National Water and Wastewater Strategy for Palestine

Toward Building a Palestinian State from Water Perspective



PALESTINIAN WATER AUTHORITY

FINAL COPY

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Part 1. Background

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National Water Policy and Strategy

The purpose of this document is to present the State of Palestine a framework for action in the water sector for the sustainable management of water resources in the Occupied State of Palestine.

Sustainable management of water resources is vital to the Palestinians' long term prosperity. Water is essential for human and other life and crucial for the development of agriculture and industry, as every sector depends on secure and sustainable access to water.

Despite the limited water resources available and the importance of water to a healthy future, there have been instances where the value of water has been overlooked. The sustainable management of water resources does not offer easy solutions as the country is suffering from water scarcity, as Israel is hindering Palestinian access to natural water resources. Thus, legal and administrative measures need to be continually updated based on a plan developed from a strategy, which in turn is the expression of a national water policy.

In addition, this policy and strategy form part of a framework derived from an integrated water resources assessment carried out by the Palestinian Water Authority (PWA) in consultation with the key stakeholders identified by the Government, the major promoter of both the policy and strategy.

Responsibilities for implementing the measures proposed in this policy and strategy document will be shared between various stakeholders, including:

- Office of the Prime Minister
- Ministry of Finance
- Ministry of Planning and Administrative Development
- Ministry of Agriculture
- Ministry of Environmental Affairs
- Ministry of Local Governorate
- Ministry of Health
- Negotiations Affairs Department
- Ministry of Foreign Affaires
- Ministry of Women Affairs
- Ministry of Education
- Water service providers and their representative association
- EWASH group

The policy and strategy title is referred to as the National Water and Wastewater Policy and Strategy. This document has been developed under the auspices of the Palestinian Water Authority, with the involvement of all major stakeholders of the water sector in the Palestinian Territories.

Purpose statement

The National Water Policy and Strategy provide the planning and management framework necessary for the protection, conservation, sustainable management and development of water resources and for the improvement and sustainable management and provision of water supply and wastewater services and related standards in the Palestinian Territories. The policy and the strategy aim to:

(a) Reinforce the Palestinian Authority's approach to sustainable water resources management by ensuring that all arms of government work together in the pursuit of shared water resources management goals; and

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(b) Establish a framework for the coordinated development, regulation and financial sustainability of water supply and wastewater services to ensure concerted efforts towards improved water systems management, rehabilitation and maintenance.

The National Water Policy and Strategy will also act as a platform for ensuring close collaboration and cooperation among all water-related agencies and stakeholders at the national, governorate, municipal and local levels. As such, the National Water Policy and Strategy should be treated as a living document to accommodate changes that will further strengthen the national framework and reflect water management at all levels.

Previous Reference

The National Water Policy and Strategy is in line with the Strategy for the Water and Wastewater Sector (2011-2013), the Draft Water Resources Management Strategy (1997), the National Water Policy (1995), Water Sector Strategy Planning Study (WSSPS, 2000), Water National Plan (NWP) 2000 and Coastal Aquifer Management Plan (CAMP)1999-2004.

Applicability

The policy refer to all natural resources (ground and surface waters, fresh, brackish and salt waters), as well as to the water and wastewater services provided to the people of Palestine.

The policy applies to the Occupied State of Palestine including international territorial water, and East Jerusalem.

Document structure

The National Water Policy and Strategy is logically structured through four interrelated parts, these being:

Part 1. Background

Part 2. Water Policy

Part 3. Water Strategy

Part 3.1. Baseline

Part 3.2. Demand for water and wastewater services

Part 3.3. Sustainable development of water resources

Part 3.4. Water and wastewater services improvement

Part 3.5. Strategy implementation, monitoring and evaluation

Part 4. Appendixes

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Part 2. Water Policy

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Policy principles

Sustainable development of water resources

- Fresh water is a finite and vulnerable resource, essential for sustaining life, development and the environment
- Water is part of larger ecological systems. Realizing the importance and shortage of fresh water, it has to be treated as an essential element for sustaining all life forms.
- Water supply must be based on the sustainable development of all water resources (conventional and non-conventional, shared and endogenous).
- Water resources development must be based on data collection and evaluation of all water resources as well as balancing between water availability and water needs for all sectors.
- Water has an economic, social and environmental value.
- Environmental goals must be achieved through rationalization of water use and protection of all water sources from pollution.

Integrated water resources management

- Water resources must be managed in an integrated manner, taking the needs and viewpoints of all existing and potential users and the long term sustainability of these resources into account.
- Just, equitable, and sustainable allocation to all legitimate users will be best ensured by the State.
- Agricultural, industrial, and other development and investments must be aligned to the water resource quantity and quality available or to be developed.

Water rights

- The Palestinians will pursue their interests in connection with obtaining Palestinian water rights, including the fair right-of-access, right-of-control and right-of-use to water resources shared with other countries, in line with international law

Access to water and wastewater services

- Water has a unique value for human survival and health. Each citizen has the right to sufficient and affordable water of the required quality for the purpose of use.
- Each citizen has the right to hygienic sanitation services.
- The needs and interests of all gender groups (marginalized, poor, restricted access, women, etc.) will be taken into account.
- The water integration concept will be applied Water supply and sewage treatment services.

Financial sustainability of water utilities

- As water has an economic, social and environmental value in all its competing uses, water services are not free.

Governance and Management

- All water resources are considered as a public property.
- Water resources development and management should be based on a participatory approach, involving all stakeholders (users, planners and policy-makers) at all levels.
- The responsibilities for water resources governance, being a regulatory function, and water services management, being an operational function, should be separated institutionally.

Sustainable wastewater management

- Water polluters should stop their pollutions and be made to pay for the damage they have produced.
- Safe disposal of wastewater requires treatment to eliminate biological, chemical and physical hazards.
- Treated wastewater effluent is considered a water resource and is added to the water balance. This is deemed feasible in light of the semi-arid climate, the modest freshwater resources, the high demand for domestic water, and the marginal cost of such resource development.

Policy statements

Sustainable development of water resources

It is the National Water Policy of Palestine to:

1. Ensure that the abstraction rate from water resources is sustainable unless specifically sanctioned by the Government, where there is no alternative source for meeting basic needs.
2. Prioritize the prevention of groundwater pollution (including non-point pollution by fertilizers and pesticides) and ensure the protection of aquifers and in the meantime, improve the quality of fresh water in water bodies that have been degraded by human activities.
3. Undertake to continuously control the quality of water resources, identify pollution sources and polluters and enforce the polluter pays principle.
4. Develop additional quantities of water from non-conventional water resources without infringing upon Palestinian Water Rights.
5. Increase storm water infiltration at upper elevations to recharge the aquifers.
6. Develop flexible strategies to deal with the impact of climate change on water resources, to limit the water sector's carbon footprint and reduce the water footprint through the most efficient use of water.

7. Support the regular collection of all hydrological and other water water-related data in a centralized data base and to make this information available to the public, for to (a) ensure the efficient management of water in Palestine, (b) ensure the optimal irrigation planning of irrigation by the Ministry of Agriculture and relevant stakeholders, and (c) to document priority investments in the sector.

8. Encourage community involvement in the various stages of water resource development projects, including public awareness and training campaigns, to create an environment for effective management and ensure an educated public understands their roles and responsibilities in the effective management of water resources.

9. Recognize water users' associations (including farmers' associations) as formal entities entitled to negotiate and manage shared national water rights on behalf of their members.

10. Raise public awareness on water and wastewater issues and increase participation in water sector management, involving them the people in the process of public participation processes and developing their understanding of their rights and role.

Integrated water resources management and allocation of water rights

It is the National Water Policy of Palestine to:

11. Define all water resources available in Palestine as the common property of the Palestinian People. No individual or organization can claim water resources for private property. The right-of-use of these resources is regulated by the relevant national authority.

12. Define the priorities for allocating available water resources to the different types of user, e.g. domestic, agricultural, environmental, industrial, recreational, touristic, etc. and ensure that absolute priority is accorded to domestic and residential purposes over all other uses.

13. Allocate water rights for economic benefit (agriculture, industry, tourism, etc.) between different users based on the economic benefits to Palestine (in terms of revenue, job creation and food security) and in agreement with national development plans.

14. Have a national organization in place to set and review the water rights allocation at national level (defining the allocation principles and quantities designated to each activity).

15. Ensure that the allocation of limited water supplies within each specific user type is fair and equitable and that distribution among the regions is fair; where necessary, transfers will be organized from basin to basin and region to region, under the responsibility of the bulk supply utility.

16. Allocate water abstraction rights through a dedicated national authority; these rights will be limited in volume, limited in time and will be allocated for well-specified purposes; to this end, all well drilling, water production and supply will be allowed only by permit or license.

17. Organize the settlement by arbitration, and, if necessary, though the courts, of any disputes that may arise from the allocation of water rights.

18. Exclude that economic development, even inadvertently, would imply unsustainable water use, or irreversible environmental damage; the regard for resources and the environment will lay the premises for economic solutions.

19. Ensure that, water consumption in the agricultural sector adjusts to ensure cost-efficiency (choice of cultivars, use of marginal-quality water and more widespread use of improved irrigation technology).

20. Consider the separation of sewerage and storm water drainage, whenever feasible, in a cost-effective manner.

Trans-boundary water issues

It is the National Water Policy of Palestine to:

21. Ensure the full water rights of Palestinians to shared water resources.

22. Cooperate with regional partners to promote the optimum utilization of shared water resources, to identify and develop new and additional supplies, and to collect and share relevant information and data.

23. Promote, where expedient, an equal distribution of available bulk water supplies in Palestine, or for temporary respite during drought, by redistributing the agreed water allocations from shared aquifers and by the trans-boundary export of bulk supplies from areas with greater access to supply and trans-boundary import to areas with poorer access to supply.

24. Promote, where expedient, the trans-boundary export of treated wastewater from Palestine in return for the trans-boundary import of fresh water over and above the agreed allocated quantities for shared resources.

Access to water and wastewater services

It is the National Water Policy of Palestine to:*

25. Pursue the right of each citizen to affordable and sufficient water (when available) of the required quality for the purpose of use.

26. Focus particularly on improving water and wastewater services provided to marginalized areas (suffering from poor service), including rural areas, remote villages and refugee camps.

Financial sustainability of water and wastewater utilities

It is the National Water Policy of Palestine to:

27. Ensure that the abstraction, transmission and distribution of water, together with wastewater collection and treatment, is financially sustainable and that providers of these services can demonstrate their financial reliability as regards the full cost recovery (FCR) of operation, maintenance, capital investment and capital replacement costs.

28. Define and enforce clear regulations for revenue collection by utilities (including customer debts), as collecting these debts is key to ensuring the financial viability / sustainability of water and wastewater utilities.

29. Define and enforce regulations to deal with illegal connections to water systems and sewers.

30. Ensure that the services' proposed financing and funding requirements reflect the approved financial objectives and cost profiles of each service provider and that, where these tariffs do not provide full cost recovery up to the medium-term, all sources of funding required to meet this gap are clearly identified and secured.

31. Set wastewater charges, connection fees, sewerage taxes and treatment fees to cover at least the operation and maintenance costs and part of the capital cost. The medium-term aim is for full cost recovery.

32. Apply different charges for different geographical areas, as a function of use and effluent quality.

33. Assess the citizens' ability to pay for water and wastewater services and ensure that this assessment forms part of tariff reviews and includes issues related to the poor and disadvantaged sections of the community.

34. Develop and implement fair and progressive tariff systems with a view to facilitating access to the service by the poor and vulnerable groups and to ensuring cost recovery by utilities.

Governance and Management

It is the National Water Policy of Palestine to:

35. Regulate the water resources, water supply and wastewater collection, treatment and disposal issues, separating the policy, regulatory functions from those of service delivery.

36. Task the regulated public organizations with the provision of domestic and drinking water supply services, and of wastewater collection and disposal services.

37. Encourage the institutional restructuring of the Water Sector and involvement of the private sector in the funding, implementation, operation and maintenance of water supply and wastewater systems to improve efficiency and the performance of water sector and the transfer of technological expertise.

38. Encourage the involvement of formal water users' associations to ensure optimal management of shared water resources (including wells, springs and treated wastewater) used for economic purposes (irrigation).

39. Ensure the adequate involvement of all stakeholders (from a gender perspective) in water and wastewater programs & projects, to support sustainability in water resources management

40. Prioritize the optimal use of water resources, including the allocation of public funds, by encouraging efficient performances.

41. Encourage water service providers to reduce the quantity of non-revenue water in order to increase the availability of scarce resources to customers and improve their operational efficiency to progressively meet national targets.

42. Develop water demand management strategies, including suitable tariff mechanisms and public awareness-raising.

43. Stipulate that the organizations responsible for the water sector produce financially and technically sound plans to meet national long-term strategic objectives and regional (within Palestine) infrastructure master planning requirements, as well as the short-term investment requirements of the water sector.

Protecting the environment from pollution by wastewater

It is the National Water Policy of Palestine to:

44. Pursue the right of each citizen to have access to suitable sanitation facilities (sewerage or on-site sanitation), to collect and dispose of wastewater in a hygienic manner.

45. Promote the improvement of on-site sanitation facilities.

46. Remedy health risks associated with wastewater production and prevent environmental pollution from wastewater.

47. Prohibit roof- and storm-water connection to public sewers. Collection of storm-water shall be done separately and will be the subject of water harvesting.

48. Treat all produced wastewater to a quality suitable for safe and productive reuse, in line with national standards, and support the distribution and productive reuse of treated wastewater.

49. Priority shall be given to agricultural reuse of treated effluent. Blending of treated wastewater with fresh water shall be made to improve quality where possible. Crops to be irrigated by the treated effluent or blend thereof with freshwater resources shall be selected to suit the irrigation water, soil type and chemistry, and the economics of the reuse operations.

50. Crop nutrient requirements shall be determined taking into consideration the prevailing effluent quality. Overuse of nutrients shall be avoided. Farmers shall be encouraged to determine the rate of water application needed for different crops, taking into consideration the value of nutrients in the treated water and other parameters.

51. Accumulation of heavy metals and salinity shall be monitored, managed and mitigated. Leaching of soils shall be advocated by the irrigation authorities.

52. Farmers shall be encouraged to use modern and efficient irrigation technologies. Protection of on-farm workers and of crops against pollution with wastewater shall be ensured.

53. Improve treated wastewater reuse through sound contractual arrangements between the producers and the users.

54. Work with relevant authorities and institutions on public awareness concerning the importance of wastewater treatment and re-use, and the risk of health and environmental impacts of sewage.

Standards for the water and wastewater sector in Palestine

It is the National Water Policy of Palestine to:

55. Work with relevant stakeholders to develop, update and enforce national standards on drinking water quality based on the most up-to-date knowledge of potential hazards, national priorities, economics, and availability of water supplies, as well as health and other environmental implications.

56. Work with relevant stakeholders to establish and enforce national standards for discharging commercial, industrial wastewater into sewers.

57. Work with relevant stakeholders to establish and enforce national standards for wastewater reuse in agriculture and suitable crops for this reuse.

58. Work with relevant stakeholders to establish and enforce national standards for discharging wastewater into natural water courses (wadis, rivers, sea).

59. Work with relevant stakeholders to establish and enforce national regulations for on-site sanitation, as it is a potential source of pollution.

60. Work with relevant stakeholders to regulate and standardize the process for sludge collection, safe disposal and use.

Strategies for the Water Sector

61. The National Water Policy of Palestine will guide the development of national strategies for the sector.

62. The Palestinian Water Authority is responsible for preparing these strategies, in close co-ordination with the other stakeholders.

Proposed institutional arrangements

Whole Water supply and Wastewater sector governance

The PWA has been given its mandate through Water Law No. 2 (1996) and has been stressed on in its amendments Law no.3 for 2002 to manage the water resources, to execute the water policy, to establish supervise and monitor water projects, and to initiate co-ordination and co-operation between the parties affected by water management. Other line ministries and agencies have leadership on specific issues:

- Ministry of Agriculture (MoA): Policy and regulation of irrigation and promotion and organization of farmers' associations.
- Environmental Quality Authority (EQA): defining environmental regulations, including standards for the discharge of treated wastewater into natural water courses[1], , carbon footprint and water footprint regulations.
- Palestinian Standards Institute (PSI): standardization of rules for water facilities, sewerage, on-site sanitation.
- Ministry of Planning and Administrative Development: national development plans (taking availability of water resources into account, to be assessed by the MoPW) in coordination with relevant Stakeholders.
- Ministry of Local Government (MoLG): implementing and supporting Joint Service Councils (JSCs).

The PWA is in charge of the overall regulation of water producers and service providers and manage water resources, including:

- Allocation of water abstraction rights;
- Regulation of the right of use of the resources;
- Develop service providers;
- Develop Water Tariff Policy;
- Providing support to PSI for the definition of standards;

1. The Regulatory Water Council

A Regulatory Water Council will be implemented. The Council's role is to monitor the performance of Service Providers from technical, economical and environmental sides.

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[1] Environment law (nom 7 for the year 1999). *Article 28: "the ministry identifies quality standards and specifications of potable water, in cooperation with the concerned authorities". Article 29: "the ministry sets, in coordination with the concerned authorities, the necessary standards and specifications for collecting, treating, reusing, and disposing wastewater and rain water in a healthy manner in order to protect environment and public health".*

The Environmental Quality Authority does all the procedures relating to control and inspection to verify compliance with the adopted standards and specifications for environment protection (in accordance with the provisions of the Environment Act).

The Environmental Quality Authority applies the Palestinian policy of environment assessment in relation to the projects that need environmental impact assessment.

2. The national Water Company

The State of Palestine will work to set up a National Water Company in charge of producing and purchasing bulk water, or transporting bulk water between different regions, in the most efficient way to service providers.

3. Local water and wastewater utilities

In order to provide effective customer service, the bulk water supplier does not serve the customers itself, but sell water to local service providers.

The Policy promotes the development of JSCs that provide water and wastewater services to more than one municipality. Ultimately, the Policy aims to support the development of regional utilities, whose concession area will include one or more governorates.

These utilities will have an autonomous status both administratively and financially, and will have to operate on the basis of cost recovery principles. On the long term, involvement of the private sector in the implementation of certain projects may be encouraged and possibly the management of services that could be contracted out by National Bulk Utility and regional utilities.

4. Water users' associations

Water users' associations (WUAs) are very important institutional partners in irrigation water management.

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Part 3. Water Strategy

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Part 3.1. Baseline

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1. General

1.1. Population

The Palestinian population has grown rapidly over the last forty years and, in 2008, the PCBS estimated that growth for the 2010/15 period will be 3.75%/year, stimulating a rise in the demand for water.

The urban population was estimated to make up 70% of the country's total population in 2010 and this percentage is still increasing, with growing numbers using more water-consuming household equipment (showers, bathrooms, washing machines).

		1997	2007	2010	2015	2020
Gaza	urban		1 346 000	1 530 000	1 856 000	2 152 000
	rural		77 000	86 000	102 000	118 000
	TOTAL	**1 022 207**	**1 423 000**	**1 616 000**	**1 958 000**	**2 270 000**
West Bank	urban		1 260 000	1 483 000	1 860 000	2 054 000
	rural		1 117 000	1 213 000	1 366 000	1 508 000
	TOTAL	**1 873 476**	**2 377 000**	**2 696 000**	**3 226 000**	**3 562 000**
Total		**2 895 683**	**3 800 000**	**4 312 000**	**5 184 000**	**5 832 000**

Source: PCBS, 2008

Table 1. PCBS population projections up to 2020 (Including Jerusalem Old City)

1.2. National economy and GDP

Over the last nine years (following the second intifada period), the Palestinian economy has expanded rapidly nearly every year (with the exception of 2006), at an average rate of 5.8 %/year.

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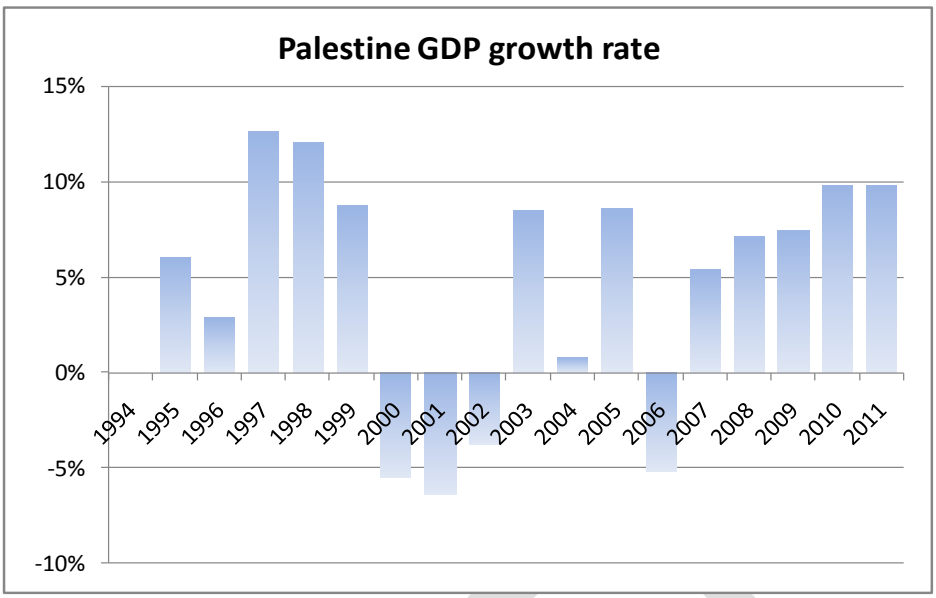


Figure 1. Palestine GDP annual growth rate.

This rate of growth is higher than the population growth rate and GDP/capita has increased from US$1,300/capita to US$1,600/capita over 7 years.

Economic Indicators – West Bank & Gaza	2004	2005	2006	2007	2008	2009*	2010	2011
Gross Domestic Product (GDP) (US$ millions) **	4,198.4	4,559.5	4,322.3	4,554.1	4,878.3	5,241.3	5,757.3	6,323.0*
GDP per Capita (US$) **	1,317.0	1,387.2	1,275.4	1,297.9	1,356.3	1,415.7	1,509.9	1,609.6*
Growth rate		8.6%	-5.2%	5.4%	7.1%	7.4%	9.8%	9.8%

Source: PIPA web-site
* Preliminary estimates and will be revised
** Data excludes parts of Jerusalem which was annexed by Israel in 1967
***GDP and GDP per capita provided in the Table are based on constant prices. 2004 is the base year.

Table 2. GDP and GDP/capita evolution

It can reasonably be supposed that GDP/capita will continue to rapidly expand during the 2013-2032 period due to the country's main economic strengths (a literate and educated population, a dynamic Diaspora maintaining commercial and financial links with their homeland, potential development of exchanges with neighboring countries, etc.). Nevertheless, a considerable factor in this economic growth has been and remains international assistance and support, which could change and slow the growth in the future in the absence of political progress

Nevertheless, Israeli occupation and the restrictions imposed on the circulation of goods and persons, as well as on investment, are major constraints that hinder the economic development of Palestine. As such, they must be taken into account when considering the feasibility of any investment, including investment in the water and wastewater sector.

1.3. Health and environment

Although environmental conditions are difficult in Palestine (as a result of the very high population density: by 2011, the population density was 456 persons/km² in the West Bank and 4,353 persons/km² in the Gaza Strip), sanitary conditions have much improved over the last few decades as

a consequence of better education and an improving health care system[2]. As a result of this improving sanitary environment, life expectancy has risen, infant mortality has decreased and most health indicators are among the best in the region.

	Infant Mortality Rate (per 1000)	Under-five moratality rate (per 1000)	Maternal mortality rate (per 100 000)	Life expectancy at birth (women)
Morocco	36.8	33	110	75
Algeria	27.7	30	120	74
Egypt	27.2	21	82	73
Syria	25.8	15	46	76
Turkey	23.07	15	23	77
Tunisia	22.5	16	60	77
Lebanon	21.8	15.3	26	77
Albania	18.6	14.2	31	75
Jordan	14.9	21	59	75
West Bank	14.5	21	13	77
Greece	5.1	5	2	83
Israel	4.1	4	7	83
Italy	3.4	4	5	84

Main data source: globalhealthfacts

Table 3. Basic health indicators.

The infant mortality rate was 24.2 per 1,000 live births between 1999 and 2003. The main causes of infant mortality are premature delivery, low birth weight, respiratory system diseases, and congenital anomalies. (PCBS, Palestinian Children - Rights and Numbers, 2005). This rate has continued to improve over the past ten years and is now only 14.5 / 1000, one of the lowest values in the Mediterranean region.

An important achievement of the health sector in Palestine is the serious drop in child mortality related to the quality water and sanitation conditions. According to the most recent annual report from the Ministry of Health (MoH, 2011), diarrhea and gastroenteritis are no longer public health issues in the West Bank, with 0 deaths among children in 2010.

However, sanitary conditions are worse in the Gaza Strip, where the very high population density (4,353 inhabit/km^2), combined with the Israeli-imposed embargo, makes development of a good sanitation service more difficult.

Water quality monitoring in Gaza has revealed very high nitrate pollution in coastal aquifers. High nitrate levels are primarily caused by the infiltration of sewage into water resources, as well as by over application of N-Fertilizers.

1.4. Institutional framework

The PWA was created in 1995, through a Presidential decree (N° 2/1996), to regulate the water sector, improve and sustain water resources, and to undertake planning and service delivery provision. The

[22] Over the last two decades, the infant and under-five mortality rates have steadily declined (and are now well below the regional average), while life expectancy has increased significantly (4 years longer on average than the typical person in the region). Total health spending stands at about 13% of GDP, which is among one of the highest rates in the region. (World Bank. West Bank and Gaza Public Expenditure Review. Vol. 1: From Crisis to Greater Fiscal Independence, Feb. 2007).

roles and responsibilities of the main water institutions in the water sector are detailed in the 2002 Water Law No 3. In general, the Water Law lacks clarity as it neglects to define the exact nature of and relationships between the sector institutions. The Water Law defines the roles and responsibilities of the PWA and the National Water Council (NWC), but fails to offer any guidance on other institutions (e.g. Ministry of Agriculture) and to define the overall sector architecture under which the NWC and the PWA have to operate. The Water Law does, however, provide PWA with jurisdiction over the utilities responsible for water provision and sewage water services.

At present, the relative roles, responsibilities and relationships of water sector institutions are in need of clarification. The unclear mandates and undefined relationships between key sector institutions, including central and local government, civil society and private actors, are severely hampering the ability of the PWA to lead, develop and regulate this suboptimal and exogenously constrained sector.

The institutions and institutional framework created since 1995 to manage water resources and water uses, including the provision of water and wastewater services, are not considered properly fit for its purpose and, consequently, do not meet the needs of the people in Palestine. The lack of clear institutional mandates has contributed to a situation in the Palestinian water sector of ineffective governance and weak capacity, which, when combined with the occupation-related restricting factors, hinders the development of integrated water resources management, infrastructure development and service provision policies, strategies and regulations.

For all those reasons PWA started the water sector reform process with a clear mandate and responsibilities for all the water actors, based on the newly developed water law which differentiates the responsibilities of PWA for policy and strategy and for regulating the water resources. In addition, a water regulatory council is to be established to regulate the providers of water supply and wastewater services.

The ongoing Israeli occupation and control over the vast majority of shared water resources complicates sector regulation by the Palestinian Government in general and by PWA in particular. Both have only limited control over the country's water resources because Israel controls most the water resources shared with Palestine, in violation of good international practices regarding the management of trans-boundary water resources.

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2. Water resources in Palestine

2.1. Surface water resources

Surface water resources in Palestine are very scarce. There are currently very few surface water resources in the West Bank, and none anymore in the Gaza Strip, where the main wadis –Gaza Wadi- has been dried up by upstream water abstraction in Israel. Most of the wadis flow only for a few weeks a year, usually as flash-floods after thunderstorms, and this resource is hard to use and capture as, in most valleys, the complicated geological/geographical features complicate the construction of large storage dams (few plains, karstic limestone substratum).

The main permanent surface water resource on the West Bank is the Jordan River, which is used heavily for irrigation and domestic water supply by Israel. Since 1967 the Palestinians do not have access to this resource. It is a trans-boundary resource, shared between Jordan, Syria, Lebanon, Israel and Palestine. The integrated management of this resource and the conclusion of a basin wide agreement is a key component of any long-term strategy.

However, the following facts should be considered:

- Jordan River, It mainly consists of two parts: the Upper Part that's flows from the river headwaters (Hasbani, Banias and Leddan) into Lake Tiberias, while the Lower Part is the continuation of flow from Lake Tiberias to the Dead Sea at an altitude of 425 meters below sea level. Historically, the quantity of water flowing into the Lower Jordan River and discharging into the Dead Sea is estimated 1400 Mm3/y. This amount decreased dramatically during the past six decades and is presently no more than 30 Mm3/y (FOEME-2010). This huge reduction in flow is mainly due to diversion of its water by Israel of more than 500 million cubic meters through the National Israel Water Carrier that extends south to the Negev, in addition to the construction of many dams upstream. Moreover, natural factors such as evaporation also had an adverse impact on Jordan River flows. Furthermore, the Jordan River is threatened by the discharge of large quantities of untreated wastewater from Israeli settlements located along south of Lake Tiberias, water status report in 2011, PWA.;
- West Bank wadis: The long-term average annual flow of flood water through wadis in the West Bank is about 165 Mm3/y. Generally, the West Bank wadis are classified into eastern wadis (toward the Jordan Valley and the Dead Sea) and western wadis (towards the Mediterranean) by the direction of flow. Currently, about 1 Mm3/y is being harvested through several agricultural bonds in Jordan Valley and a small scale dam in Al Auja Area.
- Wadi Gaza- It originates at the eastern upstream where Israel is trapping the natural flow. This action dries the wadi, except in very wet years, making the use of any remaining surface water resources is very limited. The annual average flow of this wadi is about 20 Mm3/y.

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2.2. Groundwater resources

Palestine is mostly reliant on groundwater where the majority of Palestinian water supply comes from this source either by wells or springs. The total renewable groundwater resources have been estimated as 578-814 Mm^3/year in the West Bank and around 55-60 Mm^3/year in the Gaza Strip.

In the West Bank, groundwater resources are contained in deep (karstic) limestone and dolomite aquifers. Most large production Wells are 200-800 meters deep and the water table lies between 100 and 450m below the surface. These aquifers are commonly divided into three main aquifers-Basins (Western, Eastern and North-Eastern). The Western and North Eastern basins flow to Israel where it constitutes one of the main groundwater resources.

In Gaza, groundwater resources are contained in a shallow sandy aquifer, extending eastward to Israel and southward to Egypt. There are more than 5000 water wells, most of them are for agriculture purposes with an average depth of 40-70 meters and the water table lies between 20-50m below the ground surface. Gaza is a dry area and the local aquifer recharge is very limited (55-60 Mm^3/year on average). Abstraction by all users (Israelis, Egyptians and Palestinians) already far exceeds natural recharge. Consequently, the aquifer has been depleted and suffers from seawater intrusion.

Aquifer-Basin	Area within Palestine (Km^2)	Average rainfall (mm) 2010/2011	Recharge Volume 2010 /2011 (Mm^3)	Long-term* Average Recharge (Mm^3)
Western Aquifer	1,767	407	311	318-430
Northeastern Aquifer	981	433	134	135-187
Eastern Aquifer	2,896	281	153	125-197
West Bank Total	**5,644**	**347**	**598**	**578-814**
Coastal Aquifer	365	225	33	55-60
Palestine Total	**6,009**		**631**	**633-874**

*Based on the different estimated studies as well as PWA assessment

Source: PWA, 2012c

Table 4. Recharge estimate for the main aquifers.

2.3. Non-conventional resources

Due to the scarcity of water resources (natural scarcity and inequitable sharing of water rights between Palestinians and Israelis), the Palestinian government has already started to focus on the development of non-conventional water resources.

Desalination of sea water

There is only one sea water desalination plant located in the middle area of Gaza Strip (Deir El Balah) with capacity of 600 m^3/day (0.22 Mm^3/year) by using two beach wells and it will be expanded to about 2600 m^3/d (0.95Mm^3/y) by the year 2014. A large sea water desalination plant with a capacity of 50 Mm^3/year, as a first phase, is scheduled to be constructed by year 2017 and to be located in the central part of Gaza Strip, and is to be enlarged to a capacity of 129 Mm^3/year by year 2035. The desalinated water will be mixed with abstracted groundwater and distributed to the consumers through the distribution facilities. By this additional water as well as other water and treated wastewater, it is expected that the coastal aquifer can recover to its original steady state. Generally, the additional desalinated sea water will impact significantly on the water tariff and therefore the distribution system efficiency should be improved to cover the operation and maintenance costs of these new facilities.

Sea water resources are not available for the West Bank, except as part of a long-term strategy of regional water resources management: desalinated water could be conveyed from Gaza to the West Bank or through an equitable agreement with Israel.

Desalination of brackish ground water

Small pilot desalination projects for Brackish Water exist mainly in the Jordan Valley established by the private sector with a total capacity of less than 0.5 Mm^3/year and are used mainly for agricultural purposes. A large facility is planned downstream from the Fashka Springs, near the Dead Sea (with a scheduled production capacity of at least 22 Mm^3/year by the year 2022); this project will increase water supply for the southern Part of the West Bank, and will finally be extended to produce 40 Mm^3/year in the future.

In the Gaza Strip there are about one hundred water vendors selling drinking water produced through brackish water desalination plants with a capacity of 20-40 m^3/day and operated for 4-6 hours/day, with total supplied quantities of 2.8 Mm^3/year However, the actual groundwater abstraction by these plants is about 4.8 Mm^3/year.

More than 80% of the Gaza people use this water for fulfilling their drinking and cooking water needs. The remaining 20% use in-house reverse osmosis units for desalination. In addition, there are 8 groundwater desalination plants operated by the CMWU in the southern parts of the Gaza Strip (Khan Younis- Deir Al Balah and Rafah) whose water is distributed through the domestic distribution networks, which is mixed with well water (with a total capacity of 1 Mm^3/year).

Reuse of treated wastewater

In the Gaza Strip there are different small demonstration reuse activities as a pilot projects in scattered areas with total reuse quantities of around 1 Mm^3/ year. As for West Bank, there are very few activities or projects for reuse (small scale projects on community level are implemented such as Anza, Attil, Kharas). However, some reuse projects are proposed for North-West Nablus, Jericho, Tayaseer and Auja areas in the short-term vision. An additional water resource will become available through the scheduled developments of wastewater treatment plants; this resource is already under development in the Gaza Strip (with a scheduled production capacity of 10 Mm^3/year) in North Gaza. Further developments should be undertaken in both Gaza and the West Bank; this potential resource could be relatively large (see chapter 17.4), but its development raises some important issues that are yet to be resolved.

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2.4. Abstraction from water resources

Groundwater resources have been carefully monitored, assessed and modeled by hydro-geologists over the last 50 years and this has formed the basis for the interim water sharing agreement included in Oslo 2 that extends from 1995 to 2000 (see below)[3].

Use	Oslo Agreement (Mm3)	Utilization 2011(Mm3)

[3] NB: there are some Palestinian reservations on the estimated potentiality, especially for the Eastern aquifer resource.

	Western	NE	Eastern	Total	Western	NE	Eastern	Total
Israel	340	103	40	**483**	≈411	≈103	150***	**664**
Palestine	22	42	54	**118**	25	20	42	**87****
Additional Quantity for Palestinian Development	—	—	78*	**78**	—		0	**0**
Basin Total	**362**	**145**	**172**		**436**	**123**	**192**	

Source: PWA, 2012c

*The 78 Mm^3/year is to be developed from the Eastern Aquifer and other agreed upon sources in West Bank (Oslo II)

**This Number does not include the Water quantity produced by the unauthorized wells

***The 150 includes Dead Sea springs with discharge around 100MCM

Table 5. Water interim allocation for all usages, as per the Oslo 2 Agreement

According to this interim agreement which was expired in 2000, Palestinians should have access only to 118 Mm^3/year (i.e. 18% of the resource), while the current utilization is only 87Mm3/Yr (less that the allocated quantity in Oslo II Agreement). This is clearly insufficient and unfair to meet the West Bank's 2.65 million inhabitants' 2012 demand for water and the water shortage will only increase further with the population growth.

In Gaza, the total groundwater abstracted volume in 2011 for municipal uses was about 92.8 Mm^3 in addition to approximately 86 Mm^3/y for agriculture in addition to 4.2 Mm^3/y supplied by Mekorot and 2.8 Mm^3/y from the groundwater small scale desalination plants, bringing the total supplied volume to about 185.8 Mm^3/y. Comparing needed amount with renewable water from Aquifer in Gaza (55-60 Mm^3/y) , the deficit in water balance reach 120MCM/Yr.

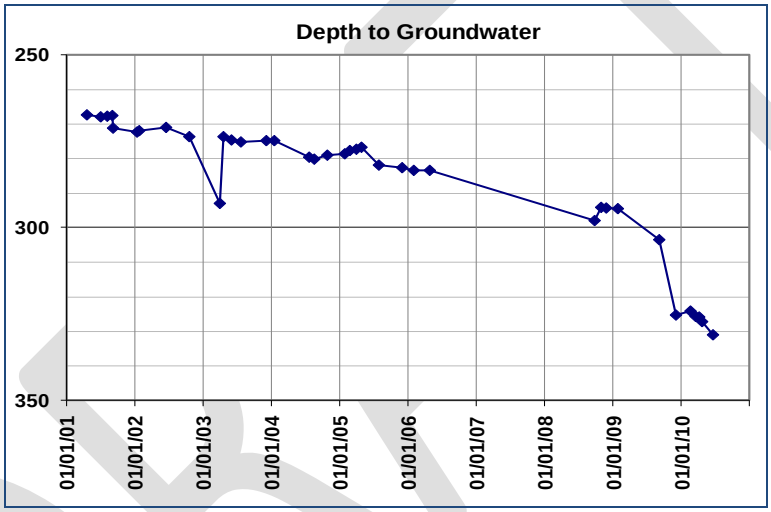
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2.5. Water resources at risk

Groundwater depletion

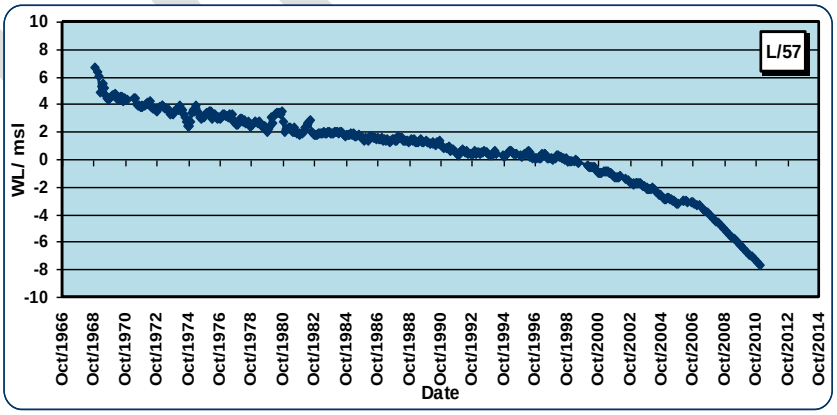
Water abstraction by Israelis already exceeds the thresholds agreed in Oslo and many sub-aquifers are mined and suffer from depletion. This depletion is particularly marked in the southern part of the Eastern aquifer, which is subject to unlimited abstraction by Israeli wells that are significantly affecting the nearby Palestinian wells. In addition, the continuation of severe drought also has a negative impact on the aquifers recharge. As a result the drawdown has been more than 70m in just ten years in some places in the southern part of the West Bank and this constitutes a great threat to the groundwater system in this area (PWA, 2012b).

The costal aquifer is also depleted as a result of un-equilibrium between the total water abstraction and its renewable amount, where the water level has been declining during the last few years to about 10-15 meters below sea level.



Source: piezometer monitored by PWA WR Department

Figure 2. Water level decline trend in Eastern Aquifer



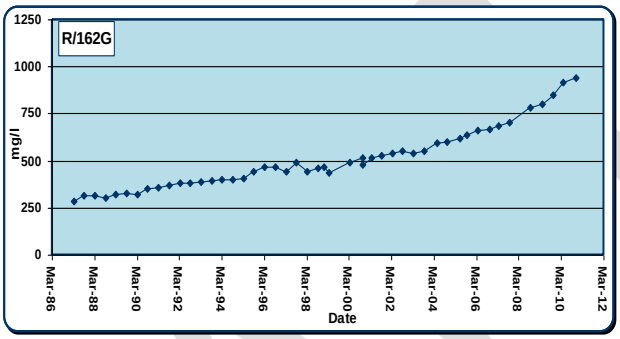
Source: piezometer monitored by PWA Gaza

Figure 3. Water level decline trend in Gaza

Sea water invasion

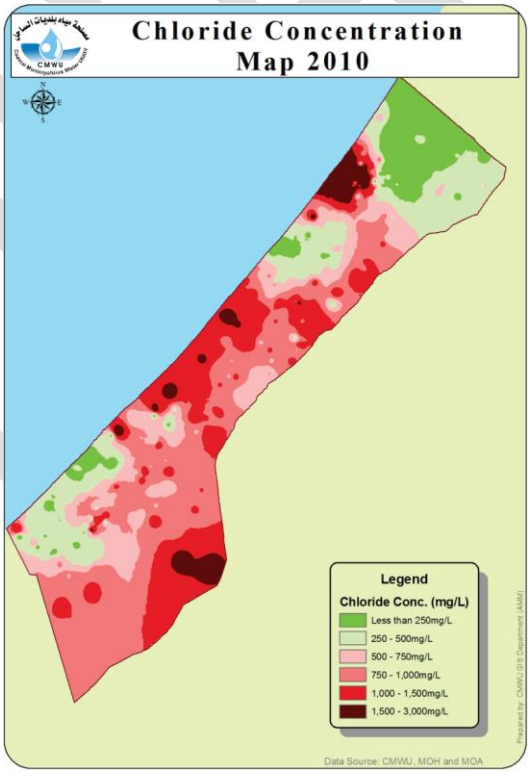
Groundwater depletion in the coastal aquifer has two major negative impacts: (a) seawater invasion of large parts of the inland coastal aquifer and (b) upward leakage of the underneath saline water.

As a result of this, the groundwater salinity has been increasing significantly to unacceptable limits, where more than 90% of the pumped water exceeds the WHO drinking limit (250mg/l) in terms of chloride concentration and it is generally in the range of 200-1000mg/l-Cl with the continuous increase in line with the aquifer depletion. It is expected that the groundwater quality of the coastal aquifer will be beyond the possibilities of use by the year 2016 and the aquifer system is expected to collapse completely by 2020 if no action is taken in terms of additional water resources and integrated water resources management.



Source: piezometer monitored by PWA Gaza

Figure 4. Chloride concentration trend in Gaza

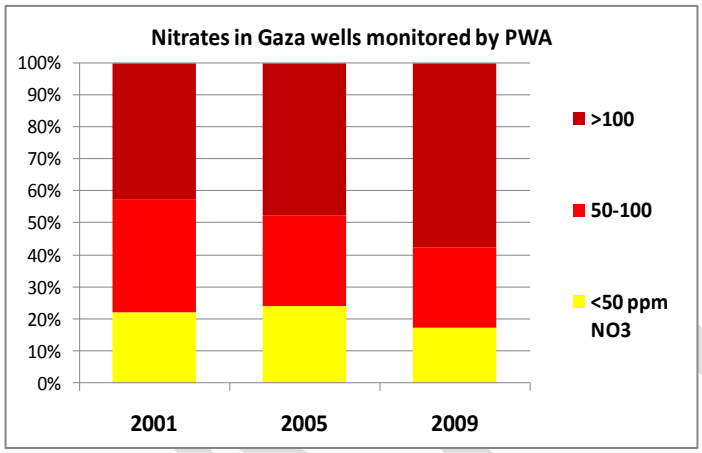


Source: CMWU, 2011

Figure 5. Chloride contour map for Gaza

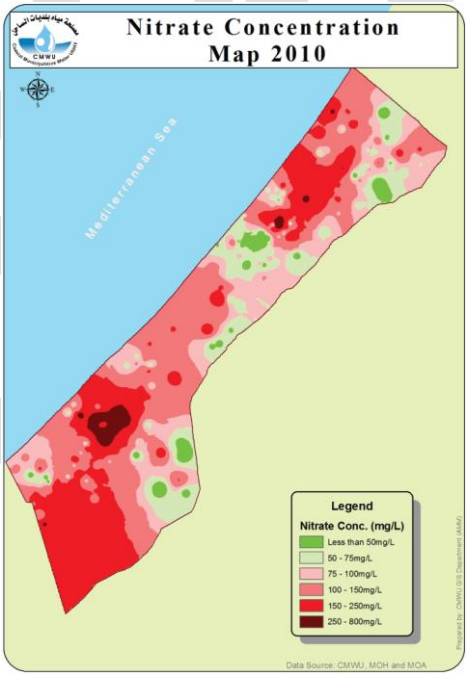
Nitrate pollution of groundwater resources

The population across the Gaza Strip is very dense, and discharge huge amounts of pollutants (organic matter, nitrogen, etc.). While around 70% of the urban area is served by wastewater collection systems, many people are still using cesspits or septic tanks for discharging their raw wastewater. This will negatively impact on the groundwater pollution as a result of the wastewater leakage through the highly permeable unsaturated sandy zone. As recorded, groundwater pollution by nitrates is already widespread in the Gaza Strip and the majority of the wells, utilized for domestic water purposes, contain more nitrates than the WHO-recommended drinking limit (50 mg/l). This percentage is still growing with higher concentrations under urban areas.



Source: TPAT computation from PWA, 2012

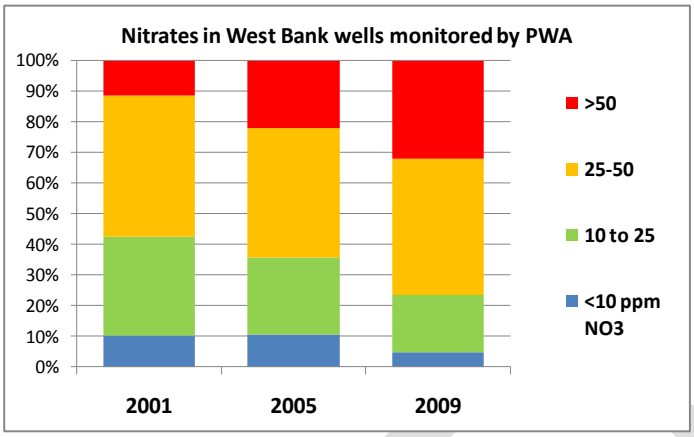
Figure 6 . Nitrate concentration /Gaza Strip



Source: PWA, 2012

Figure 7. Nitrate concentration /Gaza Strip

Although the population density is much lower in the West Bank, the combination of poor wastewater facilities, uncontrolled intensive chemical fertilizers use for agriculture, Israeli wastewater settlement and aquifer vulnerability (karstic aquifers) are causing nitrate contamination levels to rise. Accordingly, urgent mitigation measures and prevention and protection plans are needed.



Source: TPAT computation from PWA data base.

Figure 8. Percentage of wells with nitrates in excess/WB

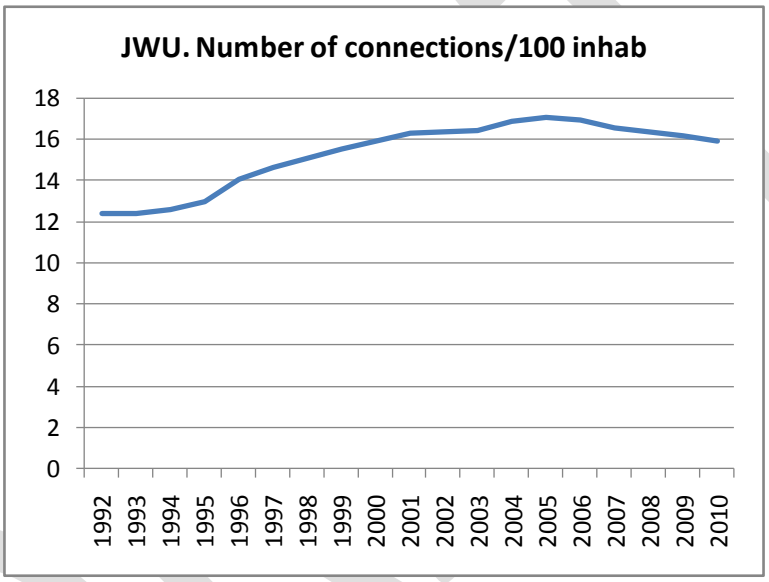
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3. Water services level, coverage and quality

3.1. Service level and coverage

The most common level of water supply service provision in Palestine is an individual household connection to a piped system. Over the last few decades, collective supply points have virtually disappeared and are no longer cited, except in zones where there is no piped water supply.

The connection rate (expressed as the number of connections per 100 inhabitants) has been increasing steadily in all urban areas and currently stands at 14 to 18 connections per 100 inhabitants. As the average household is considered to include 6.5 persons (PCBS estimates), it can be considered that, in urban areas, service coverage through household connections is almost complete and that future growth will be directly dependent on the development of new residential areas and the natural expansion of urban areas.



Data source: JWU web site.

Figure 9. Evolution of the connection rate within JWU service area.

The connection rate does not provide comprehensive picture of actual service coverage, because a significant number of customers with a connection are without a reliable service and are thus obliged to call on tankers to provide them with additional water. Other than the water provided through tankers by the WBWD, this private service delivery cannot be considered covered by the public service.

3.2. Water made available per person

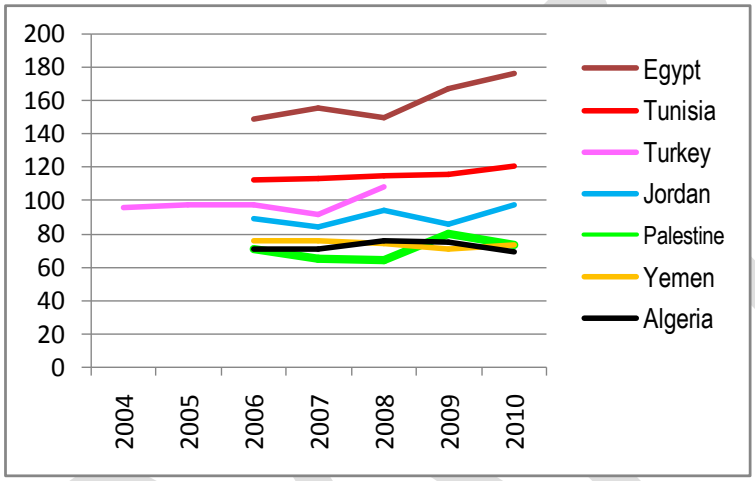
In 2012, the total amount of water consumed in the West Bank and Gaza provides each person with an average of 96 liters per capita per day (lcd) in Gaza (95% of Gaza water with unaccepted quality), 72 lcd in the West Bank with an overall average of 82 lcd. This consumption has decreased over the past 7 years in the West Bank and has shown a slight increase in Gaza.

	2004	2005	2006	2007	2008	2009	2010
Palestine	**85**	**83**	**81**	**83**	**88**	**82**	**82**
West Bank	*80*	*78*	*76*	*79*	*86*	*75*	*72*
Gaza	*91*	*90*	*89*	*88*	*91*	*92*	*96*

TPAT calculations – Various PWA data sources

Table 6. Water made available per person in Palestine (consumption)

The 82 lcd is not a particularly high value[4]. It is one of the lowest ratios in the region, similar to the domestic water provision in Algeria and Yemen, where the water services are generally considered to be poor and unreliable.



TPAT calculations - Data source: IB Net

Figure 10. Water made available per person in selected Middle East countries

3.3. Inequalities among regions

The quantity of water made available to customers varies widely from region to region (Table 7). These quantities reflect the local water resource availability, as well as the investments made over recent years to improve the water service reliability and water quantities in some cities.

The northern and southern parts of the West Bank are particularly affected by a lack of water. This is mainly due to the Israeli restrictions that prevent Palestinians from drilling new wells, rehabilitating existing wells and transporting water from one region to another.

Due to the water scarcity, many communities in the West Bank hire water tankers for their supply. This is reflected in the average tariff per governorate, which is relatively high in Hebron, Jenin and Tubas, i.e. in those governorates where many communities are obliged to use water tankers, with tariff rising up to 20 ILS/m^3, and in some communities even more. The strategy will focus on improving the service provision to these areas.

The majority of those West Bank inhabitants with no piped water supply are located within the following 4 governorates:

- Hebron Governorate, 31 communities (27,551 inhabitants) are still not served by the water supply network and pay very high tariffs for tanker water; the water piped to customers amounts only to 55 lcd;

[4] As an illustration, domestic water distribution in Europe is in the 100 – 150 lcd range; in Israel, it is 250 lcd and in Kuwait, 2,000 lcd.

- Jenin Governorate, 9 communities (19,013 inhabitants) are still without access to the water supply network and pay very high tariffs for tanker water; the water piped to customers amounts only to 41 lcd;
- Nablus Governorate, 16 communities (47,235 inhabitants) are still not served by the water supply network and pay very high tariffs for tanker water; the average water piped to customers at the governorate level amounts to 84 lcd, as Nablus city itself is well serviced
- Tubas Governorate, 8 communities (13,653 inhabitants) are still not served by the water supply network and represents 24.1% of the governorate population.

Governorate	Population	Number of communities	Served communities	Served population	Un-served communities	Un-served population	Un-served population
Jenin	281,158	72	63	262,145	12.5%	19,013	6.8%
Tubas	56,642	19	11	42,989	42.1%	13,653	24.1%
Tulkarem	168,973	35	33	167,880	5.7%	1,093	0.6%
Nablus	348,023	62	46	300,788	25.8%	47,235	13.6%
Qalqilya	100,012	33	32	98,209	3.0%	1,803	1.8%
Salfit	64,615	20	20	64,615	0.0%	0	0.0%
Jericho	46,718	13	13	46,718	0.0%	0	0.0%
Ramallah	310,218	75	74	309,383	1.3%	835	0.3%
Jerusalem	147,489	30	28	145,939	6.7%	1,550	1.1%
Bethlehem	194,095	44	44	194,095	0.0%	0	0.0%
Hebron	620,418	87	56	592,867	35.6%	27,551	4.4%
Total	**2,338,361**	**490**	**420**	**2,225,628**	**14.3%**	**112,733**	**4.8%**
					of communities		of population

Data source: PWA, 2012 b

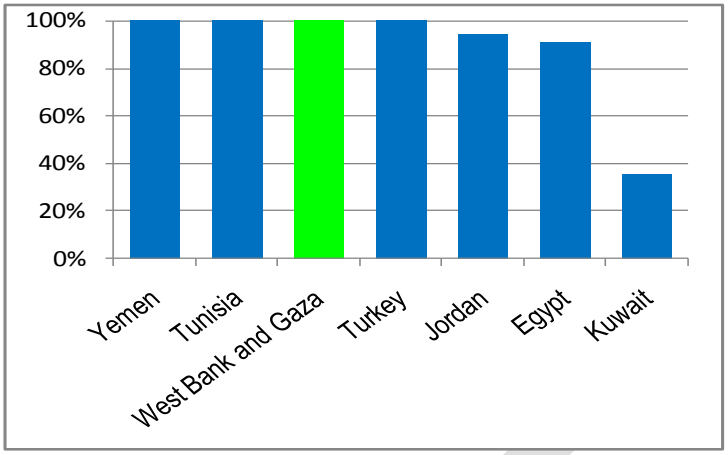
Table 7. Served and unserved communities with population

For the Gaza Strip, most of the water supplied through the network is not suitable for drinking purposes, due its high content of chloride and nitrate (exceeding the drinking limit) and most of the Gaza population depends on the desalinated groundwater for the purposes of drinking and cooking. Such water is distributed by the water vendor with a cost of 40 ILS/m3. The average household (5 persons) consumption of such expensive water is approximately 0.5-1.0 m3/month. Metering

Metering and invoicing, based on meter readings is considered a relevant tool to reduce water wastage and encourage customers to fix leaks and repair their plumbing facilities. In the Middle East, where water scarcity is a serious concern, metering is paramount for ensuring the proper and sustainable management of water resources.

As in most Middle East countries, except for the Gulf countries, where water wastage is not so much considered a crucial issue, most of the water connections in the West Bank and Gaza Strip are metered (fig. 12).

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TPAT calculations - Data source: IB Net

Figure 11. Metering rate in selected Middle East countries

3.4. Pressure and reliability of the service

Most Palestinian localities have no continuous water service. The water operator manages to pipe water to each section of the network for only a few hours per day (or a few hours every two days or even more) and customers have to invest in storage facilities if they wish to have water available at all times. This is the reason why most of the houses in Palestine have roof tanks. However, as there is insufficient pressure in the network, many customers also invest in booster pumps, which they use to fill their roof tanks.

As the network lacks pressure, it becomes very vulnerable to contamination by wastewater infiltration. In addition, intermittent water distribution causes the network to deteriorate at a faster rate which reduces its lifespan. For these two reasons, the strategy includes specific investments to improve pressure management and progressively aims to provide 24/7 service.

3.5. UFW and NRW

Unaccounted for water (UFW) is calculated as the difference between water produced and water billed to customers and is mostly expressed in % of water production. This figure aggregates leakages in the network (transmission and distribution losses) and water that is stolen. UFW estimates are based on production metering and customer metering, as well as on estimation where metering is difficult or inaccurate.

Non-revenue water (NRW) is the addition to UFW of the % of water that has been accounted for, but not billed (e.g. mosque, camps, firefighting, etc.). It is generally slightly higher than UFW and it is expressed in %.

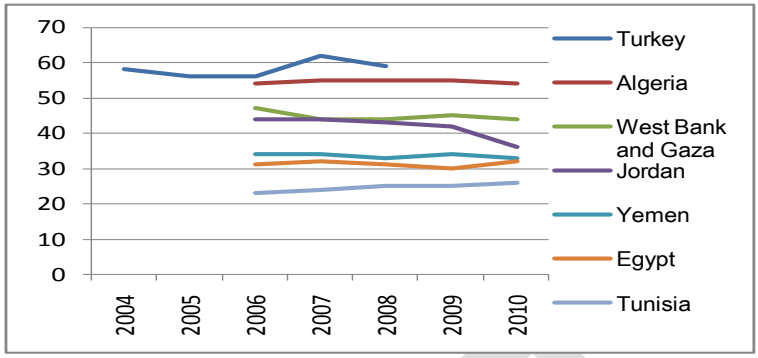
In the West Bank, UFW has been calculated by PWA as in the range of between 24% and 36%..

In Gaza, PWA has calculated that UFW stands at 41 to 46 % which, by international standards, is high for an area that is almost flat. According to CMWU officers, a significant part of this UFW is caused by stolen water, rather than by transmission and distribution losses.

3.6. Collection Rates

In addition to the relatively high UFW figures, most service providers in Palestine suffer from low bill collection efficiencies and NRW is very high. In West Bank the average collection rate is of 65-75%, while in Gaza average collection rate is in the range of 25- 50 %.

When compared with neighboring countries (such as Jordan or Egypt), it is clear that the performances of the country's water providers with regard to NRW are poor (fig.13). For this reason, the strategy includes investments specifically aimed at reducing NRW.



TPAT calculations - Data source – IB Net

Figure 12. Average NRW ratio for Middle East countries

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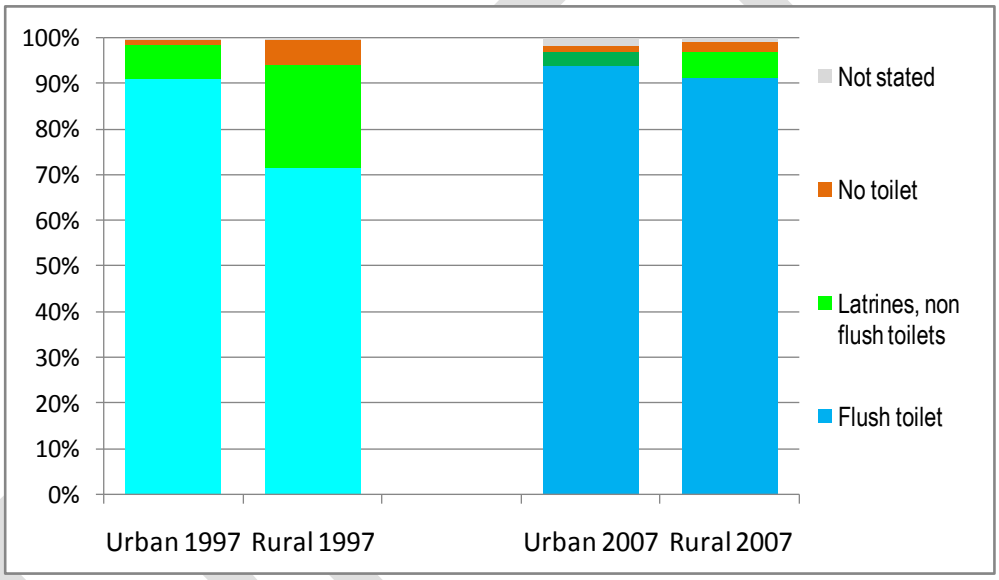
4. Wastewater services organization, coverage and quality

4.1. Household level of sanitation facilities

The Millennium Development Goals (MDG) Joint Monitoring Program, led by WHO and UNICEF (JMP, 2012b), classifies households into 3 types of sanitation facilities:

- households using flush-toilets, considered the best standard of service;
- those using non-flush toilets (i.e. latrines); and
- those without the use of toilets.

According to the PCBS census (1997 and 2007), a very large majority of households use flush toilets (93%), and this percentage remains high even in rural areas (91.1%). The level of these facilities among rural households grew significantly over the 1997-2007 period and has continued to rise ever since.



TPAT calculation. Data source: JMP (2012b).

Figure 13. Percentage of household with different standards of sanitation facilities by 2007

(1997 data are provided for comparison)

4.2. Sewerage

Localities with sewerage

The PCBS information portal (PCBS. 2012b) reports that 61% of households are living in localities where sewerage services are available (92% in Gaza and 41% in the West Bank).

Governorate	Sewered localities	Population 2010 in sewered localities	Unsewered localities	Population 2010 in unsewered localities	% popul. In non sewered localities
Palestinian Territory	**94**	**2,433,661**	**463**	**1,577,799**	**39%**
West Bank	**71**	**1,022,821**	**453**	**1,453,519**	**59%**
Bethlehem	8	85,688	37	101,195	54%
Hebron	4	210,552	88	405,543	66%
Jenin	3	61,468	77	220,888	78%
Jericho and Al Aghwar	0		14	45,433	100%
Jerusalem	24	261,618	20	81,680	24%
Nablus	12	153,617	52	153,098	50%
Qalqiliya	5	59,343	29	49,066	45%
Ramallah and Al-Bireh	9	99,009	66	204,720	67%
Salfit	1	9,313	19	53,824	85%
Tubas	0		21	54,765	100%
Tulkarm	5	82,213	30	83,307	50%
Gaza Strip	**23**	**1,410,840**	**10**	**124,280**	8%
North Gaza	5	297,269	0	0	0%
Gaza	4	531,414	1	3,144	1%
Deir AL-Balah	10	217,856	1	5,010	2%
Khan Yunis	2	194,157	6	97,580	33%
Rafah	2	170,144	2	18,546	10%

TPAT calculation. Data source: PCBS, 2012b

Table 8. Sewerage coverage in Palestine.

The population living in localities with no sewerage (39% of the country's population) relies on on-site sanitation systems (septic tanks, cesspits, pit latrines, etc.).

In the border regions of the West Bank, some Palestinian villages are connected to the Israeli wastewater treatment systems.

The % of the population living in localities with sewerage is particularly low in rural areas, but is also low in some large urban areas, such as Jericho and Tubas. In general, these figures are much lower in the West Bank (41% of the total population lives in localities with sewerage) than in the Gaza Strip (92%).

Population connected to sewers

Not all of those households living in localities that have a sewerage system are connected to the sewers and the overall connection rate (% of connected households) is lower than the % of the population living in localities with a sewerage system.

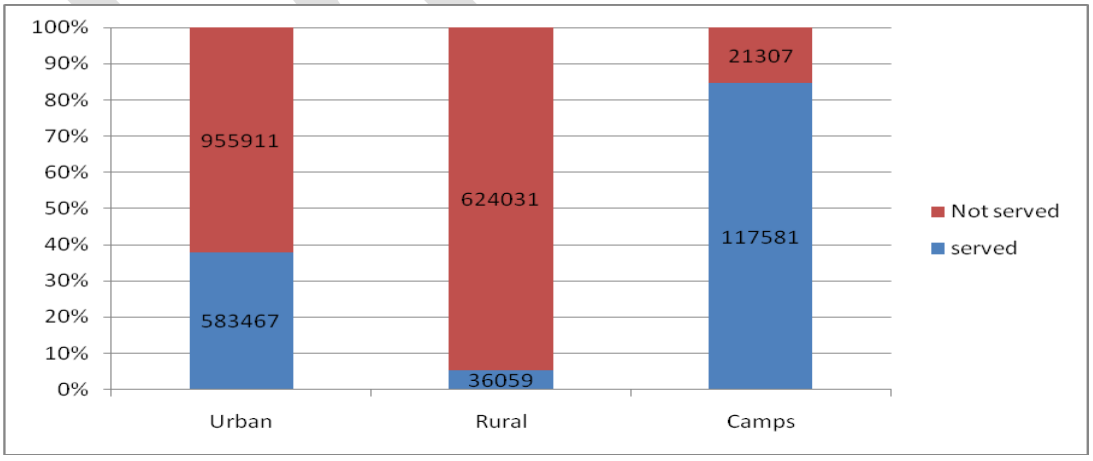
According to a PWA survey, around 46% of the total population of the occupied Palestinian State was served by conventional sewage networks (31% of the West Bank population and 72% of the population in the Gaza Strip).

Governorate	Population	Population connected to sewerage network	Population not connected to sewerage network	percentage connected to sewerage network	Percentage not connected to sewerage network
Jenin	281,158	43,861	237,297	15.6%	84.4%
Tubas	56,642	1,076	55,566	1.9%	98.1%
Tulkarem	168,973	72,996	95,977	43.2%	56.8%
Nablus	348,023	180,276	167,747	51.8%	48.2%
Qalqilya	100,012	50,906	49,106	50.9%	49.1%
Salfit	64,615	6,655	57,960	10.3%	89.7%
Ramallah	310,218	78,485	231,733	25.3%	74.7%
Jericho	46,718	0	46,718	0.0%	100.0%
Jerusalem	147,489	50,441	97,048	34.2%	65.8%
Bethlehem	194,095	81,908	112,187	42.2%	57.8%
Hebron	620,418	170,615	449,803	27.5%	72.5%
TOTAL	**2,338,361**	**737,220**	**1,601,141**	**31.53%**	**68.47%**

Source: PWA, 2012 d

Table 9. Population connected to sewage network by governorate in West Bank.

The percentage of the population connected to sewage networks varies also according to the type of locality (urban, rural or refugee camps).



Source: PWA, 2012d

Figure 14. Population served and un-served by locality type in West Bank

In Urban areas; Hebron, Nablus, Jenin, Tulkarem, Ramallah and Al Bireh have either totally or partially wastewater networks. Jericho and Tubas still lack wastewater collection networks.

United Nations Relief and Works Agency for Palestine Refugees (UNRWA) has constructed wastewater networks in the majority of the West Bank camps, such as Jenin, Balata, Askar, Jalazoun, Dheisheh, etc. while wastewater collection services are still unavailable in the Jericho camps (As-Sultan and Aqbat Jabr). Overall, wastewater network services are provided to 85% of the refugee camps. Of the served refugee camps, more than 95% of them are connected to a sewage network, while in the Gaza Strip, all refugee camps are served by sewerage networks.

In the rural population of the West Bank, which accounts for 28.5% of the total population, less than 30 towns or cities are connected in part to a piped sewage network. Other communities discharge their wastewater into unlined cesspits.

Around two thirds (72%) of the population in the Gaza Strip is served by sewage network system and the remainder disposes its raw wastewater into cesspools, open drains and vaults. Khan Younis Governorate in the south of the Gaza Strip represents the poorest area in terms of wastewater collection as well as poor treatment and infrastructure. It is estimated that the coverage of the wastewater network in the Northern area is around 80%, Gaza City around 90%, the Middle area 75%, Khan Younis 40% and Rafah 75%.

4.3. Management arrangement for sewers and WWTPs

In West Bank

In most cases, municipalities are presently in charge of:

- investing in new sewers or extensions (with PWA support);
- maintaining the sewers (cleaning services); and
- connecting houses.

Large municipalities and utilities such as WSSA, Nablus Hebron, Ramallah, Jenin, Al Bireh and Salfit municipalities are operators, being responsible for sewerage interims of operation, maintenance and expansion. It is worth mentioning that the JWU will take over this responsibility soon.

In Gaza

The main water operator (CMWU) and the municipal departments are in charge of sewerage and WWTPs for the Gaza Strip:

- house connections,
- operation and maintenance of sewers and WWTPs, and
- investments (with support from PWA).

The sewerage fee is charged by the CMUW and municipalities as part of the water bill.

4.4. On-site sanitation

Type of frequently utilized on-site facilities

In the areas not connected to the sewer network, wastewater is discharged into on-site sanitation systems (septic tanks, percolating cesspits) or/and in wadis.

In the West Bank, an estimated number of 41 Mm^3 of wastewater is infiltrated into cesspits (PWA Annual Status Report, 2011).

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In the Gaza Strip, around 8.4 Mm^3/yr is directly infiltrated into the groundwater, in addition to the 35 Mm^3/year that is collected by sewers and disposed into the sea after partial treatment.

Constraints and impacts

On-site sanitation facilities (especially septic tanks) can be efficient to remove biological contamination (bacteria, viruses); however, the exact level of efficiency is dependent on both the facility's design and the final infiltration device. If the tanks are not waterproof, wastewater can contaminate groundwater resources, especially in limestone and sand areas.

Moreover, septic tank efficiency for removing nitrogen and phosphate is generally very low. This means that most nitrogen and phosphate will ultimately infiltrate in the groundwater.

Sludge removal and treatment

In areas not connected to the sewer network, wastewater is discharged into percolating pits. Cesspits are emptied by vacuum tankers, which usually dump their contents in open areas, valleys, sewage networks and/or dump sites (Palestinian Hydrology Group: Palestine Water for Life Campaign 2006, quoted by Görlach et al. 2011). The existing WWTPs have not been designed to specifically treat the sludge collected from septic tanks, but some treatment plants accept these trucks, like e.g. the Al Bireh WWTP.

Most vacuum trucks are owned by small private companies.

4.5. Wastewater treatment plants

WW production and collection by sewers

In 2005, around 66 Mm^3 of wastewater was generated in the occupied Palestinian State, of which 36 Mm^3 was produced in the West Bank and 30 Mm^3 in the Gaza Strip. Only about 35.5 Mm^3 of wastewater, or 55.3% of the total wastewater volume produced in 2005, was collected by the sewage networks (ARIJ, 2007, quoted in Görlach et al. 2011).

More recently, the wastewater quantities generated in the West Bank have been estimated at approximately 62 Mm^3/yr (table.10), including municipal, Industrial wastewater, in addition to the 35 Mm^3/yr of untreated wastewater which was discharged by settlements and industrial zones into the West Bank environment (PWA, 2012d). The total collected quantities from the sewerage networks is either treated in Palestinian central treatment plants like Al-Bireh or small collective treatment plants like Zeita and Attil. Wastewater is also dumped into surface water streams (wadis) and then either treated in Israeli treatment plants like in Jenin, Tulkarem, West Nablus, Beit Jala, and Hebron, or disposed into wadis.

In 2011, around 15 Mm^3/yr of the wastewater collected from several areas is dumped in wadis, and subsequently treated by Israeli WWTP's inside the green line. At the expense of the Palestinian people, these treatment costs are directly deducted, every month, by the Israeli government from the Palestinian clearance account without any positive valuation of the treated waters. Moreover, this water is reused by the Israelis.

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Governorate	Total generated into Wastewater (Mm^3/yr)	Wastewater flows into Israel (Mm^3/yr)	Wastewater flows into Wadi (Mm^3/yr)	Wastewater flows to Treatment Plant (Mm^3/yr)	Wastewater into Cesspits (Mm^3/yr)
Jenin	3.99	1.1	0	0	2.9
Tubas	1.05	0	0.11	0	0.94
Tulkarem	3.64	1.46	0	0	2.18
Nablus	10.5	4.02	3.21	0	3.27
Qalqilya	3.29	2.19	0	0	1.1
Salfit	1.75	0	0.29	0	1.46
Ramallah	12.32	0.8	0.44	1.83	9.25
Jericho	2.66	0	0	0	2.66
Jerusalem	3.29	0.4	0.26	0	2.63
Bethlehem	7.91	1.17	1.64	0	5.1
Hebron	12.11	3.83	0.42	0	7.86
TOTAL	**62.51**	**14.97**	**6.38**	**1.83**	**41.17**

Source: PWA, 2012d

Table 10. Estimates of generated wastewater in the West Bank

In Gaza Strip, the collected wastewater through the sewage network system is pumped to five wastewater treatment plants (WWTPs).

Governorate	Coverage %	Wastewater generated Mm^3/Yr
North Area	80	8.40
Gaza	90	21.90
Middle area	75	3.65*
Khan Younis	40	3.65
Rafah	75	3.65
TOTAL	**72**	**41.25**

*** no treatment in the Middle area and the WW is diverted to the Wadi Gaza**

Table 11. The coverage of wastewater network and generated wastewater in Gaza Strip, 2011

Actual treatment capacity

The wastewater treatment infrastructure in the West Bank is clearly unable to handle the amount of wastewater collected.

Wastewater from Palestinian cities has been and is still discharged into wadis and natural waterways. In some cases, water even flows inside of the green line, where it is collected and treated in treatment plants built originally to treat Israeli Wastewater or plants build specifically to treat the Palestinian wastewater crossing the border. Examples of this are Yad Hanna WWTP that was built in Emek Hefer in 2003 to treat wastewater from Tulkarem and West Nablus. Shoket WWTP that was built in 2009 to treat wastewater flowing from Hebron. Those two treatment plants were financed by deducting funds from the Palestinian tax money collected by Israel.

Three wastewater treatment plants have been constructed in Tulkarem, Jenin and Ramallah. These primary treatment lagoons have formed the only significant wastewater treatment in recent years. The ponds were built in the mid-1970s and have not been improved or upgraded until the advent of

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the Palestinian National Authority and the creation of the PWA in 1996. Despite the increase in wastewater quantities flowing into those ponds and plants, they were all operating beyond their maximum capacities. The result of this was that partially treated wastewater was being discharged in areas surrounding these plants, which has led to multiple environmental and sanitary problems.

There are three central wastewater treatment plants located in Al-Bireh, Ramallah, and Jenin cities in addition to the Tulkarem pre-treatment wastewater plant. Al-Bireh treatment plant was built in 2000 and has a treatment capacity of up to 2-5.5 Mm^3/day (table.12).

The largest Palestinian wastewater treatment plants are located in the Gaza Strip, more specifically in Beit Lahiya, Gaza and Rafah. The existing plant in Khan Younis only has a collection pond with partial treatment. There is no treatment facility in the Middle area and a total of 3.7 Mm^3/Y of raw wastewater is diverted to the Wadi Gaza. The total amount of treated wastewater (treated partially) from Gaza, Khan Younis, and Rafah WWTP's are discharged to the sea is approximately 30 Mm3/Yr. Around 8.4 Mm^3/y of partially treated wastewater in the Beit Lahia WWTP is infiltrated into the groundwater. Accordingly the wastewater flow in the entire Gaza Strip is around 42Mm^3/Yr.

All the existing WWTPs in the Gaza Strip are functioning at moderate efficiency rates (45-70%); they also operate above their actual capacities and are in need of upgrading and maintenance. As shown above, 71% of all the partially treated wastewater in the Gaza Strip is discharged in to the environment (Wadi Gaza and the sea).

The total WWTP capacity is much more limited in the West Bank. The five WWTP described in the table below have a total capacity of 12,000 m^3/day (= 4.5 Mm^3/year), however two are out of order. The actual treatment capacity is less than 10% of the wastewater from the sewer system

Name	Population served	Capacity (m^3/day)	Inflow (m^3/day)	Construction date	Type of treatment	Efficiency %
West Bank						
Al-Bireh	50000	5,750	5,000	1998	single stage activated sludge	95
Ramallah	25000	1400	2,400	1970's, rehabilitated 2002-2003	Aerated lagoons	30
Jenin	40000	9250	3,000	1970's, rehabilitated 2011-2012	Aerated lagoons	Not working-under rehabilit.
Tulkarem	75000	15000	4,000	1970's, rehabilitated in 2004	Aerated lagoons	20
Gaza						
Beit Lahiya	236,298	12,000	23,000	1976	Stabilization ponds and aerated lagoons	70
Gaza	446,416	70,000	60,000	1977	Anaerobic ponds followed with bio-towers	60
Middle area*	NA	NA	> 10,000*	1998	Without treatment	NA
Rafah	150,725	12,000	10,000	1983	Anaerobic ponds followed with bio-towers	45
Khan Younis	200,000	10,000	> 10,000	2007	Anaerobic lagoons followed by aerobic lagoon	45

*Wastewater generated without treatment

Sources: PWA, 2012 d

Table 12. Main WWTP in the Gaza Strip and West Bank

Capacity and outlook of scheduled WWTP

Most municipalities, in cooperation with the Palestinian Water Authority (PWA), have been and are planning to set up many new wastewater treatment plants. Treatment plants construction is ongoing for Nablus West, Jericho and also 5 WWTPs for small communities (EU funded). Others are already funded (Tayaseer and Ramallah), and still others are partially funded such as Hebron and Nablus East

However, the instability of the situation, along with other political and social factors, has delayed and even frozen the development of many all planned wastewater treatment plants (HWE).

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Part 3.2. Demand for water and wastewater services

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5. Long-term and short-term perspectives

5.1. The long-term perspective

The long-term water and wastewater sector strategy is designed for a fully independent Palestinian State. This vision has many practical implications for the strategy. Under this scenario:

- Palestinian people will recover their full rights over natural water resources according to the 1967 border, including East Jerusalem (surface water from the Jordan River Basin, as well as groundwater in the West Bank and the Gaza Strip); it will provide Palestinians with a significantly increased volume of water, enabling water service improvements to be implemented for domestic customers and the development of economic activities that require water (agriculture and industry);
- Palestinian people will recover their full access to irrigable land, especially in the Jordan Valley, where the potential for profitable irrigated agriculture is very high;
- The Palestinian administration (at the central and local level) will be fully entitled to plan and implement all necessary water and wastewater facilities (wells, storage tanks, water and wastewater networks, wastewater treatment plants, etc.) in accordance with their own strategic plans;
- The importation of hydraulic equipment will no longer be restricted;
- The JWC will be replaced by co-operation mechanisms that will be designed to ensure the sustainable management of trans-boundary water resources by Palestine and neighboring countries (Israel, Lebanon, Syria, Jordan) based on equitable utilization of the shared water resources.

5.2. Long-term strategic objectives

The national strategy for the water and wastewater sector is based on planning for the State of Palestine. Palestinians will attain their full water rights and hence current restrictions on water use will be alleviated. This would entail improvements in the service provided to customers (hours of service, pressure, water quality), as well as service coverage being expanded to include those localities that are not currently connected to the water supply network, in addition to improve the wastewater services to include collection, treatment, disposal and reuse.

The strategy will be designed to achieve a set of strategic quantitative objectives, as defined in the next chapter.

In the event of not being able to settle a final agreement with Israel on the final status (independent situation), there will be no possibilities to implement the long-term water strategy objectives and it will have a very negative impact on the water situation in the Palestinian territories, which will give right to announce these territories as water disaster areas.

5.3. Short term implementation plan

In the present situation, PWA and service providers face a number of additional constraints linked to the Israeli military occupation (difficulties and restrictions accessing land and water resources, abnormal delays and difficulties importing equipment, etc.), and permitting constructions for wastewater treatment plants, especially in Area C.

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In view of these constraints and restrictions, the short-term implementation plan includes only investments, water resources management and actions that can be completed within the present political situation (taking the military occupation-related constraints into account). As soon as these constraints have been removed, the implementation plan will be revisited and updated to match the long-term strategy.

Under the current situation, only few additional water resources will become available to meet the growing demand of Palestinian citizens, farmers and industries. For this reason, the Palestinian Government will invest in coping strategies: UFW reduction programs, drilling new wells and/or rehabilitating existing wells, water conservation, water harvesting, desalination of brackish springs, treated wastewater reuse for irrigation, improving irrigation efficiency, evolving the crop pattern.

Sub-scenarios have been further developed for the West Bank and the Gaza Strip, as the context and constraints of the two regions are very different.

The first implementation plan (investment and action plan) will be designed to cover the next five years (2013-2017) but can be updated at any time, as and when the political situation evolves.

An overlapping period of some years is also to be considered to manage the transition period between the current situation and Independence.

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6. Synthesis of strategic objectives

6.1. Aims of the strategy

The strategy aims to improve the water and wastewater services provided to Palestinian citizens over the next 20 years. For this reason, the criteria used to design the strategy have been defined from the customers' / citizens' point of view:

- Increasing the quantity of water delivered to customers;
- Maximizing the volume of water made available for irrigation;
- Providing all citizens with good access to a reliable source of water, with an affordable tariff, in particular for the poorest families;
- Reducing inequalities among regions and localities;
- Improving the quality of the water delivered to customers;
- Improving the sanitation to protect the natural water resources from pollution and excessive depletion;
- Improving the quality and reliability of the service;
- Managing the water resources in sustainable and environmental manner
- Protecting the water resources
- Ensuring the financial sustainability of water operators;
- Maximizing the benefits of irrigation (crops, jobs, revenue);
- Facilitating the development of industry.

6.2. Sector performance indicators

The strategy has been defined through a set of quantitative objectives that reflect the improvements made to the water and wastewater services delivered to customers. Such quantitative objectives will make it possible to: (a) evaluate the progress made towards implementing the strategy over the next 20 years and (b) estimate the level of investment required for strategy implementation.

The objectives (and relevant performance indicators) have been selected to provide a comprehensive description of the sector from the customers' viewpoint (i.e. output based), rather than from the point of view of planners (i.e. input based).

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Aims of the strategy	Performance indicator	Comments
Increasing the quantity of water delivered to customers	Volume of domestic water available at tap (expressed in liter per day per capita)	This amount of water includes domestic, small shops, schools, administration, i.e. all customers excepting irrigation and industries supplied by they own
	Volume of water made available for industry	According to comparison with neighbors
	UFW	Expressed as a % of domestic + industrial WS
	Water produced through various sources (groundwater, desalination, import)	This objective will be reached through two complementary activities: increasing production and reducing UFW
Maximizing the volume of water made available for irrigation	volume of water made available to farmers	Other indicators (such as irrigation efficiency, revenue per dunum,…) will be defined by MoA and are not included in the Water sector Strategy
Providing all citizen with a good access to a reliable source of water	Number of un-served communities	A community (> 100 persons) is considered as served when it gets piped water supply + house-connection for all households ready-to-pay for this service
	Number of connection per 100 inhabitants	no comment
	Number of working house-connection	% of household has been proposed as an alternative indicator, but it requires comprehensive house-hold surveys, that are beyond the capacities of water operators
Reducing inequalities among regions and localities	Inequalities regarding access to water	Minimal volume of water available at tap (expressed in liter per day per capita) in each Governorate
	Inequalities regarding water tariff	Range of average tariff among water service operators
Improving the quality of the water delivered to customers	% of samples containing free chlorine residual	Samples must be collected at the level of the end-user. Intermediate measures are used for monitoring purposes but not included into the final calculation.
	% of samples free from total coliform contamination	
	% of samples free from fecal coliform contamination	
	% of samples with < 50 ppm nitrate	
	% samples with < 1000 TDS	
Improving the wastewater to protect the natural water resources from pollution by wastewater	% of households connected to a sewer or a satisfactory on-site sanitation device (septic tank + infiltration bed)	no comment
	% of sewered water that is treated in a WWTP	no comment
	WWTP average efficiency regarding BOD, COD, TSS	Calculated as the % of pollutant removed
	WWTP average efficiency regarding nitrogen	
	% of treated wastewater that is reused for irrigation	Taking into account that irrigation is seasonal
Improving the reliability of service	% of customers getting water everyday	These customers can use roof tanks to improve their level of comfort if water is not flowing 24h
	% of customers benefiting 24h service	24h pressure is the best protection against pollution and will be facilitated by larger storage capacities
Ensuring financial sustainability of water operators	% of operators operating independently (autonomous)	autonomy (regarding accounts and staff) is a pre condition to financial sustainability assessment
	% of metered connections	as a prerequisite to monitor UFW
	working ratio = Operation & Maintenance (O&M) costs and Administrative costs (Excluding depreciation) / Operating revenue.	this calculation does not include depreciation, whose value is subject to too many manipulations. For this reason, a sustainable operator needs to have a working ratio between 130 and 150% (depending of the facilities he is supposed to replace after a while)
	collection efficiency	is the % of bills paid in less than 12 months
Strengthening the foundations of good	New Water Law enacted, implemented	Separating the ministerial, regulatory, development and service functions

governance and the legal and institutional framework	PWA restructured, functional, capacities developed	To include water sector legislation, policy, strategy, planning and WRM regulatory functions
	Water Regulatory Council established, functional, capacities developed	New organization to regulate water and wastewater service providers
	National Water Company established, functional, capacities developed	Successor organization of WBWD
	JSCs/Regional Water Utilities established, functional, capacities developed	Aggregated organizations of several municipal departments (at Governorate level)
	IWRM effectively implemented at sub-national level	
	Relevant water regulations approved, enforced	Covering WRM, WS, WW, WW-reuse sub-sectors

Table 13. Aims of the strategy and type of performance indicators

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6.3. Strategic objectives for 2032

The strategic objectives have been fixed, taking into account the following hypothesis:

- Palestinians will get full rights of access and use of land based on the 1967 border and to their rights on water resources based on international law. Consequently, the amount of water made available for the country will be much greater than at present;
- the Palestinians will succeed in negotiating fair water sharing agreements with neighboring countries, for trans-boundary water resources (Jordan River, Gaza Wadi and groundwater); and
- the population will increase dramatically, because of demographic expansion plus many returnees coming back to the country.

The strategy developed under this scenario is ambitious in terms of both the service provided to citizens (quantity and quality of water) and economic development (irrigation and industry). It is based on:

- the equitable sharing of trans-boundary water resources (groundwater and rivers) with neighboring countries (Jordan, Syria, Lebanon, Israel and Egypt);
- the optimal use of all available water resources, from both an environmental, economic and social perspective (health, revenue, jobs); and
- the sustainable use of these resources (voluntary limited rate of abstraction and resource protection).

The strategic objectives have been translated in figures, according to the set of selected performance indicators and each performance indicator has been fixed separately for the Gaza Strip and for the West Bank (table.14).

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Aims of the strategy	Objective indicator	Strategic objectives for 2032		Comments
		Gaza	West Bank	
Increasing the quantity of water delivered to customers	water available per person (lcd)	120	120	this ratio (120 lcd) is similar to the ratio observed in modern European countries.
	water available for industry, expressed as a % of domestic WS	7%	7%	similar to the ratio observed in neighboring countries (Jordan, Lebanon, Israel, Egypt)
	UFW (%)	20%	20%	this objective is ambitious, but unavoidable in the water scarcity situation of Palestine. UFW reduction is considered as a cost-effective source of water.
	groundwater (Mm^3/year)	38	234	this volume has been calculated as the difference between the water demand and the volume of water provided by import and desalination
	desalination (Mm^3/year)	129	40	In the West Bank, desanitation capacities are almost limited to Fashka springs. In Gaza, they are limited by the investment capacity of PA.
	import (Mm^3/year)	14	120	In the Gaza Strip, the objective is to replace import by local production (desalination). In the West Bank, import will increase significantly, as desalination opportunities are limited.
	Total	**181**	**394**	
Maximizing the volume of water made available for irrigation	water made available (Mm3/year)	67	479	Other indicators (such as irrigation efficiency, revenue per dunum,...) will be defined by MoA and are not included in the Water sector Strategy
Providing all citizen with a good access to a reliable source of water	number of un-served communities	0	0	A community (> 100 persons) is considered as served when it gets piped water supply + house-connection for all households ready-to-pay for this service
	number conn./100 inhab	20	20	See detailed calculations in next chapter
	number of connections	600 000	1 309 000	
Reducing inequalities among regions and localities	water available per person (lcd): minimal average per governorate	84	84	This minimal volume per capita in each Governorate as be calculated as 70% of the national average
	range of tariff	200%	200%	this range means that the highest water tarif in the country is not more than twice the lowest tarif

Table 14. Strategic objectives for 2032

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Aims of the strategy	Objective indicator	Strategic objectives for 2032		Comments
		Gaza	West Bank	
Improving the quality of the water delivered to customers	% with free chlorine	100%	100%	this objective is already almost reached
	% free from total colif.	100%	100%	this objective is already almost reached
	% free from fecal colif.	100%	100%	this objective is already almost reached
	% of customers serviced with < 50 ppm nitrate	90%	100%	As most groundwater contain > 50 ppm nitrate in the Gaza Strip, it will be difficult to serve 100% of Gaza communities with < 50 ppm nitrate
	% of customers serviced with < 1500 ppm TDS	100%	100%	this objective will be reached in Gaza with the development of desalination plants
Protecting the natural water resources from pollution by wastewater	% households connected to sewer	95%	75%	
	% sewered water that is treated	95%	80%	
	Average WWTP % efficiency for DCO, DBO, MES	90%	90%	
	WWTP % efficiency for N	50%	50%	
	% treated WW reused for irrigation	50%	60%	See chapter 17
Improving the quality and reliability of the service	% of serviced customers every day	100%	100%	
	volume of storage expressed in hours of supply	10	10	the volume of storage (expressed in hours of supply) is a key factor of good management of pressure and reliability of chlorination
Ensuring financial sustainability of water operators	% of autonomous water utilities	100%	100%	all operators will be independant from municipalities (this has no implication on their public or private status)
	% of metered connections	100%	100%	this objective is already almost reached
	working ratio = Costs (excluding depreciation) / operating revenue	130%	150%	this ratio means that utilities are financiallly autonomous
	collection efficiency	95%	95%	
Strengthening the foundations of good governance and the legal and institutional framework	New Water Law enacted, implemented	100%	100%	
	PWA restructured, functional, capacities developed	100%	100%	

	Water Regulatory Council established, functional, capacities developed	90%	90%	
	National Water Company established, functional, capacities developed	80%	80%	
	JSCs/Regional Water Utilities established, functional, capacities developed	80%	80%	
	IWRM effectively implemented at sub-national level	100%	100%	
	Relevant water regulations approved, enforced	100%	100%	

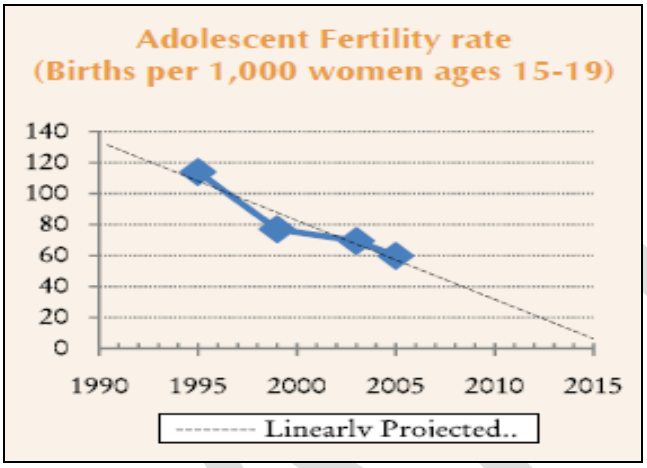
Table 15. Strategic objectives for 2032 (continued)

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7. Population growth

7.1. Hypothesis

The population of Palestine has been increasing at a very high rate for the last ten years: 3.5 %/year (PCBS, 2010). The growth rate will remain very high over the coming years, but is expected to slow down slightly as a result of changes in education and family structure, as has been observed in other Mediterranean countries. A clear illustration of this trend is the decrease in the fertility rate among young women over the past decade (Figure 15).



Source: MDG Progress Report, MoPAD, 2010.

Figure 15. Adolescent fertility rate in Palestine

7.2. Demographic trends

For the purpose of the water sector strategy, a demographic projection has been made, which includes:

- a progressive decrease from the present growth rate to a more modest rate by 2032; and
- a dramatic inflow of Palestinian returnees as a consequence of a final agreement with Israel.

These figures are based on MoPAD demographic projections for the period 2007-2050. In this document, , and based on the discussions between MoPAD and PWA, two of these 5 scenarios were considered most relevant for the development of the national water strategy (so-called scenario 4 and 5), as shown in Table 16.

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Palestine population projections used for the water sector strategy

	Source: MopAD	2012	2017	2022	2027	2032
Scenario 4	West Bank with scen 4	2,649,020	3,459,901	4,674,040	5,563,943	6,333,980
Scenario 4	Gaza Strip with scen 4	1,644,293	2,007,780	2,406,429	2,794,534	3,221,051
Scenario 4	**Palestinian Territory**	**4,293,313**	**5,467,681**	**7,080,469**	**8,358,477**	**9,555,031**
Scenario 5	West Bank - scen 5	2,649,020	3,473,267	4,742,596	5,713,113	6,548,006
Scenario 5	Gaza Strip - scen 5	1,644,293	1,994,680	2,339,313	2,645,554	3,002,518
Scenario 5	**Palestinian Territory**	**4,293,313**	**5,467,948**	**7,081,910**	**8,358,667**	**9,550,523**

Table 16. Demographic hypotheses (MoPAD).

These two scenarios have been used for demographic projections at the regional level (the Gaza Strip and the West Bank). In both cases, total population increases from 4.29 million inhabitants in 2012 to 9.55 million inhabitants in 2032. The main difference between the two scenarios is the number of people moving from one region to another (Gaza to the West Bank and vice versa). These migration flows will become easier to materialize within the State of Palestine (people will no longer be constrained by closure of the Gaza Strip), but it is not easy to predict how many households will actually move and in which governorate they will settle.

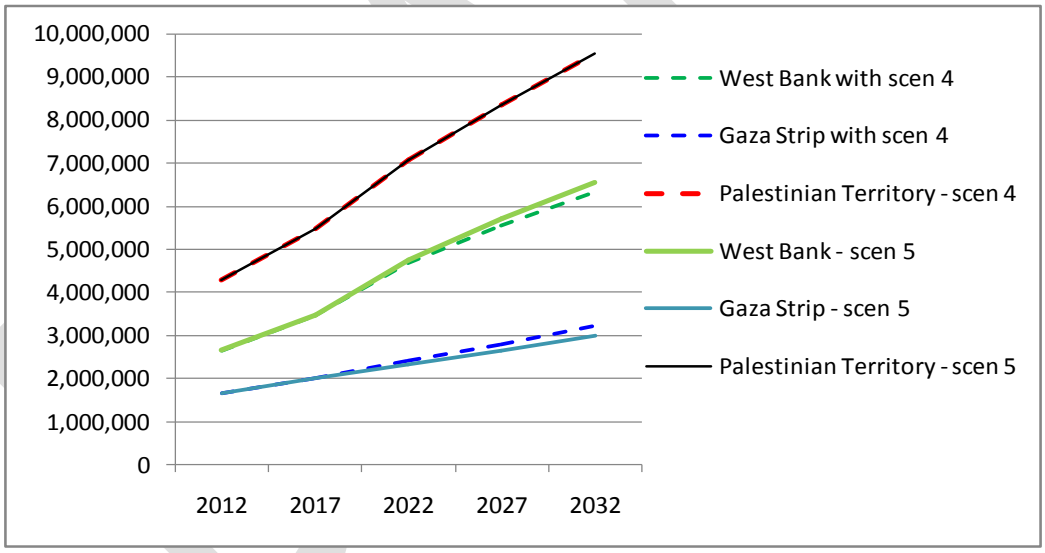


Figure 16. Demographic projections for the 2012-2032 period.

8. Demand for domestic water

8.1. Strategic objectives for per capita water allocation

In the present situation in the Occupied Palestinian State (with water shortages in many localities), one of the most relevant water service parameters is the quantity of water made available to each citizen (expressed in liters per capita and per day). The total amount of water supplied in the West Bank and Gaza provides each person with an average of 96 liters per capita per day in Gaza, 72 lcd in the West Bank and 82 lcd at the national level (see Table 6).

The strategy aims to improve customer satisfaction, providing customers with access to a reliable, permanent source of good quality tap water, at an affordable price. As a result, there is likely to be an increase in domestic water consumption. Nevertheless, this increase will be constrained not only by the customers' affordability and willingness-to-pay for this service, but also by consumers' support of the national policy that aims to limit water wastage and over-abstraction of limited water resources.

The strategy has been developed with the objective to provide 120 lcd in both regions (the Gaza Strip and the West Bank).

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8.2. Projected demand for domestic and industrial water

Using the hypothesis mentioned in the previous section, the demand for domestic water has been calculated for both the Gaza Strip and the West Bank and is presented in the tables 18 &19 below (detailed figures are presented in the annex).

In these tables, the demand for industry has been added, in order to facilitate comparisons with the tables included in chapter 9 (Demand for Industrial Water)

West Bank Water supply		baseline	short term	long-term strategy		
		2012	2012-2017	2017-2022	2022-2027	2027-2032
Demand	water available per person (lcd) at the end of each period (excluding industry)	**72**	**72**	**88**	**104**	**120**
	population (MoPAD)	2 649 000	3 473 000	4 742 000	5 713 000	6 548 000
	domestic water demand (Mm3/day)	70	91	152	217	287
	industrial water demand (as % of domestic)	3,0%	3,0%	4,3%	5,7%	7,0%
	industrial water demand (Mm3/year)	2,1	2,7	6,6	12,3	20,1
	total demand (domestic + industry) (Mm3/year)	**72**	**94**	**159**	**229**	**307**

TPAT calculation

Figure 17. Projected demand for domestic and industrial water in the West Bank.

Gaza Strip Water Supply		baseline	short term action plan	long-term strategy		
		2012	2012-2017	2017-2022	2022-2027	2027-2032
Demand	water available per person (lcd) at the end of each period (excluding industry)	**96**	**96**	**104**	**110**	**120**
	population (MoPAD)	1 644 293	1 994 680	2 339 313	2 645 554	3 002 518
	domestic water demand (Mm^3/year)	58	70	89	106	132
	industrial water demand (as % of domestic)	3,0%	3,0%	4,3%	5,7%	7,0%
	industrial water demand (Mm3/year)	1,7	2,1	3,8	6,0	9,2
	total demand (domestic + industry) (Mm3/year)	**59**	**72**	**93**	**112**	**141**

TPAT calculation

Figure 18. Projected demand for domestic and industrial water in the Gaza Strip.

9. Demand for industrial water

9.1. Baseline

As yet, there are no large industrial facilities (chemical plants, cement factories, etc.) that consume high volumes of water in Palestine. Most industries are just small factories that use the urban water supply network as their sole source of water. Many of these industries are billed as conventional customers (as are many shops). The water operators in Ramallah and Nablus estimate that these small industries use 3% of the total urban water supply[5].

At country level, 3% of urban water equates to 3.1 Mm^3/year in the West Bank and 3.0 Mm^3/year in Gaza.

In addition to the urban water supply systems, some industrial facilities use private wells. Almost all of these wells are registered as irrigation wells, as PWA has not issued abstraction rights for industry wells. According to PWA estimates, the current industrial consumption is very low, as farmers already struggle to find sufficient water to irrigate their land and are thus unwilling to resell this water to industry.

9.2. Projected demand for industry

The 3% ratio is lower than the ratios observed in neighboring countries. This can be explained by the constraints that industry in Palestine has been facing over the past 40 years (difficulties accessing land, markets, suppliers, etc.).

Once the political constraints are removed, the market opportunities for Palestinian industries are expected to increase as more investors will venture to develop small factories. Nevertheless, heavy industry requiring huge amounts of water (paper, chemical, mining, etc.) will still be constrained by the limited water resources available in the Middle East.

The long-term strategy is based on the hypothesis that:

- the demand for water for industry will rise from 3% of urban water supply to 7%;
- most of these industrial plants will be supplied by the to-be-established Regional Water Utilities; and
- wherever possible, the treated wastewater will be a source to meet the demand for water in some industries or PWA may authorize the use of private wells for industry, on a case-to-case basis, in accordance with the National Water Policy[6].

[5] This figure seems rather low, but it is similar to what is observed in similar countries: Jordan (3%), Israel (5.7%) and Lebanon (11%).

[6] Policy statement: "*It is the National Policy of Palestine to allocate water rights for economic benefit (agriculture, industry, tourism…) between different users according to economic benefits to Palestine (in terms of revenue, job creation and food security) and in agreement with national development plans. in order to preserve the limited resources available for agriculture*".

Baseline - Estimated production 2012 (Mm^3/year)

Water utilities in Palestine (CMWU, JWU, Nablus WD) estimate that 3% of domestic water supply is used by small industries

	industry share	Production for domestic	Industry share
Gaza	3%	104	3,1
West Bank	3%	101	3,0
		Total	6,1

Long-term Strategy

The long term strategy aims to provide opportunities for industry development. It is based on a significant increase of industry water supply (10% of domestic water demand), because with an easier access to water ressources, the Government will encourage additionnal investments in light industry allowing for job-creation.

	industry share	Domestic water demand	Industry water demand
Gaza	7%	131,5	9,2
West Bank	7%	286,8	20,1
		Total	29,3

Table 17. Anticipated water production needs for industry.

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10. Demand for irrigation water

10.1. Irrigable land

The Ministry of Agriculture (MoA) conducts periodic censuses of the land suitable for irrigated agriculture, taking all relevant features into account (quality of soil, field slope, accessibility, etc.).

According to the most recent data, there are 745,000 dunum (equivalent to 75,000 ha) of irrigable land in Palestine (82% in the West Bank and 17.9% in the Gaza Strip).

Obviously, the demand for irrigation water cannot be based on these figures alone, as water resources are a major constraint when developing irrigation schemes. For this reason, demand has been assessed here on the basis of IRRIGATED rather than IRRIGABLE land.

Irrigable Land (in dunum)		
Governorate	Area	%
Jenin	163,000	*21.9%*
Tubas	82,000	*11.0%*
Tulkarm	27,500	*3.7%*
Qalqilia	17,500	*2.3%*
Salfit	49,000	*6.6%*
Nablus	68,000	*9.1%*
Ramallah	35,000	*4.7%*
Jerusalem	3,000	*0.4%*
Jericho	45,000	*6.0%*
Bethlehem	12,000	*1.6%*
Hebron	110,000	*14.8%*
Sub-Total WB	***612,000***	*82.1%*
Gaza Strip	***133,000***	*17.9%*
Total Palestine	**745,000**	

Sources: PCBS (2008)
MoA records (December 2008)
Agricultural Statistics 2006/2007

Table 18. Irrigable land in Palestine

10.2. Water needs per dunum

The amount of water required per dunum varies from one place to another and is dependent on rainfall, temperature, quality of soil, etc. It also depends on the type of crop being grown and the irrigation technology used (submersion, sprinklers, drip irrigation, etc.).

For overall planning purposes, MoA recommends using an average figure of 600 m^3/dunum/year[7] in West Bank. This figure has been calculated to take into account the recent and considerable development of drip irrigation.

Presently, MoA has to manage water shortages, due to the difficulties in accessing the water resources and, for this reason, supply only 75% of the "normal" water demand (450 m^3/dunum/year instead of 600).

However, there is still some room for improvement, and the MoA considers that overall efficiency gains of 10% will be achieved over the next 20 years.

10.3. Irrigated land and projected demand for irrigation

Actual (and future) irrigated land is evaluated by cross-referencing the water used (and available) for irrigation figures with water needs per dunum.

If the current political situation (military occupation) persists, it is considered that the amount of water available for irrigation will be severely constrained. Some agricultural wells located inside the

[7] This figure is a national average, taking into account zones where the irrigation needs are only 500 m^3/dunum (e.g. the Gaza Strip) and zones where it exceeds 1000 m^3/dunum (as the lower slopes of Jordan Valley).

residential areas are expected to be taken over for domestic water purposes. At the same time, more and more treated wastewater will become available for reuse in irrigation, in accordance with the National Water Policy[8].

The Comprehensive Peace Agreement to be signed between Palestine and Israel will include agreements on the equitable shares in trans-boundary water resources (these agreements, where needed, will also involve the other riparian countries sharing the same resources: Jordan, Syria, Lebanon, and Egypt):

- Jordan River;
- Western aquifer Basin in the West Bank;
- Eastern Aquifer Basin;
- North-Eastern aquifer Basin in the West Bank;
- Coastal aquifer in the Gaza Strip; and
- Wadi Gaza.

The additional amounts of water which is to be made available upon the attainment of (Palestinian Water Rights will enable Palestine to develop an ambitious irrigation program in the West Bank.).

The amount of water available for irrigation in Gaza will still be constrained by salinity problems as a result of the intrusion of seawater into the Coastal aquifer as well as the limitations related to land availability.

Therefore, it is expected that within the State of Palestine:

- the groundwater resources available for irrigation will decrease in Gaza, because PWA will impose limits on abstraction rights in order to control aquifer invasion by seawater as well as less land available, due to urban expansion;
- the resources available for irrigation will increase dramatically in the West Bank, as Palestinians will attain their water rights in the Jordan River and shared aquifers;
- PWA and MoA will encourage the reuse of treated wastewater for agriculture, including the construction of facilities to store and transport this water; this strategy will provide the main source of additional irrigation water in the Gaza Strip; in the West Bank, the availability of other (cheaper) water resources will deter PWA from investing too much in the long distance transfer of treated wastewater.

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[8] Policy Statement *"Treated wastewater represents a potential resource and should be optimized for agricultural, recharge and aquaculture purposes*."

Policy statement : "*It is the National Policy of Palestine to treat all produced wastewaters to a quality sufficient to meet national standards for safe and productive reuse and support the distribution and productive reuse of treated wastewater.*

Irrigated land and water needs for irrigation

Baseline: stimated water use 2012 (Mm3/year)

Water use estimation, based on irrigated land (MoA census)

	type of resource	available for irrigation (Mm^3/year)	m^3/year per dunum	potentially irrigated land (dunum)
Gaza	Coastal aquif.	86	741	116 059
	Wastewater Reuse	1	741	1 306
	Total Gaza	**86**		**116 059**
West Bank	West.Aquif.	51	600	85 000
	N-East.Aquif.		600	
	East.Aquif.		600	
	Dams	2	600	3 333
	Total West Bank	**53**		**88 333**

Long-term Strategy

The final Peace Agreement to be signed between Palestine and Israel will include agreements regarding the fair sharing of transboundary water resources. Large additionnal resources will be available in West Bank (Western and North Eastern aquifers, Jordan Valley surface water).

	type of resource	available for irrigation (Mm^3/year)	m^3/year per dunum	potentially irrigated land (dunum)
Gaza	Coastal aquif.	32	741	43 185
	Dams	10	741	13 495
	TWW reuse	25	741	33 701
	Total Gaza	**67**		**90 381**
West Bank	West.Aquif.	30	600	50 000
	N-East.Aquif.		600	
	East.Aquif.		600	
	TWW reuse	83	600	138 333
	Jordan Valley	200 / 400	600	333 333 / 666 667
	Dams	45	600	75 000
	Total West Bank	**158**		**600 000 / 930 000**

Table 19. Anticipated irrigated land.

Part 3.3. Sustainable Development of Water Resources

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11. UFW and production needs for domestic and industrial water

11.1. UFW reduction hypotheses

Taking into consideration both the water scarcity and the communities without a proper water service, the present level of UFW (24 to 36% in the West Bank and 41 to 46% in the Gaza Strip) can be deemed excessive; thus the strategy aims to reduce this UFW rate.

Reducing UFW will require major investment in the transmission and distribution networks (leakage detection, illegal connection detection, pressure management, pressure districts, etc.), improving the service providers performance and/or efficiency and at customer connection level[9] and that will be reflected in both the investments and the action plans that would be prepared as a next step of water strategy. This is surely not an easy task and very few water companies worldwide have succeeded in significantly and permanently reducing UFW figures. Separate strategic objectives for UFW have been established for each region and each scenario (Table 20).

	Gaza Strip	West Bank
Long-term Strategy	Palestinians have full access to the country's water resources. Nevertheless, the natural resources are limited (due to the climatic conditions in the country and the very high population density). UFW reduction is considered as a very important component of the strategy. Each UFW program will be compared (cost/advantage analysis) against alternative options, such as additional wells or bulk water supply from other regions or other countries.	
Strategic objective	**20%**	**20%**
Comments	The strategic objective in Gaza is ambitious (reducing UFW from 41-46 % to 20%) because water production is expensive in Gaza (desalination plant). However, this objective can be achieved, because the Gaza Strip is a virtually flat, densely populated area with integrated water systems. As such, it is less difficult to implement a comprehensive pressure management scheme.	The strategic objective in the West Bank is more modest (reducing UFW from 24-36% to 20%), because it is a mountainous area, where pressure management is difficult. Moreover, the region includes many isolated villages with small water systems, managed by local communities, not all of which will be incorporated into the service area of modern regional water utilities.

Table 20. UFW reduction hypothesis.

11.2. Content of the UFW-reduction program

The actions required to achieve the UFW strategic objectives consist of both physical investments and utilities' reforms, including (but not limited to):

- the division of the water networks into pressure districts (this kind of investment is especially relevant in areas with large differences in elevation, such as Ramallah, Nablus, Bethlehem, etc.);

[9] An indication as to the scale of this investment is provided by the UFW reduction program in Nablus city: US$20 million has been invested in the UFW-reduction program over 5 years, improving the service for 232,000 inhabitants, i.e. US$86 per capita.

- leakage detection and repair programs (such programs can be implemented by the service providers or outsourced to specialized service providers);
- an improved metering system (bulk water metering, as well as customer metering);
- illegal connection detection and removal; and
- improving the services providers' efficiency and performance in both technical, administrative and financial levels order to able to achieve the above mentioned activities

The strategic objectives for UFW reduction are to be met within the next twenty years (i.e. by 2032) and the required investment are to be made, plans for which will be developed after the endorsement of the strategy.

11.3. Production needs

Taking into account the strategic objectives for domestic, irrigation and industrial water supply, as well as the UFW objectives, the water production/import needs have been calculated for the two regions (Table 17 & Table 18 where the strategic objectives are in the blue lines).

West Bank Water supply		baseline	short term	long-term strategy		
		2012	2012-2017	2017-2022	2022-2027	2027-2032
Production needs	**UFW (%)**	**32%**	**29%**	**26%**	**23%**	**20%**
	Production needs	**105**	**132**	**215**	**298**	**384**
	groundwater abstraction	**54**	**57**	**100**	**156**	**224**
	from springs (Mm3/year)	*9*	*12*	*13*	*13*	*13*
	from wells (Mm3/year)	*45*	*45*	*87*	*143*	*211*
	desalination (Mm^3/year)	**0**	**0**	**22**	**32**	**40**
	import (Mm^3/year)	**51**	**75**	**92**	**110**	**120**

Table 17 Production/import needs in the West Bank

Gaza Strip Water Supply		baseline	short term action plan	long-term strategy		
		2012	2012-2017	2017-2022	2022-2027	2027-2032
Production needs	**UFW (%)**	**42,0%**	**36,5%**	**31,0%**	**25,5%**	**20,0%**
	Production needs	**102**	**113**	**134**	**151**	**176**
	groundwater abstraction	**93**	**48**	**50**	**37**	**33**
	from springs (Mm3/year)	*0*	*0*	*0*	*0*	*0*
	from wells (Mm3/year)	*93*	*48*	*50*	*37*	*33*
	desalination (Mm^3/year)	**4,0**	**55**	**70**	**100**	**129**
	import (Mm^3/year)	**5**	**10**	**14**	**14**	**14**

Table 18. Production/import needs in the Gaza Strip

12. Groundwater resources management

12.1. Allocation of right-to-use water to Palestinians

Oslo 2 Agreement

As part of the long-term scenario, the Palestinian water rights will be negotiated with Israel and the other riparian countries in accordance with international law and best practice with regard to the management of trans-boundary water resources.-

In the meantime, the temporary allocations of water utilization to Palestinians are regulated by the Oslo 2 Agreement (see Table 5).

The Oslo 2 Agreement was mostly based on actual water abstraction at that time (1995), although it also included a slight increase to allow for population growth. Its aim was to regulate water allocations over a 5-year interim period, until a final agreement was to be reached between Palestine and Israel. This interim period was not supposed as it did to last 20 years, however, and for this reason, the Oslo 2 Agreement utilization figures no longer meet the minimal requirements of the Palestinian people. Although there is an urgent need to amend these figures (due to population change and other environmental and socio-economic factors), this agreement is still frequently cited as a reference during discussions at JWC meetings.

Additional comments:

- under the Oslo 2 interim Agreement, Israel is to supply 5 additional Mm^3/year to Gaza, and Palestinians are authorized to develop an additional 78 Mm^3/year in the West Bank (compared with their water use in 1995);
- the resource for this additional 78 Mm^3/year should be the Eastern aquifer basin or another agreed resource in the West Bank; and
- the Oslo 2 interim Agreement does not deal with abstraction rights on the Coastal aquifer (Gaza Strip); it does not include any figures on either the Israeli or Palestinian abstraction rate in 1995. It merely states that both sides should maintain the existing utilization.

12.2. Long term strategy - State of Palestine - Final agreement with neighbors

The Comprehensive Peace agreement will be based on fair and equitable negotiations between countries sharing water resources:

- The Jordan River surface water resource (a water resource shared by Jordan, Syria, Lebanon, Israel and Palestine);
- The Gaza Wadi (shared by Palestine and Israel);
- The Western aquifer (shared by Palestine and Israel);
- The North-Eastern aquifer (shared by Palestine and Israel);
- The Eastern aquifer (not shared according to Oslo 2 agreement[10]); and
- The Coastal aquifer (shared by Palestine, Egypt and Israel).

[10] From a strict hydrogeological point of view, some percentage of Eastern Aquifer groundwater cross the border with Israel, but >95% of the water resource is within Palestine and most groundwater flow is within Palestine borders.

These negotiations will be based on international law and the best practice employed in other similar negotiations.

Nevertheless, international law and existing treaties do not provide definitive rules for allocating water rights between two (or more) countries sharing the same water resource (Phillips D.J.H, Shaddad A. et al. 2009). Abstraction rights' discussions will focus on a number of criteria (population living in the basin, equality, prior utilization, basins area, recharge area, alternative sources that can be used in each country, environmental constraints, etc.).

As it is not possible to predict the outcome of these negotiations, the long-term strategy is based on a general assessment of the resources that will be made available to Palestinians, but does not set the final figures for these resources. The final negotiation agreement concerning the independent state of Palestine related to the water resources will be PWA's reference for strategy modification that may be needed, especially with relation to the water allocation and the investments.

Additional wells

Addition sources of water by new wells from the three groundwater aquifers (basins) should be considered in the long term Strategy. Due to several hydrogeological and climate change factors, it is expected that the feasible number of new wells (and their abstraction rates) could be less than the secured Water Rights. Therefore, the difference between Water Rights and actual production from wells will be considered under a swapping agreement within the context of the final negotiations with Israel.

Western aquifer

The Western aquifer is the most productive because its recharge area receives most of the rainfall. Therefore, more new wells should be drilled along the whole basin from north to south in order to utilize around 110-130 Mm^3/year by the year 2032. However, this quantity of water also does not represent the Palestinian Water Rights in this basin; it is only the quantity that can be practically taken from this basin by drilling new wells inside West Bank borders, taking into account hydrogeological constraints. Furthermore, the development of any wells in the future will be subject to negotiations with Israel concerning the final agreement and with co-operation mechanisms as a matter of trans-boundary water resources management and protection.

North-Eastern aquifer

This aquifer is a potential resource for the governorates of Nablus, Jenin and part of Tubas.

PWA has already identified that about 60-80 Mm^3/year could be developed from this basin by drilling several new deep production wells in the Jenin, Nablus and Tubas areas for the successful implementation of the long-term strategy.

Eastern aquifer

Even the southern part of this aquifer suffers from water table depletion in certain zones, and additional new wells need to be carefully sited so as not to interfere with existing wells. About 32 Mm^3/year (20 Mm^3/year from new wells +12 Mm^3/year from Dead Sea well field) of groundwater could be developed from these new proposed wells. Moreover, PWA has presumed that the existing 38 Israeli wells that pump more than 40 Mm^3/year should be finally transferred (handover) to its responsibility. Therefore, a total quantity of 90-100 Mm^3/y could be developed by wells from the Eastern Basin by the year 2032.

There are a number of large brackish springs on the slopes of the Dead Sea, and in the Bethlehem and Hebron governorates (Fashka Springs), which have an annual average discharge of 100 Mm^3/year. Many of these springs are too brackish to be used directly for domestic water supply

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purposes and have not yet been used to their full capacity. The long term strategy aims to develop this resource as:

- these springs are not too far away from the Hebron and Bethlehem governorates[11], where many localities suffer from water shortages; and
- the springs are not far away from irrigable land in the Jordan Valley.

PWA plans to develop this resource with different types of program:

- firstly, a desalination plant with a 40 Mm3/year production capacity (reverse osmosis) to produce domestic water; and
- 15 Mm^3/year of the brackish water to be used for irrigation schemes in Jericho from springs with less than 2 g/l TDS.

Coastal aquifer

The coastal aquifer has been overused in recent decades. Groundwater abstraction in the Gaza Strip has reached 178.8 Mm^3/year[12], whereas the natural aquifer recharge on this portion of the aquifer is estimated to be only 55 Mm^3/year (Yacoubi, 2012). For this reason, the long term strategy aims to reduce total groundwater abstraction in the Gaza Strip from the current rate of 178.8 Mm^3/year to 70 Mm^3/year in 2032.

Allocation of treated wastewater

The water strategy includes a large development of wastewater collection (sewerage and cesspool sludge collection) and the construction of new wastewater treatment plants, in accordance with statements in the National Policy.

The development of efficient wastewater treatment plants will provide an additional water resource over the coming years that could be allocated to farmers to irrigate their crops.

Implementing such an allocation will be a rather complex operation, requiring the co-operation of various stakeholders. The bases for the allocation will be as follows:

- wastewater will be treated in high performance treatment plants in order to produce “reuse quality water”, for irrigation and/or infiltration;
- PWA and MoA will coordinate to transport the treated wastewater to the irrigation areas;
- MoA will develop mechanisms to encourage farmers to use the treated wastewater in agriculture;
- the allocation will be organized through Water Users Associations; for areas that do not require irrigation water, the WWTP discharge of water will be used for infiltration and recharge of the aquifers; and
- MoA, PSI and MoH will define a limited list of crops for which irrigation with treated wastewater is permitted and considered safe, using efficient irrigation systems; Taking all these various constraints into account, the potential additional water resource is expected to be relatively limited in the West Bank (see chapter 17).

Studies on a number of infiltration facilities in the Gaza Strip are already underway and the strategy aims to maximize the use of these equipments as a core component of PWA’s Integrated Water Resources Management (IWRM).

[11] Although there is a huge elevation difference and pumping costs are likely to be relatively high.
[12] For the total abstraction in 2011 = domestic + irrigation.

12.3. Short-term strategy

Additional wells

According to the Oslo II Agreement, Palestinians are entitled to extract 118 Mm^3/year from groundwater (by wells and springs) in the West Bank. The current utilization is about 87Mm^3/year and as a consequence, PWA is entitled to invest in additional production capacities of at least 31 Mm^3/year to fulfill the interim allocation of Oslo II (table.22). Regardless to the severe restrictions and delays imposed by Israel in the JWC, about 15 Mm^3/y need to be developed during the short term strategy by drilling several new production wells in the three West Bank basins. Moreover, rehabilitation of existing wells and springs could improve 5% of the current available quantities, while the impact of climate change (mainly through drought) on water resources could reduce the quantities by 5%.

Western aquifer

The Western aquifer is the most productive because its recharge area receives most of the rainfall. However, the Oslo II Agreement gives Palestine very limited abstraction allocations from this aquifer (22 Mm^3/y). Furthermore, the development of any wells under the present situation is subject to negotiations with Israel and the short-term (transitional) strategy includes only a very limited number of wells that are to be agreed upon on a case-by-case basis in the JWC. The plan is to develop about 5 Mm^3/year as additional quantity from new wells in the western part of Hebron and by the rehabilitation of existing wells in Qalqilya and Tulkarem. This would bring the total quantity to 30 Mm^3/year by the year of 2017 instead of 25 Mm^3/y in 2011. However, if this option can not be achieved through the JWC as the Palestinians will pump more than their allocated quantity in Oslo Agreement, PWA needs to develop a temporary-partial swapping allocation plan between this basin and other basins (Northeastern and Eastern) in order to increase the Palestinian allocation in the Western basin in the short run.

North-Eastern aquifer

This aquifer is a potential resource for the Nablus, Jenin and part of Tubas Governorates.

Considering the current extraction rate of 15 Mm^3/year from existing wells in this basin, PWA has already determined that about 6 Mm^3/year could be developed additional quantity by drilling new wells. This will give an overall quantity of 21 Mm^3/y from wells by the year 2017. The development of any wells under the present situation is subject to negotiations with Israel through the JWC. Therefore, the additional quantity of 6 Mm^3/year could be developed mainly by drilling new 4 production wells (Janzur, Kefert, Beit Qad and Shuhada wells).

Eastern aquifer

In the Eastern aquifer, the current abstraction rate is far below the threshold fixed by the Oslo II Agreement and PWA is entitled to drill additional wells.

However, this aquifer suffers from water table depletion in certain zones and additional wells need to be carefully sited so as not to interfere with existing wells.

Within the short term Strategy, PWA intends to develop about 4 Mm3/Yr through new wells as additional quantity. The 4 Mm3/Yr will be extracted through 4-5 new drilled deep production wells in Al Auja Area (Jericho District) and in the Eastern Part of the Herodian Area (Hebron – Bethlehem District).

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Coastal aquifer

The coastal aquifer has been overused in recent decades. Groundwater abstraction in the Gaza Strip only has reached 178.8 Mm^3/year[13], whereas the natural aquifer recharge on this portion of the aquifer is estimated to be only 55 Mm^3/year (Yacoubi, 2012). Consequently, the level of the aquifer has dropped by 10 to 15 meters over the last 40 years; furthermore, as the aquifer is a coastal one, brackish and salt water have begun to penetrate the aquifer, mixing with the fresh water (see Source: CMWU, 2011

The Short Term strategy aims to reduce the total groundwater abstraction in the Gaza Strip to 153 Mm^3/yr in order to bridge the gap between supply and demand for water (Table.22). Some new wells could be built, but would not be considered an additional resource as they would replace existing wells that are to be closed because of the poor water quality (chloride or nitrate levels exceed domestic water standards).

Groundwater resources in Palestine						
Aquifer basins	Average recharge (Mm^3/year)	Actual abstraction (Mm^3/year)		5-years investment plan (Mm^3/year)	Long-term strategy (Mm^3/year)	Implementable (Mm^3/year)
		Israel	Palestine	Palestine	Palestine	Palestine
West Bank - Western aquifer	318-430a	411	25	30	100 to 300c	100 to 130c
West Bank - Eastern aquifer	125-197a	150	42	46	150	90-100
West Bank - N-E aquifer	135-187a	103	20	26	80 to 100c	60-80
Gaza Strip - Coastal aquifer	55-60a		178.8	153	70	70

a Source: PWA 2012 c

b source: PWA Gaza, 2012

c these figures are not the official PA position for future negotiation; it is just a very simplistic estimation of abstraction rights sharing between Israeli and Palestinian customers, aiming to illustrate the volume of resources in the long-term scenario.

Table 19. Expected groundwater utilization during short and long term perspectives in Palestine.

It is worth mentioning that as the feasible amount of abstraction from the aquifer is less than the approximated or simplistic water rights, the remaining quantities should be considered for swapping within the final negotiations with Israel.

[13] For the total abstraction in 2011 = domestic + irrigation.

13. Desalination

In the current situation, fresh water supply by desalination is taking place in Gaza Strip by a large-scale seawater desalinization plant.

13.1. Increasing water production capacity in Gaza

The investment program to develop the production of desalinated water in Gaza has been designed by PWA and has been presented in a draft note that forms the principal basis of this chapter (Yacoubi A. 2012). This investment program is based on the following main assumptions:

- the abstraction rate in the coastal aquifer is already excessive and has led to seawater intrusion; this must be reduced in order to restore the aquifer capacity;
- additional water from Mekorot is not a reliable source (because of political interference by the Israeli government) and cannot be considered as a major source of water for the Gaza Strip but will be considered an optional for the short and long term;
- the desalination of seawater is the main potential additional resource; and
- desalination will improve the quality of the treated wastewater effluent and will result not only in a better quality of the groundwater in many areas of Gaza Strip but also as a potential water resource for reuse.

13.1.1. Desalination of seawater

The Gaza Strip borders the Mediterranean Sea, a nearly unlimited source of saltwater. This resource can be used for soft water production in Palestine, as it is in other Mediterranean countries (Israel, Algeria, Spain, Greece, etc.). Seawater desalination technologies are mature and there is a significant number of competing manufacturers of reliable equipment in the market (many of them with good track records of producing desalination plants of the same type as planned in Gaza).

The main constraints for the construction of large desalination plants in a low-income and blockaded country such as the Gaza Strip are:

- the cost of equipment;
- the running costs of the desalination plants (power, equipment renewal);
- power production or import;
- Israeli restrictions on access to materials and equipments;
- difficulties in attracting investors due to the conflict and risks of Israel targeting the installation as it previously did with the Gaza power station;
- poor water distribution system efficiency; and
- institution constraints.

PWA has identified a large desalination project for Gaza, with a 55 Mm^3/year capacity by 2017 (to be expanded to 129 Mm^3/year in the future). The plant site has been secured (along the coast) and preliminary negotiations are under way with development banks and donor organizations.

Additional equipment could be installed on the same site or on other similar sites in the Gaza Strip.

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13.1.2. Desalination of brackish water

The south-eastern part of the Coastal aquifer provides brackish water (3 to 5 g/l) that is not suitable for domestic water supply or irrigation. This water could be desalinated for emergency purposes only with a limited capacity and at a lower cost with lower power consumption than seawater. Therefore, the desalination of brackish water could provide a cost-effective alternative resource with reduced production costs and power consumption.

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14. Purchasing from neighboring countries

14.1. Bulk supply from Mekorot in West Bank

Over 34% of the West Bank's water supply comes from water imported from Mekorot systems (PWA data, 2012). To a certain extent, these imports offset the constraints imposed by the Israeli government regarding the construction of new wells, and import levels have been increasing over the last few years.

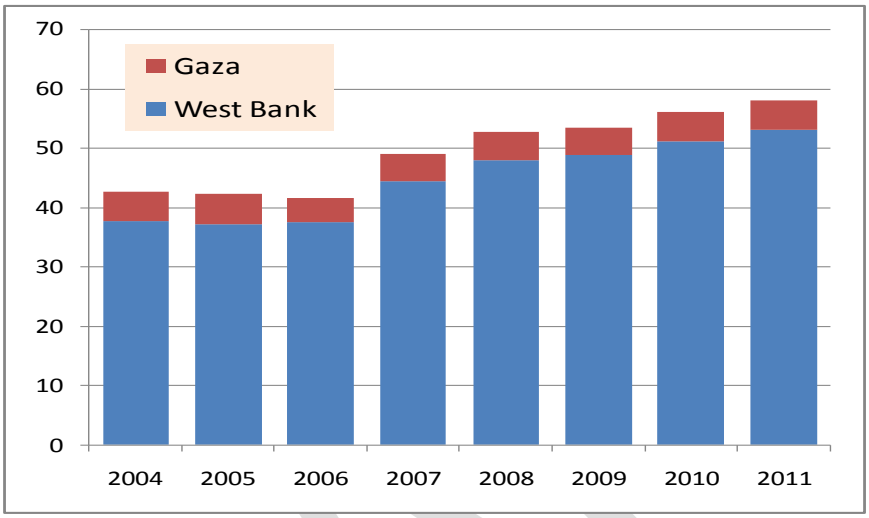


Figure 19. Annual quantity of water purchased from Mekorot for domestic use (in Mm3/year)

TPAT calculation. Data source: PWA, 2012

14.2. Bulk supply from Mekorot in Gaza

Gaza currently imports only limited amounts of water from the Israeli water utility (Mekorot): 5 Mm^3/year. This represents 3% of the region's water consumption. Israel is under an obligation to supply and addition 5 Mm^3/year under the interim agreement and negotiations over the implementation of those obligations are ongoing with a tentative price agreed.

On the long-term, any significant increase in water imports arenot anticipated as Mekorot itself is becoming increasingly reliant on expensive desalination water and Israel has expressed willingness to increase water sales, but the price could be rather high. Moreover, negotiations with Mekorot are tainted by the complex political relationship between the two countries.

Although the constant political issues with Israel discourage PWA from relying on water supply imports, however, and considering the operational cost for desalination, the strategy has been developed on the hypothesis that imports from Israel (or any other country) to Gaza will increase.

14.3. Long-term strategy

PWA has concerns regarding the purchase of Israeli water due to the following reasons:

- imports are controlled by an external source and dependent on difficult negotiations with Mekorot (an Israeli state-controlled utility);

- the supply points at which the water is piped into Palestine have to be negotiated with Mekorot, prioritizing the management of its own bulk water supply system; these priorities do not correspond with the priorities of the Palestinians (WBWD need a higher share of the water imported from Mekorot to be piped into the southern part of the country – Hebron Governorate - rather than into the northern region); and
- the Mekorot selling price is relatively high (2.7 ILS/m^3) and is expected to increase in the future, as more and more of Mekorot water is produced through very expensive desalination plants.

For these reasons, the long-term strategy should consider the import of water from other countries, and not only rely on a dramatic increase in the quantity of water purchased from Mekorot. Accordingly, the strategy considers the Mekorot water resource as an option that needs to be evaluated on a case-by-case basis through commercial agreements, but not as a permanent source of water for Palestine.

14.4. Short-term (for the next 5 years)

Some governorates in Palestine suffer from a very large water deficit (e.g. in the Jenin, Hebron, Bethlehem, Tubas and Qalqilya). In order to rapidly improve the supply situation in these regions, additional purchases from Israel is considered as a viable option, as it can be implemented in the short-term.

Two different sets of negotiation will be undertaken by PWA:

- negotiations to increase the total amount of water bought from Mekorot, from 56 Mm^3/year in 2012 (51 in West Bank and 5 in Gaza) to 85 Mm^3/year(75 in West Bank and 10 in Gaza); and
- negotiations to review the water supply points: (a) increasing the amount piped into the South of the West Bank, where few alternative resources can be mobilized in the short-term, as well as into the Gaza Strip and (b) reducing the amount supplied to the North of the West Bank.

14.5. Long-term

Importing and exporting water (and using trans-boundary water) is the normal way to address an unequal distribution of water resources among regions and countries. For a landlocked and densely populated country as Palestine, importing water will be a long-term option. After obtaining its rights on groundwater and surface water resources, according to international law, Palestine will continue to seek for agreements with its neighbors on importing and exporting water in order to meet the customer demand choosing the most cost effective options.

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15. Surface water resource management

15.1. Surface Water Resources

West Bank catchment area

Some 33 main wadis originate in the West Bank and flow either westward to the Mediterranean Sea or eastward to the Jordan valley and the Dead Sea. Some of these wadis are monitored by PWA and the total amount of water resources have been estimated as follows (see PWA. 2012c):

- Wadis flowing westward to the Mediterranean Sea: 16 wadis with a 122.7 Mm^3/year average total run-off;
- Wadis flowing eastward to the Jordan Valley: 9 wadis with a 20.6 Mm^3/year average total run-off;
- Wadis flowing eastward to the Dead Sea: 8 wadis with a 21.5 Mm^3/year average total run-off.

Wadis flowing through the Gaza Strip

The main wadi crossing in the Gaza Strip is the Gaza Wadi, whose maximum annual run-off has been estimated at 20 Mm^3/year during the intensive rainy season. This river almost dried since Israel captured the run-off upstream the Gaza Strip.

With many of its tributaries having been dammed inside Israel for irrigation purposes, this wadi is no longer flowing and is not monitored any more by PWA.

Jordan River

The Jordan River is the main water resource in the region. Its catchment area is shared among 5 riparian countries (Palestine, Jordan, Syria, Lebanon and Israel). The historical total average resource is estimated to be 1,400 Mm^3/year (PWA. 2012c).

This resource is already over-used by the riparian countries (Israel, Jordan and Syria) and the remaining flow in the lower part of the Jordan River is less than 30 Mm^3/year. The water is very salty and polluted. This low volume is not enough to maintain sound environmental conditions along the river (not to mention the Dead Sea, whose mean water level is decreasing by more than 1 m per year).

15.2. Present level of surface water use in Palestine

As Palestinians have been denied access to the majority of these resources, the country currently makes very limited use of surface water. There is only one significant dam (Auja Dam), which has a water flow regulation capacity of 0.5 Mm^3/year.

15.3. Long-term surface water strategy

Jordan River

Under a basin-wide agreement, a significant share of the Jordan River surface water resource will be available for use by Palestinians in the lowest part of the Jordan Valley.

The national strategy is to use this resource in the lowest parts of the country (in the Jenin, Tubas and Jericho governorates), firstly, to restore irrigated agriculture in the Jordan Valley, and secondly,

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to top up the domestic water supply of those localities that experience water stress and where accessing groundwater would require unreasonably high levels of investment.

This water resource will be channeled through a main water carrier, similar to the East Ghor Canal built in Jordan. Designs for a West Ghor Canal were drawn up 50 years ago and these can be considered a first hypothesis for this facility; however, additional studies are to be undertaken before a final design can be selected.

The water sector strategy does not fix the volume of water to be collected from the Jordan basin, because the specific allocations per riparian country will be agreed upon in a basin-wide agreement.

An initial proposal was made 50 years ago, during preliminary negotiations between Israel and the Arab League. This proposal (the so-called Johnston proposal) was to allocate water to the Palestinians, to be channeled through the West Ghor Canal. In 1955, this proposal was considered a sound basis for discussion for irrigation water; however, it was never formally endorsed by either Israel or the Arab League. Moreover, the demographic and economic figures used to build this proposal are no longer valid and this strategy does not aim to set objectives for future negotiations.

For this reason, the strategy does not define a figure for this future water resource. International negotiations between riparian states commonly take into account the population living in the river basin, as well as the recharge in the watershed and of the surface water. Based on such criteria, Palestinians could claim between 200 and 400 Mm3/year (table 20)).

Nevertheless, negotiations will also take into account the other water resources (groundwater, wadis, access to sea water for desalination, etc.). As a result of these uncertainties:

- the strategy does not provide a figure for the future surface water resource from the Jordan River as this will be subject to negotiation;
- for the same reason, the strategy does not include the sizing of the future West Ghor Canal;
- the strategy considers that most of this resource will be used for irrigation in the Jordan Valley and that the corresponding irrigation schemes will be sized in accordance with the volume of water allocated to Palestinians; and
- the inclusion of these schemes into the short-term investment plans will be deferred until negotiations have been successfully completed.

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	Palestine
Population living inside the Jordan basin	1,500,000
Surface of land included in the Jordan basin (km^2)	3,000
Run-off + Infiltration (mm/year)	123
Water recharge in the basin (Mm3/year)	370
	Palestine
Population living inside the Jordan basin	15%
Surface of land included in the Jordan basin	16.4%
Water recharge in the basin (surface + groundwater)	29.9%
	Palestine
Allocation of Jordan water according to Unified Plan (so-called Johnston proposal 1955)	*720 (Palestine + Jordan)*
Allocation to Palestine, according population (Mm^3/year)	**189**
Allocation to Palestine according to surface (Mm^3/year)	**211**
Allocation to Palestine according to water recharge (Mm^3/year)	**385**

TPAT calculation

Table 20. Sharing of the Jordan River water resource, based on the different criteria commonly used for the management of trans-boundary water resources.

Surface water harvesting from major wadis

The long-term strategic objective is to collect about 45 Mm3/year (table.21) from major wadis in the West Bank for various purposes including artificial recharge and to get the maximum benefit of 10 Mm3/year available from Wadi Gaza that can be captured and used either for infiltration to the aquifer and/or for irrigation.

The water in the West Bank will be collected through small and large scale infrastructures in major wadis.

Wadi	Proposed Harvesting Quantity Mm3/y	Purposes
Qilt	3.0	Domestic and agriculture
Auja	3.5	Agriculture and Artificial Recharge
Fara'a	5.0	Agriculture and Artificial Recharge
Al Mukalak	3.0	Agriculture and Domestic
Al Khudera	9.0	Agriculture and Domestic
Qana	9.0	Agriculture and Domestic
Sarida	9.0	Agriculture and Domestic
Al Moqata'a	3.0	Agriculture and Domestic

Table 21. Estimated available resource from various wadis in West Bank

These figures are rough estimates. Detailed engineering surveys and feasibility studies need to be carried out to verify these quantities and also to identify the actual scale, number and the suitable location of the interventions (harvesting structures) needed to be constructed in each proposed wadi.

Surface water short-term development strategic objective

Under the present situation (status quo and no peace agreement), the Jordan River resource is not accessible to Palestinians and is thus not taken into consideration in the short-term investment plan.

This investment plan is limited to rain harvesting systems, which are to be installed in the wadis that flow from the West Bank catchment areas. The water collected by these small dams will be used for irrigation mainly and, if possible, for artificial recharge, because:

- in the short-term, there are no plans to develop surface water treatment plants for domestic water supply; and
- this resource varies widely from year to year and does not constitute a reliable source of domestic water supply.

The short-term investment plan is sized for the collection of 10 Mm^3/year (table.22). A detailed list of projects is included in the annex of this report (see Appendix 6), while the detailed investment plan and action plan will be developed by PWA.

It should be noted, however, that under the present situation, these investments remain subject to JWC approval and to the no-objection from the ICA, as most of the rain harvesting systems will be located in area C.

Surface water resources in Palestine					
River basins	Average runoff (Mm^3/year)	Actual utilization (Mm^3/year)		5-years investment plan (Mm^3/year)	Long-term strategy (Mm^3/year)
		Israel	Palestine	Palestine	Palestine
West Bank - wadis flowing towards Mediterranean Sea	122.7[a]	?	1	5	30
West Bank - wadis flowing towards Jordan Valley	20.6[a]	0	0	5	15
Gaza Strip - wadis flowing towards Mediterranean Sea	21.5[a]	20	0	0	10[b]
Jordan River	1300	800[a]	0	0	200 to 400[b]

a source: PWA, 2012c

b these figures are not the official PA position for future negotiation; it is just a very simplistic estimation of abstraction rights sharing between Israeli and Palestinian customers, aiming to illustrate the volume of resources in the long-term scenario.

Table 22. Surface water resources and use.

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17. Reuse of treated wastewater for irrigation

17.1. Baseline

In Palestine, as in most Mediterranean countries, there is a growing awareness of the benefits of using treated wastewater as a valuable additional water resource. This is clearly expressed in the National Water Policy:

- *"Treated wastewater represents a potential resource and should be optimized for agricultural, recharge and aquaculture purposes;*
- *It is the National Policy to treat all wastewater produced to a quality sufficient to meet national standards for safe and productive reuse and to support the distribution and productive reuse of treated wastewater.*
- *It is the National Policy to strengthen treated wastewater reuse through sound contractual arrangements between producers and users".*

Despite this formal recognition of the importance of reuse, the formalized reuse of wastewater in Palestine remains minimal at the present time. The majority of existing WWTPs discharge directly into wadis or the Mediterranean Sea.

Some farmers pump this water directly out of the wadis and use it for irrigation. This activity is not regulated and there is no guarantee that the quality of the water being pumped is suitable for irrigating the kind of crops grown or safe in terms of public health. However, the mere existence of these irrigated fields clearly demonstrate that (a) there are no cultural constraints inhibiting the use of treated wastewater for agricultural purposes and (b) there is a demand for such water on the part of the farmers.

17.2. Regional perspectives for reuse

Wastewater reuse is well-established in other Middle Eastern and Mediterranean countries; thus, there are numerous lessons that can be learned by understanding the practices of others and applying and adapting them to the local conditions in Palestine.

In Israel, wastewater reuse is a core component of IWRM and the country claims to be reusing as much as 450 Mm^3/year of treated wastewater (Shellef, 2012).

In Jordan, 106,600 dunum are considered as irrigated by treated wastewater (Duqqah et al.), most of which (91,000 dunum) after mixing with fresh water from the Jordan Valley.

In Algeria, treated wastewater reuse has been on the Ministry of Water Resources' agenda for 30 years; however, project implementation has proved to be quite difficult due to legal and administrative constraints.

17.3. Potential water resources

The Table 23 provides an initial tentative estimate of the potential water available from the (existing and future) WWTPs, as well as the potential for developing irrigation. These estimates are based on the following variables:

- Population: MoPAD scenario;
- Population connected to a sewer (number of connections);
- Volumes collected and treated;
- Volumes available for irrigation during the irrigation period;

- Irrigable surface area; and
- Potential irrigated surface area.

This estimation is based on the hypothesis that all the constraints faced by the reuse of wastewater in Palestine have been removed.

	Present situation	5 year plan	Long-term strategy			
	2012	2017	2022	2027	2032	
West Bank						
Treated ww available for irrigation or infiltration	2,1	16,7	52,9	97,5	155,0	
Irrigation share	0%	25%	60%	60%	60%	60%, taking into account a longer irrigation period in Jordan Valley
Resource for reuse in irrigation (Mm^3/year) from Treated Wastewater	0,0	4,2	31,7	58,5	93,0	
Residual resource for infiltration (aq. Recharge or to the Wadi)	2,1	12,5	21,1	39,0	62,0	
Ground Water resource in Irrigation (Mm3//year)	51,0	45,8	40,5	35,3	30,0	
Dams for Irrigation (Mm3/year)	2,0	12,8	23,5	34,3	45,0	
Jordan River (Mm3/Year)	0,0	0,0	200,0	300,0	400,0	
Total Available quantity for Irrigation (Mm3/year)	**53,0**	**62,7**	**295,7**	**428,0**	**568,0**	
Irrigable land (dunum)	612 000	612 000	612 000	612 000	612 000	according to MoA land census
Irrigation needs	*600*	*600*	*600*	*600*	*600*	source: MoA
Potential irrigated land (in dunum)	**88 333**	**104 458**	**492 867**	**713 372**	**946 653**	
% of irrigable land	**14,4%**	**17,1%**	**80,5%**	**116,6%**	**154,7%**	
Gaza						
Treated ww available for irrigation or infiltration	33,2	43,5	59,3	75,8	99,9	
Irrigation share	3%	25%	25%	25%	25%	
Resource for reuse in irrigation (Mm^3/year) fron	1,0	10,9	14,8	19,0	25,0	25%, taking into account 6 months irrigation per year
Residual resource for infiltration (aq. Recharge	32,2	32,6	44,5	56,9	75,0	
Ground Water resource in Irrigation (Mm3//year)	86,0	72,5	59,0	45,5	32,0	
Dams for Irrigation (Mm3/year)	0,0	2,5	5,0	7,5	10,0	
Total Available quantity for Irrigation (Mm3/year)	**87,0**	**85,9**	**78,8**	**72,0**	**67,0**	
Irrigable land (dunum)	133 000	128 000	123 000	118 000	113 000	according to MoA land census + urban expansion reducing available land
Irrigation needs	*741*	*741*	*741*	*741*	*741*	source: PWA Gaza
Potential irrigated land (in dunum)	**117 403**	**115 882**	**106 383**	**97 112**	**90 401**	
% of irrigable land	**88,3%**	**90,5%**	**86,5%**	**82,3%**	**80,0%**	

Source: TPAT calculations

Table 23. Potential reuse of treated wastewater.

17.4. Strategy for the development of treated wastewater reuse in agriculture

Over the last decade, a number of small-scale reuse schemes have been initiated in Palestine for experimentation and demonstration purposes, in particular in Gaza, El Bireh and Al Jalazoun (HWE). The results of these experiments (plus those of the regional experience) have been sufficient to

prompt rapid progression to the next stage: medium-sized pilot projects, extending over a few thousand dunum.

The short-term strategy (next 5 years) aims to implement such pilot projects downstream from five, already well-known WWTPs: El Bireh, Jericho, Jenin and Nablus West (West Bank) and Gaza. These pilot programs will not wait for the formalization of a new institutional framework and/or the creation of new agencies. In fact, these can and will be implemented by the existing agencies: PWA, MoA, water utilities and farmers' associations.

In order to mobilize the farmers more rapidly, awareness-raising campaigns will be conducted to inform potential users of the benefits and safety of water reuse. This water reuse can include the simplest of grey water reuse by households, to much larger irrigation schemes that use either storm water or water from treatment plants. The use of mass media will be considered as an important means of promoting reuse and its associated benefits and messages.

Completing the regulatory framework

PWA and MoA will develop the mechanisms necessary to encourage the farmers to use the treated wastewater in agriculture while also taking into consideration financial and economic considerations.

MEnA, PSI, MoA and PWA will work together to develop and enforce all regulations pertaining to the Environmental Limit Values (standards and guidelines) for wastewater reuse, altogether the required specifications for different crops.

Additional regulations will be developed over the next five years, covering:

- investment in treated wastewater carriers (defining ownership, rules for implementation, funding arrangements);
- right-of-use; and
- tariff-setting mechanism.

Assessing and costing opportunities for reuse

Opportunities for the further development of wastewater reuse will be investigated, also taking into account both environmental and health constraints.

As can be seen in Table 23, and given the WWTPs under construction (or in the design phase) in the Occupied Palestinian State (to be agreed upon), the volume of water that could be available for irrigation is relatively high (27 Mm^3/year by 2017 and 39 Mm^3/year by 2022).

The short-term strategy (next 5 years) includes:

- a detailed assessment of the irrigable land located downstream from future WWTPs or that could be supplied with a moderate pumping head (< 50 meters); and
- a rapid appraisal of the investment and running costs of the facilities to be constructed for each of the schemes (canal, storage, pumping stations), in order to enable the development of a robust business model for each reuse scheme.

Organizing reuse management

The Strategy considers that clear and concise institutional arrangements will be defined within 3 years not only for the sustainable management of reuse schemes, but also to ensure the equitable distribution of water between farmers.

Reused wastewater will be affordable to agricultural users, bearing in mind that there are mutual benefits on both sides (farmers and the treated wastewater supplier): The service provider is responsible to treat wastewater into agreed standards and after that MoA and PWA will organize the

utilization of this water towards potential application with farmers and other stakeholders through clear mechanism.

Wherever large scale wastewater reuse is carried out, water quality monitoring will be conducted by an approved laboratory. Instituting such monitoring mechanisms will help to minimize any potentially detrimental impacts on the environment and, more specifically, on the soil and underlying aquifers. MoA, in association with PWA, MoH and MEnA, will coordinate and manage these monitoring activities.

Non-Governmental Organizations (NGOs) will be encouraged and supported in the development of water reuse projects, where appropriate, because it is considered important to involve the private sector in these activities.

These institutional and stakeholder involvement issues are further elaborated in Section 21.4 on institutional structure and Chapter 23 on challenges, more explicitly expressing the involvement of the stakeholder organizations, and also including the lead role of MoA in WUAs as Water users' associations (WUAs) are very important institutional partners in irrigation water management. MoA will establish WUAs with relevant stakeholders to supply agricultural water services at local level in an integrated manner.

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18. Integrated Water Resources Management

18.1. Water resources monitoring

Because of the water shortage in Palestine, monitoring the water resources is paramount. PWA is in charge of collecting, gathering and publishing data regarding the water resources (groundwater level and quality, river flow and quality, etc.)

This information is published in periodic reports, such as the "Status report of water resources in the occupied territories – 2011 (PWA, 2012c). Although the data are generally considered of good quality, the monitoring of influent and effluent wastewater quality is still rather limited.

18.2. Improving water allocation among communities

The national water strategy goes beyond defining national average indicators for coverage, service level or water quality. It aims to reduce the differences among Palestinian citizens and regions. To this end, the national strategy includes the implementation of actions at three levels:

- inter-regional: transferring bulk water from region to region in order to reduce inequalities[14];
- inter-community: interconnecting the water systems run by different service operators and water resources reallocation management; and
- inter-customer: implementing tariff policies that aim to improve access to water services by the poor.

18.3. Annual Assessment of Water Resources

Since all natural water resources in Palestinian territories are renewable, it is highly recommend to assess the water allocation annually. This includes the differences between all water inflow and outflow components of the aquifer systems. This activity will not only enhance the management of all water resources and identify any other new potential resources, but it will also allow the definition of the utilization priorities of water resources for each sector. This annual review will also describe the state of the art of water resources assessment that will be carried out by the PWA in coordination with key stakeholders and with related ongoing projects.

18.4. Impact of Climate Change and Flood Risks

In Palestine, the water and agriculture sectors are most vulnerable to climate change impacts that pose great environmental, social and economic threats. Climate change is likely to increase competition for scarce natural resources and trigger further restricted access to land and water resources. In the last few years, there are marked changes observed due to climate change which have resulted in drought, rainfall variation-shifting, minimum and maximum temperatures and extreme events through flash floods in the major wadis.

The main objectives that must be considered to ensure a reliable alleviation of climate change and flood risks impacts in Palestine include:

- Ensuring water security to meet future increases in demand for water and enable the socio-economic development;

[14] Aquifer swapping (inter and intra swapping) will be considered, to ensure fair distribution of water among regions. PWA (water resources development Dept) is now developing the position paper concerning this important issue for the strategy implementation.

- Enabling the equitable allocation of water resources among competing water uses for sustainable development of water resources;
- Deploying the principles of Integrated Water Resource Management (IWRM); and
- Developing a protection program against flash flood risks.

Therefore, there is an urgent need to develop a specific plan to assess the vulnerability of climate change which is aimed at alleviating the adverse impacts of climate change and flood risks in Palestinian Territories (currently under development by PWA). The plan should include all necessary measures and actions to (at least) halt the process of decreasing water availability and minimize the threats of floods; and also to guarantee the sustainability of local livelihoods and suitable welfare conditions for the most vulnerable groups of the population.

The measures may comprehend the following actions:

- Promoting efficient use of existing water resources by imposing water conservation measures;
- Identifying options for increasing fresh water resources;and
- Building wastewater system components either not to be affected by flooding or to drain the water quickly (elevated sludge drying beds, constructed wetland).

18.5. Delineation of Protection Zones and Rehabilitation Programs

Because most of Palestinian sources for drinking water are considered to be under real threat from several sources of pollution, an action and accompanying measures need to be formulated to ensure the reliable protection at its current status and future perspectives. Therefore, it is essential to formulate reliable protection zones, based on a detailed and advanced assessment for all major water resources, paying special attention to major springs. This step should be associated with specific rehabilitation programs for the existing wells and springs in cooperation with all related stakeholders.

18.6. Water users/customers consultation

With so many different water uses and water users, PWA is not and can not be the only responsible body for the implementation of the strategy. In Integrated Water Resources Management, all stakeholders' active contribution will be necessary for the success of the planning, management, development, conservation and protection of the sector.

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Part 3.4. Water and Wastewater Services Improvement

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19. Water service delivery improvement

19.1. Improvement of customer service

Water service coverage and number of connections

In Palestine, piped water service is already provided to more than 95% of communities, also servicing more than 95% of households, with a relatively high connection rate of 14 to 18 connections per 100 inhabitants. The strategic objective is fixed at 100% of communities serviced with piped water systems and with 20 house connections per 100 inhabitants by 2032.

Reliability and quality of service

West Bank

In the West Bank, most of the water systems do not supply water 24h/day everywhere. The most frequent service option is to deliver water every day during few hours and let the customer manage this shortage. A significant number of houses are equipped with roof tanks (and eventually a small booster pump) in order to cope with this irregular service provision. However, such service delivery is not suitable to preserve water quality. When the pressure gets negative, polluted water tends to enter into the pipes. The strategy aims to improve pressure management in the network through a mix of measures: (1) the construction of additional storage tanks and booster stations and (2) dividing the largest networks into separate sectors. The strategic objective for 2032 is fixed as 10 hours storage capacity (equivalent to a 50% of households benefiting from 24h service.

Gaza

In the Gaza Strip, none of the water systems provide water 24h/day. Like in the West Bank, the most frequent service option is to deliver water every day during few hours and let the customer manage this shortage. A majority of all houses are equipped with roof tanks (and eventually a small booster pump) in order to cope with this irregular service provision. The strategic objective is fixed as 10 hours storage capacity (equivalent to 206,000 m3) and 90% of households benefiting from 24h service by the year 2032.

The strategic objectives are more ambitious in Gaza than in West Bank, because the urban population is much larger and could benefit from modern system management, whereas the West Bank has many small rural systems, and with huge differences in altitude, making it much more difficult to provide water 24h/day.

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Quality of water and strategic objectives in West Bank

In the West Bank, the groundwater quality is satisfactory in most wells. These waters require just a simple chlorination before it can be used for domestic water supply, the main reason being that they are almost originating from karstic aquifers, vulnerable to fecal contamination (by wastewater seeping from septic tanks or fissured sewers). The strategic objective is fixed at 100% of the water systems to be equipped with chlorination systems in the short and long term strategy

The only recorded problem in the West Bank is the increasing nitrate pollution (by agriculture and poor wastewater facilities). Although the level of pollution is lower in West Bank than in Gaza, this issue will need to be taken into account. The strategic objective for 2032 is fixed at 100% of water systems delivering water with <50 mg/l NO3. For this purpose, water from wells exceeding this threshold will be mixed with other resources before it is distributed. If this would not be possible, it should be used for irrigation or industrial purposes only.

West Bank	Present situation	5 year plan	Strategic objectives			
	2012	2017	2022	2027	2032	
Total population	2 649 020	3 473 267	4 742 596	5 713 113	6 548 006	MoPAD scenario 5
Connections and network extensions						
Connection rate (conn./100 inhab)	*14,0*	*14,8*	*15,9*	*17,6*	*20,0*	strategic objective
Connection number	370 000	514 000	754 000	1 005 000	1 309 000	according to pop and connection rate objective
5-years growth (nr new connections)		144 000	240 000	251 000	304 000	difference
Tertiary network extensions (ml)		1 152 000	1 920 000	2 008 000	2 432 000	based on 8 ml/connection
Production capacity						
Water available per capita (lcd)	*72*	*72*	*88*	*104*	*120*	strategic objective
Water distributed (Mm^3/year)	70	91	152	217	287	total, per year
Industrial water, as a percentage of domestic	*3,0%*	*3,0%*	*4,3%*	*5,7%*	*7,0%*	strategic objective
Water distributed (Mm^3/year)for Industrial Use	71,7	94,0	158,9	229,2	306,9	total domestic + industrial
UFW	*31,0%*	*28,3%*	*25,5%*	*22,8%*	*20,0%*	strategic objective
Water produced (Mm3/year)	104	131	213	297	384	total, per year
West Bank boreholes	44	44	86	142	211	strategic objective
springs	9	12	13	13	13	strategic objective
import (Mekorot)	51	75	92	110	120	strategic objective
and desalination plants	0	0	22	32	40	strategic objective
Storage capacity						
Water produced annually (Mm^3/year)	104	131	213	297	384	
Water produced daily (m^3/day)	284 712	358 993	584 475	812 729	1 050 955	
Hours of storage	*2*	*2*	*4,7*	*7,3*	*10*	strategic objective
Storage capacity (m^3)	23 000	29 000	113 000	248 000	437 000	according to hours of storage
Additionnal storage capacity to be build (m^3)		6 000	84 000	135 000	189 000	difference

Table 24. Strategic objectives for water supply in the West Bank

Quality of water and strategic objectives in Gaza

Groundwater in the Gaza Strip is of a very poor quality. The main aquifers have been contaminated by sea water intrusion, chloride, sulfate, and by nitrogen release (by poor wastewater facilities and/or agriculture). Strategies will be implemented to restore domestic water quality through desalination of sea water and mixing water from different origins.

The strategic objective for 2032 is fixed at a production of a large volume of desalinated water. This water, containing no chloride and no nitrate, will be mixed with groundwater in a suitable ratio in order to have all water used for domestic purposes meeting the national quality standards (table. 25).

The strategic objective for 2032 is that all water systems are equipped with chlorination systems.

Gaza Strip	Present situation	5 year plan	Strategic objectives			
	2012	2017	2022	2027	2032	
Total population (scenario 5)	1 644 293	1 994 680	2 339 313	2 645 554	3 002 518	MoPAD scenario 5
Connections and network extensions						
Connection rate (conn./100 inhab)	*14,0*	*14,8*	*15,9*	*17,6*	*20,0*	strategic objective
Connection number	230 000	295 000	371 000	465 000	600 000	according to pop and connection rate objective
5-years growth (nr new connections)		65 000	76 000	94 000	135 000	difference
Tertiary network extensions (ml)		520 000	608 000	752 000	1 080 000	based on 8 ml/connection
Production capacity						
Water available per capita (lcd)	*96*	*96*	*104*	*110*	*120*	strategic objective
Water distributed (Mm^3/year)	58	70	89	106	132	total, per year
Industrial water, as a percentage of domestic	*3,0%*	*3,0%*	*4,3%*	*5,7%*	*7,0%*	strategic objective
Water distributed (Mm^3/year)for Industrial Use	59,3	72,0	92,6	112,2	140,7	total domestic + industrial
UFW	*43,0%*	*37,3%*	*31,5%*	*25,8%*	*20,0%*	strategic objective
Water produced and imported (Mm3/year)	104	115	135	151	176	total, per year
including groundwater	*95*	*50*	*51*	*37*	*33*	strategic objective
import (Mekorot)	*5*	*10*	*14*	*14*	*14*	strategic objective
and desalination plants	*4*	*55*	*70*	*100*	*129*	strategic objective
Storage capacity						
Water produced annually (Mm^3/year)	104	115	135	151	176	
Water produced daily (m^3/day)	285 242	314 317	370 556	414 144	481 904	
Hours of storage	*2*	*2*	*4,7*	*7,3*	*10*	strategic objective
Storage capacity (m^3)	23 000	26 000	72 000	126 000	200 000	according to hours of storage
Additionnal storage capacity to be build (m^3)		3 000	46 000	54 000	74 000	difference

Table 25. Strategic objectives for water supply in the Gaza Strip

20. Wastewater collection and treatment

20.1. Sewerage and wastewater collection

In the West Bank, sewer systems exist mostly in the oldest urban communities (Jenin, Hebron, Nablus, Qalqilya, Tulkarem, some districts of Ramallah), servicing 71 (out of 524) localities and 1.02 (out of 2.48) million inhabitants. However, where sewers exist, not all houses are connected and the overall connection rate to sewers is estimated to be 31% in West Bank (see chapter 4).

In the Gaza Strip, sewers have been installed in most urban communities, covering 23 (out of25) localities and 1.41 (out of 1.53) million inhabitants. Like in the West Bank, where sewers exist, not all houses are connected, however the overall connection rate to sewers is estimated to be 72% (see chapter 4).

The strategy aims to build additional sewer networks in all urban localities and extend the existing sewers to neighboring rural areas, where feasible, in order to collect the largest possible volume of wastewater and limit groundwater contamination by pathogens and nitrates.

The sewerage coverage rate will probably always be higher in the Gaza Strip than in the West Bank, because the Gaza Strip has a densely populated and flat area in which building a comprehensive sewerage network is more necessary and easier than in the West Bank. In the West Bank, a significant share of the population lives in remote and small villages, meaning that on-site sanitation is a more cost-effective option.

Within the short term strategy, there is a need to construct more sewage collection systems or to expand the existing collection systems in urban areas and in some selected rural areas.

The long term strategic objectives have been defined as:

- 95% of the Gaza Strip population and 75% of the West Bank population are connected to a sewer system.

20.2. Planned new wastewater treatment plants

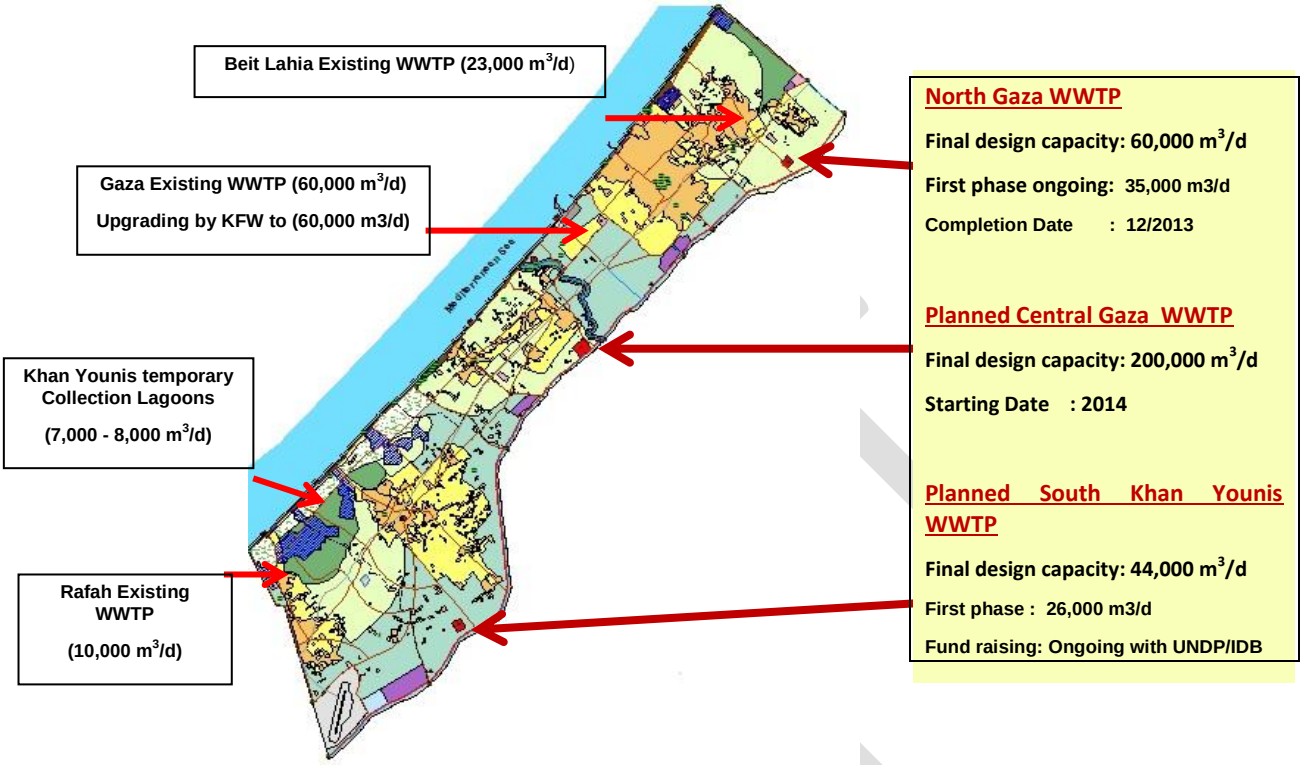
In the West Bank, there are currently only a few wastewater treatment plants (WWTPs) in place; however, a number of additional WWTPs have been designed and are currently in the planning phase or under construction (Table 26. Scheduled WWTP (in the planning or construction phase).). It is unclear if all these projects will be completed by the due date, as the Israeli administration (through the JWC or the ICA) is hindering and constraining the construction of these WWTPs.

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Treatment Plant	Governorate / Service areas	Status	Capacity to be installed (m^3/day)		
			Short term (2017)	Mid term (2022)	Long term (2032)
West Bank					
Bethlehem Industrial Zone (phase1)	Bethlehem	Implementation phase	100	100	100
Bethlehem Industrial Zone (phase2)	Bethlehem	Planning phase	300	400	500
Wadi Al'Aroub WWTP	Hebron	Design phase	1,020	1,080	1,200
West Bethlehem Rural area	Bethlehem / Battir, Husan, Nahalin, Wadi Fukin and Alwalajeh	Feasibility study	0	0	5,000
Hebron Regional WWTP	Hebron	Feasibility study	10,500	12,750	15,000
Misilya TP	Jenin	Design phase	240	320	400
Jenin TP	Jenin	Rehabilitation phase	4,500	6,750	9,000
Construction 6 WTTP's (Al-Yamun, Qabatiya, Ya'abad, Azzun, Tarqumiya, Dura)		Completed design	10080	13,440	16,800
Jericho sewerage project	Jericho	Implementation phase	3,840	7,680	9,600
Nablus West	Nablus	Construction phase	7,200	9,600	12,000
Beit Hasan WWTP	Nablus	Design phase	60	80	100
Al-Bireh TP	Ramallah	Extension and modifications phase	5,750	5,750	5,750
Al-Tireh WWTP	Ramallah	Tendering phase	1,200	1,600	2,000
Al-Rihan Compact WWTP	Ramallah	Implementation phase	416	520	520
The Diplomatic Compound WWTP	Ramallah	Implementation phase	400	500	500
Ramallah-Beitunya TP	Ramallah	Finished feasibility study	6,000	8,000	10,000
Construction small scale WTTP's (Taybe, Ramoun, Anza, Beit Dajan, Sir, Hajja)		Implementation phase	1,440	1,920	2,400
Tubas-Tayasir sewerage project	Tubas / Tayasir, Aqaba and Al'Aqaba	Tendering for Design phase	1,800	2,400	3,000
Nablus East Sewerage WWTP	Nablus	Design phase	8,400	11,200	14,000
North East Jerusalem WWTP	Jerusalem	Sanitation and base line study	0	0	5,000
Rawabi WWTP Project	Ramallah	Feasibility study	0	0	6,000
		Sub Total West Bank	**63,246**	**84,090**	**118,870**
Gaza Strip					
N.Gaza WWTP	N.Gaza	Under construction	35,000	35,000	60,000
Central Gaza WWTP	Central Gaza	Planned	60,000	200,000	200,000
South Khan Younis WWTP	Khan Younis	Planned	26,000	44,000	44,000
		Sub Total Gaza	**121,000**	**279,000**	**304,000**
		Total capacity (m^3/day)	**184,246**	**363,090**	**422,870**

Table 26. Scheduled WWTP (in the planning or construction phase).

There are already three large WWTPs in place in Gaza and additional wastewater treatment capacities are currently under construction, with little interference from the Israeli administration (except for some constraints related to the import of construction materials).



Source: PWA – Gaza

Figure 20. Existing and planned WWTPS in the Gaza Strip.

As part of the short term strategy until 2017, it is expected to:

- complete the ongoing projects to construct regional treatment plants;
- complete ongoing projects to construct community level WWTPs;
- start and complete secondary or tertiary treatment of 12-15 Mm^3/year of wastewater in West Bank and 40 Mm^3/year in Gaza strip;
- reuse at least 25% of the treated wastewater in irrigated agriculture; and
- reduce the treatment inside the green line to less than 6 Mm^3.

In the Gaza Strip, it is expected to close the Beit Lahiya treatment plant as soon as the new North Gaza treatment plant starts its operations, and to close the Gaza treatment plant as soon as Central Gaza WWTP is operating, and to close the temporary Khan Younis WWTP as soon as South Khan Younis starts to operate (fig.24).

20.3. Additional WWTPs to be planned in the West Bank

In the present situation, less than one third of all households are connected to a sewer system, collecting and conveying wastewater to an operational WWTP. The efficiency of some of these WWTP is below the design efficiency. The strategy aims to increase the percentage of wastewater treated and to improve the average rate of efficiency of the WWTPs.

The long term strategic objectives for the West Bank for 2032 have been defined as:

- 75% of households will be connected to a sewer;
- 80% of sewered water will be properly treated.

In order to meet this strategic objective, additional WWTPs with more than 300,000 m^3/day capacity need to be constructed by 2032 (Table 27. Strategic objectives for sewerage and WWTP in the West Bank.).

West Bank	Present situation	5-year plan	Strategic objectives (long-term = Statehood)			
	2012	2017	2022	2027	2032	
Total population	2 649 020	3 473 267	4 742 596	5 713 113	6 548 006	MoPAD scenario 5
% households living in sewered localities	*41%*	*55%*	*68%*	*81%*	*94%*	
% households actually connected to a sewer	*31%*	*42%*	*53%*	*64%*	*75%*	strat objective
Sewered population	821 196	1 458 772	2 513 576	3 656 392	4 911 004	
Unsewered population (on-site sanitation)	1 827 824	2 014 495	2 229 020	2 056 721	1 637 001	
Water used per capita (lcd)	72	72	88	104	120	strat objective
Water used (m^3/day) - average	190 729	250 075	417 348	594 164	785 761	
% used water that is rejected	*80%*	*80%*	*80%*	*80%*	*80%*	international benchmark
Water collected by sewers (m^3/day) - average	47 301	84 025	176 956	304 212	471 456	
Total WWTP capacity (m^3/day)	**5 750**	**68 996**	**144 840**	**267 230**	**424 620**	
% sewered water that can be treated	*12%*	*82%*	*82%*	*88%*	*90%*	% with projected WWTPs
Existing plants (m^3/day)	5 750	5 750	5 750	5 750	5 750	
WWTP in planning or construction phase		63 246	84 090	101 480	118 870	
Additional WWTP to be planned (m^3/day)		0	55 000	160 000	300 000	

Table 27. Strategic objectives for sewerage and WWTP in the West Bank.

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Additional WWTPs already planned in the Gaza Strip

In the present situation, three quarters of the households in the Gaza Strip are connected to a sewer system, channeling wastewater to an operational WWTP. Like in the West Bank, the efficiency of some of these WWTPs in the Gaza Strip is below the design efficiency. The strategy aims to increase the percentage of wastewater treated and to improve the average rate of efficiency of the WWTPs.

The strategic objectives for the Gaza Strip for 2032 have been defined as:

- 95% of households will be connected to a sewer;
- 95% of sewered water will be properly treated.

In order to meet this strategic objective, additional WWTPs need to be constructed by 2032 (table.28). The projects whose implementation has already been planned by PWA will be sufficient to meet this objective.

Gaza Strip	Present situation	5-year plan	Strategic objectives (long-term = Statehood)		
	2012	2017	2022	2027	2032
Total population	1 644 293	1 994 680	2 339 313	2 645 554	3 002 518
% households living in sewered localities	*92%*	*93%*	*94%*	*95%*	*96%*
% households actually connected to a sewer	*72%*	*78%*	*84%*	*89%*	*95%*
Sewered population	1 183 891	1 550 864	1 953 326	2 361 157	2 852 392
Unsewered population (on-site sanitation)	460 402	443 816	385 987	284 397	150 126
Water used per capita (lcd)	96	96	104	110	120
Water used (m^3/day) - average	157 852	191 489	243 289	291 011	360 302
% used water that is rejected	*80%*	*80%*	*80%*	*80%*	*80%*
Water collected by sewers (m^3/day) - average	90 923	119 106	162 517	207 782	273 830
Total WWTP capacity (m^3/day)	**104 000**	**172 000**	**212 000**	**264 000**	**316 000**
% sewered water that can be treated	*114%*	*144%*	*130%*	*127%*	*115%*
Existing plants (m^3/day)	104 000	92 000	12 000	12 000	12 000
WWTP in planning or construction phase		80 000	200 000	252 000	304 000
Additional WWTP to be planned (m3/day)		0	0	0	0

Source: TPAT calculations.

Table 28. Strategic objectives for sewerage and WWTP in the Gaza Strip

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21. Institutional Reform

21.1. Background

The current setup of the water supply and wastewater management is organized under four levels mainly; decision-making level, regulatory level, development and supply level, and service provision level:

- The National Water Council (NWC) is headed by the President. The NWC has not held a single meeting since its establishment in 2002, due to the fact that Article No. 6 of the Water Law states that the PWA falls under the jurisdiction of the President of the Palestinian National Authority. The Water Law has not been revised to be brought in line with the Basic Law, by which the post of Prime Minister was created in 2003. As a result, the discordance in PWA's reference was created as Article 9/69 from the Basic Law granted the Council of Ministers complete jurisdiction over all public institutions, excluding the National Water Council (NWC). The aforementioned situation has restricted PWA's efforts, specifically with regard to the issuance of laws and regulations in various aspects related to water. These laws and regulations were supposed to have been formulated by the NWC and submitted to the Prime Minister for approval;
- Palestinian Water Authority is the regulator;
- The West Bank Water Department is responsible for monitoring, developing and supplying bulk water to the water service providers; and
- Water service providers: There are major water utilities that supply water to the public in the West Bank. Two of them are public water supply utilities, i.e. the Jerusalem Water Undertaking (JWU) and the Bethlehem Water Supply & Sewage Authority (WSSA) while the others are water divisions of large municipalities (such as : Nablus, Hebron, Jenin, Tulkarem, Qalqilya, Jericho, Salfit and Tubas municipalities). In the Gaza Strip there is one water utility (Coastal Water Management Utility) in addition to the water divisions in a number of municipalities.

The historical situation of institutions and their legal foundations suffer from a fragmentation on the levels of their internal institutional and legal aspects, in addition to the Israeli occupations, Israeli domination at the JWC and Civil Administration and their jurisdiction in area C that requires permits for project construction.

PWA has begun to work to understand the reality of the sector and its contradictions in order to determine what can be done to stop the deterioration of services and work on reversing this situation.

The PWA requested independent bodies to conduct assessments of the water sector and the factors which influence it. These assessments included:

- "PWA Audit", funded by the Norwegian Government in 2008 regarding good governance of the water sector
- World Bank study in 2009 to evaluate the water sector since the establishment of the PWA. The study report held Israel accountable for much of the deterioration of the water sector in the occupied Palestinian territories and recommended that the PWA conducts a comprehensive reform of the water sector.
- Amnesty International report "Palestinians Denied Fair Access to Water – October 2009". The report also held Israel accountable for much of the water crisis in the occupied Palestinian territories.

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These reports emphasized the extent of the Israeli occupations influence in prohibiting the development of the water sector during the past decades. The reports stated that this negative situation has resulted in the following:

- a noticeable decline in the levels of water services, with respect to both the quality and quantities of available water;
- a near stop of wastewater services and their development, increasing environmental damage and reducing the capabilities of treating/recycling wastewater, which has the potential to be used as an unconventional resource that could be utilized for agricultural and environmental purposes. These negative developments have primarily been the result of the terms of the Oslo 2 Agreement of 1995, which placed restrictions on the sector during the transitional stage and as a result of the continuance of the Israeli occupation of vast portions of Palestinian land (approximately 61%).

In addition, many internal and external factors were considered as the core obstacles that need to be addressed as a matter of priority (Audit Report, 2009):

- strong fragmentation in the water sector;
- problems in the institutional arrangements, in particular unclear roles of the different actors as well as coordination problems;
- the application of the inherited laws;
- capacity Building requirements at all levels;
- shortcomings in the enforcement of laws and policies;
- shortage of funds and funds release in a timely manner for priority projects;
- a strong emphasis on crisis management rather than long term management;
- the sector needs to be further decentralized if PWA is to assume its determined role;
- insufficient data and information, particularly in terms of reliability, accessibility and sharing;
- poor coordination and low transfer of information between Ministries/Authorities and water sector stakeholders;
- public awareness in relation to water and wastewater related issues is limited; and
- a lack of support for PWA in negotiations with the JWC and ICA on approaches to enable the implementation of pending high priority projects.

21.2. The Cabinet of Minister Decision on the Reform Plan

On December 14th 2009 the Cabinet of Ministers endorsed an “Action Plan for Reform” towards the definition and implementation of a comprehensive program of institutional and legislative reform. The overall reform is expected to include the reorganization of the water sector and the institutions in it, capacity building, and the revision of strategies and policies, when necessary, as a result of any change that takes place in the architectural arrangements of the sector.

Sector Reform Objectives

The sector reform objectives have been defined as follows:

- With regards to institutions, the Sector Reform will establish strong (capable) and sustainable institutions within a legal framework that clearly defines their roles, responsibilities and the interface (relationship) between them;

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- With regards to infrastructure needs, the Sector Reform will improve water supply and wastewater strategies, policies, investment programs, project designs, and the implementation of projects, in an effort to substantially accelerate infrastructure development;
- With regards to service provision, the Sector Reform aims to accelerate equitable access to a quality service, while providing improved efficiency and cost-recovery of effectively regulated water operators;
- With regards to water resources management, the Sector Reform will help to build the institutional knowledge, policies, and monitoring and enforcement capacities, as part of an effort to achieve a more sustainable water resources management strategy; and
- With regards to water consumers, the Sector Reform will aim at improving water demand management awareness in line with the development of water conservation policies.

Sector Reform Plan

This reform plan consisted of several fundamental elements, all of which are closely interrelated:

- the Institutional Water Sector Review (IWSR) to propose a preferred institutional arrangement which will be derived by consensus;
- the Legislative Review (LR) to addresses the identified weaknesses within the current law and provide a new water law that will be compatible with the newly proposed institutional arrangement;
- a Capacity Building Program (Technical Planning Advisory Team – TPAT) – to provide capacity building and technical assistance to enable the PWA during the transition period to develop a new strategic vision according to the new structure, and to develop policies, strategies, regulations, master planning plans and investment plans for water resources and service provision; and

Organizational Reform (OR) and Change Management (CM) program to change the administrative and organizational structure of the PWA to coincide with the new structure that will be suggested by the IWSR.

In the short term, it was envisaged that the reform programs aims to:

- rectify the utility service procedures in a way that will ensure an equitable provision of high quality service, improve capabilities, recover operating costs of water facilities and organize them more effectively;
- achieve more sustainable management of strategic water resources by means of enhancing institutional knowledge, policies, monitoring capabilities, following up and the application of the water law, and increase awareness on water demand by means of applying policies that will help to preserve the water resources.

The long term goals of the reform program were defined as:

- to establish strong/capable institutions within the framework of sustainable development and a legal framework that clearly defines the roles, responsibilities and interrelationship between institutions in the water and wastewater sector, as well as those institutions that share responsibility on the periphery of the sector;
- to focus on improving the strategies and investment policies regarding water supply and sewage provision, project design and implementation. This will be done to expedite the growth of the infrastructure in a way that will fulfill the country's requirements.

Finally, in 2012, the Ministerial Infrastructure Committee (MIC) approved the principle of the reform plan, approved the recommendation of the IWSR and tasked PWA to prepare a new Water Law taking into consideration this principle.

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21.3. Legislation Development

A new Water Law is under development to define the general structure and function of the institutions governing and managing the water sector and to clarify the responsibilities of the different ministries involved in the water sector. The new law shall also define legal issues related to water.

Several regulations for water resources, water supply and wastewater will be developed, including, but not be limited to the water tariff regulation, regional water utilities regulation, a regulation on licensing of service providers, water and wastewater connection regulation.

Strict controls will be introduced on the use of groundwater including the elimination of the free abstraction and limiting the abstraction quantity based on the aquifer safe yield. Enforcement measures against illegal use, abuse and deteriorating groundwater conditions shall be introduced.

Water resources protection legislation will be established to legally implement water resources protection zones for drinking water resources.

21.4. Institutional Structure and Function Development

The PWA is currently performing a variety of functions, ranging from political and strategic functions (ministerial), and regulatory functions, to bulk utility operational functions, and infrastructure development project management functions. This combination functions is causing PWA to engage in a crisis management process which in turn has impaired its ability to perform and deliver its mandated duties properly. Accordingly, the institutional reform will be enacted to restructure the water sector based on functional roles separating governance level from water management level, considering the following issues:

1. PWA to be restructured to assume ministerial functions (policy and strategy) and WRM related regulatory functions;
2. Creating a new body (water regulatory council) to assume regulatory functions relating to water supply and wastewater service provision ;
3. Transform the WBWD to become a National Water Company.

   In recent time, the WBWD has not performed well financially. There is a high unaccounted-for water (UFW) factor stemming from technical and administrative losses. Billing and collection is below acceptable rates and it is currently carrying a huge debt.

   A turnaround strategy is to be implemented to see the organization operate on a business-like platform, using a commercially acceptable accounting system; operating and maintaining its assets according to internationally recognized practices, and incorporating a tariff setting mechanism that in the initial stages will target recovery of O & M costs.
4. Reorient PWA's Project Management Unit (PMU) to become more responsive to sector institutions' needs through the PWA structure and capable to provide technical assistance - capacity building support to service providers and project coordination.

   The current functionality of the PMU is focused on infrastructure development project implementation. It provides project oriented services to Donor funded projects; those services include water supply system design and review, construction supervision, procurement and contract management.

The reform may also provide opportunities for greater private sector engagement through various business models. The specific roles and responsibilities of these functional roles will be investigated before it will be formalized through legislation.

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Palestinian Water Authority (PWA)

Through the reform, PWA's main functions will include the following:

- Prepare and implement effective policy;
- Develop and enforce pragmatic legislation;
- Produce and continually update strategic action plans, master, investment and implementation plans;
- Prepare and implement a series of focused communication strategies and programs;
- Facilitate an Integrated Water Resource Management program;
- Maintain effective and successful relations with the international donor community;
- Support community involvement and provide public awareness campaigns to the organizations in the water management level; and.
- Enhance Research and capacity development.

While part of the PMU functions will be phased-out, other functions will be incorporated in the PWA structure. This relates in particular to provide technical assistance and capacity development support to the utilities in accordance with the development plans and on the basis of the Authority recommendations

The JWC will no longer exist and be replaced by a regulatory water council with different mandates and responsibilities as reflected below.

Regulatory Water Council

An independent water regulatory council will be established with the following main functions:

- Develop and implement an economic regulation model and regulate the establishment of prices and tariffs;
- Issue licenses to water supply and wastewater service providers and enforce the compliance with the license conditions;
- Regulate public service obligations, and the quality of service provided. Promote the use of benchmarking and develop programs for performance incentives and penalties.

National Bulk Water Company

A National Water Company (NWC) will be established as a state-owned public shareholding company, and all its shares shall be owned and held by the State. It can not change its status or sell any of its shares to the public or to any private party, until and unless it attains viability and financial sustainability.

The National Bulk Water Company will obtain a service provision license from the Water Regulatory Council and will be subject to its supervision and regulation. It will operate in the most cost effective manner to carry out the following primary tasks:

- Produce, treat or organize treatment of water from wells, and any other water resources, including desalination, as per licenses issued under this Law and Regulations.
- distribute all water available to it in bulk to service providers or privates, as per obtained licenses and the official water tariff in force to water service providers and private users;
- Drill, operate and maintain wells, transmission pipe mains, facilities, associated pumping stations and equipment;
- Purchase water from other available water sources subject to the approval of the Ministry;

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Regional Water Utilities

Regional Water Utilities (RWUs) shall be established by groups of municipalities, with support from the MoLG and PWA and in consultation with the relevant stakeholders. RWUs will obtain service provision licenses from the Water Regulatory Council and will be subject to its supervision and regulation.

The Regional Water Utilities shall exercise, deliver and perform the primary functions, tasks and responsibilities as listed hereunder:

- maintain, operate and extend the coverage of the existing water service infrastructure in accordance with the license and a capital investment and work program;
- supply of water to all customers in their service area; and
- provide wastewater services including the collection, treatment and disposal of wastewaters.

Water Users associations

Water users' associations (WUAs) are very important institutional partners in irrigation water management. MoA will facilitate the establishment of Water User Associations with relevant stakeholders to manage the supply of agricultural water services at local level in an integrated manner.

PWA and MoA encourage the establishment of customer associations to represent customer rights and concerns regarding the quality and reliability of the service delivery, the fair allocation of water among users and to address environmental concerns.

21.5. Commercial Practices

Operation using best commercial practices within a regulated water market will be encouraged. More business-like approaches to water resources management will save water and reduce governmental cost subsidies. Water utilities must be run like businesses with a focus on customer service, providing a quality product that is properly valued and paid for by customers. The high losses within the water distribution systems must be reduced and gradually brought in line with international best practices. It must be stressed that better commercial practices also require providing a better product to consumers. A partnership between consumers and utility companies must be established where consumers can expect to receive an improved service and utilities can expect to receive an adequate tariff for that service.

The transition from subsidized and inefficient providers of a public service to a new structure is encouraged that allows for commercial providers of a valuable commodity.

Benefits from the adoption of commercial practices are expected to include:

- reductions in man-power required per unit of water delivered to customers;
- increases in revenues from outsourcing billing, collection and customer service to private companies;
- potential reduction in tariff rate increases due to reduced operating costs;
- integration of technology into operations and management to substitute for labor, leading to increased efficiencies in water deliveries, reductions in water losses and reduced costs;
- introduction of innovative approaches to reducing water demand, thereby increasing water supply, e.g., rebate programs for retrofitting low water use fixtures; and
- introduction of a tariff system that covers operation and maintenance costs.

Particular attention will be paid to the needs of the poor while improving these commercial practices.

21.6. Private Sector Participation

Private Sector Participation involvement in the water supply and wastewater sector may be a useful management tool to achieve the following goals:

- enhance upgrading the efficiency of water use and consumption and enhance the efficiency of Operation and Maintenance;
- encourage the private sector to invest and to actively participate in the national economy;
- job Creation; and
- rationalize public expenditures.

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22. Sustainable financing strategy

22.1 Water-Pays-for-Water Principle

The strategy endorses the Water-Pays-for-Water principle, where operation and maintenance costs are totally financed by the water tariff (full cost recovery), rather than through taxes or transfers, in order to guarantee that at all times the water operators have a sound and stable funding mechanism.

On the other hand, as the investment needs to address the basic needs of Palestinian people are far beyond the municipalities and the State of Palestine scheduled capacity to invest, a significant share of investments in the water and wastewater sector will be funded with international support.

22.2 Reducing inequalities among regions and users

The production and distribution costs vary from region to region and from system to system, according to physical features (elevation, groundwater quality) and to the condition of the water network (leakages, breakdown frequency). The water tariff implemented by each water utility reflects these differences and, for this reason, tariff varies from one municipality to another.

The national water policy and the water strategy aim to reduce such inequalities among regions and users. These inequalities will not be suppressed or reduced through arbitrary tariff manipulation, but rather through economic measures, aiming to reduce the differences in production and distribution costs among regions.

For this purpose, PWA will plan bulk water transfer from regions where water production costs are relatively low to regions were water production costs are relatively high. These water transfers will be implemented through the National Water Company, regional water carriers or by bilateral agreements between water utilities from neighboring regions.

22.3 Tariff setting mechanism

PWA has developed and will continue to improve a cost analysis tool, aiming to help local water utilities to calculate running costs on a conservative full cost recovery basis and to translate this cost estimate into a sound water tariff.

Water tariffs will be set by each water utility itself, according to: (a) the full cost recovery principle, (b) the costs analysis tools developed by PWA and (c) the actual running costs accounted for by the water utility itself.

The water tariff and the basis for its calculation by each water utility will be checked by the to-be-established water regulatory council. This regulatory body will have a limited period to object to or approve the tariff proposed by the water utility. For the time being, this regulatory role will be played by PWA.

22.4 Implementing pro-Poor water tariffs

As water is an essential and basic human need, the State of Palestine will facilitate the poor to access affordable water. This means that the water utilities will be required to introduce pro-poor tariff mechanisms, to be adapted in each region according to its specificities (production cost, coverage with pipe water system). These mechanisms could include, but need not be limited to:

- rising block tariff;
- reduced connection fee for low income households; and

- monthly installments for the payment of connection fees.

In order to preserve the whole sector's self-sufficiency ("Water-Pays-for-Water principle"), these mechanisms will be funded by the tariff itself (i.e. through cross-subsidy mechanisms), rather than through direct subsidies from central or local government.

22.5 A public strategy for trucked water

The long-term strategy aims to connect 100% of communities to a water network, but until such moment has arrived, some communities, especially in area C, will still be serviced by trucked water, because the Israeli administration raises many constraints for PWA to install proper piped water systems.

For such communities, trucking water is sometimes the sole option and, for this reason, trucked water is considered as part of the public service, although it is not the most effective option. This does not mean that PWA, WBWD or another public operator have to buy and run trucks. Instead, this activity will be regulated and the strategy aims to facilitate cross-subsidy mechanisms between the customers serviced by trucks and the other customers.

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23. Investments required in the Water and Wastewater sector

23.1 Unit costs analysis

For the purpose of assessing the investment needs related to the implementation of the strategy, unit costs have been estimated for the main items, based on (a) investments made by PWA during recent years and (b) most recent cost estimates presented in PWA approved projects documents.

23.2 Costing investment needs

Achieving the strategic objectives by 2032 will require very large investments in (a) new facilities, (b) the refurbishment of old facilities and (c) permanent water system renewal, that are necessary to keep UFW under control.

These investments have been valuated, based on three main sources of information:

- the projects implemented by PWA, the PMU and the water utilities during the last 5 years. These projects provide the most reliable information, regarding the cost of works and equipment in the on-going situation of Palestine;
- the replacement expenditures incurred by some of the main water utilities (JWU, Nablus, CMWU), keeping in mind that their level of expenditure is constraint by their low level of revenue; it means that a suitable maintenance of the systems they are running would probably require additional expenditures;
- the cost estimates provided by well-known consulting firms for new projects under development (desalination plants, comprehensive sewerage, wastewater treatment plants).

The investments needs have been summarized in the two tables below, the first one for water supply, the second one for wastewater. More details are provided in Annexes (detailed investment estimates, methods for calculation and sources of information).

Water supply		short term	long-term strategy			20 years
investment needs in M$		2017	2022	2027	2032	
Production	Gaza	325	112	194	186	**817**
	WB	17	232	204	239	**692**
Storage	Gaza	4	8	9	13	**33**
	WB	1	14	23	32	**70**
Distribution	Gaza	20	35	43	62	**160**
	WB	91	158	166	201	**615**
Total (in M$)		**457**	**559**	**639**	**732**	**2 389**
Total (in MSh)		**1 693**	**2 070**	**2 365**	**2 710**	**8 838**

Table 29. Investment needs to improve water services (2013-2032)

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Sanitation investment needs in M$		short term	long-term strategy			20 years
		2017	2022	2027	2032	
Sanitation (plot level)	Gaza	44	129	178	237	**589**
	WB	70	197	334	484	**1 085**
Sewerage	Gaza	49	143	197	262	**650**
	WB	77	217	369	535	**1 198**
Treatment	Gaza	88	52	68	68	**276**
	WB	52	129	159	205	**545**
Total (in M$)		**380**	**867**	**1 304**	**1 791**	**4 342**
Total (in MSh)		**1 408**	**3 207**	**4 826**	**6 625**	**16 066**

Table 30. Investment needs to improve wastewater services (2013-2032).

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Part 3.5. Strategy Implementation, Monitoring and Evaluation

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24 Challenging issues for strategy implementation

24.1 Challenges faced by PWA

The long-term strategy aims to completely transform the water and wastewater sector in Palestine, bringing sector performances to the level of a developed country in 20 years only. To implement this strategy, PWA and PA will face some major challenges:

- the constraints of occupation;
- the limited capacity-to-invest (at the level of central and local government);
- the limited capacity-to-implement many investment programs in the same time;
- the limited capacity of existing service providers to run so many more facilities (not to speak of their capacity to run sophisticated equipments, such as desalination plants and modern wastewater treatment plants);
- the unsolved and very sensitive issue of the abstraction rights (allocation of abstraction rights among competing users);
- the very low level of cost recovery and collection rates (especially in Gaza); and

the need for intensive capacity development of water sector organizations.In order to face and overcome these challenges, these issues need to be tackled by the new sector organization that is under development by PWA.

24.2 The constraints of Israeli occupation

The strategy short term scenario has been developed under the existing political conditions, including military occupation of the West Bank and a dysfunctional JWC.

On the other hand, the strategy long-term scenario is based on the assumption that a final Peace Agreement has been signed with Israel and that, under this improved political situation, Palestinians have gained full access to the their water resources, land and water rights. Obviously, until and unless such a Peace Agreement has been reached, the long-term scenario is not realistic or applicable.

24.3 The limited capacity to invest and implement

The level of investment for the Strategy implementation has been estimated as 25 Billion ILS in 20 years, i.e. 1.25 Billion ILS/year on average. The level of yearly investments will rise during the strategy implementation, from 0.62 Billion ILS/year on average during the first five years to 1.45 Billion ILS/year with the long-term scenario.

These figures are less than what has been proposed in the Palestine National Plan for the 2011-2013 period: 5.5 Billion ILS in three years, i.e. 1.8 Billion ILS/year (PWA, 2011). By comparison, it could be considered that the 20 years Strategy is reasonable, according to the level of investments (and the level of efforts) that the PA has already decided to engage for the coming years. Nevertheless, the investment plan needs to be compared also with the recorded capacity to invest of the water sector in Palestine, because this sector is facing many difficulties.

During the last three years, PWA has recorded each year US$ 23-30 million of investments in water supply and wastewater facilities (80 to 100 million ILS). Although these figures are impressive, they represent only around 50% of the scheduled investment pace of the strategy short term scenario. There is a risk that the planned investments are not implemented in due time.

In addition, the existing Palestinian capabilities to implement projects and the existing funding levels of donors and financing institutions can only barely absorb and cope to realize the recent and ongoing projects. In order to increase the investment and implementation capacity in the water sector, the strategy promotes:

- channeling a higher share of water supply investments through the autonomous water utilities (e.g. all network extension programs, including storage tanks and pumping stations);
- channeling a higher share of wastewater investments through the municipalities (e.g. all sewer networks, including lifting systems and house connections);
- implementing a limited number of 5-year framework contracts approved by PWA with large works contractor allowing fast track procurement procedure;
- PA and PWA to strengthen their aid coordination mechanisms in order to streamline aid interventions and to minimize gaps and overlaps;
- donors and financing institutions to increase their financial commitments and to work faster towards harmonization (joint studies, joint funding, joint missions) and alignment to PA systems and procedures; and
- involving the private sector to play a more important role in large facilities, like for example in the desalination plants and the main WWTPs.

24.4 Limited capacity of existing service providers to run so many more facilities

The management of the additional complex facilities that will be implemented during the next 20 years could be a burden for municipalities or service providers, if sound rules of the game are not clearly defined. For this reason, the Strategy will be supported by a clear allocation of risks and resources to the institution in charge of each facility:

- Bulk Utility:
  - main water carriers and booster stations, transporting bulk water from region to region; and
  - desalination plants.
- Regional Utilities:
  - existing local production wells and pumps;
  - water distribution networks;
  - sewers; and
  - WWTPs
- Water associations and/or the private sector to organize and run the reuse systems in coordination with MOA, PWA other relevant Stakeholders.

24.5 Sensitive regulation of water rights allocation

Because the water resources are scarce, there is a competition among different users to access these resources and water-rights need to be allocated, according to very clear and transparent rules. This is clearly expressed in the National Water Policy:

It is the National Policy of Palestine to

- *Define the priorities for allocating the available water resources between different types of users, e.g. domestic, agricultural, environmental, industrial, recreational, touristic, etc. and*

to ensure that domestic and residential uses shall enjoy absolute priority over all other uses.

- *Allocate water rights for economic benefit (agriculture, industry, tourism…) between different users according to economic benefits to Palestine (in terms of revenue, job creation and food security) and in agreement with national development plans.*
- *Have a national organization to fix and review the water rights allocation at national level (defining the principles for allocation and quantities devoted to each activity).*
- *Ensure that the allocation of limited water supplies within specific user type is fair and equitable and that distribution among the regions is fair; where necessary, transfers from basin to basin and region to region will be organized, under the responsibility of bulk supply utility.*
- *Allocate water abstraction rights through a dedicated national administration; these rights will be limited in volume, limited in time and they will be for well-specified purposes; to this end, all well drilling, water production and supply will be allowed only by permit or a license.*
- *Organize the settlement of any disputes that would arise from allocation of water rights by arbitration and, if necessary, by the court.*

The on-going reform of the water sector will define the rules for the implementation of this policy, paying special attention tothe institutions in charge of water rights allocations and the mechanisms for the settlement of disputes.

24.6 Low level of cost recovery and collection rate

The service providers in Palestine are still very far from cost recovery. Almost all investments are supported by outsiders (PA, backed by donors and financing institutions) and the water tariff, as calculated now, barely covers the operational costs.

Moreover, bill collection rate is among the lowest in the region, especially in the Gaza Strip. This is clearly illustrated in the figure below.



TPAT calculations - Data source – IB Net

Figure 21. Collection rate in Palestine and some Middle East countries

Therefore, the implementation of the strategy will require:

- a tariff increase, in order to cover opex (operational expenditures) and capex (capital expenditure); a new tariff structure for water, wastewater and water reuse needs to be prepared based on full cost recovery; if the government decides not to raise the tariff to this level up to the medium-term, it will implement alternative and reliable funding mechanisms to guarantee water utilities financial viability, according to the National Water Policy; and

- coping mechanisms, to make water and wastewater services affordable for the poor (including cross-subsidy among water users, direct subsidies to poor house-holds)

24.7 Enhancing capacities to implement the strategy

Irrespective of the huge volumes of anticipated new investments in order to expand and improve the water infrastructure, the restructuring the sector will severely impact on the new requirements of the existing organizations that need minor or major forms of restructuring, as well as of the new organizations that will have to be established. This relates in particular to the following:

- The restructuring of the Palestinian Water Authority;
- The establishment of the Water Regulatory Council;
- The establishment of the National Water Company;
- The aggregation of municipal water departments to Joint Service Councils and Regional Water Utilities; and
- The establishment of Water User Associations.

Existing systems and procedures will have to be adapted and new systems and procedures have to be designed to facilitate the interactions between organizations and within organizations, as well as between the organizations and their respective customer bases.

Existing managers and staff will have to be trained, retrained, and/or transferred and new employees may have to be recruited to be able to effectively and efficiently deal with their new roles in the new institutional and legal framework.

Other organizations involved in the water sector will also have to adapt and adjust to the new situation. This includes Non-Governmental Organizations (NGOs), Community Based Organizations (CBOs) and national providers of capacity development services like e.g. universities, research institutes, poly-technics, industrial secondary schools, and consultants.

In order to accommodate the new institutional landscape and to absorb increasing numbers of investments, a special policy and strategy will be drafted for capacity development of water sector organizations. Subsequently, organizational action plans will be elaborated by the individual water organizations to further shape the needed capacity development efforts. Under the lead of PWA, the stakeholders have already made their first attempt to produce the capacity development policy and strategy.

25 Planning

The strategy will guide project implementation during 20 years. First of all, a Strategic Action Plan will have to be prepared once the policy and the strategy are approved. Secondly, the Strategy and the Strategic Action Plan will have to be translated into investment plans with different levels of details and with different time-horizons.

The planning procedure has been standardized by PWA in order to facilitate investment plan consolidation and understanding by all stakeholders. This standard procedure has been published by PWA (TPAT, 2013b.), and consists of three main steps:

- Master plans (20 years)
- Investment plans (5 years)
- Implementation plans (3 years).

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25.1 Master planning

To achieve the key national policy of ensuring equal levels of access to services within each region of the country, the Palestinian Occupied Territory has been divided into 6 distinct regions: North, Northwest, Jordan Valley, Central, Southern and the Gaza Strip so the development of Regional Master Plans will ensure that they are inclusive for all communities and, in addition, the regional approach allows for any intraregional schemes to be included in the plan. The main objective of the master plan is to present a plan which represents the best solution to meet the overall infrastructure and capacity requirements for the project area in sufficient detail for all this implications to be understood and then be used to develop a detailed investment plan aiming to meet the requirements of the 1st five years of the plan.

25.2 Investment planning

The objective of this plan is to present a five year plan in sufficient detail to demonstrate distinct projects and understand all the implications of those projects to allow three years implementation plans and detailed designs to be developed from these without further feasibility being required.

25.3 Implementation planning

The objective of this plan is to have a prioritized list of projects, based upon the five year investment plan, which meet the criteria according to need, cost and benefit and can be presented to the MOPAD. In addition, they include a short design brief which can easily be developed into a detailed design.

25.4 Project prioritization

A first try of this process of prioritization has already been done for the next five years (TPAT, 2013.).

A list of 385 projects for the West Bank and 58 for Gaza has been established with all information gathered at PWA level. Project prioritization criteria included:

- project area needs, defined by access to quantity of available clean water and water supply network
- benefits, described by per capita access to clean water and networked supply
- immediacy of project benefit
- project cost per person.

The process was then applied to the projects included in the list and a full ^prioritized list developed by either West Bank or Gaza and by Governorate.

26 Monitoring the strategy implementation

26.1 Water Sector Advisory Board

The sector strategy will be implemented with the support of many stakeholders, including line ministries, local government, customer groups, and civil society organizations. These efforts will be more efficient if they are coordinated and if the global strategic objectives are translated into realistic local objectives and projects. For the purpose of facilitating this sector coordination and progress monitoring, the concept of a Water Sector Advisory Board will be implemented.

This participatory approach is not specific to the water sector. As per COM decision of September 2011, each sector requires its own “Sector Strategy Advisory Group”.

Considering the cross-cutting character of the water sector, and its overlaps with other sectors, and in light of the absence of one exclusive and comprehensive responsibility for the water sector to any of the many institutions and stakeholders involved, PWA will support the establishment of this entity representing the key players, interested to participate to sector monitoring.

This Water Sector Advisory Board is still to be established. Its composition is still to be proposed and agreed, but it is clear that it will include the main stakeholders in the water sector (MoA, MoLG, municipalities, water utilities, NGOs through the EWASH Group).

26.2 Production and dissemination of progress indicators

The Water Sector Advisory Board will be in charge of monitoring the strategy implementation and will make proposals for updating the water strategy when necessary. It will produce and disseminate the relevant indicators of the sector progress (including the indicators used to define the strategic objectives.

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Aims of the strategy	Objective indicator	Strategic objectives for 2032		Comments
		Gaza	West Bank	
Increasing the quantity of water delivered to customers	water available per person (lcd)	120	120	this ratio (120 lcd) is similar to the ratio observed in modern European countries.
	water available for industry, expressed as a % of domestic WS	7%	7%	similar to the ratio observed in neighboring countries (Jordan, Lebanon, Israel, Egypt)
	UFW (%)	20%	20%	this objective is ambitious, but unavoidable in the water scarcity situation of Palestine. UFW reduction is considered as a cost-effective source of water.
	groundwater (Mm^3/year)	38	234	this volume has been calculated as the difference between the water demand and the volume of water provided by import and desalination
	desalination (Mm^3/year)	129	40	In the West Bank, desanitation capacities are almost limited to Fashka springs. In Gaza, they are limited by the investment capacity of PA.
	import (Mm^3/year)	14	120	In the Gaza Strip, the objective is to replace import by local production (desalination). In the West Bank, import will increase significantly, as desalination opportunities are limited.
	Total	**181**	**394**	
Maximizing the volume of water made available for irrigation	water made available (Mm3/year)	67	479	Other indicators (such as irrigation efficiency, revenue per dunum,…) will be defined by MoA and are not included in the Water sector Strategy
Providing all citizen with a good access to a reliable source of water	number of un-served communities	0	0	A community (> 100 persons) is considered as served when it gets piped water supply + house-connection for all households ready-to-pay for this service
	number conn./100 inhab	20	20	See detailed calculations in next chapter
	number of connections	600 000	1 309 000	
Reducing inequalities among regions and localities	water available per person (lcd): minimal average per governorate	84	84	This minimal volume per capita in each Governorate as be calculated as 70% of the national average
	range of tariff	200%	200%	this range means that the highest water tarif in the country is not more than twice the lowest tarif

Table 31. Strategic objectives for 2032

Aims of the strategy	Objective indicator	Strategic objectives for 2032		Comments
		Gaza	West Bank	
Improving the quality of the water delivered to customers	% with free chlorine	100%	100%	this objective is already almost reached
	% free from total colif.	100%	100%	this objective is already almost reached
	% free from fecal colif.	100%	100%	this objective is already almost reached
	% of customers serviced with < 50 ppm nitrate	90%	100%	As most groundwater contain > 50 ppm nitrate in the Gaza Strip, it will be difficult to serve 100% of Gaza communities with < 50 ppm nitrate
	% of customers serviced with < 1500 ppm TDS	100%	100%	this objective will be reached in Gaza with the development of desalination plants
Protecting the natural water ressources from pollution by wastewater	% households connected to sewer	95%	75%	
	% sewered water that is treated	95%	80%	
	Average WWTP % efficiency for DCO, DBO, MES	90%	90%	
	WWTP % efficiency for N	50%	50%	
	% treated WW reused for irrigation	50%	60%	See chapter 17
Improving the quality and reliability of the service	% of serviced customers every day	100%	100%	
	volume of storage expressed in hours of supply	10	10	the volume of storage (expressed in hours of supply) is a key factor of good management of pressure and reliability of chlorination
Ensuring financial sustainability of water operators	% of autonomous water utilities	100%	100%	all operators will be independant from municipalities (this has no implication on their public or private status)
	% of metered connections	100%	100%	this objective is already almost reached
	working ratio = Costs (excluding depreciation) / operating revenue	130%	150%	this ratio means that utilities are financiallly autonomous
	collection efficiency	95%	95%	
Strengthening the foundations of good governance and the legal and institutional framework	New Water Law enacted, implemented	100%	100%	
	PWA restructured, functional, capacities developed	100%	100%	

	Water Regulatory Council established, functional, capacities developed	90%	90%	
	National Water Company established, functional, capacities developed	80%	80%	
	JSCs/Regional Water Utilities established, functional, capacities developed	80%	80%	
	IWRM effectively implemented at sub-national level	100%	100%	
	Relevant water regulations approved, enforced	100%	100%	

Table 32. Strategic objectives for 2032 (continued)

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Part 4. Appendices

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Appendix 1. Acronyms

BOD:	biochemical oxygen demand
CBO:	Community Based Organization
CMWU:	Coastal Municipal Water Utility
COD:	chemical oxygen demand
CoM:	Cabinet of Ministers
CoMSC:	Cabinet of Ministers Steering Committee
EQA:	Environmental Quality Authority
EU:	European Union
EWASH:	Emergency Water, Sanitation and Hygiene group
GDP:	Gross Domestic Product
GOI:	Government of Israel
ICA:	Israeli Civil Administration
ILS:	Israeli Shekel
IWRM:	integrated water resources management
JMP:	Joint Monitoring Program (WHO/UNICEF)
JSC:	Joint Service Council
JWC:	Joint Water Committee
JWU:	Jerusalem Water Undertaking
lcd	liters per capita per day
Mm3:	millions of cubic meters
MDG:	Millennium Development Goal
MIC:	Ministerial Infrastructure Committee
MoA:	Ministry of Agriculture
MEnA:	Ministry of Environmental Affairs
MoF:	Ministry of Finance
MoH:	Ministry of Health
MoLG:	Ministry of Local Government
MoPAD:	Ministry of Planning and Administrative Development
NGO:	non-governmental organization
NIS:	New Israeli Shekel (symbol ILS)
NRW:	non revenue water
NWC:	National Water Company
NWC:	National Water Council
O&M:	Operation and Maintenance
OPS:	Occupied Palestinian State
PA:	Palestinian Authority
PCBS:	Palestinian Central Bureau of Statistics
PECDAR:	Palestinian Economic Council for Development and Reconstruction
PHG:	Palestinian Hydrology Group
PIPA:	Palestinian Investment Promotion Agency
PM:	Prime Minister
PMU:	Project Management Unit
PNA:	Palestinian National Authority
ppm:	parts per million
PSI:	Palestinian Standards Institute
PWA:	Palestinian Water Authority
RWU:	Regional Water Utilities
TDS:	total dissolved solids

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TPAT:	Technical, Planning and Advisory Team
S/m3:	Shekel per m^3 (1 $ = 3.7 S)
UNICEF:	United Nations Children's Fund
UFW:	unaccounted for water
USP:	Union of Service Providers
WB:	World Bank
WBWD:	West Bank Water Department (to become NWC)
WHO:	World Health Organization
WR:	water resources
WRC:	Water Regulatory Council
WRM:	water resources management
WS:	water supply
WSS:	water supply and sanitation
WSSA:	Water Supply and Sewerage Authority
WW:	wastewater
WWTP:	wastewater treatment plant

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Appendix 2. Definitions

The following words and expressions shall have the meaning stated below unless the context indicates otherwise:

Artificial Recharge of Aquifers - The act of directing water, including flood waters or treated wastewater, under the ground, either directly by recharging the wells or reservoirs or by drilling recharge wells, or indirectly by permitting water to seep underground from the surface of the soil.

Demand – The quantity of water that each customer is asking for (and is ready-to-pay for).

Minimum environmental flows - Minimum environmental flows of watercourses are the minimum flow levels required to maintain and support the aquatic-dependent ecosystems and fish life.

Palestine - The Palestinian State and the areas over which the Palestinian State has effective control. Option: Palestine is the territory defined by 1967 borders, consisting of two parts: the Gaza Strip and the West Bank, including East Jerusalem.

Permits and Licenses - The required permits and/or licenses to be issued by the competent authorities for the relevant tasks and activities.

Pollution - Any change that occurs to the quality and constituents of water that harms the health of humans and the environment.

Production needs – The quantity of water that has to be produced. It is more than the sum of individual user demand, because some of the produced water is lost before reaching the users (see UFW).

Regulation - Any sub-normative regulation, law, ordinance, regulation, etc. enacted for the implementation of the relevant Law, either where specifically so-mentioned or where otherwise inevitably required.

UFW – Unaccounted for water (UFW) is calculated as the difference between water produced and water billed to customers and is expressed in % of water production.

Water Resources - All water resources that lie within the territorial land of Palestine, including conventional surface or groundwater, such as water from springs, including hot springs, wells, ravines, rivers, lakes, and water collection areas, or unconventional water sources, such as sewage water, desalinated water and brackish water.

Water Facility - Any facilities or constructions intended and necessary for the abstraction, treatment and supply of water or for the collection and treatment and disposal of wastewater, and water storage structures.

Wastewater - The liquid that results from the use of water resources and which is unfit for further use other than for reuse purposes after treatment.

Water Services - The provision of piped water supplies, including treatment to the standards required for the intended use, and the conveyance, treatment and eventual collection, treatment and disposal of wastewater, or the conveyance of treated wastewater to the entities responsible for the equitable and fair distribution of treated wastewater for agricultural and industrial uses.

Well - Any facility intended for the exploration and extraction of groundwater.

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Appendix 4. Other strategies

Some specific and more technical policies and strategies are expected to be produced by TPAT and PWA as follows:

- Mitigation Measures for Climate Change: Action Plan and Budget (January 2012, produced)
- Water Sector Emergency Preparedness Strategy (January 2012, draft produced)
- Sustainable Financing Strategy for the Water Sector (June 2013, draft produced)
- Non-Revenue Water Strategy (July 2012)
- Priority WS/WW Investment Plan (August 2012)
- National Sludge Disposal Strategy (July 2013)

Other technical strategies that have been or are being developed include the following:

- Irrigation by the Ministry of Agriculture
- Water and Gender (2013)
- Capacity Development Policy and Strategy

In this Water Policy and Sector Strategy document, the contents of these technical strategies are not repeated in detail.

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Appendix 5. Surface water resources assessment

No.	Flow Direction	Catchment	Average Runoff (Mm^3/y)	2011 Estimated Runoff (MCM)
1	Western Wadis Flowing towards Mediterranean Sea	Al Moqatta'a	3.60	3.32
2		Al Khodeira-Abu Nar	8.30	7.30
3		Al Khodeira-Massin	11.70	9.70
4		Alexander- Zeimar	8.70	7.34
5		Alexander-Abraq	8.10	6.78
6		Qana	12.80	9.88
7		Sarida	22.80	19.39
8		Al-Dilb	16.40	12.59
9		Salman	6.50	3.39
10		Soreq	2.10	1.36
11		Soreq Al-sarar	1.70	1.05
12		Lakhish-Saint	5.00	3.19
13		Lakhish	5.40	3.14
14		Shiqma	2.60	2.01
15		Besor-Nar	4.90	2.94
16		Besor	2.10	1.27
Total			**122.70**	94.66
17	Eastern Wadis Flowing towards Jordan River	Malih-Shubash	0.90	0.90
18		Malih	1.20	1.13
19		Abu Sidra	0.80	0.75
20		Faria	6.40	6.17
21		Al'Ahmar	0.40	0.33
22		Auja	4.60	3.25
23		Nueima	1.70	1.42
24		Qilt	4.20	2.34
25		Marar	0.40	0.30
Total			**20.60**	16.59
26	Eatern Wadis Flowing towards The Dead Sea	Mukallak	3.50	2.60
27		Qumran	0.40	0.37
28		Nar	2.40	2.31
29		Daraja	5.30	5.13
30		Hasasa	0.50	0.32
31		Ghar	6.50	6.37
32		Abu El-hayyat	2.40	2.40
33		Abu Muradin	0.50	0.38
Total			**21.50**	19.89
Total Runoff			**164.80**	131.14

Source: PWA. 2012c

Appendix 6. Rain harvesting list of projects

Water Harvesting system	Governorate	Dam capacity (m^3)	Actual additional resource (m^3/year)	Use	Status	Location
Auja Dam	Jericho	700 000	1 000 000	Storage	existing	Auja Agriculture
Al Faraa Dam	Nablus	5 000 000	17 300 000	Detention -Storage	proposed	East Nablus Agr.
Faria retention Dam	Nablus	40 000	50 000	Recharge/ storage	ongoing	
Al Malih Dam	Tubas	UA		Storage	proposed	al malih agr.
Qelt Valley Retention Dam	Jericho	4 000 000[a]		Recharge/ storage	proposed	Jericho
Dyouk check Dam	Jericho			Flood control	ongoing	Jericho
Jenin Agricultural ponds	Jenin	300 000	300 000	Storage	proposed	Jenin
Nwiemeh	Jericho	2 500 000			proposed	
Marj Sanour ponds	Jenin					
Agricultural pond	Nablus, Jericho, Tubas	450 000 [b]		Storage	ongoing	
Cisterns	All the country	32 500	32 500	Storage		
		Total	**18 682 500**			

[a] the volume of this dam has been quoted as 4 or 2 millions in different reports.

[b] some of these ponds are located downstream majors dams and it is necessary to be carefull to avoid double counting the samewater resource.

Table 33. Rain Harvesting List of Projects.

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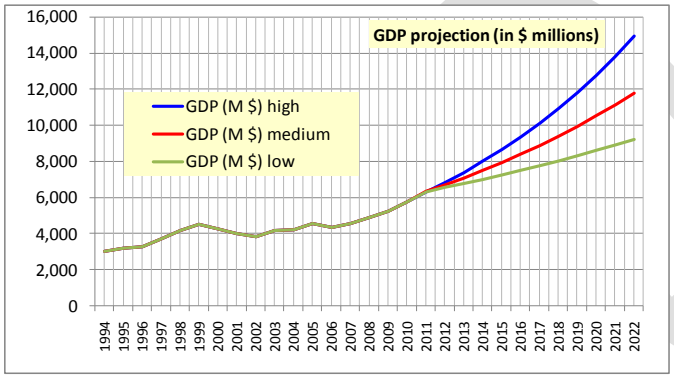
Appendix 7. GDP evolution trends and projections

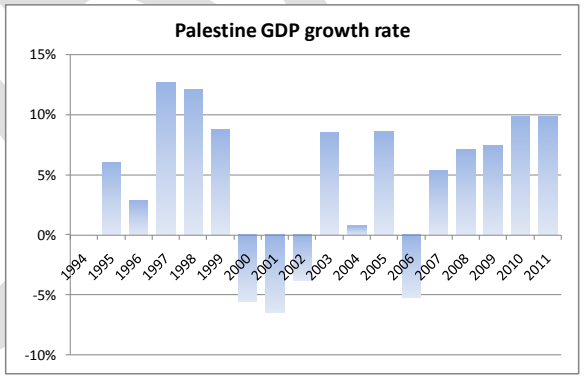
GDP trends

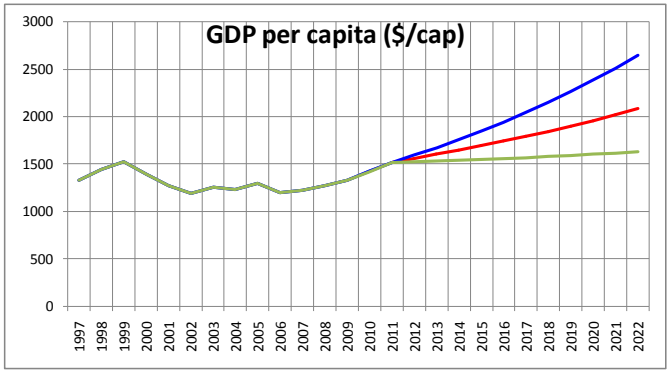
	PIPA and PCBS data																		TPAT extrapolation based on a % of 2003/2011 average growth rate											
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	
GDP (M $) high	3,012	3,193	3,286	3,701	4,148	4,511	4,261	3,989	3,839	4,165	4,198	4,560	4,322	4,554	4,878	5,241	5,757	6,323	6,837	7,393	7,995	8,645	9,348	10,108	10,931	11,820	12,781	13,820	14,944	140%
GDP (M $) medium	3,012	3,193	3,286	3,701	4,148	4,511	4,261	3,989	3,839	4,165	4,198	4,560	4,322	4,554	4,878	5,241	5,757	6,323	6,690	7,079	7,490	7,925	8,386	8,873	9,389	9,934	10,511	11,122	11,768	100%
GDP (M $) low	3,012	3,193	3,286	3,701	4,148	4,511	4,261	3,989	3,839	4,165	4,198	4,560	4,322	4,554	4,878	5,241	5,757	6,323	6,543	6,771	7,008	7,252	7,505	7,766	8,037	8,317	8,607	8,907	9,217	60%

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2003-2011 average	Projection hypotheses	low	medium	high
GDP growth rate		6.01%	2.91%	12.63%	12.08%	8.75%	-5.54%	-6.38%	-3.76%	8.49%	0.80%	8.60%	-5.20%	5.36%	7.12%	7.44%	9.84%	9.83%	5.81%		3.5%	5.8%	8.1%

GDP per capita ($/cap)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
GDP / capita ($/cap) medium	1329.82	1444.51	1522.84	1395.52	1271	1190.31	1256.6	1232.14	1299.7	1196.65	1224.49	1275.2	1331.89	1422.12	1516.72	1558.32	1601.39	1646.08	1692.57	1741.07	1791.55	1844.37	1899.66	1957.54	2018.16	2081.65
GDP / capita ($/cap) high	1329.82	1444.51	1522.84	1395.52	1271	1190.31	1256.6	1232.14	1299.7	1196.65	1224.49	1275.2	1331.89	1422.12	1516.72	1592.54	1672.5	1756.93	1846.24	1940.84	2040.97	2147.3	2260.24	2380.26	2507.86	2643.57
GDP / capita ($/cap) low	1329.82	1444.51	1522.84	1395.52	1271	1190.31	1256.6	1232.14	1299.7	1196.65	1224.49	1275.2	1331.89	1422.12	1516.72	1524.09	1531.82	1539.99	1548.71	1558.09	1568.06	1578.84	1590.45	1602.92	1616.26	1630.5
Populatio	2,783,084	2,871,568	2,962,226	3,053,335	3,138,471	3,225,214	3,314,509	3,407,417	3,508,126	3,611,998	3,719,189	3,825,512	3,935,249	4,048,403	4,168,860	4,293,313	4,420,549	4,550,368	4,682,467	4,816,503	4,952,722	5,090,365	5,229,333	5,369,521	5,510,822	5,653,121







Appendix 8. Recorded water production in Palestine

Water production in Palestine

All figures expressed in Mm3/year

196.1 PWA, 2012 | **26.1** other source | *80.0* TPAT estimation

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Water made available (wells, springs + purchase from Mekorot)						**290.4**	**309.5**	**316.7**	**335.6**	**303.6**	**311.2**	**326.8**	
Palestine	wells					196.1	214.7	223.5	241.2	225.7	227.2	244.0	
	springs					52.7	53.6	51.7	44.8	25.2	30.6	26.8	
	Mekhorot					41.6	41.2	41.5	49.6	52.7	53.4	56.0	
West Bank	wells					50.6	70.2	70.5	77.7	69.7	68.2	71.5	
	springs					52.7	53.6	51.7	44.8	25.2	30.6	26.8	
	Mekhorot					37.6	37.2	37.5	45.0	47.9	48.7	51.1	
Gaza	wells					145.5	144.5	153.0	163.5	156.0	159.0	177.4	
	springs					0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Mekhorot					*4.0*	*4.0*	4.0	4.6	4.8	4.7	4.9	

		2004	2005	2006	2007	2008	2009	2010	2011
Water made available (wells, springs + purchase from Mekorot)		**278.2**	**278.1**	**284.7**	**293.8**	**277.8**	**276.1**	**304.4**	
Palestine	domestic	148.0	151.0	153.0	163.5	178.6	172.5	181.4	
	agriculture	130.2	127.1	131.7	130.3	99.2	103.6	123.0	
West Bank	domestic	*80.0*	*80.0*	*80.0*	85.5	96.6	86.5	85.0	
	agriculture	52.7	53.6	51.7	44.8	25.2	30.6	42.0	
Gaza	domestic	*68.0*	*71.0*	*73.0*	*78.0*	*82.0*	*86.0*	*96.4*	
	agriculture	77.5	73.5	80.0	85.5	74.0	73.0	81.0	

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Gaza	water consumption	*36.0*	*38.0*	*39.0*	*40.0*	*42.0*	*43.0*	*44.0*	*45.0*	*48.0*	*50.0*	*54.0*	
	UFW	*35%*	*33%*	*36%*	*38%*	*38%*	*39%*	*40%*	*42%*	*41%*	*42%*	*44%*	

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Appendix 9. Unit costs for investments

Production	**deep wells**	**$800 000**	$/well	unit costs to built a 500 m deep well, including works, casing, screens, control…)
		$270 000	$/pump	unit costs to procure and install a 250 m3/h pump, 380 m HMT
	desalination plants	**$6 000 000**	$/Mm3/y.	unit cost for a desalination plant for sea water, with a 1 Mm3/year capacity, including works, design, control…
Storage	**storage tanks**	**$170**	$/$m^3$	unit cost for a concrete ground storage reservoir, with a 1,000 m3 capacity, at the ground level, including works, design,
Distribution	**connections**	**$150**	$/conn.	unit cost for a house connection (15 mm)
		$15	$/ml	unit cost for pipe extension in small size to a customer house (HDPE - DN 20 mm)
	network	**$40**	$/ml	unit cost for network expansion (PVC - PN 16 - DN 100 mm)
		$100	$/ml	unit cost for network expansion (PVC - PN 10 - DN 200 mm)
Sewerage	**connection**	**$1 200**	$/conn.	unit cost for individual connection
	network	**$130**	$/m	unit cost for network expansion
	lift pump	**$5 000**	$/unit	unit cost for a sewer lift pump
	WWTP	**$1 300**	$/m3/day	unit cost for 1 m3/day addtional capacity

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Appendix 10. Investment needs

West Bank Water supply			short term	long-term strategy			
			2017	2022	2027	2032	
Production	deep wells	production capacity (Mm^3/year)	44	86	142	211	
		number of production wells	88	172	284	421	*based on 500,000 m3/year per well*
		additionnal wells to be build	0	84	112	137	*starting from 63 deep wells in 2012*
		pumps installment and replacement	62	122	202	300	*based on 7-years lifespan*
	desalination plants	production capacity (Mm^3/year)	0,0	22,0	32,0	40,0	*Fashka Springs projects operational in 2020*
		additionnal production capacity (Mm3/year)	0,0	22,0	10,0	8,0	
Storage	storage tanks	needed capacity (Mm^3/year)	29 000	113 000	248 000	437 000	*for 8-hours of storage at the national level*
		additionnal storage capacity (Mm3/year)	6 000	84 000	135 000	189 000	*starting from 23,000 in 2012*
Distribution	connections	number of connections	514 000	754 000	1 005 000	1 309 000	
		addtionnal connections	144 000	240 000	251 000	304 000	
		customer connections (in ml)	1 152 000	2 400 000	2 510 000	3 040 000	*based on 8 ml/connection*
	network	main network extension DN 100 (ml)	576 000	960 000	1 004 000	1 216 000	*based on 4 ml/connection*
		main network extension DN 200 (ml)	288 000	480 000	502 000	608 000	*based on 2 ml/connection*

West Bank - Water supply			unit costs ($)		short term	long-term strategy		
					2017	2022	2027	2032
Production	deep wells							
			$800 000	$/well	$0	$67 200 000	$89 600 000	$109 600 000
			$270 000	$/pump	$16 740 000	$32 940 000	$54 540 000	$81 000 000
	desalination plants							
			$6 000 000	$/Mm3/y.	$0	$132 000 000	$60 000 000	$48 000 000
Storage	storage tanks							
			$170	$/$m^3$	$1 020 000	$14 280 000	$22 950 000	$32 130 000
Distribution	connections							
			$150	$/conn.	$21 600 000	$36 000 000	$37 650 000	$45 600 000
			$15	$/ml	$17 280 000	$36 000 000	$37 650 000	$45 600 000
	network		$40	$/ml	$23 040 000	$38 400 000	$40 160 000	$48 640 000
			$100	$/ml	$28 800 000	$48 000 000	$50 200 000	$60 800 000
Total (in M$)			1 377		108	405	393	471
Total (in MSh)			5 096		401	1 498	1 453	1 744

Gaza Strip Water supply			short term	long-term strategy			
			2017	2022	2027	2032	
Production	deep wells	production capacity (Mm^3/year)	50	51	37	33	
		number of production wells	99	102	74	65	based on 500,000 m3/year per well
		additionnal wells to be build	0	3	0	0	starting from 63 deep wells in 2012
		pumps installment and replacement	70	72	52	46	based on 7-years lifespan
	desalination plants	production capacity (Mm^3/year)	55,0	70,0	100,0	129,0	Fashka Springs projects operational in 2020
		additionnal production capacity (Mm3/year)	51,0	15,0	30,0	29,0	
Storage	storage tanks	needed capacity (Mm^3/year)	26 000	72 000	126 000	200 000	for 8-hours of storage at the national level
		additionnal storage capacity (Mm3/year)	23 000	46 000	54 000	74 000	starting from 23,000 in 2012
Distribution	connections	number of connections	295 000	371 000	465 000	600 000	
		addtionnal connections	65 000	76 000	94 000	135 000	
		customer connections (in ml)	2 017	760 000	940 000	1 350 000	based on 8 ml/connection
	network	main network extension DN 100 (ml)	260 000	304 000	376 000	540 000	based on 4 ml/connection
		main network extension DN 200 (ml)	130 000	152 000	188 000	270 000	based on 2 ml/connection

Gaza Strip - Water supply			unit costs ($)		short term	long-term strategy		
					2017	2022	2027	2032
Production	deep wells							
			$800 000	$/well	$0	$2 400 000	$0	$0
			$270 000	$/pump	$18 900 000	$19 440 000	$14 040 000	$12 420 000
	desalination plants							
			$6 000 000	$/Mm3/y.	$306 000 000	$90 000 000	$180 000 000	$174 000 000
Storage	storage tanks							
			$170	$/$m^3$	$3 910 000	$7 820 000	$9 180 000	$12 580 000
Distribution	connections							
			$150	$/conn.	$9 750 000	$11 400 000	$14 100 000	$20 250 000
			$15	$/ml	$30 255	$11 400 000	$14 100 000	$20 250 000
	network		$40	$/ml	$10 400 000	$12 160 000	$15 040 000	$21 600 000
Total (in M$)			1 011		349	155	246	261
Total (in MSh)			3 741		1 291	572	912	966

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West Bank Sanitation			short term	long-term strategy			
			2017	2022	2027	2032	
Sanitation (plot level)	connection to sewers	sewered population	1 458 772	2 513 576	3 656 392	4 911 004	
		number of connections	145 877	251 358	365 639	491 100	*1 conn per 10 inhabitants*
		additionnal connections to be installed	58 377	163 858	278 139	403 600	*based on 500,000 m3/year per well*
	septic tanks	non sewered population	2 014 495	2 229 020	2 056 721	1 637 001	*private investment*
		on-site facilities	201 450	222 902	205 672	163 700	*private investment*
Sewerage	sewer	additionnal length of sewer (ml)	583 772	1 638 576	2 781 392	4 036 004	*based on 10 m per connection*
		additionnal lifting pump	292	819	1 391	2 018	*based on 1 per 2 km*
Treatment	WWTPs	treatment capacity (m^3/day)	45 750	144 840	267 230	424 620	
		addtionnal treatment capacity (m^3/day)	40 000	99 090	122 390	157 390	

West Bank - Sanitation			unit costs ($)		short term	long-term strategy		
					2017	2022	2027	2032
Sanitation (plot level)	connection to sewers							
			$1 200	$/conn.	$70 052 676	$196 629 137	$333 767 099	$484 320 519
	septic tanks							
Sewerage	sewer		$130	$/m	$75 890 399	$213 014 898	$361 581 024	$524 680 562
			$5 000	$/unit	$1 459 431	$4 096 440	$6 953 481	$10 090 011
Treatment	WWTPs							
			$1 300	$/m3/day	$52 000 000	$128 817 000	$159 107 000	$204 607 000
Total (in M$)			2 827		199	543	861	1 224
Total (in MSh)			10 460		738	2 007	3 187	4 528

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Gaza Strip Sanitation			short term	long-term strategy			
			2017	2022	2027	2032	
Sanitation (plot level)	connection to sewers	sewered population	1 550 864	1 953 326	2 361 157	2 852 392	
		number of connections	155 086	195 333	236 116	285 239	*1 conn per 10 inhabitants*
		additionnal connections to be installed	36 697	107 833	148 616	197 739	*based on 500,000 m3/year per well*
	septic tanks	non sewered population	443 816	385 987	284 397	150 126	*private investment*
		on-site facilities	44 382	38 599	28 440	15 013	*private investment*
Sewerage	sewer	additionnal length of sewer (ml)	366 973	1 078 326	1 486 157	1 977 392	*based on 10 m per connection*
		additionnal lifting pump	183	539	743	989	*based on 1 per 2 km*
Treatment	WWTPs	treatment capacity (m^3/day)	172 000	212 000	264 000	316 000	
		addtionnal treatment capacity (m^3/day)	68 000	40 000	52 000	52 000	

Gaza Strip - Sanitation			unit costs ($)		short term	long-term strategy		
					2017	2022	2027	2032
Sanitation (plot level)	connection to sewers							
			$1 200	$/conn.	$44 036 768	$129 399 175	$178 338 838	$237 287 015
	septic tanks							
Sewerage	sewer		$130	$/m	$47 706 498	$140 182 440	$193 200 408	$257 060 933
			$5 000	$/unit	$917 433	$2 695 816	$3 715 392	$4 943 479
Treatment	WWTPs							
			$1 300	$/m3/day	$88 400 000	$52 000 000	$67 600 000	$67 600 000
Total (in M$)			1 515		181	324	443	567
Total (in MSh)			5 606		670	1 200	1 639	2 097

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