EnTech Inc.
Professional Engineers and Land Surveyors



November 15, 2011

MEMO

TO: Dan Coughlin, SAWSJPB Project Manager

FROM: David Engels, Project Engineer

RE: Booster Station Project Business Case for Green Project Reserve Funding Eligibility

## I. Introduction

The Sheridan Area Water Supply Joint Powers Board (SAWSJPB) is applying for funding to upgrade the pump and motor systems within eight water booster stations within its distribution system. This memorandum is for the purpose of supporting the eligibility of these project components for the Green Project Reserve funding in the form of a business case submittal, based upon increased energy efficiencies to be achieved by this proposed project.

## II. Project Purpose and Need

The booster stations in which the pumps and motors proposed for upgrade were originally installed between 1991 and 1994. These pumps and motors are close to exceeding or have exceeded their useful lives. The eight booster stations are included within the 17 SAWSJPB booster stations within its entire water system, which is depicted in Figure 1. All but four of the SAWSJPB's booster stations are below-ground facilities. Figure 2 is a surface view of a typical below-ground SAWSJPB booster station.


*Figure 2 - Typical Below-Ground SAWSJPB Booster Station*

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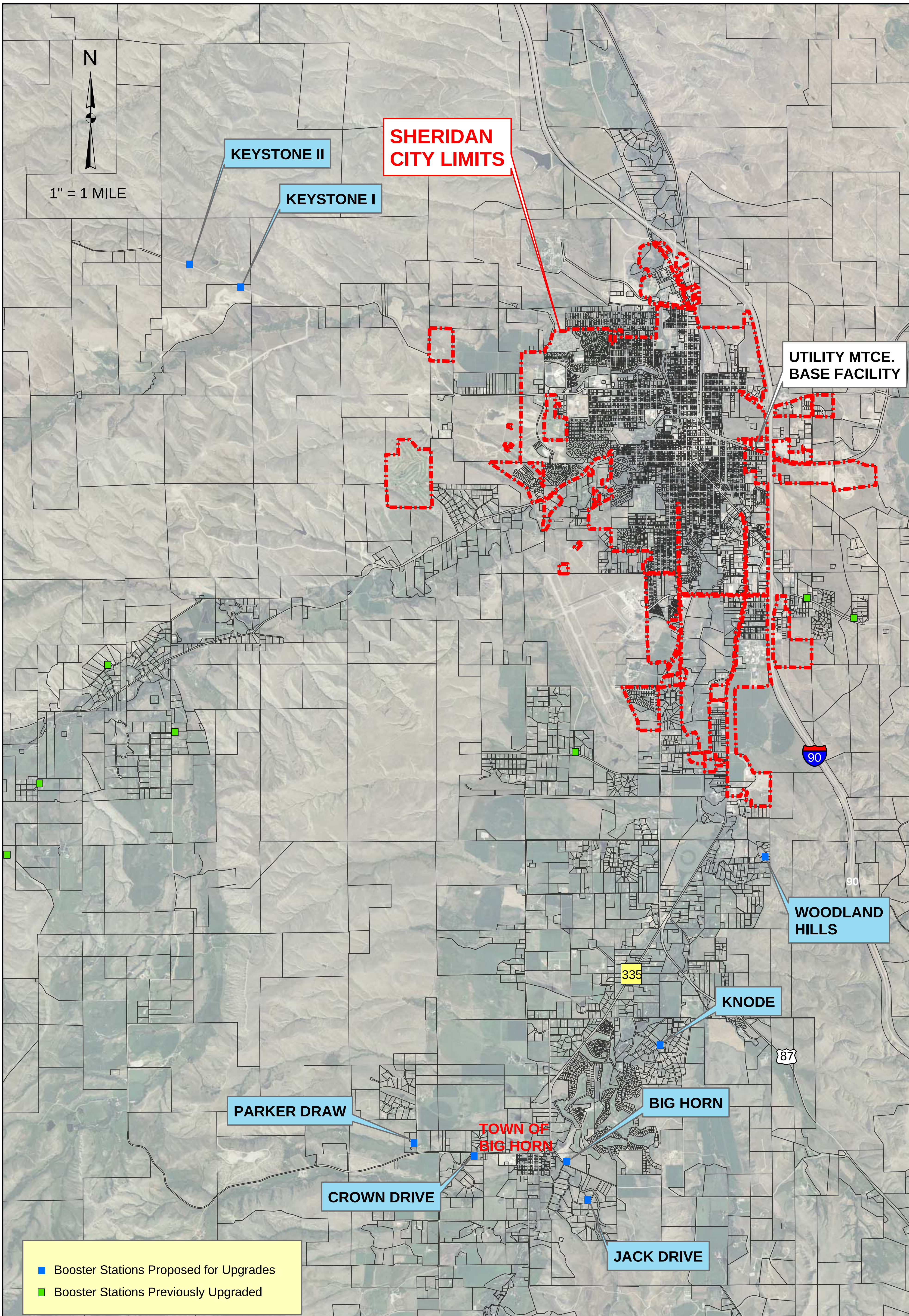


FIG. 1

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*SHERIDAN AREA WATER SUPPLY JOINT POWERS BOARD BOOSTER STATIONS PROJECT*

*LOCATION MAP OF BOOSTER STATIONS*

Due to the relatively low density and large area served by the SAWSJPB's water system, only two of the SAWSJPB booster stations pump into storage tanks. The remaining booster stations must provide uniform pressure to SAWSJPB customers without the benefit of storage.
In order to maintain uniform system pressure without storage, the 1990s-constructed booster stations utilized a Hydroconstant® variable speed pumping system. The Hydroconstant system utilizes a constant speed motor, adjusting the pump speed and, therefore, discharge pressure. Figure 3 shows a typical Hydroconstant system within an existing SAWSJPB booster station.

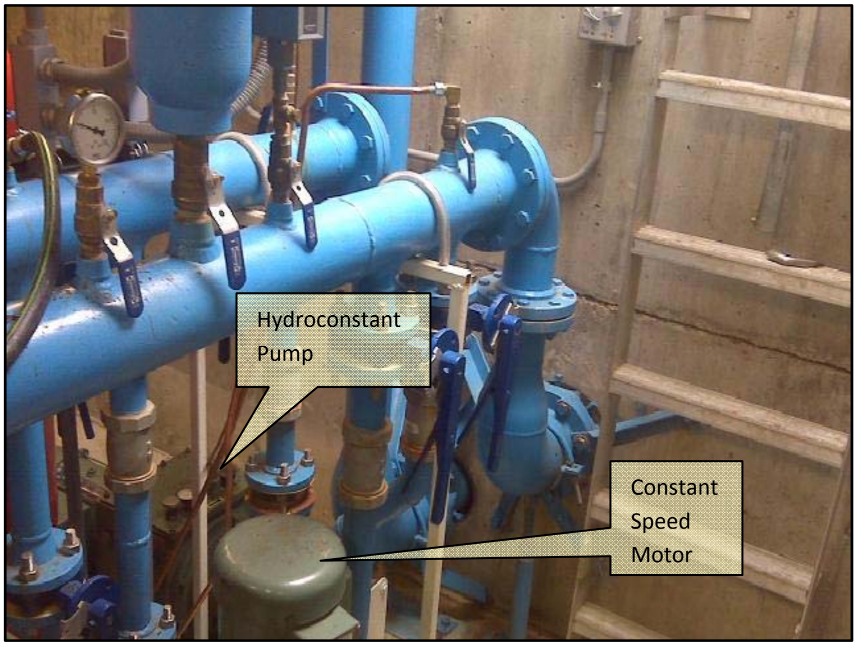



*Figure 3 – Typical Hydroconstant System in SAWSJPB Booster Station*

While effective from a pumping standpoint, the Hydroconstant technology has been supplanted by recent advances in pump and motor design, specifically use of variable frequency drives (VFDs) for modern pump motors. VFDs not only achieve the same objective as a Hydroconstant (i.e., constant water pressure without the need for a storage tank), but they do so with significantly greater energy efficiency. This energy efficiency is attained by modulating the pump motor (and correspondingly, the pump) in lieu of solely the pump itself.

SAWSJPB has replaced seven of its Hydroconstant systems over the past four years with pumps and motors that utilize VFDs. The locations of these booster stations where upgrades were previously performed are depicted in Figure 1. Significant energy efficiencies have been realized. SAWSJPB now seeks to upgrade its eight remaining booster stations that house the Hydroconstant systems with pumps and motors that utilize VFDs, in order to achieve similar energy efficiencies.

## III. <u>Estimation of Energy Savings</u>

Appendix A provides charts of historical electrical power usage data for the seven booster stations which have been upgraded over the past four years. Power consumption was determined by utilizing data obtained from Montana Dakota Utilities (MDU), the power utility in the SAWSJPB service area. For consistency, each chart includes not only historical power usage in bar chart form, but also a line graph of the two-year average for power consumption prior to the pump and motor replacements and one-year average for power consumption subsequent to pump and motor replacement.

Table 1 portrays the power usage reductions that have been achieved for four of the seven booster stations which have MDU power usage data included within Appendix A, based upon the two-year average pre-replacement and one-year average post-replacement.

**TABLE 1 – POWER USAGE REDUCTIONS FOR THE FOUR BOOSTER STATIONS WITH PREVIOUS PUMP AND MOTOR REPLACEMENTS AND ELECTRIC HEAT**

| BOOSTER STATION IN WHICH PUMPS AND MOTORS HAVE BEEN REPLACED | AVERAGE DAILY POWER CONSUMPTION PRE-REPLACEMENT (BASED UPON TWO-YEAR AVERAGE) (KW=HR/DAY) | AVERAGE DAILY POWER CONSUMPTION POST-REPLACEMENT (BASED UPON ONE-YEAR AVERAGE) (KW-HR/DAY) | PERCENT POWER SAVINGS |
|---|---|---|---|
| RAPID CK. | 27 | 15 | 45% |
| BECKTON HALL ROAD | 46 | 18 | 60% |
| TIMM DRIVE | 15 | 10 | 37% |
| ROCKY HILLS | 16 | 8 | 50% |
| TOTALS | 104 | 51 | AVG.= 48% |

Three of the seven booster stations are not included in Table 1, for the following reasons:

- The Beaver Creek Road booster station upgrade was performed in 2007, and it does not have complete records for two years prior and one year subsequent to the replacement.
- The Paradise Park booster station upgrade was performed in May 2011, and it does not have records for a period of time one year subsequent to the replacement.
- The Southeast booster station is heated with natural gas in lieu of electricity, thus it may not reflect anticipated power savings on a percentage basis from pump and motor upgrades as would the remaining four booster stations.

Appendix B provides charts of historical electrical power usage data for the eight booster stations which are proposed for upgrade as part of this project. Table 2 provides information on projected energy savings for these eight booster stations, based upon a savings of 48% as derived from records obtained from the four booster stations for which data was portrayed in Appendix A and Table 1.

Analysis of the MDU data reveals that there are also “spikes” in power usage for several of these eight booster stations during the cold winter months of December through February. As water usage is typically less during these winter months, increased power usage is thus attributed to heating requirements, as all eight booster stations rely upon electrical heaters. The initial design of the booster station upgrades will include an inspection of the existing stations to determine the feasibility of providing additional insulation to reduce energy usage as part of the project. Possible means to provide this additional insulation include:

a. spray-on foam insulation for the inside of the aluminum hatches;

b. retrofitting intake and exhaust piping to provide for dampers; and
c. insulating these intake and exhaust pipes.

**TABLE 2 – ANTICIPATED POWER USAGE REDUCTIONS FOR EIGHT BOOSTER STATIONS WITH PUMP AND MOTOR REPLACEMENTS PROPOSED AS PART OF THIS PROJECT**

| BOOSTER STATION IN WHICH PUMPS AND MOTORS ARE PROPOSED FOR REPLACEMENT | AVERAGE DAILY POWER CONSUMPTION PRE-REPLACEMENT (BASED UPON THREE-YEAR AVERAGE) (KW-HR/DAY) | PROJECTED PERCENT POWER SAVINGS (1) | PROJECTED DAILY POWER CONSUMPTION POST-REPLACEMENT (KW-HR/DAY) | ANNUAL POWER SAVINGS (BASED UPON $.047/KW-HR) ($) |
|---|---|---|---|---|
| WOODLAND HILLS (DEE DRIVE) | 19 | 48% | 10 | $154.12 |
| BIG HORN | 80 | 48% | 42 | $656.85 |
| CROWN DRIVE | 43 | 48% | 22 | $354.57 |
| PARKER DRAW | 44 | 48% | 23 | $363.65 |
| KNODE RANCH | 70 | 48% | 36 | $573.00 |
| JACK DRIVE | 37 | 48% | 19 | $305.61 |
| KEYSTONE 1 | 23 | 48% | 12 | $190.30 |
| KEYSTONE 2 | 25 | 48% | 13 | $208.75 |
| TOTALS | 342 | | 178 | $2,806.85 |

(1) based upon power savings for recently-upgraded booster stations – see Table 1.

## IV. Replacement Materials and Equipment Eligible for Green Project Reserve

Only costs associated with actually providing energy efficiency are eligible for monies from the Green Project Reserve program. The materials and equipment required for the replacement of the existing pumps and motors include the following:

- pumps, motors and associated motor control center (MCC), which includes the VGDs which link to the motors;
- associated piping, fittings and related connections;
- diaphragm pressure tank; and
- electrical wire and associated conduit connecting the motor to the MCC.

Figure 4 is a photo showing the materials and equipment used for a recent SAWSJPB booster station replacement. These materials and equipment were loaded onto a trailer that was subsequently taken to the jobsite for installation.

Of the materials and equipment shown, all are integral to retrofitting each booster station so that they achieve the energy efficiencies to be realized. The diaphragm pressure tank is required to provide an opportunity for complete shutdown of the pumping system during periods in which there is essentially no flow in the system, allowing water pressure to be maintained without a pump in operation. It also buffers excessive pressure modulations. Figure 5 portrays a typical installation of the replacement materials and equipment, and Figure 6 shows the finished product.

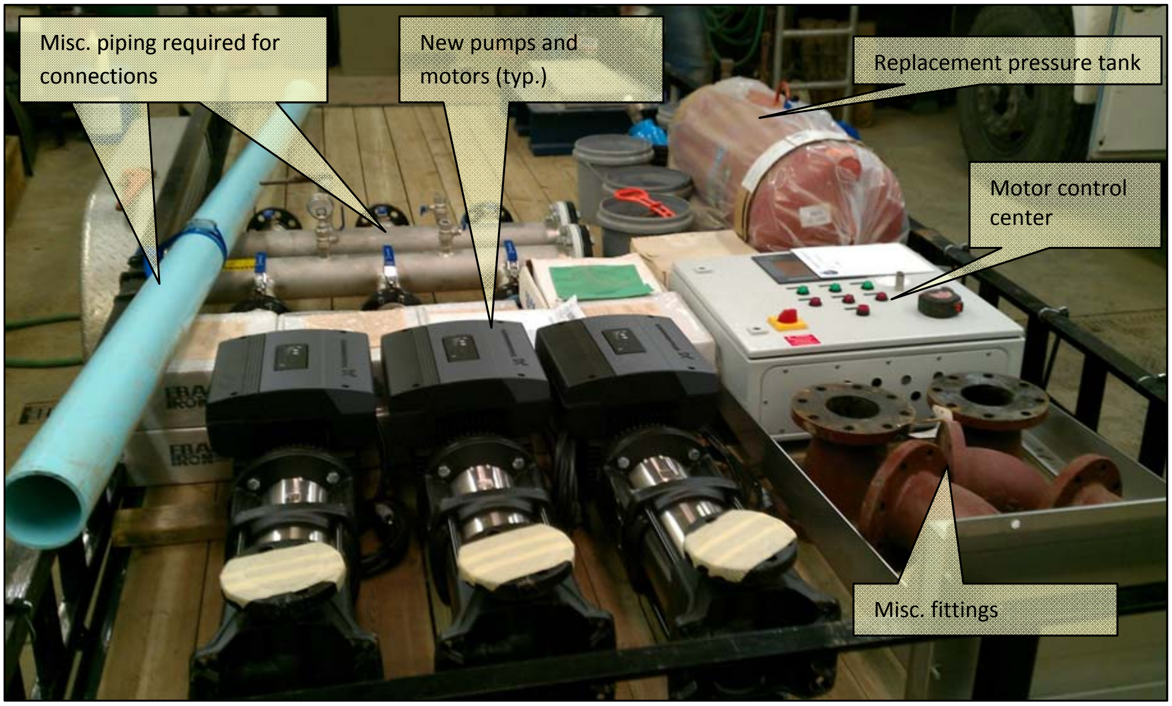



*Figure 4 – Typical Materials and Equipment Required for Booster Station Replacement*

*Figure 5 – Installation of Materials and Equipment Required for Booster Station Replacement*

*Figure 6 – Completed Booster Station Replacement*

The primary components of the replacement program for each booster station are the new pumps and motors. The National Electrical Manufacturers Association (NEMA) specifies energy-efficiency classes for single-speed, three-phase, cage-induction motors. Motors to be installed as part of this project will be E3, designated as “premium” by the NEMA due to their high energy efficiency.

Pump and motor systems used on the seven booster stations upgraded previously are the Hydro MPC system as manufactured by Grundfos. Information on the Grundfos Hydro MPC is included in Appendix C. Similar pump and motor systems are proposed for the eight booster stations associated with this project.

Besides being necessary for the proper fitting together of replacement piping, fittings replacements **also** improve energy efficiency. Existing piping and fittings in these small booster stations are made of unlined iron, which (due to their lack of lining) have incurred significant tuberculation. (See Figure 7.) New pipe will be made of PVC, and proposed iron fittings will be either epoxy or cement-motor lined, which will prevent tuberculation, maintain internal diameters and therefore improve energy efficiencies.

VFDs being installed as part of the booster station upgrades have the capability of being overridden, and thus could **in theory** reduce planned energy efficiencies. However, to override these VFDs would require manual operation of the pumps to prevent over-pressurization of the system, which would only be performed during an emergency. It would not be practical to use the new systems and bypass the VFDs. As such, the VFD systems will provide energy savings at essentially all times.

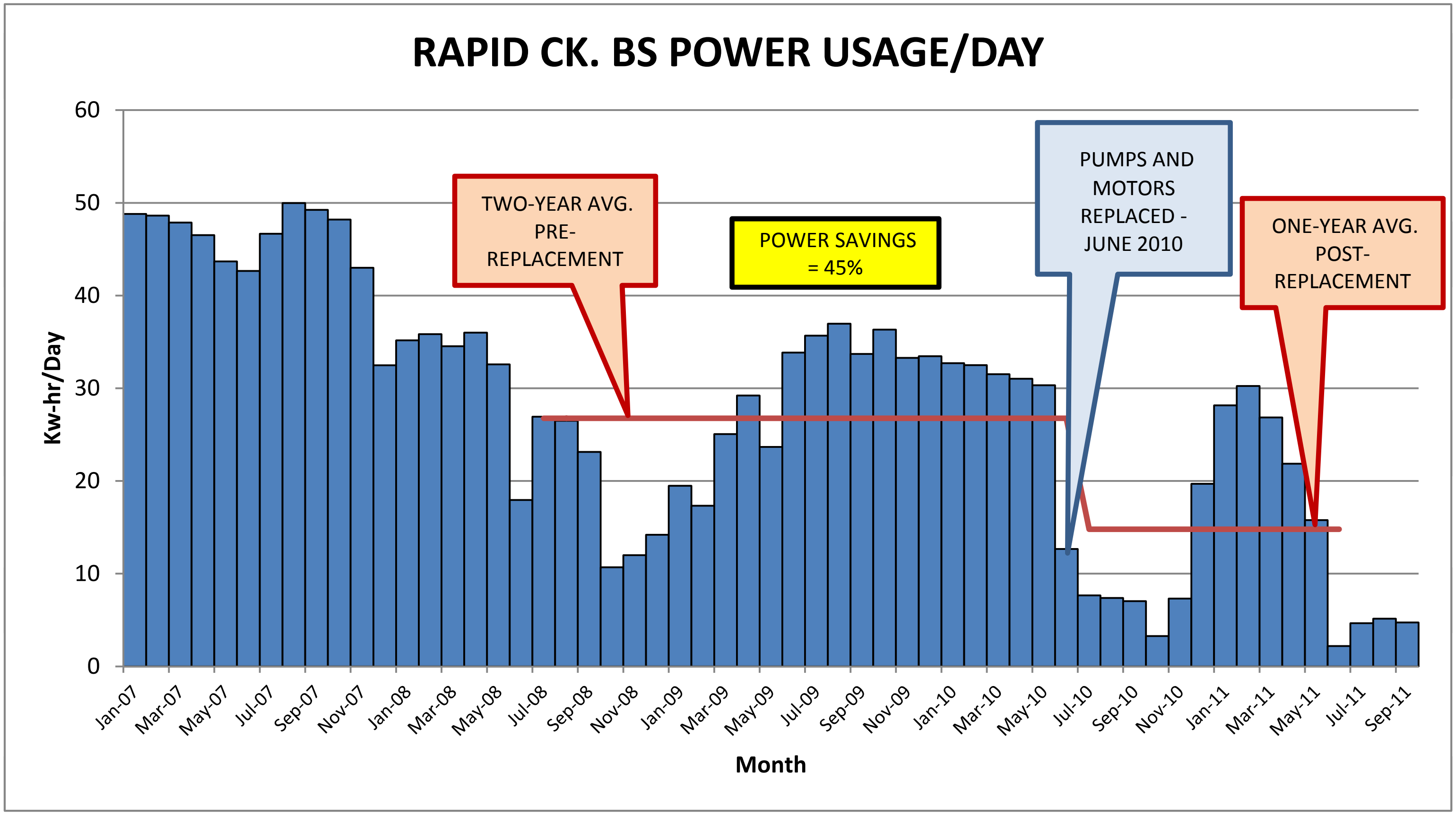
The components being installed will not only achieve direct power savings, they will provide indirect energy savings by reducing the frequency of inspection visits by utility distribution personnel. Many of these booster stations are in remote locations within the SAWSJPB’s service area, some as far as ten miles from the utility maintenance base facility. (See Figure 1.) Due to their relatively small size, only one of the booster stations (Big Horn) proposed for upgrade currently has been outfitted with telemetry equipment to monitor their operation. Without the existence of remote telemetry, and due to the current existence of mechanical equipment nearing its useful life within these booster stations (e.g., mechanical pressure switches, electrical switchgear, Hydroconstant pumps), weekly inspection is required in order to minimize the potential for problems that could lead to complete loss of the booster stations. Upon completion of the proposed upgrades, booster station reliability will increase due to advances in electronic controls, and the need for weekly inspections will decrease. Fewer routine inspections will correspondingly reduce fuel consumption and associated fleet costs.

For the reasons cited above, all components associated with this project are necessary in order to achieve energy efficiencies, and they are therefore determined to all be eligible for Green Project Reserve funding.

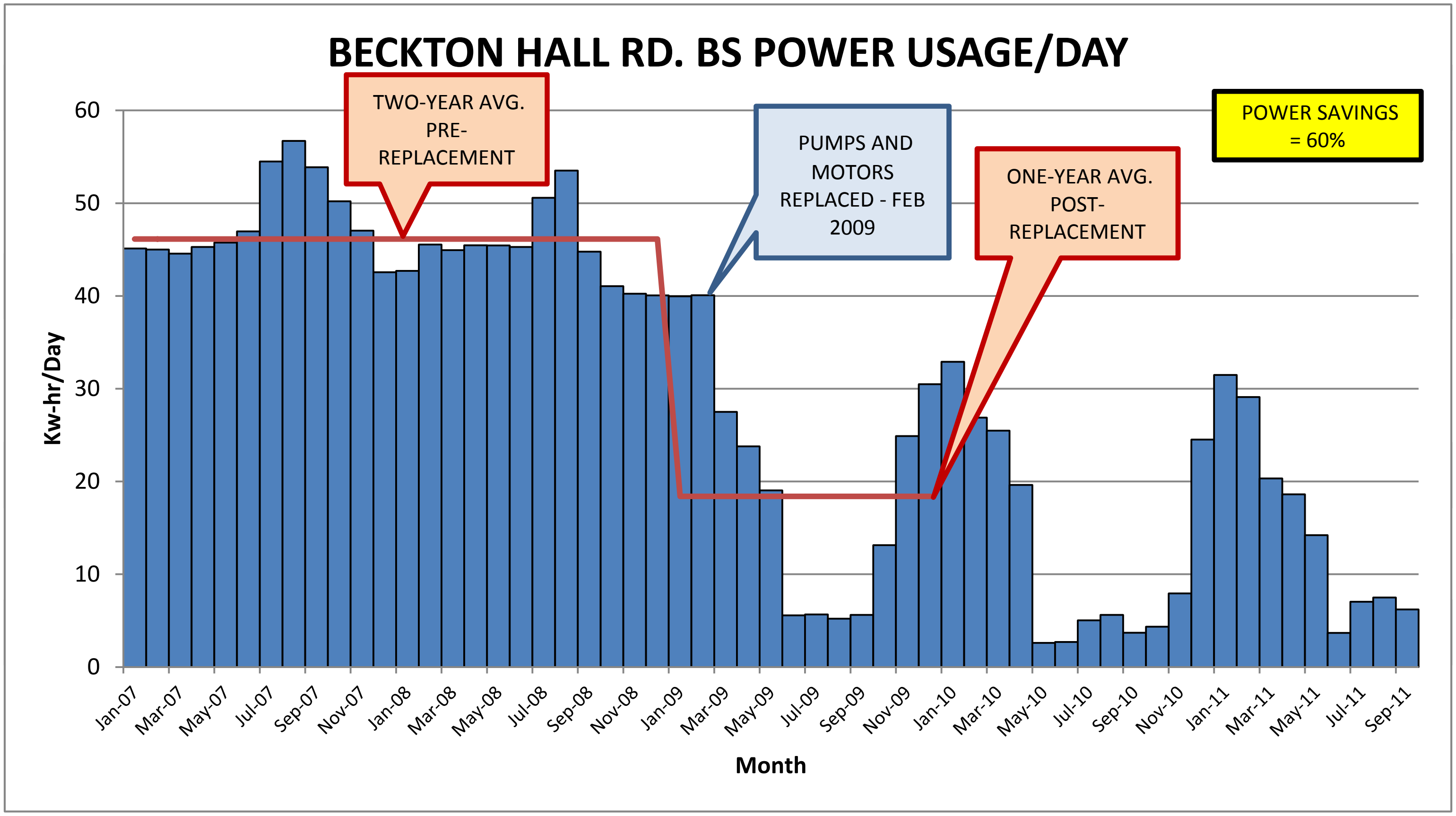
*Figure 7 – Tuberculation in Existing Fitting, Restricting Pipe Flow and Decreasing Energy Efficiency*

# APPENDIX A

## POWER USAGE DATA FOR SEVEN
## BOOSTER STATIONS PREVIOUSLY UPGRADED



RAPID CK. BS POWER USAGE/DAY
Kw-hr/Day
60
50
40
30
20
10
0
Jan-07
Mar-07
May-07
Jul-07
Sep-07
Nov-07
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Mar-11
May-11
Jul-11
Sep-11
Month
TWO-YEAR AVG. PRE-REPLACEMENT
POWER SAVINGS = 45%
PUMPS AND MOTORS REPLACED - JUNE 2010
ONE-YEAR AVG. POST-REPLACEMENT



BECKTON HALL RD. BS POWER USAGE/DAY
TWO-YEAR AVG. PRE-REPLACEMENT
PUMPS AND MOTORS REPLACED - FEB 2009
ONE-YEAR AVG. POST-REPLACEMENT
POWER SAVINGS = 60%
Kw-hr/Day
0
10
20
30
40
50
60
Jan-07
Mar-07
May-07
Jul-07
Sep-07
Nov-07
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
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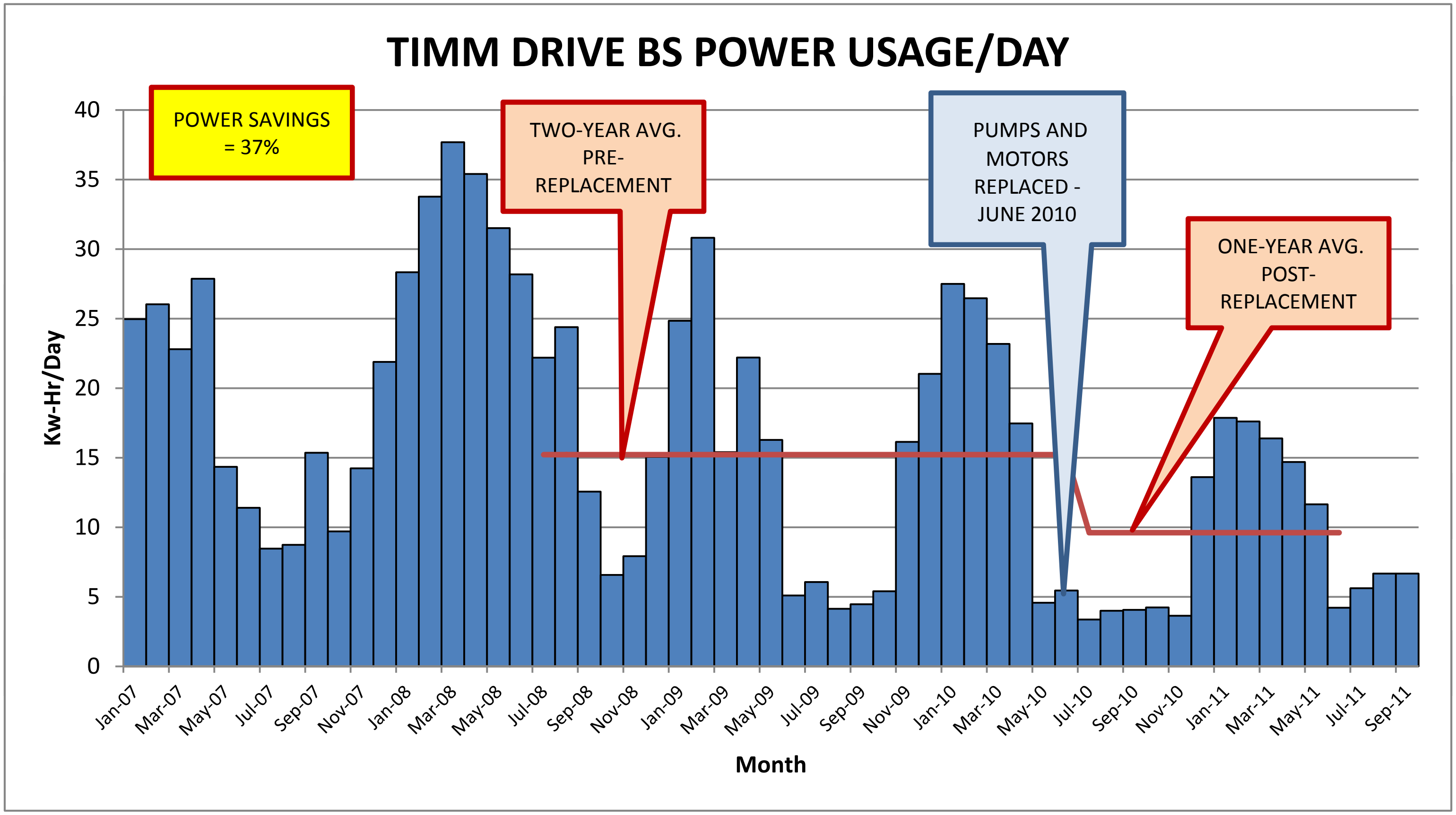
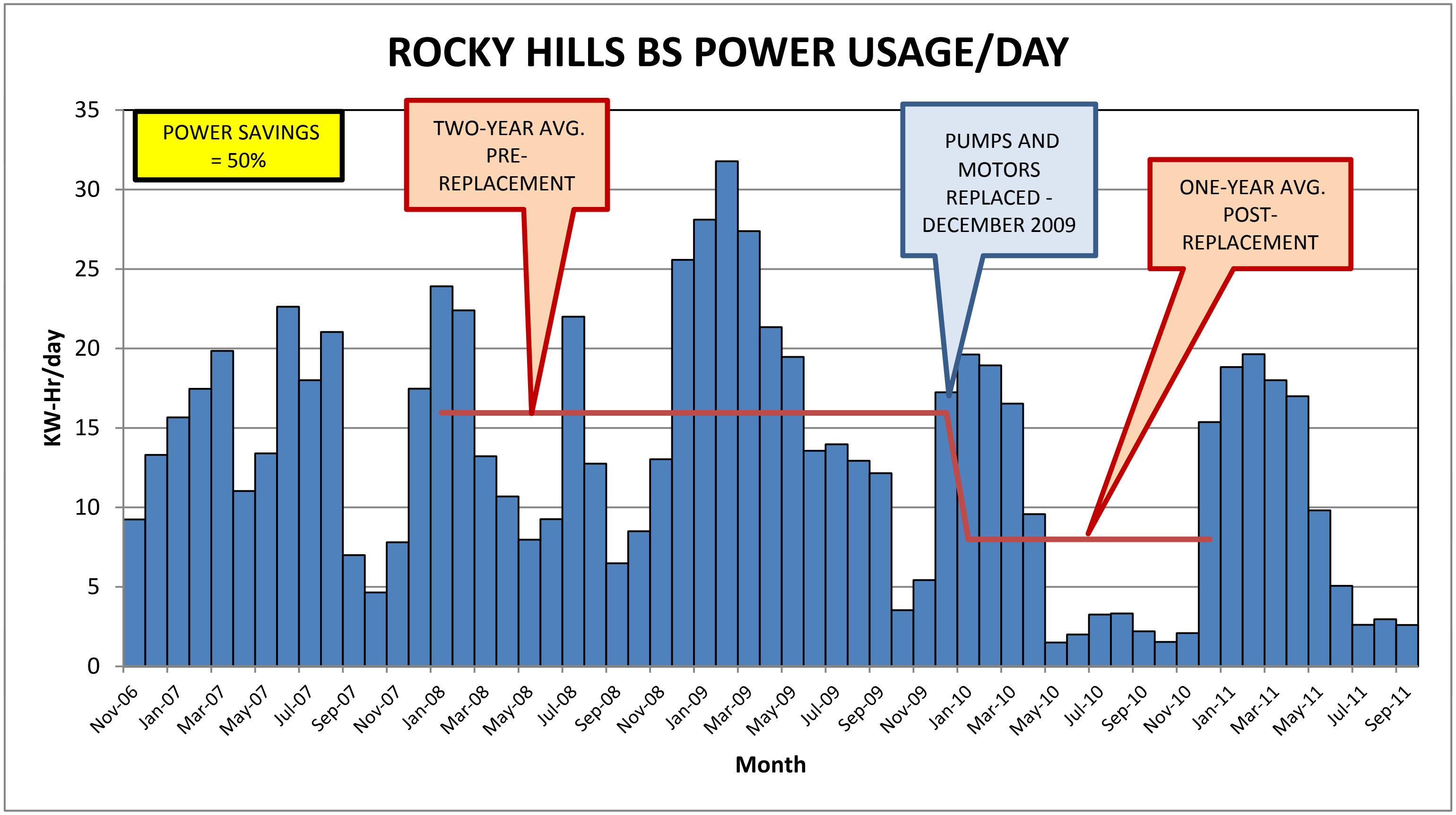
Sep-10
Nov-10
Jan-11
Mar-11
May-11
Jul-11
Sep-11
Month


TIMM DRIVE BS POWER USAGE/DAY
POWER SAVINGS = 37%
TWO-YEAR AVG. PRE-REPLACEMENT
PUMPS AND MOTORS REPLACED - JUNE 2010
ONE-YEAR AVG. POST-REPLACEMENT
Kw-Hr/Day
0
5
10
15
20
25
30
35
40
Jan-07
Mar-07
May-07
Jul-07
Sep-07
Nov-07
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Mar-11
May-11
Jul-11
Sep-11
Month



ROCKY HILLS BS POWER USAGE/DAY
POWER SAVINGS = 50%
TWO-YEAR AVG. PRE-REPLACEMENT
PUMPS AND MOTORS REPLACED - DECEMBER 2009
ONE-YEAR AVG. POST-REPLACEMENT
KW-Hr/day
0
5
10
15
20
25
30
35
Nov-06
Jan-07
Mar-07
May-07
Jul-07
Sep-07
Nov-07
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
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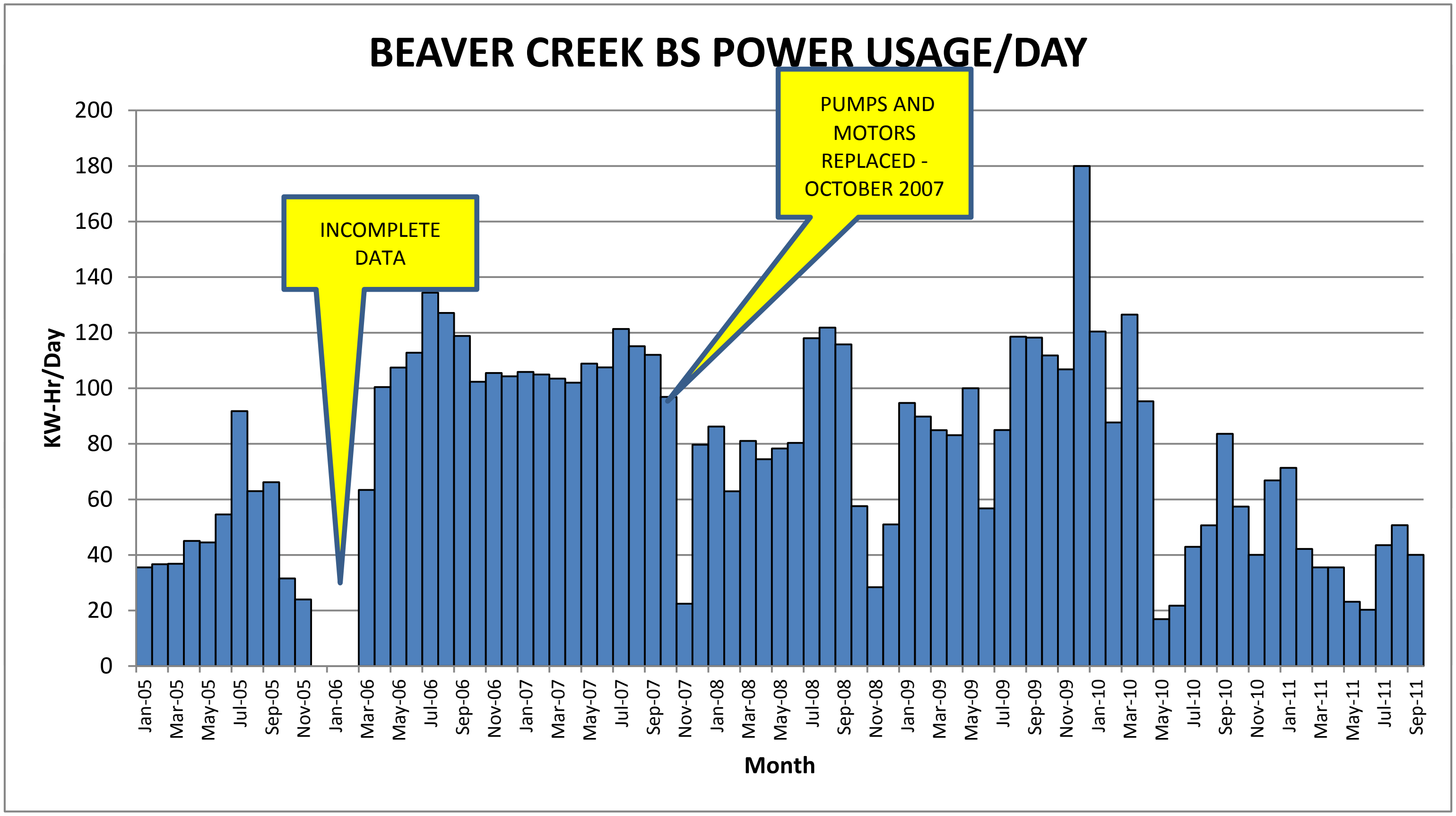
Jan-11
Mar-11
May-11
Jul-11
Sep-11
Month



BEAVER CREEK BS POWER USAGE/DAY
INCOMPLETE DATA
PUMPS AND MOTORS REPLACED - OCTOBER 2007
KW-Hr/Day
0
20
40
60
80
100
120
140
160
180
200
Jan-05
Mar-05
May-05
Jul-05
Sep-05
Nov-05
Jan-06
Mar-06
May-06
Jul-06
Sep-06
Nov-06
Jan-07
Mar-07
May-07
Jul-07
Sep-07
Nov-07
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
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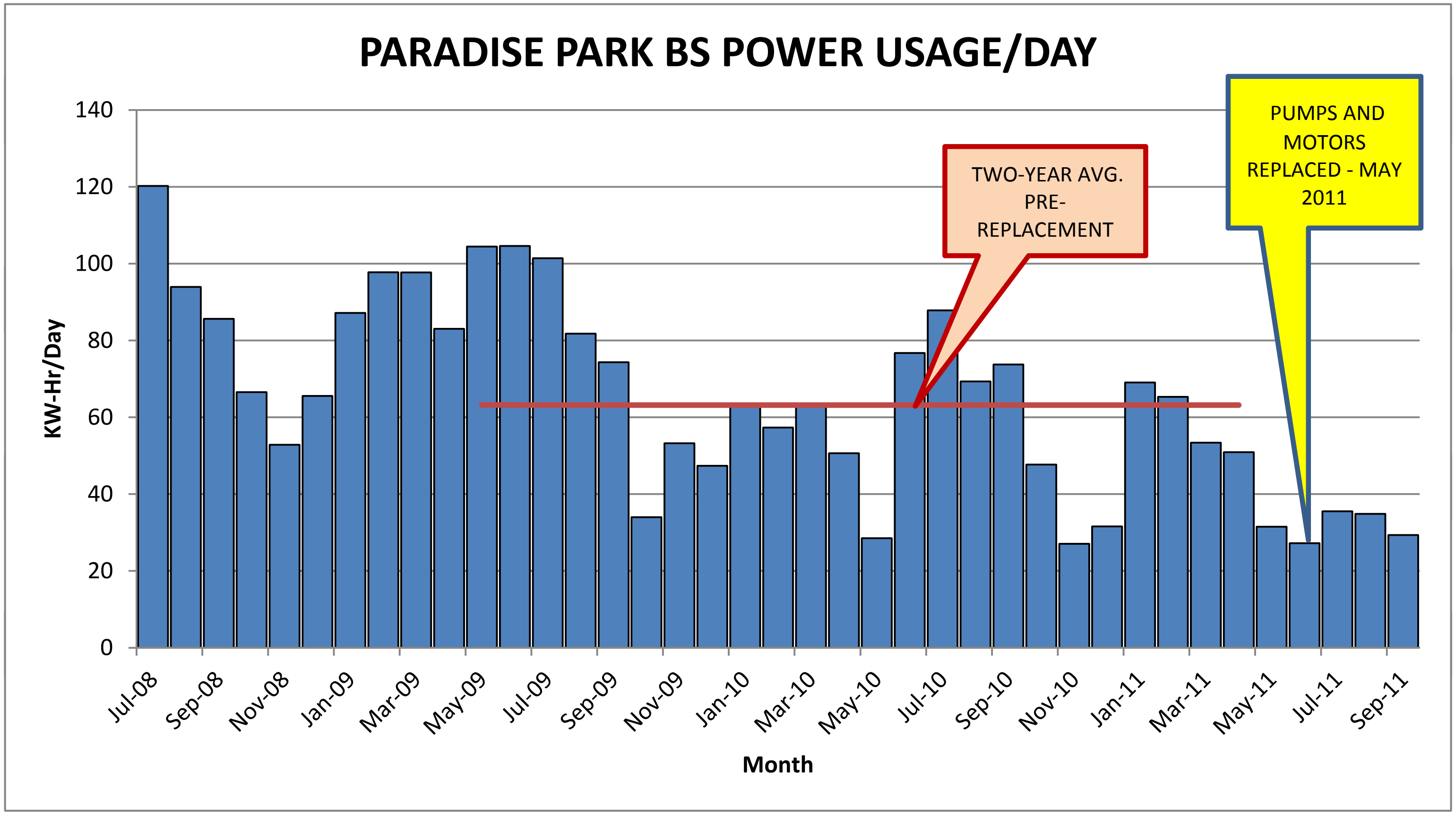
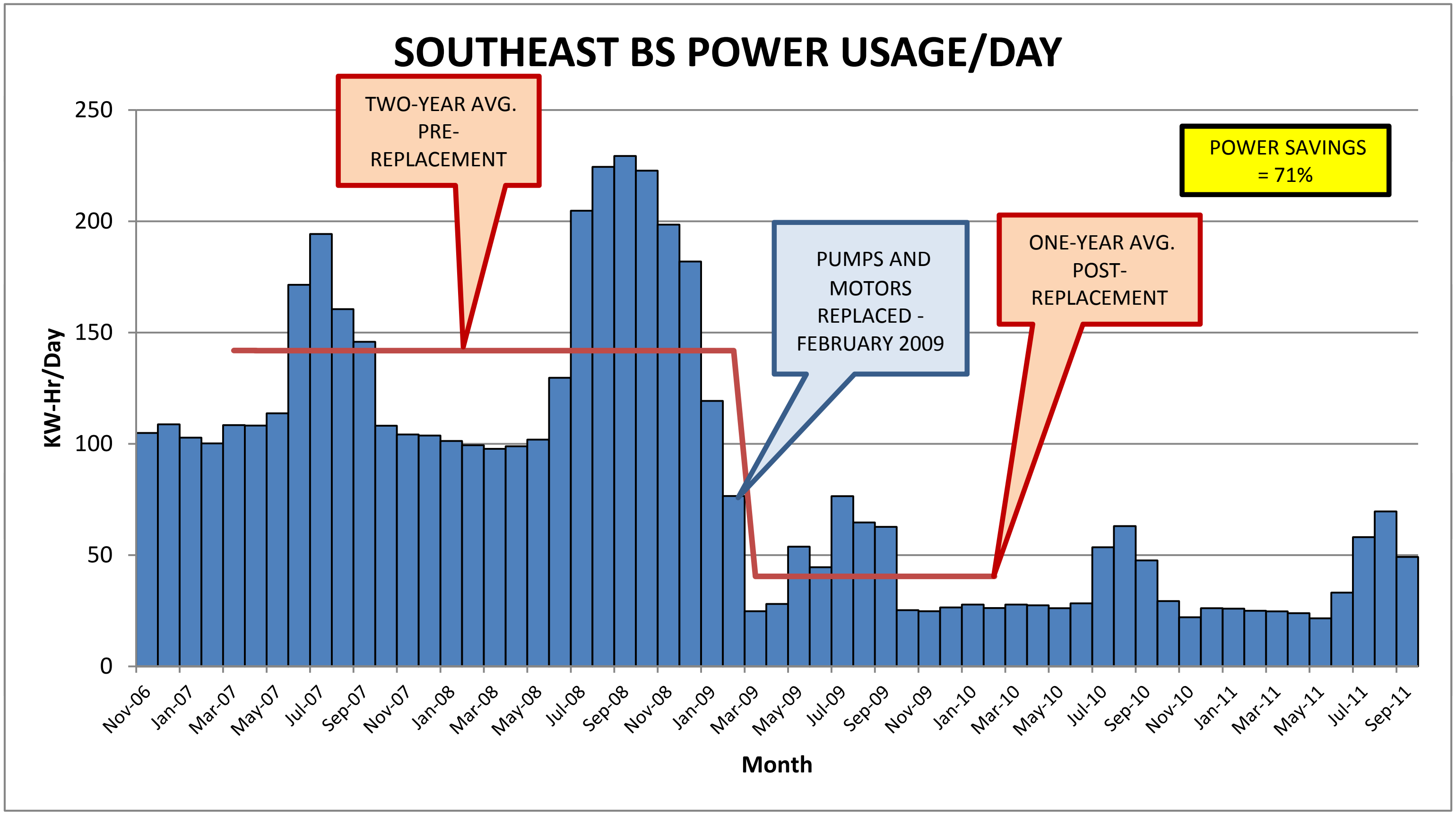
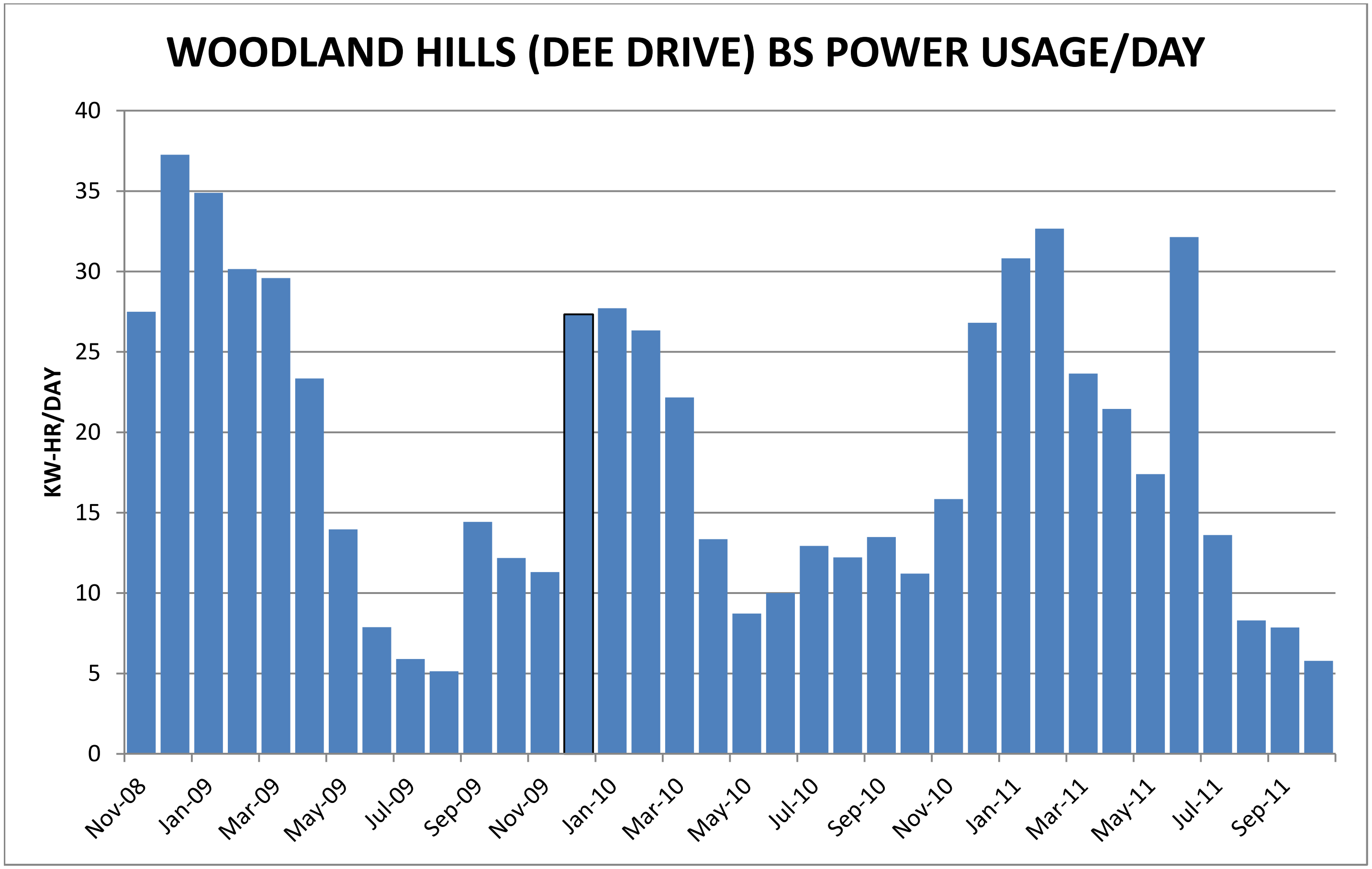
Sep-10
Nov-10
Jan-11
Mar-11
May-11
Jul-11
Sep-11
Month


PARADISE PARK BS POWER USAGE/DAY
KW-Hr/Day
140
120
100
80
60
40
20
0
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Mar-11
May-11
Jul-11
Sep-11
Month
TWO-YEAR AVG. PRE-REPLACEMENT
PUMPS AND MOTORS REPLACED - MAY 2011


SOUTHEAST BS POWER USAGE/DAY
TWO-YEAR AVG. PRE-REPLACEMENT
PUMPS AND MOTORS REPLACED - FEBRUARY 2009
ONE-YEAR AVG. POST-REPLACEMENT
POWER SAVINGS = 71%
KW-Hr/Day
0
50
100
150
200
250
Nov-06
Jan-07
Mar-07
May-07
Jul-07
Sep-07
Nov-07
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Mar-11
May-11
Jul-11
Sep-11
Month

# APPENDIX B

POWER USAGE DATA FOR EIGHT BOOSTER STATIONS
PROPOSED FOR UPGRADE WITH THIS PROJECT


WOODLAND HILLS (DEE DRIVE) BS POWER USAGE/DAY
KW-HR/DAY
0
5
10
15
20
25
30
35
40
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
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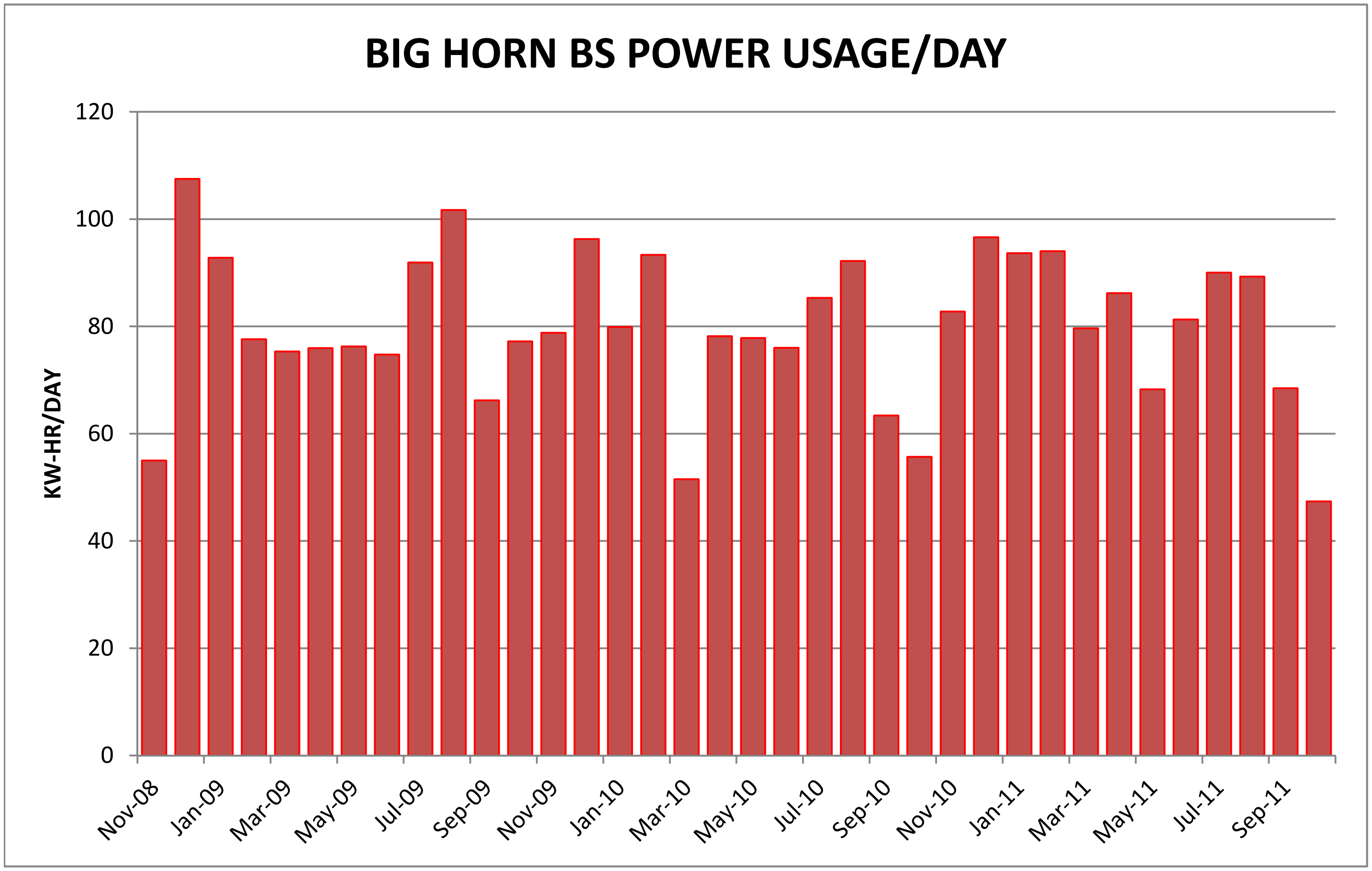
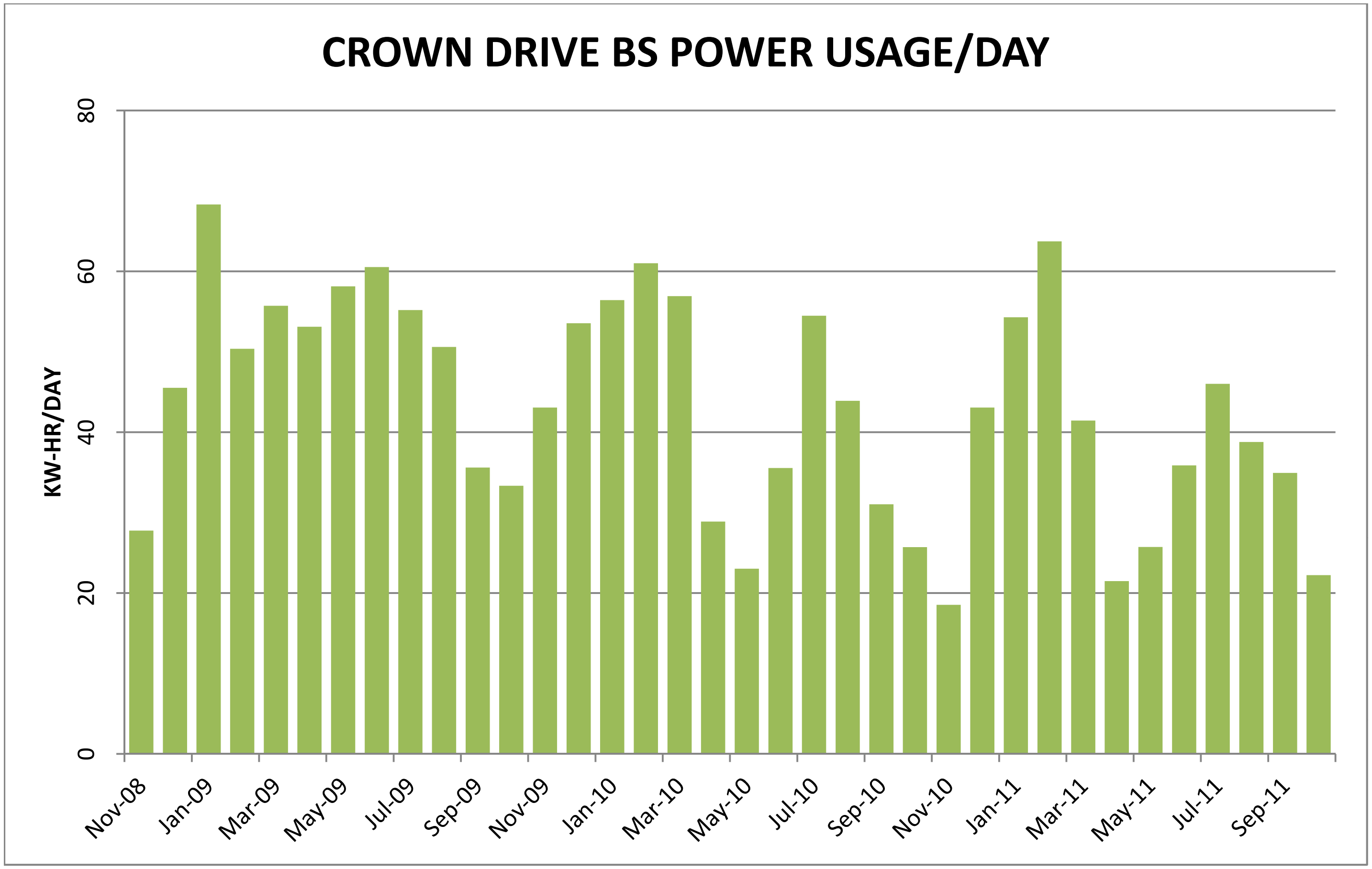
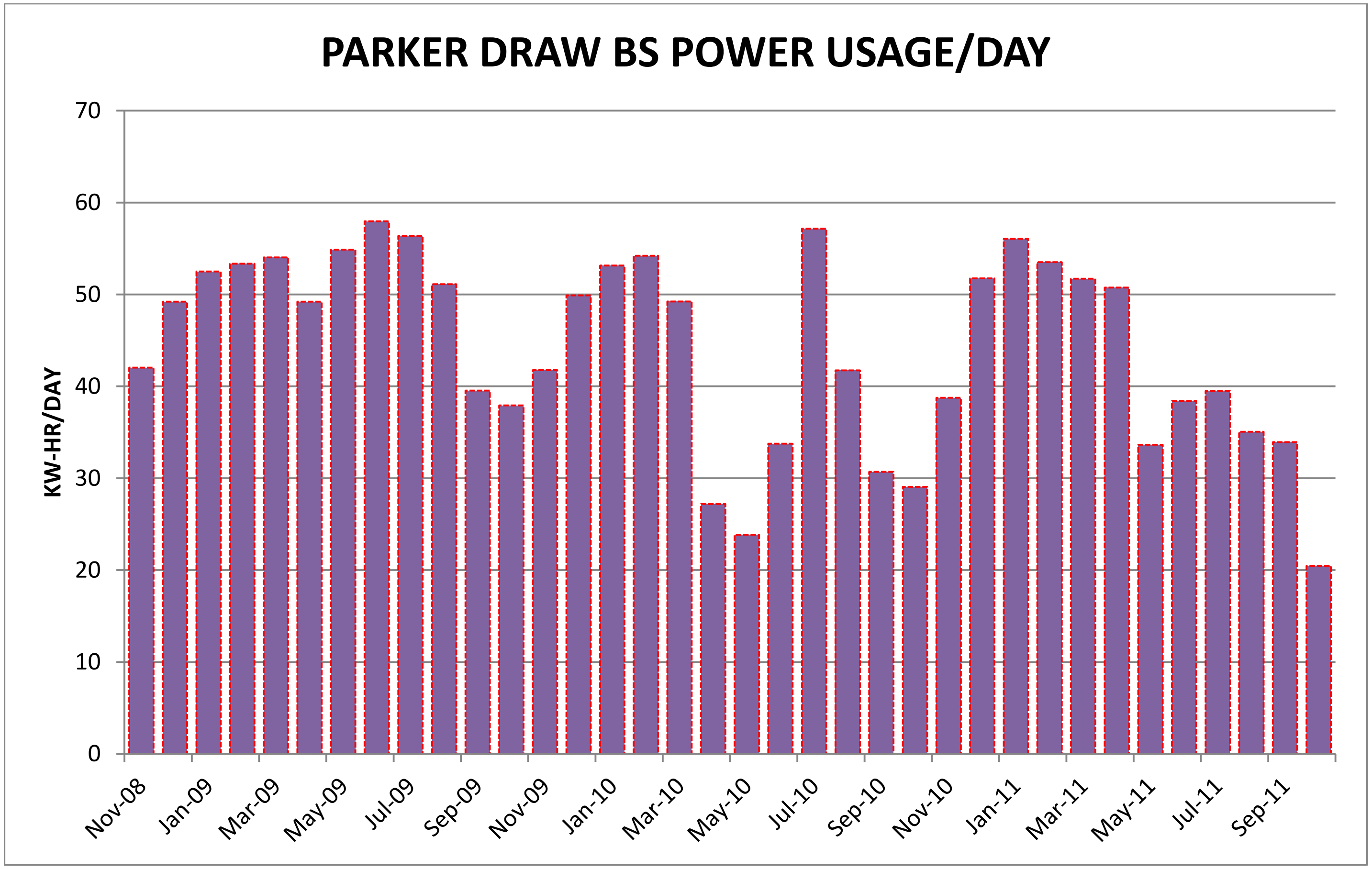
Nov-10
Jan-11
Mar-11
May-11
Jul-11
Sep-11


BIG HORN BS POWER USAGE/DAY
KW-HR/DAY
0
20
40
60
80
100
120
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Mar-11
May-11
Jul-11
Sep-11



CROWN DRIVE BS POWER USAGE/DAY
KW-HR/DAY
0
20
40
60
80
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Mar-11
May-11
Jul-11
Sep-11


PARKER DRAW BS POWER USAGE/DAY
KW-HR/DAY
70
60
50
40
30
20
10
0
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
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May-10
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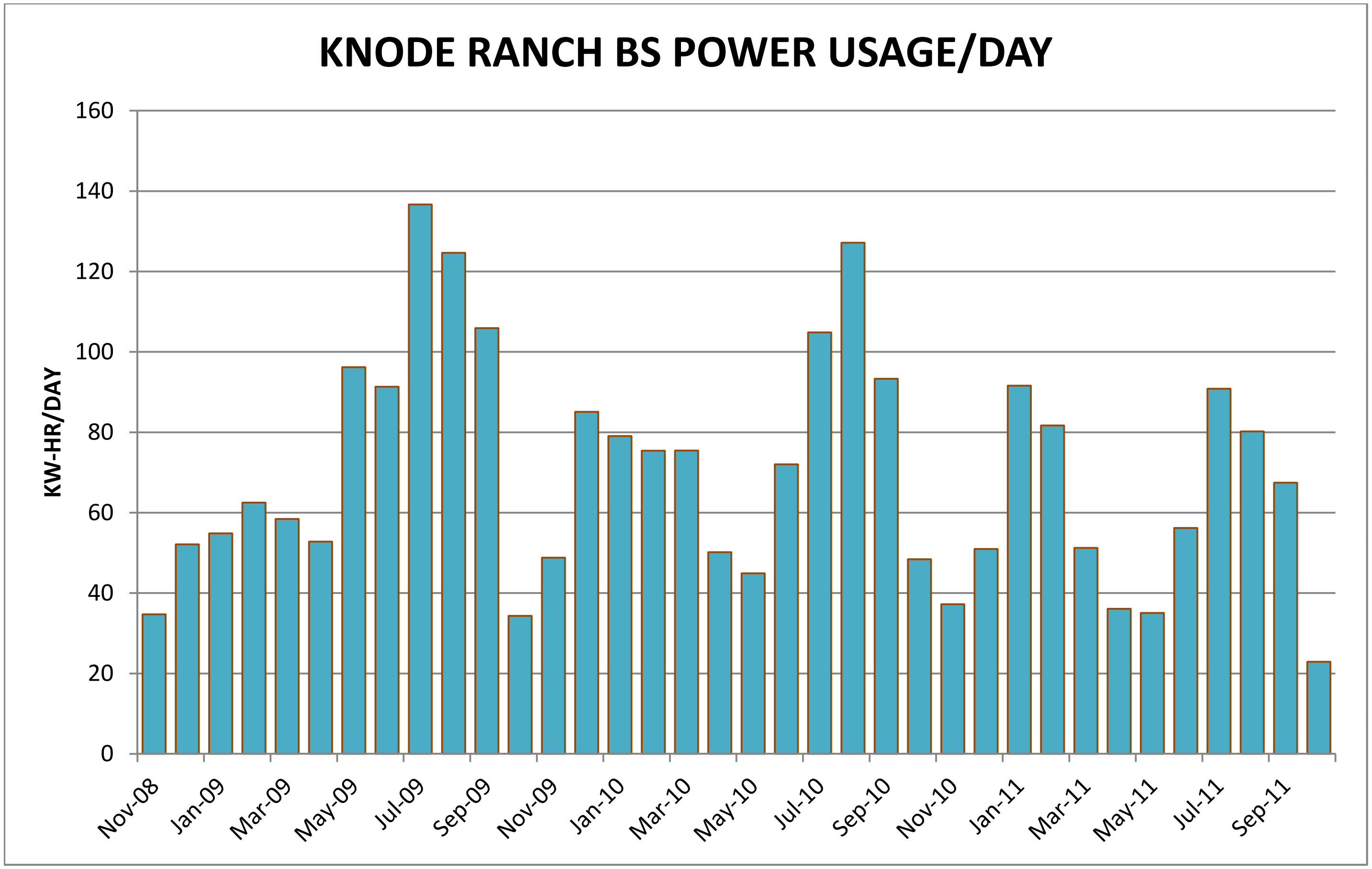
May-11
Jul-11
Sep-11


KNODE RANCH BS POWER USAGE/DAY
KW-HR/DAY
0
20
40
60
80
100
120
140
160
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
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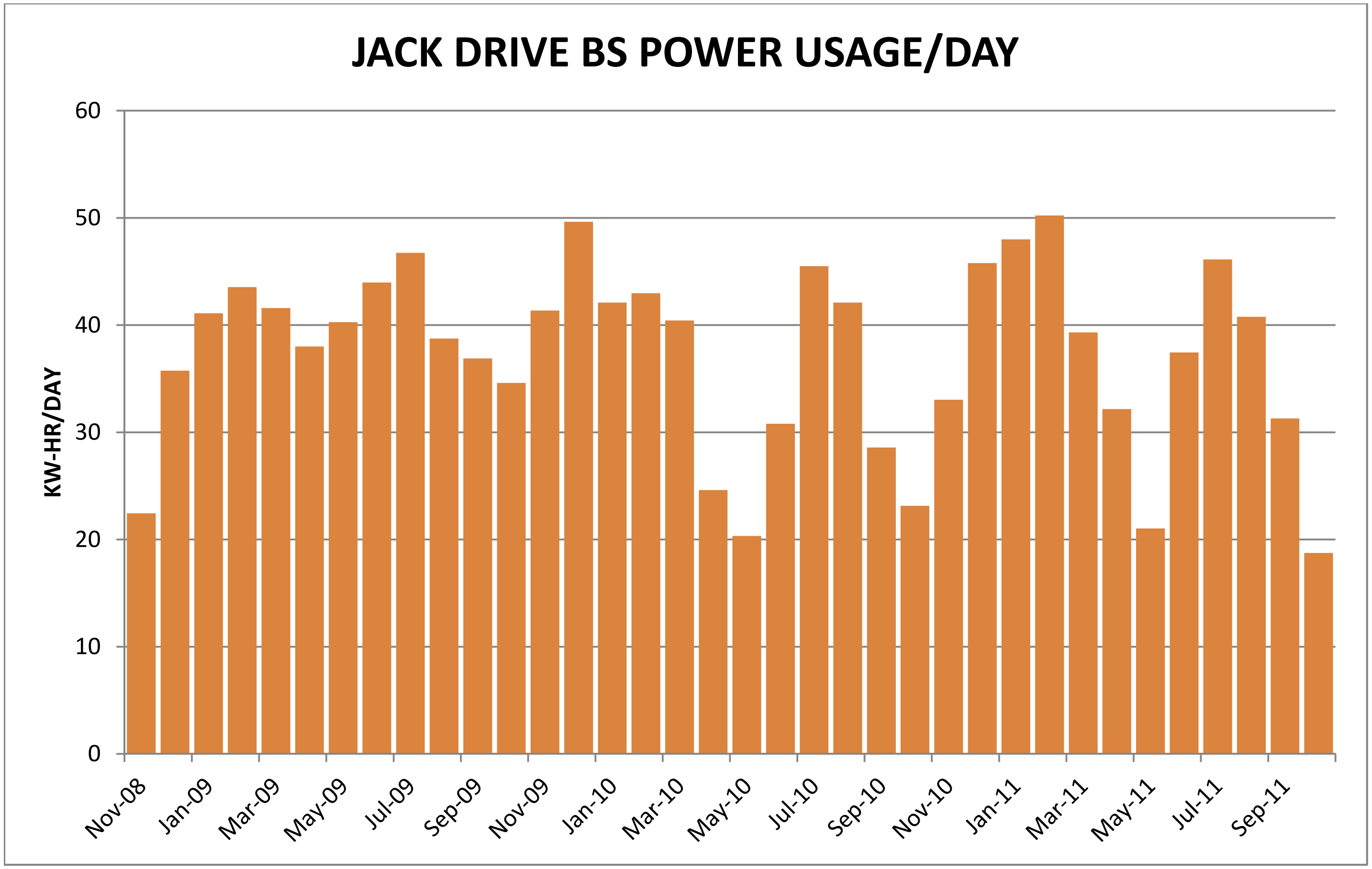
May-11
Jul-11
Sep-11


JACK DRIVE BS POWER USAGE/DAY
KW-HR/DAY
60
50
40
30
20
10
0
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
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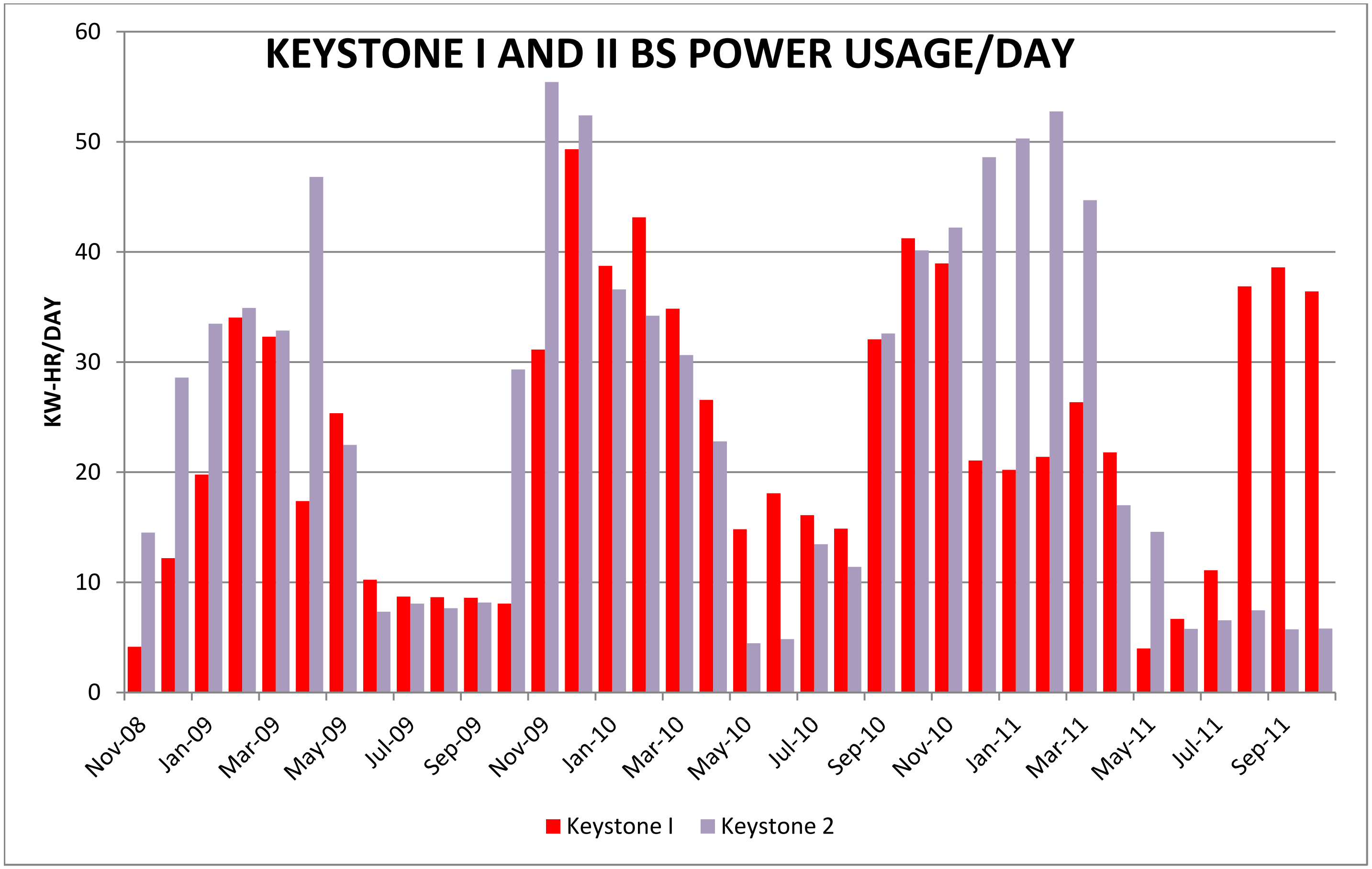
May-11
Jul-11
Sep-11

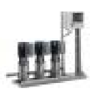
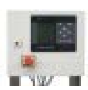


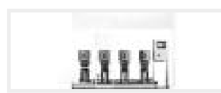
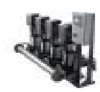
KEYSTONE I AND II BS POWER USAGE/DAY
KW-HR/DAY
0
10
20
30
40
50
60
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Sep-10
Nov-10
Jan-11
Mar-11
May-11
Jul-11
Sep-11
Keystone I
Keystone 2

# APPENDIX C

INFORMATION ON PROPOSED PUMP AND MOTOR UPGRADES – HYDRO MPC SYSTEM, MANUFACTURED BY GRUNDFOS

# Hydro MPC

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## Overview

The Grundfos Hydro MPC booster systems are made to the very highest standards. Thanks to the CU 351 controller, they handle even the most difficult boosting jobs with ease and accuracy.
All components have been combined with focus on quality and efficiency. The Grundfos Hydro MPC booster systems are designed to last: sturdy, compact units with easy access to all service parts. Grundfos Hydro MPC booster systems can be used wherever additional pressure is required. Each booster model has been designed to meet specific customer demands for capacity and control.

The intelligent cascade control ensures that the optimum number of pumps required to meet the demand runs at any time. Together with the CR with IE3 motors, this makes the Hydro MPC the most energy-efficient solution for maintaining a constant pressure during changing flow demands.

## Applications

- Offices
- schools
- hotels
- blocks of flats
- irrigation systems
- industry
- municipal supply systems.

## Features and benefits

- Reliable
- highly efficient
- service-friendly
- space-saving
- easy to commission
- perfectly adapting to the flow
- low-flow detection
- application-optimised software
- BUS and Ethernet communication option
- large, clear display
- menus in plain text.

Give Feedback

GRUNDFOS **DATA BOOKLET**

# Hydro MPC

## Booster systems with 2 to 6 pumps

60 Hz

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GRUNDFOS

# 1. Introduction

Grundfos Hydro MPC booster systems are designed for transfer and pressure boosting of clean water in places such as these:

- waterworks
- blocks of flats
- hotels
- industry
- hospitals
- schools.

As standard, Hydro MPC booster systems consist of two to six identical CR, CRI, CRE or CRIE pumps connected in parallel and mounted on a common base frame provided with a control cabinet and all the necessary fittings.

Most of the booster systems are available with either CR, CRI pumps and/or CRE, CRIE pumps. For further information, see page 8.

The pumps of the booster system can be removed without interfering with the pipework on either side of the manifolds.

Hydro MPC booster systems come in three control variants. For further information, see *Product range* on page 6 and *Overview of control variants* on page 11.

**Hydro MPC-E**
Booster systems with two to six identical electronically speed-controlled pumps. Pipework connection from R 2 to DN 350.

From 0.37 to 22 kW, Hydro MPC-E is fitted with CRE, CRIE pumps with integrated frequency converter.

As from 30 kW, Hydro MPC-E is fitted with CR pumps connected to Grundfos CUE frequency converters (one per pump).

**Hydro MPC-F**
Booster systems with two to six identical CR, CRI pumps connected to one Grundfos CUE frequency converter. The speed-controlled operation alternates between the pumps of the booster system. Pipework connection from R 2 to DN 350 and motor sizes from 0.55 to 75 kW.

**Hydro MPC-S**
Booster systems fitted with two to six identical mains-operated CR, CRI pumps, pipework connection from R 2 to DN 350 and motor sizes from 0.37 to 75 kW.

## Benefits

**Perfect constant-pressure control**

GrA0812

**Fig. 1** CU 351

The pumps of the Hydro MPC booster system are controlled individually by the CU 351 multi-pump control unit which contains application-optimised software and pump curve data. The CU 351 thus knows the exact hydraulic and electrical data of the pumps to be controlled.

**User-friendliness**
Hydro MPC features a built-in start-up wizard in a wide range of local languages that guides the installer through a series of steps until the booster system is correctly installed and commissioned. When the installation is complete, the simple, user-friendly interface makes sure that day-to-day operation is equally easy.

**Reliability**

TM04 4568 1709

**Fig. 2** Grundfos CR pumps

Hydro MPC is built on the highly renowned Grundfos CR pump range. CR pumps are known for their reliability, efficiency and adaptability.

Every vital piece of the Hydro MPC is Grundfos made. You are thus guaranteed long-lasting technology that requires a minimum of maintenance and provides a maximum of efficiency.

**Low energy consumption**

All Motors used on Hydro MPC comply with the requirements of IE3.

The standard, IEC 60034-30, defines and harmonises worldwide the efficiency classes IE1, IE2 and IE3 for low voltage, three-phase motors ranging from 0.75 to 375 kW.

IE1 = Standard Efficiency (comparable to EFF2)

IE2 = High Efficiency (comparable to EFF1)

IE3 = Premium Efficiency

Grundfos IE3 motors comply with the EISA2007 legislation in the USA and are ahead of the EU requirements laid down by the EuP Directive.

This also affects the noise level of the motors.
In electrical motors, the cooling fan is normally the main source of noise. Due to the higher efficiency, IE3 designated motors require less cooling air to maintain the motor temperature. This allows for a smaller cooling fan, which in turn produces less noise.

IE3

TM04 9709

**Flexibility**

The elements of the Hydro MPC can be combined in a number of ways to make sure that we build the perfect solution for you!

**Custom-built solutions**

If this data booklet does not provide you with a solution that meets your specific pumping needs, please contact us.

# 3. Construction

## Pump

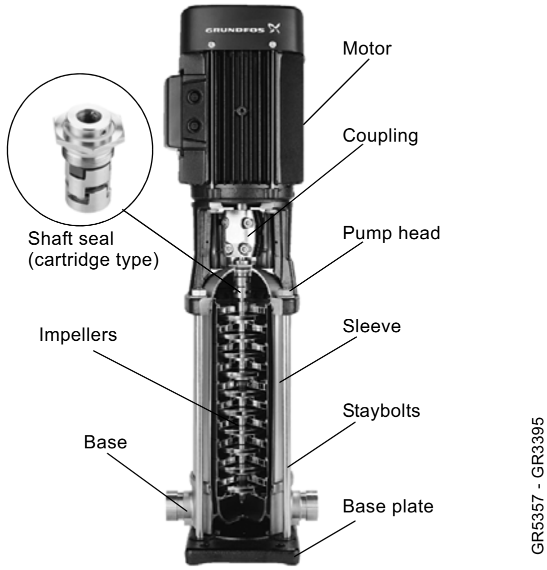



**Fig. 3** CR pump

CR pumps are non-self-priming, vertical multistage centrifugal pumps.

Each pump consists of a base and a pump head. The chamber stack and outer sleeve are secured between the pump head and the base by means of staybolts. The base has suction and discharge ports on the same level (in-line) and of the same port size.

CRE and CRIE pumps are based on CR and CRI pumps. The difference between the CR and CRE pump range is the motor. CRE and CRIE pumps are fitted with a motor with integrated frequency converter.

CR and CRE pumps have pump head and base of cast iron while CRI and CRIE pumps have pump head and base of stainless steel.
All hydraulic parts are made of stainless steel.

For further information, see the following data booklets:

| Title | Publication number |
|---|---|
| CR, CRI, CRN, CRE, CRIE, CRNE | 96488672 |
| CR, CRI, CRN, CRT, CRE, CRIE, CRNE, CRTE. Custom built pumps | 96486346 |
| Grundfos E-pumps | 96570076 |

The data booklets are available in WebCAPS on www.grundfos.com, see page 90.

For information about the pump's position in the booster set, see fig. 4 on page 10.

## Shaft seal

All pumps are equipped with a maintenance-free mechanical HQQE shaft seal of the cartridge type. Seal faces are silicon carbide/silicon carbide. Rubber parts are of EPDM.

**Note:** Other shaft seal variants are available on request.

GR3395

**Fig. 1** Cartridge shaft seal

The shaft seal can be replaced without dismantling the pump. The shaft seal of pumps with motors of 11 kW and up can be replaced without removing the motor.

For further information, see the data booklet on shaft seals, publication number 96519875. The data booklet is available in WebCAPS. See page 90.

## Motor

### CR and CRI pumps

CR and CRI pumps are fitted with a totally enclosed, fan-cooled, 2-pole Grundfos standard motor with principal dimensions in accordance with the EN standards.

Electrical tolerances to EN 60034.

| | Standard motor |
|---|---|
| Mounting designation | Up to 4 kW: V 18<br>From 5.5 kW: V 1 |
| Insulation class | F |
| Efficiency class | IE3 |
| Enclosure class | IP 55 [1)] |
| Supply voltage<br>(tolerance: ± 5 %) | $P_2$: 0.75 to 22 kW:<br>3 x 220-277/380-480 V, 60 Hz |

[1)] IP65 available on request.

Three-phase Grundfos motors from 3 kW and up have a built-in thermistor (PTC) according to DIN 44 082 (IEC 34-11: TP 211).

### CRE and CRIE pumps

CRE and CRIE pumps are fitted with a totally enclosed, fan-cooled, 2-pole motor with integrated frequency converter. Principal dimensions are in accordance with EN standards. Electrical tolerances to EN 60034.

| | Motor with integrated frequency converter | |
|---|---|---|
| | $P_2 \leq 7.5$ kW | $P_2 \geq$ 11 to 22 kW |
| Mounting designation | Up to 4 kW: V 18<br>From 5.5 kW: V 1 | |
| Insulation class | F | |
| Efficiency class | IE3 | IE3 |
| Enclosure class | IP 54 | |
| Supply voltage (tolerance: ± 5 %) | 3 x 380-480 V, 50/60 Hz | 3 x 380-415 V, 50/60 Hz |

Motors with integrated frequency converter require no external motor protection. The motor incorporates thermal protection against slow overloading and seizure (IEC 34-11: TP 211).

## Manifold

A suction manifold of stainless steel EN DIN 1.4571 is fitted on the suction side of the pumps.

A discharge manifold of stainless steel (EN DIN 1.4401 or EN DIN 1.4571) is fitted on the discharge side of the pumps.

An isolating valve and a non-return valve are fitted between the discharge manifold and the individual pumps. The non-return valve may be fitted on the suction side on request.

As an alternative, Hydro MPC is available with galvanised steel manifolds in some countries. If a Hydro MPC with galvanised steel manifolds is ordered, the base frame and stand for the controller also come in galvanised steel. For further information, contact Grundfos.

For information about the position of the suction and discharge manifold, see fig. 4 on page 10.

## Control cabinet

The control cabinet is fitted with all the necessary components. If necessary, Hydro MPC booster sets are fitted with a fan to remove surplus heat generated by the frequency converter.

### Control cabinet variants

The control cabinets are divided into four different designs based on construction:

- **Design A:** Systems with the control cabinet mounted on the same base frame as the pumps.
- **Design B:** Systems with the control cabinet centred on the base frame.
- **Design C:** Systems with the control cabinet mounted on its own base for floor mounting.The cable supplied allows the control cabinet to be placed up to 2 metres from the pumps.
- **Design D:** Systems with a control cabinet mounted on a separate base frame. The cable supplied allows the control cabinet to be placed up to 2 metres from the pumps.

For further information, see fig. 4 on page 10 and the chapter of Technical data for the individual Hydro MPC.

## CU 351

CU 351, the control unit of the Hydro MPC, is placed in the door of the control cabinet.


**Fig. 2** CU 351

The CU 351 features an LCD display, a number of buttons and two indicator lights. The control panel enables manual setting and change of parameters such as setpoint, start/stop of system or individual pumps.

The CU 351 includes application-optimized software for setting the booster set to the application in question.

## IO 351

IO 351 is a module for exchange of digital and analog signals between CU 351 and the remaining electrical system via GENIbus. IO 351 comes in the variants A and B.


**Fig. 3** IO 351A and IO 351B

### IO 351A

IO 351A is used for one to three Grundfos pumps with fixed speed.

### IO 351B

IO 351B is used for one to six Grundfos pumps with fixed speed and/or pumps controlled by external frequency converters. The module can also be used as an input-output module for communication with monitoring equipment or another external equipment.

## Base frame

A Hydro MPC booster set have a common base frame. The pumps are fixed to the base frame by means of bolts. The control cabinet is fixed to the base frame by means of a stand, see fig. 4 on page 10. The base frame and stand are of stainless steel EN DIN 1.4301.

## System components

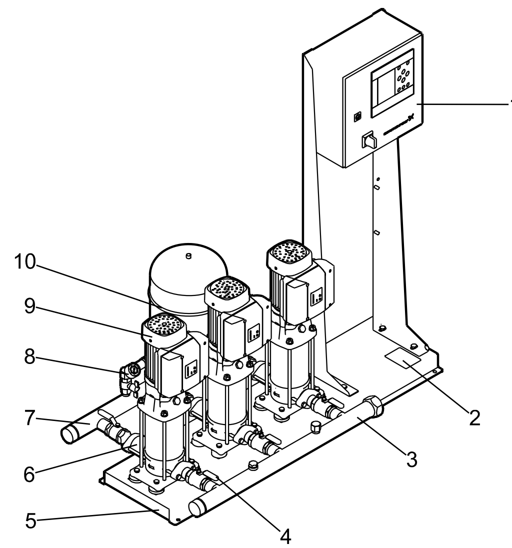


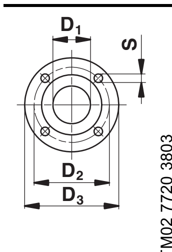

**Fig. 4** System components

| Pos. | Description | Quantity |
|---|---|---|
| 1 | Control cabinet | 1 |
| 2 | Nameplate | 1 |
| 3 | Suction manifold (stainless steel) | 1 |
| 4 | Isolating valve | 2 per pump |
| 5 | Base frame (stainless steel) | 1 |
| 6 | Non-return valve | 1 per pump |
| 7 | Discharge manifold (stainless steel) | 1 |
| 8 | Pressure transmitter/gauge | 1 |
| 9 | Pump | 2 - 4 [1] |
| 10 | Diaphragm tank | 1 |

[1] Hydro MPC booster sets with up to 6 pumps are available on request.

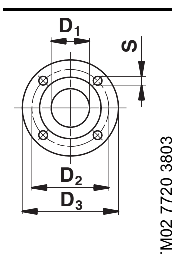
## Flange dimensions

### PN 16 flanges




| Standard: EN 1092-2 PN 16 (1.6 MPa) | | | | | | |
|---|---|---|---|---|---|---|
| Nominal diameter (DN) | | | | | | |
| DN | 80 | 100 | 125 | 150 | 200 | 250 |
| $D_1$ | 80 | 100 | 125 | 150 | 200 | 250 |
| $D_2$ | 160 | 180 | 210 | 240 | 295 | 355 |
| $D_3$ | 200 | 220 | 250 | 285 | 340 | 405 |
| S | 8 x 19 | 8 x 19 | 8 x 19 | 8 x 23 | 12 x 23 | 12 x 28 |

### PN 25 flanges




| Standard: EN 1092-2 PN 25 (2.5 MPa) | | |
|---|---|---|
| Nominal diameter (DN) | | |
| DN | 300 | 350 |
| $D_1$ | 300 | 350 |
| $D_2$ | 430 | 490 |
| $D_3$ | 485 | 555 |
| S | 16 x 30 | 16 x 33 |