

**INTERNSHIP REPORT ON GONDAR TOWN WATER SUPPLY
PROJECT**



**INSTITUTE OF TECHNOLOGY
DEPARTMENT OF HYDRAULIC AND WATER RESOURCE
ENGINEERING
HOSTING CAMPANY: CENTRAL GONDAR ZONE WATER,
IRRIGATION &ENRGY DEVELOPMENT DEPARTMENT
STUDENT NAME: SEID HUSSEN
ID NO: 4853/08
DURATION OF INTER SHIP: FOUR MONTH**

SUBMISSION DATE: 16 October, 2019

DECLARATION

I am students of **Hydraulic and water resource engineering** department at university of Gondar, I declare that the “internship program” report is the result of my own efforts and it’s based on data conducted and guidance given to me. This report is correct to best of my knowledge and so far has not been published anywhere else. I here declare that the report entitled “one semester” internship report submitted to department of hydraulic and water resource engineering department is my original work and report has not be formed basis for awarded any degree associate with other similarities.

ACKNOWLEDGEMENT

First of all, there is a scarcity of words to praise and to give honourable thanks to the entire almighty ALLAH for giving me the strength to perform my internship report within a given time. I would like to express my gratitude to all those who give me possibility to complete this project and I want to thank the department of hydraulics and water resources engineering deserve a great appreciation for their effect of arrange partial attachment for their student's. And maintenance section of university of Gondar, institution of technology, for giving me such a golden opportunity to commence this project in the first instance. I have further more to thank my advisor instructor **AGUMAS KINDE** for the constructive and valuable suggestions and for the successful completion of the project. Finally I feel great pleasure to express special gratitude my family for helping financially and morally.

EXECUTIVE SUMMARY

This internship report paper represents the design of water supply system for a specific location in kuma small rural town. Project comprises the steps and procedures of the design system. The contents of the paper have been divided in to five chapters and The first portion of the report includes the introduction, background of the hosting company such as main product or service of company, main end use or consumer of company, overall organization structure and work flow. The next portion focuses on the overall internship experience such section of company I have been working, work flow in the section, work task I have been executing, challenges I have been facing, measurement taken. The third portion of this paper is design of water supply project include general description of project area, statement of problem, objective of project, material and methodology, literature review gives more emphasis to method and procedure of population projection and design work. The output of the design components of water supply system include the source to be used, the distribution pipe network location and parameters such as diameter, head and flow in addition the total cost for the implementation of the project. In addition the design for service reservoirs which help in maintaining a constant supply at the time of excess demands is included in the paper. The data for the population number is 2439 and a water demand requirement relies on the house to house count carried out by each block in the kebele. Geometric increase method is selected to calculated population projection with the growth rate of 2.3%. the output of the system design is presented, which includes diameter pressure pipe, distribution pipe, selection criteria of water source, pipe material used and pump, reservoir carrying capacity of 50m³ in volume and sandwich type of reservoir on construction material. The fourthly overall benefits of practical skill, communication and leadership skill, team playing skill and work ethics and entrepreneurship skill is explained briefly. The fifthly conclusion and recommendation on the problems which were not solved during the internship period of the project and the last is reference I have been used.

Table of Contents

DECLARATION	i
ACKNOWLEDGEMENT	ii
EXECUTIVE SUMMARY	iii
List of abbreviations	vii
List of figures.....	viii
List of tables.....	ix
CHAPTER ONE	1
1. INTRODUCTION	1
1.1 BACKGROUND OF HOSTING COMPANY	2
1.1.1 Brief History of CNGZWIEDD	2
1.2 Main Products and Services of Company	3
1.3 Main Customers and the End Users of Company	3
1.4. Core values of the company	4
1.5. Objective of the company	4
1.5.1 Mission	5
1.5.2. Vision.....	5
1.5.3. Goal	5
1.5.4. Value.....	5
1.6. End users /Customers	5
1.7. The overall work flow in the company	6
1.7.1. Overall Organization and Work Flow	6
1.7.2 Overall Organization of the Company.....	6
CHAPTER TWO	8
2. OVERALL INTERNSHIP EXPERIENCE	8
2.1. How I Get the Company.....	8
2.2 Work flow look like in the project	9
2.3. Work Executed.....	10
2.3.2 Office work.....	10
2.4. Work task executed	11
2.5. Procedures& methods I have been using while performing my work tasks	11
2.6. Challenge I have been facing	11
2.6.1. Site Challenges	12

2.6.2. Personal Challenges.....	12
2.7. Measures I have taken for the basic challenges I have faced:.....	12
CHAPTER THREE	13
3. RESEARCH METHODOLOGIES	13
3.1 Project title: Design of Kuma rural small town water supply	13
3.2 Short summary of the project	13
3.2.1 Location	13
3.2.2 Topography and Climate	13
3.2.3. Geology and Vegetation cover	13
3.2.4. Socio Economic Activity	14
3.2.6 Existing Water Condition of Area	15
3.3 Problem statement justification	15
3.4 Objective of the project	16
3.4.1. The main objectives are:	16
3.4.2 Specific Objectives	16
3.5 Methodology	17
3.5.1. Methodology Used	17
3.5.2. Resource and Material Used	17
3.5.3. Negative Impacts of Project	18
3.5.4. Positive Impact of the Project.....	18
3.6. Literature Review	19
3.6.1. Design Period	19
3.6.2. Population Forecasting	20
3.6.3. Water Demand.....	26
3.6.4. Water Demand Factor.....	34
3.6.5. Water Source	38
3.7. Distribution System.....	44
3.7.1. Methods of Distribution System.....	44
3.7.2. Layout of Distribution System	45
3.7.3. Valve chamber construction	45
3.7.4 Water Point	45
3.7.4. Public water point	46
3.7.5. Materials used for water point	46

3.7.6. Pipe Material.....	47
3.7.7. Pipe Material Selection.....	47
3.7.8. Pipe Line System	48
3.8. Pump Selection.....	48
3.8.1. The Power of the pump	50
3.8.2. The electric motor/input/ power	50
3.8.3. Determine the Generator Power	50
3.9. Result and Discussion	51
CHAPTER FOUR.....	52
4. OVERALL BENEFITS I GAINED FROM INTERNSHIP	52
4.2. Upgrading theoretical knowledge	52
4.2. In Terms of Improving Practical Skill	53
4.3. In Terms of Improving Team Playing Skills.....	53
4.4. In Terms Of Improving Leadership Skills	54
4.5. In Terms of Improving Work Ethics and Related Issue.....	54
4.6. In Terms of improving Entrepreneurship Skill	55
Chapter five.....	56
5. CONCLUSION AND RECOMMENDATION.....	56
5.1. Conclusion.....	56
5.2. Recommendation for Hosting Company	57
REFERENCE.....	58

List of abbreviations

% -----	Percent
°C -----	Degree Celsius
A.M.S.L -----	Above mean sea level
CNGZWIEDD ----	Central North Gondar Zone Water, Irrigation and Energy Development Department
CSA -----	Central statistics Authority
CM -----	centimetre
E.C -----	Ethiopian calendar
HSD -----	static head difference
Km -----	Kilo meter
L/s -----	Litter per second
M³ -----	meter cubic
M³/day -----	meter cubic per day
PV -----	Photovoltaic
NGO -----	non-governmental organization
L/pc/day -----	Litter per capital per day
PDD -----	public water demand
TDDD -----	total domestic day demand
DWD -----	Domestic Water Demand
ADD -----	Average Day Demand
MDD -----	Maximum Day Demand
RC -----	Reservoir Capacity
ANRSBoWRD -----	Amhara National Regional State Water Resources Development bureau
HDPE -----	High quality density poly ethylin
UWL -----	unaccounted water loss

List of figures

Figure 3. 1 borehole of kuma.....	40
Figure 3. 2 circular reservoir of Kuma.....	42
Figure 3. 3 mixer.....	44
Figure 3. 4 valve chamber.....	45
Figure 3. 5 valve chamber.....	46
Figure 3. 6 HDPE.....	47

List of tables

Table 3. 1 Main Occupations of Family Heads (source: Keble administration at year2017.)	14
Table 3. 2 Households Monthly Income Categories (source: Keble administration at year 2017)	15
Table 3. 3 Normal Design of Various Units of Water Supply System	19
Table 3. 4 Population data obtained from Keble administrators (2017 G.C)	21
Table 3. 5 Projected Population for Kuma rural Town at five year interval.	26
Table 3. 6 Projected Average Per Capita domestic Water demand.....	29
Table 3. 7 Projected Percentage of Mode of Service	29
Table 3. 8 Projected populations by Mode of Service.....	30
Table 3. 9 Determination of domestic water demand	30
Table 3. 10 Climatic grouping and factors (WSSA, 1982).....	31
Table 3. 11 Adjustment for socio-economic factor (WSSA, 1982).....	31
Table 3. 12 Summary of Adjusted Domestic Demand.....	32
Table 3. 13 adjusted public water demand.....	33
Table 3. 14 Maximum Daily Demand Factor (MDD factor) (Source: WSSA, 1982(water supply and sewerage Authority)	35
Table 3. 15 Summaries of Adjusted Average Day Demand.....	36
Table 3. 16 The peak hour factor	37
Table 3. 17 Summery of water demand	38
Table 3. 18 bore hull data	40

CHAPTER ONE

1. INTRODUCTION

All human beings require water and food to sustain their life. Water plays an important role in making life comfortable. Water is essential for human being and for all living things, not only that but also water used for constructions, recreation, industry, washing, navigation, agricultural, electric power etc. About 80% of human body contains water. Generally we can say all things need water if we see the detail of everything. This tells us how much water is important for everything. Even though, water is critical for life; it may have an adverse effect on life unless properly used. The combined effect of the poor water supply situation virtually none of the existence of sanitation facilities account for over 75% of the disease in the country. Therefore, for significant socio-economic development of the community adequate safe water supply is one of the most important and prior actuality. Ethiopia is very well known for its enormous potential of water resource all of which is generated in its own territory and it is still known the water towers in Africa. However, most towns of Ethiopia have the problem of adequate and potable water supply of water. The need for potable water is not still scarified and the potential is not expected more over sanitation any standard of the society is not developed. As a result many people suffer from water borne diseases. Similarly kuma small rural town has serious problem of water. N/Gondar Water Resources Development Department has studied and designed of the Small town water supply system namely Kuma Small town. This report presents the results of the study and design on water supply, sanitation and hygiene of the above mentioned town carried out in accordance with the scope of works with the following two main objectives:-

- To conduct feasibility study on the water supply system in order to improve living conditions of the population in the study area by enhancing the level of water supply services in terms of quantity, quality and its accessibility.
- To formulate a plan for diffusion of sanitary facilities in order to improve environmental sanitation this will be able to prevent the contamination of sources and to secure safe water supply.
- The aim of the report is to collect, review and analyse data on the new water supply system, to prepare a preliminary design, discuss options, water supply

system of the Small town to the year 2018 and to propose implementation for the water demand up to the year 2033.

1.1 BACKGROUND OF HOSTING COMPANY

1.1.1 Brief History of CNGZWIEDD

One of the governmental developmental organizations established to improve the living standards of peoples of the region with respect to food self-sufficiency, water shade management, and water supply and sanitation projects by use of water and land resources is Central North Gondar Zone Water, Irrigation and Energy Development Department which was established in the government of dreg around 1980.

The Amhara National Regional State Water Resources Development bureau (ANRS BoWRD) is one of the leading public enterprise which supervises zone and woredas water supply, irrigation, urban drainage design and supervision service etc. and Central North Gondar Water Zone Irrigation and Energy Development Department is one of the department which included in Amhara national regional state water resource and development bureau. 1994-1999E.C it was under agricultural and rural development department as water desk. Then, from1999-2000E.C it becomes Central north Gondar Zone water resource and development department branch office still now. This branch office has established with the following core process,

Planning, monitoring and evaluation unit/process

- Water resource management core process
- Water supply and sanitation core process
- Irrigation and drainage study and design core process
- Mining Resource &Development Core Process
- Energy Resource& Technology Promotion process

Currently (CNGWIEDD) water supply is supervised by city council of BahiarDar, the Amhara national regional state government and the federal government is understood not to hold any direct ownership. It is somewhat unclear as to how this is organized. The office water service is organized as an autonomous public organization under the administration of the town. The office has responsibility for the production, transmission, distribution and sale of potable and sufficient water to the town

Following the associated water supply of the town under the direct supervision of regional proclamation. It had also been established as class one town water service.

1.2 Main Products and Services of Company

Central North Gondar Zone Water, Irrigation and Energy Development Department is the company which plays great role in supervision and design works related to water and irrigation. The company encourages society by providing water and irrigation to develop society economically as well as to see their better health status. It is one expanding water and irrigation for the zone as well as for the regional development strategy. In the water sector mainly to solve problem of water supply scarcity of the community, This can be implemented by design and construct small water supply project and it is working to minimize water born disease by providing clear water and giving profession training to avoid miss use of water.

Central North Gondar Zone Water, Irrigation and Energy Development Department has a wide range of service and engaged in the construction of water related works service including the following activities: -

- Irrigation dams
- Construction of different water supply structure
- Water based mode irrigation construction
- Construction of clear and portable water supply line
- Borehole and deep water well drilling works
- Manufacturing water based construction mate
- Maintenance services of generators

1.3 Main Customers and the End Users of Company

The main customers and the end users of Central North Gondar Zone Water, Irrigation and Energy Development Department are:

- Communities: - most of the structures that can be constructed by CNGWIEDD are water related structures and used for supplying water for the communities.

- Investors: - at this time there are many investors who are works on the water work like water supply, irrigation etc. CNGWIEDD also has a contract with these investors.
- Different government sectors
- Micro and small scale enterprises
- Different non-governmental organization
- Low income people of the town
- Construction
- Women & children
- Skilled and unskilled Labors

1.4. Core values of the company

- Customer oriented
- Team work (motivation, dedication etc...)
- Honesty
- Equitable service
- Transparent
- Reliable service
- Accountability

1.5. Objective of the company

Design the water supply system using deep well source to meet the water demand of Kuma small town from the year 2018 to the year 2033 and improving the health status by recommending sanitation facilities.

- To minimize the burden of women and children in traveling long distance.
- Improve water supply of the town.
- provide good quality drinking water in sufficient quantity to the resident of the town

To improve the shortage of water supply in town through safe, potable and adequate water

- To make water supply service potable, permanent, reliable by increasing the capacity of the schemer correlated to the progressive demand

- Provide adequate water supply in terms of quality and quantity
- Specializing infrastructural construction project network over nation wide
- To make beneficences of pure water and develop agricultural product
- Provide wide construction service and quality work
- Under take leading development activities

1.5.1 Mission

To render construction of rural pipe system timely and with reasonable cost.

1.5.2. Vision

Working strongly to increase the total coverage of potable drinking water.

1.5.3. Goal

Improve the current critical water shortage & at the same time ensure the future water demand and decreasing poverty.

1.5.4. Value

The cores values that govern central north Gondar zone water irrigation and energy development Department are: -

Professionalism, sound ethics, integrity, fast track to occurs innovation, quality first and detest Corruption to excel customers demand and expectations.

1.6. End users /Customers

- Amhara national state water resource development bureau.
- City municipal
- Governmental organizations and institutes
- Non-governmental organizations and institutes

Private sectors and Individual

1.7. The overall work flow in the company

1.7.1. Overall Organization and Work Flow

In order to handle the construction, marketing, financial and administrative activities of the business enterprise, strong management team is required. To build this team systematically the following summarized organization structure is implemented. Any project no matter how big or small the scale requires a well put together organization and work flow that is suitable to nature of the project. This may depend on:

- Time required to finish the project
- Number employees involved
- Scale of project
- Type of the project
- Location of the project site

1.7.2 Overall Organization of the Company

Central North Gondar Zone Water, Irrigation and Energy Development Department is a well-structured and adequately staffed organization capable of handling a number of projects at a time. The company uses the combined knowledge and experience of personnel, from manager to skilled workers, for consistent quality project delivery. In Central North Gondar Zone Water, Irrigation and Energy Development Department (CNGWIEDD) generally leading by manager includes the following department (Study and design Dep't, construction Dep't, maintenance Dep't, Irrigation Dep't, alternative energy Dep't).

- Study and design department works
- Construction department works
- Maintenance department works

Irrigation department work

Organization Work Flow Chart

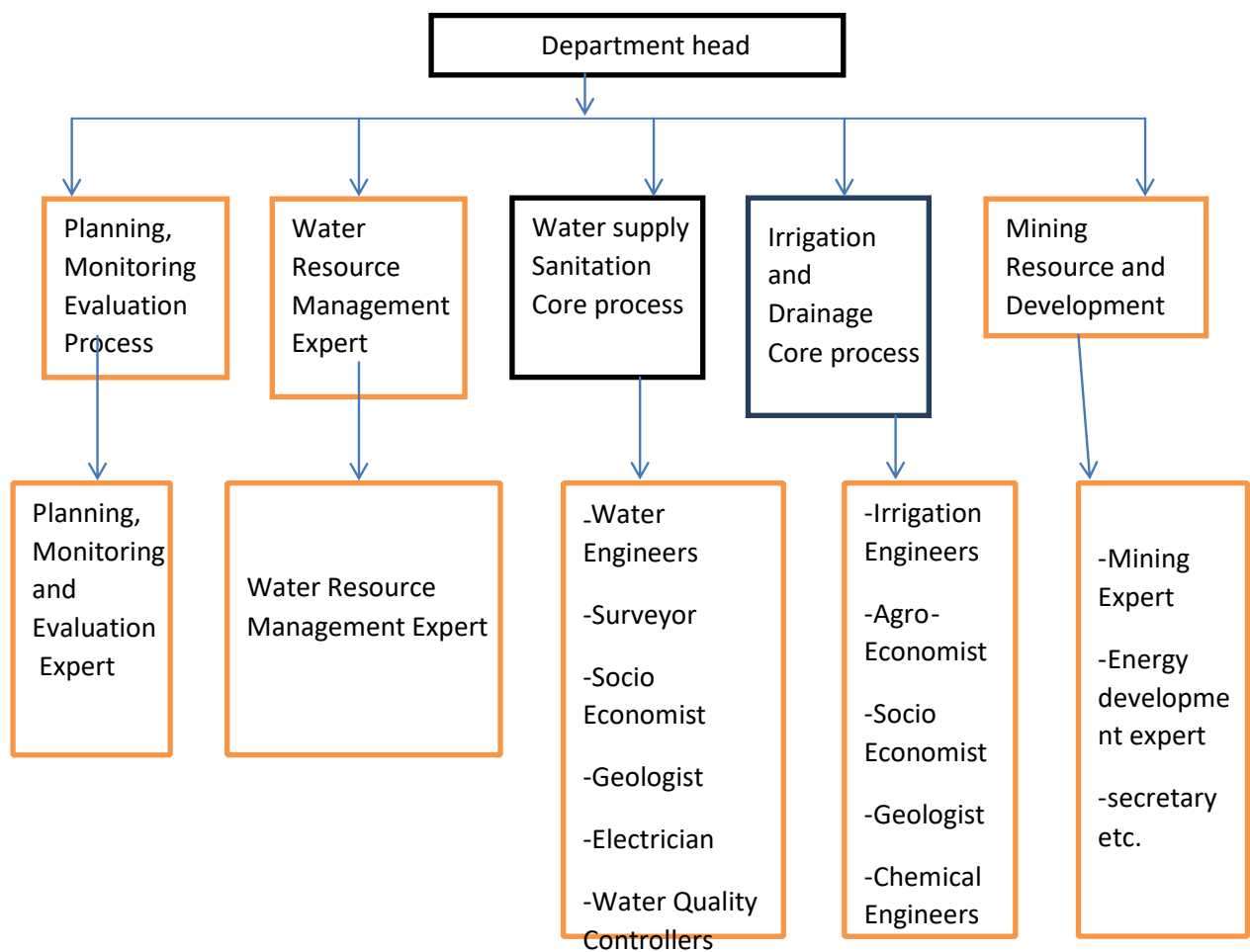


Figure 1. 1 Work flow of CNGZWIEDD

CHAPTER TWO

2. OVERALL INTERNSHIP EXPERIENCE

2.1. How I Get the Company

At the time of applying request paper, I had wasted much of my time in searching a company, which can host me. Finally thanks to the university industry linkage cooperation that gives advice about different organizations which are governmental and nongovernmental to accept me for my internship program the CGZWIEDD is the best and willing company to host me.

Section of the Company I Have Been Working

For my internship period I have worked under water supply department. Moreover I participate in community water supply projects. I have taken part in observing the boreholes, reservoirs, each water point& fitting pip finally distributing the water to different water points in addition to try to design works of water supply projects. And I also asked any skilled man and get knowledge from them in site. In addition to that I gate knowledge: -

- By observing and hand checking
- By asking oral question to site engineer

By communicate with the society

2.2 Work flow look like in the project

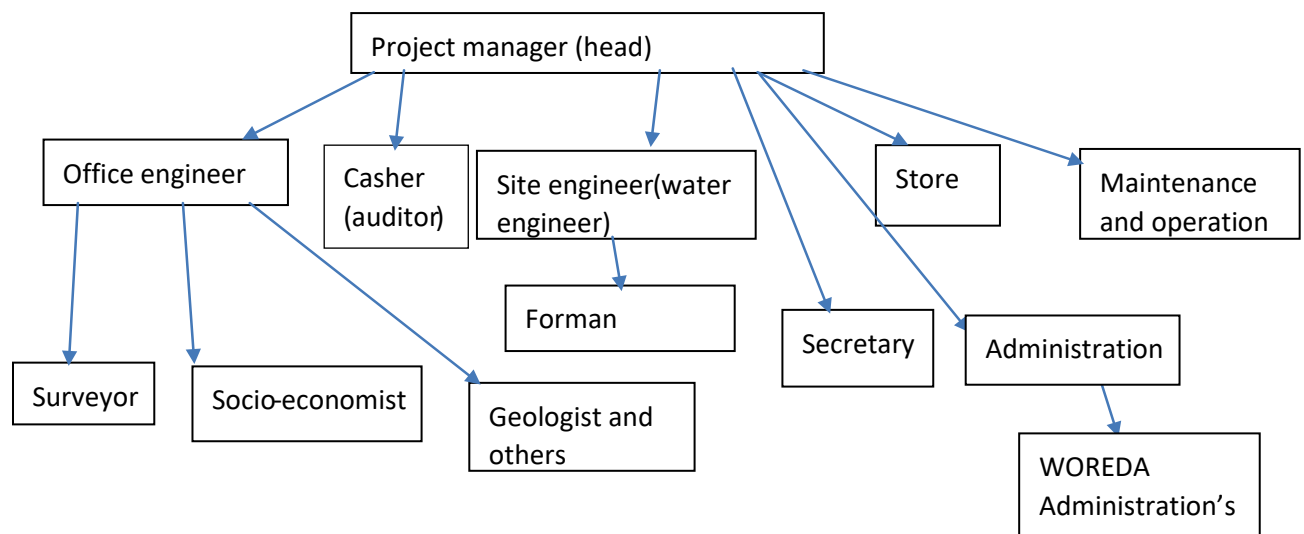


Figure 2. 1 Work flow in the site

Work flow description:

Project manager: - He Controls the overall activities being undertaken in the site. He organizes different components of the site and assigns different professionals such as Engineers, Forman and others to the components. Project manager controls and allocates different resources to the various sections of the site. Among these he deciding on how much workers should be included under each Engineer or under each Forman, deciding on monthly budget and distribution of budget, deciding on the distribution of construction materials through different components. He organizes and prepares meetings with different stake holders in the site.

Site engineer: - Site engineer in construction has a responsibility to make sure that the work is implemented based on the design and based on specifications used by the company. He communicates with the office engineers and construction engineer if the design has to be modified and orders the Forman to make it implemented. He visits the site on day to day basis for the purpose of making sure that the work is flowing as planned.

Office Engineer: - Collect data on the site from data collector or surveyor and compile these data and make report to the Project manager and make detail drawings to be easy for construction and installations and provides them to the concerned section.

Foreman: - Acts as an agent's right hand man for the execution of the work in the field, his duty being to keep the work moving ahead daily as the agent has planned it. The foreman has much authority on site and since long experience of construction any junior engineer could learn lot.

Cabo: - Cabo controls the distribution of labors throughout the site. He also controls the number of labors at each work place, transfer of labors from one place to another, whether or not labors are performing their work properly. He also assigns different workers at the proper place. The cabo has the power to give allowance to the workers to stop work and go home at the time of sickness or any other occasions.

Administrator: - Administer the workers (employees), takes care of the employment of new workers and checks the working performance and punctuality of the workers with the time keeper.

Finance: -Takes care of monthly salary (fee) of the employees, finance the purchasing of requested materials.

Store keepers: - Controls the amount and type of material of the construction Entering and leaving from the store by preparing some forms.

Data collectors: - Collect the daily data about the work being done. Like: the type, the executed amount, the different materials and equipment's used to execute the work, and also the different trade labors participated on the specific work.

2.3. Work Executed

2.3.1 Site work: In site work I observed and manage different operations directly related to my theoretical knowledge and gave me experience about all the office and site works.

2.3.2 Office work

In the office work executed in different ways:

- How the water supply is can be design?
- Population forecasting & demand estimation
- Connecting pipe using WATER CAD soft ware
- How to organize and change the raw data for design

- Revising the design data
- Demand analysis by using WATERCAD Software

2.4. Work task executed

I executed in water supply project, which is found in kolladiba woreda in Kuma kebele 65km from Gondar town. The selected structure for the project are well, elevated reservoir construction and design of solar power system to pump water and replace the diesel generator water supply scheme, so my sole role is as a supervisor. To control the overall things that has been working in the project.

2.5. Procedures& methods I have been using while performing my work tasks

I have been use the following procedures to perform my tasks

- My supervisor gave me soft copy of the construction document to read before I started my work.
- Then I read the construction document and I saw the project area.
- Next I ask my supervisor when I got ambiguity idea
- After this he gave me an exercises

Finally, he corrects me that I made errors during the exercise.

2.6. Challenge I have been facing

Even though my internship period is so interesting and it upgrading my practical skill there was some challenges that I have faced during my work but they thought me basic things. Some of the challenges that I have faced are:

- Transport facility shortage
- There is no finical support from the company
- Lack of potable water (lack of treated water) near the site
- the project work area finished and the company has no near to the project
- no enough office
- Lack of computer access.

2.6.1. Site Challenges

- During laying of pipe line there was disturbance of small amount of agricultural land and vegetation due to this reason outbreak of disagreement between site worker and communities.
- Lack of skilled labor.
- Lack of transportation of construction material in time.
- Problem of infrastructure during rainy.
- Lack of financial support from the company since it is mini project.

2.6.2. Personal Challenges

- Problem of Communication with the engineers, Foreman and daily labors, because I was new for the local construction terms they use at the site but eventually, I know almost all the terms in the site
- Lack of transport to go from company to site
- Scarcity of money. There is no payment to us so it was difficult to survive

2.7. Measures I have taken for the basic challenges I have faced:

I have taken some measures or mitigation for basic challenges faced me during my internship time. Some the measure I had taken area as follow bellow:

- To solve transport problem of the company we use transportation our self.
- I had used by bought highland water to solve lack of potable water.
- Asking contracture and site engineers for their consult on what I saw in site
- We use Saturday and Sunday for office work to solve office accesses
- To solve lack of computer service I wrote the whole project report in intern time with my friend pc.

CHAPTER THREE

3. RESEARCH METHODOLOGIES

3.1 Project title: Design of Kuma rural small town water supply

3.2 Short summary of the project

3.2.1 Location

The town Kuma is located in North Gondar Administrative Zone in Amhara National Regional State, the study area is located about 65 km from the capital of the Zone Gondar town and also 15 km from the woreda town Kolla diba. It is situated in Dega climate area. The road from Gondar to the study area is Asphalt road, When compared to the town & population size, the water supply and sanitation system is not adequate. Hence to assure its progress a potable, reliable and adequate water supply system, sanitation and hygiene must be established and should be constructed.

3.2.2 Topography and Climate

The study area occupies flat area in the Southern part and mountainous terrain in the Northern and Eastern parts. Kuma Small Rural town is situated in kola climatic group. Rainfall of the locality and air temperature in general characterizes climate of the area. However, additional factors like sunshine hours, humidity, wind speed, etc. has impacts on the two climatic parameters. Temperature is varying in every season to season. The mean monthly temperature of the area is 30⁰c. The rainy season usually appears from May to September and has the mean annual rainfall of the town is 700-1200 mm. The town is found an average altitude of 1795m above mean sea level.

3.2.3. Geology and Vegetation cover

The project area mainly covered by basaltic flow and pyroclastic deposit of rhyolite compositions. The top parts or surfaces of this area are covered by dark brownish, grayish and reddish grey clay soil, which has a depth of up to about 10m at most flat areas like flood plain of the major streams and even at the top plain area of water divides as it can be seen from shallow wells drilled on such area. The area has very dense vegetation including inset, coffee and cereal crops cover.

3.2.4. Socio Economic Activity

The major economic activity of the population in the area is found to be agriculture. This means that the entire population of the area depends on agriculture for their livelihood. On the other hand there are some households who depend on small trade activity as to earn income to subsidize that of the agriculture one. The local women have a great role in area more than male. Usually they are involved in selling and buying of farm and cattle products.

The investigation of socio-economy as it has conducted a sample survey, the main and the largest occupation of the head of the households in the Small town is Farming and the private business is the second while the rest are Government & public Employee, daily labourer, and unemployed etc.

Table 3. 1 Main Occupations of Family Heads (source: Keble administration at year2017.)

No	Main Occupation	Percentage share
1	Private clinic	3
3	Farming	45
4	Government Employee	10
5	Daily Laborer	36
6	Small traders	6
Total		100

3.2.5 Income

To roughly see the level of the community's cash earnings the socio economic survey has made an inquiry about the household's monthly cash income. The result of the sample survey is presented in table 3.2

Table 3. 2 Households Monthly Income Categories (source: Keble administration at year 2017)

No	Monthly Cash Income range	Percent Household
1	Less than 1000 Birr	24.17
2	1001- 2000 Birr	40.36
3	2001- 3000 Birr	10.78
4	3001- 4000 Birr	17.39
5	Above 4000 Birr	7.3
Total		100

3.2.6 Existing Water Condition of Area

There is no any existing piped water supply system in the project area.

The sources of water for the existing water supply system of KUMA Town include one traditional spring with including Tana Lake.

The source they use at present time are one traditional spring and Tana Lake which are located at the town which is polluted and seasonal springs around the town at their houses which is not satisfactory.

The existing water sources are not sufficient enough to full fill all the water demands of the community residing in the project area. Besides, they are far from human settlements and are prone to flooding during the rainy season.

3.3 Problem statement justification

The water supply and sanitation status in most of Ethiopian urban and semi urban areas is generally characterized by water scarcity as well as insufficient services. Where ever water scarcity is noticed, it is usually associated with sanitation problems. Solving this crucial problem of water supply and sanitation in kuma small rural town,

located in koladiba woreda at a distance of 65km from Gondar and 15 km from Koladuba town to undertake detail study and design of kuma water supply project. There is water demand and supply imbalance due to insufficient yield from existing source. Though due to siltation problem developing new water sources is critical thing

- Time spent for fetching of water, particularly by women.
- The expansion of water borne diseases in the area.
- Decline of existing reservoir & population number increase.
- Less commanding capacity of the existing reservoir.
- Lack of techniques for maintenance likes bore hole, collection chamber, and reservoir.
- Most public fountains are non-functional.
- Absence of fence and drainage facility at the reservoir

3.4 Objective of the project

3.4.1. The main objectives are:

The overall objective of project is to design safe, adequate, accessible and sustainable water supply system for the proposed design periods i.e. 2033 kuma rural small town by improving health condition of the community and increasing productivity.

- To provide potable water supply for the existing resident of one village i.e Kuma small rural town with estimated total population of 3110 at the end of 2033.
- To improve the living standard of the community there by increasing the awareness towards the community using safe water.
- To improve the health and hygienic standard of the community
- And to distribute the water for each bono used for drinking.

3.4.2 Specific Objectives

For Design the water supply system using Deep well as a source to meet the water demand of kuma rural small town from the year 2015 to the year 2033 and improving the health status by recommending sanitation facilities.

- Construction of gravity mains
- Construction of reservoir
- Construction of distribution net work
- Construction of public fountain
- To increase water converges of kolladiba woreda.
- To increase the living condition of the community
- To reduce the transmission rate of water borne diseases
- To upgrade health and sanitation practice

3.5 Methodology

3.5.1. Methodology Used

The material and methodology used is guide for the designer. That mean the methodology guide for how to collect the data or information from different aspect the same is true the material which is used for construction justification also important.

In order to achieve the proposed objective the following method were used.

- Conducting community need assessment concerning safe water supply;
- Reviewing of pervious work conducted in the area of interest and vicinity;
- On site visit of formerly existing sources of water;
- Conducting detail hydro-geological and geological study;
- Direct discussion with the local community living in the village;
- The geophysical survey applied in this survey is Electrical Resistivity Method. The method was used to verify variation of resistivity with depth with the procedure called vertical electrical sounding (VES).

3.5.2. Resource and Material Used

- The human resource employed on the study includes: - 1 hydrologist, 3, engineers, an economist, drafts man and other support staff;
- One 2H vehicle;
- Laptop computers and related (e.g. printer);
- Using topographic maps (scale 1:50,000);

- Using global positioning system (GPS);

Surveying equipment (total station) ;

3.5.3. Negative Impacts of Project

Possible negative impacts of the proposed kuma small rural Town water supply project are:

- Disturbance of a small amount of agricultural land due to laying of pipelines and consequent decrease in crop yield.
- Loss of land due to access construction.

3.5.4. Positive Impact of the Project

- Time and energy saving in the collection of drinking water. Especially the burden of women and child in fetching of water from other sources can be reduced.
- Create job opportunity and other
- General improvement of the water supply, sanitation and standard of living.
- Improve the health and life standard of the people. Proper implementation of the proposed water supply project would improve the health and life standard of the people.
- Provide better quality and sustainable water supply for the town.

Mitigation measures to reduce or overcome the negative impact listed above are.

- Care full selection of pipeline routes.
- Carrying out of awareness activity about the importance of the project aimed at local people.
- Collect and disposal any solid and liquid wastes in a proper and safe place.
- Avoid water logging and seepage at public taps.

3.6. Literature Review

3.6.1. Design Period

Design period is the number of year for which a provision is made in the designing the capacities of various components of water supply scheme. Or the number of year for which the design of water works has been done. It should be neither too long nor too short. It should be optimum. The economic design period of the components of a water supply depends on their life, initial cost, rate of interest on loan.

The factor affecting design period of water supply scheme

- Useful life of the component structure and life of pipe
- Funds available for completion of the project
- The rate of interest
- Anticipated rate of population growth
- Capacity of water sources
- Economic growth of the town

In order to design parts of a water supply system, the flow at the end of the design period must be estimated. The Design periods recommended for designing the various components of a water supply project listed below.

Table 3. 3 Normal Design of Various Units of Water Supply System

Item	Design period a year
Storage by dam	30
Infiltration	15
Pumping	
• Pump house	30
• Electric and motor pump	15
Water treatment unit	15
Pipe and fittings	30
Service reservoir	15

Finally by considering the above all factor the design period to kuma small rural town water supply system is estimated to be 15 years. From above factor we ask why it is adopted 15 year design period and answered to us fund availability, life of pipe because of the project area is humid or high in temperature.

3.6.2. Population Forecasting

In order to predict the future population, as correctly as possible it is necessary to know the factors affecting population distribution, size and growth rate of a certain area.

Population is always a relevant factor in estimating future water use, it is necessary to predict what the future population will be. The date in the future the projection is made depends on the particular component of the system which is being designed. Elements of the system which are relatively easy to expand tend to have shorter design lives; hence population projections periods may range from as little as 5 to as long many as 50 years. Through knowledge of the community and external factors which may affect its growth are very important in population estimation. Generally population growth of a town or a city is affected by the following factors

- Births, It increases population
- Deaths, it decreases population
- Migration, it increase/ decrease population

All these factors are influenced by social & economic factors and conditions prevailing in the various communities among which the important ones are: -

- Family planning practice
- Education and awareness
- Development & advancement of medical facilities
- Industrialization & commercialization of the area
- Factors like war and natural disaster

The present population of a town or city can be best determined by conducting an official enumeration called census.

Base Population

Even though, the central statistics Authority (CSA) is recognized in Ethiopia to determine the official population figures and growth rates that should be taken for any development activity throughout the country, Kebele Administrators also count population periodically. The data obtained from Kebele Administrators of the project area is tabulated below. In this project the kebele administrator data is taken because of the number of immigrants to village becomes increasing years to years as it is a new village.

Table 3. 4 Population data obtained from Kebele administrators (2017 G.C)

Source	Year	Got	No. Population		
			Male	Female	Total
➤ Kebele administrator	2017	Kuma	1,865	1,129	2,439

According to the data collected directly from the community by CSA the present population of kuma small rural town water supply user community is 3110 from for the projection of the population until the year 2033 with growth rate of 2.3 per annual .This hypothesis was verified using Geometric increase method with is more appropriate than other method for rural town with growth rate.

DESIGN PERIOD

Generally the design period of water supply system is determined by considering the following facts: -

- Funds available for the construction of the project
- Useful Life span of materials that are used in the water supply system
- Rate of interest on the loans taken to complete the project
- Operation & maintenance cost
- Anticipated expansion of the population

Kuma Keble is rural villages and based on the above-mentioned facts, 15 years design period is adopted (2018 – 2033).

3.6.2.1. Methods of Population Forecasting

The knowledge of population forecasting is very important for design of any water supply scheme. The design will be done on the basis of projected population at the end of the design period otherwise the present scheme will be inadequate in the future. There are many methods of population forecasting

1. Arithmetic increase method
2. Geometric increase method
3. Incremental increase method
4. Decrease rate of growth method
5. Simple graphical method
6. Comparative graphical method
7. Master plan or zoning method
8. Logistic curve method

1. Arithmetic increase method: - This is the simplest method of population forecast. It gives relatively lower result and suitable for old and saturated cities. In this method, the increase in population from decade to decade is assumed constant.

Mathematically it can be expressed as:

$$\frac{dP}{dt} = K$$

Where dP/dt is the rate of change of population and K is a constant. K is determined graphically or from populations in successive censuses as:

$$K = \Delta p / \Delta t$$

The arithmetic average of the population increase for the past 3 or 4 decades is used as the design growth rate. The population in the future is then estimated from

$$p_n = P_o + Kn$$

Where,

P_n = the population at n decades or years in the future

P_o = the present population

K = Arithmetic increase

n = decade or years and

t = the period of the projection. It gives relatively lower result and suitable for old and saturated cities.

2. Geometric increase method

In this method, it is assumed that the percentage increase in population from decade to decade is constant and the increase is compounded over the existing population every decade. It gives higher value and suitable for new/ young industrial cities. Geometric mean increase is used to find out the future increment in population. The formula used to forecasting by using geometric increase method is:-

$$p_n = p_o \left(1 + \frac{r}{100} \right)^n$$

Where, Po= present population

Pn=population at nth decade or year (future population)

n = number of decades (design period)

r =Geometric growth rate

3. Incremental increase method

It is based on the assumption that the decade growth rate is progressively increasing or decreasing depending upon whether the average of the incremental increases in the past data is positive or negative. in this method the population for a future decade is worked out by adding mean arithmetic increase (say x) to the last known population as in arithmetic increase method, and to this added the incremental increase (say y), once for the first decade, twice for the second & for third decade, & soon.

4. Decrease Rate of Growth Method

This method is applicable only in cases, where the rate of growth shows a downward trend. In this method the average decrease in the percentage increase is worked out and is then subtracted from the latest percentage increase for each successive decade.

5. Simple Graphical Method

In this method, a curve of population against time is drawn for the city under consideration. The known census records are put up the graph to get the shape of the curve. Then, the curve is carefully extended from the present to future decades and population after each successive year is read from the curve.

6. Comparative graphical method

If the population of town is plotted with respect to time, the curve so obtained under normal condition shall be shaped logistic curve. When the growth rate of population due to birth, death and migration takes place under normal situation and it is not subjected to extraordinary changes to unusual situations like war, epidemic, earthquake, exodus of refugees etc.

- ❖ For such developing Villages, population geometric progress method is the commonly used formula to forecast the population at the end of n years.

$$p_n = p_o \left(1 + \frac{r}{100} \right)^n$$

Where:

P_n = population at the target year

P_p = present population

r = geometric growth rate

n = design period, in year

$$P_n = 2439(1 + 2/100)^1$$

$$P_{2018} = 2439 * (1.023)^1$$

$$= 2439 * 1.02$$

$$= 2488$$

$$P_{2023} = 2488(1 + 1.7/100)^5$$

$$= 2488 * 1.08794$$

$$= 2707$$

$$P_{2028} = 2707(1 + 1.5/100)^5$$

$$= 2707 * 1.0773$$

$$= 2916$$

$$\begin{aligned}
 P_{2033} &= 2916(1+1.3/100)^5 \\
 &= 2916 \times 1.0667 \\
 &= 3110
 \end{aligned}$$

Table 3. 5 Projected Population for Kuma rural Town at five year interval.

Year	2017	2018	2023	2028	2033
Growth rate (%)	2	2	1.7	1.5	1.3
Population	2,439	2,488	2,707	2,916	3,110

(Source World Bank cost effective guideline)

There for, the projected population at the end of the design year (2033) is 3,110

3.6.3. Water Demand

In the design of any water supply project it is necessary to estimate the amount of water that is required to satisfy and serve up to the end of the design period. This involves determining the number of people who will be served and their per capita water Consumption; together with an analysis of the factors that may operate to affect consumption.

A water supply system capable of supplying safe, adequate and reliable water is necessary for any community under consideration. In order to estimate the total demand of a particular community as correctly as possible, all demands must be considered. In general speaking, in designing the water supply scheme for a town, it is necessary to determine the total quantity of water required for various purposes. The demand includes domestic, non- domestic (commercial, industrial, institutional, public use etc.), demand due to loss (unaccounted for animal drinking and fire demand). It varies according to the requirement of the population. Institutional and social establishment municipal water supplies for the watering of public green area. In addition to this demands allowance need to be include for leakage, wastage and operation requirements such as flushing of main.

Some of the factors affecting the amount of water demand are:-

- Size of a town
- Industries
- Cost of water
- Quality of water

- Location and climatic condition
- Standard of living
- Pressure in the distribution system
- Cost and quality of water
- Installation of water meter
- Efficiency of the water service administration.
- Time taken to fetch water from the service center etc.

Water consumption for various purposes is dividing under the following categories

1. Domestic demand
 2. Non domestic demand; i.e. (*Commercial water demand.*Industrial water demand, *Demands for public use, * Institutional).
- Public demand
 - Water losses
 - Animal demand

From this the major types of water consumptions considered for Kuma Keble rural piped system design purposes are discussed below.

Mode and Level of Services

In most of water supply studies in our country, it is common practice to generally use to five modes of services.

These are:-

- Public tap users (Water point) (PTU)
- Yard tap user (YTU)
- House tap user (HTU)
- Neighborhood tap users (NTU)
- Traditional source users (TSU)

During field visit and study, the town communities use water services by those methods but due to electric volt problem, pipe size limitation & distribution line shortage they are not use their water source properly.

However after the implementation of the new project, other than affordability, all the hindrance to use proper water supply system will be solved. After the completion of the project, it is assumed that traditional users will have the chance to use yard and public tap connections. Therefore, the numbers of traditional source users will be decreased remarkably.

3.6.3.1. Domestic Water Demand (DWD)

It includes in- house purpose of water such as cooking, ablution, washing utensil, washing clothes, flushing toilet, drinking, bathing ,etc. the amount of water used for domestic purposes varies depending on life style, living standard, climate, mode of service.

The implementation of the project will result in change of the per capita water demand through each mode of service. To estimate the projected per capita demand using the initial demand of 30l/c/d for yard connection and 25l/c/d for public tap users, the water demand to grow at growth rates of 1% per annum for public and 2% for yard and house tap user is considered.

Table 3. 6 Projected Average Per Capita domestic Water demand

Demand category	Years				
	2018	2023	2028	2033	
Yard Tap User	30	33	36.3	39.93	
Public Tap User	25	26.25	27.56	28.94	

Source: - MoWR Design Criteria

Population distribution by Mode of services

Based on the socio-economic survey carried out during study and the previous experiences, it is reasonable to assume and adopt that about 94 percent for public tap user, 6 percent for yard tap user at the inception of the project.

Table 3. 7 Projected Percentage of Mode of Service

demand category	Year			
	2018	2023	2028	2033
Yard Tap User	6%	13%	20%	27%
Public Tab User	94%	87%	80%	73%

Table 3. 8 Projected populations by Mode of Service

demand category	Year			
	2018	2028	2028	2033
Yard Tap User	149	352	583	840
Public Tap User	2,339	2,355	2,333	2,270
Total Population	2,488	2,707	2,916	3,110

Table 3. 9 Determination of domestic water demand

Demand category	Year				
		2018	2023	2028	2033
Yard Tap User	m3/day	4.48	11.61	21.17	33.53
	l/s	0.05	0.13	0.25	0.39
Public Tap User	m3/day	58.46	61.81	64.29	65.71
	l/s	0.68	0.72	0.74	0.76
Domestic daily demand	m3/day	62.94	73.42	85.46	99.24
	l/s	0.73	0.85	0.99	1.15

❖ Climatic adjustment factor

The town is situated in Kola the mean annual rain fall is about 700-1200 mm. The mean monthly maximum air temperature ranges from 29 to 38 °C during the dry season and to 23 to 27 °C during the wet season. On the other hand, the mean monthly minimum air temperature reaches 21° C in the rainy season and only 22-23 °C in the dry season.

So, by considering this value for Kuma village, the annual rain fall is 700-1200 mm. Which is found above 901mm, the project area belongs to the climatic group C.? Thus, an adjustment factor of 0.9 is considered.

Table 3. 10 Climatic grouping and factors (WSSA, 1982)

Group	Mean annual precipitation	Factor
A	< 600	1.1
B	601 – 900	1.0
C	> 901	0.9

Source:- From ministry of Water resources design criteria guide line

❖ Socio economic adjustment factor

Kuma rural village can be considered as an area having a very high potential for development but lower living standard at present and based on this it is categorized in group C with a Socio economic adjustment factor of 1.0

Table 3. 11 Adjustment for socio-economic factor (WSSA, 1982)

Group	Description	Factor
A	Towns enjoying high living standards and with very high potential development	1.1
B	Towns having a very high potential for development but lower living standard at present	1.05
C	Towns under normal Ethiopian condition	1.0
D	Advanced rural towns	0.9

Source: Planning of Water Supply Minister of Water Resources (JICA), CSA 1999

Summary of Projected Population and Growth in Domestic Demand

The following table presents summary of the results on population projection, percentage of population served by different mode of services, Water demand determination and its growth in the expected service year of the new system and the calculated adjusted average domestic demand in litter per second.

Table 3. 12 Summary of Adjusted Domestic Demand

Demand category	Year				
		2018	2023	2028	2033
Domestic daily demand	m3/day	62.94	73.42	85.46	99.24
	l/s	0.73	0.85	0.99	1.15
Climatic adjusted factor		0.90	0.90	0.90	0.90
Socio Economic Adjustment factor		1.00	1.00	1.00	1.00
Adjusted domestic demand	m3/day	56.65	66.08	76.91	89.32
	l/s	0.66	0.76	0.89	1.03

3.6.3.2. Public water demand (P_d)

Under this category includes water furnished to Institutional and commercial establishment such as offices, stores, airport etc. to determine the quantity of water require as there is no clear consumptive data for each public Institutional of the area, but by gathering rough information on the site we have consider the required water demand for design purpose as $10\%D_{wd}$ for this project.

$$P_{wd} = 10\%D_{wd}$$

Table 3. 13 adjusted public water demand

Demand category	year				
		2018	2023	2028	2033
Adjusted domestic demand	m ³ /day	56.65	66.08	76.91	89.32
	l/s	0.66	0.76	0.89	1.03
Public water demand (P _{wd})=10%D _{wd}	m ³ /day	5.665	6.608	7.691	8.932
	l/s	0.066	0.076	0.089	0.103

3.6.3.3 Animal water Demand

In the town and the surrounding area there are many livestock of which the exact number is not known. Livestock found in the town and the surrounding area includes cattle, sheep, goats and horse. They require too much water for their drinking purposes. Consideration of animal water demand in the design will make the water supply system costly, hence the usual way of using rivers / ponds for livestock drinking purpose is assumed in this study.

3.6.3.4 Fire demand

A quantity of water required for extinguishing fire should be easily available and always kept in storage reservoir. Since the village is small additional reserve water for the fire demand is not necessary. By stopping the supply to the consumer it is better to satisfy the fire demand

5.8. Unaccounted water or Water Loss (U_L)

All water leakages in the system and unauthorized connections are categorized under unaccounted for water. This includes:

- Leakage and Overflow from service reservoir,
- Leakage from mains and service pipe connections,
- Defective pipe joint, cracked pipes,
- Loose valve and fittings.
- Under registration of supply meter and premises of consumer to get unmetered supply
- Wastage from public tap.

Loss will be minimal at the beginning of the design period and will increase gradually with time in the expected service life of the new system unless intermediate leakage detection & subsequent remedial work is carried out. It is logical to presume an increase in water loss with time in designing water supply system. Take constant water losses the system will be 18%.

3.6.4. Water Demand Factor

3.6.4.1. Average Day Demand (ADD)

The average day demand is taken to be the sum of domestic demand s, public demand, animal demand and water losses, which is used to estimate the maximum day and peak hour demand. Average day demand is used in economic calculation over the project of life.

This means that Average day demand (ADD) =DW+PD+AD+WL

$$ADD = (89.32+8.932+2.6796+4.466) \text{ m}^3/\text{d}$$

$$ADD = 105.4 \text{ m}^3/\text{d}$$

3.6.4.2. Maximum Day Demand (MDD)

The maximum day demand is the highest demand of any one 24 hour period over any specific year. It represents the change in demands with season. The water consumption varies from day to day. The maximum day water demand is considered to meet water consumption changes with seasons and days of the week. The ratio of the maximum daily consumption to the mean annual daily consumption is the maximum day factor (MDF). The maximum day factor utilized to calculate the maximum day demand is dependent on the population of the town. As per the design criteria of the ministry of water resources the maximum day factor as show in the table.

Table 3. 14 Maximum Daily Demand Factor (MDD factor) (Source: WSSA, 1982(water supply and sewerage Authority))

Town population	MDF
0 – 20, 000	1.3
20, 00 - 50, 000	1.25
50, 000 and above	1.2

For our case (i.e. kuma small town), the maximum day factor (MDF) to calculate the maximum day demand is 1.3 because, our population size is in the range between 0 and 20,000.

This means that maximum day demand (MDD) = MDF*ADD

$$\text{MDD} = 1.3 * \text{ADD}$$

$$= 1.3 * 105.4 \text{ m}^3/\text{d}$$

$$= 137.02 \text{ m}^3/\text{d}$$

3.6.4.3. Total Average Daily demand

This demand is considered to be the sum of domestic demand, public, animal, firefighting demand and system water losses. In this case, livestock and fire requirements are assumed to be null.

Table 3. 15 Summaries of Adjusted Average Day Demand.

Demand Category	year				
		2018	2023	2028	2033
Domestic Demand	m3/day	56.65	66.08	76.91	89.32
	l/s	0.66	0.76	0.89	1.03
Public Demand	m3/day	5.66	6.61	7.69	8.93
	l/s	0.07	0.08	0.09	0.10
Average Day Demand	m3/day	62.31	72.69	84.61	98.25
	l/s	0.72	0.84	0.98	1.14
Losses take constant (18%)	m3/day	11.22	13.08	15.23	17.68
	l/s	0.13	0.15	0.18	0.20
Total Average Day Demand	m3/day	73.53	85.77	99.83	115.93
	l/s	0.85	0.99	1.16	1.34

3.6.4.4. Variation of water use

The rate of water use varies from season to season, day to day and even hourly. Water requirement in dry seasons is more than wet seasons. The use of water is also more during weekends than working days. More water is also required at rush hours when people come back from work than normal working hours. Therefore, to satisfy this variation of demand the average day demand is scaled up by certain factors to get the maximum day demand and peak hour demand. These scaled up water demand figures are used to size or determine the capacities of Pump stations, reservoir, rising main and distribution networks.

3.6.4.5. Maximum daily demand

The ratio of the maximum daily consumption to the average annual daily consumption is the max day factor and the factor varies from 1.2 to 1.3, (MoWRD, 2006). For this

specific project, 1.3 is taken to be economical for design purpose. This demand is used to design source capacity, riser mains components and pump capacity.

3.6.4.6. Peak hour demand

The peak hour demand is the highest demand of any one hour over the year. It represents diurnal variation in water demand resulting from behavior patterns of the local population. Usually the peak hour demand is significantly influenced by the size, mode of service and social activity patterns of the town. Further experience based studies show that the peak hour factor is greater for smaller population Figures. The population of the project village is about 3,110 which are in the range of less than 20,000. Therefore, depending on the information shown in table below, the peak hour factor is taken as 2. The peak hour factor varies inversely with the size of the consumer.

Table 3. 16 The peak hour factor

Population range	Peak hour
<20000	2
20000-50000	1.9
50000-100000	1.8
>100000	1.6

Source; WSSA, 1982

The water demand calculated based on discussions made in the previous several sections is summarized and presented in the table below.

3.6.4.7. Summary of Water Demand

Table 3. 17 Summery of water demand

Description	year				3033
		2018	2023	2028	
Total Average day demand	m3/d	73.53	85.77	99.83	115.93
	l/s	0.85	0.99	1.16	1.34
Maximum Day Coefficient		1.3	1.3	1.3	1.3
peak hour factor		2	2	2	2
Maximum day demand	m3/d	95.6	111.5	129.8	150.7
	l/s	1.1	1.3	1.5	1.7
peak hour demand	m3/d	147.1	171.5	199.7	231.9
	l/s	1.7	2.0	2.3	2.7

3.6.5. Water Source

The origin of all water is rainfall water collected as it falls as rain before it reaches the ground; or as surface water when it flows over the ground; or pooled in lakes or ponds; or as ground water when it percolates in to ground and flows or collects as ground water, from the sea/ocean in to which it finally flows.

The source of water can be classified as

- Surface water source
- Ground water source

3.6.5.1. Surface Water Source

Surface water source is the water source that water dose not water infiltrate in to the ground. Or surface water source is the water source that water on the earth surface. Surface water source are water which found directly surface of the earth. Most of surface water include such as river, stream, lakes, storage reservoir, Ponds ...etc.

3.6.5.2. Ground Water Source

Ground water source is the water source that water infiltrates in to the ground or the water exist below the ground. It includes spring, well, infiltration galleries, infiltration well.

3.6.5.3. Water Source Selection Criteria

Source selection is one of the most essential in designing of water supply system. The yield of the selected source should meet the entire demands requirement. Generally the choice of water supply to a town or city depends on the following criteria,

- Location: -the sources of water should be as near as to the town as possible.
- Quantity of water: - the source of water should have sufficient quantity of water to meet up all the demand throughout the design period.
- Quality of water: - the quality of water should be good which can be easily cheaply treated.
- Cost: -the cost of the units of the water supply schemes should minimum.

The selection of the source supply is done on the above criteria and the source, which will give good quality, and quantity at least cost will be selected. Considering these all the above Criteria for selecting potential water source for kuma small rural town rural water supply project is ground water (borehole).

3.6.5.4. Proposed Water Supply Sources

The adequacy of water source to meet the water requirement of the Town population till the end of the design period is an important factor to be considered in rendering sustainable water supply service. The borehole is located at Easting 313378, Northing 1354987, and Elevation 1795, well yield is 22 l/s from this 2.5l/s and the maximum day demand of the town at the end of the design period 2033 is estimated to be 1.7 l/s. This signifies that the source satisfies the community water supply demand throughout the design period.

Bore hole

The deep well is located 1.5km far from the project area Location and other necessary borehole data are shown below.

Table 3. 18 bore hull data

Source	Easting	Northing	Elevation		Depth of	Pump
Deep Well	313378	1354987	1795	22	120	99



Figure 3. 1 borehole of kuma

Objective of well: -

- to provide good quality and quantity of water
- to use water at low cost
- to provide water for long life

3.6.5.5. Design of System Unit

In kuma rural small town water supply project consists of construction of different system units.

This unit includes:-

- Construction of borehole protection.
- Construction of service reservoir(50m³).
- Construction of transmission pipe line (Pressure line and Distribution line).
- Construction of Pump and Generator house.
- Construction of Water points.
- Construction of Valve chambers and Anchor blocks.
- Supplying and installation of pump and Generator.

3.6.5.6. Reservoir Capacity (RC)

In order to equalize the supply and demand to allow a uniform rate of pumping throughout the day, the reservoir capacity of the system is calculated to be 1/3* the maximum day demand.

That means reservoir capacity (RC) = 1/3* maximum day demand (MDD)

$$\text{MDD} = 137.02$$

$$\text{RC} = 1/3 * 137.02$$

$$\text{RC} = \mathbf{45.67\text{m}^3/\text{d}}$$

$$= 45.67\text{m}^3 \text{ or take for economical aspect } 50\text{m}^3$$

3.6.5.7. Type of Reservoir

There are different types of reservoir depending on the geometry

- Circular Reservoir
- Rectangular Reservoir



Figure 3. 2 circular reservoir of Kuma

Advantage of circular reservoir over rectangular reservoir: -

- The operational process with in the water often requires circular structure to ensure their systems of work are efficient and economical;
- Circular tank is geometrically the most economic shape giving the least amount of walling for a given volume and depth.

Generally there are two types of service reservoir. These are:

- A) Elevated reservoir: - is a reservoir that is constructed at high elevation in order to distributed water in to consumer by gravity system.
- B) Reservoir Surface: - is types of reservoir used to store water and distributed water. And it is constructed at surface if the location it at higher elevation to distribute water easily.

3.6.5.8. Accessories of Service Reservoir

- Inlet pipe: - requires for the entry of water.
- Outlet pipe: - require for withdrawal of the water.
- Overflow pipe: - to prevent the over flow of reservoir and it collects to the drain.
- Float switch: - to stop the pump when the tank is full.

- Float gauge: - to show the depth of water in the tank.
- Wash out pipe: - for washing out the suspended impurities in the tank.
- Manhole: - for providing entry and inspection in the tank.
- Ladder: - require reaching the top and bottom of the tank.
- Air ventilation: - for fresh air circulation in the tank steel mesh is necessary.

3.6.5.9. Material used for reservoir construction

The raw materials which use for constructions of circular reservoir are:-

- Cement: - is a product of lime and clay materials which mixed with water forms a past.
- Gravel:-hard stones are crushed to the required size.
- Water:-used for making of concrete.
- Sand:-are a fine particle which helps to occupy the space between the larger particles called coarse aggregate, thus resulting in dense mortar and permitting the most economical used of cement.
- Mixer-used to mix cement, sand, aggregate and water Reinforcement bars
- Tube-used for the project polyethylene pipe type.
- Water stop:-used to prevent leakage
- Form work:-used to fill reservoir wall



Figure 3. 3 mixer

3.7. Distribution System

The system of distributing water to consumers is called distribution system. After completed all design & construction works of the reservoir it becomes necessary to distribute the treated water to the residents of the town by means of distribution system. The distribution system is designed to accommodate the peak hour demand.

Distribution system involves; -

- Pipes in various size
- Valves
- Water meter
- Pump etc.

Requirements of good distribution system

- It should convey clean water/treated water/ up to the consumer at the required rate.
- It should be economical and easily to maintain and operate.
- It should safe against any future population.
- It should be designed that the supply should meet maximum hourly demand
- To deliver sufficient quantity of water for water demand.
- It should be reliable.
- The pipe line should be good and it should not burst.
- The water due to leakage should be minimum as far as possible.

3.7.1. Methods of Distribution System

Distribution of water is a system by which water is conveyed from the source or treatment facility to the point where it is delivered to the users. Depending up on the method of distribution the system can be classified as:

- Gravity system
- Pumping system and
- Dual system

3.7.2. Layout of Distribution System

Generally there are four different distributions which are used.

- Dead end or Tree system
- Grid iron system
- Ring system
- Radial system

3.7.3. Valve chamber construction

Valve chamber is a box like structures that are constructed behind water point in order to protect water meter from any danger. The materials that are used to construct the valve chamber are aggregate, cement and water etc.



Figure 3. 4 valve chamber

3.7.4 Water Point

Water point is one of the distributing or networking system. It is used to distribute water to the community or it receives water from service reservoir and distributes water to the end users. Those are made up of different materials such as cement, aggregate, water and sand. Each water points consist of different materials such as valve chamber, get valve and faucet.



Figure 3. 5 valve chamber

3.7.4. Public water point

There are 5 public water points constructed at different locations of the Kuma small rural town.

3.7.5. Materials used for water point

To facilitate feasibility study of the assigned project and address the objectives set for it, during water point construction we used the following materials:

- Selective material
- Hardcore
- Cement
- Sand
- Gravel
- Water and Water points pipe

3.7.6. Pipe Material

A pipe is a circular closed conduit through which the water may flow either under gravity or under pressure. They are mostly used for the transportation and distribution of water. Pipes are made from different materials like cast iron, wrought iron, asbestos, steel, plastic etc.



Figure 3. 6 HDPE

3.7.7. Pipe Material Selection

The selection of the pipe material is based on:

- Local cost
- Maximum water pressure on the pipe
- Commercial pipe size availability
- Soil strata and over burden pressure
- It is also based on corrosion resistance
- strength durability & life of pipe
- Carrying capacity of the pipe
- Type of water to be converged & it's possible corrosive effect on the pipe
- Ease of transportation, handling & installation
- Maintenance cost, repair

3.7.8. Pipe Line System

From the results of hydraulic calculations, water can reach the required points by gravity from the reservoir. Therefore the pipelines system required to be designed in this scheme are Pressure main gravity mains pipes, & distribution pipes.

3.7.8.1. Pressure Main Pipe

The pressure main should supply maximum day demand. Transmission main pipes are connecting lines from wet well to service reservoir. In transmission main pipe we use economic diameter using the following empirical formula.

The empirical formula for determining pipe diameter is given by: $-0.969\sqrt{Q} - 1.22\sqrt{Q}$

Where,

D = pipe diameter in meter

Q = discharge in m³/sec or maximum day demand = 2.5×10^{-3} m³/s

$$D = 0.97\sqrt{2.5 \times 10^{-3}} \text{ to } 1.22\sqrt{2.5 \times 10^{-3}}$$

$$= 48.5 \text{ mm to } 61.0 \text{ mm}$$

Take it is better to take 54.5 mm HDPE pipe. OD 63 .PN10

Checking the permissible velocity

$$V = Q/A$$

$$V = (2.5 \times 10^{-3}) / (3.14 \times (0.0545)^2) = 1.08 \text{ m/s, since}$$

it is between permissible velocity $0.6 \text{ m/s} < 1.08 \text{ m/s} < 2 \text{ m/s}$ (OK!)

HDPE pipe is recommended for transmission main lines and for all size of distribution lines for the proposed kuma water supply project. The inlet, outlet, drainage and washout pipe at service reservoirs is designed to be HDPE pipes.

3.8. Pump Selection

For proper selection of pump, it is necessary to have a certain necessary data on the pump installation. And the main criteria for selection of pump based on

- Number of pump required
- Capacity of pump
- Discharge condition
- Initial cost

- Location of topography
- Easily started
- Have flexibility of operation
- Can meet variation in load
- Should have high suction lift

In KUMA small rural town we use submersible pump. In submersible pump, the motor and the pump are both attached together and lowered inside the borehole.

Installation of submersible pump

- Generally submersible pump are installed 3 - 4 meter below the dynamic water level
- The lowering water level helps as to cool lubrications the windings, insulated in a plastic impervious water
- Gate valve is provided at the tip of pump, as a non return valve discharge the water.
- The pump and generator set will be work at the specific location masl, temperature and humidity conditions.
- $P_p = \frac{Q \cdot H}{102 \cdot \eta_m} \text{ kw}$, $p_m = \frac{p}{\eta_e} \text{ kw}$, $G_p = 1.5 \times P_m (\text{kw})$
- Power cable size should have a maximum current carrying capacity higher than the motor full load current as well as with a voltage drop of less than 3% for the total cable length.
- Each pump provided with the following automatic cutouts, to stop the pump and indicate a fault, at the pump panel.
 - Low source level
 - High reservoir water level
 - High delivery pressure (closed valve);
 - Phase failure, phase sequence
 - Over current or under current
 - Under voltage, or over voltage.

The diesel generators installation would include the following:

- Diesel generator pipe works
- Switchgear

- Cables
- Earthing
- All accessories and other necessary items

3.8.1. The Power of the pump

- From pump well site /pumping station/ to Service Reservoirs determined using the empirical formula as shown below.

$$P_i = \frac{\gamma QH}{\eta} \text{ where:}$$

P_i = Power of the pump in kW.

H = total head = 134.66m

Q = pump discharge = 2.5 l/s

γ = specific unit weight = 9.81

$$P_i = \frac{\gamma QH}{\eta}$$

$$= \frac{9.81 \times 2.5 \times 134.66}{65\%}$$

$$P_p = 5080\text{w} = 5.08\text{kW}.$$

3.8.2. The electric motor/input/ power

- The electric motor/input/ power can be determined by divide the pump power to the electric motor efficiency.

$$P_m = \frac{P}{\eta_m} \text{ Where:}$$

P_m = the input power of the electric motor.

P = power of the pump,

η_m = efficiency of the motor.

Assume that efficiency of the electric motor is 80-90%, take 80% induction motors.

$$P_m = 5.08/0.8 = 6.34\text{kW} = 9.2 \text{ kW (standard)}$$

3. 8.3. Determine the Generator Power

The generator power should be exceed from 30% to 50% of the electric motor power. Take 50%

$$G_p = 1.5 * P_m$$

$$G_p = 1.5 * 9.2 = 13.8 \text{kw, where } G_p \text{ is power of generator.}$$

3.9. Result and Discussion

Kuma water supply project is essential for community to satisfy demand and the problems of water. Because kuma small rural town one of kebele in kolla diba woreda which have problem of water supply The existing water supply was not adequate and potable for the community due to un functional existing water source in the Keble and the existing water supply is not satisfy the public need the New components are 50m³ service reservoir, water point, anchor block, chamber box. The expected design period of the water supply system is 15 years. Generally kuma small rural town water supply scheme is technically feasible and believed to solve safe water supply, sanitation and hygienic chronic problems of the user communities.

There are a lot of results due to the selection of kuma water supply project such as: -

- Unemployed people, the company created job opportunity for them.
- Farmers, they can change traditional farming system to modern irrigation system to increase food production.
- Everyone will be benefited by getting clear water.
- Solve Time spent for fetching of water, particularly by women.
- Protection of expansion of water borne diseases in the area.

CHAPTER FOUR

4. OVERALL BENEFITS I GAINED FROM INTERNSHIP

Internship program is one way of learning method which student achieves to interpret the theoretical knowledge to practical skill. Since the program was not only give practical skill rather to make, improve and upgrade different skills. This internship program helps to realize what hydraulics engineering deal with.

Since theory and practical are direct proportional with each other, the more you have known the theory; you will also have better practical knowledge by asking questions. Rather than I know theoretically, everything is easy to understand in the field works. For example

- I know how I can design the capacity of a reservoir
- How water distribution is made
- How the site is selected
- How can I fit pipes with each other by using fittings
- How to select pump
- critical thinking and the ability to evaluate designs, plans and projects;
- effective assessment and management of risk, resources and time;
- interpersonal sensitivity and the ability to work as part of a team;
- clear written and oral communication skills;

4.2. Upgrading theoretical knowledge

Before this internship period I knew only calculations and theories. The practical work is used to know different parties involved in the project. For example, I knew client, consultant, contractor, Forman, supervisor, and other parties by name or by theory. This practice helps me to connect each parties with their working responsibilities and it shows me how they interact with each other. The following are the crucial area that helped me to upgrade theoretical knowledge:

- Construction materials and construction equipments
- Reservoir construction works
- Cross drainage works etc
- Pipe fitting
- Selection of source of water

4.2. In Terms of Improving Practical Skill

In my internship period I have gained a lot of practical skills during the internship period are,

- How to select reservoir position.
- Adopt social interaction in work place
- Observing easily any water supply structures on fields and their functions
- I have seen practical how distribution systems to supply for customer
- I have seen more information through observation by relating with theories,
- To identify the designed position of reservoir components, such as in-let, out-let, washout (drain), overflow, vent-pipe, and manhole ladder.

4.3. In Terms of Improving Team Playing Skills

It is the skill of person to work with other people co-operatively. This was developed easily and rapidly. It is begins when I was in campus, some assignments are given were done in group.

Generally from our team working with each other I have understood the following benefits of team working skill;

- More creativity leading into more ideas and better results. When peoples become together they get the chance to bring new ideas and following this new idea they will have a better results.
- Increased employee satisfaction. The main objective of the work is just having good work satisfaction in one's life and leading works with other being involved in works.
- The opportunity to develop and acquire new skill. When persons work together they will share knowledge from each other; this will also help in developing practical skills.

4.4. In Terms Of Improving Leadership Skills

Leadership is a critical management skill, is the ability to motivate a group of people toward a common goal. Leadership skill in any project work is available to facilitate the project. Due to this reason, I was actively participated in Kuma town& related kebele multi village water supply projects and how to become a leadership. The following are some advantages of internship to improve a leadership skill:-

- To increase the quality of work.
- To facilitate and terminate on time.
- To increase the organization of project work.
- To have a confidence at any project activities.
- To have cost effective to the company as well as the country.

4.5. In Terms of Improving Work Ethics and Related Issue

To improve work ethics related issues, it is essential provided in the intern ship activities. Because to work with any person or any activity you must be have a good work ethics. From the intern ship gained good work ethics by taking experience from the workers. These are:-

- Punctuality: - means keeping the companies work beginning and ending time and to complete a given task within the given period.
- Office disciplines: - in work place you don't have to disturb the working atmosphere. For example abstain from opening loud voice, loud music, songs and things which disturb others workers working mood or style.
- Reliability: - The worker should be
- e qualified for the part He/ She is supposed to be performing. He/she must have appropriate skill and knowledge for the task assigned .
- Honesty: - Regarding this value each worker regardless of its status should abstain from bad behaviors such as cheating, bias, corruption etc.
- Cooperation: - Each worker should interact and cooperate with each other while working. That is because it is through such system problems could be easily solve.

4.6. In Terms of improving Entrepreneurship Skill

What is Entrepreneurship? Entrepreneurship can be defined as the process of involving the creation of new enterprises and that the entrepreneur is the founder. He or she is the person who perceives the market opportunity and then has the motivation, drive and ability to mobilize resources to meet it. I have got a wide range of entrepreneur skills such as

- ✓ Ability to work both as part of team and independently.
- ✓ The ability to manage time and people (both myself and others) successfully.
- ✓ Able to plan, coordinate and organized effectively.
- ✓ How to manage the finance and financial literacy.

Chapter five

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

The main objective of the internship program is to enable the intern to experience the practical activities carried out on site (working environment) and correlate it with the theoretical background gained through learning in four years class time. Other objectives include if problems exist to identify its cause and take engineering measures to solve it, to get accustomed to the working environment, to be governed by the rule and regulation of the employer, to be more of team player.

I got practical work experiences and benefits after I attend in to kuma small rural town water supply project.

The population of kuma small rural town communities faces different problems especially in water supply and sanitation. Previously the community has no hygienic supply of water at the nearby and they use simply seasonal springs, river water and from neighboring keels by traveling large distance. Due to this problem they have a shortage of water occur in the woreda. kuma small rural town water supply has great advantage to the community. The main product is to supply potable water for the community. Per capita demand of this project is 20 l/c/d, the design period is 20 years, the population for casting methods use geometric increase method. The type of service reservoir is surface reservoir, and the storage capacity of the reservoir is 100 m³.

Generally, after the project is completed it is expected that the population can get enough water and become healthy productive. Moreover, the provision of potable water enhances the development of the community and contributes to the poverty reduction and also, it was important to visualize the relation of the practical field works with the theoretical principles learned in class and provides some site experience for those who need joining to such site works.

5.2. Recommendation for Hosting Company

In my four months of internship experience period I have seen some negative sides about the internship hosting company. The company should host more intern students in the future for the common good of the student and its company. The company has no enough skilled person related to water. Because they have only one engineer and only one assistant so the company should have skilled persons (engineers) who solve the problem related to water works. There is some design problem of civil structures i.e reservoir. In the service reservoir air vent is one structure provided for the entry fresh air in to the reservoir. But air vent is not provided on kuma small rural town water supply project. Former reservoir which constructed before forty years ago the top coverage is covered by roof structure so, I recommended that it must reconstructed by slab. I calculate the efficiency of pump and power of generator. But the power of generator is not much enough to operate a pump. So I recommended that it must change the generator it to operate pump. As I engineering student both office study and in site work is necessary to upgrade our knowledge. In our hosting company there was no office study so I recommend that for the future the central Gondar zone water, irrigation and energy development department office have to be solve this problem.

REFERENCE

- [1] Irrigation and Hydraulic Structures, by Garg 1976
- [2] Soil mechanics and foundation engineering, by Aurora 2004
- [3] Irrigation engineering and hydraulic structure by Gorg Santosh Kumar 2015
- [4] Reinforced Concrete Design, W.H Mosley, J.H. Bunge, and Hules. 2007
- [5] Design Guide Line on Hydraulic Structures, Ministry of Water Resource.
- [6] Ground water hydrology books. by Todd David Keith 2005
- [7] Water supply engineering by Garg Son tosh Kumar 2015
- [8] Hydraulic structure by Novak Pavel 2001
- [9] Design report for kuma small rural town water supply Project
- [10] WSSA, 1982 (water supply and sewerage Authority)
- [11] Kuma Keble administration at year 2017)