January 17, 2012

10 Proposed Projects for Land Reform and Power Generation To sustain the life of the People of Egypt*

MIK Technology, Houston, Texas USA

Maher Kelada

Abstract:

Egypt is one of the most populous countries in Africa and the Middle East. Current population exceeds 80 million people with most of them live near the banks of the Nile River. Egypt's area is 1,000,000 km^2 of mostly desert with only 5% of arable land. Several international organizations estimate Egypt's population in 2050 between 113- 128 millions. However, the estimate of local media approaches 200 million!

Year	1950	1975	2000	2025	2050
Population in millions(1)	21.834	38.865	67.884	94.770	113.840
Population Growth, %(2)	2.46	2.15	1.89	1.28	0.5

Existing infrastructure and local municipal resources can't support its normal growth. This situation is further complicated by continuous populace migration from dilapidated poor rural community to towns hoping for better life. Population growth and the fast rate of urbanization seem to suffocate Egyptian towns and exacerbate the problems with its antiquated utilities and service systems. Means to provide simplest essentials of life to the unregulated random communities are no longer available, causing fractures in the morality and integrity of many citizens that cannot afford their daily bread!

It will be crucial that a serious mitigation plan must be considered by all responsible parties in the Egyptian community to relief the agony of the people of Egypt. A plan that does not consider displacing or relocating people to barren land, but a plan that provide security, basic needs and respectable living to every Egyptian family. It has been said, *"Whoever does not command the means to feed himself can neither feel freedom nor dignity - M. H. Mubarak".* Words of wisdom alone do not feed the hungry, without the intent to reform.

MIK Technology vision is to harness the potential of water for the advancement of human welfare. This small emerging company with its genuine technologies and fresh ideas strongly believes that it can help alleviating the suffering of millions. MIK Technology is offering a plan to reclaim new arable land, enrich depleted soil and generating renewable energy. Our plan will help in relieving the consequences of high population density in the Nile Valley and create more stable and prosperous communities.

No doubt that the Egyptian Government is eager to secure decent living to its citizens. In our attempt to complement this effort, we are proposing new obscured sources and means for developing more than 2 million acres of arable land, potentially saving the Nile Delta from sea flooding and avoiding displacement of 10 million of people. The price is high, but we have to attempt the impossible to prevent the demise of the world's first civilization!

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http://esa.un.org/unpp/ (1) , Population Growth in the 21st Century: Challenges and Aspirations
http://www.zohry.com/pubs/alyaa.pdf (2)
* Updated on January 17, 2012

MIK Technology plan comprises the following:

1. Maximizing the use of Egypt's land depressions:
   - Qattara Depression self-sufficiency development.
   - El Farafra Oasis development.
   - Toshka Depression development.
   - El Bardawil Lake development
2. Expanding arable land along the Nile Valley.
3. Egypt's Eastern Infrastructure Development
4. Saving the Nile Delta from flooding.

All of these are a payback of Aswan High Dam Hidden Treasure… "The Alluvium"!

Aswan High Dam:

The Aswan High Dam (AHD) was constructed in 1968 at a distance of 7 km south of Aswan City. It is a rock-filled dam made of granite rocks and sands and provided with a vertical cutoff wall consisting of very impermeable clay. The structure is 3,830 meters long, 980 meters wide at the base, 40 meters wide at the crest and 111 meters tall. It contains 43 million cubic meters of material, about 17 times the size of the great pyramid. The reservoir, named Lake Nasser, is 550 km long and 35 km at its widest section with a surface area of 5,250 square kilometers. A diversion channel was excavated on the eastern bank leading to the hydro-power main tunnels. The 6 tunnels deliver water to the 12 generating hydroelectric turbines, which generate 2,100 MW of hydroelectric power.

The total reservoir storage capacity is about 162 km^3 at water level of 182 above mean sea level (AMSL). Operationally, 90.7 km^3 was estimated as active normal water storage (between 147-174 m AMSL), 31 km^3 for sediment deposition (between 85- 147 m AMSL) and 41 km^3 (between 175-182 m ASML) for emergency flood protection.

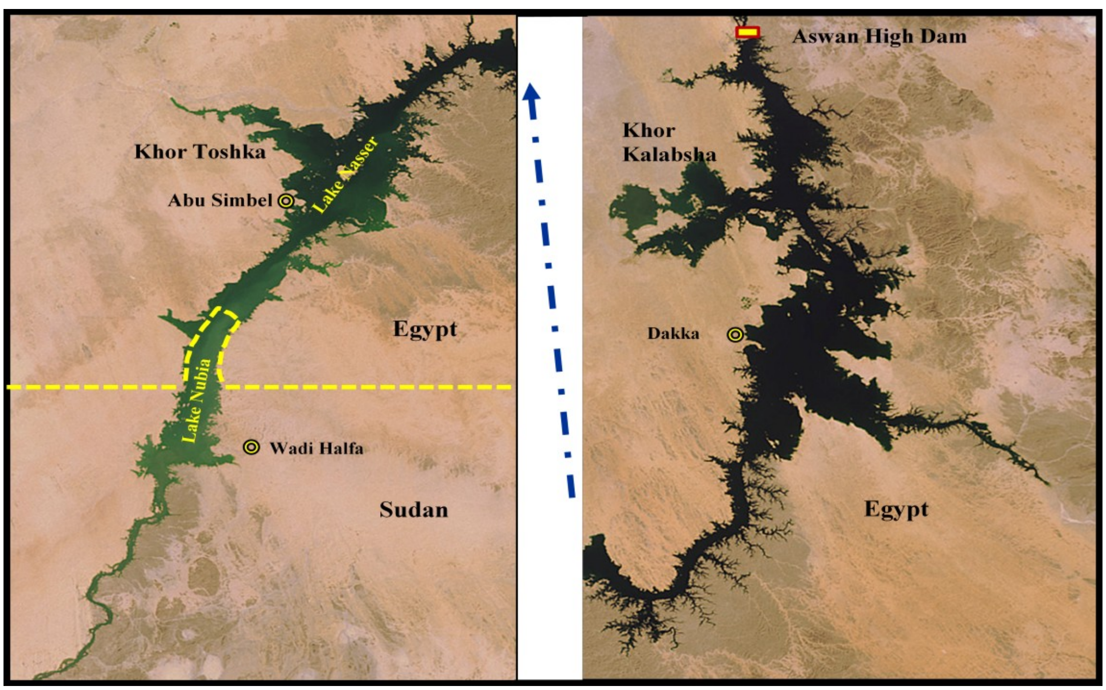

Figure 1: Aswan High Dam Reservoir-Lake Nasser of Egypt and Lake Nubia of Sudan

Normal range of annual water level fluctuation is 25 m. Maximum allowed flow through the dam is 11,000 m^3/ s. The dam was provided with an emergency spillway for an additional 5,000 m^3/s to the Toshka Depression west of the reservoir.

It is estimated that on the average 133.54 million tons enter Lake Nasser each year. About 97 % of this amount precipitates (85% in Lake Nubia and 15% in Lake Nasser). The remainder of 3 % or about 4.0 million tonnes a year is carried through the Aswan High Dam (AHD). The estimated amount of sediments (Alluvium) is about 6 km^3, but it will reach about 7 km^3 by the end of this decade. The future of the Nile flow and sedimentation is expected to change drastically in the following decade, as it will be explained later.

The Aswan High Dam contributed greatly to the economic development of Egypt. It supplies 15% more irrigation water and 2,100 MW electric power and protecting the lower reaches of the Nile from seasonal floods. On the other hand, its environmental impacts are serious. The rapid siltation in the narrow Nile valley in Nubia threatens closing this pass in a short time. Although, floods have been prevented along the Nile, the erosion of Nile delta on the Mediterranean coast is becoming serious. Further, the loss of soil fertility and the increase of soil salinity are noticed in cultivated fields along the Nile owing to the cease of annual silt and flood water supply. Lack of annual silt has dictated extensive use of chemical fertilizers as a substitute for the natural nutrients.

During the period from 2001 to 2005, the river average annual flow was 51.3 billion m^3 at Aswan, 40.4 billion m^3 at the mouths of the distribution canals and about 34.9 billion m^3 at the irrigated fields. The difference between Aswan and the fields of more than 16 billion m^3 (32%) is lost due to evaporation and leakage of the distribution networks.

The Egyptian industrial sector [(1)] consumes about 7.8[(2)] billion m^3 annually. About 1.15 billion m^3 of this quantity is used in product formulation. While the remainder of 6.65 billion m^3 is used in supporting production, such water cooling towers, vessels cleaning, maintenance work, commissioning equipment, etc. this waste stream is returned to the river or to the sea as a polluted industrial drainage. It is our opinion that this amount of water can irrigate one million acres, if the industry environmental controls are not so sloppy and well enforced!

From a demographic point of view, building this dame necessitated permanent relocation of more than 100,000 Nubians people, 600 km from their homes. After more than 40 years, many of these people are still suffering the anguish of their displacement. May the history overlook the inconvenience of some of the people for the benefit of the multitude, as the high dam commissioned to do? On the other hand, history will condemn us, if the rising sea forces millions of the Nile Delta inhabitants to flee their homes and land because the solution to prevent it is costly.

Our vision covers several areas of Egypt and comprises several engineering components. Each proposed component of our plan is a mega project by world's financial standards. The objective of our paper is to highlight the basics of each project in a simple format and supported by a simple drawing to give the reader a precise and clear understanding of our goal. Most of the proposed projects rely on AHD alluvium (river sediments) as a fundamental and necessary building material. Therefore, a scheme to retrieve, transport and apply alluvium wisely, to rebuild the land of Egypt, is an essential goal of our plan.

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[1]Ministry of water resources and Irrigation, Water and Egypt's Position, Water information unit, August 1999 p. 2.
[2]Ministry of Water Resources and Irrigation, unpublished data.

To simply this presentation, all relevant projects are highlighted on one map of Egypt to give the reader a global view of our plan, as shown in Figure 2.

Figure 2: Our Vision for Reclaiming and Saving the Land of Egypt by year 2050

This map highlights the following proposed projects:

1. Qattara Depression
2. El Farafra Oasis
3. Toshka Depression Land Development
4. Nile Valley Expansion I & II
5. Toshka Lakes Modifications
6. Lake Bardawil
7. Alluvium Operation
8. Heavy Service Railroad
9. Eastern Infrastructure Development
10. Saving the Delta

Project 1: Qattara Depression

Transforming the mid-Saharan Qattara Depression region (30,000 square kilometers) into a completely self-sufficient and habitable community for 3-5 million people, generating well paid jobs for multitude of citizens, working in advanced industries and modern agricultural activities.

This project relies primarily on MIK Technology for hypersaline osmotic power generation of 3-4 Gigawatts of power. The large power potential will be used in constructing the new Qattara city, desalinate billions of cubic meters of brackish and agricultural drainage waters to cultivate one million acres, using fertile soil from Aswan High Dam.

The project will create the largest manmade inland marine life lake ever! The project will facilitate developing world-class resorts around more the 400 km Qattara Sea shores for millions of tourists and citizens in the midst of Egypt's western desert.

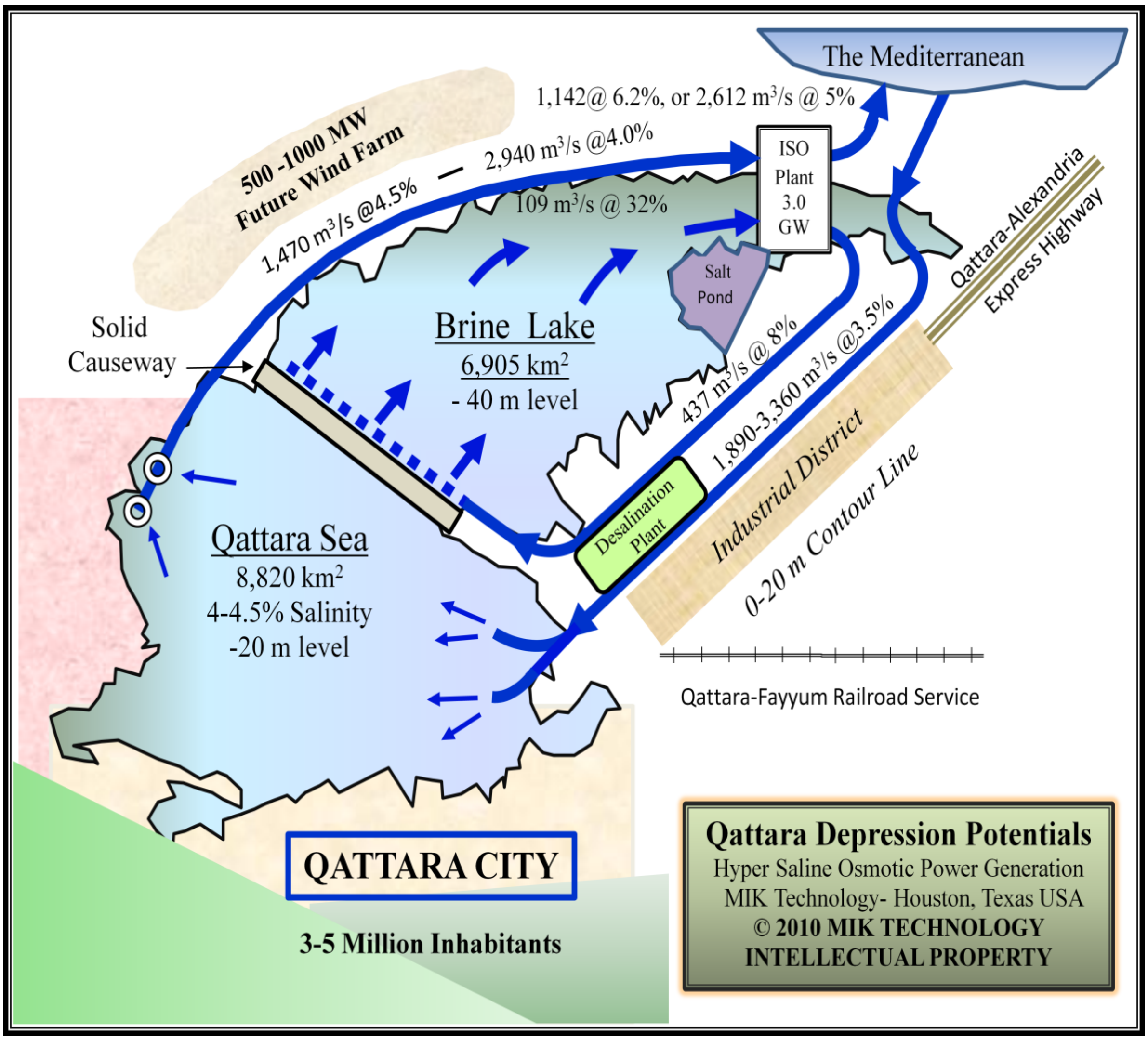


Figure 3: Qattara Depression Development- Hypersalinity Osmotic power Option

Project 2: El Farafra Oasis Development

Developing El Farafra Oasis depends on extending El Ibrahimia canal at Asyut, in a westerly direction to the perimeters of El Farafra Depression. This proposed "El Farafra Canal" will be used to supply water to the depression for developing low land and as a water way for Nile cruises .This project is intended basically for two main objectives:

1. Make advantage of the low land that can be partially irrigated directly by a canal from the Nile. Apply alluvium from Lake Nasser would be spread to a depth of 0.5 meter. High elevated land my developed in the form of terraces (mastabas). The project intends to develop 250,000 acres.

2. Develop an important tourism center in the mist of the Sahara. Extensive effort by the Egyptian administration (tourism, antiquities, security, etc.) will be required to maintain and promote relevant antiquities and rock art sites in and around El Farafra Oasis. Future airport is envisioned.

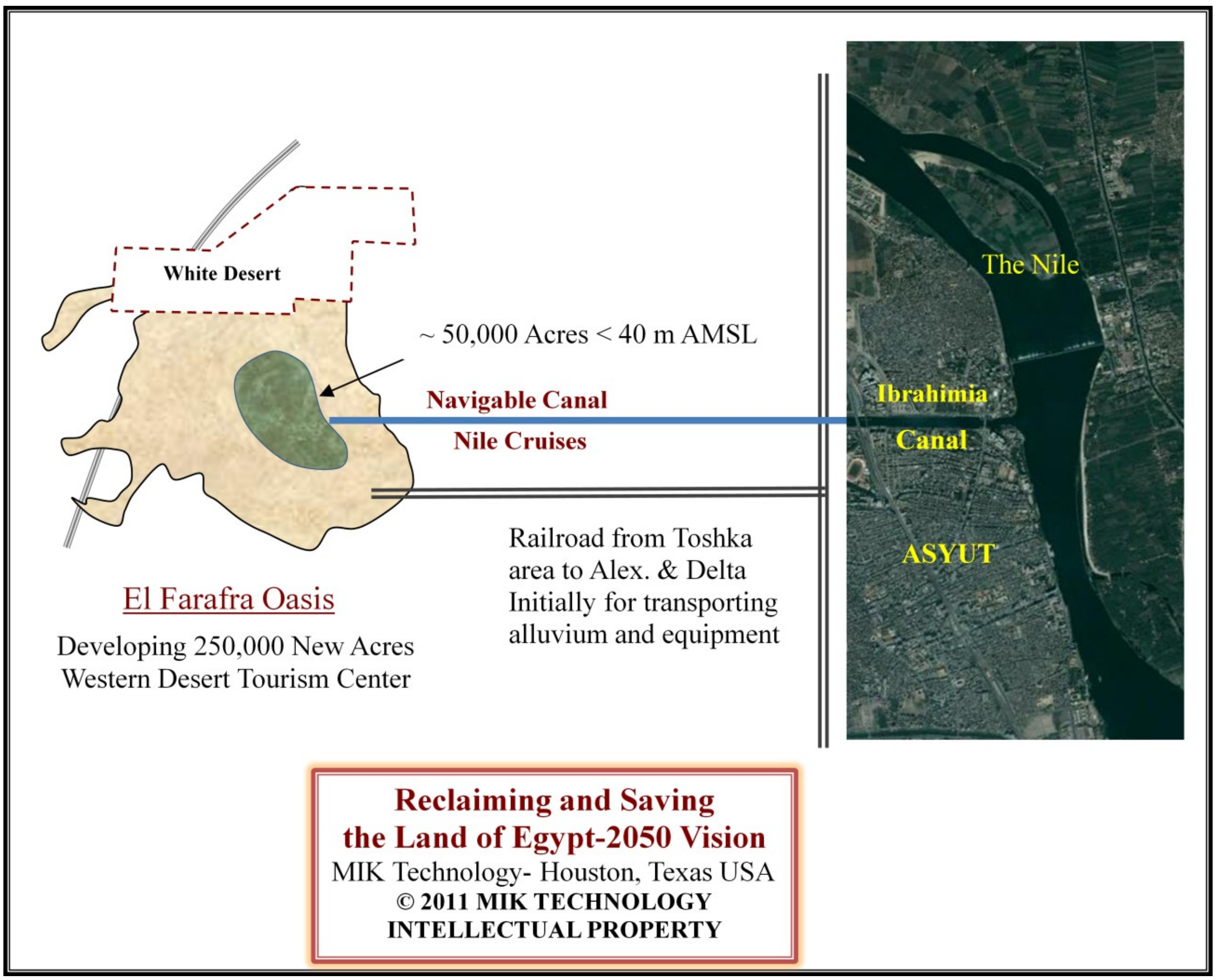


Figure 4: El Farafra Depression Development

Project 3: Toshka Depression Lowland Development

Toshka Depression is a massive 6000 km^2 of relatively low land. This domain comprises 5 unnamed lakes and several shallow spots at elevation below water level in Lake Nasser. The area of those low level spots exceeds 150,000 acres and can be developed, with limited risk, for agricultural production; seasonal crops and live stocks.

As a first step in developing these areas, alluvium from Lake Nasser would be transported in the form of slurry to build a depth of about 30 cm. Water for Irrigation will extended temporarily from the excess capacity of Mubarak Pumping station. The first phase (also considered as a pilot test) of the development will be the 5000 acres area just west of El Walid Project (160 m AMSL). The required alluvium amount is about 7 x 10^6 m^3.

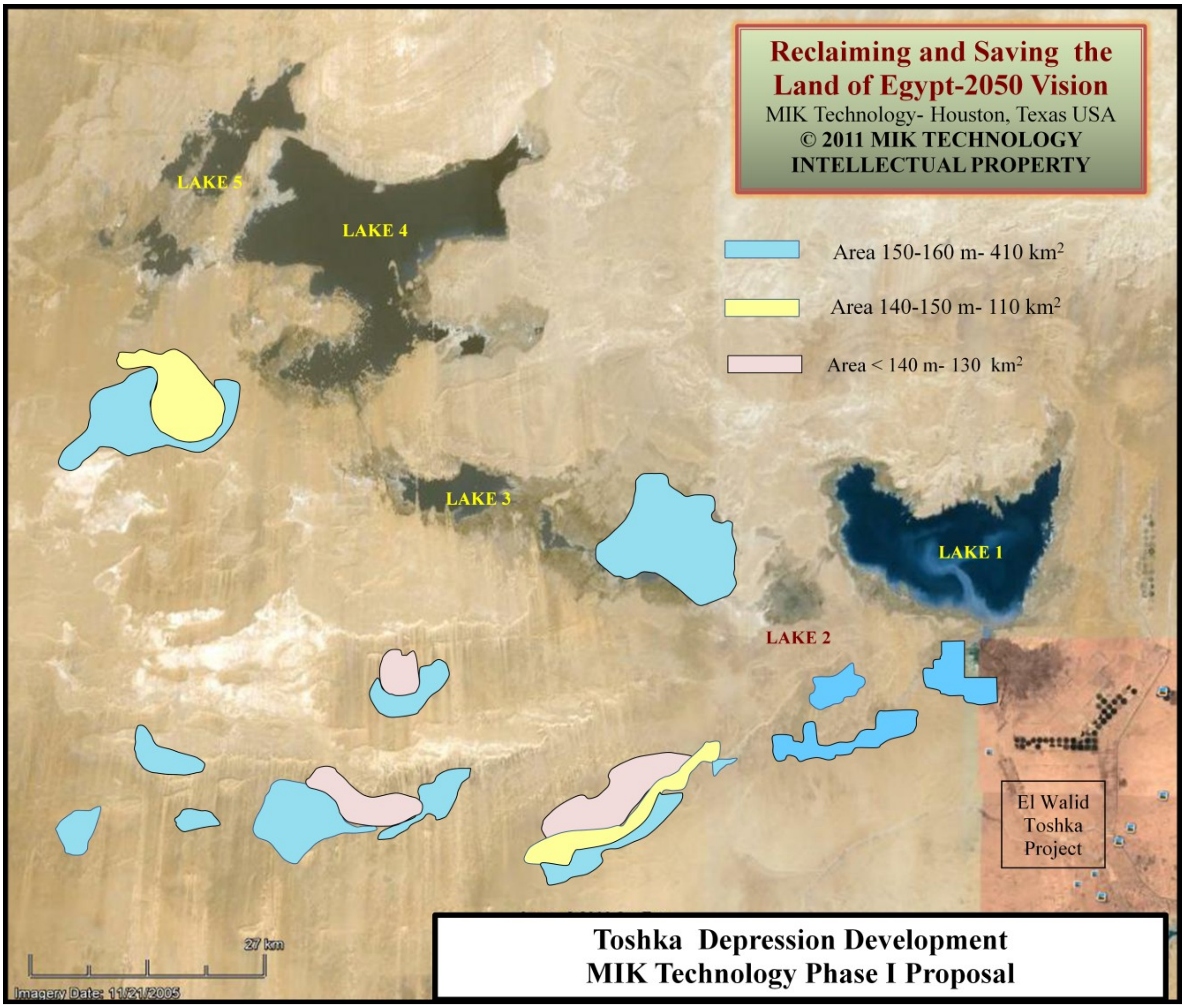


Figure 5: Development of Low Land around Toshka Lakes

Project 4: Expanding arable land along the Nile Valley

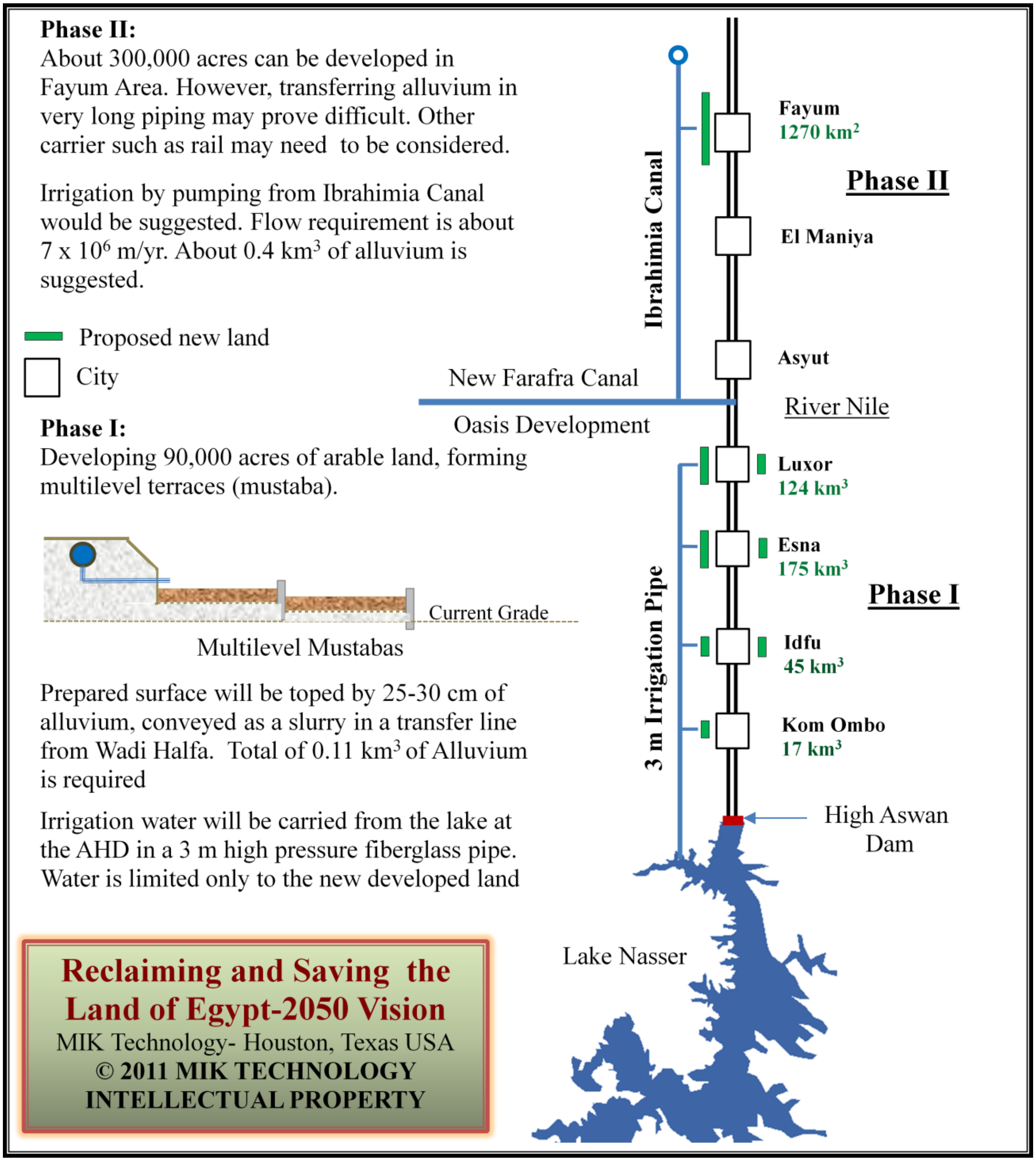


Figure 6: Phase I & II to increase Nile Valley arable land by 400 acres

Project 5: Toshka Lakes Modifications

This is a controversial Project. MIK Technology believes that the need for these lakes as a river high flood relief system will not be needed within 10 years. Both Sudan has already built Merowe Dam (2009) on the Nile and contemplating two smaller ones; the Kajbar and Dal dams. Ethiopia built Grand Renaissance Dam on the blue river and is also contemplating a series of new four dams on the Blue Nile, including Beko Abo, Mendiya, Chara Chara Weir and Kara Dodi dams to reserve water and generate power. These dams will have a serious impact on the water quantity that Egypt receives as well as on the flood cycle as we used to know it. No significant amount of alluvium is expected after building these dams.

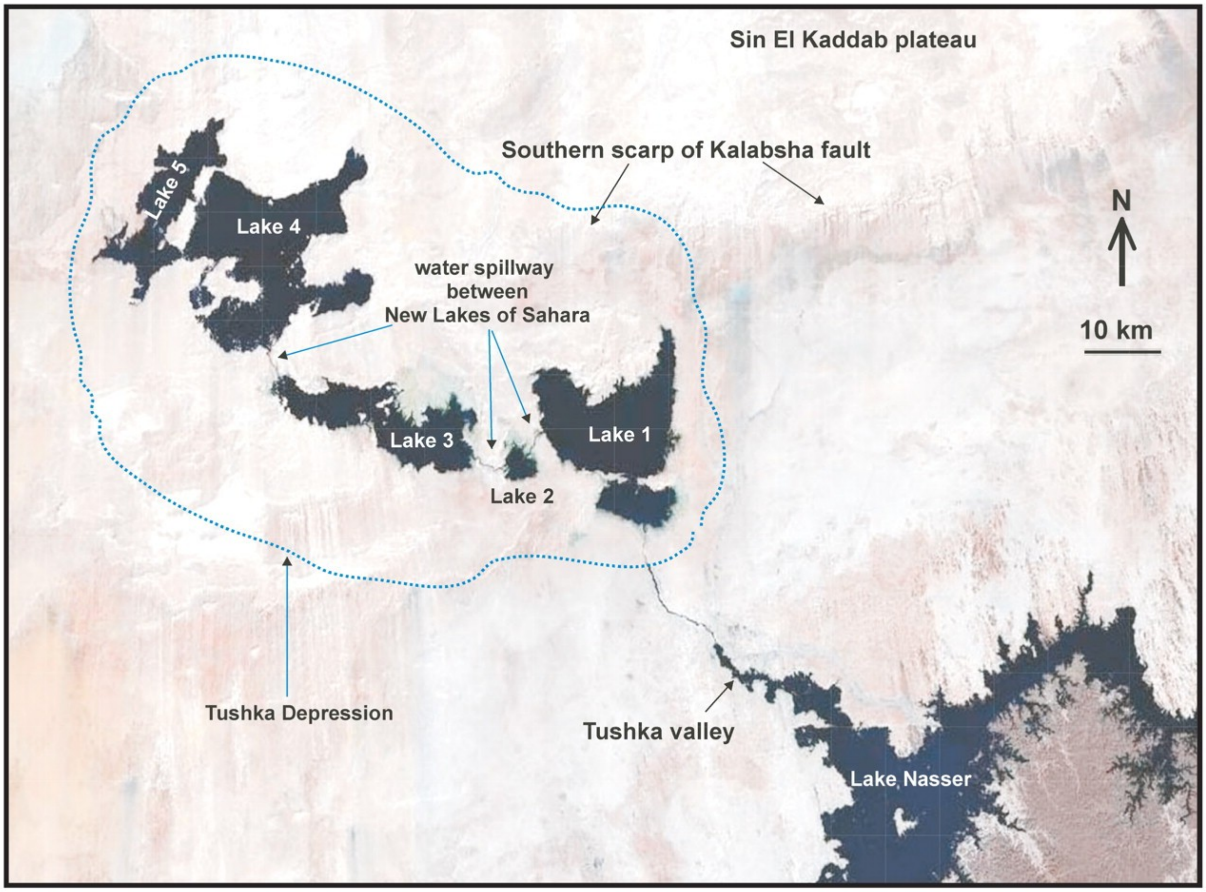


Figure 6: Toshka Depression

Year	Lake 1			Lake 2			Lake 3			Lake 4			Lake 5		
	A km^2	H m	Vol km^3	A km^2	H m	Vol km^3	A km^2	H m	Vol km^3	A km^2	H m	Vol km^3	A km^2	H m	Vol km^3
2002	**449**	**153**	**6.8**	**20**	**151**	**.04**	**265**	**141**	**2.2**	**807**	**140**	**16**	**255**	**140**	**?**
2006	**281**	**143**	**3.5**	**Dry Lake**			**101**	**131**	**0.4**	**550**	**130**	**8.8**			

Table 1: Toshka Lakes' capacity during 1998 flood and in consecutive years

In this case, it would be prudent to envisage a plan to maximize the benefit of these lakes and surrounding low land. Therefore, all of Toshka lakes will have different function and will be developed for commercial use. Lakes 1 and 4 (449 km^2 and 807 km^3 respectively) will be developed as fresh water fisheries taking into consideration their depth and capacity (Table 1). The rest of these lakes (540 km^2) will be filled with deposited alluvium in the reservoir and irrigated, mostly by gravity flow from Lake Nasser and be used for crop production. Total surface of these Lakes is 1796 km^2

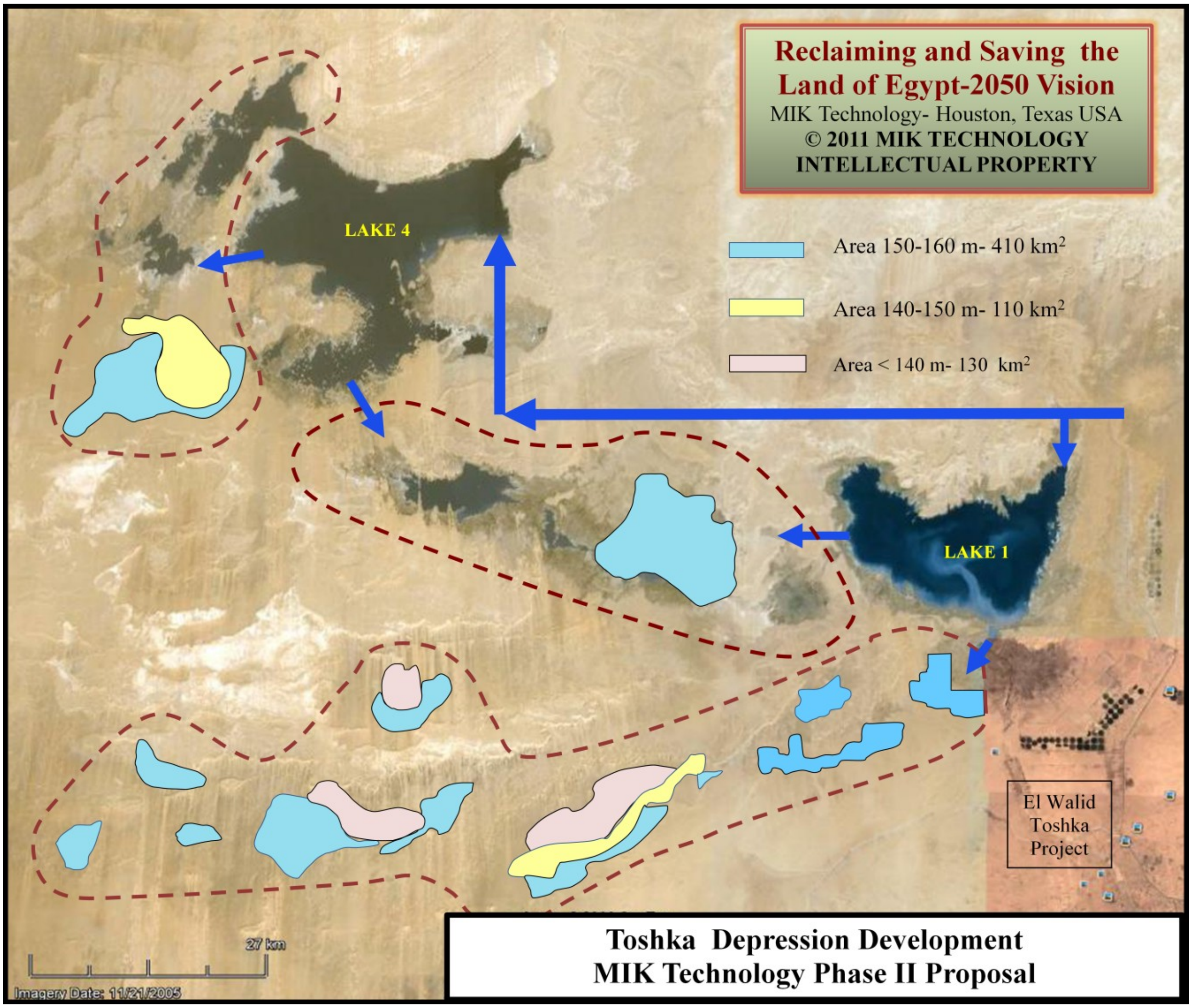
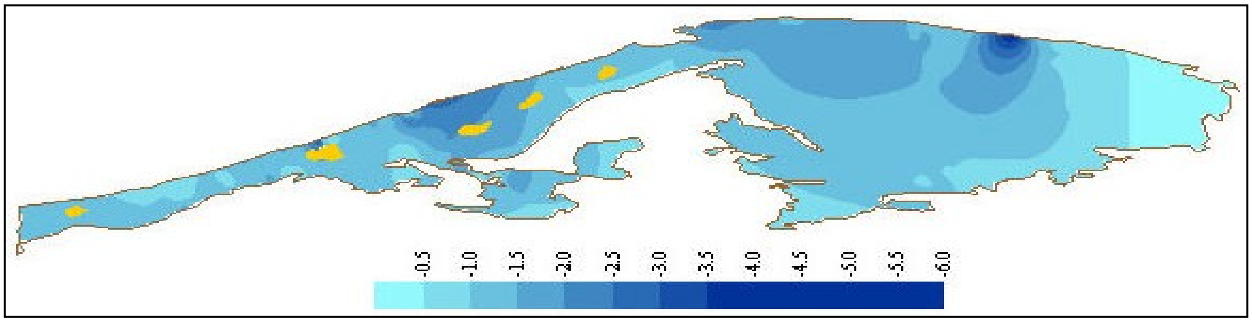


Figure 7: Toshka Depression Development

Managing the proposed fresh water fisheries (1256 km^2) requires maintaining water salinity stable. Therefore, these lakes cannot be used as endorheic lakes and continuous flow of fresh water has to be maintained, implying some of the water has to leave the lakes, forming return streams. These streams will be used to irrigate all the lowland that has been already developed for agricultural use, as per phase I. Estimated average rate of evaporation from the lakes is 100 m^3/ s, or a total of 3 km^3/ yr. Evaptranspiration of the cultivated 1190 km^2 (293,000 acres) of low land is about the same rate for a total of 2.6 km^3/yr. This implies that the agrarian development requires about 6 km^3/ yr or 11% from Egypt's share of in the Nile water.

Project 6: Lake El Bardawil Development



The bathymetric map of Bardawil Lake *(Abd Ellah & Hussein 2009)*

January-July variation of the water salinity in Bardawil Lake

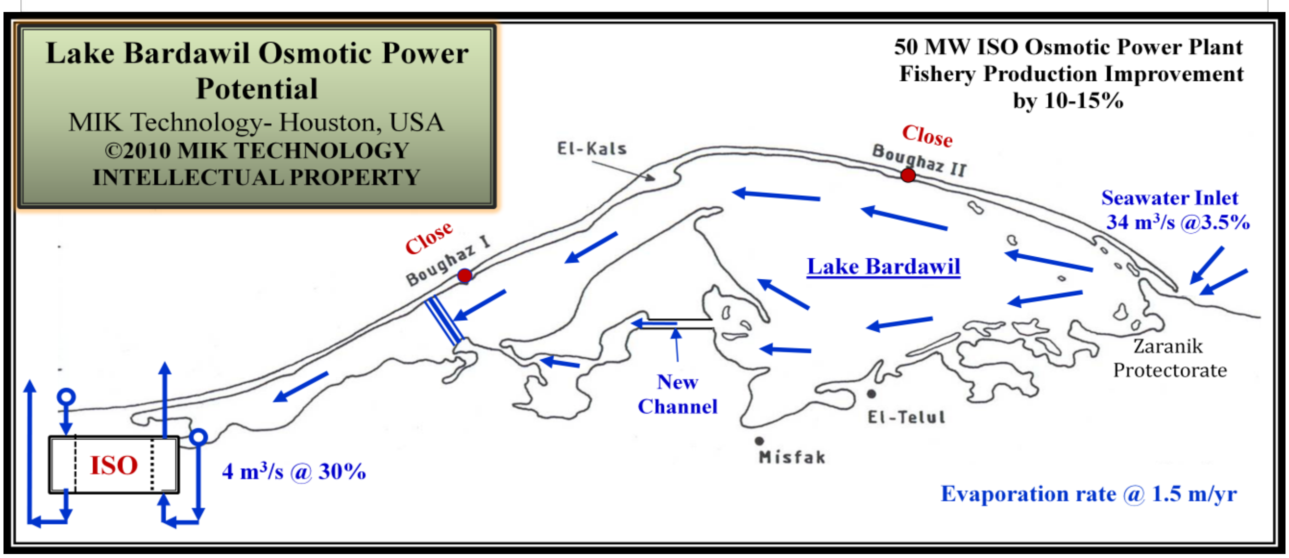


Figure 8: Modification of Lake Bardawil to improve marine life & generate 25-50 MW of power.

This project proposes modification and development of Lake Bardawil, Egypt to improve flow pattern in the lake by preventing seasonal salinity shifting, which affect marine life production; spawning and hatching. Controlled induced flow at the western end of the lake, given the rate of evaporation, results in gradual change in lake salinity from the eastern seawater inlet at Zaranik to the western end where the proposed ISO power plant is placed. The western end of the lake is a narrow endorheic strip that is not affected by the current flow movement in the lake. Water trapped in the section can potentially reach saturation and allows for water exchange with seawater to generate osmotic power.

Project 7: Alluvium Operation

It is estimated that on the average 133.54 million tons enter the high dam reservoir each year. About 97 % of this amount precipitates in the reservoir and 3% is carried through Aswan High dam. About 85% of the sediment is accumulated in Lake Nubia of Sudan and the balance in Lake Nasser of the Egyptian side. The estimated amount of sediments (Alluvium) will reach about 7 km^3 by the end of this decade. Composition of the sediment is about 30% fine sand with particle size of 0.2 mm to 0.06 mm, 40% silt of particle size 0.06 mm to 0.002 mm and 30 %clay with particle size less than 0.002 mm.

The accumulated sediment forms what is called a delta (not to be confused with the Nile delta on the Mediterranean). This delta continues expanding year after year by the accumulation of the sediments that is carried by the annual river flood. The moving front edge of the delta appears to be about 360 km from the dam. Continuing accumulation of sediment reduces water inventory volume in the reservoir, but more seriously, it shortens the life of the Nile River as Egypt's only water source!

Therefore, MIK Technology believes that an urgent plan must be considered to mitigate the serious consequences of blocking this crucial waterway. In addition, makes use of this valuable sediments to reclaim and develop new arable land in Egypt, as well, as protecting the Nile delta from flooding by the sea due anticipated global warming. Making use of all the stored alluvium should be a national objective!

Excavation and removal of sediments from waterways is well established technology. This process is referred to as a dredging. Dredging of sediments, raw material aggregates, and minerals in rivers, canals and mine is well established technology. Alluvium can be retrieved in the form of slurry (1) in thousands of cubic meters per hour, and can be conveyed in pipes for few hundred kilometers. However, intermittent pumping (every 4-5 km) is required along the way. Polyethylene piping is normally used but requires frequent replacement every 3-4 years.

Dredging equipment may vary depending on the size of the operation or its frequency. For the massive volume of sediments in the reservoir, hydraulic dredging such as suction dredger is preferred. Such process is followed by pumping slurry to its depositing destinations, or accumulated in mud ponds on the bank of the reservoir for dewatering and mechanical handling. We are inclined to use slurry lines for short distances, where line are protected and power is available to run booster pumps along the way.

Consideration should be also given for using rail in faraway depositing sites or where distributing slurry line is not practical. This includes developing El Farafra region, Nile Valley Phase II, the Qattara region and the Nile Delta saving project.

1 B. Abulnaga & M. Abdel-Fadile: Enhancing the Performance of the Nubia-Nasser Lake by Sediment Dams.

Project 8: Heavy Service Railroad

The western desert is seriously lacking dependable well managed transportation system. Dual track, heavy service railroad seems is a reliable means for transporting millions of cubic meters of alluvium for developing El Farafra oasis and in topping the delta surface. Rail cars for transporting alluvium have to be designed for quick unloading of content safely at the various depositing sites. Large fleet of these rail cars will be needed. It is our recommendation that these cars be manufactured locally to help the labor market. Rail will be also required for moving exported and local equipment; pumps, dredging heavy equipment from others site. The rail will be an important asset for the domestic sector in moving building materials, land products, live stock, etc.
Our proposed railroad system will be an important starting catalyst for constructing F. El Baz Project "The Development Corridor".

Project 9: Egypt's Eastern Infrastructure Development

About 75% of power in Egypt is generated by natural gas. Although electrical power consumption per capita has increased in the last decade by more than 50% (1000 KWH in 2000 to 1548 KWH in 2009), we believe that such rate will not support the country recent aspiration. It is our opinion that other sources of energy must be envisaged, particularly when fossil fuel in Egypt and the Middle East is being depleted. MIK Technology has proposed the installation of its new Osmotic power technology to generate 3 Gigawatts from the Qattara. This is a significant renewable energy addition, but will not suffice the country optimistic plans to support its population in 2050.

Therefore, an additional reliable source of energy is needed to confront future challenges and allow exploration of mining and mountain range potential of Egypt's Eastern Desert and further developing Egypt's eastern shores. Power and infrastructure are two essential factors for national development. In our paper "10 Proposed Projects for Land Reform and Power Generation to sustain the life of the People of Egypt" we have proposed the construction of a power plant in the south eastern corner of the country. For the development of Egypt's Eastern Region, we recommend a nuclear power plant of at least 2 Gigawatts and construct an advanced railroad system.

1. We suggest that the nuclear plant be constructed in the Halaiba territory for its remote location and for being less affected by seismic activities. A third generation nuclear power plant using boiling water reactor (Advanced Boiling Water Reactor- ABWR) of standard power output of 1.35 MWe is suggested. The reactor is seawater cooled, with Nile river water backup is a potential. Such reactor has been certified by US Nuclear Regulatory Commission. Two units are needed for a total power production of 2.7 Gigawatts, with the possibility for additional units. The estimated cost of the 2 units' plant is about $ 25 Billion.

2. Regarding railroad, we suggest an electrical, Light/Medium/Freight rail system with a speed up to 200 km/hr, depending on run length, service and time of the day. Estimated cost of construction is about $ 20 million/kilometer. The railroad will be formed of at least four segments (Figure 9):

a. Main Railroad: Halaiba to Port Said of about 1000 km.

b. Gulf of Suez Crossing*: north of Gemsa on the western shore of the gulf to the northwest of Rass Mohamed on the gulf eastern shore. The crossing length is about 35 km mostly at low water depth. The navigable section is about 12 km, with a maximum depth of 80 meter.

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* Benjamin Franklin Bridge is a typical example for water way crossing Bridge

Other crossings (at City of Suez and /or at Port Tewfik) will be considered if the current proposed scheme faces technical or political difficulties.

c. Taba Branch: 200 km
d. Suez Canal East Branch: 400 km.

Figure 9: Layout of the major infrastructures to develop Egypt's eastern territories

The estimated cost for the conceptual surface rail system of 1,700 kilometers is about $ 34 Billion. Bridge crossing and rolling stocks (locomotives and wagons) are about $ 6 billion. Total project cost is about $65 billion. Compensation for securing right-of-way for the rail corridor is not included.

Railroad construction can proceed, with the assumption of using conventional motive force temporarily until the power plant is constructed and electricity is available to operate the electric rail circuits.

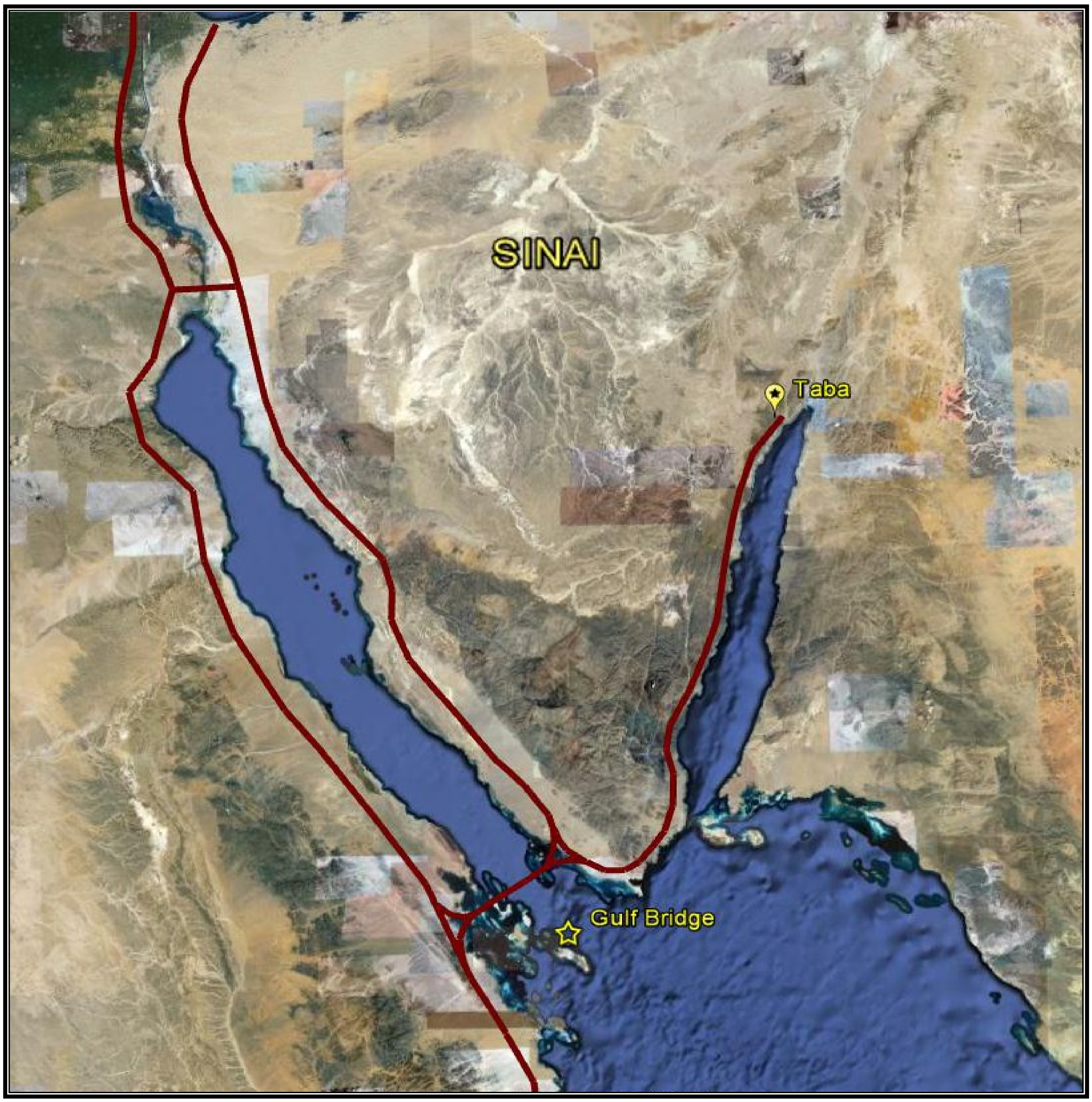

Figure 10: Layout of the proposed railroad crossing at the Gulf of Suez.

Project 10: Saving the Nile Delta from Sea flooding.

Flooding the Nile delta with seawater would be the worst event that Egypt could experience since the cataclysmic eruption of Santorini volcano over 3500 years ago. The abrupt tsunami that was generated by the volcano's eruption swept almost half way into the Nile delta, sparingly populated delta, at that time, was completely annihilated, but land had recovered after water receded. In our age, the rising sea due to the current climatic changes is rather slow and gradual, but it will cause serious devastation that may last hundreds of years. The most affected are the poor people that have no means to change the course of their life. In such event they may wish to trade their misery for a tsunami!

It has been claimed that the sea will rise one meter within the next 100 years. This implies that

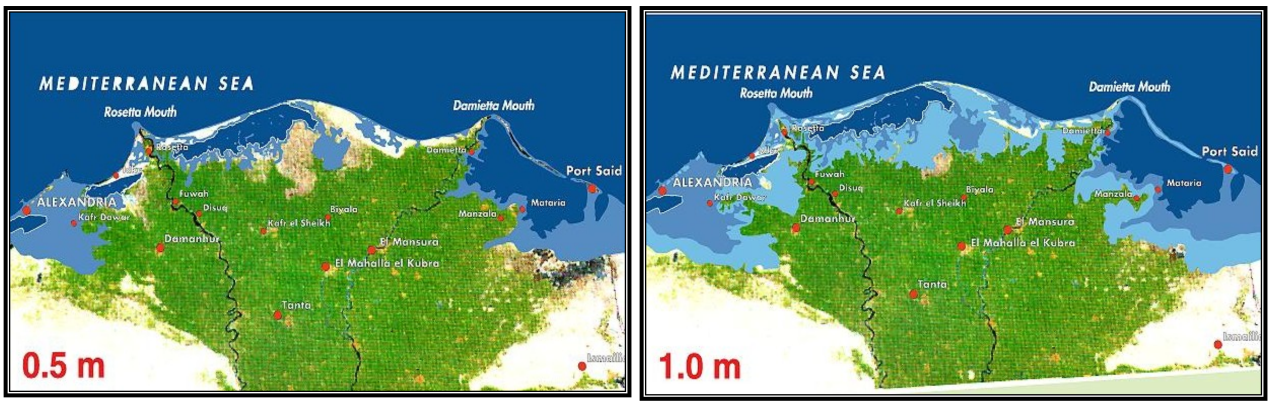

Figure 11: Predicted effect of sea rise on Nile Delta (UNEP/GRID)

many nations and large metropolitan communities will face the same calamity and most of them will give up to the mighty sea. In the case of Egypt, we may have a choice!

The rise of 0.5 meter will flood about 450,000 acres and will displace more than 4,000,000 people within 50 years. Sea rise by one meter will flood about 1,100,000 acres and displace 6-8 million people, in addition to the destruction of Egypt's business & commercial centers on its sea shores.

Few scenarios were postulated to mitigate the effect flooding. One scenario claims the diverting water from the Mediterranean to the Qattara Depression will solve the problem. This scenario is scientifically unfounded, unless the straits of Gibraltar Strait (14 km) and Babb el Mandeb (32 km) at the southern tip of the Red Sea are completely blocked. Strategically and militarily, this option will never take place.

Another scenario was proposed to build a partition wall isolating the delta from the sea. Obviously, this wall has to last for hundreds of years, but what will happen if an accident demolished part of it? An identical case happened in 2005 during Katrina Hurricane that ended by flooding the City of New Orleans, USA. The same scenario has also over looked the fact that the seawater elevation will be higher that the delta surface, salty water will seep under the partition and completely destroy the agriculture land in the delta.

Therefore, MIK Technology proposes a solution that reserves the land and potentially enhances its productivity, without the need to displace people and destroy their livelihood. We promote the concept of elevating the areas of the delta that could be subjected to flooding by one meter. Then, one may question the amount of top layer that is required, the source of and the cost.

Based on 1.0 meter seawater rise, it is estimated that 4,500 km^2 will be flooded. Then, to maintain the same integrity of the delta land, 4.5 billion cubic meters (4.5 km^3) of soil are required. Where we get this huge amount of material? Simply from what I have described earlier in the abstract as the hidden treasure, The Alluvium!

Over the last 42 years, about 6 km^3 of sediments has been deposited in Nubia and Nasser lakes and expected to reach 7 km^3 in the next 10 years. Therefore, we have enough material to build the delta and support the entire project that I have heighted in this paper. The question is how to retrieve it and what is the cost?

Dredging of waterways in Egypt is performed regularly in the Sues Canal and many other estuaries. In fact many dredging equipment are manufactured in Egypt. As mentioned earlier in project 7 section, alluvium can be retrieved in the form of slurry and pumped to delivery sites. Since the distance between the sediments' source and the delivery points could exceed 1200 km, mostly in unattended desert, it would be prudent to consider a dedicated rail service, in addition to slurry lines for shorter distances and for evacuating hopper cars. Barges are normally economical means for such service, but considering the required large number of barges and the numbers of locks that each barge has go through, the river will become dangerously congested. Therefore, this option seems impractical. Sediments need to be applied in evenly leveled layers to coincide with advancement of the sea. Therefore, several applications have to be considered to reach the desired alluvium depth, i.e. 10 cm/application. Estimated alluvium per application is about 1,600 m^3 per acre.

To prevent infringement of the sea upon waterways, particularly in Rosetta and Damietta branches, new dams would be constructed downstream of the exiting Edfina sand Damietta dams, and be placed close to the mouth of the branch to minimize seawater intrusion into waterways. Riverwater behind the proposed dams must be kept higher than seawater across those dams.

Tentatively, if 50 years are considered a project schedule target, then material has to be transported and applied at a rate of 11,000 m^3/ hr, every hour of the day. The cost of delivering alluvium to the shore is about \$3-5/ m^3 depending on the operating conditions. Cost for long delivery routes could double the cost (\$8). The rough estimated cost is \$650/ acre-yr for 50 years.

No doubt that the productivity of land will improve and we presume that the government may subsidize large portion of the cost, but for how long? For comparison, one may ask, what is the cost per acre to develop land of similar productivity to that of the delta in the New Valley? Or, what is the cost of relocating and housing millions of people and providing them with just the bare minimum, hoping to keep them alive and not let them beg for a meal? This is not an exaggeration. This is exactly what has happened in Sudan two years ago (2009) when the Sudanese government built their Merowe Dam and let 50,000 marooned in the desert [(1)].

Maher Kelada
MIK Technology, USA
Maher.kelada@miktechnology.com

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http://www.internationalrivers.org/africa/merowe-dam-sudan