 Hz

Selection file: (untitled)

Catalog: TURB60.MPC v 1.6.1

Curve: 1135-1

Design Point: Flow: 2100 US gpm
Head: 250 ft

Pump: TURBINE - 1800
Speed: 1760 rpm

Size: 12DHHO; (5 stages)
Dia: 7.6875 in

Limits: Temperature: --- °F
Pressure: 325 psi_g

Sphere size: 0.81 in
Power: --- bhp

Specific Speed: Ns: 3750 Nss: ---

Vertical Turbine: Bowl Size: 11.6 in Max Lateral: 0.88 in
Thrust K Factor: 23

Motor: 200 hp Speed: 1800 Frame: 447T
NEMA Standard TEFC Enclosure
sized for Max Power on Design Curve

Fluid: Water Temperature: 60 °F
SG: 1
Viscosity: 1.122 cP
Vapor pressure: 0.2568 psi_a
Atm pressure: 14.7 psi_a

NPSHa: --- ft

Piping: System: ---
Suction: --- in
Discharge: --- in

Suction Size-10" Discharge Sizes-8",10"

---- Data Point ----

- Flow: 2100 US gpm
- Head: 253 ft
- Eff: 82.1%

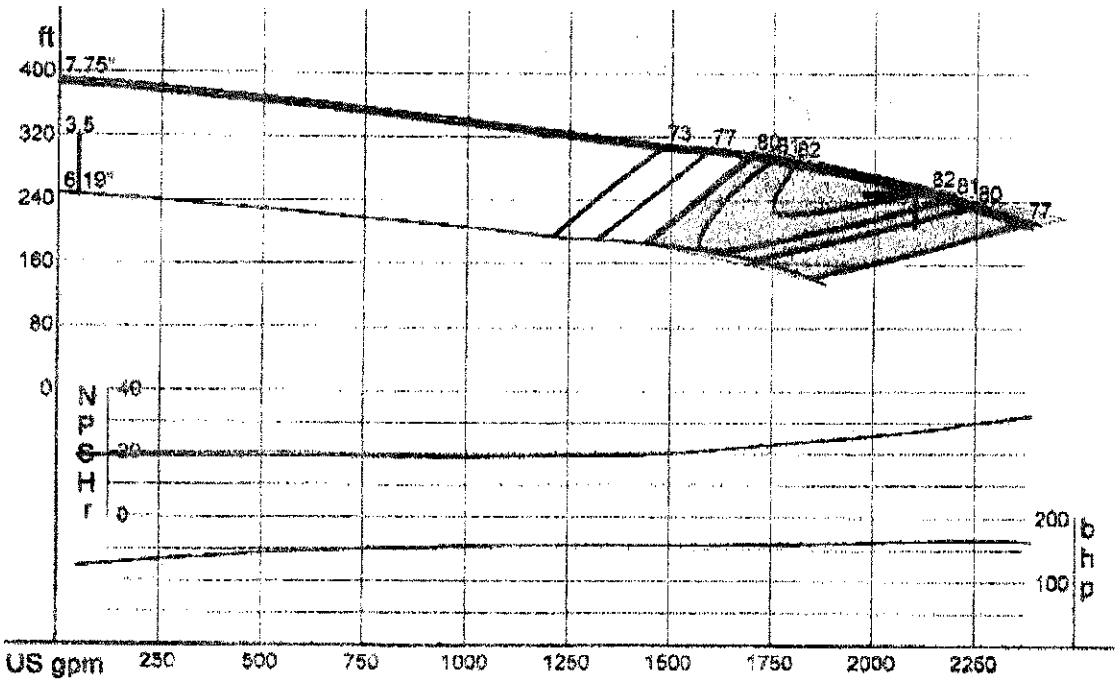
Power: 163 bhp
NPSHr: 27.4 ft

-- Design Curve --

Shutoff Head: 385 ft
Shutoff dP: 167 psi
Min Flow: - US gpm
BEP: 82.9% eff
@ 1921 US gpm
NOL Pwr: 165 bhp
@ 2177 US gpm

-- Max Curve --

Max Pwr: 169 bhp
@ 2200 US gpm



--- PERFORMANCE EVALUATION ---

Flow US gpm	Speed rpm	Head ft	Pump %eff	Power bhp	NPSHr ft	Motor %eff	Motor kW	Hrs/yr	Cost /kWh
2520	Flow Rate is Out of Range for this Pump								
2100	1760	253	82.1	163	27.4				
1680	1760	285	79.5	158	22				
1260	1760	319	64.9	156	19.2				
840	1760	345	47.3	151	19				

Christensen Pumps

Performance Test Results

North Kingstown, Rhode Island Well No. 10 Date: 10/22/02

Readings During Test

POINTS	1	2	3	4	5	6	7
PSI	182.50	178.80	136.20	141.70	112.90	104.10	91.10
Disch Ft	421.58	413.03	314.62	327.33	260.80	240.47	210.44
Elev Ft	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Vel Ft	0.00	0.03	0.14	0.32	0.58	0.66	0.76
Pipe Fric	0.00	0.00	0.02	0.03	0.06	0.07	0.08
Pump Hp	203.07	153.97	137.22	160.81	174.50	176.50	175.93
Input KW	161.00	121.00	108.00	127.00	137.00	139.00	138.00
Amperes	235.00	196.00	184.00	203.00	215.00	215.00	215.00

Test Data Recorded At Test RPM

RPM	1798	1798	1797	1797	1797	1797	1796
GPM	0.0	480.0	1040.0	1580.0	2130.0	2280.0	2440.0
TDH-Feet	426.6	418.1	319.8	332.7	266.4	246.2	216.3
Pump Hp	203.1	154.0	137.2	160.8	174.5	176.5	175.9
Pump Eff	0.0	32.9	81.2	82.5	82.1	80.3	75.7

Test Data Converted to Customers RPM

RPM	1770	1770	1770	1770	1770	1770	1770
GPM	0.0	475.0	1020.0	1580.0	2100.0	2250.0	2400.0
TDH-Feet	413.4	405.1	310.2	322.8	258.5	238.9	210.1
Pump Hp	193.7	146.9	131.1	153.7	166.8	168.7	168.4
Pump Eff	0.0	32.9	61.2	82.5	82.1	80.3	75.7

Christensen

Christensen Pumps
Performance Test Results

CUSTOMER: LAYNE DRACUT
CUST P/O: 69-3678

ITEM:

S.O. NUMBER: 460378
DATE: 10/22/02

CONDITIONS

PUMP NUM:	1	SP. GR:	1.00	BOWL TDH:	250.0
PUMP TYPE:	DWT	VISC. SSU:	32	PUMP TDH:	0.0
PUMP MODEL:	12DHHO	WATER TEMP (F):	69	REQ GPM:	2100
STAGES:	5	WITNESSED:	N	MAX GPM:	2400
IMP. MATL:	1102	MOTOR S/N:	YO270280R-1	EFFICIENCY%:	62.0
1ST IMP. DIA:	7.75	1ST IMP. QTY:	5	TEST RPM:	1785
2ND IMP. DIA:	0.00	2ND IMP. QTY:	0	TEST MOTOR:	600 HP
CUST RPM:	1770	TRQ METER:	16	TEST LINE:	12
CUST HP:	200	TESTED BY:	ERIC CERDA	CURVE RPM:	1770

READINGS DURING TEST

POINTS	1	2	3	4	5	6	7
PSI	182.5	178.8	136.2	141.7	112.9	104.1	91.1
DISCH. FT.	421.56	413.03	314.82	327.33	260.80	240.47	210.44
ELEV. FT.	5.00	5.00	5.00	5.00	5.00	5.00	5.00
VEL. FT.	0.00	0.03	0.14	0.32	0.58	0.66	0.75
PIPE FRIC.	0.00	0.00	0.02	0.03	0.06	0.07	0.08
PUMP HP	203.07	153.97	137.22	160.81	174.50	176.50	175.93
INPUT KW	161.00	121.00	108.00	127.00	137.00	139.00	138.00
AMPERES	235.00	196.00	184.00	203.00	215.00	215.00	215.00
VIBRATION	-	-	-	-	-	-	-

TEST DATA RECORDED AT TEST RPM

RPM	1798	1798	1797	1797	1797	1797	1796
GPM	0	480	1040	1580	2130	2280	2440
TDH-FEET	426.6	418.1	319.5	332.7	266.4	246.2	218.3
PUMP HP	203.1	154.0	137.2	160.8	174.6	176.5	175.9
PUMP EFF	0.0	32.9	61.2	82.5	82.1	80.3	75.7

TEST DATA CONVERTED TO CUSTOMER RPM

RPM	1770	1770	1770	1770	1770	1770	1770
GPM	0	475	1020	1560	2100	2250	2400
TDH-FEET	413.4	405.1	310.2	322.8	258.5	238.9	210.1
PUMP HP	183.7	146.9	131.1	153.7	166.8	168.7	166.4
PUMP EFF	0.0	32.9	51.2	82.5	82.1	80.3	75.7

Certified Test Results
By: [signature]
Title: Engineer
Date: Oct 24 2002

1 of 2

EN.F003 Rev1 5/2002

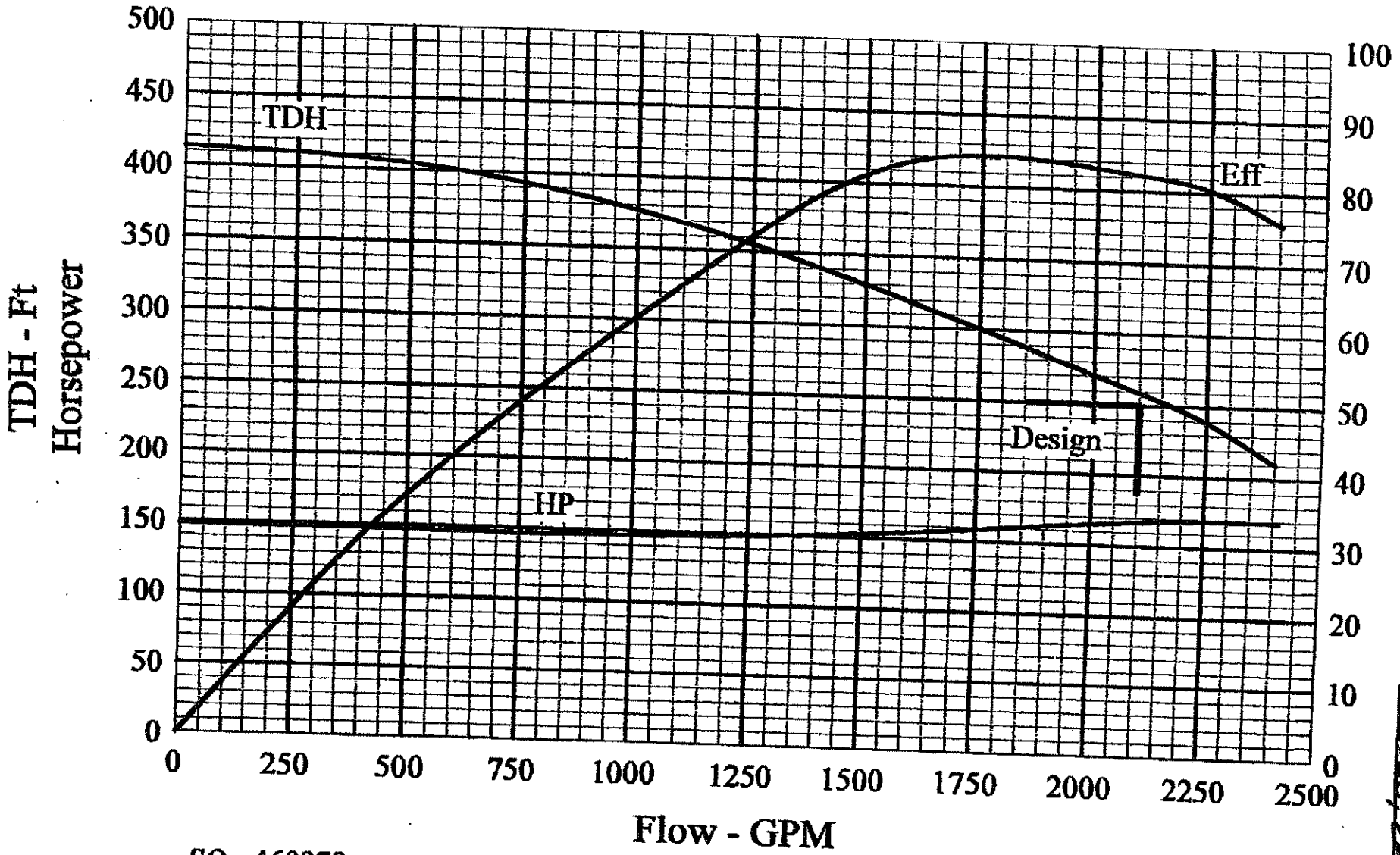
Attn: [illegible]

Rev 1
5/2002

Correct Curve
Tom Hydro

Christensen Pumps

A Division of Layne Christensen Company



SO: 460378
Model: 12DHHO/5

Imp Dia: 7.75 in
Speed: 1770 RPM

OCT.25'2002 09:13 18067435733 ITT GOULDS PUMPS TURBINE OPERATS #5347 P.001/001

By:
Title:
Date:

Layne Christensen Company
16 Commercial Drive, P.O. Box 309 • Dracut, Massachusetts 01826 • Phone: (978) 937-2242 • Fax: (978) 937-2252

2 of 6

November 11, 2002

Mr. Robert Silvia
Process Engineers & Constructors, Inc.
159 Knight Street
Warwick, RI 02886

Re: New Well Pump Installation @ Well #10 - North Kingstown, RI

Dear Mr. Silvia,

We are in receipt of the "Review of Submitted Pump Data" fax from Fay, Spofford & Thorndike, Inc. and have prepared the following information in response.

1. A dimensional diagram of the proposed new pump bowl is attached. As the existing discharge head is to be reused no drawing will be provided.
2. A copy of the Operations and Maintenance Manual for the Christensen Pump is attached.
3. The existing discharge head is equipped with a standard packed stuffing box.
4. The O.D. of the Christensen Pump is 11.5-inches and the I.D. of the steel well casing is 12-inches. While this is an extremely tight fit we do not anticipate any problems during installation for several reasons: a) the previous pump bowl was also nominally 12-inch diameter and there was no indication (such as wear on the outside of the bowl) that the pump was in contact with the screen or casing; and b) by reusing the existing discharge head the alignment of the setting should not change.
5. Upon reviewing the possible selections for the replacement bowl the 12DHHO, an open impeller unit, provided the highest efficiency over a range of flow rates including the design point of 2,100 gpm @ 250' TDH.

We trust that the information presented is complete, however, if FST or the Town require additional information please contact our office at 978-937-2242.

Please note that while the pump bowl has been constructed and tested it will not be released for shipment from the manufacturer until a written acceptance has been received from FST.

A final schedule for installation of the bowl can be discussed once we receive the bowl in our yard.

Sincerely,
Layne Christensen Company

Thomas S. Hydro

Thomas S. Hydro
District Manager

Layne

Christensen Company

Subject North Kingstown, RI - Well #10

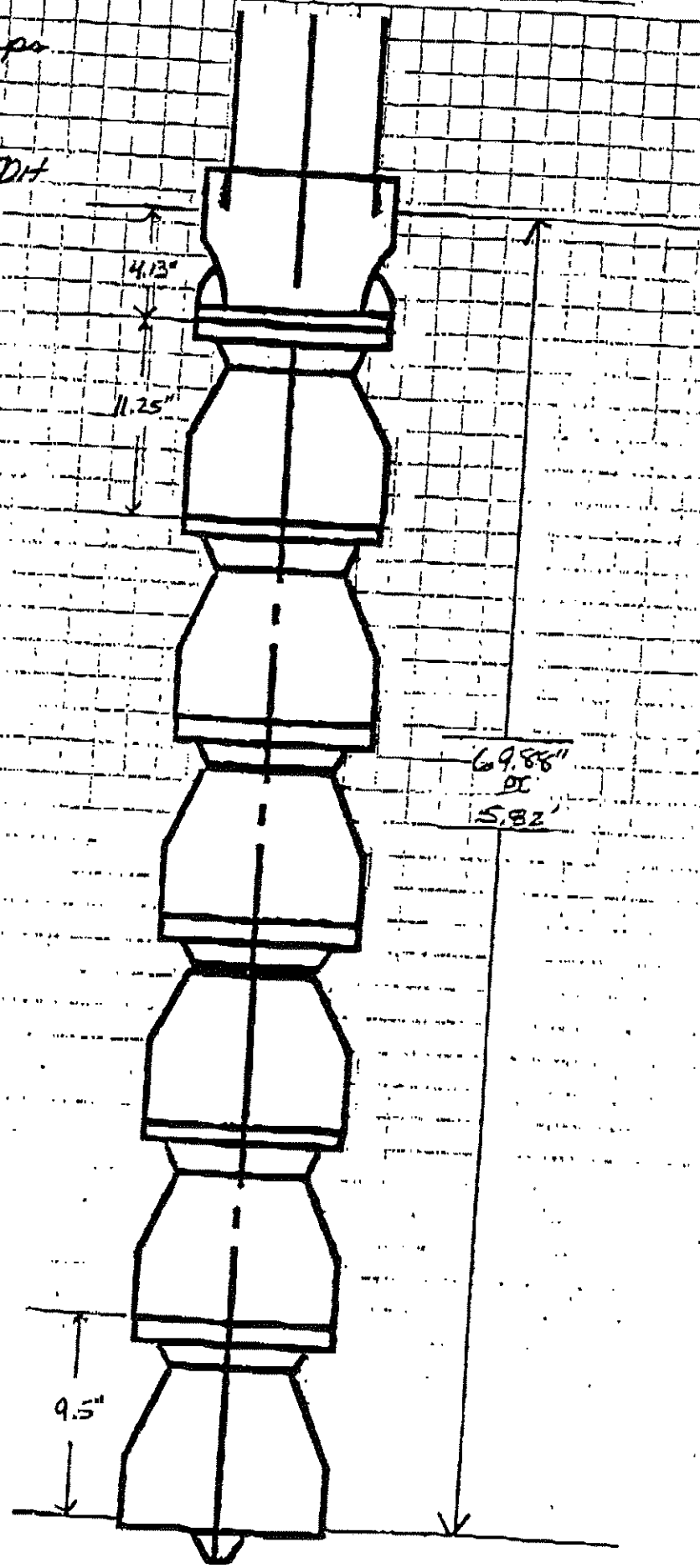
3 of 6

Date

Christensen Pumps

12 DHHO, 5 Stg

2,100 gpm @ 250' TDH



A division of Layne Christensen Company

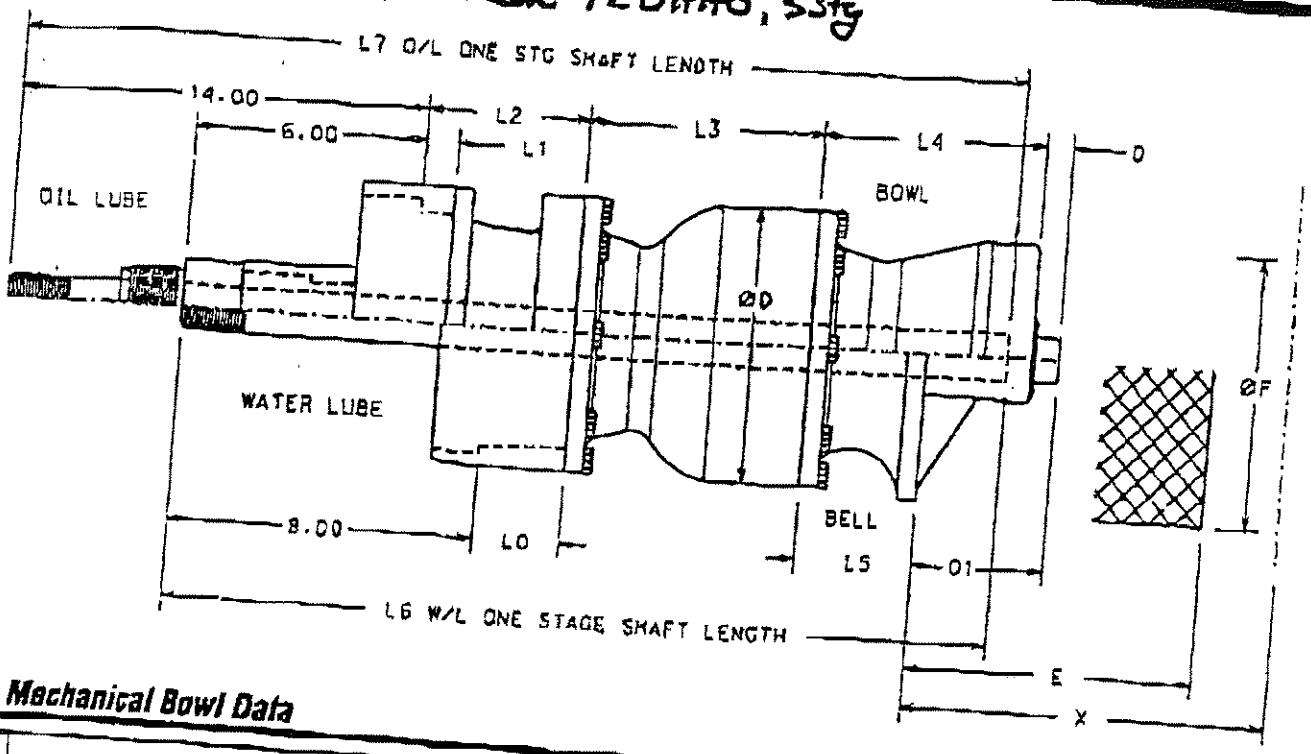
Engineering Data

Effective January 1, 2000

North Kingstown RI

Well #10 Christensen 12DHHO, 5stg

4 of 6



Turbine Mechanical Bowl Data

Model and Size	Bowl Assembly Length										Basket Strainer (Optional)		Floor Clearance	Bowl O.D.	Bowl Shaft Dia.	Available Lineshaft Sizes	Column Pipe Size	Suction Pipe Size	1st Stage Bowl Assembly Wt.		Add'l Stage Wt.
	L_8	L_1	L_2	L_3	L_4	L_5	L_6	L_7	D	D1	E	F	X	B					Open Shaft	Encl. Shaft	
18DH	2.94	1.25	5.19	9.25	8.38	5.75	30.63	38.88	4.44	7.06	11.38	14.75	14.00	9.50	1.89	1.00-1.89	4,6,8	8	140	170	84
18L	2.94	1.25	7.63	8.75	9.38	9.38	30.81	41.50	4.00	4.00	6.63	12.75	8.50	9.50	1.89	1.00-1.89	6,10	8	165	225	84
18RA	2.94	1.25	5.19	6.63	N/A	3.94	25.08	33.31	N/A	6.69	7.25	8.50	7.88	9.50	1.50	1.00-1.50	4,6,8	N/A	141	176	78
18RJ	2.94	1.25	5.19	8.40	9.88	5.88	28.13	36.44	0.84	4.75	6.25	12.75	7.50	9.50	1.50	1.00-1.50	6,8	8	130	165	60
18WA	2.94	1.25	5.19	7.63	9.19	5.06	27.13	35.38	1.00	5.13	6.63	11.25	9.00	8.50	1.50	1.00-1.50	4,6,8	6	128	180	56
11C	3.50	1.00	5.75	9.88	10.13	5.63	30.25	38.50	0.88	5.38	6.25	12.13	8.00	11.00	1.89	1.00-1.89	6,8,10	8,10	240	265	97
11RA	4.13	2.13	5.75	8.00	N/A	4.69	28.63	38.25	N/A	8.00	6.63	10.63	8.13	11.50	1.89	1.00-1.89	6,8,10	N/A	216	231	103
11WA	3.50	1.00	5.75	8.75	10.13	5.63	28.38	37.63	0.88	5.38	6.25	12.13	9.50	11.00	1.89	1.00-1.89	5,6,8	8	229	254	80
12C	4.13	2.13	5.75	11.00	10.38	6.88	32.83	40.25	0.88	4.38	6.25	12.13	8.00	11.75	1.89	1.00-1.89	6,8,10	8,10	283	266	124
12DH	4.13	2.13	5.75	11.25	9.60	6.00	33.25	40.88	2.50	4.00	6.25	12.13	13.00	11.60	1.94	1.00-1.94	6,8,10	10	275	300	129
12FR	4.13	N/A	8.25	12.50	9.13	8.00	33.75	43.88	2.88	4.00	6.25	12.13	13.00	11.75	1.94	1.00-1.94	10	10	255	320	129
12WA	4.13	2.13	5.75	9.00	9.75	6.88	28.88	37.50	1.00	3.88	6.25	12.13	8.00	11.60	1.89	1.00-1.89	8,8,10	5	240	285	95
12RJ	4.13	2.13	5.75	9.60	10.38	8.88	30.81	38.50	0.88	4.38	6.25	12.13	8.00	11.60	1.89	1.00-1.89	6,8,10	8	250	275	95
12C	4.13	N/A	5.75	11.13	10.13	5.56	32.00	39.83	1.00	5.56	6.25	12.13	8.00	12.38	1.94	1.00-1.94	8,10	10	315	380	150
13RA	3.13	3.00	9.00	9.80	N/A	7.00	31.38	43.25	N/A	5.50	11.50	14.75	7.63	13.38	1.94	1.00-1.94	8,10,12	N/A	374	458	184
14DH	3.13	3.00	9.00	13.25	10.75	10.75	37.00	49.88	5.88	5.88	13.25	15.50	18.00	13.25	2.19	1.19-2.19	10,12	12	405	490	189
14F	6.50	N/A	13.50	13.63	11.00	11.00	40.25	53.25	3.75	3.75	11.38	13.75	12.00	14.00	2.19	1.19-2.19	10,12	10	493	588	195
14H	6.50	N/A	13.50	13.63	11.00	11.00	40.25	53.25	3.75	3.75	11.38	13.75	12.00	14.00	2.19	1.19-2.19	10,12	10	493	588	195
14RJ	3.13	3.00	9.00	11.50	10.38	8.25	31.75	43.63	1.13	5.25	9.63	14.00	10.00	13.63	1.94	1.00-1.94	8,10,12	10	380	475	155

(All dimensions are in inches and weights in lbs.)

Continued on next page.

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A division of Layne Christensen Company

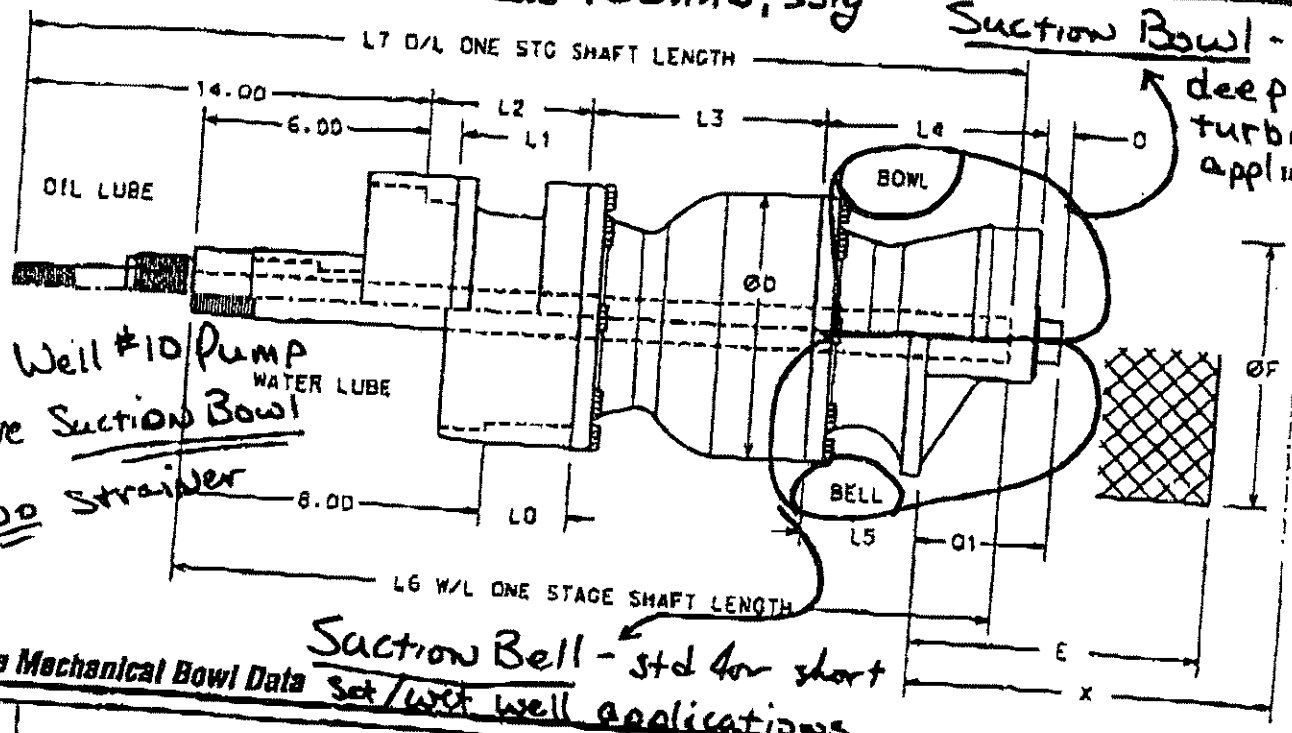
Engineering Data

Effective January 1, 2000

2 of 2

North Kingstown RF

Well #10 Christensen 12DHHO, 5 stg



Suction Bowl - std for deep well turbine application:

New Well #10 Pump to have Suction Bowl and NO Strainer

Suction Bell - std for short set/wet well applications

Turbine Mechanical Bowl Data

Model and Size	Bowl Assembly Length L4	L1	L2	L3	L5	L6	L8	L7	O	O1	Basket Strainer (Optional) E	F	Floor Clearance X	Bowl O.D. D	Bowl Shaft Dia.	Available Lineshaft Sizes	Column Pipe Size	Suction Pipe Size	1st Stage Bowl Assembly Wt. Open Shaft	Encl. Shaft	Add'l Stage Wt.
7DDH	2.94	1.25	5.19	9.25	9.38	5.75	30.63	38.88	4.44	7.06	11.38	14.75	14.00	8.50	1.88	1.00-1.88	6,8	8	140	170	64
10L	2.84	1.25	7.83	8.75	9.38	9.28	30.81	41.50	4.00	4.00	8.83	12.75	8.50	9.50	1.88	1.00-1.88	8,10	8	195	225	84
10RA	2.94	1.25	5.18	8.83	N/A	3.94	25.06	33.31	N/A	5.69	7.25	8.50	7.88	9.50	1.50	1.00-1.50	4,6,8	N/A	141	178	76
10RJ	2.84	1.25	5.19	8.40	9.69	5.88	28.13	36.44	0.94	4.75	8.25	12.75	7.50	9.50	1.50	1.00-1.50	8,6	6	130	185	60
10WA	2.84	1.25	5.19	7.83	8.19	5.08	27.13	35.38	1.00	5.13	8.83	11.25	9.00	9.50	1.50	1.00-1.50	4,6,8	6	128	180	58
11C	3.50	1.00	5.75	9.88	10.13	5.83	30.25	38.50	0.88	5.38	8.25	12.13	8.00	11.00	1.88	1.00-1.88	8,8,10	8,10	240	265	87
11RA	4.13	2.13	5.75	8.00	N/A	4.83	28.83	36.25	N/A	8.00	6.83	10.63	8.13	11.80	1.88	1.00-1.88	8,8,10	N/A	218	291	103
11WA	3.50	1.00	5.75	8.75	10.13	5.83	29.38	37.63	0.88	5.38	8.25	12.13	8.50	11.00	1.88	1.00-1.88	5,8,8	8	229	254	90
12C	4.13	2.13	5.75	11.00	10.38	6.88	32.63	40.25	0.88	4.38	8.25	12.13	8.00	11.75	1.88	1.00-1.88	8,8,10	8,10	283	295	124
12DN	4.13	2.13	5.75	11.25	9.50	8.00	33.25	40.88	2.50	4.00	8.25	12.13	13.00	11.60	1.94	1.00-1.94	5,8,10	10	275	300	128
12FR	4.13	N/A	8.25	12.50	9.13	8.00	33.75	43.88	2.88	4.00	8.25	12.13	13.00	11.75	1.94	1.00-1.94	10	10	255	320	128
12WA	4.13	2.13	5.75	9.00	9.75	6.88	29.88	37.50	1.00	3.88	8.25	12.13	8.00	11.60	1.88	1.00-1.88	5,8,10	6	240	265	95
12RJ	4.13	2.13	5.75	8.80	10.38	6.88	30.81	38.50	0.88	4.38	8.25	12.13	8.00	11.80	1.88	1.00-1.88	5,8,10	8	250	275	95
13C	4.13	N/A	5.75	11.13	10.13	5.86	32.00	38.63	1.00	5.58	8.25	12.13	8.00	12.38	1.94	1.00-1.94	8,10	10	315	380	150
13RA	3.13	3.00	9.00	9.50	N/A	7.00	31.38	43.25	N/A	5.50	11.50	14.75	7.83	13.38	1.94	1.00-1.94	8,10,12	N/A	374	459	184
13DN	3.13	3.00	9.00	13.25	10.75	10.75	37.00	49.88	5.88	5.88	13.25	15.50	18.00	13.25	2.19	1.19-2.19	10,12	12	405	490	189
14F	8.50	N/A	13.50	13.83	11.00	11.00	40.25	53.25	3.75	3.75	11.38	13.75	12.00	14.00	2.19	1.19-2.19	10,12	10	483	588	185
14N	8.50	N/A	13.50	13.83	11.00	11.00	40.25	53.25	3.75	3.75	11.38	13.75	12.00	14.00	2.19	1.19-2.19	10,12	10	493	668	185
14RJ	3.13	3.00	8.00	11.50	10.38	6.25	31.75	43.83	1.13	5.25	9.63	14.00	10.00	13.83	1.94	1.00-1.94	8,10,12	10	380	476	155

All dimensions are in inches and weights in lbs.)

Continued on next page.

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Layne Christensen Company

16 Commercial Drive, P.O. Box 309 • Dracut, Massachusetts 01826 • Phone: (978) 937-2242 • Fax: (978) 937-2252

November 26, 2002

1 of 2

Mr. Robert Silvia
Process Engineers & Constructors, Inc.
159 Knight Street
Warwick, RI 02886

Re: New Well Pump Installation @ Well #10 - North Kingstown, RI - Additional Information

Dear Mr. Silvia,

In response to Fay, Spofford & Thorndike, Inc.'s "Conditional Approval" letter we offer the following information:

1. As the original pumping equipment did not include a suction cone strainer on the intake of the pump bowl, a suction bowl strainer will not be provided for the new bowl assembly. Typically strainers are not used for deep well applications as over time the strainer itself may become encrusted with mineral deposits thereby reducing the flow of water into the pump.

2. The suction case of the proposed new bowl assembly will be a standard deep well turbine pump suction bowl with a female thread at the intake. While the female thread allows for installation of a suction pipe below the bowl assembly no suction pipe is to be provided.

We trust that the information presented is complete, however, if FST or the Town require additional information please contact our office at 978-937-2242.

Please note that while the pump bowl has been constructed and tested it will not be released for shipment from the manufacturer until a written acceptance has been received from FST.

A final schedule for installation of the bowl can be discussed once we receive the bowl in our yard.

Sincerely,
Layne Christensen Company

Thomas S. Hydro

Thomas S. Hydro
District Manager

Christensen

North Kingstown, RI
Well #10
12 DHHO, SSfg

6056

Christensen Pumps

A division of Layne Christensen Company

Installation, Operation and Maintenance Instructions

MODEL VT

Effective November 1988

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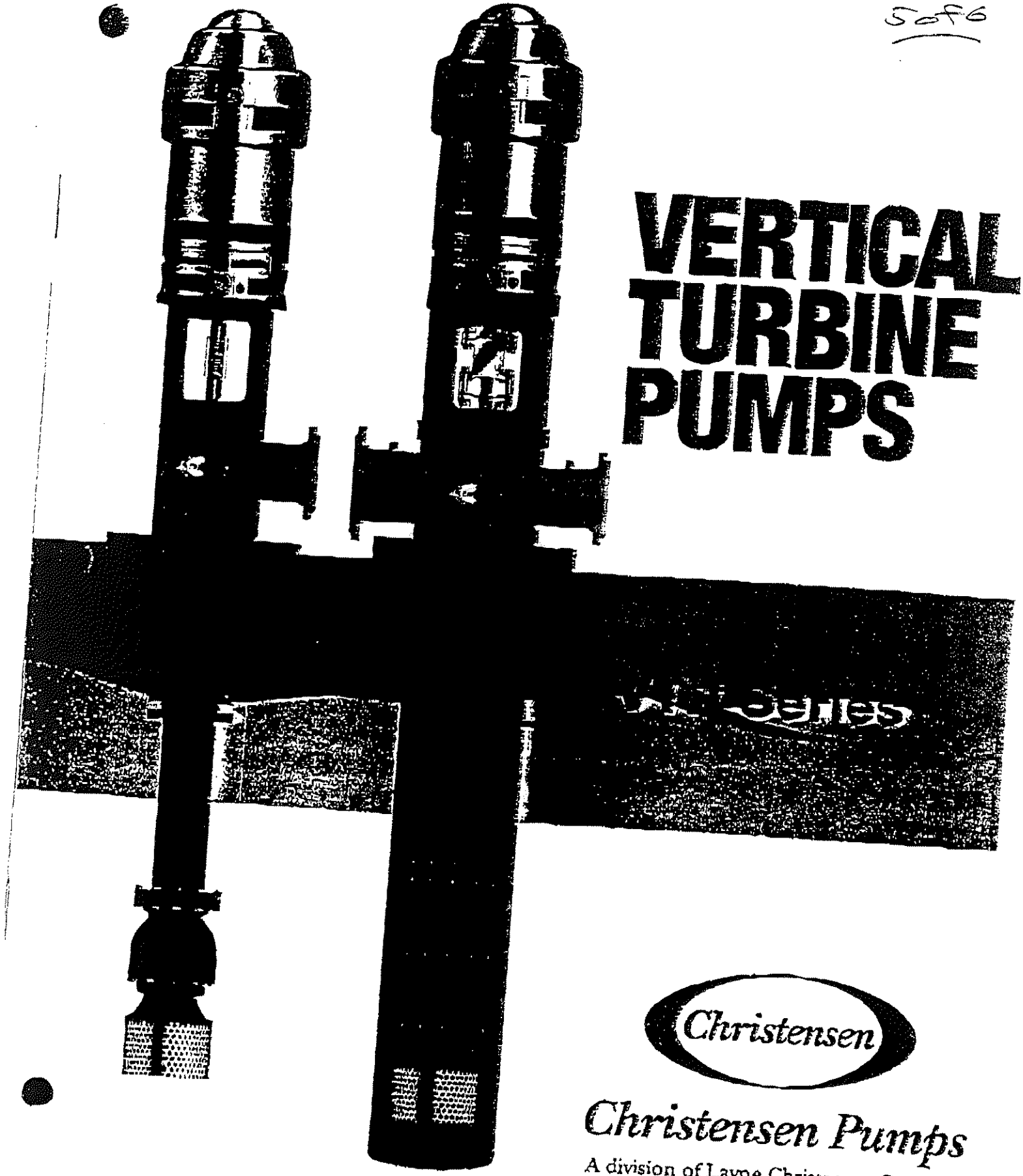

VERTICAL TURBINE PUMPS

Christensen

Christensen Pumps

A division of Layne Christensen Company

Layne Christensen Company

16 Commercial Drive, P.O. Box 309 • Dracut, Massachusetts 01826 • Phone: (978) 937-2242 • Fax: (978) 937-2252

October 9, 2003

Mr. Robert Silvia
Process Engineers & Constructors, Inc.
159 Knight Street
Warwick, RI 02886

Re: New Well Pump Installation @ Well #10 - North Kingstown, RI - Pump Performance

Dear Mr. Silvia,

The purpose of this letter is to address concerns regarding the performance of the Christensen 12DHHO, 5-stage vertical turbine pump installed within the North Kingstown Water Department's Well No. 10.

Project History

As part of the upgrade to the Well No. 10 Station the existing well and pumping equipment were scheduled to be reconditioned to return the installation to peak performance. In order to complete this work the existing vertical turbine pump had to be removed from the well. Once removed the pump was disassembled, cleaned and inspected by our Installer. Observations made during that inspection indicated that, while the motor and column assemblies were in relatively good condition, all components of the Deming H12, 9-stage pump bowl were worn and out of tolerance to the point that replacement of the pump was necessary.

Pump Design and Selection Process

Based on the pump ID tag and a review of available documents, it was determined that the design point of the existing Deming pump was 1,500 gpm @ 405' TDH. As the new treatment system was to be designed for a flow rate of 2,100 gpm a revised design point was required to select the proposed replacement pump. The Town was advised of this situation and they in turn contacted representatives from Pare Engineering to review historical documents and system requirements to arrive at a design point for the new pump. Based on Pare's evaluation a final design point of 2,100 gpm @ 250-foot TDH was selected.

Combining the new design point with the actual well diameter of 12-inches, we began a review of available pumps suitable for installation. Unfortunately, due to the extremely high flow rate and the relatively small well diameter, it was quickly apparent that the selection would be very limited. While several manufacturers offer a 12-inch, 1800 RPM bowl that can deliver the required 2,100gpm, the actual outside diameter of the bowl for nearly all possible selections was 11.75-inches. With this tight of a tolerance there are serious concerns regarding not only the initial installation, but future service work on the pump as even the slightest amount of mineral build up or debris that gets between the bowl and well casing could lock the unit in place, as is the situation at the Town's Well No. 5.

In the end the pump selected and accepted was a Christensen 12DHHO, 5-stage, 11.6-inch OD open impeller bowl designed to deliver 2,100 gpm against a TDH of 250-feet with an efficiency of approximately 82.1%. The new unit was constructed to accommodate the reuse of the existing 8-inch x 1-13/16-inch column/shaft assembly.

Installation and Initial Testing

Upon acceptance of the factory test data by the Town's design engineer, Fay, Spofford and Thorndike, (FST) the new bowl was delivered and installed within the well on December 17, 2002. Despite the expected tight fit within the well casing, there were no problems noted during installation. The actual field test of the equipment was postponed until April 8, 2003 so as not to conflict with other on-site activities. During this testing the pump was discharged to waste on-site monitoring flow rates, water levels and discharge pressures utilizing Layne's calibrated equipment. The test was conducted with the open impellers set at various clearances until the optimal performance could be achieved. During the second to last test with the pump delivering 1,971 gpm, the pump TDH was within 3.44% of meeting the design curve. As it was noted that the impellers appeared to be dragging at start up, an adjustment was made to raise the impellers. At the completion of the field testing the pump was delivering 1,962 gpm against a TDH of 258.37-feet.

Once the data was tabulated several copies of an Engineering Document Package containing all of the filed test and pump submittal data were provided to Process Engineers as required. While we have not yet received any

official written notification, we have been advised that the Town's engineer, FST, has not authorized final acceptance of the equipment.

Subsequent Testing and Performance Concerns Noted by Process Engineers
Once the final system components were installed, additional pumping tests were completed by Process Engineers. During these tests several performance concerns were noted:

1. Apparent maximum flow rates generated by the pump fell in the range of 1,800 gpm +/-.
2. The 200Hp motor starter was tripping out on overload.

As no Layne representatives were present during this subsequent testing we can only speculate at the reasons for the lower flow rates (impeller adjustment, valve adjustment, etc...). However, regarding the motor overload situation, we believe that a combination of the slow opening Golden Anderson Valve in-line within the pump station and the phenomenon of shaft stretch are contributing factors. As this valve is closed upon start up of the pump and opens very slowly as the pressure builds, the pump operates in a "no flow" condition for a period of time resulting in high discharge pressures and shaft stretch/elongation that can cause the impellers to drag within the bowl assembly. If the valve does not open fast enough the continued impeller drag puts additional load on the motor driving up the input amperage eventually causing the starter to trip out on overload.

Shaft stretch is a common occurrence in all lineshaft turbine pumping units. Typically the actual stretch realized is not sufficient to affect the overall pump performance, however, in some cases, depending on the shaft diameter and the head pressures developed by the pump, the stretch can result in impeller drag on start up. While the performance of both enclosed and open type impeller pumps can be affected by shaft stretch, it is the open impeller units that are more at risk due to the nature of their design. The performance of an open impeller pump is dependent upon proper adjustment of the impellers as this controls the clearance of the impeller veins above the bowl face. The tighter the clearance the better the performance.

Once the performance problems were noted and confirmed shaft stretch calculations were completed. The data generated indicates that it is theoretically possible that stretching of the existing 1-13/16-inch diameter shafting may be inhibiting the pump performance. For peak performance of an open impeller pump the impeller clearance is generally set between 0.007 and 0.025-inches. By our calculations the theoretical shaft stretch occurring during operation of the pump ranges from 0.0826-inches at shut off to 0.0498-inches at a TDH of 250-feet. (see attached calculation sheets)

Additional Testing
In order to properly confirm and address the pump performance issues, Layne would like to collect additional data by conducting further field testing of the equipment. Ideally we'd like to run the pump first to waste through the station piping to verify that the pump does or does not meet the design curve, and then into the system to verify performance under standard operating conditions. Once this testing is complete we will be able to offer suggestions for remedying the situation.

If the plan to proceed with the additional testing is acceptable, we would like to schedule the testing within the next 2-weeks if possible.

We trust that the information presented is complete, however, if you have questions or require additional information please contact our office at 978-937-2242.

Sincerely,
Layne Christensen Company

Thomas S. Hydro

Thomas S. Hydro
District Manager

Flow rate + discharge pressure

Layne Christensen Company
16 Commercial Drive / Box 309
Dracut, MA 01826
ph: 978-937-2242
fx: 978-937-2252

Owner: N.Kingstown Water Dept.
Supt.: Mike Martin
Inspector: D.R.Bernatas
Inspection Date: January 20th, 2000

WELL INFORMATION

Well No.: # 10 Diameter: 12" Depth: 107.5'
Drilled: Last Serviced: 1984 by R.E.Chapman

SCREEN INFORMATION

Diameter: 8" Length: 38' Slot Size: 0.15

PUMP INFORMATION

Pump No.: T-30551 Make: Demming Column: 10" X 1 13/16"
Discharge: 10" Old Style Demming Installed: Air Line:
Depth to Suction: Flow Measurement: 5" X 6" Orfice attached to Blow off

MOTOR INFORMATION

Make: US,Premium Frame: 445TPA Hp / Volts: 200 / 460 RPM: 1785
Base: 20" Type: RUS Design Amperage: 228
Last Amperage: 190.8 / 190.9 / 193 Present Amperage: 202 / 211 / 202

WELL PERFORMANCE

	Date	Static	GPM	Pumping Level	Drawdown	Specific Capacity	Percent Off
Original	1984	6.17'	340	8.17'	2'	170	
Last Insp.	11/18/98	11.45'	988	20.65'	9.20'	107.39	
Present	1/20/00	11.25'	1045	22.37'	11.12'	93.97	

PUMP PERFORMANCE

	Date	GPM	Pumping Level	Discharge Pressure	Observed TDH	Curve TDH	Percent Off
Original	11/20/97	1041	19.35'	170	414'		
Last Insp.	11/18/98	988	20.65'	170	414.75'		
Present	1/20/00	1045	22.37'	180	439.57'		

MAINTENANCE SERVICE

Motor Oil: Yes Grease: Yes Packing: Yes

Layne Christensen Company
16 Commercial Drive / Box 309
Dracut, MA 01826
ph: 978-937-2242
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Well and Pump Inspection and Test Data Sheet

Owner: No.Kingstown RI. Water Dept.
Well / Pump No.: # 10
Pump Make & Serial No.: Demming , T-30551
Motor Information: US,200Hp,Frame445TPA,TypeRUS,Base20" Rpm1785,Volt460,Amp228,Model R488A
Inspector: D.R.Bernatas
Inspection Date: January 20th, 2000

Static Water Level: 11.25' Add 1.4' PSI CL

Pumping Level	Draw Down	Flow Meter	Pitot or Orifice	Specific Capacity	Discharge Pressure	TDH	AMPERAGES			KILOWATTS			Total	VOLTAGES		
							L1	L2	L3	L1	L2	L3		L1	L2	L3
			0		240	567.05										
18.74'	7.49'		782	104.4	210	505.24'	192	200	191	42.7	44.7	43.4	130.8	471	473	476
20.00'	8.75'		871	99.54	200	483.4'	195	204	193	43.5	45.9	45	134.4			
22.37'	11.12'		1045	93.97	180	439.57'	202	211	202	45.5	47.7	47.3	137.5			

Comments:

Electrical Hp = 184.31 , Water Hp = 116.16 , Wire to Water = 63.02% , Motor Oil ,Grease and Packing were replaced

The Flow test was conducted thru a 5" X 6" orfice connected to the station blow off line.

Both the Motor and Pump appear to be operating normally

Layne Christensen Company
Thomas Hydro
North Kingstown Well No. 9 - Option B

Goulds Turbine Pump Selection ver: 8.042
11/08/01

PUMP DATA SHEET
Goulds Turbine 60 Hz

Selection file: (untitled)
Catalog: TURB60.MPC v 1.6.1

Curve: 1133-1

Design Point: Flow: 1600 US gpm
Head: 210 ft

Pump: TURBINE - 1800
Speed: 1760 rpm
Size: 10LHC (8 stages)
Dia: 5.81 in

Limits: Temperature: --- °F
Pressure: 245 psi_g
Sphere size: 0.62 in
Power: --- bhp

Specific Speed: Ns: 5350 Nss: ---

Vertical Turbine: Bowl Size: 9.5 in
Thrust K Factor: 14
Max Lateral: 0.5 in

Motor: 125 hp
Speed: 1800
NEMA Standard
Frame: 444T
TEFC Enclosure
sized for Max Power on Design Curve

Fluid: Water
Temperature: 60 °F
SG: 1
Viscosity: 1.122 cP
Vapor pressure: 0.2568 psi_a
Atm pressure: 14.7 psi_a

NPSHa: --- ft

Piping:
System: ---
Suction: --- in
Discharge: --- in

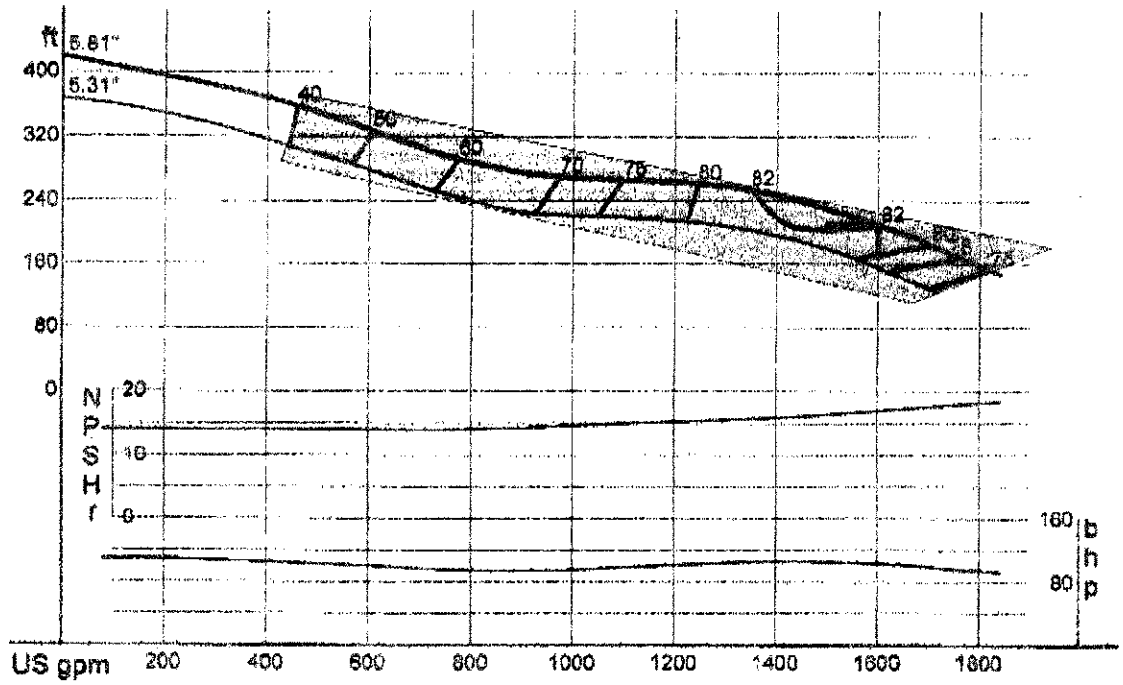
Suction Size-8" Discharge Sizes-6",10"

---- Data Point ----
- Flow: 1600 US gpm
- Head: 210 ft
- Eff: 82.1%

Power: 103 bhp
NPSHr: 17 ft

-- Design Curve --
Shutoff Head: 420 ft
Shutoff dP: 182 psi
Min Flow: - US gpm
BEP: 83% eff
@ 1487 US gpm
NOL Pwr: 110 bhp
@ 200 US gpm

-- Max Curve --
Max Pwr: 110 bhp
@ 200 US gpm



--- PERFORMANCE EVALUATION ---

Flow US gpm	Speed rpm	Head ft	Pump %eff	Power bhp	NPSHr ft	Motor %eff	Motor kW	Hrs/yr	Cost /kWh
1920	Flow Rate is Out of Range for this Pump								
1600	1760	210	82.1	103	17				
1280	1760	258	80.7	103	15.5				
960	1760	271	69.3	94.7	14.5				
640	1760	320	52	99.3	14				

CHRISTENSEN PUMPS
MEMPHIS, TENNESSEE
NORTH KINGSTOWN, RI - WELL No. 10

PUMP DATA SHEET

Turbine 60 Hz

05/21/03

Selection list: ---

Search Criteria:
Flow: 2100 US gpm
Head: 250 ft
Tolerance: --- % of head

Fluid: Water
Temperature: 60 °F
SG: 1
Viscosity: 1.105 cP
Vapor pressure: 0.2563 psi a
Atm pressure: 14.7 psi a

NPSHa: --- ft

Advanced Criteria:
Preferred Operating Area: ---
Secondary Operating Point: ---
Max temperature: --- °F
Max suction pressure: --- psi g
Max sphere size: --- in
Max power: --- bhp
Max suction specific speed: --- (Nss)
Min trim: --- % of max diameter
Min head rise: --- % to shutoff

Curve Corrections: none

Catalog: Lineshaft 60Hz vers 2.03

Pump: 12DHHO (5 stages)
Type: Lineshaft
Synch speed: 1800 rpm
Speed: 1760 rpm
Dia: 7.6875 in
Curve no.: 1135-1

Specific Speeds
Ns: 3750 Nss: ---

Dimensions:
Suction: --- in Discharge: --- in

Vertical Turbine:
Bowl size: 11.6 in
Max lateral: 0.68 in
Thrust K factor: 23 lb/ft

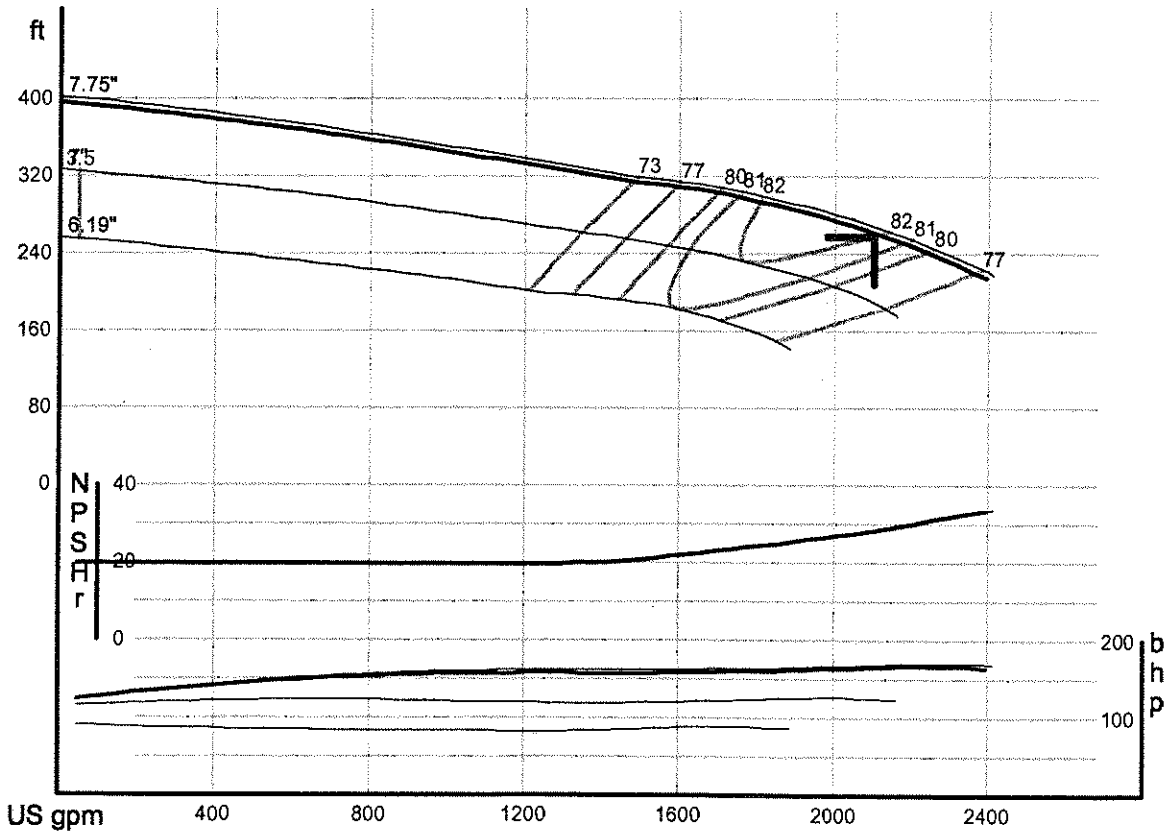
Pump Limits:
Temperature: 120 °F
Pressure: 325 psi g
Sphere size: 0.81 in
Power: --- bhp

Motor: 200 hp
Speed: 1800
Frame: 445
Standard: NEMA
Enclosure: WPI
Sizing criteria: Max Power on Design Curve

---- Data Point ----
Flow: 2100 US gpm
Head: 253 ft
Eff: 82.1%
Power: 163 bhp
NPSHr: 27.4 ft

-- Design Curve --
Shutoff Head: 385 ft
Shutoff dP: 167 psi
Min Flow: --- US gpm
BEP: 82.9% eff
@ 1921 US gpm
NOL Pwr: 165 bhp
@ 2177 US gpm

-- Max Curve --
Max Pwr: 169 bhp
@ 2200 US gpm



Pump note: Suction Size-10" Discharge Sizes-8",10"

CHRISTENSEN PUMPS
MEMPHIS, TENNESSEE
NORTH KINGSTOWN, RI - WELL No. 10

PUMP DATA SHEET

Turbine 60 Hz

05/21/03

Selection list: ---

Catalog: Lineshaft 60Hz vers 2.03

Pump: 12DHHO (5 stages)

ormance Evaluation:

Flow	Speed	Head	Pump	Power	NPSHr	Motor	Motor	Hrs/yr	Cost
US gpm	rpm	ft	%eff	bhp	ft	%eff	kW		/kWh
2520	Flow Rate is Out of Range for this pump								
2100	1760	253	82.1	163	27.4				
1680	1760	295	79.5	157	22				
1260	1760	319	64.9	156	19.2				
840	1760	345	47.3	151	19				