




Kingdom of the Netherlands



Dutch Risk Reduction Team:
Reducing the risk of water related disasters

DRR-Team Mission Report

Argentina:

Dique Paso de las Piedras – emergency mission

Rio Salado – pre-scoping mission

May 29 – June 4, 2016



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SUMMARY

Between 29 May and 4 June 2016, a mission of the Dutch Risk Reduction Team (DRR team, Annex A) took place to the Province of Buenos Aires, Argentina. The Mission focused on two different regions. Support was solicited by the Government of Argentina to the Dutch Government to provide assistance in the evaluation of the actual condition of the dam of a reservoir, the 'Dique Paso de Las Piedras'. The reservoir provides water to the city of Bahia Blanca. The area of the 'Dique Paso de las Piedras' is located northeast of the city of Bahía Blanca (500 km south of Buenos Aires).

The second focus was on assisting in finding an integrated approach for the management of the catchment of Rio Salado, a river basin South – South West of the city of Buenos Aires and to explore opportunities to optimally use international experience on integrated water resources management (IWRM). The mission team was composed of three representatives of the Dutch Water Sector (Annex B):

- Klaas de Groot / Integrated Water Resources Management (Scoping mission Rio Salado)
- Marcella Busnelli / River Basin Development - Reservoir Management and Morphology (Emergency mission Dique Paso de Las Piedras)
- Rik Beekx / Geo technology and Civil Engineering (Emergency mission Dique Paso de Las Piedras)

The Netherlands Embassy in Buenos Aires has organized the mission together with the Undersecretary of Water Resources (Subsecretario de Recursos Hidricos), and attended all meetings. International Financing Institutions (IFI's) showed great interest in the results of the mission and the World Bank participated in the mission to the Rio Salado. The Undersecretary of Water Resources of the province of Buenos Aires is responsible for the water works in the province and has introduced us to the challenges in the two focus areas.

The preliminary results of the mission were shared with the national authority in water resources of Argentina.

The DRR Team would like to thank everybody who has made this mission possible and shared with us their knowledge on water management related challenges in Argentina and the Province of Buenos Aires in general and for the Rio Salado and the Dique Paso the las Piedras more specifically. There clearly exists a mutual interest in managing the water system in an integrated manner. Sharing information and experiences has led to new opportunities and insights on how to integrate water management and facilitate socio-economic and environmental development.

Rio Salado

The mission (Klaas de Groot) visited several locations where structural works are being carried out or have been completed to reduce the flood risk in the basin. The objectives of these interventions are threefold:

- Reduce the negative impacts of inundations and droughts
- Improving the conditions for economic development of the region, specifically for industrial, agricultural and cattle sectors, protecting and developing the environmental value of the river basin.
- Reducing the duration of flooding in the river basin by generating an efficient discharge by eliminating natural and structural obstructions.

Focus in the first three phases of the projects has been mainly on the first objective and the province wants to adopt a more integrated approach for the fourth phase. This integrated approach than also has to have its effect on the three phases already carried out. The first three phases have been successful in reducing the flooded area and, even more important, reducing the duration of the flooding of important agricultural areas from 6-9 months to only 2 month. The improved drainage, however, is leading to concerns in relation to the retention of water in the region in case of prolonged periods of droughts.

Focus in the first three phases of the projects has been mainly on the first objective and the province wants to adopt a more integrated approach for the fourth phase. This integrated approach than also has to have its effect on the three phases already carried out.

Challenges in the region have been faced to a great extent with the first three phases when considering the flood risks. The flooded area has been reduced and, even more important, the duration of the flooding of important agricultural areas has been reduced from 6-9 months to only 2 months.

The improved drainage, however, has led to another challenge. This challenge concerns the regional retention of water to increase the availability of water in case of prolonged periods of droughts.

Furthermore, improving conditions for economic development have not been integrated sufficiently in to the master plan as the water system offers a great deal of additional opportunities to stimulate economic development. This could be, amongst others, in the tourist sector, the agricultural sector and the aqua cultural sector.

The activities needed to stimulate economic development also have to consider the impact on the environment. Many natural habitats depend on the availability of water. The wetlands in the region are important and planning should be done in such a way that there is a balance between 'people, planet and profit', the triple bottom line of sustainable development.

Challenges have been discussed in different meetings with stakeholders including a meeting with the producers attended by the Minister of Agroindustry of the Province of Buenos Aires. A meeting with several mayors provided the mission with insight in their challenges in bringing different objectives together and what their ideas are related to the institutional setting to manage the basin and its river.

Aspects that need further detailing are:

- Institutional setting for integrated management
- Monitoring networks and automated operation of water works
- Land use and water balances
- Environmental development of the river

These aspects could be taken in to consideration when assessing the need for follow up initiatives. This mission could provide the Undersecretary of Water Resources of the province of Buenos Aires with important information on how to face these challenges and to share experience on how these challenges are encountered in the Netherlands.

Dique Paso de las Piedras

The objectives (Annex C) of the emergency mission to the "Dique Paso de las Piedras" are summarized as follows:

- Assess actual physical condition
- Evaluate present maintenance
- Advice on emergency repair and improvements of the dike
- Investigate in a broader perspective regarding regional water supply, prevention and mitigation, drought related impacts and flooding
- Advice on strategies to improve water safety

To achieve the above objectives the DRR-Team visited the dam, collected the available information, met with the authorities, technicians, local engineers, researchers and stakeholders of the dam. A quick diagnostic of the challenges and opportunities that should be addressed was made.

The region of Bahia Blanca faces the following challenges:

- To take urgent actions to keep the dam and its reservoir functioning such as maintenance of the dam to prevent dam failure and reducing algae growth.
- To take urgent actions to secure the reservoir to prevent loss of lives.
- To implement measures to avoid the problem of insufficient or no water supply during dry years to the region.

It is recommended to carry out a more detailed technical study as soon as possible to further assess the actual condition of the earth dam and structures and to analyze the availability of water resources and water demand at present and in the future. These studies can be carried out within a period of three to six months.

Furthermore, the following recommendations are made:

- Integrated management of water resources in a sustainable way includes not only the technical aspects but also environmental, social and economic aspects. Integrating all those aspects will make it possible to analyse the possible benefits of the community as a whole. The ideal strategy to come to IWRM is to first develop an integrated long term vision or plan in which first the joint goals (or needs) of the region in terms of water (social, economic, environment) are described. The overall and main goal is to provide the region for now and in the future with enough water of good quality and prevent the region against flooding. Secondary, potential goals are or could be in the field of recreation and the environment.
- It is important to assure the participation of the different actors in this development.
- It is necessary to establish clear responsibilities and to enforce them to work towards an implementation plan with actions/projects to be executed on short, mid and long term.
- Upscaling will improve integrated management and identification of additional interventions. The upscaling is recommended up to the development of the Southwest Pampa region (Río Negro, Colorado River, Arroyo Naposta, Sauce Grande and Chico). For this a comprehensive regional plan is to be elaborated. The construction of an aqueduct from the Rio Colorado in combination with the reservoir and other water resources (subsurface water, reuse of industrial and/or sewage water) might reduce the risk of discontinuity in the water supply and could lead to an increase in water availability. This could lead to additional opportunities for water users in the region, for instance for irrigation.
- The CAF will finance the Aqueduct from Rio Colorado. It should be investigated whether there are shared interests to include this initiative in an integral study of the management

of the water resources in the region. This could strengthen the ongoing collaboration between the CAF and the province of Buenos Aires.

The province of Buenos Aires could profit from broad international experience to assure that use of IWRM knowledge available will be optimized and will support implementation of interventions that lead to sustainable development.

More specific the DRR-Team has identified the following possibilities for further collaboration related to integrated management of water resources:

- Environmental management and sharing experience related to water quality and algae problematic;
- Flood risk management and risk assessment;
- Erosion and sediment control in relation to reservoir management;
- Operational reservoir management and optimization of water use;
- Water treatment (drinking water as well as waste water management);
- Monitoring to facilitate integrated basin management;
- Institutional capacity building and process management for inclusive water management.

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LIST OF ABBREVIATIONS

ABSA	Aguas Bonaerenses S.A.
ADA	Autoridad del Agua Buenos Aires Province
AMSL	Above Mean Sea Level/Sobre el nivel medio del mar
AyA	Acuaductos y Alcantarillados
CAF	Andean Development Corporation – Development Bank of Latin America / Corporación Andina de Fomento – Banco de desarrollo del América Latina
DRR	Dutch Risk Reduction
EKN	Embassy of the Kingdom of the Netherlands
ENSO	El Niño Southern Oscillation
FEWS	Flood Early Warning System
IDB / BID	Inter-American Development Bank / Banco Interamericano de Desarrollo
IFI	International Financing Institution
NGO's	Non Governmental Organizations
OPDS	Organismo Provincial para el Desarrollo Sostenible
PNUD	Programa de las Naciones Unidas para el Desarrollo
RVO	Rijksdienst voor Ondernemend Nederland / Netherlands Enterprise Agency
WB / BM	World Bank / Banco Mundial

1 INTRODUCTION

Floods are a recurrent problem in many regions of Argentina, with the main impact concentrated in the center and north east/west of the territory. The El Niño phase of the ENSO phenomenon increases these flood risks in these regions.

There are several river basins that cross these provinces: Río Reconquista, Río Paraná, Río Paraguay, Río Uruguay, Río Salado, and many others.



Figure 1-1 Major rivers in Argentina

In the Province of Buenos Aires alone there are 56 individual basins of different sizes and characteristics. This province is basically a big delta, with the well-known water related problems that this typically involves. In these regions the highest agricultural and livestock values are concentrated. This means that every flood has immense economic impact, as well as social and political. In some regions, water logging is a common problem, it takes months before the land recovers and is suitable for agricultural activity again.

This also has an important logistic impact, as the majority of the agricultural goods are transported by road, which can be blocked for weeks because of flooding. This disrupts the whole value chain, causing economic and financial losses to farmers. The province of Buenos Aires has 17 million inhabitants (39% of the total population of

Argentina), and represents 37% of the country's GDP. Hence, the impact is felt not only in the province, but country wide.

During several recent meetings between Argentinian and Netherlands officials, the Argentinian government requested Dutch support, prioritizing two specific subjects:

1. Advice regarding the vulnerability and risk of the City of Bahia Blanca and surrounding area due to various problems related to the "Dique (dike) Paso de las Piedras"
2. Assistance in the review of the Water Master Plan for the Rio Salado Basin

It was agreed to carry out an emergency mission that focuses on advice regarding Dique Paso de la Piedras and make an inventory of the present and foreseen water system related problems associated with the Rio Salado Basin and the Water Master Plan that was developed 16 years ago. The results of this first inventory will lead to decisions on future initiatives.

Background

During the World Economic Forum in January 2016 in Davos president Macri of Argentina met with Prime Minister Rutte and Queen Maxima. During this meeting PM Rutte offered Argentina to send a team of experts to assist on water / flood management related challenges.

On the 12th of February 2016 a request was sent to the Ambassador of the Netherlands in Argentina by the Undersecretary of Water Resources of the Province of Buenos Aires supported by the Argentinian Federal Government, Ministry of Infrastructure and Public works. The official request followed on the 10th of March 2016.

The objectives of this mission are twofold and comprise:

1. The objective for the Dique Paso de las Piedras is deliver an assessment and evaluation on present maintenance and management of the dike. This assessment has to be positioned within frameworks related to regional water supply, risk reduction of or mitigation of drought-related impacts and flooding in the region of the City of Bahia Blanca.
2. The objective for the Rio Salado is to provide an inventory of the present and foreseen problems and urgency regarding the effectiveness of the Water Master Plan for the Rio Salado Basin.

2 DIQUE PASO DE LAS PIEDRAS

2.1 Actual situation and challenges

The Dique Paso de las Piedras is geographically located in the northeast of the city of Bahía Blanca (south of the Province of Buenos Aires). This reservoir is principally devoted to the accumulation of water to ensure the supply of drinking water to more than 500,000 inhabitants of the city of Bahía Blanca, Gran Bahía Blanca and Coronel Rosales (Punta Alta), as well as the distribution of water for industrial use of the "Bahía Blanca Industrial and Petrochemical Industrial Area" (the largest petrochemical center of the province, 45% of the national production of this industry).

The Dique Paso de las Piedras was built in 1972 (Figure 2-1, Figure 2-2 and Figure 2-3) in the Rio Sauce Grande with the main objective of supplying drinking water to the city of Bahía Blanca.

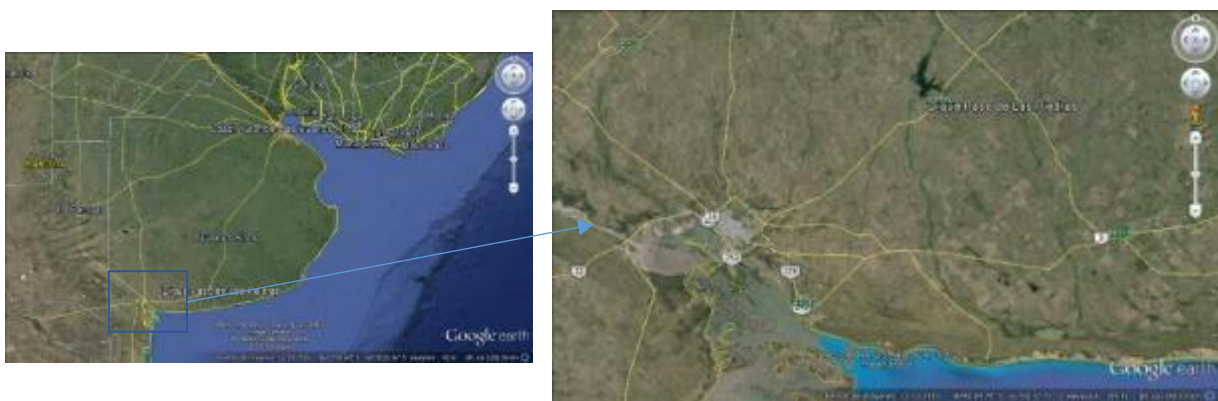


Figure 2-1. Location of Dique Paso de las Piedras

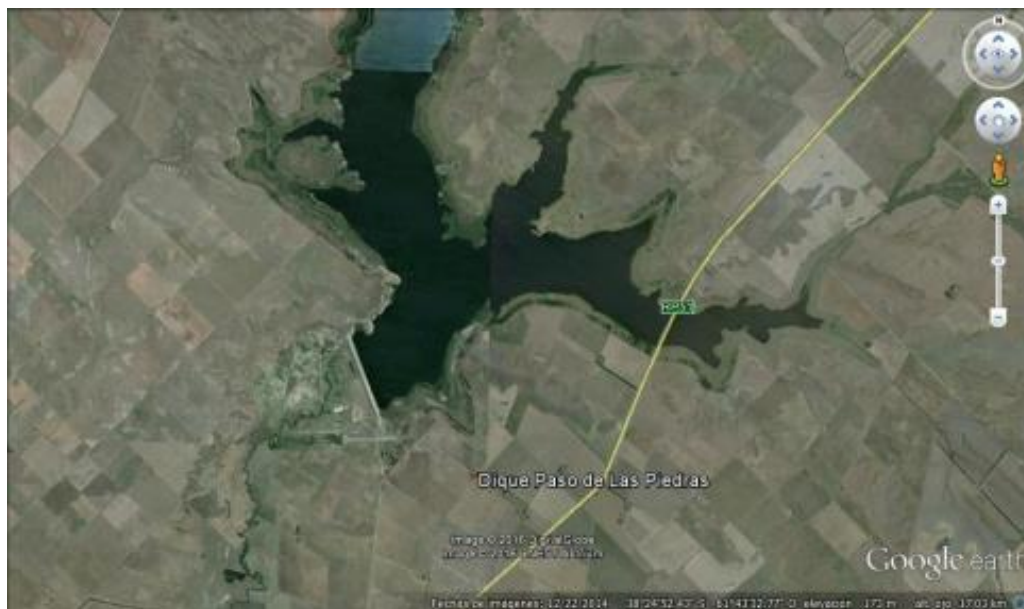


Figure 2-2. Plan View Reservoir



Figure 2-3. DRR-Team visit to reservoir 31 May 2016

The height of the reservoir was determined based on the hydrological analysis of flow over a period of approximately 40 years and the demand for water in the city projected to the year 2000. The spillway was designed for a 1/200 years' flood dimensioned for a peak discharge of 2000 m³/s. The regulation capacity of the reservoir when designed was of 300 hm³ which allows for a multiannual regulation, facilitating the supply of water in periods of dry years as occurred between 1934-1939. The water level in the reservoir was supposed to oscillate approximately 3 metres (162 m – 165 m AMSL- Above Mean Sea Level) and the water accumulated would satisfy the demand in critical years (return period of 40 year).

Subsequently, to avoid flooding downstream, it was decided that the maximum water level of the reservoir was reduced to 163 m AMSL. In 2005-2010 a critical dry period occurred, there was not enough water to supply to Bahia Blanca in 2010. During this period wells were constructed and groundwater was used. This dry period has resulted in returning to the original operational protocol with a maximum level of 165 m AMSL. When the water level exceeds 165 AMSL, water will be discharged via the spillway. Depending on the discharge, this can cause flooding downstream. The consequences of flooding are considered much less of a problem than the water supply quality and quantity to Bahia Blanca. Other alternatives to reduce risks of discontinuation of the water are being developed.

The Dique Paso de Las Piedras and its reservoir are actually being used to accumulate water to ensure the provision of drinking water and industrial consumption to the region of Bahia Blanca. The use of the reservoir for recreational purposes is prohibited by ADA (Autoridad del Agua, Buenos Aires Province). Nevertheless, people have illegally used the reservoir and surroundings for recreational activities, what resulted in people drowning due to dangerous currents in the reservoir and deterioration of the water quality of the reservoir. Furthermore, due to the growth of "pejerreyes" (Silverside fish) population, the concentration of algae has increased. Actions are needed to guaranty water supply for the city and for industrial use. The region faces challenges in water safety, water availability and water quality. For this it needs:

- To take urgent actions to keep the dam and its reservoir functioning, such as maintenance, to prevent dam failure and reducing algae growth;
- To take urgent actions in and around the reservoir to prevent loss of lives;
- To implement measures to decrease the risk of discontinuity of water supply to the region during dry years.

These challenges offer the opportunity to develop an integral vision and implementation plan for the use and management of the water resources in Bahia Blanca and the region, that considers all aspects: technical, institutional and relational as well as environmental, social and economic. In this plan recreational alternatives should be included.

In this report the findings and recommendations of the DRR-Team are presented. These are based on the information that was made available to the team and discussions held with authorities and stakeholders.

2.2 Objectives and Approach of the mission

The objectives of the mission to the “Dique Paso de las Piedras” as indicated in the Terms of Reference are:

- Advice on the assessment of the dam, its operation and affected areas due to the actual condition of the dam after approximately 40 years of operation;
- Advice on the possibilities to develop an integral plan for the management of the reservoir including other uses in cooperation with the stakeholders;
- To establish the cooperation and following steps in the analysis and evaluation of integral solutions associated to the management of the regional water resources including environmental, social and economic aspects.

The approach of the mission to achieve above objectives is given in the following steps:

1. Visit to the dam, collection of available information and recognition of the condition of the dam as a whole, including not only structural aspects but also environmental, social and economic aspects;
2. Meet with the authorities, technicians, local engineers, researchers and other stakeholders;
3. Make a quick diagnostic of the challenges and opportunities that should be addressed. These challenges/opportunities are structured within the framework of “Water Governance” as described by the Netherland Water Governance Centre, consisting of three different levels (Content, Institutional and Relational);
4. Give recommendations to address the challenges/opportunities defining actions as immediate (now), short term (1 year) and mid-term (1-4 years) and added value of international experience.

The program and meetings (Annex D) are organized/oriented to accomplish the above objectives during the mission. A description of the followed steps 1 and 2 is given in section 2.3 where the program and the meetings are described. Section 2.4 presents the quick diagnostic (step 3) and section 2.5 gives the recommendations (step 4).

2.3 Program (description of meetings – actors and summary of discussion)

The program was defined by the Dutch embassy and the Province of Buenos Aires together with RVO and the DRR-Team. The program was oriented to accomplish the objectives of the mission (section 2.2) and also to get information about the water resource management plans of the Province of Buenos Aires and Argentina.

The program and the list of participants to the meetings are included in Annex D and E respectively. This section summarizes the most important topics of the meetings.

Monday 30 May 2016 – Buenos Aires city

The first day of the mission was dedicated to introductions to local partners, authorities, Dutch embassy, and the DRR-Team. A presentation was given by Rodrigo Silvosa (Sub-secretary of Infrastructure of Buenos Aires Province) about the water resource plans in the Province of Buenos Aires. Klaas de Groot (team leader DRR-Team) gave a presentation about water management in The Netherlands.

Tuesday 1 June – Wednesday 2 June 2016 - Bahia Blanca

The following points were addressed during these two days in Bahia Blanca:

- Visit to the dam, collection of existing studies, meeting with technicians and engineers of the dam and local engineers.
- Quick diagnostics of the hydraulic, structural functioning of the parts of the dam (such as structural damage, rate of sedimentation)
- Preliminary evaluation of the operational management of the water levels/volumes of the reservoir in the past 40 years and problems in the past, such as flooding downstream of the dam, deficit in water supply, environmental, social and economic challenges.
- Identify other possible uses of the reservoir such as recreational.
- Identify and meet stakeholders (municipalities, governmental and private organizations).
- Institutional setting for the management of the dam.

Tuesday:

The DRR-Team and Juan Manuel Albisetti, representative of the Dutch embassy, were received at the airport of Bahia Blanca by the Mayor of Bahia Blanca.

The DRR-Team visited the dam together with representative of the Dutch embassy, technicians and engineers of the dam, ADA, ABSA, local specialists from Mendoza, Buenos Aires and Bahia Blanca. An inspection of the dam was done and reported in October 2015. Unfortunately engineers from the company that did the inspection were not able to attend the visit.

ADA (Autoridad del Agua) owns and is responsible for the dam and also the management of water resources). ABSA (Aguas Bonaerenses S.A.), is a company created by the State of the province of Buenos Aires, 90 % of the shares of ABSA corresponds to the provincial government; while the remaining 10 % belongs to the workers, gathered through the Union of sanitary works of the province of Buenos Aires.

In the morning the director of the dam explained the functioning of the different parts of the dam (earth dam, spillway, water intake, bottom discharge valve).

In the afternoon Rik Beekx gave a presentation about the management of dykes in The Netherlands and Marcela Busnelli gave a presentation about the application of IWRM and active public participation in The Netherlands. The presentations were an introduction to an interactive session/workshop where not only technical aspects were discussed but also institutional and relational. The session was moderated by the Vice-president of ADA Agustin Sanchez Sorondo and Marcela Busnelli.

Wednesday:

In the morning we had a meeting with representatives of the tourism department of Tornquist and Pringles. Ideas of the representatives of both municipalities were presented and discussed with the Vice-president of ADA and DRR-Team. Also in the morning we had a meeting with "Polo industrial" (the group of companies in this specific industrial zone) of Bahia Blanca and specifically with the company DOW. "Polo industrial" is the name given to the petrochemical complex with the set of companies. DOW gave a presentation about the industrial activities in Bahia Blanca and the importance for the society. They also shared with the DRR-Team and ADA their concerns about water supply from the reservoir and ideas to increase the availability of water for industry by reusing industrial water and sewage water of the city of Bahia Blanca. No clear expansion plans are being developed at this moment, however, possibilities to expand clearly depend on the availability of water in the region.

During a lunch with the “Bolsa de Comercio de Bahia Blanca” and representatives of the “Polo industrial” of Bahia Blanca ideas were shared about possibilities of other uses of the reservoir and supply of water to Bahia Blanca.

In the afternoon the DRR-Team, Director of the dam and Vice-president ADA had a guided visit to the industrial facilities of DOW, “Polo industrial”.

Thursday 3 June 2016 – Buenos Aires city

In the morning a meeting was held with the authority of OPDS (Organismo Provincial para el Desarrollo Sostenible) with the whole DRR-Team and therefore relevant for emergency mission “Dique Paso Las Piedras” and scoping mission “Rio Salado”. OPDS is responsible for the executive coordination for sustainable development, environmental economic planning and the development of alternative energies. Important for the mission of “Dique Paso de Las Piedras” was to talk about the possibility of making the reservoir areas a Natural Reserve.

Afterwards DRR-Team Dique Paso de las Piedras had a meeting with authorities of ABSA who explained about two projects (already approved and to be executed): water treatment of sewage water of the city of Bahia Blanca and aqueduct from the Rio Colorado. Also losses of water in the distribution system were discussed, as well as issues related to the maintenance of the system and opportunities related to the integrated management of the water resources.

In the afternoon a meeting took place with the authorities of the Province of Buenos Aires, the embassy and International Financial Institutions (World Bank, CAF (Andean Development Corporation – Development Bank of Latin America) and IDB (Inter-American Development Bank)). In this meeting the interest for investments in both studies was identified. Furthermore, the Province of Buenos Aires expressed its intention to seek further cooperation with The Netherlands.

Friday 4 June 2016 – Buenos Aires city

In the morning a meeting at the Dutch embassy was held with authorities of Province of Buenos Aires to prepare the results to be worked out together with members of WB who have participated in the mission of Rio Salado. Also the preliminary results of the mission to Dique Paso de las Piedras were summarized.

The meeting was followed by a meeting with the members of the WB to summarize the results of both missions and to prepare a presentation to be given to the Sub-secretary of Water Resources of the Nation.

In the afternoon the preliminary results of the mission were presented to the Sub-secretary of Water Resources of the Nation by the authority of the Province of Buenos Aires.

2.4 Analysis / Findings

In this section the observations of the quick diagnostic of the challenges and opportunities are presented. These challenges/opportunities are structured within the framework of “Water Governance” as described by the Netherland Water Governance Centre (figure 2-4), consisting of three different levels (Technical or Content, Institutional and Relational). The different levels of the three-layer model of water governance as a framework are introduced and explained as follows.

Technical or Content layer: knowledge of the water systems and of the problems, data base, experience and skills required to solve the water problems are essential. However, this is not enough to achieve good water management. An adequate organizational framework together with the necessary legal instruments and a good financing structure are fundamental requirements for successful integrated water resources management (*the institutional layer*).

In addition, attention to what is called the *relational layer* is required. Important elements of this layer are communication and cooperation between different stakeholders, stakeholder participation, transparency and trust.

The three layers are important to be considered to elaborate an integrated water resources and flood risk management plan. If levels are not being considered sufficiently the plans might be not effective on the short and or long term.

It has to be indicated that this report is the result of a quick scan of available information and a five-day visit. Recommendations are based on the collected information

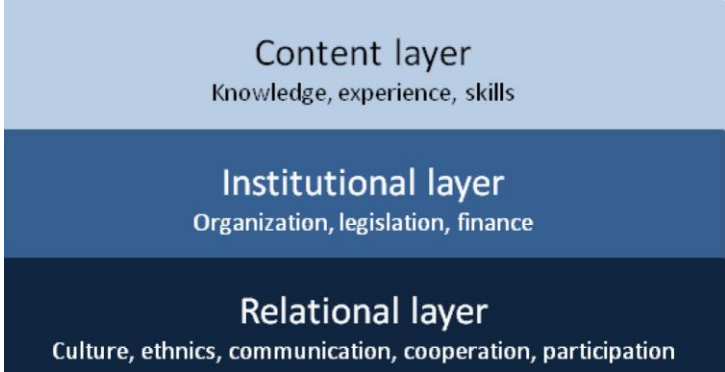


Figure 2-4 Levels of water governance

and further detailing is needed by the province of Buenos Aires and more specifically the ADA. Recommendations for further analysis of the challenges/opportunities are given in section 2.5.

2.4.1 Technical

General

As indicated the analysis is based on existing data made available to the DRR-Team, visit to the dam and the workshop that took place at the dam with technicians, researchers and local engineers.

The following technical aspects are distinguished:

- Structural aspects
- Hydrology, Hydraulics, Sediment, Morphology
- Water quality
- Capacity building

Structural aspects

An assessment of the stability of the dam is extremely relevant in relation to risks and impacts associated with dam breaches in terms of loss of life, supply/reduction of drinking and industrial water for the city of Bahía Blanca as well as the environmental consequences of a breach.

The Dique Paso de Las Piedras is formed by an Earth Dam. The crest elevation is 170 m above sea level, with a width of 15 m and a length of 1.71 km. The maximum height is 31 m, with an average slope of 1:2.75. The reservoir has a normal water level at 165 m AMSL and a maximum at 168 m AMSL. The capacity at the maximum water level of 165m AMSL is 300 hm³. On the left bank of the dam the relief works for the water are constructed, composed of a spillway with upstream facing inclined at 45 ° and crest level at 165 m AMSL (Figure 2-7 and Figure 2-6). The return to the river is achieved through a channel evacuator of 50 m wide and side walls with slope 2:1, which ends in an energy absorber. Downstream a drainage channel is built, with a length of 1.22 km to connect at 130 m AMSL with the river. These structures are made of concrete.

On the right bank, the work presents a bottom outlet (“descargador de fondo”) that consists of a tunnel that connects to the channel downstream through an energy dissipater.

The main parts of the Dique Paso de Las Piedras are illustrated in Figure 2-5.

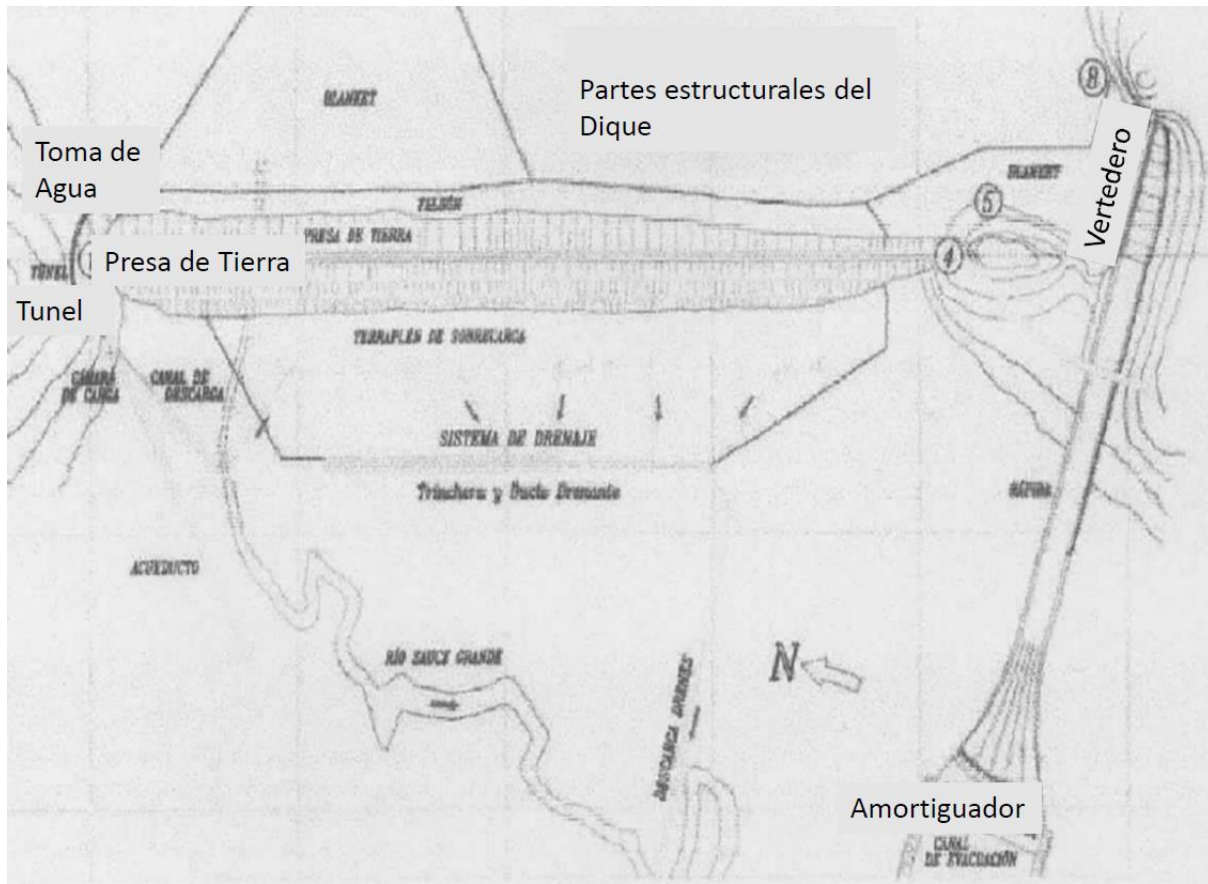


Figure 2-5. Plan view with schets parts of the Dique.

The earth dam has been adapted over the years. Piping (internal erosion of the subsoil as a result of water level differences) problems occurred in the past after the filling of the reservoir. Piezometers to measure the phreatic levels inside the dam were installed in the lower berm and downstream toe of the dam. In 1996 several improvements were carried out to improve the stability the dam. In Augustus 2015 an inspection and evaluation of the constructions works was carried out. The results of this study were made available to DRR-Team. The result of the inspection was that several structural aspects, among which the door of the water inlet and the joints of the concrete slabs of the inlet tunnel, should be repaired.



Figure 2-7. Spillway and Channel downstream 31 May 2016



Figure 2-6 Upstream of spill way 31 May 2016

Below, the observations on structural aspects of the Dique Paso de las Piedras in the actual situation are given. A distinction is made between the earth dam and the other parts, structures of the Reservoir.

Based on available time it is important that acknowledge that the below-presented recommendations may not be conclusive. Data available to the team was limited and for example did not include cost-benefit analyses to determine dam safety levels to justify design considerations. Collection of data – if not already available, through additional research – will improve future safety and efficiency of the dam.

Structural aspects: Earth Dam

It is important to evaluate the stability of the dam in the present situation. In the past water levels exceeding the present water levels have occurred. Therefore, with the current water levels no immediate danger for dam failure is visible as far as can be concluded by the limited visual inspection of the dam during the site visit. However, keeping in mind the critical water levels of the past, it is essential to analyse the current stability of the dam. An analysis could be based on existing information. Also the probability of the critical water levels to occur (both high and low water levels) should be analysed to predict what their return period is (flooding or droughts, this in relation to climate change) and how they affect the safety of the dam. With rising water levels, the water pressure on the dam increases. The level at which the required safety is no longer guaranteed (critical water level) should be determined based on stability calculations. The management plan of the dam should involve measures to prevent the critical levels to occur and measures to be taken when the critical levels might be exceeded. Based on the water supply and demand balance an estimate of the probability of the occurrence of the critical water level should be made.

The stability of the dam is not yet defined since failure not only may occur in the case of overflow. The dam has presented problems in the past and has been modified for example with a jet grouting which has changed safety conditions. Furthermore, concrete coating has been applied instead of the original rip-rap design. Concrete coating will cause a wind wave run up higher in comparison to rip-rap. It is not clear if this was taken into account in the design of the dam.

Furthermore, cracks were observed in the concrete coating. These cracks are not affecting the stability of the dam.

At this moment automatic measurements with piezometers are being restored/implemented within the dam. Furthermore, infiltrated flows and reservoir levels are being measured automatically. The data of piezometers and measurements of infiltrated flows have not been analysed yet. Their analysis will provide valuable information about the stability of the dam. At this moment it is not determined what the measured values mean in relation to the safety of the dam and actions to be taken.

Structural aspects: Structures

During the site visit several problems related to the structures of the dam were identified. These problems do not pose an immediate threat to the stability of the dam. Over time the risk of dam failure may however increase due to these defects and also the effectiveness of the dam is decreased. It is imperative that these issues are resolved to prevent further deterioration and to improve the effectiveness of the dam.

In the inlet works the lower gates, which are meant to be used as a discharge valve, cannot be opened due to local sedimentation. In order to solve this problem this local sediment should be removed (i.e. by means of dredging). To prevent this problem from reoccurring the maintenance plan and operations manual should be updated including periodical opening of the lower gates in order to discharge any local sedimentation gathering near these gates. The period in between opening the gates should be determined based on an analysis of the sedimentation in the reservoir. Furthermore, the period should be chosen taking into account the amount of water in the reservoir. Most efficient would be to open the gates at water levels when the spillway almost comes into function. This way the flow velocities will be at a maximum (this is positive to remove sedimentation but it should be analysed whether the dam and the structures can cope with these circumstances) and the loss of water will be minimal (since most of the water would pass over the spillway anyway). If this proves to be an effective measure, it could also be taken into account that when water is discharged through the lower gates, less water passes over the spillway which means less inundation of the land directly below the spillway.

With regards to the spillway some damage was observed in the concrete slabs. Also plants growing in front of the spillway and in the spillway were noticed. It should be analysed what the effect of these plants is. Plants growing upstream of the spillway may hinder the water from passing the spillway in an efficient manner which may lead to higher water levels in the reservoir. This may have an effect on the stability of the dam itself. Furthermore, the roots of plants growing in any concrete part may damage the concrete and possibly undermine the integrity of the dam. Therefore, periodic plant removal should be incorporated in the maintenance and operations manual.

In a previous evaluation of the structures the outlet tunnel was inspected. It was observed that leaks through the joint of the concrete tunnel cause significant water losses. Recommendations were made to fix the joints. It is not clear if this is done, when it was done or if it was effective. In order to improve the effectiveness of the dam and prevent failure due to internal erosion through the joints, this should be resolved.

Furthermore water losses are reported related to the pipes in the distribution system of the water to Bahía Blanca and the industrial zone. It is however not clear where these losses occur and how much water is lost exactly. These losses are actually not further investigated.

Hydrology, hydraulics, sediment, morphology

Hydrological data are very important to evaluate the actual management of the reservoir and to predict its management in the future. At this moment there are no automatic hydrological records of discharge measurements or meteorological records (such as wind conditions, precipitation, temperature and evaporation).

The measurements of the reservoir water levels are automatized. There is data available of these water levels in the reservoir in the past. The available data however has not been analysed to enhance understanding of the water system and to improve reservoir management. The frequencies – both historically and in the future - of extreme weather events (wet as well as dry years) need to be determined to assist in developing a safety strategy for management of the reservoir from a technical point of view.

Another important aspect for the management of the reservoir is the reduction of its volume due to sedimentation. Sedimentation in the reservoir is mainly related to the sediment transported by the streams to the reservoir. From the meetings with technicians and local engineers it appears that the sedimentation of the reservoir is reduced more rapidly when compared to other reservoirs of Argentina. There have only been local problems of sedimentation. However, bathymetries of different years were not analysed and the curves elevation area volume of the reservoir have not been updated. We observed during the visit that trees are growing upstream of the spillway (Figure 2-7). This indicates accumulation of sediments locally. Furthermore, these trees might increase water levels in the reservoir what might affect the earth dam safety (as indicated before).

In the past, particularly in dry periods the reservoir had insufficient water to supply the city of Bahia Blanca and its industries. According to the technicians this was not only related to the dry periods but also to the management of the volumes and water levels of the reservoir. Water levels were kept lower than 163 m AMSL to prevent flooding downstream, and after that a dry period happened. However, the frequency and consequences of flooding downstream are not known and have not been reported. When water was not available from the reservoir, wells were made to access subsurface water.

The water balance (water available and demand) in the present situation and in the future has not been made available. The efficiency of the reservoir to supply water in dry periods in the actual situation is not known. However, it is crucial to guarantee the water supply for the population and industry. Further economic expansion of industries might be hampered by lack of water.

At this moment and due to the problems faced in the past in the dry years a new project will be developed to provide water to the city: the aqueduct from Rio Colorado. The reservoir and the aqueduct will work in a combined manner. Therefore, to manage the reservoir and its volumes it is necessary to measure and analyse the information (hydrological, hydraulic and morphology) to evaluate its effectivity and if necessary to take actions.

Water quality

The water quality might be affected by untreated effluent into the reservoir due to recreational use, even though this is not allowed by the ADA. Algae growth has affected the water quality and it will be a problem in the future. At this moment water can be taken from three depth levels (in the vertical) from the reservoir. The level to take the water is chosen based on measurements of algae concentrations in the vertical (see control panel in Figure 2-8).

Research is being conducted by Universidad del Sur (Bahía Blanca) on algae growth. However, no method/technique has yet been developed to eliminate / significantly reduce algae growth. It has been observed that with the increased population of the fish Silverside (“pejerrey”) algae reproduce. The explanation is related to the pejerrey’s food chain which allows algae to grow. The Silversides (“pejerreyes”) were introduced in the reservoir for fishing despite a prohibition of any recreational activity in the reservoir and surroundings. Therefore, enforcement / compliance of this norm should be regulated to avoid degradation of water quality in the future.

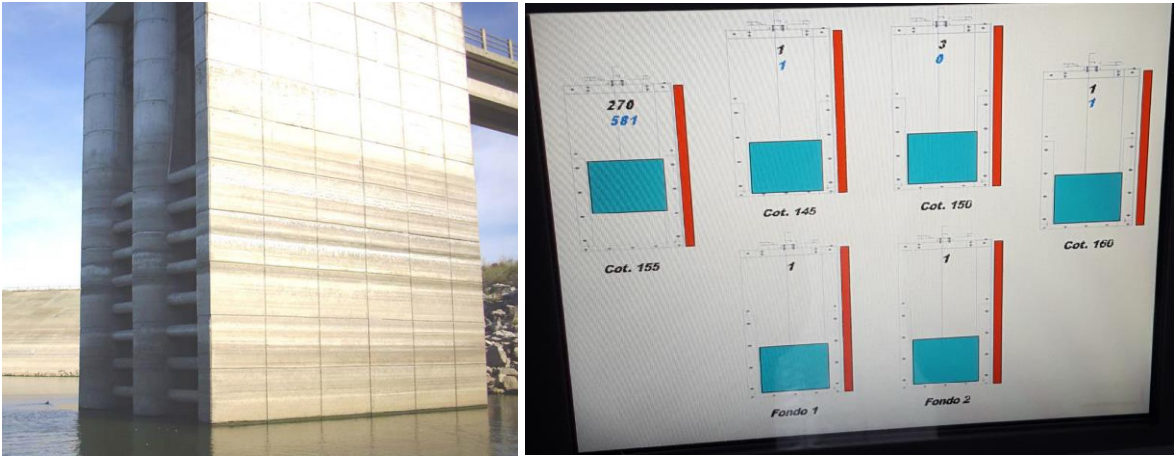


Figure 2-8. Water intake (left) and Control panel water intake

Capacity building

Trained technical personnel is scarce in Bahia Blanca. This is a concern of ADA. Civil engineers from Mendoza and the city of Buenos Aires were invited by ADA to visit the dam and to evaluate its condition together with the DRR-Team.

2.4.2 Institutional

ADA owns the dam and is responsible for its management. ABSA has the concession for the supply of drinking water. ABSA should pay ADA for the use of the water of the reservoir, but this does not happen. It is not clear how much has to be paid and why ABSA has failed to do so. However, the Vice-president of ADA explained to the DRR-Team that this is part of the regulating, legal framework that has not yet been enforced.

Another important issue when alternative uses are being proposed is that ADA has thus far prohibited the recreational use of the reservoir and surroundings. This is done to avoid the contamination of the water (main objective of the reservoir is water supply to the city of Bahia Blanca) but also to prevent activities such as swimming in dangerous parts of the reservoir as there are dangerous currents in certain locations.

The authorities of ADA are now open to ideas for recreational use in a controlled, regulated manner. Municipalities and other public or private entities are conducting studies related to the recreational use however they do not include ADA in their studies. These studies do not consider the integrated use of water resources but they are posing very interesting ideas for recreation (cycling, canoeing, sailing, etc.). The DRR-Team experienced the willingness of the municipalities to work together for the benefit of the community. Regardless, the reservoir and surroundings are extensively used by the people for recreation. The use for recreational purposes without supervision has caused loss of lives placing emphasis on the urgency in the institutional

establishment of the control/surveillance. The municipalities are very concerned about this situation. The municipalities mentioned the option to declare the area as a nature reserve, which would facilitate the control of the use of the reservoir for recreation by the authorities.

2.4.3 Relational

The DRR-Team observed that public and private entities are not working together to generate solutions or alternatives for the use of the reservoir. These solutions/alternatives are not shared or co-developed with other stakeholders and most importantly these are not coordinated with ADA. This lack of an integrated approach, poses the risk that these solutions/alternatives that are now generated, tackle specific single aspects/objectives (functions) but fail to factor the larger context. As a result, solutions may not be most effective in the whole, but serve the interest of a limited group of stakeholders. For instance, only recreational use, or only water supply. At the moment the interdependence between all relevant aspects/objectives is not considered so integrated solutions related to the availability of water resources and the demand in the region as a whole are not investigated.

The technical situation of the dam and the objective of the reservoir are not clear for all entities resulting in restlessness what, in turn, leads to the development of possible solutions for the water supply without taking into account the whole balance of water resources and the complementary application of the solutions to serve the region.

The dialogue between authorities and stakeholders is very limited. There is no coordination of the ADA of the entities and of the process for the formulation of alternatives of use of the reservoir and other water resources. However, there is a great willingness to work together for the best of the region (from all the parties visited).

2.5 Recommendations - possible interventions (Immediately-short-mid-long term)

Recommendations and follow-up actions were discussed with ADA and authorities of the Province of Buenos Aires. These recommendations are summarized below under the three levels of water governance: technical, institutional and relational.

They are defined as immediate (now), short-term (within 1 year) and mid-term (1-4 years). In the long-term (4-20 years) these measures should be implemented, operated and maintained. For the long-term it is necessary to define a strategy for the management and maintenance of the system.

The recommendations are divided according to the objectives of the mission:

1. Advice on emergency repair;
2. Advice on the function of the reservoir in a broader perspective regarding water supply, prevention and/or mitigation drought related impacts and flooding;
3. Advice on interventions to improve water safety.

2.5.1 Advice on emergency repair

The current water level (just below the level of the spillway) has already occurred several times in the past without dam breach occurring. Even significant higher water levels have occurred. According to the concept of “proven stability” no dam breach is to be expected under “similar circumstances”. In order to determine whether these circumstances are still similar it is advised to take some actions as soon as possible (immediately).

The current critical level of the reservoir is not known. In order to manage the water levels in the most effective manner and to ensure the safety downstream of the dam it is recommended to execute a detailed assessment of the current state of the dam as soon as possible. In these analyses the geotechnical stability (macro-stability, piping) of the earth dam as well as the current state of the concrete structures should be incorporated. Changes in the design (such as different cover material and grout injection shields) should be incorporated in such an assessment.

Furthermore, it is imperative to include in this assessment the consequences of a dam breach (disaster risk / impact analysis). The situation has changed in comparison with the period that the dam was originally designed. More people and industry may depend on the dam and its structural integrity. It is required to evaluate the consequences including costs. Also evacuation plans need to be adapted.

The suggested approach is based on using the existing information. The following steps are suggested:

1. Recollection and organization of existing information (amongst them: water levels, discharges, precipitations, bathymetries, piezometric measurements, geotechnical and geological data) to identify knowledge gaps and to create a data baseline;
2. Analysis of the stability and piping risk of the dam on the basis of the existing information. Take into account the risk of wave overtopping due to concrete slabs as cover instead of rip-rap. Downstream slope may be vulnerable to wave overtopping during extreme water levels;
3. Analysis of the water levels and water balance in the reservoir leading to identifying critical periods in the supply of water/flood downstream/water quality;
4. Analysis of the sedimentation in the reservoir by comparing the available bathymetries. Also to look at the cause and level of the local sedimentation near the bottom outlet. Determine the necessity to repair and formulate recommendations;
5. Analysis and update of the current dam manual, maintenance plan and emergency response plan. From the study it could be possible to make recommendations on these aspects for instance also regarding automatic measurements and locations, and when actions should be taken.

2.5.2 Advice on the function of the reservoir in a broader perspective

On the function of the reservoir in a broader perspective regarding water supply, prevention and/or mitigation drought related impacts and flooding, the DRR-team recommends developing (short term, within 1 year) an integral water vision and implementation plan for the region of Bahia Blanca. Clear challenges are identified regarding water safety, water availability and water quality which should be seen in a long term perspective (water needs, water availability, climate change implication and socio- economic developments). In the short-term actions and preliminary studies shall be carried out towards and as input for a comprehensive integrated management plan of the reservoir that shall be developed in the mid- and long-term.

The dam needs maintenance in order to deal with the challenges ahead (remaining stable for the coming decades under different climatic circumstances and to continue to be a valuable resource in the supply of increasing water demands). This is not only a matter of maintenance of the dam itself. Alternatives for dam improvements should be carried out in an integral manner, incorporating all relevant stakeholders, aspects and other projects. In this way the most effective technical, social and economic solution can be defined.

The technical aspects should be considered integrally with the water supply and demand, water quality and morphology. Furthermore it is advised to take into consideration additional uses of the reservoir and environmental improvements. Also other projects, such as the planned aqueduct from Rio Colorado to Bahia Blanca, wells to extract subsurface water and reuse of industrial, sewage water from Bahia Blanca should be taken into account in the analysis. Therefore DRR-team recommends undertaking the following preliminary, short-term actions:

1. Installation of measurement network of hydrological records (discharges measurements, meteorological records, subsurface water levels).
2. Recollection/organization of the existing projects related to the use of the water resources in the region of Bahia Blanca and also projects for the use of the reservoir for other use such as recreational.
3. Analysis of the water balance at present and in the future (availability and demand of water, climate change implication).
4. Further analysis of the algae problem, contact with other institutions working on the same topic and make use of international experience on this topic.
5. Analysis of the flooding risks downstream of the dam (frequency and consequences of flooding).

2.5.3 Advice on interventions to improve water safety

Taking into account a long(er) period (mid-term, 1 – 4 years) additional information needs to be gathered continuously in order to keep the reservoir functioning properly. Data collection over a longer period increases the precision of the forecasting and continued analysis secures the future compliance of the dam and its reservoir under changing circumstances.

Primarily wide scale data collection of hydrological, hydraulic and morphological data over an extensive period should be made in order to get more accurate predictions of discharges and water levels and the changes in wet and dry periods. With these data the dam operation can be adapted to cope with changing water supply in the most effective manner. This has a direct relation to the water levels that may occur in the reservoir.

The piezometric levels that are currently being monitored should be incorporated in a periodic analysis of the dam. The objective of these measurements should be clearly defined and if needed the monitoring should be adapted in order to support specific analysis.

Depending on the recommendations, following the immediate and short-term assessment of the dam, issues may need to be further studied.

The growth of algae negatively impacts the water quality. In the mid-term environmental adaptations should be investigated and carried out.

Furthermore, there are water losses that are related to the pipes in the distribution system of the water to Bahía Blanca and the industrial zone. Significant losses are noticed by the authorities. It is however not clear where these losses occur and how much water is lost exactly. It is recommended to analyse this problem in order to increase the effectiveness of the water distribution system and reduce operating costs.

A comprehensive integrated management plan of the reservoir is proposed to be developed and implemented. Alternatives can be proposed and developed to ensure the provision of drinking water and for the industry in the current and future situation. The possibility of other uses of the reservoir may be considered in this analysis, for example the identification of recreational use, provided it does not affect the main purpose of the reservoir (such as cycling, sport and controlled

fishing). A water funding strategy that estimates overall investment requirement and identify funding sources is needed.

The lack of trained personal is an issue at this moment in Bahia Blanca. Capacity building is needed for a sustainable integrated approach in the long term. The possibility of organizing training programs in combination with learning on the job. International programs could be identified to strengthen capacity and exchange knowledge and information.

In the long-term (4-20 years) the above proposed measures should be implemented, operated and maintained. For the long-term it is necessary to define a strategy for the management and maintenance of the system.

For example, in the Netherlands the dyke safety conditions are evaluated periodically (the third evaluation took place in 2006, the fourth evaluation is planned to take place in 2017). This means that periodically the stability of the dyke is checked by applying the latest industry techniques (such as undrained macro stability calculations and piping tests based on extensive geotechnical investigations), new measurements and knowledge gained by programs such as “Flood Risk in the Netherlands (VNK)”. If necessary, measures are defined and planned in an integral manner with the participation of the stakeholders. A description of the program VNK2 is available on:

<http://www.helpdeskwater.nl/onderwerpen/waterveiligheid/programma'-projecten/veiligheid-nederland/publicaties/>.

A brochure of this project (VNK2) is added as Annex F.

These evaluations are extensive projects that need political support and proper preparation. Therefore such projects are considered “long term”. It should however be initiated in the “short term”. Dutch experience in these types of projects is extensive and could prove a valuable addition to the water management in Argentina in general.

2.5.4 Institutional

The institutional issues were defined during the workshop in the dam, meetings with ADA, ABSA, Municipalities, “Polo industrial” of Bahia Blanca and OPDS. In this section recommendations are given.

Immediately (now):

Urgent actions have to be taken to avoid loss of life resulting from recreational activities in the reservoir and surroundings. Therefore, surveillance of the dam, reservoir and surroundings shall be set up though no recreational use is allowed actually.

ABSA and ADA will need to redefine their roles vis-à-vis the reservoir to ensure regional safety and reservoir effectiveness. This is essential for the future collaboration and the development of the region.

Short-term (within 1 year) and midterm (1-4 years)

In the short term it is necessary to organize the way to control the use of the dam, reservoir and surroundings. One possibility to do this that was mentioned during the workshop and meeting with the municipality was by declaring the Dique Paso de las Piedras and its reservoir “natural reserve”. This option and other alternatives should be further considered, evaluated and a decision should be taken by ADA.

ADA is responsible for the dam and also the management of water resources. Managing water systems is preferably done in an integrated way. To develop an integrated water resource plan, ADA and the Province of Buenos Aires will need to coordinate their activities. ADA and Province of Buenos Aires should establish the institutional settings that will facilitate the development of the integrated management plan of the water resources of Bahia Blanca.

It is also advised to take concrete actions towards the implementation of an integrated management plan of the reservoir by defining a work plan that includes development of effective framework for policies, legislation, financing structures, capacities of institutions with defined roles and management tools.

2.5.5 Relational

The polo industrial (the group of companies in the industrial zone of Bahia Blanca) is fully dependent on the water supply of the reservoir of Dique Paso de las Piedras. They have great interest in the new aqueduct that will be built in order to secure the water provision to Bahia Blanca. Also they are interested in methods to recycle industrial and sewage water for their industrial processes.

Immediately (now):

It is advised to manage the water resources in an integrated way. This means collaboration between all the important stakeholders of the region. Besides in an integrated approach all the important aspects and possible uses will be incorporated. It should also include future changes (such as climate, water demand, social, and economical). Applying a broad view in the management of the water resources might generate resources to fund the project. Therefore, the DRR-Team advises to organize and continue promoting participation, cooperation of the entities that was initiated during the mission. Promote the dialogue and participation between the stakeholders. Make use of the created moment and willingness of the parties to work together for the benefit of the region.

Short-term (within 1 year)

It is very important to keep the entities, stakeholders and public informed on the results of the studies, and process related to the management of the water resources. A communication plan also needs to be developed and implemented. The way of working together for the development of the water resources of the region shall be organized further defined with the participation of stakeholders.

Mid-term (1-4 years)

It has been noticed by the authorities that the water use per person in Bahia Blanca appears to be high in comparison with other cities. Education awareness about the true value of water as a resource and considerate water use shall be promoted. Communication programs are required to improve the awareness of the public. Also it is important that people understand how the water system is affected by human activities, and how they can contribute in a positive way to the system, applying a principle of solidarity. Direct link between responsible water usage and lower costs (taxes) in the future needs to be clearly communicated.

Furthermore, relational plans for the management of the water resources of the whole region (not only Bahia Blanca) might be further implemented.

2.5.6 Main conclusions/recommendations

The city of Bahia Blanca has faced serious water supply problems during dry years. When water was not available from the reservoir, wells were made to use subsurface water. A dam breach could have catastrophic consequences, but also the potential of a dam failure has negative consequences in relation to willingness to invest by the private sector. As immediately action it is recommended to carry out a detailed technical study to evaluate the actual condition of the earth dam and structures and to analyze the water resources and water demand at present and in the future. These studies can be carried out within a period of three to six months and should build on previous analysis done in October 2015.

During the mission the DRR-Team identified the following possibilities to increase water availability and to guarantee water supply to the city of Bahia Blanca alongside the reservoir "Dique Paso de las Piedras":

- Aqueduct from Rio Colorado. Project and financing have already been approved. This aqueduct will work together with the reservoir/Dique Paso de las Piedras. The managing of water supply of both should be analysed together.
- Wells already constructed to extract subsurface water. It is not clear if they are ready to use if needed.
- Reuse of sewage water of the city of Bahia Blanca and reuse of industrial water. A project has been approved by ADA and will be carried out for the treatment of sewage water. At this moment the water flows to the bay of Bahia Blanca with hardly any treatment. Though the treatment of the sewage water is not completely adequate for reuse, this is a first step. There are regulations for the water quality of effluents to the bay however the law is not enforced.
- Improving the water conduction/distribution to the city of Bahia Blanca. High losses of water are estimated by the ABSA and stakeholders (30-40 % losses) due to constructional aspects (old material, junctions, etc.).

The integration and combination of all these possibilities (including management of the reservoir Dique Paso de las Piedras) into an integrated water resource management plan might result in a positive water balance (more water available than needed) for the region what might open opportunities for expanding the industry in the region and other uses such as irrigation and tourism which will result in further social and economic development of the region.

It should be noticed that the development of new ideas/alternatives does not mean that the reservoir has reached its designed lifetime. Maintenance of the dam and later on of the new structures of the system is an essential aspect of the water resource plans for the region. In the case the aqueduct cannot function, the reservoir will provide water or vice versa. Plans need to be elaborated together to maximise the possibilities for the use for the region.

Therefore, the following recommendations are made:

- Sustainable integrated management of water resources includes not only the technical aspects but also environmental, social and economic aspects. Integrating all those aspects will make it possible to analyse the possible benefits of the community as a whole. The ideal strategy to come to IWRM is to first develop an integrated long term vision or plan in which first the joint goals (or needs) of the region in terms of water (social, economic, environment) are described. The overall and main goal is to provide the region for now and in the future with enough water of good quality and prevent the region against flooding. Secondary, potential goals are or could be in the field of recreation and the environment.

- Furthermore, it is necessary to establish clear responsibilities and to enforce them to work towards an implementation plan with actions/projects to be executed on short, mid and long term.
- Upscaling: Studying a comprehensive plan for the development of the Southwest Pampa region (Río Negro, Colorado River, Arroyo Naposta, Sauce Grande and Chico). The construction of the aqueduct in combination with the reservoir and other water resources (subsurface water, reuse of industrial and/or sewage water) might allow for an integrated using of the water resources in the region. It might also be possible, in case of positive water balance to also use the water for instance for irrigation.
- The CAF will finance the Aqueduct from Rio Colorado. It should be investigated whether there are shared interests to include in an integral study of the management of the water resources in the region in the ongoing collaboration between the CAF and the province of Buenos Aires.

In relation to optimal use of international experience on IWRM and integrated reservoir management, the DRR-Team recommends intensifying exchange of information on:

- Environmental management and sharing experience related to water quality and algae problematic
- Flood risk management and risk assessment
- Erosion and sediment control in relation to reservoir management
- Operational reservoir management and optimization of water use
- Water treatment (drinking water as well as waste water management)
- Monitoring to facilitate integrated basin management
- Institutional capacity building and process management for inclusive water management

The DRR-Team experienced in Buenos Aires and Bahia Blanca the willingness and energy of the new authorities to work together with the stakeholders to develop hydraulic plans in an integrated manner. The DRR team had useful conversations and inspiring exchange meetings with authorities, local engineers and stakeholders. The authorities are working hard to get the works done and in an efficient and effective manner. Some of the authorities visited the Netherlands together with WB officials. There is awareness of the benefits of an integrated approach were all water governance aspects (technical, institutional and relational) are taken into account. Furthermore, in relation to international experience and best practices, The Netherlands is seen as an example of how to implement integrated water resource management. Ongoing exchange of experiences can lead to improving each other's water management practices.

3 RIO SALADO

3.1 Approach for the mission / objectives

The objective of this pre-scoping mission is to make an inventory of the present and foreseen problems and urgency regarding the effectiveness of the Water Master Plan for the Rio Salado Basin. The master plan focusses on flood risk management and the mission should identify opportunities to develop a more integrated vision on management of the river basin, also covering issues related to water scarcity, water quality and environmental quality. This mission had the objective to make an inventory of the challenges and to define interventions / problem solving strategies that are to be addressed in consecutive initiatives and to clarify the essence of the Rio Salado challenges. This also includes the identification of opportunities for agricultural land revalorization. This DRR report is limited to an assessment of the potential for land revalorization as a source of (private) funding for improved water management.

Alongside the analysis of the challenges of the Rio Salado a broad and general analysis on other water related challenges in the whole of Argentina has been carried out to define additional added values for ongoing and strengthened collaboration.

3.2 Program

To achieve the objectives of the short mission an intensive programme was put together. Annex G presents the program and Annex E summarizes the results of the meetings that took place.



Figure 3-1 Discussion with local stakeholders (land owners and farmers)

The program provided the required interaction with the stakeholders to make a first inventory of the challenges that the province of Buenos Aires is facing in managing the basin of the Rio Salado. A short mission can only lead to a general analysis of challenges and solutions. For a first overview, these challenges can be categorized as technical, institutional and relational challenges and will be further detailed below.

3.3 Actual situation and challenges

The Rio Salado is the largest river basin in the Province of Buenos Aires.

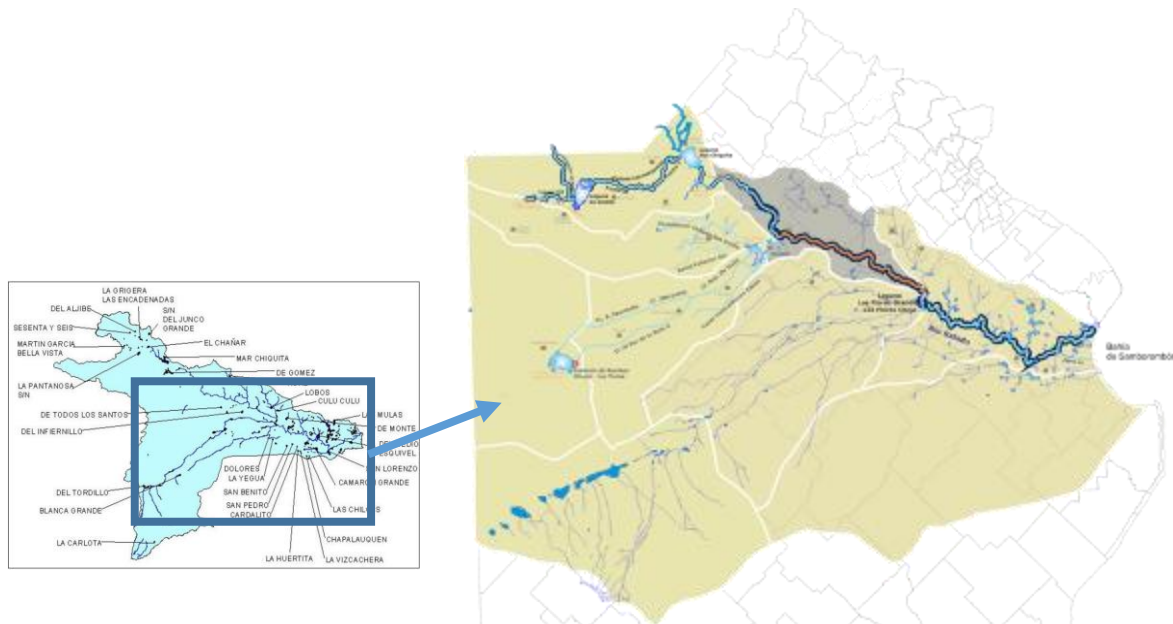


Figure 3-2 Catchment of the Rio Salado – flowing from West / South West to East (source: Water Master Plan Rio Salado)

The river is 640km long, it drains a total area of 170.000 sq. km (comparable with the total catchment area of the River Rhine), and runs through the richest agricultural lands in the region. On average, around 25-30 % of the total Argentinian meat and grain production is produced in this region (source: Plan Maestro Integral Cuenca del Río Salado). Every flood (which are very recurrent) causes immense economic damage, and has a huge social and political impact. In 2015 around 4.1 million ha, or close to 25% of the land was flooded, some for 6-9 months. According to the newspaper 'La Nacion' this has led to an economic damage of over 1 billion Argentinian pesos (around 100 million euros) only factoring in the wheat and meat production.



Figure 3-3 Flooded area august 2015, source: La Nacion)

The Federal Government as well as the Provincial government has asked the Netherlands government for assistance with the revision of the existing Water Master Plan of the Rio Salado.

The Water Master Plan was elaborated by the Province of Buenos Aires at the beginning of the year 2000.

The plan comprises 5 phases. The first three phases have been implemented and it is foreseen

Tramo	Longitud	Montes de suito	Estado	% Avance	Obras de Arte	Inversión
I	46 km	18.230.615,00 m ³	Completado	100	Si	\$100.992.766,00 -
II	67 km	22.441.206,00 m ³	Completado	100	Si	\$210.912.844,40 -
III	118 km	44.200.000 m ³	En ejecución	91	Si	\$1.632.840.466,37 -
IV	190 km	100.000.000 m ³	No Completado	0	Si	\$12.806.000.000 -
V	64 km	20.000.000 m ³	No Completado	0	Si	\$3.000.000.000 -
St. Luis Horquillas	254 km	10.000.000 m ³	Completado	100	Si	\$200.000.000 -
	780 km	218.151.843,00				

that the implementation of the fourth phase will start shortly. The first three phases comprised the downstream area of the basin before the river discharges in the delta of the Río Plata.

The interventions in these sections over a total length of 223 km basically covers the dredging of the river to develop a deeper river with an increased discharge capacity, and a number of small and medium

Figure 3-4 details of the different phases included in the Master Plan

infrastructure works along and across the river. In some cases, natural lagoons have been used as areas to retain water in order to control sudden peak discharges. Reserving room for temporary water retention is often a good intervention to reduce flood risks and increase availability of water during dry spells. The work that has been done in the first three phases has been carried out by local firms. The map below indicates the different tranches.



Figure 3-5 locations of phases 1 to 5 (source: Water Master Plan Río Salado)

The map also indicates sections 4 and 5 that are still to be implemented. The region is extremely flat. The average gradient over the basin is 0.025%. This means that flow velocity is low and that with high rainfall intensities a large area is needed to retain the water before it can be drained towards the Río de la Plata. Neighboring basins have similar challenges. For this reason some interconnections have been constructed between the neighboring catchments and the Río Salado

such that these catchments also partially drain via the Río Salado. Furthermore, the different catchments are interconnected through groundwater flows.

The groundwater level is high, on average 2 to less than 10 meter (Source: communication with local agricultural producers) and with long duration of rainfall the groundwater level rises. Floods are not only caused because of surface flows and rivers overflowing their borders, but also because of the fact that the absorption capacity has been used to its full extend and groundwater surfaces. If these areas cannot be drained because of absence of drainage canals this results in what is called water logging. It can take several months before the water level has gone down sufficiently for all the water to infiltrate. The only way to drain the water is to ensure that downstream drains have sufficient discharge capacity or retain the water in areas that have been allocated as retention ponds or lagoons.

As the region suffers from the effects of the ENSO (El Niño–Southern Oscillation phenomenon (El Niño / la Niña) as well as from longer cyclic climate variations (source: Building Safer Cities: The Future of Disaster Risk, Chapter 10, Flooding in the Pampean Region of Argentina: The Salado Basin, Hilda Herzer), the wetter years are interchanged with dryer years. The focus on drainage only increases the risks of droughts during the years with rainfall deficits as water will be discharged downstream as soon as possible.

The first three phases of the Master Plan have only taken the reduction of flood risks into consideration and did not consider the retention of water in anticipation of dryer periods. The main challenges at present are:

- The upstream part of the basin is not drained sufficiently because phases 4 and 5 have not been carried out yet;
- The neighboring river basins that are planned to be drained via the Rio Salado cannot be connected yet because of the actual drainage capacity; These basins are located East and North East of the Salado basin.
- Many of the water works constructed during the first three phases have not been appropriately maintained and, hence, are not fully operational (or not at all);
- The interventions (measures) have been planned with a hydrological and hydraulic model that has been developed in the 1990's of the last century. An update of the model has been carried out by the Instituto Nacional de Agua (INA). The model indicates that the planned interventions will have the foreseen effects and that optimization is possible. When optimizing, new insights can be included in relation to climate change, up- and downstream effects and effects of other interventions to come to an integrated system;
- The basin lacks an appropriate governance agreement. The municipalities are responsible for maintenance, but these responsibilities are not clearly defined and funding is not assured. The Comision de Cuenca (committee of Mayors) does not function as perceived and an analysis is needed to find a better way to manage the basin in an integrated manner.
- Because of the deficient drainage capacity floods along this river are increasingly recurrent. This affects a growing part of the local populations and decreases the value of the agricultural land. Furthermore it affects the mobility in the region. Prolonged disruption of the mobility because of water logging also hampers accessibility of markets where agricultural products have to be sold. Each flood event, disrupts the whole value chain, causing economic and financial loss to farmers.
- Due to low resiliency, land that could be used for various agricultural uses, is not optimally used. Value of land per ha could be five times as much if the flood risk can be reduced significantly (as was indicated by local farmers).

3.4 Analysis / Findings

The provincial authorities as well as the local farmers believe that the implementation of phase 1-3 of the Water Master Plan has reduced the risk of flooding as well as the duration of the flooding. This is the general idea that exists under the stakeholders but there is no hydraulic evaluation available at this moment that indicates how much this risk has been reduced. However, it seems that the actors support the fact that these interventions have had their effect, even though 2015 has been an extreme year when considering the amount of rain and discharge. Flooding has seriously affected the land but here is general support for the fact that the flooding would have caused a lot more damage if the structural interventions in phase 1-3 had not been implemented.

The Water Master Plan is a technical plan that describes all the technical or structural interventions that are and still have to be implemented. The three main objectives of the plan are:

- Reduce flood risks (magnitude and duration) and drought risks;
- Improve the conditions for socio-economic development in the basin, taking in to consideration the needs of the agricultural and livestock production;
- Protect and develop the environmental values of the basin.

It can be indicated that detailing and implementation of the plan has mainly focused on the reduction of flood risks through structural interventions.

It is crucial to continue with the fourth phase of the Master Plan to assure that the up-stream part of the basin also drains in such a way that flood risks will be reduced. There is a strong tendency to adopt a more integrated approach for this phase and to incorporate this integrated approach also in the operation and maintenance of the first three phases and the area that is drained by the sections that have already been carried out. To be able to adopt an integrated approach authorities face a series of challenges. These can be related to technical aspects, to institutional aspects and to relational aspects and are described as such below. See also paragraph 2.4 for explanation of the water governance framework consisting of 3 levels.

Technical

The approach chosen for phase 1-3 towards flood risk management is very much from a traditional point of view where it is believed that the river can be fully controlled by technical interventions.

As far as could be overseen during the week and based on discussions with involved actors it can be indicated that there is insufficient information to evaluate effects of interventions in a proper manner. There is an integrated surface / groundwater model (MIKE) that has been actualized by the INA in 2008. This model has proven to be very valuable in the decision making and design of the successive phases. Dr Ángel Menendez, being responsible for updating the model, has indicated that the model can be improved and cooperation with other knowledge institutions is being sought to share knowledge and experience on these specific types of circumstances.

Morphological data and simulation would improve strongly the ability to simulate effects of new interventions as erosion and sedimentation processes in these types of rivers very much affect the discharge capacity of the river. At present these effects are not incorporated in the present model.

When considering other than hydraulic and morphological effects, it is also important to improve knowledge on environmental aspects and the effects of interventions. The Rio Salado could function as a corridor for migration of flora and fauna. The mission was not able to assess up to

which level these environmental aspects have been considered during the design and implementation of the water works.

Also social and economic aspects and the effects of the interventions have only slightly been touched upon in the water master plan. Even though, facilitating socio economic development in the region is one of the three main objectives of the master plan. There is a general level of knowledge on land use, but for sustainable water management it is needed to deepen that insight and use this to develop a water balance including availability and water demand. This will also provide the required information on whether it is needed to retain water on the fields and in the tertiary and secondary drainage system. During the mission it was indicated that land prices of the land that was elevated with the soil from dredging has increased from 5000 dollars per hectare to 20 – 25.000 per hectare. If this is the case then a business case could be developed to partly finance the implementation of the fourth phase. During the mission it was not possible to collect more references on this increase of land prices.

If there is a need for integrated water resources management in the basin the knowledge base needs to be improved to support sound decision making. Choices have to be made between competing users and insufficient information increasing the risk of making the wrong choices.

More information is needed to develop decision support systems. These decision support systems could prove useful in the arena of policy making, but also in the operation and maintenance of the system. As the rainfall in the system can be very local it is important to have good information on where excess rainfall is taking place. This information from good field monitoring on precipitation and discharges can be made available through early warning systems. This information allows the operators to make decisions on gates to be closed or opened in the water system. This operational system could also be developed in to a fully automatic system that optimizes the retention and discharge of water through the water system.

Alongside an analysis and modelling of the primary drainage system, it is essential to get more insight in the function of secondary and tertiary canals. These canals are normally the responsibility of the land owners and play a crucial role in providing sufficient drainage and in maintaining a certain ground water level that will facilitate growth of crops. When flying over the basin only scattered secondary and tertiary canals could be identified. Many of these canals have been dug illegally. In picture 3.11 the difference between the landscape in the Rio Salado basin and the polder landscape in the Netherlands is presented. It is clear that de drainage system in the Netherlands is a lot denser.

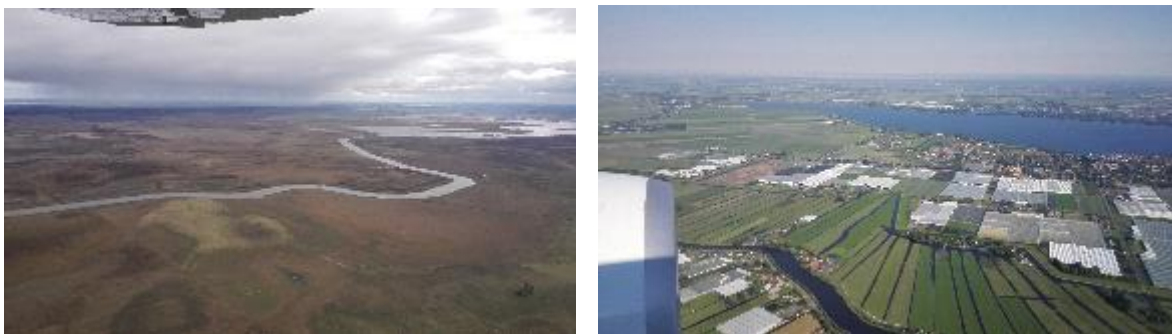


Figure 3-6 Density of drainage system in the Rio Salado basin and in the Polders of the Netherlands

Institutional

During the five-day mission it became clear that responsibilities are not always well defined and if they are well defined the financial arrangements to support those assignments are not in place.

The Undersecretary of Water Resources is responsible for the implementation of the structural interventions while the Autoridad de Agua (AdA) is responsible for the non-structural aspects. The difference between structural and non-structural is not always clear and therefore it is not clear who is responsible and who has to report on what has been done and to which effects this has led. In the basin of the Rio Salado a Comité de Cuencas has been established. This committee is an assembly of all the Mayors in the basin. During the meeting with the Mayors it was indicated that responsibilities are not clear and that they do not have sufficient power, instruments, knowledge to carry out the tasks assigned to these committees. It was stated by various stakeholders that a different institutional setting is needed to assure that the basin of the Rio Salado is managed in an integrated manner.

There are many norms and rules. One participant at the meeting with the agro producers indicated that there are more than 1100 norms and regulations of which around 150 have a relation with water management. It is not that there are insufficient norms and regulation, but that it is very difficult to have the people abide by these rules. Therefore, it would be good to evaluate the existing set of norms and regulations and to improve their coherence. Furthermore, institutional strengthening should be programmed to assure that the authorities have the necessary instruments to enforce these norms and regulations.

When looking at the institutional capacity it can be stated that with the increasing pressure on land and water, also more investments will be required to facilitate good management of these resources. That also means that the responsible authorities should get the resources to contract and train more personnel, to set up the required infrastructure and to have enough people on the ground to assure that policies are being implemented and operation and maintenance is carried out. At the moment there is insufficient capacity to carry out all these tasks and an analysis of the institutional setting and requirements would provide important information on steps to be taken.

Relational

The mission provided several opportunities to interact with different stakeholders. The general impression was that a lot of attention is being given to stakeholder participation. More in-depth research is needed to get a better view on whether this leads to a bottom up decision making or that decision making is top down and stakeholders are sufficiently informed about the decisions that have been made by the national, provincial and municipal authorities.

Several times it was indicated that there is only little interaction between the different responsible authorities and policy making related to water in taking place in silo's. This results in the fact that water is not sufficiently taken into consideration when other developments take place, for example in infrastructure, spatial planning, and agricultural zoning.

Procedures for permits take a lot of time. This results in implementation of interventions without having received the required permission. All farmers try to drain their area as quickly as possible. This makes it very difficult to implement an integrated approach and water works carried out by the farmers are known to have negative effects in downstream areas.

A more in-depth analysis of the relational aspects of water management could lead to a better view on how to increase efficiency in policy making and how to reach a more effective implementation, operation and maintenance of the basin and its water system.

3.5 Recommendations

Key elements of an integrated management of the river basin are:

- Development of the knowledge level, including public and private financing options for water management
- Develop a vision on water management in function of socio-economic development
- Continue with the development of the infrastructure
- Valorize and protect the environmental resources of the basin.

Each of these elements will be elaborated upon below.

Development of the knowledge level:

For the development of the knowledge level it is necessary to update the information on the actual status of the river basin. For this it is required to design and put in place a monitoring network. With this additional information it will be possible to assess the social, economic and environmental effects of all the water works that have been carried out over the last decade. This will also allow for a cost benefit analysis of the work that has been done to reduce the risk of flooding.

An analysis is needed of the available water resources. This is basic information to arrive at a sustainable water balance. To get a better overview of the demand for water a land use study is needed. This land use study should include an impact study of these land uses on the water balance. Not only considering their demand, but also their evapotranspiration and with that their effect on ground water levels.

With an improved monitoring network, it will also become possible to improve the existing hydrological and hydraulic models, to develop new models and to improve the ability to prognosticate extreme events with early warning systems.

The production capacity of the landfills has to be assessed as this is important information to establish the land prices of these areas that are less prone to inundations. If land prices rise as has been indicated, this could be used to finance (part of) the interventions.

The drainage system has to be optimized. To be able to improve, a basin wide inventory of the existing system has to be made. Effects of this system on surface water runoff as well as ground water drainage has to be studied. Some of these drainage canals have been dug by private initiative and with private funding and many of them without the needed permits in place. It is needed to get a good overview of the works that have been carried out with the proper approvals and which canals have been dug without permits. This is important basic information to take corrective measures. In some cases, it might be possible to start with immediate corrective measures that allow for sufficient drainage capacity but also allow for storage of water.

Throughout the basin many large and smaller wetlands are located. Also along the borders of section number four of the Rio Salado these wetlands perform different functions. The values (ecological, social, and economic) of these wetlands have to be defined – eco-system services - to assure that the proper information is taken in to consideration when making decisions. From a hydraulic point of view these wetlands provide room for retention of water and as such reduce the risk of flooding and increases the availability of water during prolonged periods without rainfall.

The relation between the management of the waters system and the land use has to be improved. An inventory of actual land uses will allow for a sound estimation of water demands. This will also allow for optimization of the water use of these land uses. For example, in agriculture crop patterns strongly influence water demand. With the required information cropping

patterns could be adapted in time to take in to consideration longer periods of reduced water availability. Also the efficiency of water use can be improved. An integrated water-land use approach will allow for a better synchronization of water demands and availability.

Management of the water resources to facilitate the socioeconomic development of the basin:

First of all, to come to integrated water resources management capacity strengthening of the Undersecretary of Water Resources as well as the ADA is needed. This is necessary to manage the natural resource, to resolve conflicts and to be able to make proper decisions. Instruments (e.g. information systems, decision support systems, enforcement mechanisms, revolving funds mechanisms) that are required to manage the system have to be developed and the main body of the basin committee has to be strengthened.

Mechanisms (e.g. websites, early warning systems, regular information meetings, education and training) have to be put in place to assure sufficient interaction with the stakeholders and to assure that water management practice is put in place to facilitate a sustainable development of the basin and its resources. With the proper instruments decision making will be supported and interventions will be identified taking in to consideration the different interests of the stakeholders as well as the availability of natural and financial resources. This will further facilitate the socio economic development of the basin.

With the proper institutional capacity and instruments in place, the continuation of operation and maintenance of the water system in place will become feasible.

Development of the needed infrastructure

It is necessary to continue with the implementation of the master plan and to start as soon as possible with the realization of phase four of the plan. This will reduce the risk of flooding in large parts of the basin. However, this should be done as much as possible with an integrated approach as this will not only lead to the reduction of the floods but also to optimize social, economic, environment development and increase resiliency in relation to floods and droughts. This integrated approach should then also be translated to the sections of the river that have already been altered in phase 1-3.

It is also needed to focus on the secondary and tertiary system to assure that drainage as well as retention of water is taking place in the most efficient and effective manner. This has to be done in coordination and in cooperation with the landowners. Aside from local retention of water in the secondary and tertiary canal system additional interventions have to be identified to improve the retention of water to assure that not only flood risks are being reduced but also sufficient water can be retained to reduce the risk of social, ecological and economic losses during prolonged periods of droughts (see figure 3.12 for an example of local water retention in the Netherlands)



The institutional setting should assure that the proper instruments are set in place to continue with operation and maintenance measures, also after the realization of phase four. These instruments include information systems, decision support

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Figure 3-7 local water retention in the Netherlands

systems, communication systems, instruments for enforcement, financial resources and instruments to assess the effectiveness of new policies and institutional arrangements.

Valorize and protect the environmental resources of the basin

Reducing the risks of flooding and droughts is crucial for the river basin of the Rio Salado, but also ample attention should be given to the environmental aspects. To be able to assure sufficient protection of the environmental values it is needed to make an inventory of its environmental resources and assess impacts of planned interventions. An important aspect is the monitoring of the water quality aspects of the surface water as well as the ground water and the potential to retain water in order to provide sufficient buffers for the environment.

Erosion and sedimentation processes have important impacts on the environmental values in the river basin. A morphological model would provide the needed insight in this process and the effect of interventions.

The data collected with the activities mentioned above should provide enough information to develop an updated plan for the management of the wetlands in the basin and alongside the Rio Salado.

Follow up:

In view of the analysis and the recommendations above the DRR team advises to perform a follow up mission of the DRR Team to the province of Buenos Aires. This will have high added value in furthering an integrated approach for the Rio Salado. Many characteristics of the Rio Salado are comparable to the river system in the Netherlands and, hence, exchange of information would enrich both sides.

During the discussions with the Undersecretary of Water Resources, the following aspects were identified as potential subjects to be further detailing during possible follow-up initiatives:

- Institutional setting for integrated management
- Monitoring networks and automated operation of water works
- Land use and water balances
- Environmental development of the river

These are all important aspects of IWRM that receive a lot of attention in the Province of Buenos Aires / Argentina as well as in the Netherlands.

In many regions of the country comparable challenges are being faced. Some of the river basins also include mayor urban centers that have reduced the room available to discharge the water. This has caused flooding in a series of locations, also in the Rio Salado basin. This even more underlines the added value of an collaboration between Argentina and the Netherlands. Water management is high on the Argentinian political agenda. And, as has been indicated during several meetings, the required resources are being allocated from national and provincial budgets in Argentina. The Undersecretary of Water Resources is carrying out efforts to plan, implement, operate and maintain the required infrastructure to reduce water related risks, to do so in an integrated manner and to learn from international experience in order to optimize local application of the concept of IWRM. IFI's are interested to cooperate in these efforts.

ANNEX A – DRR-TEAM

Dutch Risk Reduction Team: reducing the risk of water related disasters

Many countries around the world face severe water threats. Often, these countries are in urgent need of expert advice on how to prevent a disaster or how to recover from a calamity. For instance, when a country has been struck by severe flooding and the first emergency relief workers have gone, the need for advice on how to build a sustainable and safer water future arises. To meet these needs with a swift response, the Dutch government has initiated the Dutch Risk Reduction Team (DRR-Team). This team of experts advises governments on how to resolve urgent water issues related to flood risks, water pollution and water supply, to prevent disasters or to rebuild after water related disasters. With climate change and a fast growing world population, water issues are becoming more urgent. As a country renowned for its' expertise on water and delta management, the Netherlands feels a responsibility to share its' knowledge worldwide. That is just what the DRR-Team does; sharing expertise with governments to come up with the best possible approach/solutions for tackling urgent water issues. Because of the unique cooperation between government and sector, the best experts can be fielded quickly. The Dutch government offers a specific number of advisory missions each year.

Advice for all water issues

The Netherlands has brought its best water experts together in the Dutch Risk Reduction Team. It consists of high level advisors supported by a broad base of technical experts who can provide top quality and tailor made expertise to governments that are confronted with severe and urgent water challenges. The Dutch are experts in adapting to water in a changing world; from delta management to water technology, from urban planning to governance, public private partnerships and financial engineering.

How does the DRR-Team work?

Governments that have to deal with an urgent water issue are encouraged to contact the Dutch embassy in their region. The embassy will liaise quickly with the Dutch government. Interventions will only take place after a request from a central government has been received by the Dutch government, and after a recent calamity or to prevent a threatening disaster. The DRR-Team does not focus on emergency relief, but on sustainable solutions. If the decision to respond to the request is made, relevant Dutch experts will be rapidly fielded to the area that is under pressure. Together with the government and local experts, the situation will be assessed and analyzed after which the team will come up with a set of recommendations. For example advice on technical interventions including immediate measures and long term sustainable solutions, advice on governance and advice on financing options. The DRR-Team enables a foreign government to take action on the basis of sound advice and expertise.

ANNEX B – TEAM MEMBERS

The team member of the scoping mission are:



Klaas de Groot – team leader / IWRM
Marcela Busnelli – River basin development, reservoir management and morphology
Rik Beekx – Geo technology / civil engineering

Klaas de Groot is a senior advisor and business developer at ARCADIS the Netherlands. He has more than 25 year work experience in the implementation of integrated water resources management, flood risk management and coastal zone management. He has worked in the Netherlands as well as in Developing and Least Developed Countries for UN Organization, National Governments and Consultancy firms. The assignments abroad include long-term assignments in Yemen (3 years) and Panama (4 years) as well as short-term assignments in Colombia, Mexico, Belgium, Honduras, Paraguay, Hungary, Romania, Slovakia and Thailand. He has broad experience in the field of water governance in general, and more specific in policy analysis and process management. He has assisted in the elaboration of master plans for strategic water use and flood risk management plans. In the last few years he has been involved intensively in the adaptation of the water system in the Netherlands to climate change. During the last year he is involved in projects abroad to transfer Dutch experience and knowledge. He is mission leader for the Dutch Risk Reduction Team. He has led the elaboration of a Flood Risk Management Plan for the Cauca River in Colombia. During 2014 he was involved intensively in the Water Strategy Study for the National Water Plan of Myanmar. At the moment he is involved in the organization of the Water Dialogue process in Panama and working for the World Bank on an Investment Plan for the Bangladesh Delta Plan.

Marcela Busnelli is senior expert hydraulics & morphology at Royal HaskoningDHV the Netherlands. She is a civil engineer with hydraulic specialization with more than 20 years of experience in flood protection schemes and river basin management. She has international experience with projects in the Netherlands, Italy, Argentina and Colombia. She obtained in 2001 her PhD degree at the Delft University of Technology, with specialization in the numerical simulation of free surface flows. Marcela has extensive experience in working within integral and multidisciplinary projects (as task manager and/or expert), such as environmental impact assessments of flood protection projects in the Rhine and Meuse delta (several Room for the River, Delta programme projects); dredging optimization; morphological monitoring studies and analysis of closing strategies of the Eastern Scheldt storm surge barrier. Furthermore she has knowledge of the application of Water Framework Directive, for example as task manager working on the Water Framework Directive measures (WFD measures) on the River IJssel. Marcela is at this moment working on water management in Canal del Dique, Colombia, where several issues are tackled: water supply, navigation, flooding, water quality in the lakes and in the coastal zone, social and economic problems.

Rik Beekx is a senior engineer specialized in flood protection. He has over 10 years of experience in international hydraulic and geotechnical engineering. During his study he worked on several projects in South America (reservoir dam Bolivia, jetty Ecuador). After graduating (MSc degree in Hydraulic Engineering at Delft University of Technology) he worked for a contractor (Van Oord: dredging and land reclamation in Nigeria, Vietnam and Dubai during 3 years) and a consultancy firm (LievenseCSO: Project Manager/ specialist flood protection in the Netherlands, Sint Maarten, Saudi Arabia during 7 years). He was an engineering specialist for the project "VNK2" in which the flood risks of the Netherlands were evaluated in an integral manner and on a national level. Currently he works as a project manager for several flood protection projects in the Netherlands.

ANNEX C – TERMS OF REFERENCE

ANNEX D – MISSION PROGRAM

ANNEX E - PARTICIPANTS MISSION DIQUE PASO DE LAS PIEDRAS

ANNEX F – VNK2 PROJECT FOLDER

ANNEX G – SUMMARY MEETING RESULTS RIO SALADO

ANNEX H – SUMMARY RIO SALADO PROGRAM

On Monday (30/5) meetings were convened in the City of Buenos Aires with the Subsecretario Recursos Hidricos (Undersecretary of Water Resources) of the Province of Buenos Aires and the Embassy of the Kingdom of the Netherlands (EKN). The morning program focussed on understanding the challenges of the Rio Salado as well as the Dique Paso de las Piedras, and to begin to understand the regional setting of these challenges. In the afternoon a meeting took place at the Ministry of Finance (Ministerio de Hacienda) with a large group of stakeholders including governmental authorities at national and provincial level, international financing organizations and non-governmental organization. This gave the Undersecretary of Water Resources the podium to present the objectives of the meeting and for the DRR team to present itself and to share information on water management experience in the Netherlands.

At the end of the afternoon a presentation was given by Ms. Iris Frida Josch to the DRR team on the development and the implementation of the Master Plan for the Rio Salado. She has been National Director of Hydraulic Projects and Public Works for the Undersecretary of Water Resources in Argentina since 1999.

During the evening the ambassador hosted a dinner with the DRR team and invited some of the Dutch companies and businessmen that have been active in Argentina for many years to join and share their opinion on doing business in Argentina.

On Tuesday morning (31/5), the mission team split up to cover the challenges of the Dique Paso de las Piedras and the Rio Salado. The team leader of the DRR mission together with two representatives of the World Bank and a Civil Engineer of the Undersecretary of Water Resources joined in a flight (figure 3.5) with a Cessna to get a good overview of the actual



Figure 3-8 flight plan

situation along the river.

Flying over the areas that were included in phase 1-3 (figure 3.6) as well as the section of the river that will be included in phase 4 (figure 3.7), it was possible to get a good understanding of the effect of the interventions implemented and the works that still had to be carried out.



Figure 3-10 Rio Salado in section 1-3



Figure 3-9 Sections of the Rio Salado to be included in phase 4

On Tuesday evening a working session was organized with a number of engineers of the Undersecretary of Water Resources whom are involved in the planning, the design and the implementation of the first three phases and the upcoming fourth phase.

On Wednesday (1/6) a field visit was organized to various locations of Phase 3 that are under construction (figure 3.8). The contractor showed details of various projects for which the contractor has been responsible.



Figure 3-11 Internal working session



Figure 3-12 work in progress

In the afternoon a discussion session was convened in Gral. Belgrano (fig 3.10). This session was presided by the minister for Agroindustry of the province of Buenos Aires, Mr. Leonardo Sarquis.



Figure 3-13 Discussion with local stakeholders (land owners and farmers)

On Thursday (2/6) the DRR team had a meeting with the OPDS (see 2.2, Organization of the Province for Sustainable Development) and this was followed by a session with a selected group of Mayors of municipalities located in the basin of the Rio Salado. This discussion focused on the challenges of these Mayors in relation to water management and the affected stakeholders. The Mayors are member of the Comités de Cuenca (Basin Committees). Together, they are responsible for an integrated approach towards water management.

In the afternoon a meeting was dedicated to sharing the first impressions with representatives of the WB, the IDB and the CAF. The IFI's shared their interest in the Dutch initiative and their shared view on what the added value of the Dutch water sector could be.

Friday (3/6) was mainly dedicated to preparing the presentations for the Federal Sub Secretario Recursos Hidricos, Mr. Pablo José Bereciartua, and other interested actors (Governmental, IFI's, NGO's).

During the lunch on Friday a press conference took place at the embassy (la Nacion, Radio Balgrano, Het Parool).

During the meeting with Mr. Pablo José Bereciartua, it was agreed that the implementation of phase 4 is crucial for the overall effect of flood risk reduction in the basin and to adopt a more integrated approach. It was indicated by the Subsecretario that at federal level, also in the communication with the International Financing Institutions such as the World Bank, the needed collaboration will be given to assure that phase 4 is initiated as soon as possible and that the financial resources will be allocated to this initiative. All actors agree that an integrated approach is needed for sustainable development of the basin.

On Saturday (4/6) the DRR-Team returned to the Netherlands.