NEC Consultants (Pvt.) Ltd.

Punjab Cities Governance Improvement Project

# Energy Audit & Energy Efficiency Improvement Program for WASAs in Punjab

**CITY REPORT**
**Faisalabad WASA**

**March 2016**

THE URBAN UNIT
Urban Sector Planning & Management Services Unit (Pvt.) Ltd.
A Public Sector Company.

THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

# Energy Audit & Energy Efficiency Improvement Program for WASAs in Punjab

**March 2016**

**NEC Consultants Pvt. Ltd**
Perfect SITE, 22 KM Ferozepur Road, Near Gujju Matta Metro Bus Station, Lahore
+92-42-35273741-46, www.nec.com.pk
necnorth@nec.com.pk

This study was assigned by **The Urban Unit, Punjab**

## DISCLAIMER



A publication of the Urban Sector Planning and Management Services Unit (Private) Limited, the opinion expressed in the document are solely those of the authors and publishing them does not in any way constitute an endorsement of the opinion by the USPMSU.

## ACKNOWLEDGEMENTS

This report has been prepared by The Urban Unit (Urban Sector Policy & Management Unit), P&D Department, Government of Punjab. The Urban Unit, under the Punjab Cities Governance Improvement Project (PCGIP)-DLI-4 is supporting WASAs for implementing Energy Audit Management Opportunities. Energy management opportunities have been extracted from the energy audits of WASA pumps.

**The Team**

Dr. Nasir Javed
Engr. Abid Hussainy
Engr. Ali Raza
Shafqat Ullah
Muhammad Rizwan
Kashif Shaukat
Adnan Khan

**Editing & Layout By:**

Ms. Madiha Qamar

**Printed in Pakistan**

## CONTENTS



## LIST OF FIGURES



## LIST OF TABLES

## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| **Bhp** | Brake Horsepower |
| **Cusec** | Cubic Feet per Second |
| **Ehp** | Electrical Horsepower |
| **Gpm** | Gallon Per Minute |
| **Hp** | Horsepower |
| **kVA** | Kilo Volt Ampere |
| **kW** | Kilo Watt |
| **kWh** | Kilo Watt Hour |
| **LESCO** | Lahore Electric Supply Company |
| **m/s** | Meter Per Second |
| **$m^3/hr$** | Cubic Meter Per Hour |
| **MCB** | Fuses or Miniature Circuit Breaker |
| **Mm** | Millimeter |
| **MS** | Mild Steel |
| **Psig** | Pound Per Square Inch (Gauge) |
| **RPM** | Revolution Per Minute |
| **TDH** | Total Dynamic Head |
| **VFD** | Variable Frequency Drive |
| **WASA** | Water and Sanitation Agency |
| **Whp** | Water Horsepower |

## GLOSSARY

| | |
|---|---|
| **Discharge Pressure** | The pressure obtained at center line of pump discharge pipe using a calibrated gauge (psig). Discharge pressure is converted to feet and expressed as “Discharge Head”. |
| **Brake Horsepower** | The output horsepower of a motor to a pump; may also be used to refer to the required input horsepower to the pump itself. |
| **Deep Well Turbine Pump** | A turbine pump installed inside a well casing below the pumping water level in the well. |
| **Discharge Head** | Head measured above center line of pump discharge pipe. |
| **Drawdown** | The measured distance that a well’s water level changes from standing/static level to operating pumping level during observed test conditions. |
| **Dynamic Head** | The sum of the pressure and the pumping head developed by a pump |
| **Friction Head** | The head required to overcome the fluid friction in a pipe or water system |
| **Friction Losses** | Energy losses associated with moving water against rough surfaces. In water pumping applications, it is the water pressure lost as a result of contact between moving water and a pipeline or open channel. |
| **GPM per Foot Drawdown** | The ratio of capacity (GPM) to drawdown feet is useful in determining the well’s performance. |
| **Head** | Alternate term for pressure. One pound per square inch (psi) = 2.31 feet of water head |

| | |
|---|---|
| **Overall Plant or Pumping System Efficiency** | The ratio of the water horsepower (the overall output of the plant) to input horsepower (the power input). The overall output can also be defined as the amount of horsepower required to deliver the measured capacity (water gallons per minute) and the measured total head. |
| **Pumping Water Level** | The well's operating water level below center line of discharge pipe as observed during test condition |
| **Static Water Level** | The well's water level obtained when pumping plant is at rest. |
| **Suction Head** | Head measured above center line of pump suction intake. Most often obtained with calibrated bourdon tube pressure gauge (suction pressure) and converted to feet by conversion factor 2.31 ft. water/psi |
| **Suction Lift** | The distance between pump discharge head and water level. |
| **Total Head** | The sum of the water head above and below the center line of the pump discharge pipe. For well applications, the Total Head is the sum of the Discharge Head and the Pumping Water Level. Total head is used in determination of water horsepower and pump performance. |
| **Water Horsepower** | The output horsepower of a water pump. It is the combination of flow rate and pressure. |

## EXECUTIVE SUMMARY

Government of the Punjab, Pakistan with financial assistance from the World Bank, is implementing "Punjab Cities Governance Improvement Project (PCGIP)" for strengthening systems for improved planning, resource management, and accountability in five large cities of Punjab i.e. Lahore, Faisalabad, Multan, Gujranwala and Rawalpindi. The project utilizes a result-based approach and, consistent with this focus, the disbursement decisions to the city and its entities are based on achievement of pre-specified results, referred to as Disbursement linked Indicators (DLIs) which reflect priority elements in furthering the Government's urban agenda, critical at the provincial level, within the existing legislative, regulative and policy framework of the Government.

Disbursement Linked Indicator 4 (DLI -4) aims for improvements in own source revenue collection system that encourages the City Local Government (CDGs), Development Authorities (DAs) and Service providers (WASAs) to bring improved systems for revenue enhancement. This DLI is linked with the initiative of WASAs to carry out the Energy Audit for resources conservation and efficiency to improved service delivery, accountability and own source revenue. One of the proposed actions and initiatives to enhance revenue was to conduct energy audit of WASAs to reduce the power cost by various systematic analysis of the energy use and finding out the energy management opportunities. In the context of existing scenario energy audit of WASAs is a technical and efficient way to obtain energy analysis and savings through improvements that optimize pumping systems of tube well stations and disposal stations to operate efficiently with significant cost saving.

The installed capacity of WASA tube wells of Faisalabad city is about 109.37 million $m^3$ per annum whereas actual discharge is 90.44 million $m^3$ per annum, for average 4-18 hours per day operation and 365 days per year. This actual discharge is about 15% lesser than the installed capacity. The installed capacity of WASA disposal pumps of Faisalabad city is 392.02 million $m^3$ per annum whereas actual discharge is 326.08 million $m^3$ per annum, for average 12 hours per day operation and 365 days per year. This actual discharge is about 17% lesser than the installed capacity.

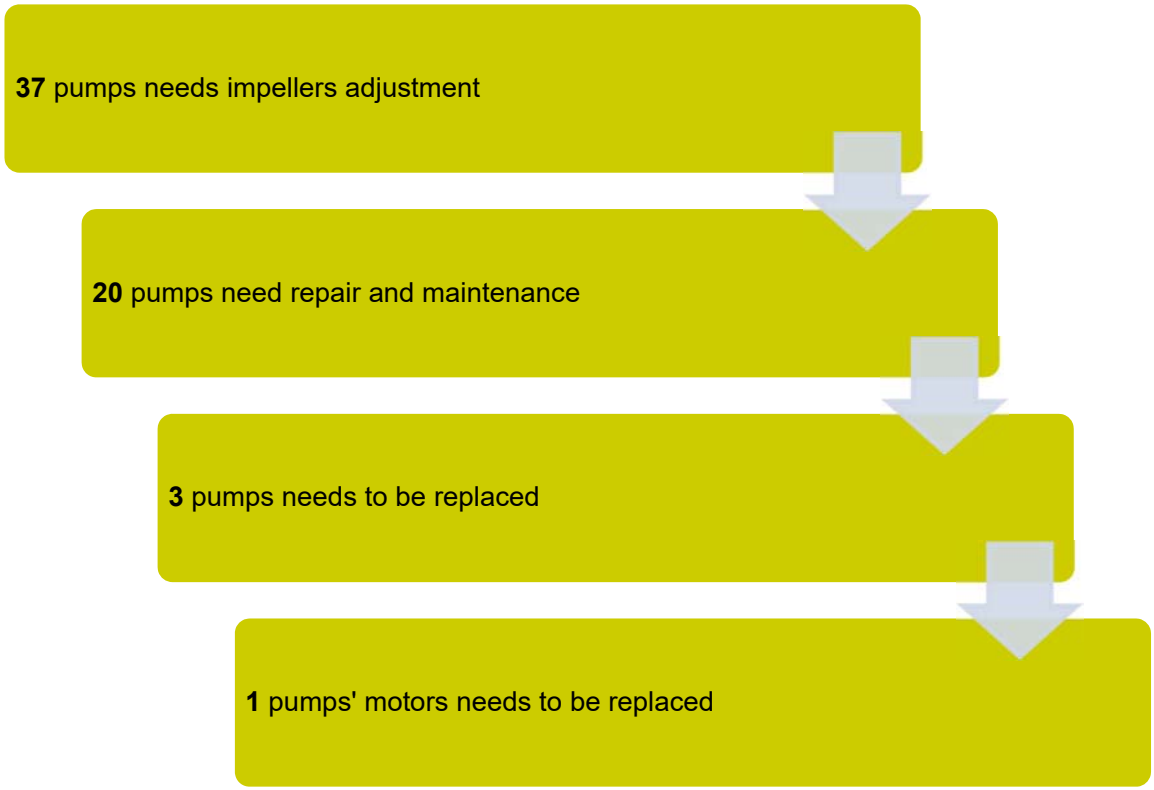
Total annual electricity consumption of Faisalabad city to operate tube wells and disposal pumps is about **36 million kWh**. This energy, in monetary terms, is about **Rs. 467 million** (@ Rs. 13/kWh). The contribution of tube wells in the energy consumption is about 50%.

Pumping plant efficiency of each tube well and disposal pump was monitored by measuring water flow rate, head and electricity consumption. The efficiency of each pumping system was classified as "Low", "Fair", "Good", or "Excellent". About 79% of the tube wells and disposal pumps are under excellent and good category of pumping system efficiency whereas 21% are under fair and low category. The pumps of excellent and good category of system efficiency do not require any intervention to improve their efficiency whereas low and fair category pumps need efficiency improvement. The efficiency of pumping system can be improved by following interventions:

- Replacement of pump
- Replacement of motor
- Replacement of pumping system (pump and motor)
- Adjustment of pump impellers
- Repair and maintenance of pump
- Adjustment of pump impellers and repair and maintenance

There are total 41 tube wells and wastewater disposal pumps (21% of total pumps) having

system efficiency in the category of FAIR to LOW, need efficiency improvement. These pumps need interventions such as:




Total investment for the efficiency enhancement and improvement of electrical and mechanical and housekeeping condition of 41 pumps is **Rs. 27.90** million with annual saving of Rs. **36.72** million. The payback period is 09 months. The pumping system efficiency improvement will result into **8%** energy reduction.

Energy audit activity of WASA stations of Faisalabad city revealed that there are certain areas of electrical, mechanical and housekeeping which needs improvement along with efficiency improvement. About **Rs. 132.65** million are required to improve all WASA stations of Faisalabad city.

# 1.0 Introduction

## 1.1 Background

Government of the Punjab, Pakistan with financial assistance from the World Bank, is implementing "Punjab Cities Governance Improvement Project (PCGIP)" for strengthening systems for improved planning, resource management, and accountability in five large cities of Punjab i.e. Lahore, Faisalabad, Multan, Gujranwala and Rawalpindi.

The project utilizes a result-based approach and, consistent with this focus, the disbursement decisions to the city and its entities are based on achievement of pre-specified results, referred to as Disbursement linked Indicators (DLIs) which reflect priority elements in furthering the Government's urban agenda, critical at the provincial level, within the existing legislative, regulative and policy framework of the Government. DLIs includes intermediate outcomes, incremental steps and results contributing to improved efficiency, effectiveness, accountability and service delivery during and beyond the project life by building capacities , system and processes .

Disbursement Linked Indicator 4 (DLI -4) aims for improvements in own source revenue collection system that encourages the City Local Government (CDGs), Development Authorities (DAs) and Service providers (WASAs) to bring improved systems for revenue enhancement. This DLI is linked with the initiative of WASAs to carry out the Energy Audit for resources conservation and efficiency to improved service delivery, accountability and own source revenue.

One of the proposed actions & initiatives to enhance revenue was to conduct energy audit of WASAs to reduce the power cost by various systematic analysis of the energy use and finding out the energy management opportunities. WASAs each year incur significant cost. It was ***Rs. 4,697 million*** in 2014 year for energy/Electricity bills, with an installed capacity of approximately 131 MW for 5,663 Million Gallons per Day (water management), which can be reduced through detailed energy audit and implementing its findings.

In the context of existing scenario energy audit of WASAs is a technical and efficient way to obtain energy analysis and savings through improvements that optimize pumping systems of tube well stations and disposal stations to operate efficiently with significant cost saving.

The Urban Planning and Management Services Unit, Pvt. Ltd. has assigned NEC Consultants Pvt. Ltd to conduct energy audits of WASAs in Punjab in five major cities of Lahore, Rawalpindi, Faisalabad, Multan and Gujranwala.

This is the energy audit summary report of **Faisalabad City**.

## 1.2 Methodology

The primary and secondary sources were used to collect data for different WASAs and pumps installed there. The Urban Unit provided information and contact detail of all the WASAs. An energy audit report template was developed to collect field data from each WASA subdivision. Prior to start the on field measurements of each subdivision, meetings were conducted with the respective WASA management and briefed them about the activity. The technical team then collected data by on field measurements of each pump and recorded in their energy audit report template. On the basis of this energy audit report template, The Urban Unit also developed Android based software to record data of each pump online. This data was also recorded on line in this Android based application.

On the basis of field measurements, efficiency of the pumping system was calculated and

energy efficiency opportunities were identified.

### 1.3 Scope

The scope of the this assignment is to conduct energy audits of about 1,600 fresh water supply and wastewater disposal pumps installed at different WASA stations in five major cities of Lahore, Rawalpindi, Multan, Faisalabad and Gujranwala. The detail of these pumps is given in Table-1.

**Table-1: Detail of WASAs Pumps**

| WASA | Population Served (Million) | Total Water Connections | Total Sewerage Connections | Total Supply Stations | Total Disposal Stations | Total No. of Pump Sets |
|---|---|---|---|---|---|---|
| WASA Lahore | 5.48 | 587,595 | 583,532 | 491 | 99 | 776 |
| WASA Gujranwala | 0.54 | 29,375 | 97,236 | 66 | 23 | 112 |
| WASA Faisalabad | 1.55 | 110,452 | 217,002 | 87 | 43 | 222 |
| WASA Multan | 1.2 | 43,996 | 175,615 | 102 | 21 | 161 |
| WASA Rawalpindi | 1.17 | 92,468 | 38,437 | 362 | - | 362 |
| **Total** | **9.94** | **863,886** | **1,111,822** | **1,108** | **186** | **1,633** |

The efficiency of each pumping system was evaluated and energy efficiency improvement opportunities were identified for those pumping systems whose efficiencies were not at required level. The detail of reports prepared is as under:

- The energy audit report of each pump was prepared.
- On the basis of each pump report, summary report of findings of each WASA subdivision was prepared.
- On the basis of each subdivision summary report, one consolidated report of each city for energy efficiency improvement opportunities of the WASAs was prepared.

## 2.0 Energy Audit Findings

This chapter describes summary of energy audit findings of WASA tube wells and wastewater disposal pumps of Faisalabad city. These findings are based on energy audit summary reports of 07 divisions of Faisalabad city. These 07 reports are available with The Urban Unit of Punjab for further review.

## 2.1 Administration of WASA of Faisalabad City

Faisalabad city is divided into seven zones for the WASA administration. The detail of these zones and number of audited tube wells and disposal pumps is given in Table-2. There were few tube wells and disposal pumps which could not be monitored during energy audit activity due to various reasons, such as i) non operational due to maintenance reasons, ii) non accessible, and iii) out of order.

**Table-2: Detail of WASA of Faisalabad City**

| # | Zones | No. of Water Supply Pumps | No. of Wastewater Disposal Pumps | Total No. of Pumps |
|---|---|---|---|---|
| 1 | Chiniot Well Field | 24 | - | 24 |
| 2 | Jhang Branch | 22 | - | 22 |
| 3 | Rakh Branch | 14 | - | 14 |
| 4 | OHR & City Area | 33 | - | 33 |
| 5 | Water Works | 11 | - | 11 |
| 6 | East Division Disposal Pumps | 0 | 38 | 38 |
| 7 | West Division Disposal Pumps | 0 | 55 | 55 |
| | **Total** | **104** | **93** | **197** |

## 2.2 Tube Wells Discharge Pattern

The detail of water discharges of tube wells for each division is given in Table-3. These discharges were monitored on field. There were few tube wells where water flow measurements were not possible. For these tube wells, the flows were estimated on the basis of loading of the electrical motor and physically observing the pump conditions.

**Table-3: Tube Well Discharge Pattern**

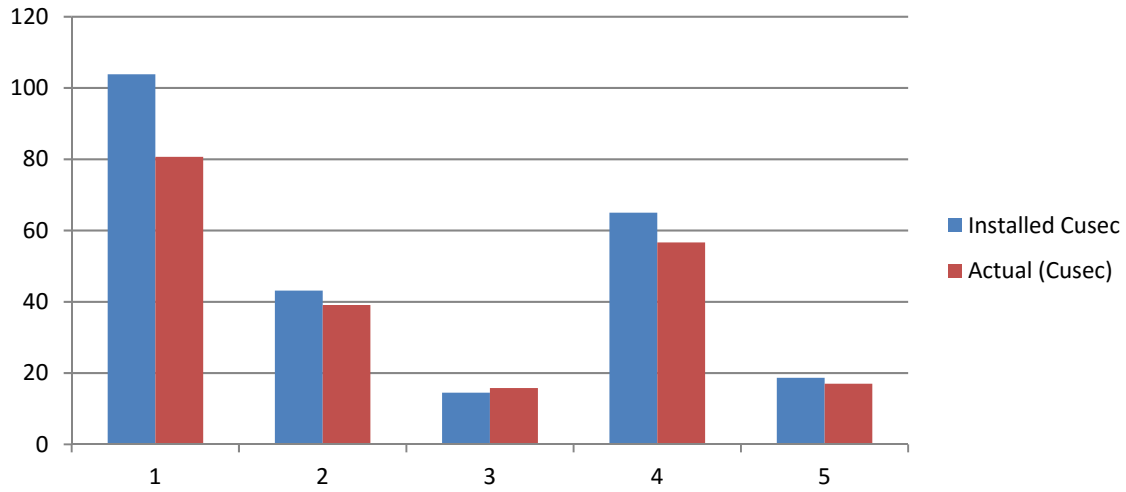
| # | Zone | Installed Cusec | Capacity (million $m^3$/yr) | Actual (Cusec) | *Avg. Discharge (million $m^3$/yr) |
|---|---|---|---|---|---|
| 1 | Chiniot Well Field | 103.85 | 69.59 | 80.71 | 54.09 |
| 2 | Jhang Branch | 43.12 | 24.08 | 39.12 | 21.85 |
| 3 | Rakh Branch | 14.50 | 3.24 | 15.82 | 3.53 |
| 4 | OHR & City Area | 65.02 | 9.68 | 56.65 | 8.43 |
| 5 | Water Works | 18.69 | 2.78 | 17.05 | 2.54 |
| | | **245.18** | **109.37** | **209.35** | **90.44** |

**Avg. Discharge is based on average 4-18 hours per day operation and 365 days per year.*

The installed capacity of WASA tube wells of Faisalabad city is about 109.37 million $m^3$ per annum whereas actual discharge is 90.44 million $m^3$ per annum, for average 4-18 hours per day operation and 365 days per year. This actual discharge is about 15% lesser than the installed capacity.

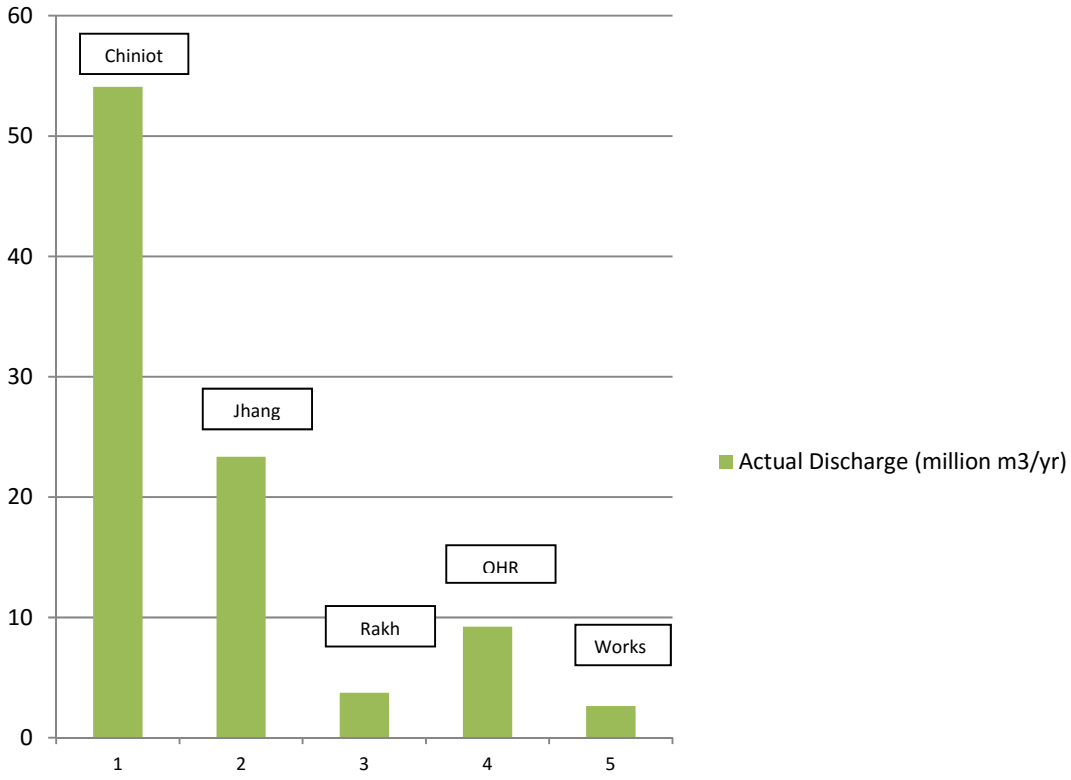
The comparison between installed capacity and actual discharge, in cusec, is illustrated in Fig-1.

**Figure-1: Installed Capacity Vs Actual Discharge (Tube Wells)**




The actual discharge, in million $m^3$/yr, for each division is illustrated in Fig-2.

**Figure-2: Actual Discharge Pattern of Divisions (Tube Wells)**




## 2.3 Wastewater Disposal Pumps Discharge Pattern

The detail of discharges of wastewater disposal pumps for each division is given in Table-4. These discharges were monitored on field. There were few pumps where water flow measurements were not possible. For these pumps, the flows were estimated on the basis of loading of the electrical motor and physically observing the pump conditions.

**Table-4: Wastewater Discharge Pattern**

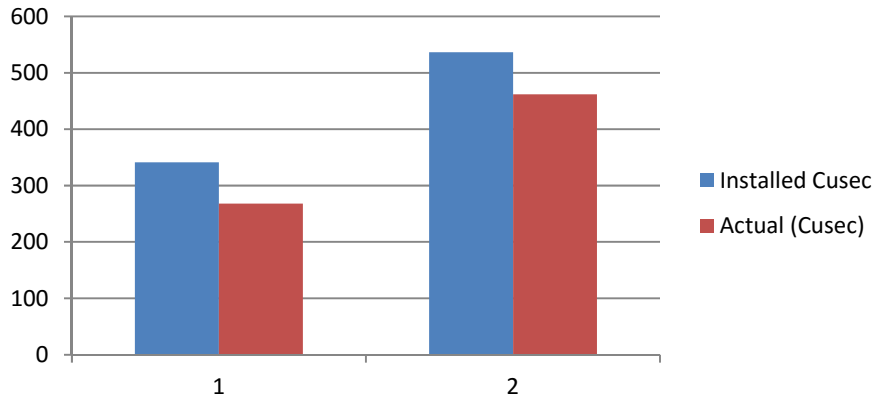
| # | Zone | Installed Cusec | Capacity (million $m^3$/yr) | Actual (Cusec) | *Avg. Discharge (million $m^3$/yr) |
|---|---|---|---|---|---|
| 1 | East Division Disposal Pumps | 341.16 | 152.41 | 267.91 | 119.69 |
| 2 | West Division Disposal Pumps | 536.34 | 239.61 | 461.77 | 206.39 |
| | | **877.5** | **392.02** | **729.68** | **326.08** |

**Avg. Discharge is based on for average 12 hours per day operation and 365 days per year.*

The installed capacity of WASA disposal pumps of Faisalabad city is 392.02 million $m^3$ per annum whereas actual discharge is 326.08 million $m^3$ per annum, for average 12 hours per day operation and 365 days per year. This actual discharge is about 17% lesser than the installed capacity.

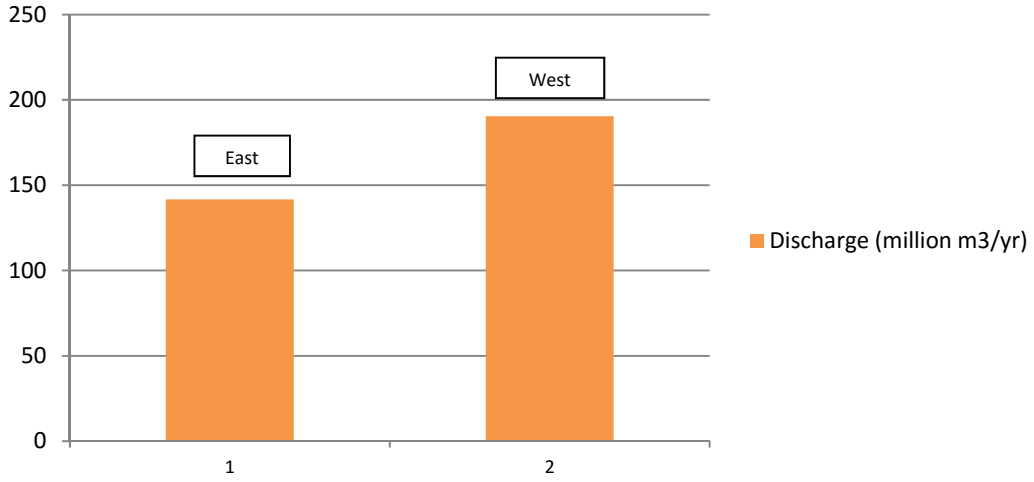
The comparison between installed capacity and actual discharge, in cusec, is illustrated in Fig-3.

**Figure-3: Installed Capacity Vs Actual Discharge (Disposal Pumps)**




The actual discharge, in million $m^3$/yr, for each division is illustrated in Fig-4.

**Figure-4: Actual Discharge Pattern of Divisions (Disposal Pumps)**




## 2.4 Energy Consumption Trend

The detail of annual water discharge and correspondingly electricity consumption and unit electricity consumption of each division of WASA station tube wells is given in Table-5.

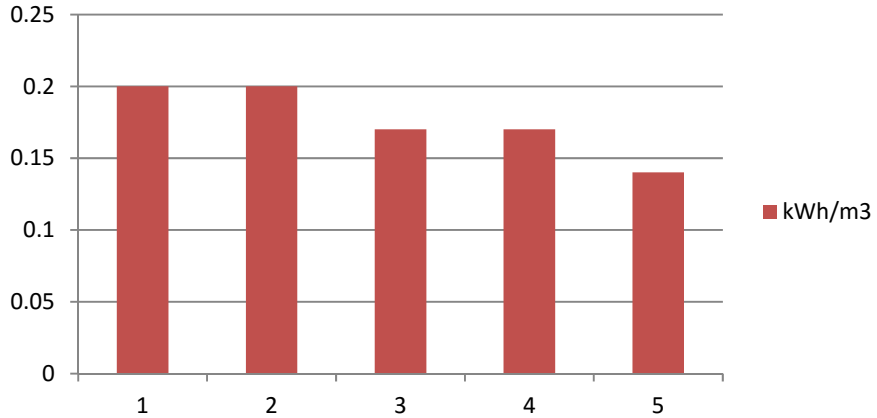
**Table-5: Detail of Water Discharge and Electricity Consumption**

| # | Zone | *Actual Discharge (million $m^3$/yr) | Annual Electricity Consumption (million kWh/yr) | Unit Electricity Consumption (kWh/$m^3$) |
|---|---|---|---|---|
| 1 | Chiniot Well Field | 54.09 | 10.89 | 0.20 |
| 2 | Jhang Branch | 23.35 | 4.63 | 0.20 |
| 3 | Rakh Branch | 3.74 | 0.64 | 0.17 |
| 4 | OHR & City Area | 9.24 | 1.56 | 0.17 |
| 5 | Water Works | 2.64 | 0.37 | 0.14 |
| | | **93.06** | **18.09** | **0.19** |

**Actual discharge is based on actual water flow rate measurement and actual no. of operational hours of tube wells per year.*

The unit electricity consumption trend for each division is illustrated in Fig-5.

**Figure-5: Unit Electricity Consumption Trend (Tube Wells)**




The detail of annual wastewater discharge and correspondingly electricity consumption and unit electricity consumption of each division of WASA station disposal pumps is given in Table-6.

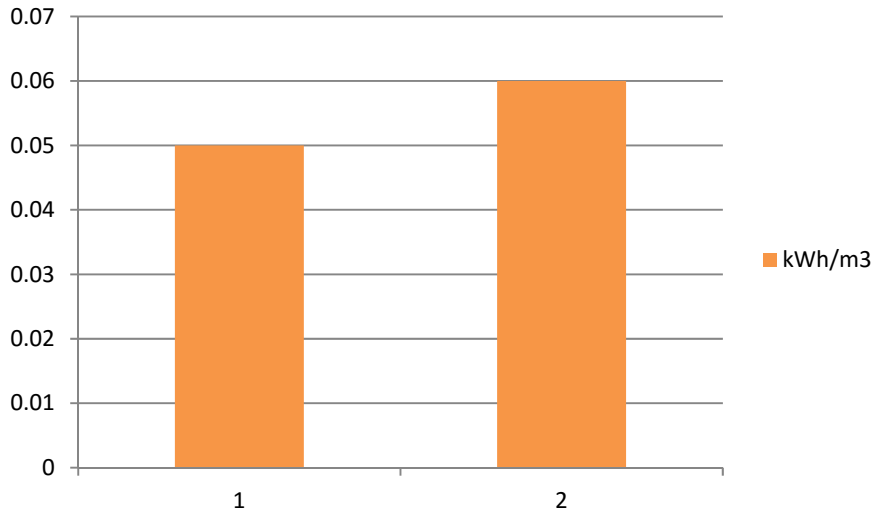
**Table-6: Detail of Wastewater Discharge and Electricity Consumption**

| # | Zone | *Actual Discharge (million $m^3$/yr) | Annual Electricity Consumption (million kWh/yr) | Unit Electricity Consumption (kWh/$m^3$) |
|---|---|---|---|---|
| 1 | East Division Disposal Pumps | 141.65 | 7.27 | 0.05 |
| 2 | West Division Disposal Pumps | 190.50 | 10.55 | 0.06 |
| | | **332.15** | **17.82** | **0.05** |

**Actual discharge is based on actual wastewater flow rate measurement and actual no. of operational hours of disposal pumps per year.*

The unit electricity consumption trend of each division for disposal pumps is illustrated in Fig-6.

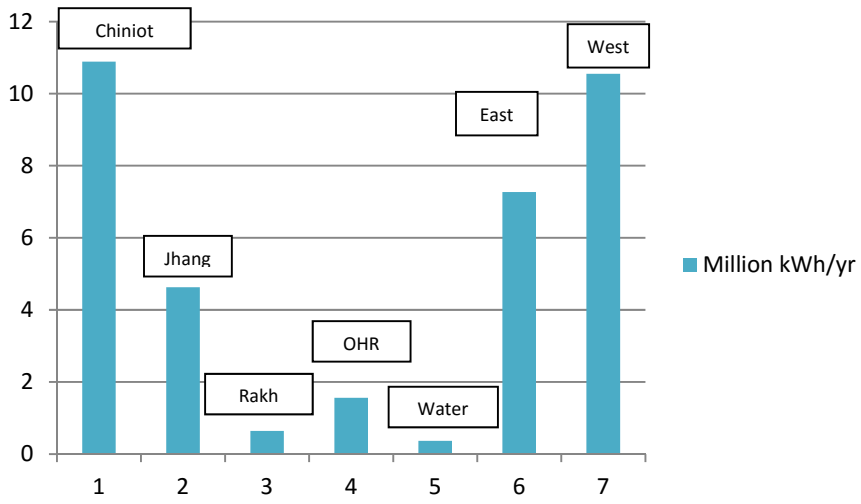
**Figure-6: Unit Electricity Consumption Trend (Disposal Pumps)**




Total annual electricity consumption of Faisalabad city to operate tube wells and disposal pumps is about **36 million kWh**. This energy, in monetary terms, is about **Rs. 467 million** (@ Rs. 13/kWh). . The contribution of tube wells in the energy consumption is about 50%.

Energy consumption trend of each WASA division is illustrated in Fig-7.

**Figure-7: Electricity Consumption Trend of Each Division**




## 2.5 Pumping System Efficiency Trend

Pumping plant efficiency of each tube well and disposal pump was monitored by measuring water flow rate, head and electricity consumption. The efficiency of each pumping system was classified as “Low”, “Fair”, “Good”, or “Excellent” by referring to the following table, which is based upon the results of thousands of pump tests conducted by Pacific Gas & Electric Company, USA. This classification is used to categorize WASA pumps.

**Table-7: Typical Overall Pumping System Efficiency Classification**

| Motor HP | Low | Fair | Good | Excellent |
|---|---|---|---|---|
| 3-7.5 | <44.0 | 44-49.9 | 50-54.9 | >54.9 |
| 10 | <46.0 | 46-52.9 | 53-57.9 | >57.9 |
| 15 | <47.1 | 48-53.9 | 54-59.9 | >59.9 |
| 20-25 | <48.0 | 50-56.9 | 57-60.9 | >60.9 |
| 30-50 | <52.1 | 52.1-58.9 | 59-61.9 | >61.9 |
| 60-75 | <56.0 | 56-60.9 | 61-65.9 | >65.9 |
| 100 | <57.3 | 57.3-62.9 | 63-66.9 | >66.9 |
| 150 | <58.1 | 58.1-63.4 | 63.5-68.9 | >68.9 |
| 200 | <59.1 | 59.1-63.8 | 63.9-69.4 | >69.4 |
| 250 | <59.1 | 59.1-63.8 | 63.9-69.4 | >69.4 |
| 300 | <60 | 60-64.0 | 64.1-69.9 | >69.9 |

*Source: Pacific Gas & Electric Company, USA*

The pumping system efficiency trend of each division is given in Table-8:

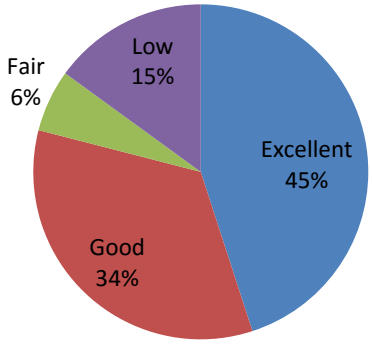
**Table-8: Pumping System Efficiency Trend of Subdivisions**

| # | Zone | Number of Pumps | | | | |
|---|---|---|---|---|---|---|
| | | LOW | FAIR | GOOD | EXCELLENT | Total No. of Pumps |
| 1 | Chiniot Well Field | 15 | 1 | 5 | 3 | 24 |
| 2 | Jhang Branch | 0 | 0 | 2 | 20 | 22 |
| 3 | Rakh Branch | 3 | 1 | 3 | 7 | 14 |
| 4 | OHR & City Area | 1 | 3 | 6 | 23 | 33 |
| 5 | Water Works | 1 | 0 | 0 | 10 | 11 |
| 6 | East Division Disposal Pumps | 2 | 5 | 24 | 7 | 38 |
| 7 | West Division Disposal Pumps | 7 | 2 | 27 | 19 | 55 |
| | | **29** | **12** | **67** | **89** | **197** |

About 79% of the tube wells and disposal pumps are under excellent and good category of pumping system efficiency whereas 21% are under fair and low category as illustrated in Fig-8.

The pumps of excellent and good category of system efficiency do not require any intervention to improve their efficiency whereas low and fair category pumps need efficiency improvement.

**Figure-8: Pumping System Efficiency Category**




## 3.0 Pumping System Efficiency Improvement Potential

This chapter describes pumping system efficiency improvement potential of WASA pumps of

Faisalabad city. The efficiency of pumping system can be improved by following interventions:

- Replacement of pump
- Replacement of motor
- Replacement of pumping system (pump and motor)
- Adjustment of pump impellers
- Repair and maintenance of pump
- Adjustment of pump impellers and repair and maintenance

## 3.1 Pumping System Efficiency Improvement Potential of Faisalabad City

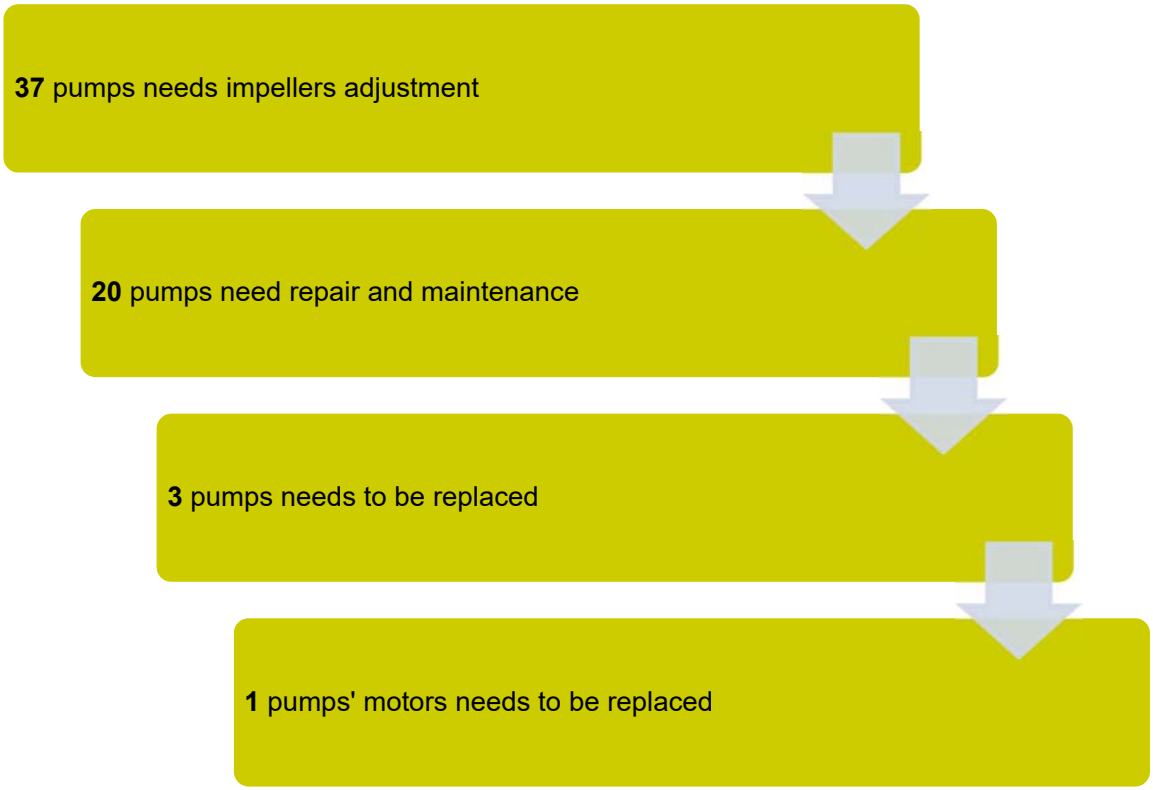
There are total 41 tube wells and wastewater disposal pumps (21% of total pumps) having system efficiency in the category of FAIR to LOW, as given in Table-8, have the potential of efficiency improvement into the GOOD category. Table-9 gives detail of this efficiency improvement potential.

**Table-9: Pumping System Efficiency Potential of Pumps**

| # | Zone | No. Pumps for Efficiency Improvement | Annual Saving | | Intervention | | | | Invest. (M. Rs) | Pay Back (Yr) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Million (kWh) | Million (Rs) | IA | R & M | MR | PR | | |
| 1 | Chiniot Well Field | 16 | 1.77 | 23.04 | 15 | 11 | - | 1 | 13.09 | 0.6 |
| 2 | Jhang Branch | - | - | - | - | - | - | - | - | - |
| 3 | Rakh Branch | 4 | 0.07 | 0.89 | 3 | 2 | 1 | - | 3.21 | 3.6 |
| 4 | OHR & City Area | 4 | 0.08 | 1.02 | 4 | 1 | - | - | 2.97 | 2.91 |
| 5 | Water Works | 1 | 0.02 | 0.28 | 1 | - | - | - | 0.28 | 1.0 |
| 6 | East Division Disposal Pumps | 7 | 0.23 | 2.98 | 6 | 1 | - | 1 | 5.42 | 1.82 |
| 7 | West Division Disposal Pumps | 9 | 0.65 | 8.51 | 8 | 5 | - | 1 | 16.02 | 1.88 |
| | | **41** | **2.82** | **36.72** | **37** | **20** | **1** | **3** | **27.90** | **11.21** |

***IA*** *Impeller Adjustment,* ***R&M*** *Repair & Maintenance,* ***MR*** *Motor Replace,* ***PR*** *Pump Replace*

The 41 pumps require interventions, such as:




## 3.2 Investment and Saving

Total investment for the efficiency enhancement and improvement of electrical and mechanical and housekeeping condition of 41 pumps is **Rs. 27.90** million with annual saving of **Rs. 36.72** million. The payback period is 09 months. The pumping system efficiency improvement will result into **8%** energy reduction.

Energy audit activity of WASA stations of Faisalabad city revealed that there are certain areas of electrical, mechanical and housekeeping which needs improvement along with efficiency improvement. About **Rs. 132.65** million are required to improve all WASA stations of Faisalabad city.

The detail of investment of each division of Faisalabad city is given in Table-10 along with improvement interventions.

**Table-10: Investment Requirement for Improvement of WASA Pumps**

| # | Zone | Investment (Rs. Million) | Improvement Interventions |
|---|---|---|---|
| 1 | Chiniot Well Field | 15.58 | - Impeller adjustment |
| 2 | Jhang Branch | 1.36 | - Repair & maintenance of pump |
| 3 | Rakh Branch | 7.16 | - Replacement of motor/pump |
| 4 | OHR & City Area | 20.73 | - Installation of PFI plant, VFD, water flow meter, digital |
| 5 | Water Works | 5.65 | pressure gauge, current & voltage relays, volt & |
| 6 | East Division Disposal | 25.57 | ammeter, motor terminal box, fuses, hour meter, and |
| 7 | West Division Disposal | 56.60 | chlorinator |
| | | **132.65** | - Proper/safe wiring |
| | | | - Maintenance (ratchet plate/gland leakage) |