The new dam (Kokaral dam) between South and North Aral basins.

(april 2006)

Before 1960, these two basins communicated through a straits, named " Berg" after the name of the russian geographer who published the first complete monograph of the Aral Sea in 1906. This straits, about 12.5m deep, was located between the mouth of Syr Darya river and the island Kokaral; a second straits between this island and the Chevchenko peninsula was only one metre deep and dried in the first year of Aral regression.

A 1975 Nasa picture from space showing Berg straits ; the white trail is from a Tachkent-Moscow regular aircraft.

Later on at the beginning of the 1980's, communication between Southern Aral, (Ushai harbour, near Munak) and Aralsk could be preserved for a few years by dredging a 4 km long channel in the Berg straits which had to be constantly dredged, and was finally abandonned when the water level went down yet more . At the end of the years 1980, N. Aladin, a biologist who made the first studies on the evolution of Aral biotopes, suggested that a dam was to be built between Kokaral and the eastern shore, in order to maintain water in the small Sea, to which most of the Syr water could be directed.

Above and left: the first dam on Berg straits (courtesy N. Novikova)

In 1992 the canal linking the Small Sea to the Big Sea was 5 km long, 200 metres wide and 2 metres deep, and carried about 100 m^3 of water coming from the Syr Darya. As it was constantly cut down by Syr Darya flood water, it was feared that finally all water of this river should go through the past Berg straits, leading to the dessication of the Small Sea, which would have been catastrophic for the fishing activities, on which ten of thousands people made a living. The Mayor of the Aralsk town M. Avdigazevich, took up the idea of Aladin. The canal was first dammed in the early part of 1992 (fig), but water broke and washed away the dam., which was rebuilt in August 1992. Finally, with the modest earth-moving means of the Aralsk district, and a total budget of 2 millions US dollars, a dyke of about 13 km long and four m high was built through the straits.

But as the dyke was entirely built with sand and reed fascines, it was very fragile and sensitive to waves action on the unsteady material of sand and reed faggots, broke several times and required constant repairs. Moreover, being built without underground foundations, a large part of the incoming water to the now autonomous Small Sea, perhaps 10%, percolated through the dyke basement. Anyway, the water level could be maintained at about 13 m under the 1960 level, while the level in the southern sea fell down under 20m below the pre-1960 level. Salinity of the Small sea could be maintained at a value of about 20g/l, through the input of river water (3g/l) and the elimination of excess salt due to evaporation through underground seepage. Conservation of a good part of the Small Sea, allowed fishing activities, although reduced, to be carried on, and a partial restauration of the Syr Darya delta ecosystem.

reinforcement of the dyke (1997; courtesy Tetrahedron)

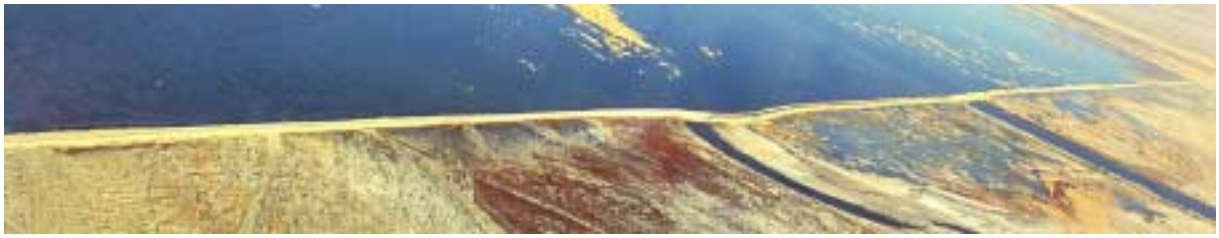
northern slope of the dyke (1998, R. Létolle))

Helicopter view to the west (courtesy R. Cagnat)

A rebuilt part of the dam after a breakdown
(R. Létolle)

Reinforcement of the dyke with reed faggots
(courtesy N. Aladin)

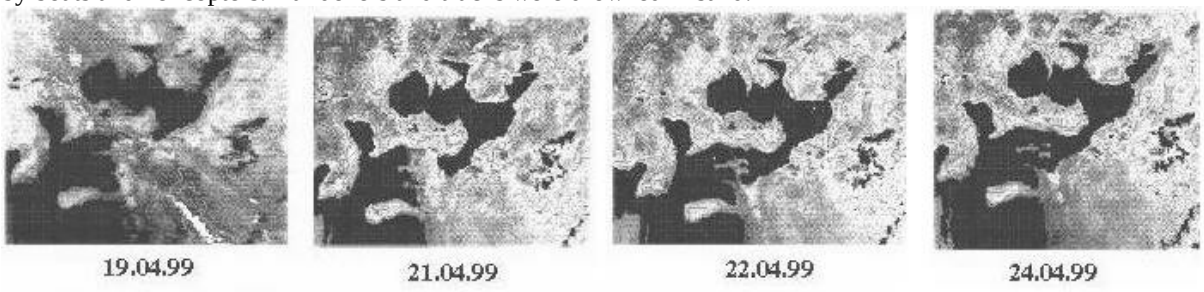
Two views towards north (Courtesy Arthus-Bertrand, 2000)



From the testimony of the mayor of Aralsk, the lack of money forbade a serious approach to protect the flimsy dyke which was strengthened in 1996, with little success ; in 1998 he considered using limestone slabs taken from the neighbouring Kokaral cliff to reinforce the upside bank of the dyke.. In 1998 the International Foundation for Saving the Aral Sea started financing preliminary studies for the construction of a stronger dam, now named the Kokaral Dam.

Kokaral cliff, view to the SW (R. Létolle)

Unfortunately on April 20 2002, as a consequence of a tempest who killed 7 persons in the Aralsk region, waves destroyed the dam- the upper part of which was just one meter above water level. People were yet working on it. Two of them were drowned , 27 workers stayed during 1-1.5 days on the roofs of trucks, tractors and cranes waiting help from outside, and were rescued by boats and helicopters. Bulldozers and trucks were drowned in sand.



Extension of the inundation (from Spot and Nasa pictures)

Upper: drown truck after the april break

Two views of the broken dyke (april 2004)

The mayor of Aralsk – courtesy N. Aladin)

The Small Sea water poured towards the Big sea, eroding the loose silt cover of the former lake bottom, and following what could be considered as past channels of the Syr Darya during the previous regression of XVI-XVIIth centuries.. A japanese expedition (*Tethys Society* and *Japanese Research Association in Kazakhstan)* visited the area in may: everything was yet drown, but in september, the level of the Small Sea had gone down by about 2.5 m, and drown vehicles could bd be recovered.

Provisional repair
(Courtesy N. Aladin, 2003)

P

An intensive lobbying of local authorities and international associations asked immediately for the reconstruction of the dam, but the central autorities in Astana first turned a deaf ear to this . Papers worldwide presented the restoration of the dam as an example of ecological duty. The World Bank and other international organizations took interest in the project of restoration. After long discussions, a reconstruction of the dyke was accepted by the governments of Kazakhstan and Uzbekistan – the latter having the upstream control of Syr Darya waters, through the Chardara dam (near Tachkent). It was necessary to improve the release of water and to ameliorate its circulation and use on the lower course of the river. Money could be provided by various organizations, especially the Koweit government, to the height of 28 million US dollars. This was insufficient, and the help of the Kazakh Government and of the World Bank was necessary.

Break in the dyke (2003, courtesy N. Aladin)

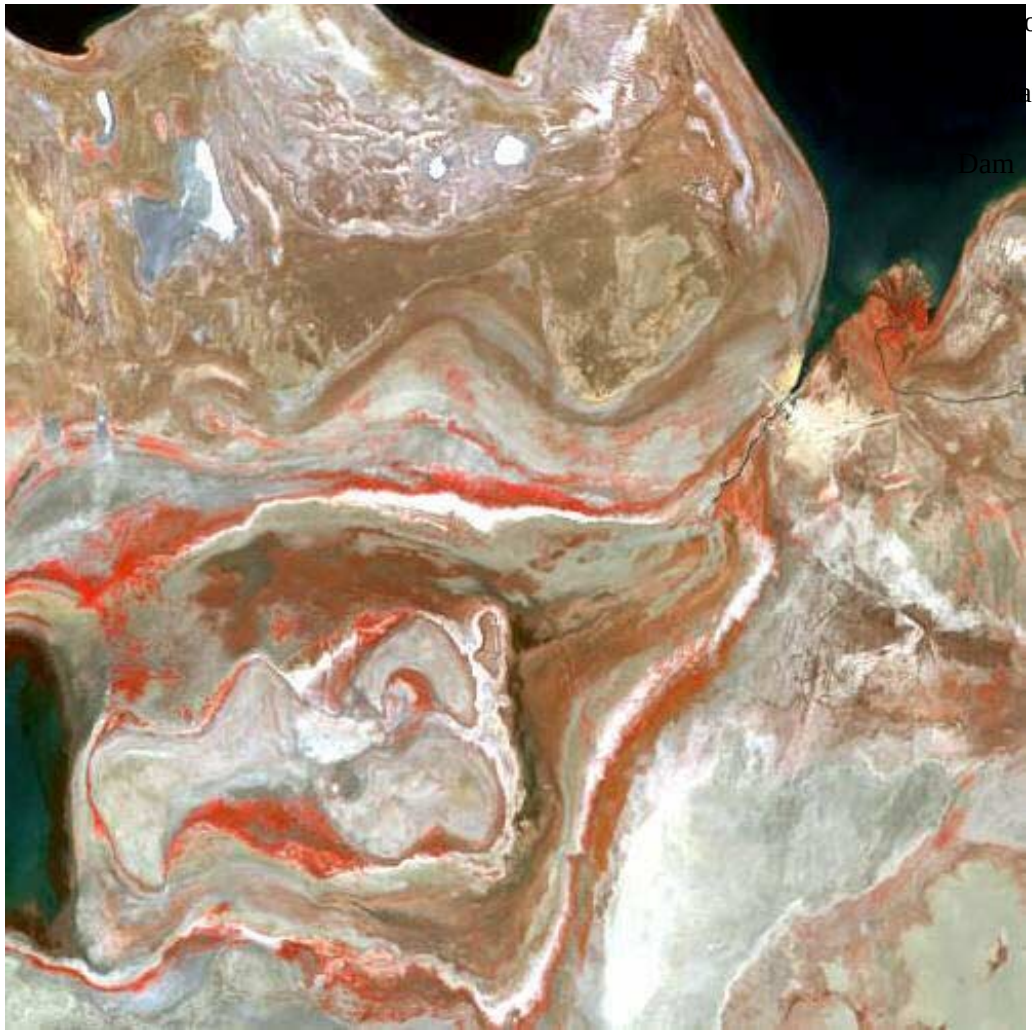
The water resources committee of the ministry of agriculture of Kazakhstan headed the project; the British-Turkish company «Mott MacDonald» handled the technical supervision of the pre-project: Experts estimated that the project promised significant profit

Thorough preliminary studies or the projected dams were carried on, as concern its various characteristics. A concrete dam was necessary. Ten foreign companies (five of them Turkish, two Chinese, one Russian, one Italian and one Iranian) competed for the right to become a general contractor. Kazakhstani building companies had the possibility to compete for contract works. To the 62 millions US$ forwarded by World Bank from december 2000 to february 2004., were finally added 21.3 US$ from the Kazakh government. World Bank granted 9 contracts, the most important going to China-Geoengineering (16.6 M US$), and rusian Zarubezhvodstroy, (27.8 US$) known for its large-scale projects in Africa and the Middle East, which won the tender; so that in october 2003 preparation works were in process, a concrete factory built, and construction itself was to begin in spring 2004. Water retention began in the autumn of 2005. An annual inflow of around 3 cubic km could sustain the water level at 40m a.s.l.

A modern highway was built from the railway line to Kokaral A concrete production plant was set up. According to the Russian project, on the completion of the construction, a Transaral automobile road will be built over it.. Over 400 local residents of the Aral and Kazalinsk districts received jobs in the construction project. Moreover, the Russian company helped build a mosque in Karateren village.

There were no special difficulties, as the dam is low and water pressure light. The dam is 11500 m long, 300 m wide at the bottom and 8 m wide at the summit, with a maximum height of 8 m. The slope on the upstream side is low in order to break waves. The nucleus of the dam is sand, mixed with some limestone rocks and is covered with a shell of concrete 30 cm thick. Over 3 million m3 of sand and crushed stone, and some 10,000 m3 of concrete have been used on the construction of the dam.

Nasa 2002 (Google Earth)：trace of the dam at right; delta of Syr Darya middle up.



ot image,

arch 2006

Dam at the middle right

In the axis of the east-west branch of the dam nine gates for water evacuation have been constructed in reinforced concrete, using cofferdams to get foundations down to 10 m under the original bottom of the Berg straits. Each door is 5.6m high x 5.3 m wide, and the flood-gates may accept 110 m3/sec (one source indicates 60 m3/s, which seems too low). It is said that for emergency situations water discharge is provided which amounts to several cylindrical apertures with the carrying capacity of 46 cubic/meters per second.

The watergates (2005, courtesy Ph. Micklin)

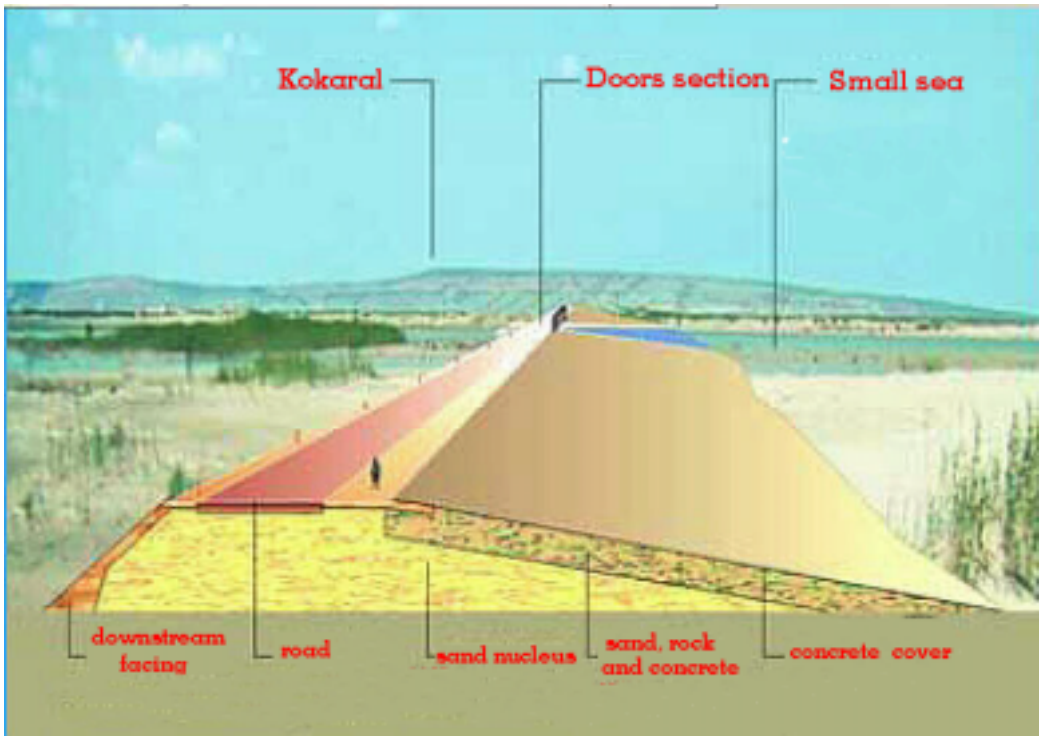
Construction of the weir

Water deflectors

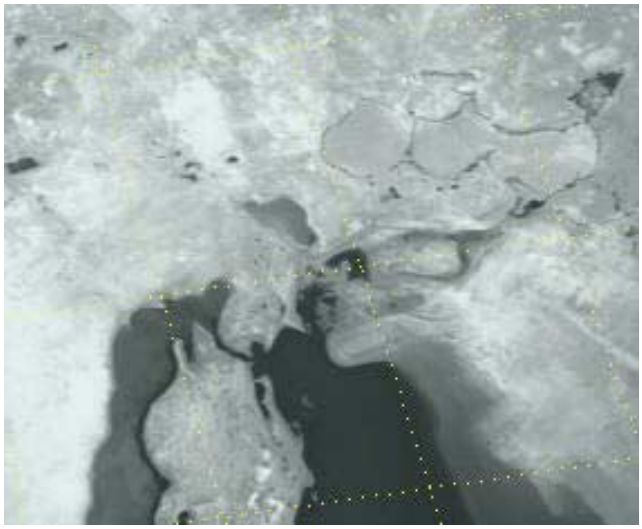
In front of the doors are concrete deflectors to lower the current speed of evacuated water. Below there is a concrete slipway several hundred meters long to avoid undermining by evacuated water.

As soon as autumn 2005, the level of the lake shifted, more quickly than anticipated, due to rectifications and scouring in the lower course of Syr Darya which now avoids dispersion of water in lateral marshes, and also to a good pluviometry on the basin. In december, water had re-invaded almost all the past Aralsk bay. Some 880,000 hectares of dried up seabed are to be covered by water once again, which should augment the present fishing area

In the contract were also to be studied and realized renovation and new constructions of weirs on the lower Syr Darya, under Kazalinsk (Aitek weir and Aklak structures) for irrigation and feeding of numerous lakes in the Syr delta, existing installations being obsolete or deteriorated. Other important earthworks and constructions are in course between the Chardara dam and Kazalinsk to avoid the loss of water in swamps and to recover part of inundation waters. These works are presently in progress, under WB, BIRD, BERD etc. contracts



Schematic view of the dyke structure



NOAA infrared picture (march 29 2006), showing the progress of water in Arask gulf.

.

Now several questions arise:

Apart from the satisfaction of local inhabitants, which may hope for an amelioration of local climate (less sand winds, augmentation of the air humidity), a big amount of money has been spent , which seems out of comparison with the benefit the fisher population may hope from the augmentation of fish production, in as well the canning factory in Aralsk has to be rehabilitated. Moreover, nothing today seems to have been foreseen for the dam maintenance. It may be hoped that land development in the Syr delta will provide new resources to the local population.

It seems that apart tourism, Aralsk region may gather resources of 1- oil production; 2- development of communications from North western Caspian area to China, as oil pipelines presently in course north of Aral Sea will ask for management installations.

Annex*: Brief Description of Works:Contract SYNAS/001-2001*

- Part 1: Northern Aral Sea Dike and Spillway. Located at the Kokaral Peninsula, the dike has the following parameters: fill material of local sand, fill volume of about 3,000,000 m3, length of 13.5 km, average height of 4 m, crest elevation at 44.50 m asl and crest width at 8 m, upstream slopes of 1:48 below elevation 44 m asl and 1:10 above this elevation, and downstream slopes of 1:3. The spillway consists of 9 barrel openings 5.5 x 5.3 m each provided with stoplogs.

- Part 2: Aklak Weir and auxiliary offtakes. The weir located at the Aklak village in the Syrdarya Delta (1628.5 km downstream of the Chardara Dam) would consist of four openings controlled by radial gates 10 m wide and 4 m high each with a sill elevation at 48.00 m asl. The maximum expected runoff of the Syrdarya at the site is 515 m3/s in summer and 395 m3/s in winter. The auxiliary structures consist of eight gated offtakes to be rehabilitated and/or reconstructed with capacities between 1 and 10 m3/s upstream of the weir, which supply water for fishing lakes and irrigation of hayfields in the Syrdarya Delta. A fish pass of a slot type is foreseen. The works are to completed within three years.

Contract SYNAS/002-2001: Aitek Weir and auxiliary structures. The weir would be located some 20 km west of the KzylOrda city. The weir consists of three openings controlled by radial gates with 16 m width and 6 m height. The sill elevation is 118.50 m asl. The expected runoff of the Syrdarya River passing the structure is 700 m3/s in summer and 425 m3/s in winter. The auxiliary structures subject to rehabilitation consist of the offtake to the Aitek irrigation canal – gated structure with a maximum capacity of 50 m3/s –and a gated culvert at Karaozek Branch with maximum discharge capacity of 60 m3/s. The works included in Contract Package SYNAS/002-2001 are likely to be completed within two years.The loan is expected to be approved in May 2001….

. For each contract a complete set of prequalification documents in English language for international and Russian language for local companies or firms may be purchased by interested bidders on the submission of a written application to the address below and upon payment of a nonrefundable fee of US$ 150 for foreign companies and 9,000 Tenge for local companies. “

The World Bank on the December 23, 1996 approved a U.S $7 million loan for a Pilot Water Supply Project, to which Kazakhstan added $388,000 . The loan help to finance the project in the Aralsk and Kazalinsk districts of the Kyzyl Orda Region in Kazakhstan.
The Pilot Project represented an initial learning phase of the full-scale Aral Sea Community Rehabilitation Project, the main goals of the latter being to improve the health of the urban and rural population of the two districts by providing safe drinking water and the improvement of hygiene education and sanitation facilities; and by strengthening the management, operation and by financial performance of the regional water supply and sanitation utilities, thereby ensuring their long-term viability.

Project Components are:

-Rehabilitation of Aitek weir / enlargement of Aitek main canal: Aitek weir diverts water to the 17,000 ha Aitek irrigation scheme. The structure is under-designed, appears to be unsafe and complete failure seems to be a real possibility. Either a new weir would be constructed or the 46 km long right bank canal from Kyzyl-Orda weir to Aitek irrigation scheme would be enlarged and extended. During preparation studies the feasibility of both options would be considered.
-Terenozek bridge: a new, high level bridge would be constructed at Terenozek near Kyzyl-Orda, to replace the pontoon bridge.
-Delta infrastructure: Amanotkel and Aklak structures are located in the Syrdarya delta. The Amanotkel weir is important for the diversion of water to Kamiyshlibash lake and other small lakes. This free-flowing weir has a small capacity and other is damaged and out of use. Aklak structure is located not far from the Aral Sea shoreline and diverts water to small lakes. The structure is danger of collapse. Permanent weirs with flood protection dikes would be constructed at Amanotkel and Aklak. They would control the distribution of water to 20 lakes, with a total area of approximately 44,000 ha, through both newly constructed and rehabilitated channels of 63 km in total.
To improve the ecological conditions on the Northern Aral Sea (N.A.S.) Kazakhstan, with the assistance of the World Bank, is also considering a dike construction which separates the N.A.S. from the Larger Aral Sea (L.A.S.). The level of the dike would depend on the availability of water and the results of the environmental studies. Initial calculations reveal that with A spillway would be incorporated to release excess water into the L.A.S. and for flushing purposes to control mineralization.
A preliminary assessment of the project costs is U.S. $90 million and the Bank loan is tentatively planned to be U.S. $50 million. The government's contribution is yet to be defined. Participation of co-financiers would be considered. The main categories of expenditure would be civil works and technical assistance.
There are no other investment projects with similar scope in the Central Asia region.
Assurance of adequate and timely availability of funds from the national and local governments is needed.
Riparian issues should be resolved before the start of the project in order to minimize the risks of disagreements and delays after implementation has begun.
Government should develop a partnership with and meet the wishes of the local population to ensure a successful project.

The proposed project would improve existing major infrastructure in the Syrdarya and dam the N.A.S. to create a freshwater reservoir. All project components would be designed for positive environmental impacts within the immediate project areas. There would, however, be some negative impacts on the surrounding areas, especially the L.A.S.
Potential positive environmental impacts in and around the N.A.S. and the Syrdarya delta would include: (i) the creation of a freshwater reservoir; (ii) the filling of lagoons and delta lakes; (iii) an increase in wetlands; (iv) a reduction in salt and dust storms; (v) the restoration if biological diversity; and (vi) an improved ecological system. On the other hand, the project would result in additional lowering of the L.A.S., as well as small increase in its water salinity level. The actual impact would depend on the design water level in the N.A.S. Major potential social, resettlement and cultural heritage issues are not foreseen.

Part of the current spills into the Arnasai depression[1] would be released into the Syrdarya, once its hydraulic capacity has been increased under the project. Therefore there would be some impact on the Arnasai depression, which could be either adverse or positive (for example, reduction in the total area affected by flooding along the Syrdarya could decrease expenditure to provide and maintain annual flood protection along certain stretches of the Syrdarya).

Since the proposed project is located in an environmentally sensitive area and has potentially negative impacts, a full environmental assessment is warranted, in order to scrutinize all environmental issues and arrive at a project that would be environmentally and politically acceptable.

Careful analysis of all impacts and benefits should take place during later stages of the project preparation and information on it needs to be shared with other riparian states before its final endorsement.

The first dam from the south (courtesy R. Cagnat)

[1] The Arnasai depression is located SW of Chardara reservoir and is used as a wasteweir for Syr Darya overflow and drainage water from the " Hungry Steppe" cultivation area in Uzbekistan ; its water is lost in sand dunes.