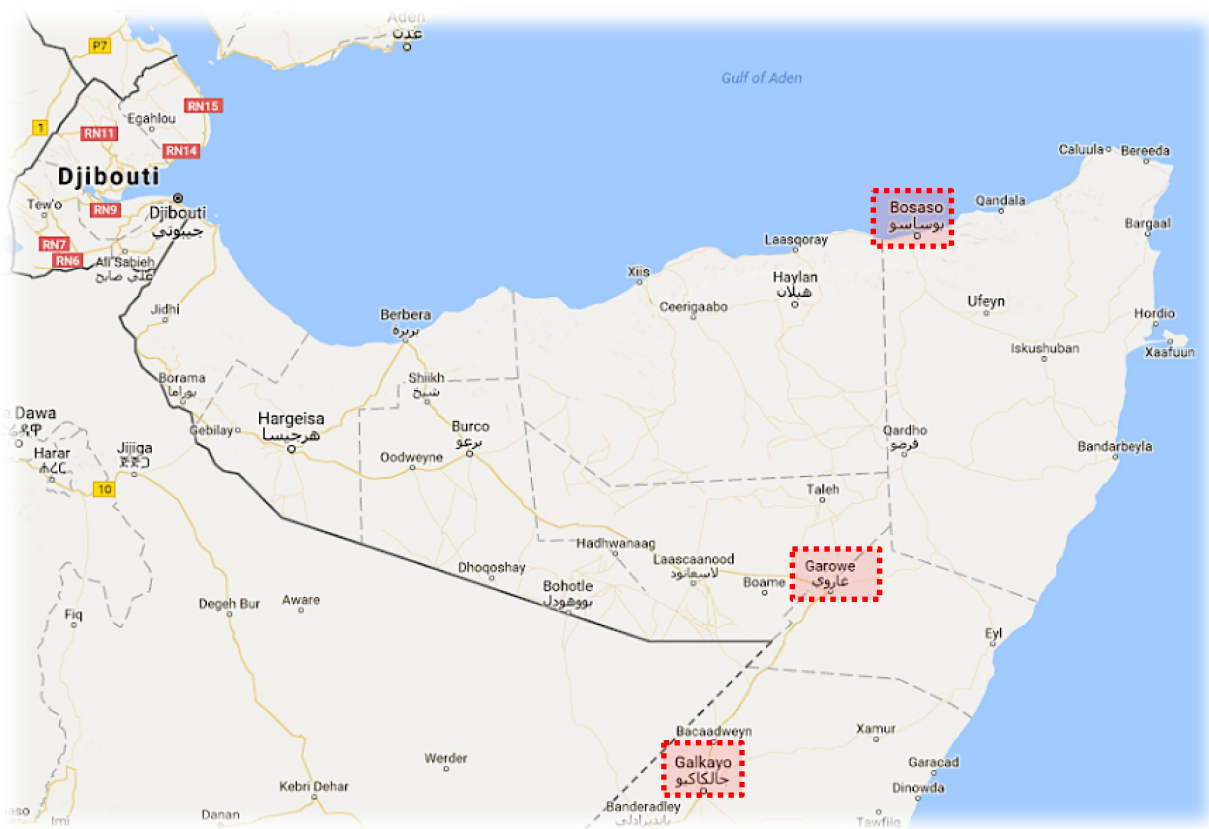




TECHNICAL SUPPORT TO PUNTLAND STATE OF SOMALIA

SUMMARY INVESTMENT PLAN FOR THE WATER SECTOR OF THE CITIES OF GAROWE, BOSASO AND GALKAYO



FINAL – JANUARY 2018



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SUMMARY

THE NEED FOR INFRASTRUCTURE INVESTMENT

Changes in demography, climate and economic activity have contributed to the current low level of access to water in Puntland towns: demand has doubled in recent years leaving many of the existing wells and springs dry. Water agencies in urban areas such as Garowe, Galkayo and Bosaso are unable to meet even the most basic demands for drinking water. As a result, water trucking has become a common method to supply the growing need. Water trucking, often from wells and wadis outside these towns, is expensive and often of questionable quality. It can also lead to conflicts with, or within, the local communities from which water is trucked..

Access to surface water resources remains challenging because of the unfavourable climate and hydrological conditions. Furthermore, the exploitation of groundwater resources is limited as knowledge of hydrogeological conditions – including quality and quantity of groundwater resources – is limited. In many cases, groundwater drilling projects are unguided taking place without geophysical investigation and leading to low success rates and wastage of critical financial resources.

In order to sustain growth in a manner that meets residents' needs, the three cities need to a) develop new water resources often outside the town or city limits, b) improve the ability to store water, and c) expand the existing distribution network.

This investment in the development of the water supply infrastructure needs to be complemented by institutional development.

THE NEED FOR INSTITUTIONAL REFORM

Puntland State Agency for Water, Energy and Natural Resources (PSAWEN) has assumed a range of *de facto* roles in the water sector (energy aside), including: a) planner and policy maker (setting out guidelines and standards for sector development); b) asset-holding authority for urban water assets (being the public party to series of lease contracts with private sector service providers); c) regulator (setting tariffs for service providers and collecting data on service provider performance).

In its asset-holding role PSAWEN entered into a form of lease contract with private service providers that now function as water utilities. These lease contracts signed between 2000 and 2006 for a 10 year period, were with the Nugal Water Company (NUWACO) in Garowe, the Bosaso Water Agency (GUMCO) in Bosaso and the Galkayo Water Agency (GAWA) in Galkayo.

This first generation of Public Private Partnership (PPP) arrangements had a number of short-comings particularly in the definition of roles and responsibilities for asset creation and maintenance that will need to be addressed as the contracts are renewed.

For example, under the existing lease contracts, the utility companies were required to increase the number of direct connections to households. Although the utility

companies have made an effort to expand connections from tariff revenues and their own resources, this expansion can only be tackled along with increased investment in water resource development and production facilities.

Though the utility companies have shown themselves capable of collecting fees and generating cash flows – as well as managing construction projects – they remain unable to move past managing the systems in an ‘emergency mode’. Cash flows from tariffs have barely been enough to pay for the work needed to fund immediate operation and maintenance requirements of the existing networks, let alone to fund additional water sources. Given the rapid growth of towns in Puntland and the ‘lumpy’ nature of water resource development investments, additional public investment will be required in addition to renegotiating the lease contracts.

This public investment needs to be underpinned by institutional reform to more clearly differentiate PSAWEN’s role as asset holder from its roles as planner, policy maker and regulator. The existing multiple roles undermine sector governance and accountability, making it difficult to match lease payments from the utilities with asset replacement by PSAWEN. Overcoming this, and improving sustainability of the sector, will either require much more transparent internal checks and balances or an unbundling of PSAWEN’s multiple roles. In parallel to institutional reform investment is needed in human resources, equipment and buildings. Buildings need renovating and extending. Equipment is needed for everything from basic mobility to GIS. There are skills gaps across the spectrum from financial management to regulatory economics.

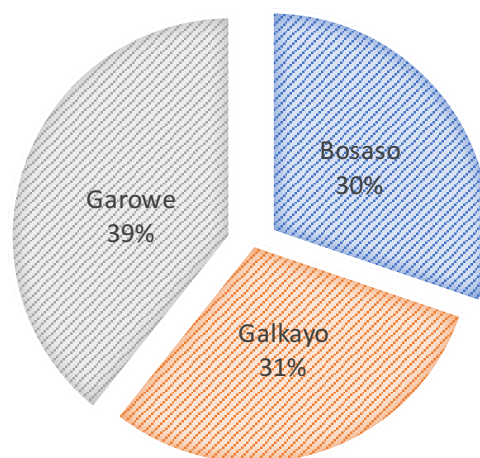
THE NEED FOR CAPACITY DEVELOPMENT

PSAWEN has been unable to raise funds to support the long-term development of water infrastructure. Reasons for such a dysfunctional environment are many, including the lack of a clear legal environment that supports investments within the PPPs, lack of adequate financing mechanisms to support the water agencies in taking long-term loans and, in general, lack of technical and institutional capacity within PSAWEN and the local water agencies. According to PSAWEN’s estimate, strengthening the institutional and technical framework will require **8.5 million US\$** for trainings, technical assistance, staffing and equipment as detailed in the following table.

	CAPACITY DEVELOPMENT NEEDS	FINANCIAL NEEDS (US\$)	FUNDED	TERM	POTENTIAL FINANCING SOURCES
CB	Institutional Capacity Building	\$400,000	No	Medium	Development Banks
2	Training Support/Development of Water Agencies	\$1,200,000	No	Medium	Development Banks
3	Procurement of equipment & tools	\$2,200,000	No	Medium	Commercial Banks
4	Advanced Water Metering	\$600,000	No	Medium	Commercial Banks
5	Staffing	\$2,400,000	No	Medium	Commercial Banks
6	Performance Improvement plan	\$350,000	No	Long	Commercial Banks
7	Performance monitoring & benchmarking	\$600,000	No	Long	Commercial Banks
8	Customer Service surveys & Awareness Campaign	\$750,000	No	Long	Commercial Banks
	TOTALS	\$8,500,000			

INVESTMENT PLANS

In 2014/2015, PSAWEN, financed by the European Union, prepared Master Plans for Bosaso (November 2015), Galkayo (February 2016) and Garowe (January 2016). These studies, developed by international consultants with experience in water resource development and groundwater exploration in Puntland and Somaliland, provide the most up-to-date and realistic proposals of how to address domestic water needs for the three cities for the next 25 years. These plans suggest several short-term (to be urgently implemented), medium-term (to be implemented in the next 1- 3 years) and long-term (to be implemented within the next 1-to-5 years) measures, requiring a total capital investment of nearly **36¹ Million US\$** over a five-year period (pie chart on the left shows the share of the investment requirements for each city).

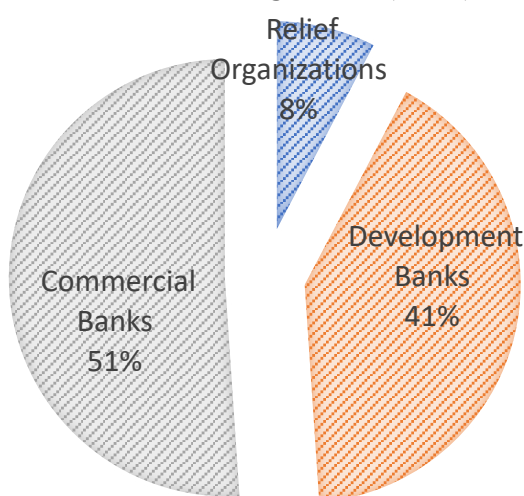


The majority of the measures set out in this investment plan remain unfunded. Where there are funding commitments (even if tentative) these are indicated below in the investment tables for each of the cities.

The total investments requirements, including the financial support for strengthening the institutional and technical framework of PSAWEN, adds up to **44.3 Million US\$**.

SOURCES OF FINANCIAL SUPPORT

External Support Agencies (ESAs) have a central role in jump-starting the long-term development of the water sector. ESAs with a tradition of emergency relief (UNICEF, ICRC) are well positioned to take up the most immediate needs and access less secure areas. International development banks (AFD, AfDB, KfW, WB, etc.) are better positioned to support the medium-term 'lumpy' infrastructure investments and provide the expertise to enable a long-term legal, institutional and technical developments needed to sustain service delivery. As the roles of ESAs recede over time, water utilities and local governments, are well positioned to take on the incremental improvements drawing on



¹ This value represents the cost of all -yet to be funded- investments after the original estimates were adjusted to account for changes of the price for labour, construction material and equipments.

finance from commercial banks. Based on this model of comparative advantage, the specific lots in the investment plans for each of the towns have been broken down by potential financier.

	TOTAL FINANCIAL REQUIREMENTS	RELIEF ORGANIZATIONS	DEVELOPMENT BANKS	COMMERCIAL BANKS
BOSASO	\$10,825,648.00	\$552,500.00	\$7,282,120.00	\$2,991,029.00
GALKAYO	\$10,917,556.00	\$1,378,000.00	\$2,026,726.00	\$7,512,830.00
GAROWE	\$14,074,895.00	\$1,486,165.00	\$7,360,847.00	\$5,227,883.00
PSAWEN	\$8,500,000.00	\$-	\$1,600,000.00	\$6,900,000.00
TOTAL	\$44,318,100.00	\$3,416,665.00	\$18,269,693.00	\$22,631,742.00

GAROWE

THE NEED FOR INVESTMENT

Population	150,000 (Source: PSAWEN)	Assuming Puntland remains peaceful, it is likely that many of the nearly 30,000 internal displaced people (IDP), or refugees will return home over the next years.
Population growth	3.4%	Population is expected to reach 250,000 by the year 2030 and 320,000 by the year 2040 at the end of the planning horizon.
Current Production	1,800 m³/d	Provided by 10 municipal wells 7 of which are connected to the water supply system. 2 wells are connected to a 650m ³ storage tank.
Current per capita supply	12 l/p/d	This amount is below the minimum survival requirements of 15 l/p/d and well below the desirable targets of 35 l/p/d.
Existing Household (HH) connection	<30%	Running 58km of pipes over an area of 618ha
Quality of Drinking Water	Poor	Water is saline (TDS ranging between 2.7 and 6 g/l) and bitter, containing excessive amount of heavy metals and fluorides. Risk of contamination of the freatic, shallow, aquifer with the sewage water is high as a sewage network is not existing in the area. Few cases of cholera have been recorded in the area during the past year.)

PROPOSED INVESTMENT PLAN

Short-Term/Emergency Actions	Development of three new well fields located in the immediate vicinity of the city (see sites labelled 4.1, 4.2 and 4.3 in Figure 1 below) including their connection to the proposed 1,000m ³ storage tank (see Figure 2 below)
Medium-Term	Development of groundwater resources near Salaxley (see site labelled 3.1 in Figure 1 below) would require the construction of wells able to produce an estimated 30 l/s, a storage tank of 500

	m ³ , and 15.3 km of pipelines.
Long-term/Development Actions	Development of groundwater resources in the Jubagale area (see site labelled 1.1 and 1.2 in Figure 1 below) would require the construction of several productive wells, yielding an estimated 70 l/s, an additional 1,000 m ³ storage tank and 19.4 km of pipelines.

The city water Master Plan (2015) identified several potential groundwater sources and recommended the development of two: one located near the village of Salaxley and one in the Jubagale area (see Figure 1 below). The two proposed sites will provide a water quality that is still far from potable standards yet is possibly the only available solution since brackish water is predominant all around Garowe.

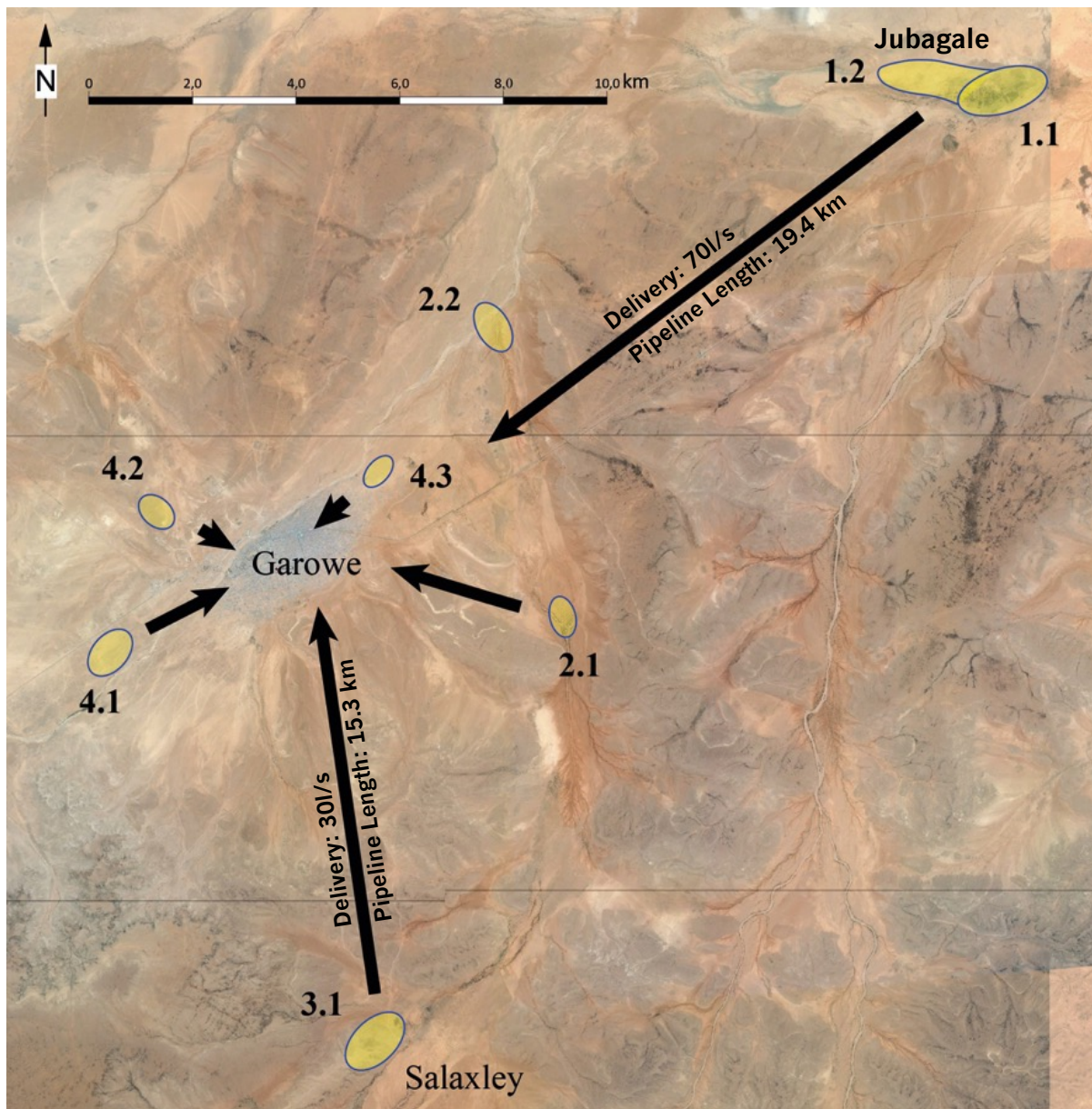


FIGURE 1: LOCATION OF NEWLY PROPOSED WELL FIELDS

The detailed designs of the main infrastructures concerning the distribution system inside the city are already available. Feasibility studies are available for both sites but additional geophysical investigations, test boreholes and detailed designs are yet to be prepared and would be needed before procurements and construction can start. The involvement of the communities located in the vicinity of the water sources will also need to be taken into consideration.

The estimated water demand at the end of the project period would be 11,325 m³/day, equivalent to 131.1 l/s, the supposed productive capacities of Salaxley and Jubagale jointly will be 100 l/s. The difference (equal to 31.1 l/s) will be provided by the boreholes already present in the urban area.

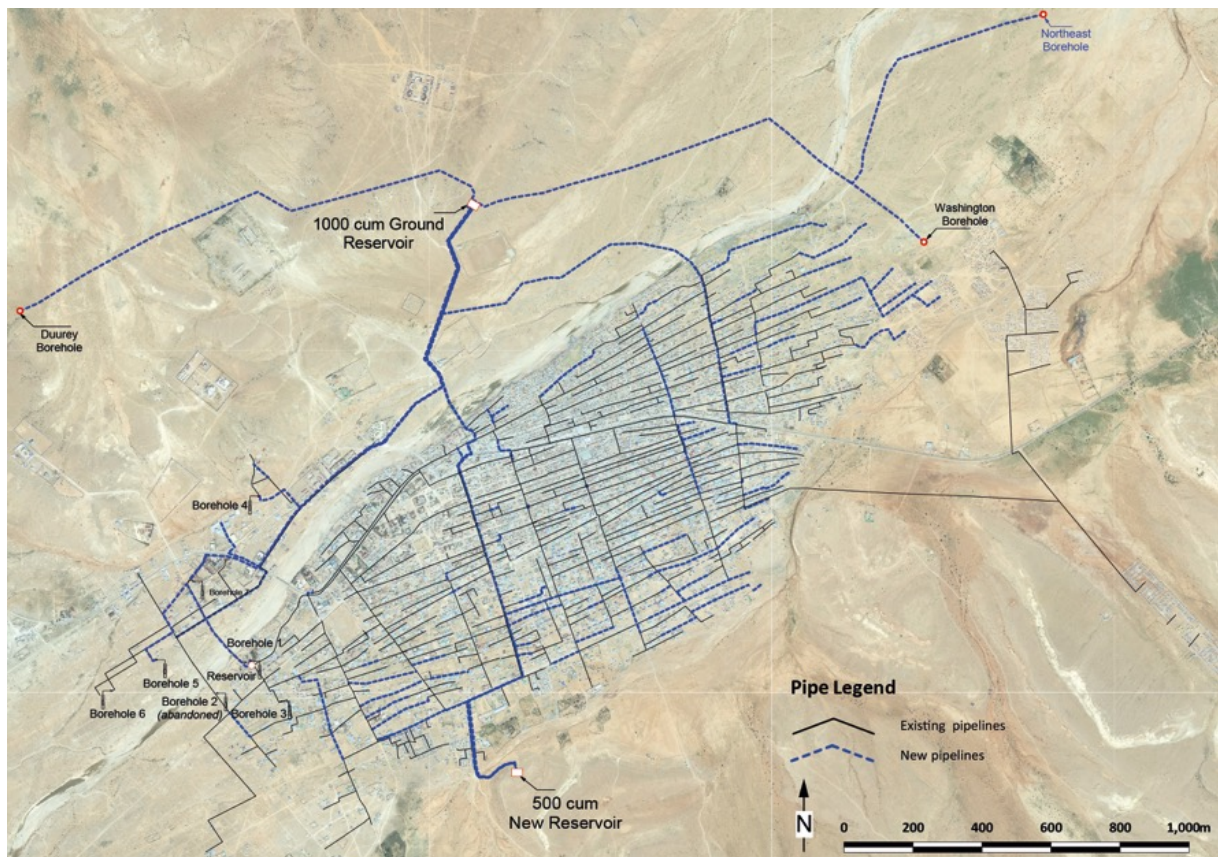
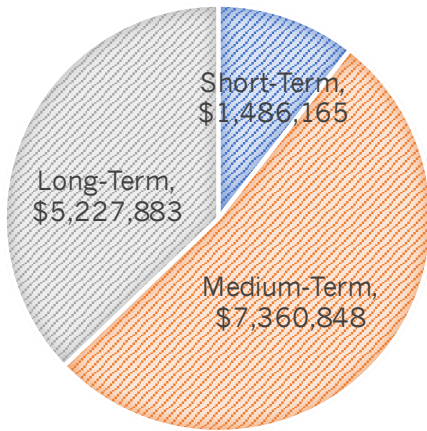


FIGURE 2: EXISTING AND NEWLY PROPOSED STORAGE AND DISTRIBUTION NETWORK

FINANCIAL NEEDS

The total financial needs, excluding NUWACO's institutional strengthening component which has yet to be determined, is approximately **14 million US\$**, over 5 years. According to PSAWEN's own investment plan, the government and private sector have pledged 2% contribution of the total investment, so the government is looking for 98% contribution from external donors. Financial needs have been prioritized into 'short', 'medium' and 'long'-terms to identify actions that should be implemented within the next year, the next two-to-three years and the next five years respectively.



The following table provides details of the various actions required for the full implementation of the water resources master plan and secure water needs for the next 25 years. Actions have been grouped in lots that can be tendered separately. Short-term measures must be implemented before medium and medium before long-term. Additional information are provided in annex.

LOT N	IMPLEMENTATION OF THE MASTER PLAN RECCOMENDATIONS	FINANCIAL NEEDS (US\$)	TERM	POTENTIAL FINANCING SOURCES
0	Institutional Capacity Development	TBD	Medium	Development Banks
1	Implementation of two exploratory/productive boreholes in urban area (sites 4.1 + 4.2 + 4.3 in the above map)	\$178,463	Short	Relief Organizations
6	Construction of pipelines connecting the old boreholes to the proposed 1,000 m ³ Reservoir	\$507,156	Short	Relief Organizations
7	Construction of pipelines connecting the new boreholes to the proposed 1,000 m ³ Reservoir	\$599,526	Short	Relief Organizations
8	Construction of pump stations on new boreholes	\$201,020	Short	Relief Organizations
10	Construction of the distribution system of drinkable water	\$378,824	Medium	Development Banks
11	Drilling and completion to productive of n° 3 boreholes in Salaxley Village Area (site 3.1 in the above map)	\$326,403	Medium	Development Banks
13	Construction and equipment of n°3 pump stations in Salaxley Village Well Field	\$218,888	Medium	Development Banks
15	Trunk line connecting Salaxley Village Well Field to the proposed 500 m ³ Reservoir	\$1,955,550	Medium	Development Banks
17	Primary and Secondary Distribution Network, extension to secure the service	\$946,083	Medium	Development Banks
2	Construction of new 1,000 m ³ Ground Reservoir	\$754,190	Medium	Development Banks
3	Construction of new 500 m ³ Ground Reservoir	\$485,934	Medium	Development Banks
4	Pipeline connecting 1,000 to 500 m ³ Reservoirs	\$526,079	Medium	Development Banks
5	Pipeline connecting Reservoirs to distribution system	\$1,182,890	Medium	Development Banks
9	Construction of the desalinization plant	\$586,008	Medium	Development Banks
12	Drilling and completion to productive of n° 4 boreholes in Jabagale Area (sites 1.1 + 1.2 in the above map)	\$468,389	Long	Commercial Banks
14	Construction and equipment of n°4 pump stations in Jabagale Area Well Field	\$270,154	Long	Commercial Banks
16	Trunk line connecting Jabagale Well Field to proposed 1.000 m ³ Reservoir	\$4,182,775	Long	Commercial Banks
18	Hydrogeological and geophysical studies with boring tests in Nugal valley	\$306,565	Long	Commercial Banks
TOTALS		\$14,074,895		

BOSASO

THE NEED FOR INVESTMENT

Population	425,000 (PSAWEN)	It is estimated that 40,000 are IDPs.
Population growth	3.2%	Population is expected to reach 520,00 people by 2030 and nearly 600,000 by the year 2040 at the end of planning horizon.
Current Production	3,600 m³/d (GUMCO) + 3,500 m³/d (Private)	GUMCO manages 14 boreholes excavated in 2 nearby aquifer zones a 500 m ³ elevated tank and a 1,000 m ³ semi-buried storage tank which is presently non-operational. Private companies manage and truck water from 18 additional wells located in the vicinity of the city.
Current per capita supply	8 l/p/d (GUMCO)	Water across town is unevenly distributed among rich areas and poor areas and some portions of the city, such as the western quarters, are not served at all. The amount provided by GUMCO is well below the minimum survival requirements of 15 l/p/d and the desirable targets of 35 l/p/d). Private wells owners extract and deliver large quantity of water as well.
Existing HH Connection	<30%	The west and port sectors of the city are not served at all.
Quality of Drinking Water	good	Water is generally saline near to the coastline (TDS> 2 g/l) and of good quality everywhere else. Over exploitation of the privately owned wells caused many of them to run dry and/or become saline. Few cases of cholera were recorded during the past year.

PROPOSED INVESTMENT PLAN

Short-Term/Emergency Actions	Focus on the implementation of secondary lines in the western quarters, which are presently not served, for water to reach the port area (see Figure 3 and Figure 4 below)
Medium-Term	Focus on the development of new water sources (see Figure 4 below), increase access to potable water (see Figure 3 below) and

	stopping water truckers, who often deliver water collected from polluted and unregulated wells with the risk that this might lead to the spread of infections.
Long-term/Development Actions	Focus at the implementation of the entire set of master plan's recommendations making it possible to service at least 35 l/d/p of water across the entire city.

The city water Master Plan (November 2015) identified 4 groups of springs located 26 km south of the city (see Figure 4 below), in addition to the 3 sites where water is presently extracted near Bosaso. The water from these springs is good quality: according to available data the water probably only requires minor chlorination to prevent the proliferation of pollutants in the system (reservoirs + pipes). As far as quantity, the springs will yield 290 l/s and thus provide the 20,600 m³/d's projected needs by the year 2040.

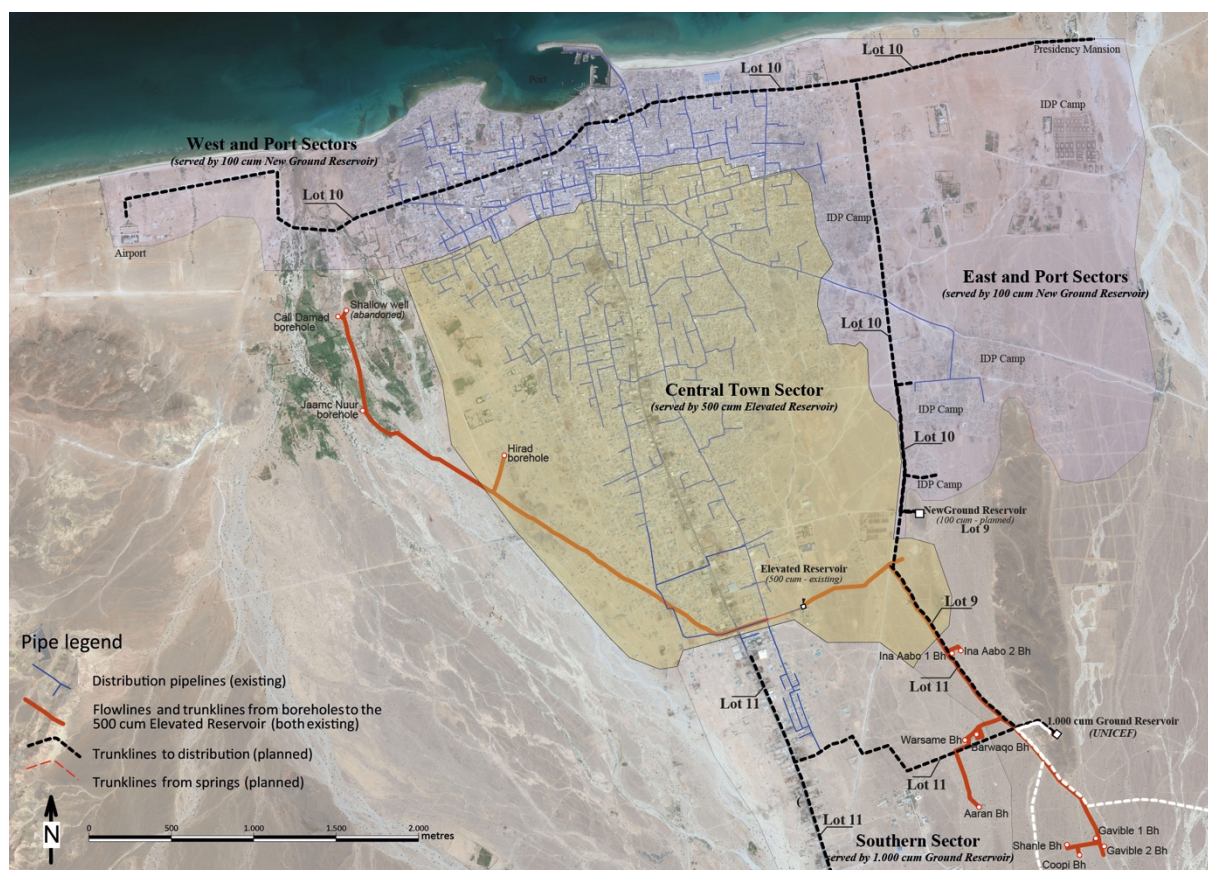


FIGURE 3: EXISTING AND NEWLY PROPOSED STORAGE AND DISTRIBUTION NETWORK

A prefeasibility study has been drafted, this includes: water production, transmission, storage and primary distribution. The design has been divided into 12 lots plus a study and design phase, called "Lot 0". The secondary and tertiary distribution will be in the responsibility of the Agency, which will implement them according to the needs.

Additional actions, which are not part of the city master plan, but GUMCO is presently seeking to implement, include testing the viability of seawater desalination programs, desalinating some of the water from wells that have been affected by seawater intrusion

as well as the installation of solar powered water wells as a mean to reduce operational costs and reduce water tariffs.

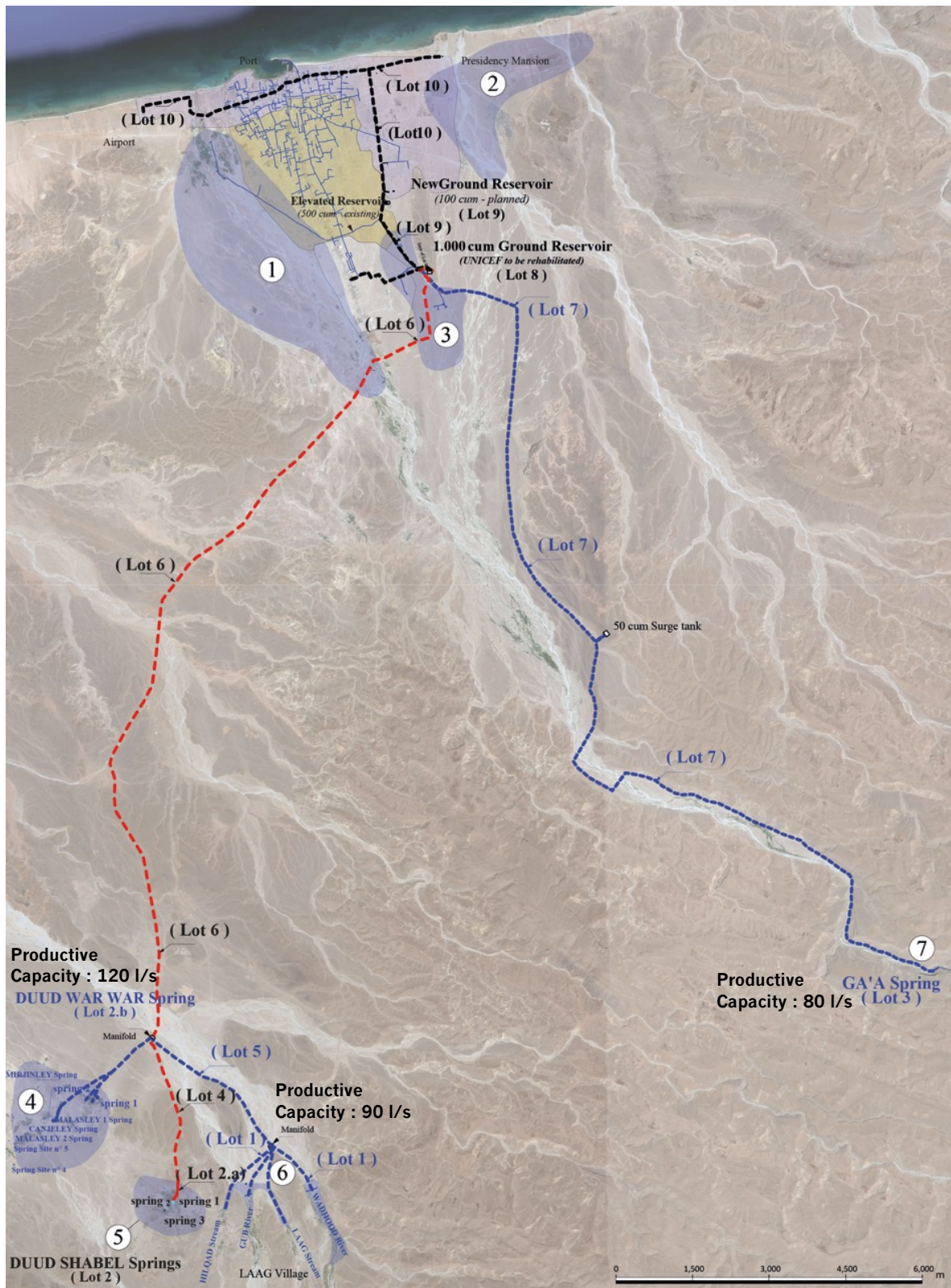
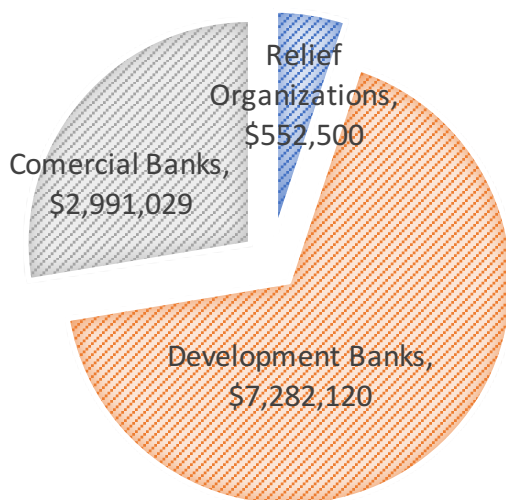


FIGURE 4: LOCATION OF NEWLY PROPOSED SPRINGS

FINANCIAL NEEDS

The financial – presently unfunded - needs for water supply in Bosaso are about **10.9 million US\$**, over 5-10 years. Some of the most urgent investments have already secured with funding from the European Union, the Italian Cooperation and UNICEF, who have pledged 5 million US\$ required for the short-term actions (Lots 2.A, 4 and 6 listed in table below). Medium- and long-term investments remain entirely unfunded and it is unlikely government or private funding will be able to fill the gap. Support will also be needed for capacity building of GUMCO (financial needs have not been accounted as they have yet to be identified). Development banks are probably the best vehicle to provide additional fundings required for training activities and technical advisory



services.

The following table provides details of the various actions required for the full implementation of the water resources master plan and secure water needs well beyond the next 25 years. Actions have been grouped in lots that can be tendered separately. Each lot can be clearly identified in Figure 3 and Figure 4 above. Additional information are provided in annex.

LOT N	IMPLEMENTATION OF THE MASTER PLAN RECCOMENDATIONS	FINANCIAL NEEDS (US\$)	FUNDED	TERM	POTENTIAL FINANCING SOURCES
CB	Support to Institutional Capacity Building	TBD	No	Medium	Development Banks
LOT 2.A	Captation of Duud Shebel Springs	\$-	Yes	Short	Funded by EU/Italian Cooperation
LOT 4	Flowline from Duud Shebel uptake to the adduction main	\$-	Yes	Short	Funded by EU + Italian Cooperation
LOT 6	Adduction main from springs to 1.000 m ³ reservoir	\$-	Yes	Short	Funded by EU + Italian Cooperation
LOT 8	Rehabilitation 1,000 m ³ reservoir	\$-	Yes	Short	UNICEF (already completed)
11	Pipeline connecting 1,000 m ³ Res. to 500 m ³ Elevated Reservoir	\$552,500.00	no	Short	Relief Organizations
LOT 1	Captation of springs sourcing in the water courses near Laag Village	\$2,428,777.00	No	Medium	Development Banks
LOT 2.B	Captation of Duud War-War Springs	\$733,057.59	No	Medium	Development Banks
LOT 5	Flowline from manifold connecting La'ag sources to the adduction main	\$273,585.00	No	Medium	Development Banks
9	Construction of 100 m ³ Satellite Reservoir + connecting pipeline from 1,000 m ³ reservoir	\$720,200.00	no	Medium	Development Banks
10	Distribution pipelines toward lower quarters of the town	\$2,538,900.00	no	Medium	Development Banks
12	Distribution pipelines toward elevated quarters of the town	\$587,600.00	no	Medium	Development Banks
LOT 3	Captation of Ga'a Springs	\$230,100.00	No	Long	Commercial Banks
LOT 7	Adduction main from Ga'a spring to 1,000 m ³ reservoir	\$2,760,928.63	No	Long	Commercial Banks
		\$10,825,648			

GALKAYO

THE NEED FOR INVESTMENT

Population	300,000	Presently the inflow of internal displaced people (IDP) or refugee people has practically come to an end.
Population growth	3.2%	Population is expected to reach 490,000 by the year 2030 and nearly 660,000 by the year 2040, at the end of planning horizon.
Current Production	2,550 m³/d (GALWA) + 1,950 m³/d (Private)	5 existing boreholes are connected to the water distribution system. 11 more - privately owned - boreholes exist in the area augmenting the total water supplied to the city to the minimum survival standards of 15 l/p/d.
Current per capita supply	8.5 l/p/d (GALWA Co.)	Water provided by GALWA Co. is well below the 15 l/p/d requirements for survival. Privately owned wells service additional water to guarantee minimum survival rates.
Existing HH Connections	<30%	Large portion of the city are presently not connected to existing network.
Existing Sanitation coverage	None	Galkayo is not served by a piped sewerage system, waste water from the sewers seeps into the ground and pollutes the perched aquifer tapped by shallow hand dug wells.
Quality of Drinking Water	poor	The water produced is salty (TDS > 3 g/l), bitter, absolutely disagreeable and showing above norm levels of boron and sulphates. Sporadic cases of cholera have been recorded during the past year.

PROPOSED INVESTMENT PLAN

Short-Term/Emergency Actions	Focus on redesigning and replacing the existing elevated reservoir, the construction of two new reservoirs and a new water supply system to feed the eastern quarters, which cannot be served with the present infrastructure.
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Medium-Term	Focus on building the infrastructure required to supply the Eastern quarters of the town: drilling, completion, equipment and connection of three boreholes to the distribution network in the NE sector of the Town. Furthermore, medium term actions are required to install a desalinization plant and implement a small system to distribute water through kiosks
Long-term/Development Actions	Focus on the execution of studies and exploratory drillings to find fresh water about 15-18 km westward of the town, toward Gelgaris and connect the new boreholes to the water supply system of the city in order to guarantee the long-term water requirements for the growing population.

A water resource and infrastructure plan was devised in February 2016. The Plan, developed on behalf of PSAWEN and GALWA Co. and sponsored by the European Union (EU), identified a potential groundwater source some 15 km westward of the city and recommended its development.

Feasibility studies are available but additional geophysical investigations, test boreholes and detailed designs are yet to be prepared and would be needed before procurements and construction can start.

The deep groundwater present in Galkayo Area is a multi-layered regional aquifer, which will secure further development but the produced water is saline. Some 15 km westward of the town it is possible to find more fresh water than available in the urban area (see Figure 5 below). Productive boreholes will require a new design, therefore a new well field and transmission to the town should be a long-term target.

In the medium period, the only solution to supply fresh drinking water is to convert the salty groundwater present in the urban area with a desalinization plant and distribute it with a system of water kiosks (see following Figure 6).

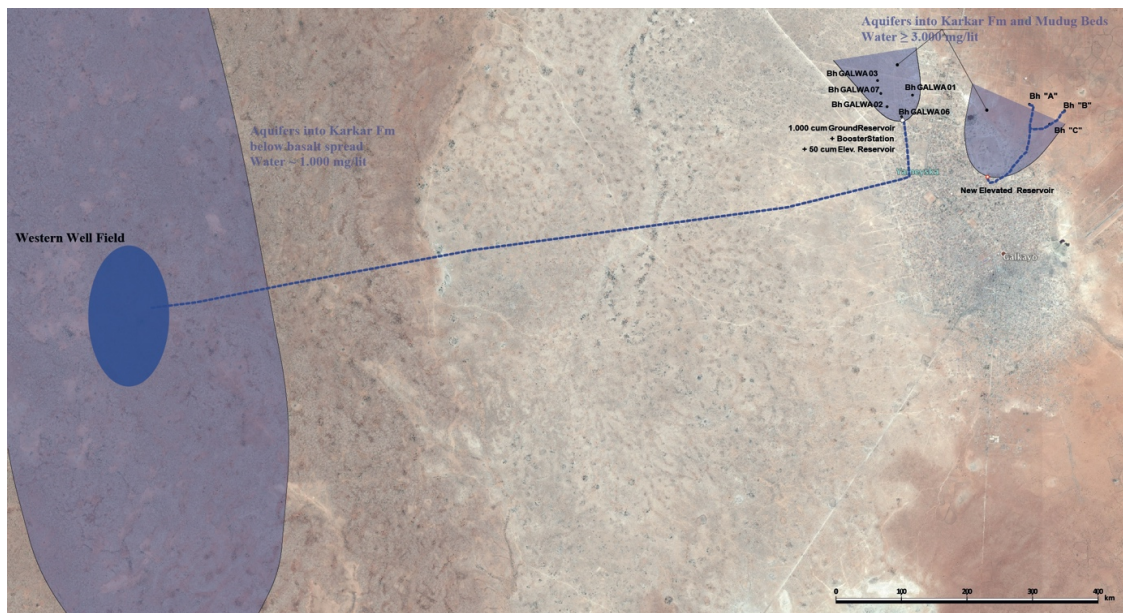


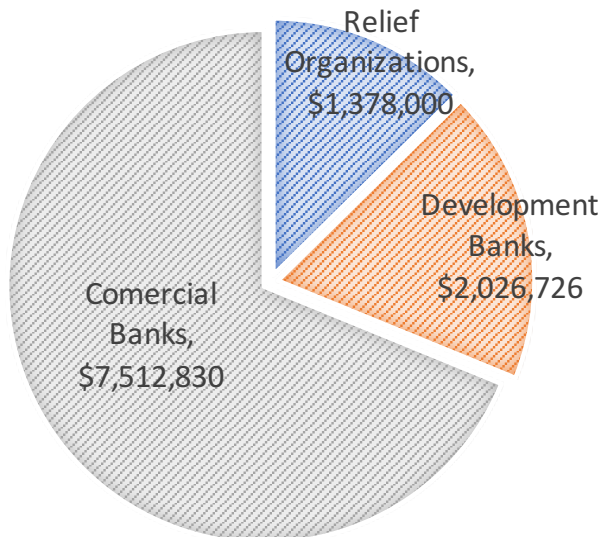
FIGURE 5: LOCATION OF EXISTING AND NEWLY PROPOSED WELL FIELDS



FIGURE 6: EXISTING AND NEWLY PROPOSED STORAGE AND DISTRIBUTION NETWORK

FINANCIAL NEEDS

The financial needs of the water sector in Galkayo are about **11 million US\$**, over 5 years. The plan is unfunded and it is unlikely government or private funding will be able to fill the gap. Support will also be needed for capacity building of GALWA Co. (but financial requirements have not been identified yet). Development banks are probably the best vehicle to support initial training activities and technical advisory services.



The following table provides details of the various actions required for the full implementation of the water resources master plan and secure water needs well beyond the next 25 years. Actions have been grouped in lots that can be tendered separately. Additional information are

provided in annex.

LOT N	IMPLEMENTATION OF THE MASTER PLAN RECCOMENDATIONS	FINANCIAL NEEDS (US\$)	TERM	POTENTIAL FINANCING SOURCES
	Support for Institutional Capacity Building	TBD	Medium	Development Banks
0	Installation of new valves in the distribution network	\$20,800	Short	Relief Organizations
1	Construction of a 1,000 m ³ Ground Reservoir	\$547,300	Short	Relief Organizations
2	Implementation of 50 m ³ Elevated Reservoir and Booster Station	\$457,600	Short	Relief Organizations
8	Construction of connecting pipeline from the 50 m ³ Reservoir to the 1,000 m ³ Reservoir	\$352,300	Short	Relief Organizations
3	Drilling, completion and testing of n° 3 boreholes	\$190,450	Medium	Development Banks
4	Construction and Equipment of n° 3 New Pumping Stations	\$250,640	Medium	Development Banks
5	Construction of flowlines from pumping stations to the Elevated Reservoir	\$346,320	Medium	Development Banks
6	Construction of Elevated Reservoir and ancillares	\$323,700	Medium	Development Banks
7	Drilling, completion, testing and equipment of a new borehole for drinkable water system	\$87,516	Medium	Development Banks
9	Construction of the desalinization plant + Elevated Reservoir	\$577,200	Medium	Development Banks
10	Construction of the distribution system of drinkable water	\$250,900	Medium	Development Banks
11	Primary and Secondary Distribution Network, extention to secure the service	\$236,600	Long	Commercial Banks
12	Drilling n° 12 exploratory boreholes and complete n° 4 boreholes to productive and testing	\$795,860	Long	Commercial Banks
13	Construction n°4 pump stations and equipment the relative boreholes	\$364,260	Long	Commercial Banks
14	Construction n°4 pump stations and equipment the relative boreholes	\$786,110	Long	Commercial Banks
15	Construction of flowlines + trunk line to the Town 1,000 m ³ Reservoir	\$5,330,000	Long	Commercial Banks
TOTALS		\$10,917,556		

ANNEXES

REVIEW OF GAROWE CITY INVESTMENT PLAN

POPULATION AND WATER DEMAND

Garowe has over 150,000 persons and growing (see table below). The only data for water production are for the months of January, February and March 2015. According to this data, the current mean daily supply is 1,784.73 m³/day, equivalent to 11.9 l/p/d.

The goal of the government is to reach 35 l/p/d (considered by WHO as “mean standard of life”) as soon as possible. At that amount with the projected population growth, by the end of the project period the water demand will reach 11,325 m³/day.

Assuming Puntland remains peaceful, it is likely that many internal displaced people (IDP) or refugees will return home. Accordingly, the growth rate may be less than what has been estimated.

TABLE 1: POPULAITON AND WATER DEMAND FORECAST

		Years											
		2015	2017	2019	2021	2023	2025	2027	2029	2031	2033	2035	2040
Population	n°	150.000	159.600	169.814	180.683	192.246	204.550	217.641	231.570	246.391	262.160	278.938	323.568
Water demand x (15 lit/pc/ day)	cum/day	2.250	2.394	2.547	2.710	2.884	3.068	3.265	3.474	3.696	3.932	4.184	4.854
	lit/sec	26,0	27,7	29,5	31,4	33,4	35,5	37,8	40,2	42,8	45,5	48,4	56,2
Water demand x (25 lit/pc/ day)	cum/day	3.750	3.990	4.245	4.517	4.806	5.114	5.441	5.789	6.160	6.554	6.973	8.089
	lit/sec	43,4	46,2	49,1	52,3	55,6	59,2	63,0	67,0	71,3	75,9	80,7	93,6
Water demand x (35 lit/pc/ day)	cum/day	5.250	5.586	5.944	6.324	6.729	7.159	7.617	8.105	8.624	9.176	9.763	11.325
	lit/sec	60,8	64,7	68,8	73,2	77,9	82,9	88,2	93,8	99,8	106,2	113,0	131,1

EXISTING WATER SOURCES

Current water sources include:

- Shallow hand dug wells (HDW): produce heavily polluted water and are used for non-domestic uses (although the poorest people use it for cooking and drinking creating diffuse water borne diseases). These are mainly privately owned, but some are public. Urban development has spread human waste, which pollutes the HDW that are still productive.
- Lined or unlined ponds of small capacity and buried cisterns collect surface runoff of small catchments. These waters are highly polluted and not suitable for human consumption.

In the area, there are no surface water sources suitable for urban water supply and there is unreliable rainfall. The sole secure water source is groundwater.

The water supply service is managed by the Nugal Water Company (NUWACO Co.), a private shareholder company. The NUWACO boreholes are not equipped with dependable water meters so production is unknown.

There are seven boreholes dedicated to water supply: 5 are productive and connected to the system, 2 have been completed recently and are waiting to be connected.

TABLE 2: BOREHOLES MANAGED BY NUWACO

Borehole	Easting	Northing	Elevation (m asl)	Depth (m bgl)	Yield (lit/sec)	Production (cum/day)	Pumping time (hours/day)	SWL (m bgl)	WEC (μ S/cm)
Bh - 1	221.449,02	928.888,40	475,97	135	7,5	648	24	-	4450
Bh - 2	221.248,65	928.695,93	472,05	224	0,8	abandoned	0	-	-
Bh - 3	221.626,44	928.648,09	472,76	250	0	abandoned	0	-	-
Bh - 4	221.506,51	929.848,56	468,69	285	4,2	?	?	80	5350
Bh - 5	220.894,88	928.892,43	474,41	100	6,4	322	14	-	3.800
Bh - 6	220.649,07	928.709,30	475,81	100	0	abandoned	0	-	-
Bh - 7	221.115,03	929.349,41	472,23	105	12,5	1080	24	19,76	4360
Bh - 8 (Dunurey)	220.106,15	930.929,34	476,31	302	4,2	0	0	23,35	5600
Bh - 9 (Washington)	225.386,90	931.333,75	453,32	84	12,2	-	-	8,35	4600
Bh - 10 (North-East)	226.081,92	932.663,62	449,69	282	7	0	0	4,2	4300

EXISTING INFRASTRUCTURE

WATER STORAGE

Large structures are not present in Garowe. The Elevated Reservoir has a total volume of 692 m³. The composition of Garowe groundwater rusts the steel, producing leakages.

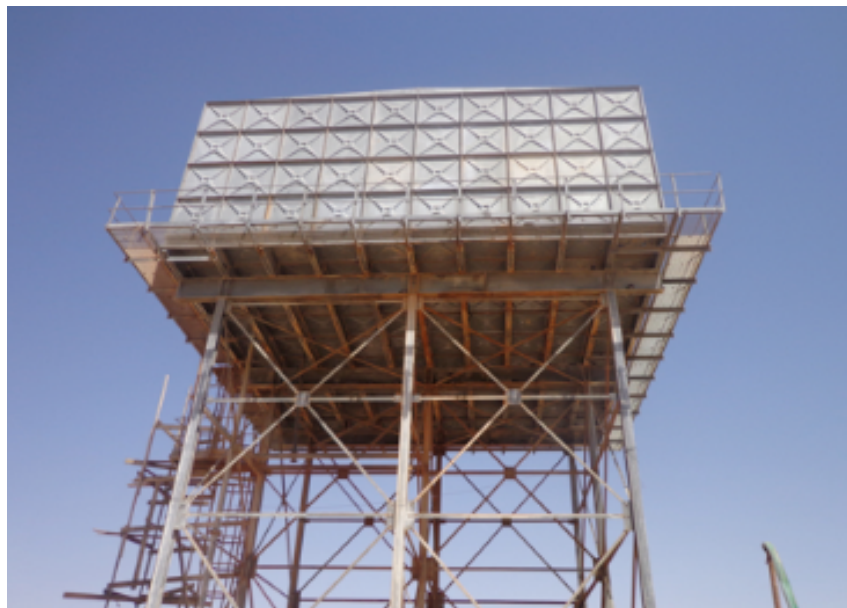


FIGURE 7: ELEVATED RESERVOIR

DISTRIBUTION NETWORK

The distribution system consists of about 52 km of pipelines spread over 618 hectares of urban area, plus some 6.2 km of pipelines to connect two IDP camps located in the eastern outskirts of town.

The distribution network is spread relatively evenly, therefore the service could be made in a uniform manner. In the opinion of NUWACO technicians, leakages are insignificant; the major problem is the scarcity of resources.

PROPOSED DEVELOPMENT PLAN

A temporary solution to quickly reach the target quantity of water could be to drill boreholes in the surrounding area of the town, pumping directly into the distribution system. This will alleviate the present water demand but when water is more abundant it will create water hammering, which will damage the existing piping system. To address this, it would be necessary to modify the starting system of the pumps with inverters with pressure switches so the flow will be regularized and the water hammering effects will be negligible.

POTENTIAL FUTURE SOURCES

According to the data of existing boreholes, there are two deep aquifers located around the city, one with static water level (SWL) at ~ 445 m asl and one with SWL at ~ 385 m asl. The difference of 60 metres between the two aquifers implies the presence of a continuous aquiclude. The aquifers held in the bedrock have regional character, so it makes no sense to relate the recharge to local rainfall. The potential water resources in the bedrock will satisfy the demand into the distant future.

Additional promising zones include:

- Salaxley Village: Surface geology suggests that the surroundings of Salaxley are promising for drilling productive boreholes.
- Jabagale Areas: This area is an oasis with intensive plantations. There are already productive boreholes and several hand dug wells. Some problems may arise with farmers over abstraction but the aquifer has the capacity to sustain both the farmers and town needs, because this is a regional aquifer.

Other zones with lower chances of finding water are:

- Along Salaxley river at the junction with the Garowe River
- In Garowe Urban Area

Water resources capable of supplying beyond the project period (year 2040) is in the Nugal Valley, which is the largest catchment basin of northern Somalia. The "Nugal Basin" is also the most promising oil bearing structure of all of Somalia. As a result, the findings are not accessible because they constitute industrial secrets of the oil company.

It is recommended to conduct geophysical studies near Jabagale, in the Nugal Depression, to evaluate the potentiality of this area.

PROPOSED INVESTMENT

Present needs will be met with the construction of one 1,000m³ and one 500m³ reservoirs and the installation of 35km of new pipelines.

The estimated water demand at the end of the project period will be 11,325 m³/d, equivalent to 131.1 l/s, the supposed productive capacities of Salaxley and Jubagale jointly will be 100 l/s. The difference (31.1 l/s) will be provided by the boreholes already present in the urban area.

When the productive boreholes are drilled, completed and tested, the following should be done:

- land acquisition study;
- optimization of pipeline routes with topographical and geotechnical surveys;
- design of pumping systems;
- design of pipeline.

PROPOSED NETWORK

The proposed network includes:

- Expand the water service with private connections and kiosks to sell water. A new 1000m³ reservoir is planned and the location has been selected jointly with the government (Northern Reservoir). It will be able to feed the southwestern quarters only, so a subsidiary reservoir of 500m³ has been designed that will be fed by the Northern Reservoir by gravity.
- Install a small desalinization plant to feed a distribution network, which will distribute drinking water through public fountains (kiosks), without any private connection. The distribution system will consist of 12 public fountains throughout the urban area and 2 in the refugee camps in the Eastern outskirts. The selling cost of drinkable water will be sufficient to cover the production costs. In the beginning, the production cost of the water will be 2,66 US\$/m³. In the future when the technicians improve, this figure will be considerably reduced.

The executive designs of the distribution system are already available, the development of water sources outside the urban area, the extension of primary and secondary networks and the drinkable water system are at the level of preliminary design.

REVIEW OF BOSASO CITY INVESTMENT PLAN

POPULATION AND WATER DEMAND

The population of Bosaso is 385,000, plus some 40,000 internal displaced people (IDP) and refugees in settlements in the southern outskirts of town. A reasonable prediction estimates the population will grow to 600,000 inhabitants in the next 25 years.

		Years											
		2015	2017	2019	2021	2023	2025	2027	2029	2031	2033	2035	2040
Population	n°	425.000	437.600	450.603	464.023	477.871	492.163	506.912	522.134	537.842	554.053	570.782	588.047
Water demand X (15 lit/pc/ day)	cum/day	6.375	6.564	6.759	6.960	7.168	7.382	7.604	7.832	8.068	8.311	8.562	8.821
	lit/sec	73,78	75,97	78,23	80,56	82,96	85,44	88,01	90,65	93,38	96,19	99,09	102,09
Water demand X (25 lit/pc/ day)	cum/day	10.625	10.940	11.265	11.601	11.947	12.304	12.673	13.053	13.446	13.851	14.270	14.701
	lit/sec	122,97	126,62	130,38	134,27	138,27	142,41	146,68	151,08	155,63	160,32	165,16	170,15
Water demand X (35 lit/pc/ day)	cum/day	14.875	15.316	15.771	16.241	16.725	17.226	17.742	18.275	18.824	19.392	19.977	20.582
	lit/sec	172,16	177,27	182,54	187,97	193,58	199,37	205,35	211,51	217,88	224,44	231,22	238,21

FIGURE 8 – POPULATION AND WATER DEMAND FORECAST

EXISTING WATER SOURCES

The water supply provided by GUMCO Co. is estimated to be 3,600m³/day at the price of 1.3 US\$/m³, which is a per capita/day supply of ~ 7.65 l. The water supply is augmented by private truckers who fetch water from private boreholes or shallow wells. According to these figures, the cumulative supply (GUMCO + private) is approximately 15 l/p/d, which is the WHO survival limit in desert environments, such as Bosaso. The problem is that this water is a minimum for survival and is not equitably shared between the rich and poor.

The present water production is from 14 boreholes excavated in two aquifer zones. The aquifers are overexploited and getting worse with uncontrolled private drilling activities.

Three shallow wells located eastward of the town are devoted to private trucking services; another shallow well located in the area is used for a factory. A large number of shallow wells for livestock watering and for domestic or rural use have been excavated. There are 18 privately owned boreholes in the surroundings of the town for various use. In total, the volume of the water abstracted from the ground ranges between 7,000 and 9,000m³/d.

EXISTING INFRASTRUCTURE

WATER STORAGE

The 14 boreholes managed by GUMCO Co feed a 500m³ elevated steel tank. It has very minor leakages and can be classified in medium-good status.



FIGURE 9: 500 M³ ELEVATED RESERVOIR



FIGURE 10: 1,000 M³ GROUND RESERVOIR

The Bosaso Water Supply also includes a 1,000m³ semi-buried reservoir and a trunkline from the reservoir to the port. The reservoir is out of service because the available water is not sufficient for normal operations. The reservoir is seemingly in good condition; the only recommended activity is the rehabilitation of the internal lining to remove bacteria and algae.

The piping system of the reservoir is completely covered with rust. Also, the trunk line toward the port is out of service because of excessive leakages.

DISTRIBUTION NETWORK

The distribution network is in good shape. GUMCO Co. states that leakages are rare events, but in any case, their technicians are rapid in the repairs. The major problem is the availability of water to distribute.

PROPOSED DEVELOPMENT PLAN

POTENTIAL FUTURE SOURCES

About 20 km southward of the town there are several springs which have the potential to meet the water demand for the project period and beyond, with an estimated capacity of 290 lit/sec. The water quality of these springs is very good; according to the data the water does not require any treatment, except minor chlorination will be necessary to prevent the proliferation of pollutants in the system (reservoirs + pipes).

PROPOSED INVESTMENT

Before proceeding to design the uptake works of the springs, the following studies must be executed:

- Geological and geophysical studies
- Mechanical investigations (study bores and open pits)
- Short term pump testing
- Detailed topographical beaconing
- The design

After the completion of the spring uptakes, an observation period is mandatory to collect basic data for further designs. The completion works will include the installation of a flow meter and a valve to regulate the flow at the end of each evacuation pipeline. The evacuation pipelines, which will drain the sourcing waters, will be extended downstream in order to find the elevation to ensure a gravity flow to the ground level. The pipelines from the uptake evacuation pipelines to the main reservoir constitute the largest investment costs.

PROPOSED NETWORK

The water distribution system in town is divided into three macro-sectors:

- **Southern Sector**, extending from 45.0 to 80.0 meters above sea level; presently the inhabitants are scarce but in the future large developments are planned. This sector will be served by the 1.000m³ ground reservoir, by means of a fully dedicated OD 250 mm pipeline, and has two connections with the Central Town Sector.
- **Central Town Sector**, extending from 13,0 to 45,0 meters above sea level: the majority of the Bosaso inhabitants live in this area. This sector will be served by the 500 m³ elevated reservoir through the existing OD 200 mm pipeline. This sector has 8 connections with the East and Port Sector.
- **East and Port Sector**, extending from 0.0 to 37.0 m asl, more than one third of Bosaso's population lives in this area. There is the port, the airport, the quarantine camps and the IDP camps; in the eastern side, large developments are expected. This area will be served by a planned 100m³ ground reservoir and

a OD 350 mm pipeline that will be divided into two branches: the Eastern branch; and the Western branch.

Each macro-sector will be separated from the adjoining with butterfly valves, which in case of emergency could be opened thus securing the water to the sector out of service.

All water sources (springs + boreholes) will flow into the 1,000 m³ ground reservoir and from there be distributed into 2 satellite reservoirs and to the Southern Sector of town. The two satellite reservoirs will play the role of water towers to regulate the pressure in the sectors; a certain storage capacity will be necessary to absorb the top of the peak demand.

The 500 m³ elevated reservoir is too big to be a water tower, but it exists and is in relatively good condition, so it will be utilised as it is. The planned 100 m³ ground reservoir has been dimensioned to fit the necessary storage.

REVIEW OF GALKAYO CITY INVESTMENT PLAN

POPULATION AND WATER DEMAND

Galkayo, capital of the Mudug Region, is divided into two zones: the northern portion, part of the Puntland State; and the southern tip, governed by the Galmudug Administration. The present study concerns the northern part only, where about 300,000 people live. Presently the inflow of internal displaced people (IDP) or refugee people has practically come to an end.

The population growth forecast is in the following table:

		Years											
		2015	2017	2019	2021	2023	2025	2027	2029	2031	2033	2035	2040
Population	<i>unit</i>	300.000	319.507	340.283	362.409	385.975	411.072	437.802	466.270	496.588	528.878	563.268	659.346
Water demand X (15 lit/pc/ day)	<i>cum/day</i>	4.500	4.793	5.104	5.436	5.790	6.166	6.567	6.994	7.449	7.933	8.449	9.890
	<i>lit/sec</i>	52,08	55,47	59,08	62,92	67,01	71,37	76,01	80,95	86,21	91,82	97,79	114,47
Water demand X (25 lit/pc/ day)	<i>cum/day</i>	7.500	7.988	8.507	9.060	9.649	10.277	10.945	11.657	12.415	13.222	14.082	16.484
	<i>lit/sec</i>	86,81	92,45	98,46	104,86	111,68	118,94	126,68	134,92	143,69	153,03	162,98	190,78
Water demand X (35 lit/pc/ day)	<i>cum/day</i>	10.500	11.183	11.910	12.684	13.509	14.388	15.323	16.319	17.381	18.511	19.714	23.077
	<i>lit/sec</i>	121,53	129,43	137,85	146,81	156,36	166,52	177,35	188,88	201,16	214,24	228,18	267,10

FIGURE 11: POPULATION AND WATER DEMAND FORECAST

The growth of water demand for the next 25 years (to reach 35 l/p/d) is 16.51 %/year. The current supply is unable to satisfy these targets due to the scarcity of resources, but also due to structural deficiencies of the distribution network.

EXISTING WATER SOURCES

In the Galkayo area, there are no surface water sources suitable to satisfy the demands of a large town. The only reliable source is groundwater. The traditional shallow wells secure non-domestic uses; data on productive capacity do not exist at present.

An important contribution to the water supply is by private boreholes exploited in the town and in the surrounding area by water trucks. No data concerning this service exists.

The water supply is managed by the Galkayo Water Company (GALWA Co.), a private share company. The present water supply is ~ 8.44 l/p/d. There are 16 boreholes: 5 are managed by GALWA Co., which are productive and connected to the distribution system; 11 are privately-owned.

The main characteristics of the 5 boreholes are listed in the table below.

		Borehole names				
Coordinates	Easting	GALWA 1	GALWA 2	GALWA 3	GALWA 6	GALWA 7
	Northing	6.79587	6.79400	6.79832	6.79236	6.79619
Elevation (<i>m asl</i>)		47.41565	47.41142	47.40987	47.41379	47.41039
Borehole total depth (<i>m bgl</i>)		293	293	295	293	
Casing		210	210	210	210	210
Pump rising main		10" PVC	10" PVC	10" PVC	10" PVC	
Flow meter size		3" G.I.	3" G.I.	3" G.I.	3" G.I.	
Pump position (<i>m bgl</i>)		100 mm	100 mm	100 mm	100 mm	
Static Water Level (<i>m bgl</i>)		160	140	160	160	
Water Electrical Conductivity		51	51	51	42.64	
Working hours a day		3920 $\mu\text{S/cm}$	3690 $\mu\text{S/cm}$	3660 $\mu\text{S/cm}$		3.534 $\mu\text{S/cm}$
Yield (cum/hour)		20	20	20	20	20
		38	47	21	57	42

FIGURE 12: MAJOR FIGURES CHARACTERIZING THE BOREHOLES IN USE FOR WATER SUPPLY

Other traditional water sources are small ponds, balleys, buried cisterns and berkats. These water sources are not perennial, the seepage and evaporation restrict the water availability and depend on the fortuity of rainfall.

EXISTING INFRASTRUCTURE

WATER STORAGE

The productive boreholes in use by GALWA Co. are pumped into a 692 m³ elevated reservoir. The frame supporting the reservoir was founded on separate pillars directly on the gypsy crusts. This inappropriate method of foundation caused the settling of the whole structure of about 0.3 m toward one side and stressed the tank so that it leaks extensively. For security reasons, the filling is limited to one meter only, whereby the present capacity is limited to ~ 140 m³. This infrastructure must be replaced urgently.

DISTRIBUTION NETWORK

The basic primary and secondary network is 25 km long and was installed in 2003. This original network has been extended by GALWA Co. with more 295 km of pipeline. It appears that the water supply network of Galkayo has large unaccounted water losses.

The Eastern Sector of the town is not regularly served and the South-Eastern quarters do not receive water at all. With the present network configuration, it is not possible to secure the supply for that area.

PROPOSED DEVELOPMENT PLAN

POTENTIAL FUTURE SOURCES

The groundwater in the urban area is a multi-layered regional aquifer, which will secure further development but the produced water is saline. Some 15 km westward of the town it is possible to find fresher water. The necessary boreholes to secure this require a new design, therefore the implementation of a new well field and the transmission to the town will be a medium-term target.

In order to drill high yielding boreholes in gipsy and limestone rocks, it is necessary to:

- execute highly detailed geophysical surveys to locate the most favourable areas,
- make test boreholes to give information on productive capacities and allow the collection of water samples to make preliminary quality tests, and
- the design of test boreholes can allow the conversion to productive of the ones denoting proper characteristics, selecting them according to experience.

In the short term one solution to supply fresh drinking water is to convert the salty groundwater present in the urban area with a desalinization treatment plant and distribute it with a small system.

According to the existing data, it's possible to deduce the presence of a deep multi-layered aquifer tapping the Karkar Formation, with a static water level (SWL) at ~ 50 m below ground level. The geophysical study also identified some locations favourable to the implementation of productive boreholes.

The proposed exploration area 15-18 km westward of town has been selected on the basis of bibliographic information; no field surveys have been carried out. To obtain fresh water, it is mandatory to prevent the inflow of the saline water present in the Mudug Beds into the fresh water present in the Karkar Limestone.

The following scheme has been proposed:

- pump stations with submersible pumps;
- flow lines for a total of 5 km;
- a booster station with direct drive pumps + surge tank;
- trunk line.

PROPOSED INVESTMENT

PROPOSED NETWORK

The following has been proposed:

- expand water service with raw water to supply town needs with private connections and some kiosks selling water;
- install a small desalinization plant feeding a minor distribution network, which will distribute drinkable water through public fountains (kiosks), without any private connection. The selling cost of drinkable water will be sufficient to cover the production costs.