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MEXICO WATER REPORT



This edition of the Mexico Water Report continues our series of articles on water issues in other Latin American markets as well as covering Mexico's water segments. In light of its highly developed market, Chile is profiled in this edition, following the review of Brazil's market in the last issue. The Chile article is a collaborative effort with our Chilean colleagues at [Trade Chile](#), a consulting firm with a growing water segment focus that has helped foreign companies enter Chile and other Spanish-speaking South American markets since 1995. The LGA/Trade Chile alliance together with the Brazilian TVZ/LGA alliance allows us to offer comprehensive Latin America-wide market entry and market expansion services for companies with water-related products, as well as other industrial/B2B and retail products.

In this edition we will address:

- [Chilean Water Segment Overview](#)

Water supply and sanitation in Chile is characterized by high levels of access and good service quality. Compared to most other countries, Chile's water and sanitation sector distinguishes itself by the fact that all urban water companies are privately owned or operated. The sector also prides itself on having a modern and effective regulatory framework.

- [Analysis of the Municipal Wastewater Projects for 2011](#)

According to a list provided by the Mexican National Water Commission (Conagua), in 2011 there were 204 proposed projects with at least 65% federal funding from one of three principal funding sources (APAZU, PROTAR, FONADIN) for the construction or rehabilitation of municipal wastewater treatment plants. To find out how many of these projects were really bid and/or carried out in 2011, LGA Consulting reviewed and analyzed the information on each in two different ways.

- [Mexico Market Size Estimate Explanation for the 4 Major Water Sub Segments](#)

In past presentations at WWEMA and WEFTEC events, the LGA Consulting General Manager provided extensive water sub segment market size estimates for municipal and industrial wastewater and municipal and industrial potable/clean water markets. In this article we explain the methodology behind the different sub sector scenarios and the data that applies to these areas.

- [2030 Mexico Water Agenda and 2011 Modifications](#)

The water sector in Mexico has gone through positive and negative changes in the last few years. Despite the efforts made so far, the water sector faces various challenges that require strong measures. The 2030 Water Agenda was proposed to achieve water sustainability in Mexico during the next 20 years. The four main objectives are: clean rivers, universal coverage (potable and sewerage services), all waters treated, and habitable areas protected from catastrophic floods. The program has 14 actions directly related to these main objectives.

- [Water Reuse in Mexico](#)

In terms of wastewater reuse in agriculture, Mexico ranks second in the world – but this is hardly an accolade since much of that wastewater is untreated. Of the wastewater that is reused in Mexican agriculture, 80% is not treated and its use is highly unregulated. While rain water reclamation projects at government levels are at infant stages here, Mexico is making some strides with strategies and efforts to reuse treated water. Two reasons for this change are related first and foremost to the scarcity and the cost of potable water. While residential potable water prices remain extremely low in Mexico, the prices that businesses have to pay is increasing significantly, supposedly increasing faster than general inflation for the first time in Mexico's history. Also, while the southern states in Mexico have over 15,000 m³ of water per capita, the northern and central states per capita water is only 500 and 1700 m³ respectively. Water stress severity is greatest where 75% of the population lives and where 87% of the Mexican economy is located.

- [Water Quality Problems and Challenges in Mexico](#)

The lack of confidence in Mexican potable water supply and in general superficial water sources has caused the country to position itself as one of the major consumers of bottled water in the world utilizing 234 liters per capita, one of the highest consumption rates in the world. Over 80% of Mexicans are not satisfied with the water quality coming into their homes and do not drink it, fearful of contracting diseases because of the lack of treatment and aquifer pollution. Water quality is also affected by water pollution problems from somewhat uncontrolled municipal and industrial discharges and the insufficient monitoring and low compliance with related regulations. Furthermore, it is important to mention that in 2010, according to the United Nations Development Program, Mexico was 106 out of 122 countries in water quality.

Upcoming Activities and Visits by the LGA Consulting General Manager

LGA Webinar on the Latin America Water Segment, January 26, 2012, 2:00 P.M. Eastern – LGA will be offering a webinar to all companies interested in taking the “next step” in their Mexico and Latin America sales and channel efforts and discussing the pros and cons of regional presence to ensure success in the challenging but growing region. If anyone is interested in participating in the

webinar, please contact us.

Mid-May Visit to the Upper Midwest: The General Managers of both LGA Consulting and TVZ International will be in the upper Midwest during the middle of May. If you would like to meet with either General Manager during this trip, please contact us.

AWWA ACE 12 Event in Dallas, Texas, June 10-14, 2012 – The director will be attending the event and available to meet with business people during and after the show.

Reorganization of the Mexico Water Report section on the website – LGA Consulting has reorganized the Mexico Water Report section of its website: <http://www.lgaconsulting.com/water/report.html>. With these changes, the front page of the section will show the title of each edition as well as the title of each article so that you don't have to search edition by edition to identify articles of interest. We believe that this will be a significant value added for companies trying to access information from the last two years of Mexico Water Report editions for information.

If you would like copies of past Mexico Water Reports, presentations given by the director of the Wisconsin Trade Office in Mexico on the Mexican water segment, or copies of the translations of Mexico's two wastewater treatment regulations (NOM 001 and 002), please go to the [LGA Consulting website](http://www.lgaconsulting.com) or contact the office director by email at vlencioni@lgaconsulting.com or by toll-free U.S. Number: (1) (888) 750-0988.

Chilean Water Segment Overview

Water supply and sanitation in Chile is characterized by high levels of access and good service quality. Compared to most other countries, Chile's water and sanitation sector distinguishes itself by the fact that all urban water companies are privately owned or operated. The sector also prides itself on having a modern and effective regulatory framework.

According to the regulatory agency SISS (Superintendent of Sanitary Services), the Chilean urban areas access to water supply stood at 100% and access to sanitation at 98% in 2010, which is one of the highest levels in Latin America. One of the reasons for the high coverage rates in Chile is the early effort for extending and improving the infrastructure. As a result, in 1990, 97% of the urban

population was already connected to water and 82% to sanitation.

Service quality is generally good in Chile and water supply is continuous, both in urban areas and in concentrated rural areas. It is regularly controlled by the SISS since it was founded in 1990. The agency examines if services comply with the Chilean Norm NCh 409, which was modified in 2005, and includes standards concerning water quality, water pressure and continuity among others. At the beginning of the 1990s, there were problems regarding the chlorination systems of some water service providers. Consequently, in 1991, 20% of the companies did not comply with the bacteriological norms. In 2010, this share has dropped to about 1%. In the same period, compliance with disinfection norms increased from 89% to more than 99%.

On the wastewater side, as of 2010, 83.3% of Chilean wastewaters were being treated. The sector is currently involved in a major investment program with the goal of treating 100% of all collected municipal wastewater by the end of 2012. It appears that the actions taken since 2010 to reach this 100% goal are still on track.

Policy and Regulation

Responsibility for sector policy in Chile is vested primarily in the Ministry of Public Works, which grants concessions and promotes rural water supply and sanitation through its Department of Sanitation Programs. The responsibility for regulation is shared between the SISS, the superintendents in urban areas, and the Ministry of Health which controls drinking water quality standards in both urban and rural areas.

The SISS controls water and sanitation services in urban areas according to financial and quality norms. To guarantee political independence, the SISS is a decentralized organization with its own budget. It has the right to impose fines on service providers in case of violation of norms, fines which flow directly into the superintendent's budget. Furthermore, it receives user complaints, assesses their validity and acts on them.

The water and sanitation regulatory system in Chile is considered by the World Health Organization to be a model not only for Latin America but also for Europe. One of its innovative features is the use of a hypothetical efficient model enterprise to assist in determining if tariff increases requested by service providers are justified.

Rural areas

In rural Chile, the ministry of health and the ministry of economy are responsible for supervising water cooperatives and water committees. However, in rural areas, there is no independent regulator such as the SISS in urban areas. Since 1994, the Direction for Water Works (DOH) is in charge of executing the national Rural Potable Water Program (APR).

In rural areas, local water cooperatives and water committees provide water supply services to almost 1.7 million rural consumers. In

concentrated rural areas (i.e. rural communities with 150 to 3,000 inhabitants with a concentration of not less than 15 houses per km of water network), there has been significant development due to the national Rural Potable Water Program (APR).

Unlike urban service providers, the rural water supply and sanitation sector has not been the target of regulation like urban services. During the Bachelet Presidential Administration (2006-2010), the government submitted a bill to the Chilean Congress to give this sector a new institutional framework in the form of a specialized agency. While there is still momentum for this reform, to date no changes have been implemented and this agency still has not been created. However, with only 1.2 million or 9% of the Chilean population considered rural, the challenges of rural water access are not nearly as serious as in other Latin American countries. However, the most isolated housing in Chile still lack adequate water connections.

Service provision

Water supply and sanitation services in Chile's urban areas are provided by more than 50 entities. To prevent monopolization, the providers were classified into three categories according to the percentage of the population they serve by them. No person or company is allowed to possess more than 49% of the companies within one category.

Category	Criterion	Number of Companies	Total Category Share of Population
Larger Companies	Serve more than 15% of total population	2	50.5%
Medium Sized Companies	Serve between 4 and 15% of total population	6	34.3%
Smaller Companies	Serve less than 4% of total population	45	15.2%

The three largest companies are:

- **Aguas Andinas**, serving the capital Santiago, majority-owned by the Spanish company Aguas de Barcelona.
- **Empresa de Servicios Sanitarios del Bio-Bío (ESSBIO)**, serving the sixth region and eighth region around Concepción, majority-owned by the Latin American Investment Fund Southern Cross.
- **Empresa Sanitaria de Valparaíso (ESVAL)**, serving the Valparaíso Region, owned by various institutional investors.

Together, the three companies serve 63% of urban water customers in Chile.

Financial aspects

Tariff Level - Water tariffs in Chile differ substantially between regions, reflecting differences in the cost of supplying water. Tariffs in urban areas varied between US\$0.80 (Aguas Cordillera in Chicureo) per cubic meter and US\$ 4.10 (Aguas Patagonia in Coyhaique) per cubic meter in 2010. In rural areas, tariffs only cover operation and maintenance costs.

Affordability - On average, the water and sanitation bill accounted for 1.14% of household income according to a 2009 survey by the National Statistical Institute. They varied between 0.77% for the highest (wealthiest) quintile and 2.35% for the lowest (poorest) quintile.

Financing and Subsidies - Urban water and sanitation systems do not receive direct subsidies and are financed through the capital market, and ultimately through user fees. However, Chile has an innovative system of means-tested subsidies that allows qualifying poor households to receive a subsidy administered by the municipalities to pay parts of their water and sanitation bills. Rural water systems receive a partial investment subsidy that is defined in the Ley del Subsidio al Agua Potable y Saneamiento. By law, the subsidy can cover 25%-85% of a household's water and sewer bill up to 15 m³ per month. The client pays the rest of the bill. Beyond 15 m³, households are charged full price. The subsidy is meant to target only those subsistence level households that are unable to pay for water and is based on ability to pay. Opponents argue this subsidy program can act as a regressive policy and actually hurt the poor because a false assumption is made that high consumption is positively correlated to high income. On the contrary, poor families do not have access to efficient methods of using water in cooking, cleaning, and washing.

Investment - Since the sector was prepared for self-sufficiency, investment increased significantly from an annual average of about US\$ 100m in the period 1965 to 1989 to an annual average of US\$ 242m in the period 1990 to 1998, when the first company was privatized. According to SISS, since 1998, the annual investment has ranged from US\$ 151m in 1999 to US\$ 443m in 2002. Total investment in 2010 was US\$ 325m.

Analysis of the Municipal Wastewater Projects for 2011

According to a list provided by the Mexican National Water Commission (Conagua), in 2011 there were 204 proposed projects that counted with at least 65% federal funding from one of three principal funding sources (APAZU, PROTAR, FONADIN) for the construction or rehabilitation of municipal wastewater treatment plants.

To find out how many of these projects were really bid and/or carried out in 2011, LGA Consulting reviewed and analyzed the information on each in the following two ways:

- 1) Review of the Compranet system to confirm the existence and the status of the project– said system is supposed to contain information on all federal, state, and municipal bids and awards.
- 2) Calls to the municipalities and states where the projects were not found in the system, trying to contact the person in charge of the project at the applicable municipal or state water authority for information.

To facilitate the analysis, the findings were divided in 5 groups: 1) Bids founded, 2) Bids canceled, 3) Bids postponed, 4) Bids not found in applicable state or municipal water authorities (i.e. “no info”), and 5) Bids where the identified authority was impossible to reach for comment (“no answer”).

Of the total 204 wastewater projects requested by municipalities and states and which had more than 65% funding from FONADIN, PROTAR, APAZU, 47% were published in Compranet or confirmed by phone with the appropriate water entity (See below).

	Not Found (postponed, no Info, or no Answer)	Found/Existing	Canceled	Total
Rehabilitations	22.5%	14.5%	2.0%	39.0%
New Construction	24.5%	32.3%	4.2%	61.0%
TOTAL	47.0%	47.0%	5.8%	100.00%

Some of these projects had already been concluded and others were still in the bid and/or construction process. 123 projects or 61% corresponded to new plant construction while 39% corresponded to rehabilitation or major maintenance projects. Concerning new construction projects, 32.3% have been or are currently being carried out while 24.5% corresponded to pending projects (i.e. postponed, no information or we were unable to get an answer). Concerning rehabilitation projects, almost twice as many projects were pending (22.5% of the total) than those that we found in the system (14.7% of the total).

The below table gives a more detailed breakdown of the new construction and rehabilitation projects by the five confirmations or answers we received.

	# of Projects		
	Rehabilitations	New	Total
Found	30	66	96
Canceled	5	7	12
Postponed	13	7	20
No Info	24	22	46
No Answer	9	21	30
Total	81	123	204

Then considering both new and rehabilitation projects together, 12 projects or 6% were canceled. There are several reasons why a project is canceled. However, the municipal authority in charge of the bid or the description of the cancellation in Compranet

indicated, in the majority of cases, that there was a lack of compliance with the bid regulations and that if they continued the process, it would cause damage to the entity or almost certainly result in cancellation at a later stage in the process.

20 projects or 9.3% were postponed or still pending, meaning that they are not in the system and do not have a specific or approximate start date. In some cases, they were delayed due to lack of resources from the municipal and/or state authorities (i.e. the other 35%). In other cases, they were postponed because of conflicts between the applicable municipality and state about which entity would carry out the project.

30 projects or 15.2% could not be found (i.e. “no answer”), that is, we could not locate a contact to get information on the bid. In these cases, we called applicable the municipality as well as the applicable state and were unable to get a response.

In the case of 46 projects or 22.5%, no one knew or had any information about the project, that is, they either did not know about the project or they had a notion but they had no idea who in their agency was in charge of the project or when it would take place. An example of this problem was the case of the wastewater treatment plant extension and rehabilitation project in the municipality of Angostura, Sinaloa. We contacted the applicable municipal and state water authority, and while they had notions about the project, no one had any idea which entity or person was in charge of the project or when it would be carried out. A similar situation existed in the case of the wastewater plant rehabilitation project in the municipality of Macuspana, Tabasco where when we called the respective municipal and state water authorities, we were told that no such project existed. Finally, in some cases, municipal or state authorities simply told us that they did not want to give information about the project or its status.

Analysis of Results: Why are only 50% of the federal funded projects in the system?

The projects that have are pending or have no information or where we were unable to get an answer totaled 47%. This is very similar to the percentage of projects actually found or identified (48%). One might ask why the percentage of projects found is not a lot higher than those postponed or impossible to identify?

To address this concern, we can turn to the results of the APAZU funding authority questionnaire for the evaluation of program results for some interesting context. Said questionnaire system indicates that each year there are very significant and extensive delays in bid and project deadlines resulting in proposed projects for a given year being delayed 6 months or more, generally resulting these projects being pushed back into the next fiscal year. The results of these questionnaires establish that the main problems or hindrances

that exist for the bidding, initiation and/or execution of projects are the following: (a) lack of additional financial resources required to finish the project (i.e. additional 35%) either because of lack of funds or because said funds were allocated to a different project, (b) deadlines were not respected in the bid process, (c) monthly progress reports on the construction were incomplete or unreliable, (d) local water authorities have very limited technical capabilities and inaccurate benefit projections, and (e) federal rules and regulations were too complicated or difficult to comply with or simply were not complied with.

Conclusion

During 2011, solid wastewater new construction and rehabilitation projects were presented by the states and municipalities to Conagua and to the different federal funding agencies and were approved. However, less than half of the proposed, federal funded projects were bid and/or executed in this calendar year. The other half were detained because of problems like lack of additional funding, bureaucracy, party politics, state vs municipal agency in-fighting, and without a doubt corruption was a major factor as well. This generates a considerable backlog of projects contributing to Mexico's very bad infrastructure project execution record. In fact, Mexico's water infrastructure system is considered to be much less efficient than those in Argentina, Brazil, Chile, and Colombia and is even below Peru. It is also considered to be one of the slowest in project bid and execution processing in Latin America, something that has to change.

Based on the above and from the specific information given by municipal water agencies, of the 20 postponed projects, LGA expects 12 to take place in 2012. Concerning the 76 federally funded projects where we could find no information ("no info" or "no answer" categories), LGA uses 3 scenarios to try and project how many of these projects will come back on line: (a) low (less than 25 projects), (b) moderate (between 25 and 50 projects), and (c) high (more than 50 or more than two-thirds). Because Mexico is entering a Presidential election year in 2012, LGA does not consider the "high" scenario to be realistic. While it is entirely possible that the moderate scenario could take place, it believes that the low scenario is unfortunately probably the most realistic for 2012.

In another article in this Report, we will more extensively discuss market size estimates for the waste water municipal.

Mexico Market Size Estimate Explanation for the Four Major Water Subsegments

In past presentations at WWEMA and WEFTEC events, the LGA Consulting General Manager provided extensive water sub segment market size estimates for municipal and industrial wastewater and municipal and industrial potable/clean water markets. In this article we hope to fully explain the methodology behind the different sub sector scenarios and their respective numbers for these areas.

On the public sector side, this exercise is important since (a) it is hard to get decent budget estimates from Conagua, (b) even when you get them, their accuracy is often questionable, and (c) even if budget information is accurate, it is often not a reflection of the actual money spent by Conagua on projects. Often Conagua budgets funds for a state or municipal project and the local politics, personal interests (i.e. corruption), errors in bidding or lack of sufficient complementary local funds can postpone or even cancel projects duly confirmed with Conagua. For example, in another related article in this edition, we describe how less than 50% of 204 wastewater projects planned for 2011 that were submitted to Conagua and approved with 65% or more financial support simply did not materialize.

On the private sector side, while we don't have to deal with the uncertainties and politics of the public sector in these efforts, private sector market size estimates and scenarios can be even more difficult to develop. In these cases, we don't have public sector budgets as a benchmark nor can we interact with officials for information at a central agency like Conagua that happens to supply more than 50% of the funding for all projects and has a decent feel for what will be coming on line during the year. That being said, we are able to speak with different private sector companies selling into these sub segments, and these opinions tend to be more accurate and based on truer, realistic sales estimates. However, in the case of the private wastewater sub segment, with the less than extensive, viable or credible enforcement of the applicable treatment regulations, it is hard to get a good handle on the size of the sub segment because you cannot base it on an analysis of the universe of non-compliant companies.

Despite these challenges, LGA Consulting has tried to come up with some estimates for these water sub segments that we believe are better than any others simply because we of our extensive research and, frankly, because in some cases we are the only ones taking a stab at these estimates. Below are the descriptions and explanations of the different market size scenarios/estimates along with median and average figures for the scenarios of the five above water sub segments. We also provide our opinion about what we believe are the best market size scenarios and most likely estimates for each sub segment.

Municipal Potable Water Market Size

The largest of the five water sub segments but probably the most challenging, especially for foreign companies, is the Municipal

Potable Water Market. We include some analysis of the hydro-agricultural sub segment in this section as well. This sub segment is tricky for foreign companies in general and especially in 2012 for three reasons. First, since the great majority of Mexican consumers do not drink tap water, the demand for many potable water services is less clear and not at the level of not only developed countries but also developing countries where potable water product is used more extensively for drinking purposes. Therefore, while potable water funding is still a high priority in many developing countries and despite the fact that Mexico still has many potable water challenges, often other sub segments get priority funding over the potable water sub segment. Second, for legal reasons and despite NAFTA, all sales in this public sector sub segment must go through a Mexican-based distributor or integrator/contractor. Third, local elections happen every three years and reelection is legally prohibited at all levels of government which can make it a nightmare to deal with municipal officials who have limited experience and when a sales cycle for some of these projects can be 2-3 years. With 2012 being a Presidential election year and with 25% of the state governorships and 50% of municipal positions up for election, these difficulties become even more complicated and unpredictable in 2012.

Scenario Details – LGA Consulting has created or “deduced” one budget scenario for this sub segment and a budget scenario for the agricultural sub segment. The Conagua water budget for 2011 was listed as approximately \$3 billion US with 50% of the budget for projects and 40% for potable water projects. This provides us with a figure of \$600 million US from federal sources. LGA estimates that 1/3 to 1/2 of federal figures represent the additional, matching funds that come from state and local sources which brings this number up to \$800-900 million US. If we assume that approximately 50% of these budgeted funds go to construction and other purely basic, local content, then the other 50%, or \$400-450 million US, are probably funds that should be used for products and services that could or maybe should be sourced from abroad. Somewhat ironically, the US Embassy estimated in 2005, arguably two years before the international economic crisis began, that this sub segment represented \$470 million US with \$370 million US likely targeted for products and services that need to be sourced abroad. We tend to feel that US Embassy estimates for the water sector tend to be a bit on the generous side. If so, we feel that our figure demonstrates the strength of this sub segment without overestimating its importance or likely spending.

The hydro-agricultural sector figure is a much simpler deduction where 19% of the total federal water budget is destined for this sub segment and this figure is \$570 million US. With the Mexican agricultural sector heavily dependent on subsidies and with it using about 75% of all water resources in the country and losing more than 50% in bad delivery systems, this will be a key area for current and future investment and funding. Since 2008, federal funding for this hydro-agricultural sub segment has increased and impressive 60%. However, the tiny, barely inflationary increase of 4% in 2011 demonstrates that despite it being a priority sub segment, it can

and will be underfunded when there is economic malaise or budget shortfalls. This sub segment offers enormous short, medium, and long term opportunities to companies with agricultural water products and solutions. However, working with the agricultural sector in Mexico can be very difficult in light of its very provincial mentality. Also, with its needs often being very basic, it is hard to understand how and where these funds will be spent. For this reason, we think that at the most, 50% of these funds or \$285 million US, can be earmarked for products that might be viable areas for foreign companies. If the money trail is hard to identify in Conagua and difficult to identify in local water agencies, it is even harder to identify in the predominantly rural agricultural areas that lack central organization and administration.

Municipal Wastewater Market Size

The second largest water sub segment, the municipal wastewater market, is also the one with the most references and potential benchmarks and the one that LGA Consulting has most analyzed. This segment, like the municipal potable water sub segment, is equally tricky for foreign companies. First, as mentioned above, foreign companies need to sell through Mexican-based intermediaries and can be inhibited by national content regulations. Second, and also referenced above, three year local municipal terms and the Presidential, governor, and municipal elections in 2012 further complicates things this year. Third, many, many Mexican municipalities ignore Conagua fines and instructions with impunity if their residual waste is not compliant with wastewater standards.

If you put these factors together it can become an “imperfect storm” of sorts that can lead to a municipality with wastewater problems to simply ignore the problem. In light of these problems, Conagua and many municipalities are pushing for BOT or PPP projects but most foreign companies who have experience in these areas still have reservations about the uncertain revenue and relatively high political risk associated with these types of projects.

Despite these problems and reservations, in the emerging world, when urban potable water and sewerage systems reach 90% plus figures and leakage issues are addressed, wastewater treatment generally come on line shortly thereafter. If this is a valid trend, and if Mexico will divert less money to potable water projects than in most other emerging markets for the reasons mentioned above, we should see considerable more spending on municipal wastewater treatment, especially in tourist and medium-sized cities (60 with over 100,000 persons and 45 with over 250,000), perhaps not in 2012 with the distraction of federal, state, and federal elections, but very likely from 2013-2018 during the next presidential administration.

Scenario Details – LGA has taken information from several different sources to come up with 5 separate scenarios for this sub

segment along with average and median figures for these scenarios to try to arrive at a single point of reference. The first three scenarios are based on Conagua 2011 budget categories, one is from a Frost & Sullivan Latin American water segment study and the last is an estimate of the sub segment by the US Embassy. These scenarios provide us with a somewhat broad range, from a little over \$200 million US to a high of \$546 million US, creating an average between the five scenarios of \$321 million US and a median of \$280 million US.

The first Conagua budget scenario is \$195-220 million US in annual spending. This scenario is based on the total 2011 Mexican federal budget for the water segment (\$3 billion US) and breaking it down in the following four ways (a) 48% of the Conagua budget for Projects (\$1.53 billion US); (b) 12% of Projects budget for Saneamiento or municipal sanitation/treatment (\$183 million US); (c) 80% of Saneamiento for municipal wastewater projects (\$146 million US); plus (d) municipal and state matching funds (1/3 to 1/2 of federal funds) which gives us a figure of \$195-220 million US.

The second Conagua budget scenario is based on the “Saneamiento” or drainage/sanitation budget concept which includes wastewater treatment spending, and is a much simpler formula, taking the “Saneamiento” or sanitation/treatment budget of \$189.8 Million and applying two figures to it: (a) 80% of Saneamiento destined for municipal wastewater projects (\$152 million US); plus (b) the municipal and state matching funds (1/3 to 1/2 of federal funds or \$200-230 million US).

The third Conagua budget scenario is based on the following, specific Conagua wastewater related categories: S218, K007, S074 and S075. These four wastewater specific categories total just over 3 million pesos or \$255 million US. If, once again, we estimate that 1/3 to 1/2 of federal fund figures equal the amount of matching state and local funds, then this figure increases to \$340-380 million US.

The fourth scenario is based on a Frost & Sullivan Latin America-wide municipal wastewater treatment figure for 2008 of \$43.1 billion US where they assigned 27.5% of the total or \$11.85 Billion to Mexico. If we take this Mexico figure that we believe is a fair estimate for 2011 if not 2012 figures and apply the following formulas similar to those mentioned above, we arrive at a figure of \$546 million US: (a) 48% of the Conagua budget for Projects; (b) 12% of Projects budget for Saneamiento; and (c) 80% of Saneamiento budget for municipal wastewater projects.

Finally, a US Embassy 2010 study on Mexico Water and Wastewater Imports provided us with bases to use their information to arrive at the final scenario. This study established the entire (federal and local) water budget in 2010 as \$3.922 billion US with the specific,

municipal water segment estimated at \$2.9 Billion US. If we apply the above-mentioned concepts (12% of Projects budget for Saneamiento and 80% of Saneamiento budget for municipal wastewater) to this figure, we come to an estimated municipal wastewater market size of approximately \$280 million US.

Industrial Wastewater Market Size

The third largest water sub segment is one of great need but without the necessary regulatory support to allow it to be a sub segment that is easy to predict. Industrial wastewater equipment and related products are required by the more than 400,000 Mexican companies that use water for their manufacturing processes, especially by many high water use and high contaminating industrial segments. However, Conagua says that only 19% of industrial waste is currently treated; and, it generally fails to clarify that this figure is for industrial wastewater dumped into federal bodies that are regulated by NOM 001. Conagua officials admit that they have no idea how much industrial wastewater is dumped into municipal bodies/sewerage systems or how much is treated, and only 35-40% of municipal wastewater is currently treated. As a result, it is entirely possible that Mexico treats less than 10% of its current industrial wastewater.

Scenario Details - LGA took information from three different sources to come up with 4 separate scenarios for this sub segment along with average figures for these scenarios to try to arrive at a single point of reference. The first two scenarios are based on US Embassy information. The third scenario is based on Conagua 2011 budget information and the last scenario is based on a 2010 Frost & Sullivan Latin America Industrial Wastewater Equipment study. These scenarios provide us with an equally broad range, from a little over \$100 million US to a high of \$350 million US, creating an average between the four scenarios of \$277 million US. While we will comment on this in the conclusions section, we consider the three highest scenarios, those based on information from the US Embassy and Frost & Sullivan sources, to be on the high side while we consider the scenario based on Conagua information to be on the low side. As a result, we think that a more appropriate figure to be closer to a \$220 million US figure.

The first scenario based on US Embassy information is an estimation from a 2006 Mexico Industrial Wastewater Equipment study that estimated the sub segment market size as \$325 million US in 2005 and \$346 million US in 2006. Considering that this is figure is from one of the last pre-international crisis years and that it was not until 2011 or perhaps 2012 that we could claim we were at a full recovery stage, we feel that this 2006 number could stand on its own for 2011 or 2012. The US Embassy estimates that 40% of the money spent in this category is with large companies and 60% with small and medium size companies.

The second scenario, also based on US Embassy information, is an estimation based on figures on imports from a 2010 Total Mexico Water& Wastewater Imports study that estimated the size of total water and wastewater imports as \$3.314 Billion US. The document establishes that 88% of this figure is for products rather than services and 20% of this product figure is for products, arriving at a total water figure of \$593 million US. The consensus is that 50% and perhaps more of water products would correspond to municipal wastewater rather than municipal potable or clean water products. The low figure of 33% would represent \$221 million US and the moderate figure of 50% would represent \$336 million US. Despite the fact that we think that the moderate percentage is probably closer to the mark, we feel that the lower figure of \$221 million is probably a more accurate estimate of the size of this sub segment.

The third scenario is a simple estimate of the most appropriate percentage of the Conagua municipal wastewater sub segment water budget that would represent the industrial wastewater sub segment. Two reputable private sector water sources felt that this percentage would be 30-33% of the total or 50% of the municipal wastewater sub segment. In this case, half of the average between the five municipal wastewater scenarios (\$321 million US) and half of the median (\$280 million US) would be \$160.5 million US and \$140 million respectively.

The final, multiple scenario based on information from the 2010 Frost& Sullivan Latin America Industrial Wastewater Equipment study, establishes total 2012 industrial wastewater spending in Latin America as \$1.17 billion US and 2014 spending in the region as \$1.27 billion US. Other private sector sources have confirmed that if Mexico represented 27.5% of the municipal wastewater market, the industrial wastewater sub segment in Mexico should represent about 25% of the Latin American figure and at least 20% of the total. Using these percentages, the moderate 25% figure for 2012 would be \$295 million US while the lower 20% figure would be \$234 million US. Likewise, in 2014, the moderate 25% figure would be \$320 million US while the lower 20% figure would be just over \$250 million US.

Industrial Clean Water Market Size

The smallest of the traditional water sub segments is industrial clean water and high purity industrial use water. Unlike the other three traditional sub segments, this sub segment is the only one that is not affected by government policy and regulatory enforcement or lack thereof as tends to be the case in Mexico. This sub segment is driven by almost exclusively bottom line manufacturing and related process issues and therefore should be an area for targeting during the tumultuous 2012 Presidential election year when the other three sub segments, especially the two public sub segments, should see at best unpredictable growth and project follow-through.

Scenario Details – These scenarios are much less true scenarios with formulas and more estimates from what we consider to be reliable private sector contacts. These contacts estimate that the industrial clean water and related products sub segment probably represents somewhere between 25% and 33% of the total industrial water market, that is, 33-50% of the industrial wastewater sub segment. 33% of the average of the four industrial wastewater scenarios (\$277 million US) would be approximately about \$90 million US while 50% would be just under \$140 million US. We believe that this is a faithful range for this sub segment and therefore we would estimate its size at approximately \$125 million US with considerable potential for growth as Mexican industrial water prices continue to increase beyond inflation and as water scarcity and stress continue in the arid north and somewhat arid central parts of Mexico where 87% of the Mexican economy and industry are based.

Conclusions

With the Presidential election, 1/3 of Governor elections and 100% of municipal elections taking place in July 2012, with the new federal administration not coming into office until December 2012 and with the majority of cabinet and Conagua director appointments not likely to take place until the at least the first quarter of 2013, we think that the two largest sub segments, those focused on the public sector, are those that are the least clear and the most likely to disappoint. As a result of this dynamic and for other positive private sector reasons, we think that the best sub segments to target in 2012 are actually the three smallest sub segments all focused on the private sector: industrial wastewater, industrial clean water, and to some extent residential clean water. From a number of sources, LGA Consulting has come to believe that most industrial projects will not be negatively affected by or delayed because of local, state, or federal elections in 2012.

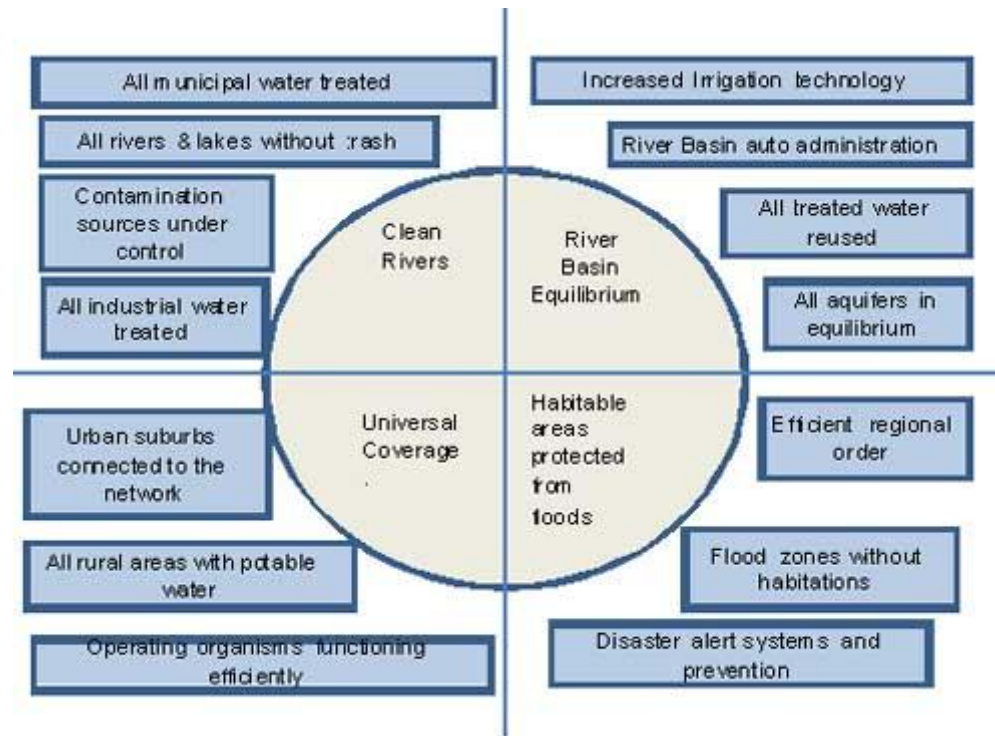
In summary, below are the LGA projections of the annual spending for four water sub segments listed above:

- A. Municipal Potable Water: \$450 million US
- 1. Hydro Agricultural Water: \$ 285 million US
- B. Municipal Wastewater: \$ 280 million US
- C. Industrial Wastewater: \$ 220 million US
- D. Industrial Clean Water: \$ 125 million US

Finally, we hope that you find these estimates helpful and we welcome all comments and constructive criticism about the bases or details concerning these scenarios.

2030 Mexico Water Agenda and 2011 Modifications

The water sector in Mexico has gone through positive and negative changes in the last few years. Despite the efforts made so far, the water sector faces various challenges that require strong measures. The 2030 Water Agenda was proposed for this purpose. This program establishes the objectives during the next 20 years in Mexico in order to achieve water sustainability. The 4 main objectives (see the circle below) are: Clean rivers, universal coverage (potable and sewerage services), all waters treated, and habitable areas protected from catastrophic floods. The program has 14 actions directly related to these main objectives. The following graph describes these goals, objectives, and actions.



To make compliance with these 2030 goals more viable, annual, national targets were established for the 2007-2012: 92% potable water coverage, 88% sewerage coverage, 60% municipal wastewater treatment, and the rehabilitation of 500 dams. It was expected that by 2016 all main urban areas would be free from flood risks, by 2015 irrigation would be 100% technified and 100% of wastewater would be reused. By 2024, rural access to sewerage and potable water services would be 100% and by 2025, all industrial and municipal wastewater would be treated.

Some have said that these goals were lofty especially considering the following facts. Currently, 97% of urban areas but only 76% of rural areas have access to potable water. While 96% of urban areas have access to sanitation/sewer systems, only 63% of the rural areas have this access. While CONAGUA says that currently 46% of the municipal wastewater is treated in the country, in reality we believe that this figure is probably closer to 35%. To date, the competitiveness of Mexico's water and sewage systems is considered to be 20% below the Latin American average, well below Chile, Colombia, Argentina, and Brazil, and just below underinfrastructure Peru.

Formal Modification of Goals in 2011

Considering the above comments and understanding that the 2030 Water Agenda goals were simply too ambitious, in 2011 goals for the Agenda 2030 were adjusted to create more practical and realistic goals. As a result of these changes, described at length below, national goals were reduced for the most part to regional goals and almost every one of the proposed actions and objectives were adjusted downward, most reprioritized from compliance by 2030 to compliance "after 2030" or "undefined".

As a first step, Conagua and the other government entities involved in the creation of the 2030 Agenda and in its modifications, established the following five regions/river basins as priorities: Valley of Mexico, Higher Lerma Mexico, Central Veracruz, Lower Papaloapan Veracruz, and Northeastern Quintana Roo. Supposedly, 76% of the 2030 Agenda budget will be destined for these regions all five of which have 3 or more of the identified priority problems. Details about these problems and priorities will be addressed later in the article.

The second step was to determinate the time lapse for each one of the goals divided into three groups: "by 2030", "after 2030" and "undefined". It is important to mention that the groups "after 2030" and "undefined" are almost indistinguishable and therefore add little value. However, at least with this difference, we can come to understand that the objectives of the group "after 2030" are supposedly higher priorities than those of the group "undefined".

Inside the first group (“before 2030”) are three goals: (1) treat all municipal waters, (2) connect urban suburbs to sewerage networks, and (3) technify all irrigation. In the second group (“after 2030”), there are 5 goals that were originally established as pre-2030: (a) treat all industrial wastewater, (b) all water basins be self administrated, (c) all aquifers in balance, (d) all rural communities with potable water access, and (e) viable, fully functional local water agencies. In the third group (“undefined”) there are 6 goals that were also originally established as pre-2030 goals: (1) all rivers and lakes waste free, (2) have all sources of contamination under control, (3) reuse all treated water, (4) achieve an effective water territorial order, (5) all flood zones free of human settlements and (6) flood/storm warning and prevention systems using high technology. It is important to mention that these current, modified goals could change with the new Presidential and potentially different Conagua administrations that will come on line in late 2012. If the PRI party that has been out of power for 12 years wins the Presidential election, it is probable that at least part of those goals will changed and that some goals will move back into the “before 2030” group or, on the other hand, be further deemphasized.

As one can see, the formidable levels of the original 2030 Agenda goals dropped considerably with these 2011 adjustments. As mentioned above, regions were prioritized over national goals in order to more realistically address problem areas. Also, of the total goals that were designated for compliance “before 2030”, only 21% were maintained as “before 2030”, 79% were reduced to the very ambiguous “after 2030” (35%) or “undefined” (44%).

Expected and Required Funding to Reach Modified 2030 Agenda Goals

In order to accomplish these goals, Conagua and other governmental and NGO bodies have determined that \$1,024 trillion pesos or \$75.85 billion US will be required. From that total, as mentioned above, 76% will supposedly be destined for projects related to the previously mentioned 4 main goals/objectives in the 5 priority regions. Of this 76% or \$57.65 billion US, 44% will be for basins in balance, 27% for universal coverage, 15% for clean rivers and 13% for the protection of habitable areas from catastrophic floods. One can surmise from related 2030 Agenda action information that, for instance, in the area of basins in balance, extensive, new opportunities should exist for wastewater treatment plant and irrigation technification projects considering that 44% or over \$25 billion of the budget will be assigned to these two goals.

The other 24% of the total expected 2030 budgeted funds, or \$18.2 billion US, will be divided between two still somewhat ambiguous operational areas: operation & maintenance, and government actions. For the category operation and maintenance, supposedly 10% of

the 24% will be designated. For the category of government actions, the other 14% of the 24% will be allotted. We hope to get better a better understanding of the types of activities and related projects and actions that will be part of these categories in the near future.

The following table shows a sample of the budgets and percentages from the 76% of the “project” related budget mentioned above.

Main Objectives (76%) and Related Required Investment			
Objectives	Percentage	Investment (Trillion Pesos)	Investment (Billion USD)
1. River Basin Equilibrium	44%	\$348	\$25.7
2. Universal Coverage	27%	\$215	\$15.9
3. Clean Rivers	15%	\$114	\$8.4
4. Habitable areas protected from floods	13%	\$107	\$7.9
Total	100%	\$784	\$57.9

There exist somewhat specific lines of action for each one of the four main goals, actions that were not defined prior to the 2011 modifications. With regards to point 1 ((River Basin Equilibrium), \$18.3 billion US will be designated to help diminish water demand while \$7.4 billion USD to increase water supply. As a result, water reuse has to become an unwritten priority for the adjusted 2030 Water Agenda, especially when one realizes that currently 15% of Mexican aquifers are considered overexploited, a figure that will reach 25% by 2015, and that many of these aquifers already have high contamination levels.

In relation to point 2 (Universal Coverage), \$9.4 billion US will be assigned for the further expansion of potable water networks and

\$6.5 billion USD for expansion of sewerage networks. The expansion of both networks are important actions if Mexican authorities truly want to meet publicized total, national coverage percentage goals.

In relation to point 3 (Clean Rivers), \$8.4 billion US will be assigned to the construction of wastewater treatment infrastructure. Opportunities in this area should directly impact companies supplying all types of wastewater treatment equipment as well as those handling disinfection systems. Finally, in relation to point 4 (Habitable Areas Protected from Catastrophic Floods), \$7.9 billion US will be assigned to increase equipment and systems for this important, troublesome, and politically sensitive objective.

Comments and Opinions about the Viability of the New Priorities

Analyzing the goals and the new time groups for the Agenda 2030, we found some anomalies and surprises that we would like to mention.

“Before 2030” Group – Of the 3 goals that remained as priorities for “before 2030”, we consider that 2 of them will not be possible to accomplish by 2030: (a) all municipal waters treated, and (b) all the irrigation areas technified. With between 35% and 45% of municipal waters currently treated depending on who you speak to and with the still limited efforts and commitments to creating treatment coverage in medium and small size cities, we do not feel that 100% municipal treatment coverage during the next 18 years or three Presidential administrations is realistic. Considering that there are still 6.5 million non-technified irrigation hectares, we do not feel that it is likely that the goal of 100% coverage is likely by 2030. Therefore, two of the three priorities still targeting a “before 2030” time frame need to be downgraded to a post 2030 date and as a result, we feel that the investment in these two areas will not live up to expectations.

“After 2030” Group - In this group, there are 5 goals, 3 of which we think should be lowered to “undefined” or tertiary priorities: (1) treat all industrial wastewaters, (2) all aquifers in balance, y (3) viable, fully functional local water agencies. Considering that CONAGUA says that only 19% of industrial waters destined for federal water bodies are currently being treated and that no one knows the percentage of treatment for municipally dumped industrial waters, and considering that Conagua does not seem to be making serious investment or regulatory commitments in this area, we think that one cannot consider 100% treatment of industrial wastewaters as even a secondary priority in Mexico and that this is an area that we hope is readdressed and elevated with the new 2012 Presidential administration. In relation to the second point and considering how problematic municipal and industrial treatment goals are, we feel that it is impossible to assign a realistic time frame for all aquifers being in balance. Finally, in relation to the third

point, considering that infrastructure efficiency of the water segment is 76th in the world and well below Argentina, Brazil, Chile, and Colombia and below Peru, we don't see how Mexico is going to make this type of a leap nor do we see the funding or internal regulatory commitment by Conagua to make this a secondary rather than a tertiary priority in the modified 2030 Agenda.

“Undefined” Group - This group has 6 goals and somewhat surprisingly, we believe that 50% should actually be classified as a higher, secondary rather than tertiary priority (as “after 2030”). These three goals not only have high urgency but they also appear to be areas with relatively feasible solutions. In our opinion, creating alert and prevention systems with high technology and all flood zones free of human settlements while not simple should not be so complicated that we have to describe them as priorities that can't be assigned a defined compliance period. Also, we find it unacceptable that the Mexican authorities are not making this a higher priority considering the more than \$1 billion US in damages that have affected almost 8 million Mexicans because of storms and floods, problems that have happened yearly for decades without acceptable remedies and solutions. The third area, the reuse of all treated waters, seems like something that can and should be a higher priority and a priority with viable medium-term solutions. If Mexico wants to ensure that overexploited aquifers do not reach 50% or more by 2030 and that Mexico has sufficient potable water supply 20 years from today, water reuse has to be a much higher priority. And, if Mexico currently reuses more than half of its treated water and is the second country in the world for the reuse of non-treated residual wastewater, Mexican authorities should be able to visualize a time frame (rather than describing this as “undefined”) and be able to carry-out a medium-term, adequately funded and regulated program to accomplish this important goal.

Conclusions

The 2030 Water Agenda started as a very ambitious program and as a result it very quickly became evident that the objectives of the Agenda were going to be extremely difficult if not in some cases impossible to meet. The 2011 Agenda modifications and attempts to better quantify actions related to these goals and objectives were an important step to ensure that this Agenda did not simply become an irrelevant academic exercise. The modifications will allow for a more realistic approach to many of the most urgent water problems and re-establish priorities according to the realities of the segment and available funding. Also, prior to these modifications, there existed no serious attempts to estimate the required funding to achieve these goals something that deserves recognition. And while it is good that CONAGUA has succeeded in separating and reprioritizing goals into three tiered groups, these groupings as they currently stand are almost meaningless and offer us little or no insight into how secondary priorities are distinguishable from lower, tertiary ones. As a result, it is imperative that sometime in the first half of 2013, the new Presidential administration and the new leaders in CONAGUA study these problems and assign clear but realistic dates to these objectives and not continue to accept or work with

vague time frames such as “after 2030” or even worse “undefined” for these urgent and underfunded water segment goals and solutions.

Water Reuse in Mexico

In terms of wastewater reuse in agriculture, Mexico is second leading country in the world – but this is hardly an accolade since we are referring to untreated wastewater. 80% of the wastewater that is reused in Mexican agriculture is not treated and its use is highly unregulated. While rain water reclamation projects at government levels are at infant stages here, Mexico is making some strides with strategies and efforts to reuse treated water. Two reasons for this change are related first and foremost to the scarcity and then the price of potable water. While residential potable water prices remain extremely low in Mexico, the prices that companies have to pay is increasing significantly, supposedly increasing annually greater than inflation for the first time in Mexico`s history. Also, while the southern states in Mexico have over 15,000 m³ of per capita water, in the northern and central states per capita water is only 500 and 1700 m³ respectively which demonstrates the water stress severity outside of south, where 75% of the population lives and where 87% of the Mexican economy is located.

Reuse of Non-Treated Wastewater

The use of non-treated wastewater in agriculture is practiced today in more than 50 countries and irrigates a surface of 10% of the total cultivated surface on the planet. These practices are becoming more common place in countries in Africa, Asia and Latin America, allowing these governments to save on the cost of pumping subterranean water and at the same time saving the aquifers from over exploitation. In many cases, the construction of expensive hydraulic works for transport, extraction and distribution of water for irrigation also can be avoided or lessened.

After China, Mexico es the second country in the World for reuse of wastewater for agriculture, ten times more than in the US, four times more than India and three times more than in the 10 next countries (see table below). In Latin America, Mexico is the country with the largest number of hectares irrigated with non-treated wastewater. The National Water Commission (CONAGUA) estimates that in 2009, 350,000 hectares were irrigated using 160 m³/sec. of non-treated municipal and to a less extent industrial wastewater with some superficial waters.

COUNTRY	HECTARES IRRIGATED
China	1,330,000
Mexico	350,000
India	85,500
South Africa	18,000
Chile	16,000
United States	11,875
Australia	10,000
Israel	8,800
Peru	6,800
Tunisia	4,450
Argentina	3,700
Saudi Arabia	2,850

There are more than 30 major cities in Mexico where local agricultural irrigation depends on the wastewater it generates. All of these cities are located in the north or central parts of the country:

North - Monterrey, Obregón, Chihuahua, Cd. Juárez, Camargo, Delicias, Jiménez, y Ojinaga.

Center - Durango, Guadalajara, Aguascalientes, Morelia, Puebla, Querétaro, Tula/Valle de Mezquital.

The Valle del Mezquital in Hidalgo, is the largest agricultural area in the world (over 130,000 hectares) irrigated with untreated wastewater, all of it coming from Mexico City.

While water reuse standards exist, these regulations have very limited application to non-treated water for reuse. And where they do apply, enforcement is negligible or completely absent. While non-treated waters are only supposed to be used to irrigate grains and similar products that do not absorb the water and its nutrients, it is almost impossible for authorities to ensure that such waters are not been used for vegetables and fruits and there appears to be a dearth of moral authority that might provoke some better oversight in this area.

Water Reuse Dynamic - Limited Water Supplies and Low Prices

Currently, subterranean water is used for the following purposes in Mexico: (1) the irrigation of two million hectares (a third of the total irrigated surface), (2) the supply of almost 75% of the total water volume required in the cities for public-urban use servicing 55 million people, (3) the supply of most industrial installations, and (4) to satisfy almost all rural water demand. 75% of the water volume required for cities comes from subterranean waters, and the main cities of the country are supplied at the expense these overexploited aquifers and to a lesser extent from other surface sources. Nonetheless, according to Conagua, 104 aquifers or 15% of the total are already considered to be overexploited and by 2015, 25% of all national aquifers will be considered overexploited. Said overexploitation has been caused by limited water sources in the the north and center areas and because of the lack of treated water which has led to a less than efficient and effective program for treated water reuse.

In 2003, the price of treated water in Mexico varied from \$1.48 to \$5 pesos per cubic meter (m³) depending on the level and type of treatment. In comparison, the cost of potable water fluctuated between \$2.5 to \$14 pesos per cubic meter depending on the region. While we were unable to confirm current treated water prices, the general consensus was that it is about 50% of the cost of residential water. With that context, it is important to analyze 2010 residential and industrial water prices. In Mexico City, residential water cost about 5.26 pesos per m³ (assuming 30 m³/month consumption) or about 45 cents US while industrial water prices were almost 4 times

higher at 20.16 pesos or about \$1.85 US. Prices in Guadalajara seem to be very similar to those in Mexico City. Meanwhile, residential water prices in Monterrey were almost double those of Mexico City while for some reason their industrial prices were about 2/3 of Mexico City at 14.39 pesos. The most expensive water in Mexico was found in Tijuana (37 pesos or over \$3 US for residential or industrial water) followed by Leon, Morelia and Aguascalientes (residential: 25-28 pesos, industrial: 32-35 pesos).

If indeed treated water costs are half of potable residential water costs, then they are probably a third of industrial potable water costs. This cost differential would seem to offer significant cost savings to businesses that use a significant amount of water and do not require high quality water sources for their manufacturing processes. However, we are not uncertain if delivery costs are included in these reuse figures. And, despite the above mentioned savings associated with water reuse, residential and even industrial potable water prices are still too low relative to reuse prices to properly stimulate more effective and comprehensive water reuse at this time. These price realities together with the Mexican government's willingness to use and dependence on untreated water in agriculture (80% of reuse water for agriculture is untreated) creates disincentives for companies, municipalities, and farmers to seriously turn to water reuse strategies.

Water Reuse Activities

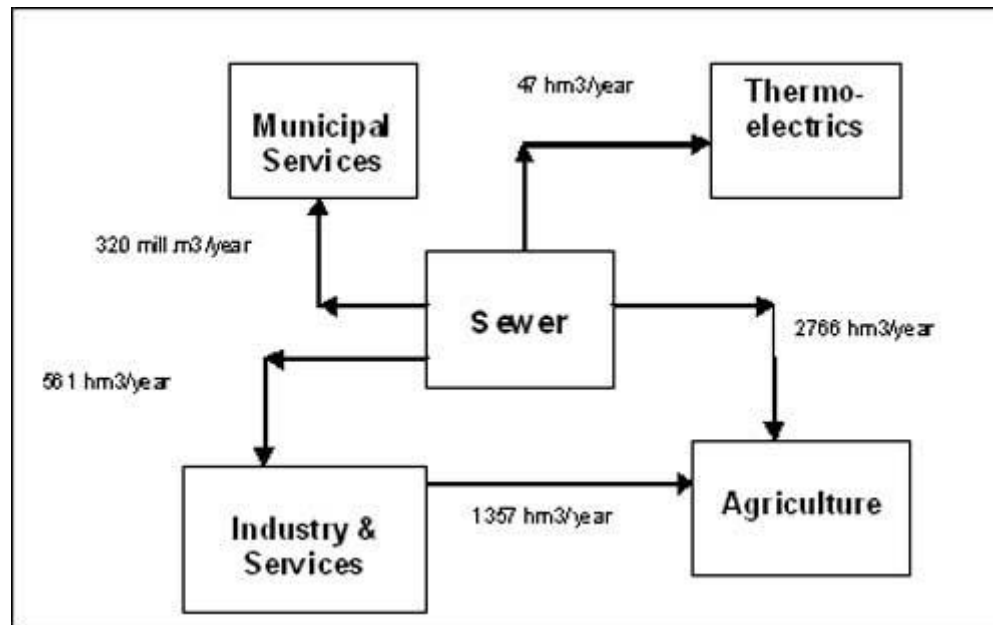
Treated water reuse is mainly carried out in large cities and areas with greater water requirements and water scarcity like in the north of the country. Treated wastewater has several applications. In industry, it is used extensively for cooling and washing in production processes. Treated wastewaters are also used in recreational applications like fountains, lakes and other water channels. Or course, a large amount of water reuse ends up in agricultural activities. And, it is worth mentioning that in most of Mexico, there is either extremely inconsistent or no vigilance over water quality and reuse activities for treated reuse water.

Reused water quality levels and water reuse activities are regulated by two standards or NOMs. NOM-001-ECOL-1996 regulates discharges into federal bodies and includes important detail about permissible limits for pollutants for water reuse activities. NOM-003-ECOL-1997 deals exclusively with wastewater reuse including the conditions and criteria for sampling, testing, disposal, and parameters for fecal coliform and helminth eggs. Together, these standards establish the maximum permissible limits of chemical and biological pollutants in surface water bodies for reuse activities.

While NOM 003 is known as the water reuse standard for Mexico, NOM 003 depends extensively on the parameters established in two tables in NOM-001-ECOL-1996. These parameters are based on two categories: (1) place of disposal and reused water

use/activity, and (2) quantities of pollutant/water characteristics. The place for disposal includes rivers, natural and artificial reservoirs, coastal waters, or directly into the ground. Use or activities includes the following activities: irrigation, public use, urban use, aquatic life protection, fishing, recreation, estuaries and wetlands. The quantities of pollutant and water characteristics, at the moment of disposal, include: temperature, oils and fats, settled solids, TSS, BOD, nitrogen, phosphorous, arsenic, cadmium, cyanide, copper, chromium, quicksilver, nickel, lead and zinc. It is worth mentioning that the pollutants and water characteristics are sampled in milligrams per liter either based on a daily or a monthly average. If you are interested in a translated copy of NOM-001-ECOL-1996 to further review the parameters for each disposal location and activity, please contact us.

Below there is a graphic that shows the sources and uses of the reused wastewater in Mexico in 2009. During that year, 5,051 million cubic meters were reused, equivalent to 160 m³ per second. Of the total volume reused, 3,694 million, or 73%, came from municipal wastewater sources while 1,357 million or 27% came from industry and services. 74% of the total municipal wastewater volume was used in agriculture, 16% was used by industry, 9% for municipal services, and the remaining 1% for power generation. 100% of the treated and reused wastewater from industry went to agriculture.



Estadísticas del Agua 2010-CONAGUA

According to information from a 2003 studied carried out by IMTA (Mexican Institute for Water Technologies), of total treated wastewater, around 33% was used for agricultural irrigation. The states that used more treated wastewater for irrigation (crops and green areas) were the State of Mexico, Queretaro, Baja California Sur, the Federal District, Michoacan and Puebla. While things could have changed during the last 9 years, in 2003 the states of Campeche, Chiapas, Colima, Guerrero, Morelos, Tabasco, Tlaxcala, and Yucatan did not reuse any treated wastewater. At that time and probably still, the states Nuevo Leon, State of Mexico and Coahuila were leaders in the use of treated wastewater for industrial applications, the most important reuse area in Mexico. In fact, these three states industrial reuse volumes represented almost 30% of total reuse in the country. Treated water used in green areas irrigation was the second priority, representing almost 20% of the total. The states that reused more water for this purpose were Quintana Roo, San Luis Potosi, Nuevo Leon and the Federal District.

Treatment and Reuse per State

According to information from CONAGUA, in 2009 the following 5 states had the largest volumes of treated water:

STATE	VOLUME
Nuevo León	10,877.2 l/s
Chihuahua	5,937.3 l/s
Baja California	5,620.0 l/s
Estado de México	5,190.3 l/s
Sinaloa	4,574.3 l/s

For obvious reason, wherever there is more treated water, one will find more treated water reused. It is worth noting that these states, except for the State of Mexico, are located in northern Mexico, the driest part of the country where there are severe problems with the water supply, surface waters contamination, overexploitation of aquifers, high water costs. As a result, in the arid north, reuse is not just a profitable option, it is a necessary one.

The 4 states with the lowest volume of treated water are:

STATE	VOLUME
Yucatán	82.0 l/s
Campeche	97.3 l/s
Hidalgo	289.2 l/s
Zacatecas	644.6 l/s

Two of the these four states (Yucatan and Campeche) are in the south of the country where there are almost no water supply problems, where per capita water is more than 15,000 cubic meters, the highest in the country and one of the highest in the world. As a consequence, the practices of reuse is not promoted nor needed in the south. In the case of Hidalgo and Zacatecas, even though their treatment numbers are not as low as those in the southern states, their volume of water treated is in terms of installed treatment capacity - 88% for Hidalgo and and 86% for Zacatecas. Nonetheless, treatment volumes in Hidalgo and Zacatecas respectively represent only 3% and 6% of the total volume treated in Nuevo Leon. Obviously, the level of wastewater infrastructure in these two states is very low and unquestionably insufficient. And, as mentioned earlier, if Conagua was stricter about the reuse of non-treated waters for agriculture where it is a world leader, it would have a distinct incentive to treat more water which would allow them a greater and healthier source of water for reuse.

Artificial Recharge of Aquifers and Its Regulations– A Start

When discussing how to deal with overexploited and contaminated aquifers, artificial aquifer recharge is a topic that Mexican water authorities and organisms have been discussing more and more. In fact, during the last decade, CONAGUA published two NOMs (NOM 014 and NOM 015) related specifically to the process of injection of water into aquifers which we describe in greater detail below. While CONAGUA is considering this alternative as a future solution for aquifer overexploitation, the reality is that it is being carried out in mostly pilot projects only and at relatively insignificant volumes. Aquifer recharge is an alternative that will require large investments to be significant and viable in helping solve Mexico's aquifer overexploitation and contamination problems. And, it will have to compete against other, probably higher priority and less expensive water projects which will probably make it viable only in the medium-to-long term.

Nonetheless, CONAGUA has started the construction of two major wastewater treatment plants in the State of Mexico, El Caracol and Zumpango, whose purposes will be, amongst others, artificial aquifer recharge. Supposedly, within three, these two plants will be fully functional and functional with recharge activities. Once El Caracol plant initiates operations, it will begin to recharge one cubic meter per second into a nearby aquifer, representing 31.5 million cubic meters a year of treated wastewater recharge. CONAGUA is also working in feasibility projects and exploration of the best locations for artificial aquifer recharge, especially in the metropolitan area of Mexico City where the problem is persistent and becomes more serious every day with the rising water demand of its more than 25 million inhabitants. Also, CONAGUA is currently pushing for the construction of five catchment wells in the southern part of the Valley of Mexico where it has been determined that these types of wells would be feasible

Concerning the regulation of this process, the above mentioned artificial recharge NOMs establish the mandatory guidelines for the aquifer recharge. NOM-014-CONAGUA-2003 provides the requirements for the recharge with treated wastewater while NOM-015-CONAGUA-2007 provides the regulations regarding the characteristics and specifications for the water being injected and the systems and procedures employed. Unlike NOM 001 which only deals with discharges into federal bodies and unlike NOM 002 which only deals with discharges into municipal bodies, NOMs 014 and 015 are applicable nationwide and establish the requirements that authorities must comply with regarding water quality, operation, and monitoring of aquifer recharge processes using treated wastewater.

Current Projections for Wastewater Reuse in the Valley of Mexico

Currently, the Mexico City metropolitan area generates more than 40m³ per second of wastewater. There is installed capacity for the

treatment of only 25% or 10m³ per second and only about 12.5% or 5.2 m³ per second is actually treated. Unfortunately, the great majority of these wastewaters waters are simply returned to drainage channels and sent to the State of Hidalgo without treatment. Despite this situation, the treated wastewater in the Valley of Mexico is used extensively for filling channels and lakes, metropolitan agricultural and green area irrigation, parks and gardens, and of course industrial reuse. Mexico City's most important and one of its oldest wastewater treatment plants, Cerro de la Estrella, generates a large portion of this treated water supply. Since the 1950's it has been the most important source of treated water to help maintain the drying Xochimilco lake areas in the southern part of the city.

The Mexican Fund for Preservation of Nature, a non-profit research organization based in Mexico, has carried out a detailed study of the potential uses for current treated wasters from the Valley of Mexico, by volume, location and required water quality. The below the table describes these options and gives us a glimpse of how treated wastewater can and should be used in the future in Mexico's most important urban area.

Activity for Reuse	Vol. (m³/s)	Location	Quality Required
Agricultural Irrigation	23.0	Agricultural land over recharge zones in north, east and south Valley areas.	Medium to low
Municipal and Industrial reuse	7.5	Local plants throughout the metropolitan area	High to medium
Infiltration lagoons	7.5	Recharge zones in north, east and south Valley areas	High
Expand small agricultural and lake areas	2.0	Southern and Western areas: Xochimilco, Tláhuac, Texcoco	Medium

Wells for the injection of treated waters	1.0	Recharge zones in north, east and south Valley areas	Very high
Total	41		

It is important to mention that Mexico City, despite being the area with the highest water demand in the country, does not have a solid reuse program. It also does not have currently have sufficient infrastructure to treat all of its wastewater to help avoid the further deterioration of its subterranean and close to surface sources. Monumental works like the Atotonilco wastewater treatment plant and the Tunel Emisor Oriente – TEO (East Issuer Tunnel) demonstrate the need the city has to make a better handle and make use of its water resources including its wastewater resources.

However, these mega projects only provide a partial solution to the Mexico City's large and vast water problems. We are still left without sufficient treated water supply for the reuse demand that could and should exist. For example, once the Atotonilco plant comes on line, the great majority of the wastewater in the Valley of Mexico will be conducted through the TEO to the edge of the Valley and on to Atotonilco technically to the north of the Valley of Mexico. One has to ask whether the Mexican authorities want to return the treated water from Atotonilco to Mexico City for its resue needs and how and at what cost this will happen. Hidalgo will probably want to continue to use this wastewater source for agriculture as it has done for decades. However, in that case, one has to ask where the most important urban and industrial center in Mexico will continue to find access to sufficient reusable water sources?

Conclusions

Although water demand and the amount of wastewater in Mexico increases daily at almost exponential levels, there currently does not exist a serious reuse program capable of satisfying demand and seriously addressing the overexploitation of superficial sources and aquifers. Even though the reuse situation is not close to being what it should be in the Mexico City metropolitan area and while reuse in the south is practically non existent, it is important to point out that cities like Monterrey, Torreon and Ciudad Juarez in northern Mexico have implemented treated wastewater reuse as an important basis for their current and future development. The extreme weather in the region, the low water availability, the urban concentration and the high industrial activity of these cities require significant reuse measures and have so for sometime. Let's hope that central Mexico water stress does not reach northern Mexican levels before Conagua and central Mexican state and municipal governments make the necessary commitment to water reuse.

As mentioned above, without higher potable water prices and more subsidies for treated water, it will be very difficult to effectively promote water reuse. Simply put and despite inevitable, initial political backlash, prices have to go up and Mexican residents, municipalities and businesses have to begin to understand and accept that water does not “grow on trees” and is a commodity that they have to pay full price for. Without this change, water reuse will not play the role that is needed in aquifer overexploitation prevention and we will all suffer in the medium term if not the short term.

The Mexican authorities are recognizing current water supply problems. Projects like Atotonilco and el Caracol in the Valley of Mexico and el Ahogado in Guadalajara are mega projects meant to at least partially address these problems. Pilot projects and programs focused on infiltration of treated waters directly into aquifers are some examples of this commitment. However, Conagua and Mexican municipal and state water agencies have to come up with a more extensive if not comprehensive reuse program if they are going to solve their aquifer problems. Without such a program and adequate funding, these mega project measures will not make significant dents in the problem nor become significant, medium-to-long term water reuse drivers.

Water Quality Problems and Challenges in Mexico

The lack of confidence in Mexican potable water supply and in general superficial water sources has caused the country to position itself as one of the major consumers of bottled water in the world utilizing 234 liters per capita, one of the highest in the world. Naturally, over 80% of Mexicans are not satisfied with the water quality coming into their homes and don't drink it fearful of contracting diseases because of the lack of treatment and aquifer pollution. Water quality is also affected by water pollution problems from somewhat uncontrolled municipal and industrial discharges and the insufficient monitoring and low compliance with related regulations. Furthermore, it is important to mention that in 2010, according to the United Nations Development Program, Mexico was 106 out of 122 countries in water quality.

NOMS for water quality in Mexico

There are 3 NOMS or Mexican norms that regulate water quality in the country: NOM-127-SSA1-1994, NOM-179-SSA1-1998 and NOM-230-SSA1-2002. NOM-127 establishes the bacteriological and physical chemical limits for human consumption, NOM-179 regulates the surveillance procedures that water authorities must meet to remain in compliant with NOM-127, and NOM-230

establishes the sanitary requirements that public and private supply systems must meet. To obtain results and compliance information on these 3 NOMS, Mexico has a water quality monitoring network.

National Water Quality Monitoring and Laboratory Networks

To monitor and help control the water quality of surface water, Mexico has a National Monitoring Network with 1,510 test sites divided in 4 networks: primary, secondary, special studies and ground water reference. These sites are also divided or classified according to the applicable water source: surface bodies, coastal zones and ground waters. According to CONAGUA officials, in order to properly monitor BOD and COD indicators, Mexico needs to at least double the number of monitoring sites, something that Conagua says is a medium term if not a short term priority.

National Networking Monitoring Locations		
Network	Area	Number
Primary Network	Surface Bodies	220
	Coastal Zone	78
	Ground Water	150
Secondary Network	Surface Bodies	272
	Coastal Zone	23
	Ground Water	45
Special Studies	Surface Bodies	162

	Coastal Zone	53
	Ground Water	409
Ground Water Reference Network		98
Total		1510

Mexico also has a national laboratories network composed of 13 laboratories located in major water basin administrative centers and 15 laboratories located in state Conagua offices located outside of these basins. These 2 networks monitor the levels of physical chemical and bacteriological substances. In order to assist with this problem, in 2012 Conagua will begin to implement a 5 year program to subcontract an important part of the monitoring responsibilities to private companies/laboratories that will allow for the monitoring and measurement of all of the substances currently mentioned in the different Mexican wastewater and potable water regulations. With additional monitoring it is expected that more problems will be detected and new and higher fines will be issued which hopefully will lead to a greater and more dynamic demand for wastewater equipment and technology.

Mexico Water Quality Monitoring Results: BOD, COD, and TSS

To evaluate the water quality of surface bodies and determine the organic matter quantity in water bodies, 3 main indicators are used in Mexico: BOD, COD and TSS. The BOD indicator (Biochemical Oxygen Demand) measures the quantity of oxygen needed for a given organism to oxidize the organic matter. COD (Chemical Oxygen Demand) measures the total chemical oxidant which consumes organic matter. The TSS indicator (Total Suspended Solids) measures the capacity of a water body to support diverse aquatic life. Below is a table with the number of monitoring locations for each one of these indicators, virtually all of which are located in high human impact (anthropogenic) areas.

Number of Monitoring Locations	
Water Quality Indicator	Locations

BOD	605
COD	646
SST	744

BOD

According to Conagua authorities, of the 3 indicators, BOD is of the most concern in terms of the level of contaminants and toxicity. Based on monitoring results from the BOD monitoring sites, 7.9% of national water is considered “contaminated” and 4.6% is considered “highly contaminated”. This is especially the case in central Mexico where 75% of Valley of Mexico water region is “contaminated” or “highly contaminated”. Likewise, the other three river basin regions in Central Mexico, Lerma-Santiago-Pacific, Balsas and Central Gulf, have 15-18% of their water supplies “contaminated” or “highly contaminated” with BOD. In the north, there are two river basin regions with BOD problems, Rio Bravo and Baja California’s peninsula where respectively 20.6% and 18% of their waters are considered to be “contaminated” or “highly contaminated”.

However, there are some regions with positive results. 41% of the waters in the national network had “excellent” quality according to the monitoring done for this indicator. Over 70% of the waters in seven of the thirteen major river basins have “excellent” or “good” BOD water quality and 5 basins (Yucatan Peninsula, North Central, North Gulf, North Pacific, and South Border) have “excellent” or “good” quality in over 80% of their waters.

Distribution Percentage of monitoring locations in surface water by Water Region according to BOD Indicator						
River Basin Regions		Excellent	Good	Acceptable	Contaminated	Heavily Contaminated
I	Baja California Peninsula	27.3	9.1	43.5	13.6	4.5

II	North East	50	26.5	23.5	0	0
III	North Pacific	70.7	12.2	17.1	0	0
IV	Balsas	16.6	23.8	41.7	13.1	4.8
V	South Pacific	0	0	0	0	0
VI	Río Bravo	48.6	46.2	2.6	20.6	0
VII	North Central Basin	90	10	0	0	0
VIII	Lerma-Santiago-Pacific	48.7	9.3	24	12.7	5.3
IX	North Gulf	80.9	11.9	4.8	2.4	0
X	Central Gulf	0	70.3	13	11.1	5.6
XI	South Border	0	86.1	13.9	0	0
XII	Yucatán Peninsula	90	0	10	0	0
XIII	Valley of Mexico	40.2	0	20.8	25	50
Total		41	26.8	19.7	7.9	4.6

The Mexican states that count with good water quality in terms of BOD are Jalisco, Nuevo Leon, Tamaulipas, Veracruz, Aguascalientes, Chihuahua and Baja California. According to the results of monitoring by state, the states that most require treatment

for BOD are the Federal District and the State of Mexico (Valley of Mexico and Valley of Toluca), Guanajuato and Tlaxcala where monitoring sites are detecting over 30mg per liter of BOD. All of these states are located in the central part of the country where most of the population and industry are concentrated. In summary, two-thirds of water samples tested for BOD are classified as “good”, over 85% fall within the “acceptable” range (“Excellent”, “Good”, or “Acceptable”) while 12.5% were not acceptable (“contaminated” or “heavily contaminated”). These are better test results than those obtained for COD but considerably higher than those for TSS.

COD

BOD is an important indicator of the toxicity levels in Mexican Waters. According to monitoring results, it is the only indicator that does not have at least two-thirds of its sample results as “excellent” or “good”, with only 50.4% reaching these higher levels and less than 60% reaching the minimum acceptable classification of “acceptable”. The table below shows the results of the monitoring for BOD, demonstrating that 23% of national surface waters are considered “contaminated” and 7.5% “highly contaminated”. Again, the Valley of Mexico water region is the most contaminated in the country with 54% considered “highly contaminated” and 23% “contaminated.” As a result, less than 25% of the Federal District and State of Mexico water supply can be considered appropriate for human use.

Distribution Percentage of monitoring locations in surface water by Water Region according to COD Indicator						
River Basin Regions		Excellent	Good	Acceptable	Contaminated	Heavily Contaminated
I	Baja California Peninsula	4.5	0	13.6	68.2	13.7
II	North East	43.5	17.7	24.2	14.5	0.1
III	North Pacific	11.7	41.2	11.8	35.3	0
IV	Balsas	9.5	21.4	27.4	28.6	13.1

V	South Pacific	96	0	4	0	0
VI	Río Bravo	51.6	39.8	1.1	7.5	0
VII	North Central Basin	25	30	45	0	0
VIII	Lerma-Santiago-Pacific	4	17.3	26.7	42	10
IX	North Gulf	55.6	22.2	11.1	6.7	4.4
X	Central Gulf	39.6	8.3	22.9	25	4.2
XI	South Border	16.6	50	13.9	13.9	5.6
XII	Yucatán Peninsula	55	30	10	5	0
XIII	Valley of Mexico	4.1	0	12.5	29.2	54.2
Total		28.3	22.1	18.6	23.5	7.5

In addition to the Valley of Mexico problems, we found similar problems with other river basin regions in central Mexico. There exist serious COD pollution problems in the Lerma-Santiago-Pacific river basin region and in the Balsas river basin region where 50% and 42% of the waters respectively are considered “contaminated” or “highly contaminated” with COD. Likewise, much of the waters in northern Mexico have COD contamination problems. For example, 80% of the water in the Baja California river basin region is considered “contaminated” or “highly contaminated” with COD, and 35% of the North Pacific river basin region is considered “contaminated.”

The Mexican states that have good water quality in terms of COD are Nuevo Leon, Tamaulipas, Veracruz and Queretaro. There are 10

states with important problems where average sampling generate results with over 40mg per liter of COD: the Federal District, State of Mexico State (Valley of Mexico and Valley of Toluca), Jalisco, Guanajuato, Baja California, Aguascalientes, Chihuahua, Puebla and Tlaxcala.

We should mention that relative to BOD and TSS, monitoring for this COD indicator has the highest results of “contaminated” and “highly contaminated” representing almost 1/3 of all samples. At the same time, only 28.3% of samples have “excellent” quality while BOD is 41% and SST is 53.5%. Similarly, while the not acceptable (“contaminated” or “highly contaminated”) BOD and TSS levels are 12.5% and 7.5% respectively, the COD level (31%) is 2.5 times higher than BOD levels and 4 times higher than TSS levels. It is easy to see from these figures that COD is more prevalent in water supplies than BOD or TSS and therefore why COD treatment must be a bigger priority in Mexico in the future.

TSS

Concerning TSS monitoring, contrary to the somewhat negative general levels of COD and BOD, only 8% of national waters are considered “contaminated” or “highly contaminated”. Over 50% of the waters tested had “excellent” TSS quality and over 90% are considered “acceptable” or better. Only the Valley of Mexico water basin region presents important TSS problems, with 32% of its waters being considered “contaminated” while only 48% are considered “excellent” or “good”, and only 2/3 reaching the minimum “acceptable” classification. The only state with serious TSS problems, with over 150mg per liter, is Hidalgo. This makes sense since Hidalgo has historically been the recipient of all municipal wastewater from the Valley of Mexico, the one water basin region that has TSS problems.

Distribution Percentage of monitoring locations in surface water by Water Region according to TSS Indicator						
River Basin Regions		Excellent	Good	Acceptable	Contaminated	Heavily Contaminated
I	Baja California Peninsula	68.4	18.5	5.6	5.6	1.9
II	North East	69.4	17.7	4.8	4.8	3.3

III	North Pacific	41.4	36.6	17.1	4.9	0
IV	Balsas	35.6	42.9	14.3	6	1.2
V	South Pacific	32	52	12	4	0
VI	Río Bravo	82.8	12.9	4.3	0	0
VII	North Central Basin	30	40	20	5	5
VIII	Lerma-Santiago-Pacific	35.4	38.4	15.1	7.6	3.5
IX	North Gulf	51.7	31	12.1	5.2	0
X	Central Gulf	72.1	14.8	1.9	9.3	1.9
XI	South Border	69.4	30.6	0	0	0
XII	Yucatán Peninsula	95	5	0	0	0
XIII	Valley of Mexico	24	24	20	32	0
Total		53.5	28.9	10.1	5.9	1.6

Of the rest of the river basin regions, only the Central Gulf (11.2%) and Lerma-Santiago-Pacific (11.1%) have TSS samples that surpass 10% “contaminated” and “highly contaminated” levels. In a real sense, these figures establish that on the national level, of the 3 indicators, TSS is probably the least concern. And, while the Valley of Mexico and Hidalgo are still clear areas for concern, when the Atotonilco wastewater treatment plant comes on line in the near future, it is hoped that these levels, measured following treatment,

will drop dramatically.

Mexican Beaches and Water Quality

In the case of the beaches in Mexico, a different classification is used based on the Mexican Health Secretary and World Health Organization standards that classify beaches as suitable for recreational use or not suitable. Those that are suitable have a maximum limit of 200 enterococcus per 100 ml. In 2003, the Clean Beaches Program was created to try and obtain 100% certification of Mexican beaches as suitable for recreational use. The program promotes the sanitation of beaches, basins and aquifers related the beaches. While in 2003, when the program began, only 93% of beaches met this standard, by 2009, this percentage increased to 98%. As a result, while Mexico does not have to target many more beach areas to reach the targeted 100% coverage, its real effort will have to be concentrated on having these beaches continue to meet these levels year in and year out.

Water Quality Problems and their Relation to Wastewater Treatment

In developed countries, wastewaters and surface water sources are generally kept separate. However, Mexico like many other emerging countries has a combined system that presents special challenges to keep the surface sources viable for potable water use. This combined system in Mexico presents Mexico with its greatest water quality challenges in light of the unacceptable current levels of wastewater treatment. Underground and well water quality problems are also serious issues as well but issues for a future article in the Report.

Today, only 30 to 40% of total Mexican wastewater is treated with municipal wastewater treatment somewhere between 35-45% and industrial wastewater treatment below 20%. Only 3 states (Nuevo Leon, Aguascalientes and Baja California) treat 100% of their wastewater and only 1/3 or 10 states treat more than 2/3 of their wastewaters. Of these 10 states, the five that have had important treatment increases are all in the arid north where water is scarce and water reuse is required to meet water supply needs. Another 1/3 or 11 states have treatment between 25 and 65%. The final 1/3 of states treat less than 25% of their municipal wastewaters. In this group, we find the major urban areas of the Federal District (14.4%), the State of Mexico (22.2) and Jalisco (24.1%). In the cases of three somewhat rural states - Hidalgo, Yucatan y Campeche - treatment is below 10%. The low treatment percentage in the state of Hidalgo is somewhat ironic since the Tula Valley in Hidalgo uses more untreated wastewater for agricultural purposes than anywhere else in the world.

There are currently over 2100 municipal wastewater plants and over 2100 industrial wastewater plants in the country. Also, there are

regular, annual plans for the construction and rehabilitation of 100-200 treatment plants throughout the country. However, in 2011, 204 municipal wastewater projects were programmed with funding, while only 96 were actually bid and/or executed before the end of the year. Also, the current inventory of municipal plants needs to double and the inventory of industrial plants probably needs to triple before Mexico will be able to adequately address wastewater treatment and therefore surface water contamination issues.

PROSANEAR Program – Part of the Solution

In 2007, the Federal Wastewater Sanitation Program (PROSANEAR) was created. Its purpose was to raise municipal wastewater treatment levels through the forgiveness of fines whereby municipalities would designate fine payment funds to wastewater treatment projects. A similar program exists for companies but its implementation does not have the breadth of the municipal program. The incentives of the program are granted via an establishment and carrying out of a wastewater project action program start to finish with a fully functioning plant. Conagua also offers these municipalities access to 65% federal funding from Apazu and Protar funding authorities. These incentives together with this additional funding made these vital wastewater projects feasible to many tax and money-strapped Mexican municipalities who in many cases could neither afford to pay the fines nor build the plants to eliminate the conditions creating the fines.

In 2008, 46 cities in 11 states participated in PROSANEAR resulting in the cancellation over \$5 million US in previous fines for non-treatment. In 2010, as a result of the increase in participation and actual completion of projects, these fine cancellations increased by over 600% representing more than \$30 million US. The municipalities that participated in PROSANEAR in 2008 are showed in the below table. We were unable to get a more current listing of those municipalities currently participating in the program.

Municipalities Participating in PROSANEAR (2008)	
State	Municipality
Coahuila de Zaragoza	Matamoros, San Pedro
Hidalgo	Zempoala

Michoacán de Ocampo	Morelia, Uruapan, Jungapeo, Zitacuaro, Pátzcuaro, Zamora, Lázaro Cárdenas, Tlalpujahua
Morelos	Cuernavaca, Ayala, Tétela del Volcán, Emiliano Zapata, Ocuituco, Totolapan, Tlayacapan, Temixco, Zacualpan de Amilpas
Puebla	Atlixco, Cuautlancingo, Tehuacán, Zacatlán, San Salvador El Verde, Xicotepec de Juárez, Venustiano Carranza, San Martín Texmelucan, San Andrés Cholula, Tlatluquitepec, Huauchinango
Querétaro de Arteaga	Amealco de Bonfil, San Juan del Río
San Luís Potosí	San Luis Potosí - Soledad de Graciano Sánchez
Sonora	Cananea, Guaymas, Empalme, Hermosillo, Navojoa
Tamaulipas	Cd. Madero
Tlaxcala	Zacatelco, Tepetitla de Lardizábal, Tenancingo, Xaloztoc, Contra de Juan Cuamatzi, Tetlatlahuaca

In 2009, 143 new municipalities joined the program and 30 municipalities from 2008 continued in the program for a total of 173 municipalities. In 2010, 59 new municipalities were incorporated into the program, while 83 of the 173 participating municipalities finished their projects and obligations resulting in 142 municipal participants in 2010. The states with the largest number of participants in PROSANEAR in 2010 were Michoacan (36) with over 25% of the participants followed by Puebla (20), and Chihuahua (17), Guerrero (13), and the states of Hidalgo, San Luís Potosí, and Tlaxcala (each with 9).

Without a doubt, the lack of monitoring, enforcement, incentives and severe penalties for polluting municipalities and industry contribute greatly to water quality problems in Mexico. Programs like PROSANEAR are excellent initiatives that will help to manage and control water treatment and water quality. However, in the future, programs like PROSANEAR should not be good options for municipalities, they should be obligatory programs that Conagua can effectively implement and enforce.