Houston Ship Channel Success Story

The Houston Ship Channel is part of the third largest port in the United States in terms of total tonnage (largest in foreign tonnage). It serves as the port for the largest petrochemical complex in the world. In October of 1970, however, residents of Houston and the surrounding area declared the ship channel biologically dead. Dissolved Oxygen (DO) in the channel dipped dangerously close to zero, and aquatic life proved unsustainable. Today the Houston Ship Channel has a new look. The water is cleaner, fish are thriving, aquatic plants are growing, and people are coming back to the beaches along Galveston Bay. While the Houston Ship Channel is not pristine, reclamation efforts continue to prove successful.

General Geography

The Houston Ship Channel is located within the San Jacinto River Basin in Harris County. The first 25 miles of the channel runs from the Turning Basin on its western end to Morgan's Point and then to Galveston Bay where it ends at Bolivar Road on the Gulf of Mexico. The inland portion of the channel is composed of three water quality segments, 1005, 1006, and 1007 designated by the Texas Water Commission (TWC). Segment 1005 runs from Morgan's Point upriver to the confluence of the San Jacinto River and Buffalo Bayou. Segment 1006 flows from the end of 1005 to the confluence of Buffalo and Green's Bayous. Segment 1007 extends from that point upstream to the Turning Basin, within sight of downtown Houston which is only ten miles further inland (Figure 1).

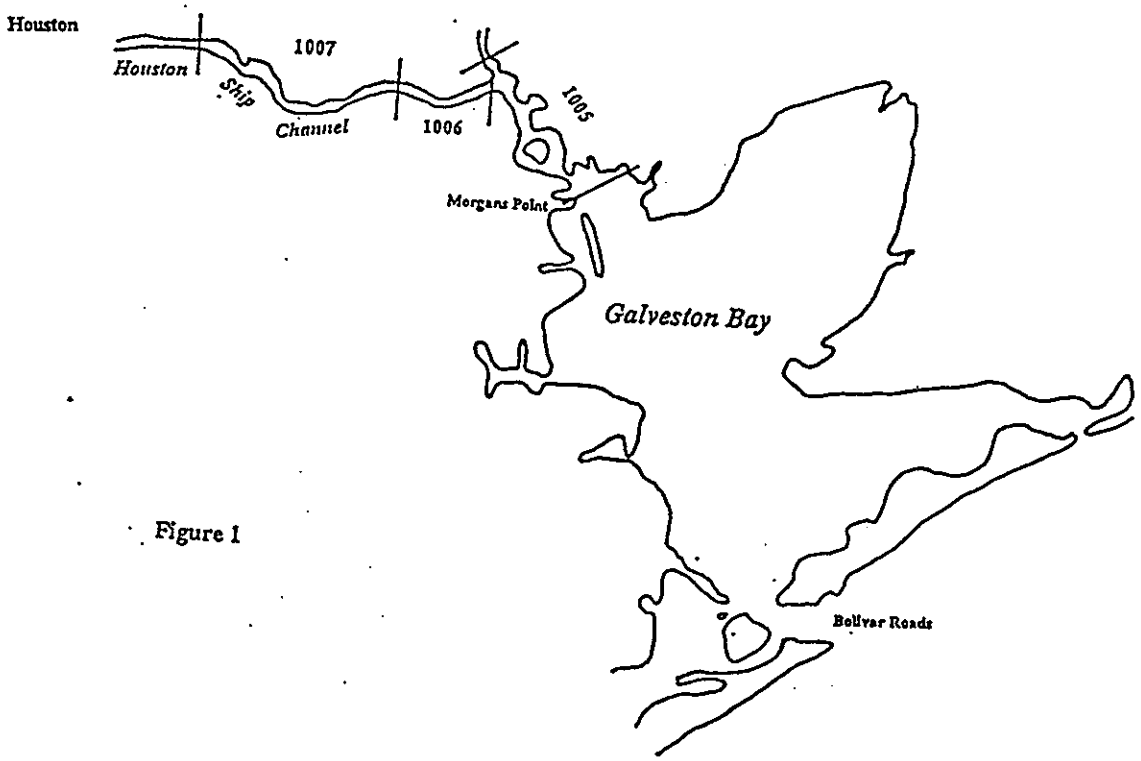

Figure 1

The channel is at present 40 feet deep and 400 feet wide. It was dredged out of portions of Buffalo Bayou and the San Jacinto River in 1914. The original channel was 25 feet deep. In 1925 the channel was deepened to 30 feet and brought to its present depth in 1966. The waterway receives fresh water from approximately 400 industrial and municipal wastewater dischargers, 13 tributaries, and the San Jacinto River.

The ship channel flows through an area that is relatively flat; from the Turning Basin, which is about 40 feet above sea level, to Morgan's Point on Galveston Bay. The average slope of the land surface is about .04 percent. Because of the lack of slope in the area the channel is an extremely slow moving body of water. It requires approximately 38 days for water to move 12 miles, an average speed of 1.15 feet per minute. Because of this slow rate of movement, it takes the upper channel a long time to flush out pollutants.

The vast majority of the landcover surrounding the Houston Ship Channel is impervious, thus causing problems with stormwater runoff. The Houston area, on average, receives 44 inches of rainfall annually. With that much rainfall there

is a high potential for a large amount of pollution from nonpoint sources to wash into the channel. Herbicides, pesticides, oil, grease, and other assorted pollutants are easily washed into the ship channel during rainy periods.

Relationship to the City of Houston

Houston's petrochemical industry, along with many other industries located along the channel, employ thousands of workers. Thus, a significant share of Houston's job base depends on port-related activities.

The Houston Ship Channel has played a very big role in Houston's growth over the last 50 years. In 1940 the City of Houston had a population of 384,000. By 1950 the population had increased to 600,000. In 1972 Houston's population had climbed to 1,341,000. Today the city's population is at 1,630,500. That means that Houston has gained an average of 1,200 people per month since 1972. That is a heavy burden to place on any municipality.

Trade through the Port of Houston has also increased since the early 1970s. While trade has been in flux throughout the last two decades, the overall trend shows an increase. In 1974 there were 4,413 vessel arrivals at the port, carrying 89.1 million tons of cargo. By 1990 that number had increased to 5,169 ship arrivals carrying 125.3 million tons of cargo (Figure 2).

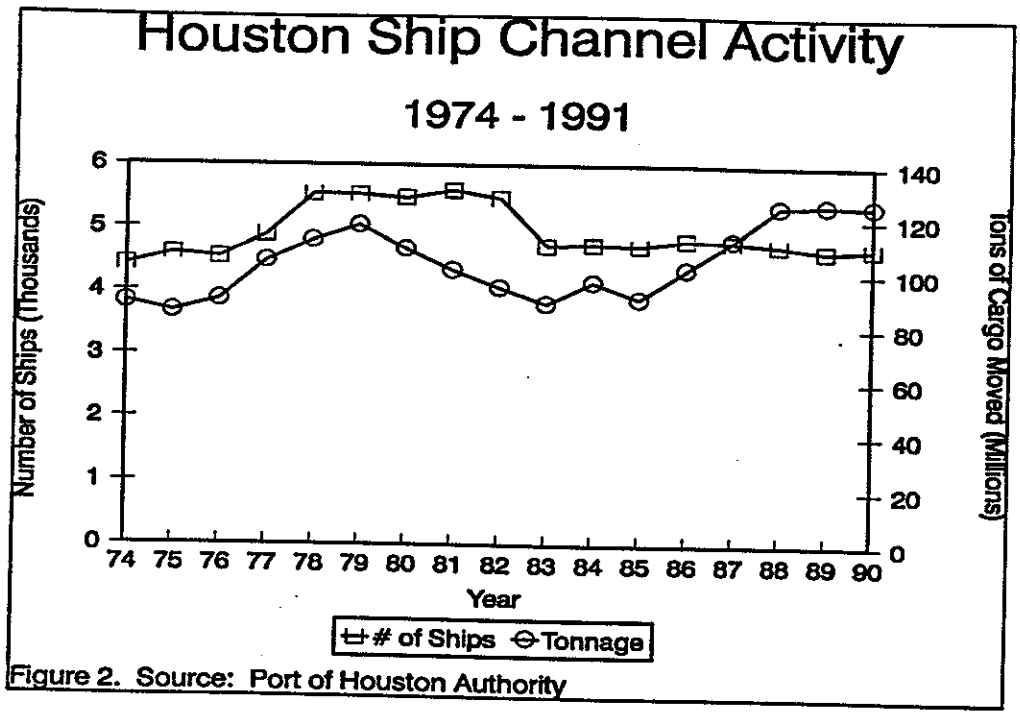

Figure 2. Source: Port of Houston Authority

Relationship to Galveston Bay

The Galveston Bay Estuarine System is the largest such system on the Texas coast. It covers 600 square miles and produces over 30 percent of the coastal fish harvest in Texas (GBF1 p. 1). The Houston Ship Channel is the Bay's largest contributor of fresh water. Any material, be it sediment, trash, chemicals, oil, etc., that the ship channel carries is emptied into Galveston Bay. The cleaner the channel becomes, the cleaner the Bay will become.

Galveston Bay is a very dynamic and complex body of water. The diversity of species found in the Bay is impressive. The Bay can accommodate this large number of different species due to its combination of fresh water and salt water. This brackish mixture supports dozens of different types of finfish and shellfish, many of which are harvested by commercial and sport fisherman year round. This diversity of fish draws a large number of waterfowl to the Bay.

Where there are birds there are bird watchers. David Marrick, a member of the Audubon Society, believes that bird watching contributes to the local

economy. For instance, when the tattler was spotted along Galveston Bay, bird watchers from all over gathered to observe this rare bird. Marrick estimates that in that one weekend the bird watchers may have contributed as much as $100,000 to the local economy.

Throughout the 1950s, 60s, 70s, and early 80s finfish and shellfish production was down in the Bay. What had once been a large producer of finfish and shellfish became only a moderate producer. And it was questionable whether the finfish and shellfish that were coming out of the Bay were edible or not. In fact, many areas of the Bay were closed to the harvesting of finfish and shellfish to protect the health of consumers. Today there are still sizable portions of the Bay where state officials restrict the taking of finfish and shellfish or at least put a limit on the quantity of fish that it is safe to consume from those areas. The Bay is still not producing the amount of finfish and shellfish that it once did, but with improving water quality conditions it is producing more and more all the time.

Historical Water Quality

Biochemical Oxygen Demand (BOD) is a significant indicator of water quality. BOD is a measure of the oxygen required by chemical reactions in the water. BOD is usually measured in mg/L, and BOD loading is measured in pounds per day. The City of Houston has decreased the BOD loading to the channel considerably, from 242,000 pounds per day in 1974 to 5,000 pounds per day in 1990. The city achieved this 98 percent reduction in BOD loading despite a 30 million gallon per day increase in flow during the same period (Figure 3).

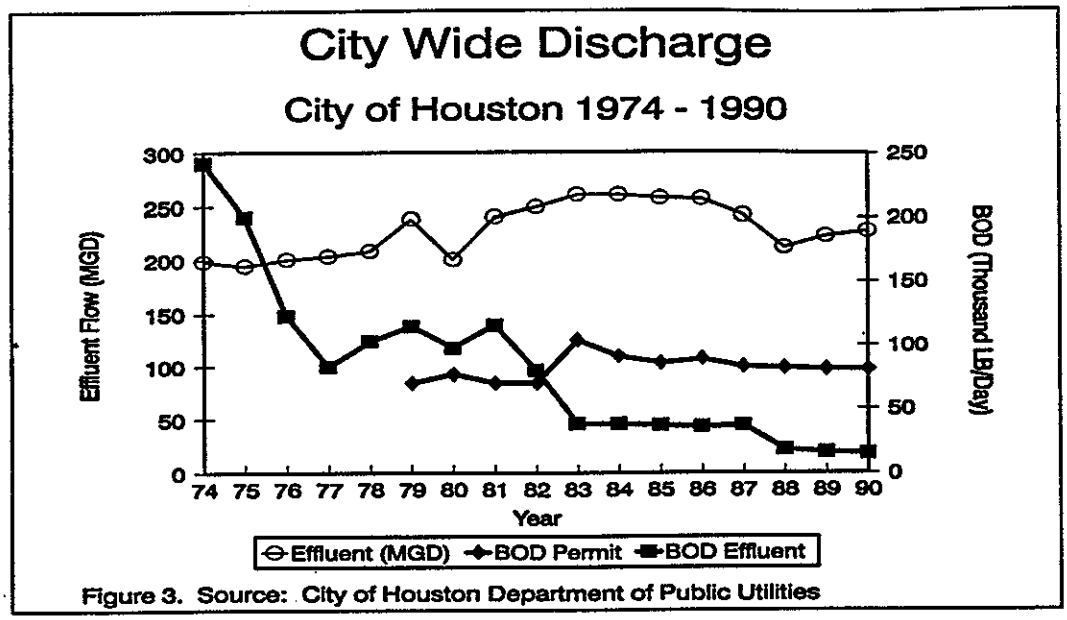

Figure 3. Source: City of Houston Department of Public Utilities

Dissolved Oxygen (DO) is another indicator directly related to BOD. The lower the BOD the higher the DO level. Another factor that effects DO is temperature. The lower the temperature the higher the DO level. Typically, the higher the DO level is in a water body, the more aquatic life it can support. This is one element the ship channel will have a hard time overcoming. Because of all the industrial discharges and the relatively warm temperatures in the Houston area, water temperatures in the channel are usually very warm. At one point in 1969 the Turning Basin had a DO level of zero, and the adverse consequences of reduced DO levels became well known. Today the DO level in the Turning Basin is approximately 5.02 mg/liter (Figure 4).

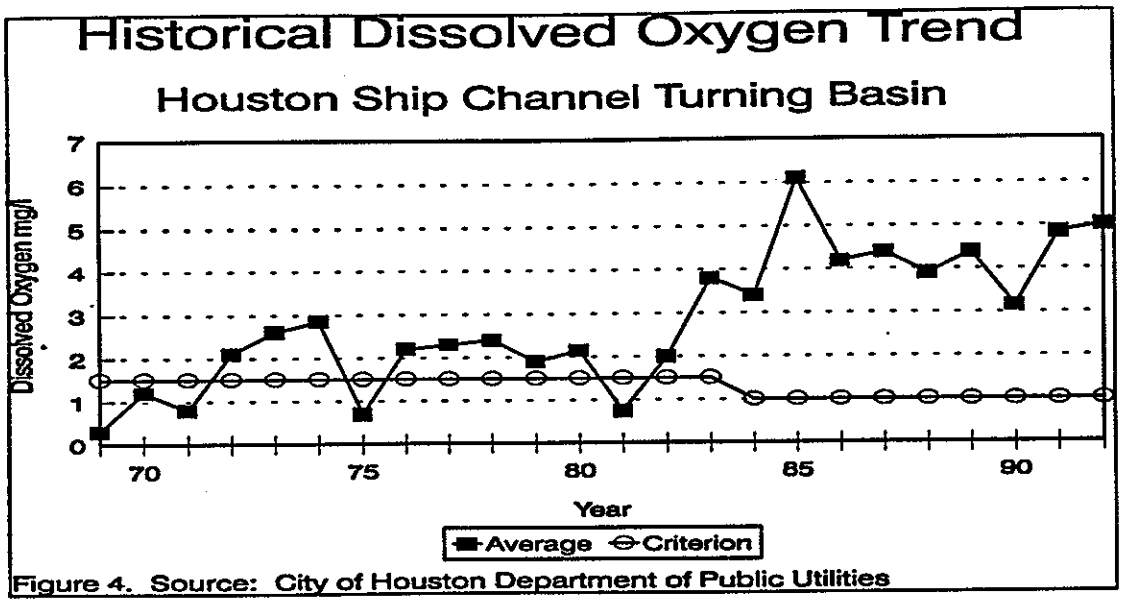

Figure 4. Source: City of Houston Department of Public Utilities

Recently the EPA completed a study that looked at trends for 27 water quality parameters. Seven of those parameters will be discussed here. The EPA study looked at sample data taken from five sample sites along the first 25 miles of the channel (Turning Basin, Greens Bayou Confluence, San Jacinto Monument, Channel Marker 120, and Morgan's Point).

The Dissolved Oxygen trend is increasing overall in the channel (Figure 5). However, the DO trend is decreasing in segment 1005 (Channel Marker 120, and Morgan's Point sampling sites) where you would expect the DO level to be rising. The study points out that this drop in DO in segment 1005 could be the result of point source BOD loading in the segment or supersaturation caused by phytoplankton blooms.

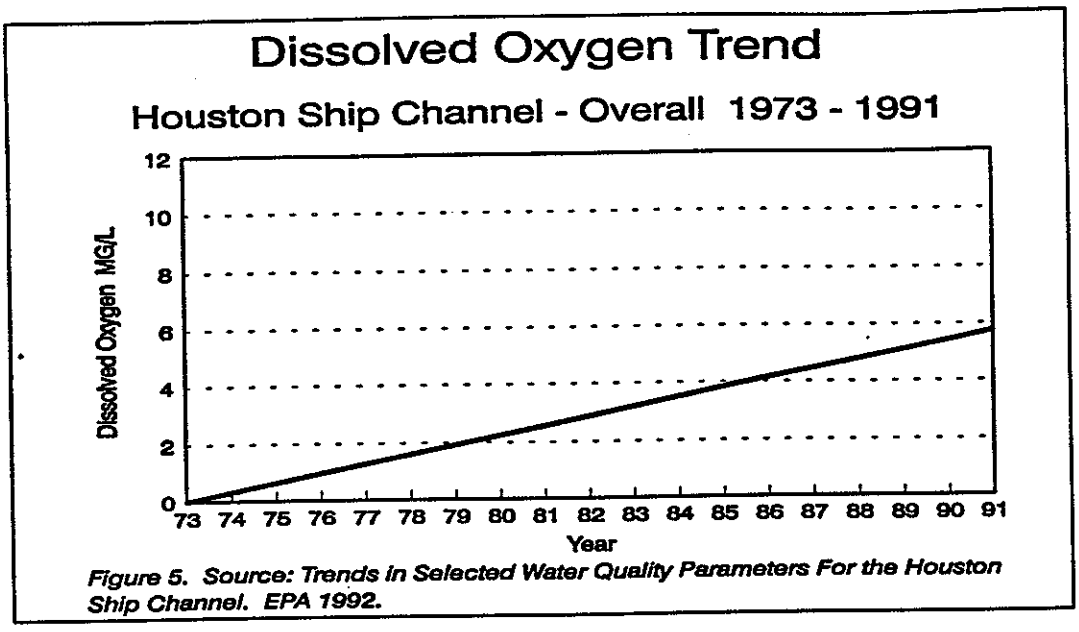

Figure 5. Source: Trends in Selected Water Quality Parameters For the Houston Ship Channel. EPA 1992.

Overall fecal coliform levels are also dropping in the Houston Ship Channel (Figure 6). Strong downward trends are found in the Turning Basin and Greens Bayou, while possible downward trends are found further downstream. No appreciable change in fecal coliform levels has been found at Morgan's Point.

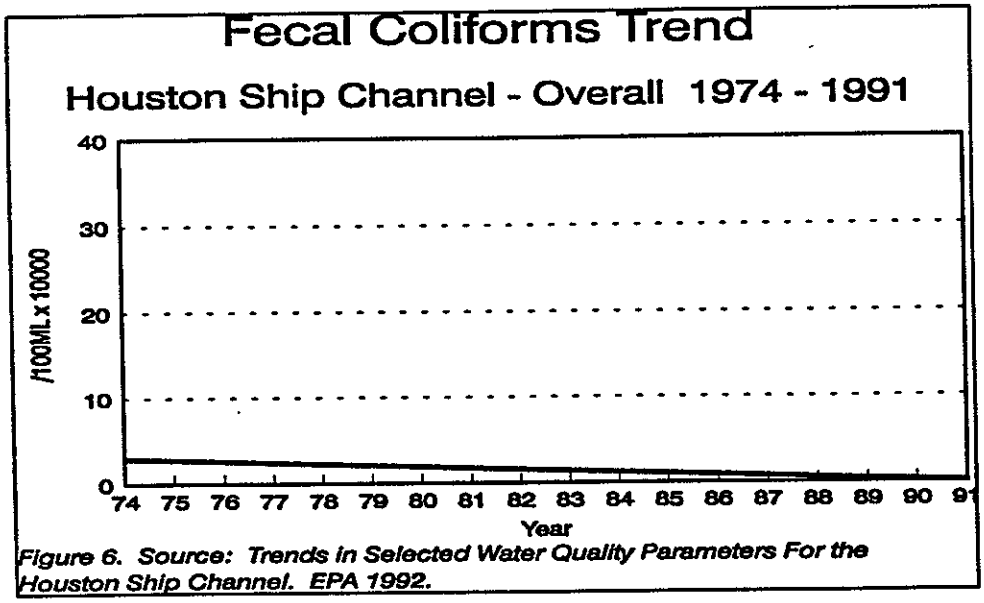

Figure 6. Source: Trends in Selected Water Quality Parameters For the Houston Ship Channel. EPA 1992.

Total lead levels have gone down in the channel (Figure 7). The greatest decrease in total lead is occurring in the Turning Basin. There is an increase in total lead concentration at the San Jacinto Monument sample site.

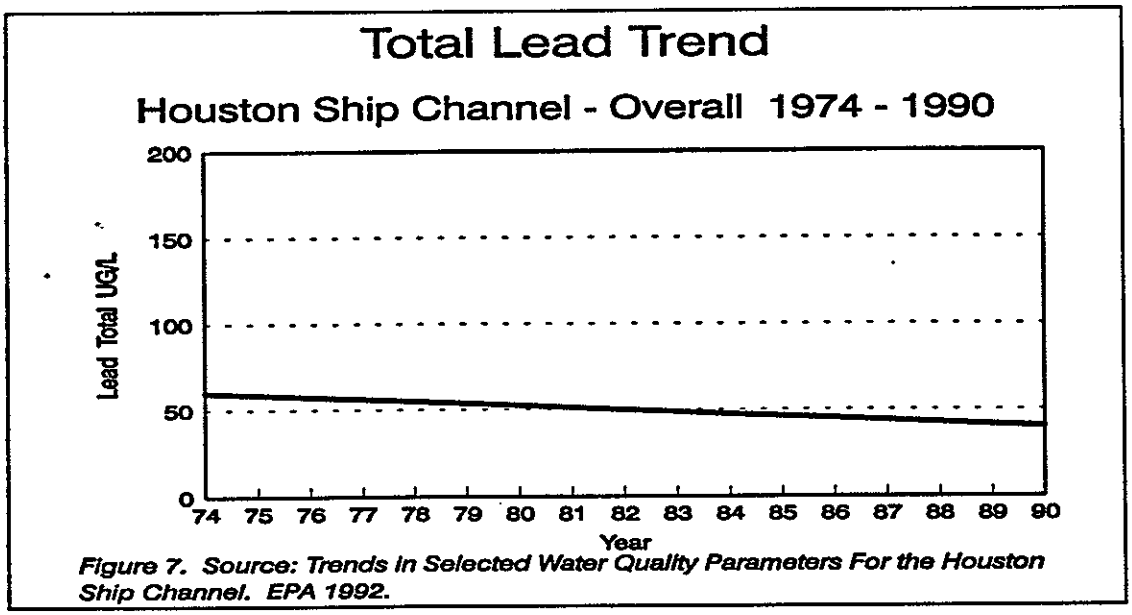

Figure 7. Source: Trends In Selected Water Quality Parameters For the Houston Ship Channel. EPA 1992.

The overall total Mercury trend in the Houston Ship Channel is going down (Figure 8). The most noticeable drop in mercury levels has occurred around Channel Marker 120. Mercury levels at the Morgan's Point sample site had an almost negligible increase. The other sample sites showed a slight decline in total mercury levels.

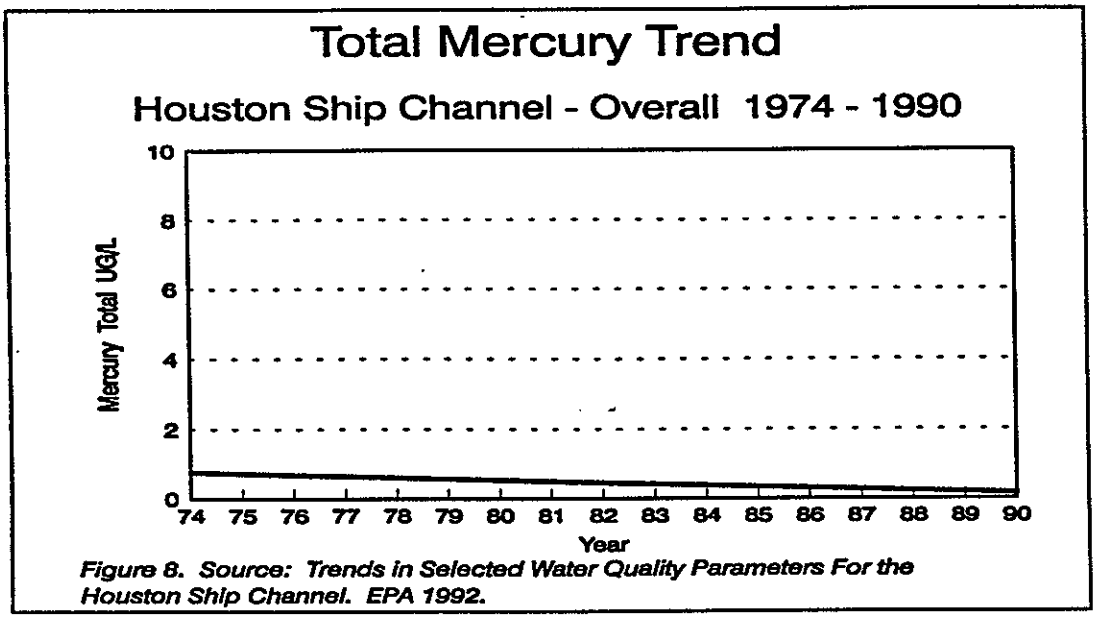

Figure 8. Source: Trends in Selected Water Quality Parameters For the Houston Ship Channel. EPA 1992.

Nitrate levels in the channel have gone up since the late 70's. This increase in nitrates may be caused by the increased efficiency of wastewater treatment operations in nitrifying ammonia. This has eliminated ammonia toxicity problems in most areas of the channel, but it has raised the nitrate level substantially (Figure 9) which aids in the eutrophication process.

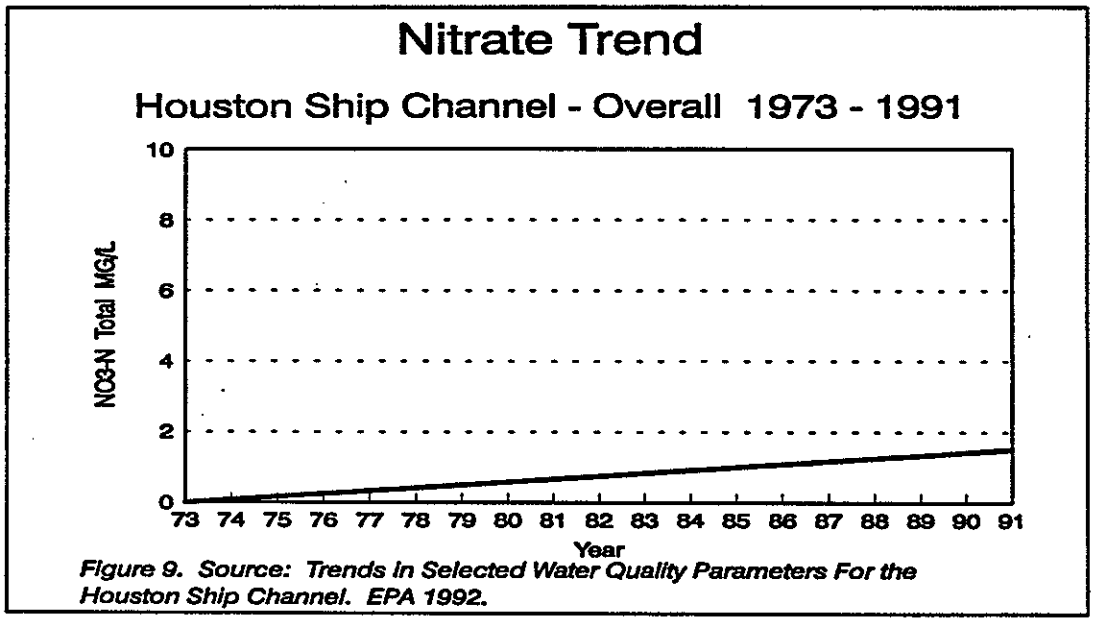

Figure 9. Source: Trends In Selected Water Quality Parameters For the Houston Ship Channel. EPA 1992.

Nitrite levels have also increased in the channel (Figure 10). All areas of the channel are increasing in their levels of nitrite, however, the most significant increase has occurred at the Greens Bayou location. This increase in nitrite may be related to the effective oxidation of nitrate in treatment plants or the waterbody.

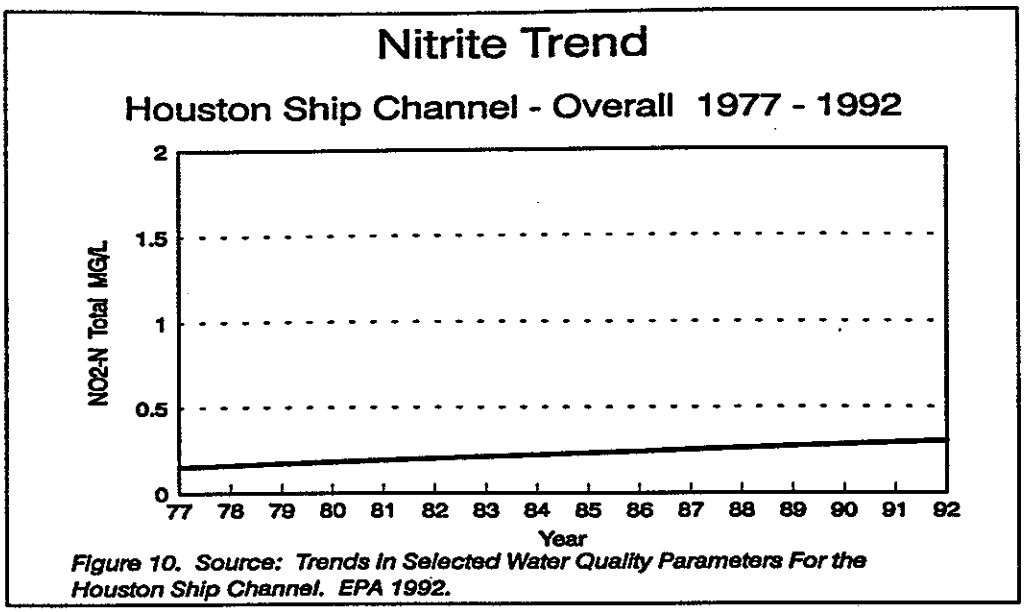

Figure 10. Source: Trends In Selected Water Quality Parameters For the Houston Ship Channel. EPA 1992.

Total Suspended Solids (TSS) levels have also decreased in the HSC (Figure 11). The most significant downward trend in TSS has occurred the Turning Basin where it is decreasing at approximately 4 mg/l/year. TSS has decreased at the other sample sites, but the amount is almost negligible.

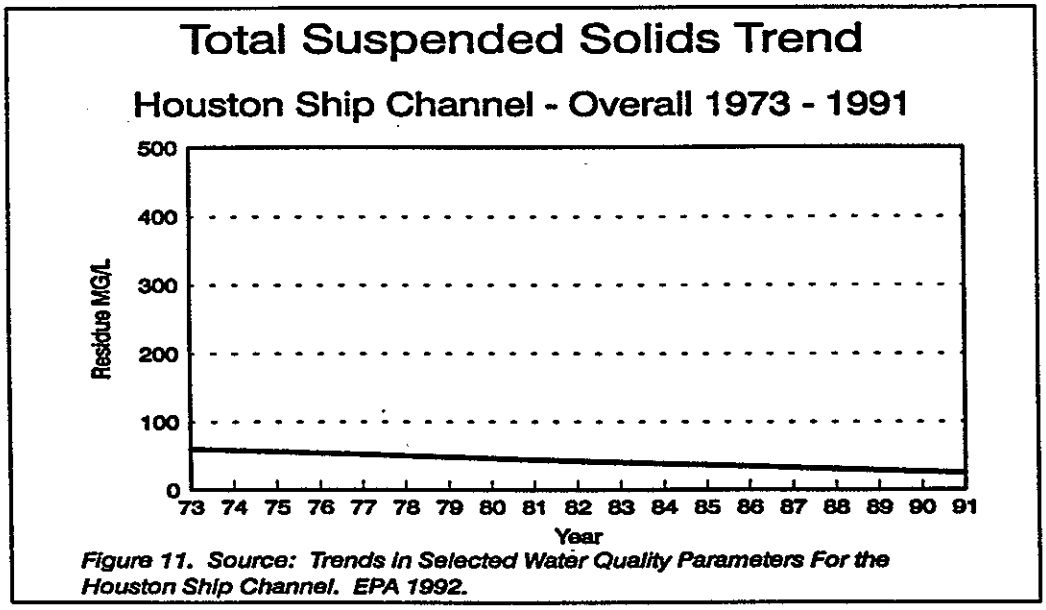

Figure 11. Source: Trends In Selected Water Quality Parameters For the Houston Ship Channel. EPA 1992.

Industrial Point Source Controls

There are an incredible number of industrial complexes along the Houston Ship Channel that discharge their effluent into the channel. There are over 360 industrial outfalls that are monitored twice weekly.

Industries using the Ship Channel contributed heavily to cleaning up the waterway. Before the late 1960s no one regulated discharges into the channel, thus allowing industries to indiscriminately dispose of wastes. In 1967-68 Texas started to require waste water discharge permits. These permits, however, merely registered the dischargers and provided no effluent regulations. The Health Department simply wanted to know who was out there and what they were doing with their waste. At this point, the Health Department had no wastewater regulations to enforce and their only recourse was to convince industry that it was in the public's best interest to clean up their operations. Sometimes they agreed, but most of the time they did not.

In the early 70s strict regulations were imposed forcing industries to begin the cleanup process. By 1974 industries had to have complete treatment for the wastes that they were producing in order to adhere to the strict regulations that were put upon them. Industries were required to treat their waste water prior to its discharge into the Ship Channel. If the industry was unable to treat their effluent on site, they had to contract for cleanup services through an independent treatment facility. Because the industries generated the waste water, they were also required to bear the expense in treating the waste water. Industry received no subsidies, grants, etc. to build these treatment facilities. One of the benefits of the new regulations was that the "playing field was made level." In other words, no single company was responsible for the cleanup - they all were assigned responsibility. Pollution reduction activities were not a source of competitive

disadvantage for firms. All industries were forced to improve their pollution control systems.

Some industries, however, felt they were above the law and tried to fight the system. Some tried dumping industrial waste down drains within their facility. David Marrick recalls when Dr. Walter Quebedeaux, of the Harris County Pollution Control Department, fought these violators by flying around in a helicopter at night with a spotlight looking for illegal activities. These activities ranged from dumping barrels of chemicals to emitting dangerous air pollutants under the cover of darkness. In one instance Quebedeaux confronted an industrial site when he found a drain they had been using to dump chemicals and waste. When asked where that drain led, the person in charge said that it didn't go anywhere. Quebedeaux, who was not satisfied with that claim, brought in a truck with about three yards of cement and filled the hole. While he was filling the hole he said, "If this hole doesn't go anywhere you won't mind if I fill it." Activities like that got the attention of industry. Today ship channel industries are regulated by state and federal permits for air, water and hazardous waste disposal; they undergo periodic site inspections; and they are being required to release more detailed information than ever before on their air emissions and wastewater discharges.

Exxon Chemical Americas is one ship channel discharger that has gone above and beyond what has been required by the Environmental Protection Agency (EPA) and the Texas Water Commission. The effluent discharged into the channel by Exxon Chemical Americas - Houston Chemical Plant (HCP) has met or been below permit levels for every regulated pollutant. In most cases, tests indicate that pollutant levels are far below required permit levels. For example, Exxon Chemical Americas HCP is located on stream segment 1007. The Texas Water Commission requires that the diurnal average for DO for that segment must

be 1 mg/L. The Exxon Chemical Plant has consistently been releasing effluent with a DO level between 10 and 11 mg/L. Effluent samples downstream from their outfalls have consistently shown a DO level between 7 and 9 mg/L.

In addition to cleaning up its effluent discharges through improved treatment, Exxon's HCP has reduced the amount of waste water it produces. In 1988 the plant was producing waste water in excess of 250,000 gallons per month. By December of 1991 that number had been decreased to 62,420 gallons per month.

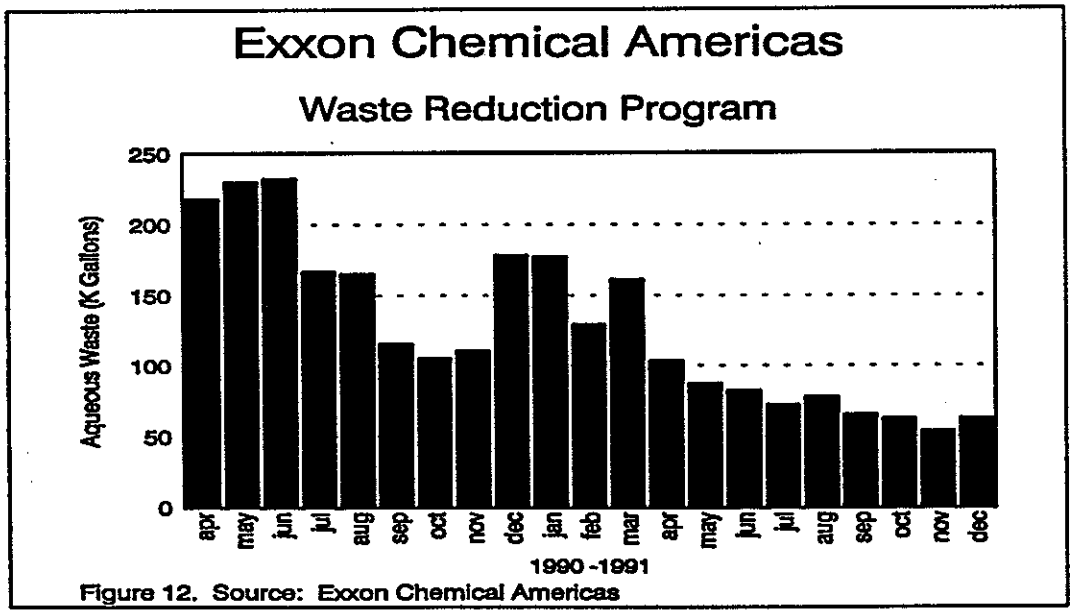

Figure 12. Source: Exxon Chemical Americas

This success is the result of a program that was put into motion by Exxon workers and management. They call the program W.R.A.P. (Waste Reduction Awareness Program). The program encourages employees to come up with innovative ideas to help reduce wastewater generation. Innovative ideas and the achievement of new goals are rewarded with drawings for prizes and monthly ice cream socials. The program is good for the Houston Ship Channel, the environment, and Exxon's pocketbook. All waste reduction that has taken place so far hasn't required one cent. In fact, it has saved the company $40,000 - $60,000 per month. It has all

been accomplished through new tank and vessel cleaning techniques, as well as better planning. In 1988 Exxon's HCP sent four, one million gallon capacity barges full of wastewater to Louisiana for treatment and deep well injection. This year the plant has yet to send one. Manuel Flores, Exxon Chemical Americas, Environmental and Regulatory Affairs, says he doesn't know if they will even send one barge this year. Exxon's HCP has been permitted by the TWC to downgrade its permit for concentrated wastes from toxic to non-toxic. The oil layer that sits on top of the concentrated wastewater is now being removed and sold as a corrosion inhibitor. W.R.A.P.'s goal is to have zero wastewater disposal via deepwell injection.

Exxon Chemical Americas has also addressed their nonpoint source pollution problem. All rainwater that falls within their facility is funneled to a 800,000 gallon retention pond, where it is left to settle out solids. It is then sent to a separator where it receives further treatment. When the effluent leaves the separator it is discharged into the ship channel. Manuel Flores stated that at times of extremely heavy rainfall the facility does have problems with overflow and untreated water does enter the channel. However, when any overflows occur that water is sampled and reported to the TWC.

Municipal Point Source Controls

Municipalities have also made a marked improvement in the effluent they are releasing into the channel. However, they have not made the strides that industry has because the funds are hard to come by. Municipal wastewater treatment facilities have really just been keeping up with the population increases that have been taking place over the last three decades. In some cases these population increases could be better described as population explosions.

Municipal treatment plants had all they could do to keep up with the greater number of people that needed to be served.

Municipalities also had to comply with the new regulations that came out in 1974. However, these cities received more help than did industry in building new or improving existing facilities. There were two programs that municipalities could turn to for help. The first was the PL660 program. This was a municipal wastewater treatment aid package. The second such program was the Accelerated Public Works Program. Since these federal programs have expired, there is now a state program that offers low interest loans to municipalities for improving or building new wastewater treatment facilities.

The Texas Department of Water Resources (TDWR) found another way to improve the quality of the water that municipal treatment plants were discharging into the Houston Ship Channel. The TDWR and the City of Houston formulated a Memorandum of Understanding that gave the area around the Houston Ship Channel from 1975-78 to develop plans for regional sewage treatment plants. Today there are approximately 120 small sewage treatment plants discharging into the HSC. There is only one regional plant discharging into the HSC - the City of Houston's 69th Street Plant. The groundbreaking for this Plant was December 1977, and service from the plant began in September of 1983.

The 69th Street Facility is one element of a significant capital improvements program by the City of Houston. It is a cooperative effort of the city, the Texas Department of Water Resources (now the Texas Water Commission) and the Environmental Protection Agency. The EPA provided 75 percent of the funds needed to finance the complex. The facility receives wastewater from a 53,500 acre area. It serves the Central Business District, major shopping centers, and 1/3 of the city's population. The plant was designed to treat 200 million gallons of wastewater and 112 tons of sludge per day.

Nonpoint Source Pollution

Nonpoint source pollution (NPS) is water pollution that emanates from disperse sources such as impervious surfaces, agricultural land, and the atmosphere. Contaminants such as oils, herbicides, pesticides, greases, toxics and heavy metals are all washed over land or stripped out of the air by rain. These pollutants are carried into the nearest water body downstream from their point of generation.

Houston has a severe problem with nonpoint source pollution. On average Houston receives 44 inches of rainfall annually. With that much rain, contaminants are constantly being washed from the land and stripped from the air. Most of these contaminants that originate from within the City of Houston are deposited into the ship channel or tributaries of the channel.

Recent estimates show that 85 percent of all waste that is deposited in the Houston Ship Channel is coming from nonpoint sources. These wastes may be in the form of oil and grease, pesticides, herbicides, sediments, and solvents, etc. These pollutants are coming from roads, parking lots, industrial sites, construction sites, lawns, stack emissions, and many other sources.

In 1972 point sources such as industrial and municipal wastewater treatment plants were targeted by the Federal Water Pollution Control Act because they were easy to identify. Stormwater is much more diffuse and harder to clean up, so the EPA elected to focus its efforts on the problem that could be taken care of most easily. Now that pollution from point sources has largely been taken care of, the focus of water pollution control is on stormwater runoff. The 1987 Water Quality Act, which amended the Clean Water Act, states that municipalities with separate storm sewer systems (Houston fits this category) that have a population exceeding 100,000 must apply for a permit to discharge stormwater. Cities are

required to submit permit applications for industrial related activities such as airports, landfills, etc. There is a two step application process that must be completed. The first step requires the municipality to give a description of their discharges, and the nature of the waters that will be receiving these discharges. They must provide a topographic map or aerial photographs of the area that identifies stormwater outfalls and projected land uses. This first application should also include a description of the existing management program as well as the legal authority the municipality has or plans to acquire to control nonpoint source pollution. The second step in the application process requires the city to submit a stormwater management plan. Upon review of the plan and the completion of any necessary revisions, the municipality will be issued a five year discharge permit by the EPA. The City of Houston had to meet the first application deadline by 11/18/91. The second part of the application needs to be submitted by 11/16/92.

These new permits will help ensure that pollutants carried by stormwater runoff into the Houston area bayous or the ship channel will be reduced, helping to improve water quality.

Who is Saying that the Ship Channel is Cleaner?

Many people and organizations are saying that the Houston Ship Channel is much cleaner than it used to be. Many articles in local newspapers have stated that the ship channel as well as the bayous that feed it are much cleaner than they were 20 years ago. An article, by Stefanie Asin, that recently appeared in the Houston Chronicle on "Resurging Bayous," had several good things to say about the higher quality of water that is flowing through Buffalo Bayou. In the article she says that at least 20 people train several days a week in canoes and kayaks on

the bayous in Houston. The following is an excerpt of the article, that shows how bayous have improved over the last ten years.

> "The Bayous weren't always pleasant escapes from the rat race, however. They earned their unpleasant reputation 10 years ago when large amounts of untreated sewage were dumped into them. The sewage, combined with stormwater runoff, industrial waste and the bayous' natural brown color, kept people far from the banks. But in the past decade, the city and local industries have made great progress in cleaning up the waterways, said George Guillen, environmental monitoring director of the Texas Water Commission in Houston...Guillen said the Houston Ship Channel was void of living creatures 20 years ago because of the mass of pollutants. Now the bayous, which flow into the Houston Ship Channel, carry an abundance of life."

Many people that have had a long association with the ship channel are saying they have seen fantastic improvement in the quality of its water. David Marrick with the Houston Audubon Society stated that the Houston Ship Channel is becoming somewhat of a wildlife corridor in many respects. Many different types of waterfowl are coming to the ship channel and its surrounding bayous. This is a result of better water quality, cleaner beaches, more wetlands, and the planting of trees. Marrick attributes the higher water quality to industrial efforts to clean up their effluent. Marrick is also very pleased to see the Galveston Bay National Estuary Program organizing tree plantings, beach cleanups and other events that enhance the beauty of the area, as well as provide habitat for birds, fish, and other wildlife.

Dr. Truett Garrett, Technical Director, Wastewater Operations Division, City of Houston Public Utilities Department has seen greatly improved Dissolved

Oxygen levels in the Turning Basin, which he attributes to the opening of the 69th Street Wastewater Treatment Complex. He also stated that the City of Houston Public Utilities is nitrifying all its effluent. They are changing all ammonias to nitrates. Thus toxicity in the channel due to ammonia has disappeared. Garrett also stated that Houston's stormwater system is improving. In 1988 and 1989, the Department of Public Utilities began a program where if a leak in the storm sewer system is detected, it is fixed and that location is then checked every three months. This program is a joint effort between maintenance and research. As a result of this program bacterial counts have dropped.

Don Greene, President of the Bayou Preservation Association also thinks that the bayous and ship channel are much cleaner than they used to be. In fact, his organization which has been organizing the Buffalo Bayou Canoe Race for the last 26 years, decided they had better stop calling the race the "Reeking Regatta," because it wasn't doing justice to Buffalo Bayou. Greene said, "The fact is, it doesn't reek anymore."

One of the reasons that there has been such great improvement in the ship channel's water quality is improved water quality monitoring. Today industries, enforcement agencies, and citizens, have the ability to measure water pollution with much greater precision than in the past. By having precise pollution measurements, water quality monitors have the ability to trace these pollutants back to their source. Thus, the problem can be identified and the condition causing the problem can be remedied. This improvement in water quality monitoring also enables monitoring groups to see water quality progress much more clearly. That is a point many organizations and individuals overlook. Improved water quality is real and those that are responsible for it should be commended.

Future Developments and Needs

One of the biggest conflicts concerning the Houston Ship Channel is the project that has been proposed by the Army Corps of Engineers. The project would deepen the channel from its present depth of 40 feet to 50 feet and widen it from 400 to 600 feet. According to the Houston Port Authority and the Greater Houston Builders Association, a wider and deeper channel is needed to stay competitive in the world market. Many others say that is not the case. Environmental groups such as the Galveston Bay Foundation are opposed to the projects. Their concern lies in the fact that a huge amount of sediment has collected in the bottom and on the sides of the channel. This sediment may contain large amounts of heavy metals and/or toxins that would be stirred up if dredging were to take place.

Senator Lloyd Bensten withdrew his support for the channel projects because he wants to be sure that any damage to Galveston Bay due to this dredging activity would not be irreparable. Bensten said, "When it comes to taking sides for the protection of the environment, I'm for that, I would like to go along, but first I want to be satisfied. I'm deeply concerned about something that could happen that you can't go back and undo."

At present the channel is dredged every three to five years to remove sediment that has settled to the bottom and is filling up the channel. Many people would like to see this "maintenance" dredging of the channel occur at most every ten years. That would be impossible with the present sedimentation rates. That means that there must be more controls established to combat erosion in areas that drain into the channel.

Another idea that has been put forth in recent years to improve the quality of water in the Houston Ship Channel, is that of instream aeration. Instream

aeration would increase the amount of oxygen present in the channel, thus increasing the ability of more aquatic plants and fish to reside in the channel.

There have been several studies that have looked at the feasibility of instream aeration for the Houston Ship Channel. One such study was done by Espey, Huston and Associates, Inc., for the Gulf Coast Waste Disposal Authority in 1978. Of the several available types of aeration that are possible, that study found that a mobile, barge-mounted aeration system would be the most attractive alternative. Other studies have issued the same results. At this time there are no aeration units in operation in the Houston Ship Channel.

Houston's population has been projected to increase more than 40 percent over the next 30-50 years. Therefore, it will be increasingly important to have effective point source and nonpoint source pollution regulation and control strategies. This will only be possible through continued monitoring of the channel and timely responses to changes in water quality due to both point and nonpoint source pollution that is entering the channel. These responses should be in the form of updated permit requirements.

CONCLUSION

There have been vast improvements in the water quality in the Houston Ship Channel. There is still much to do to enhance the channel's water quality even further. Efforts to improve water quality should have much more support now than they have received in the past. Over the last decade or so, there seems to have been a strong increase in the environmental awareness of Texans and Houstonians. This heightened awareness has put greater pressure on government and industry to reduce pollution. There are now more environmental "watchdogs" out there. Dozens of volunteers and organizations, that have been trained by the Texas Watch program, are doing citizen monitoring. The media is also giving

more attention to environmental concerns. This environmental awareness should help ensure that the Houston Ship Channel and its many tributaries will become cleaner.

But we must remember what John Latchford, then Assistant Director of Enforcement and Field Operations of the Texas Department of Water Resources, said in an interview with the EPA for their 1980 Ship Channel Success Story, "Assuming that the quality of these waters reaches a totally pristine condition, one must not forget that the channel was created for a specific purpose -- to provide a lane for commerce between Houston and the rest of the world. Even if all industrial and municipal discharges to the channel suddenly stopped overnight, you would still have a highly stressed, man-made, 40-foot-deep dredged waterway with continuous hydraulic mixing and shores which do not slope gently toward the bottom but are bulkheaded vertically at the shoreline most of the way downstream. This simply is no natural habitat for aquatic life to reproduce or carry out a normal life cycle. The Houston Ship Channel is not a swimming pool. It can never be a mecca for Sunday sailors and swimmers, for regardless of the increasing cleanliness of its water, a sailboat and human being are no match for immense ocean-going ships and tankers which have barely enough room to pass each other."

The key point to remember is that, by improving the water quality in the Houston Ship Channel and its many tributaries, the Galveston Bay Complex becomes a healthier and more productive body of water. By doing that the quality of life in the area goes up for everyone.

REFERENCES

U.S. EPA. 1992. "Trends in Selected Water Quality Parameters For The Houston Ship Channel." United States Environmental Protection Agency, Region 6, Dallas, Texas. September 1992.

Arvin, R. H. "Water Quality Success Story on the Lower Houston Ship Channel and Galveston Bay." United States Environmental Protection Agency, Monitoring and Data Support Division. June 1980.

Exxon Chemical Americas. "Waste Reduction Awareness Program 1992 Goals and Plans." 1991.

AnalytiKEM. "Acute Toxicity to *Cyprinodon variegatus* and *Mysidopsis bahia* of Effluent From Exxon Chemical Company in a 48 Hour Static Renewal Test." 10-20-90.

Galveston Bay Foundation. "Toxic Discharges into the Houston Shop Channel During 1988." January 1992.

U.S. EPA 1991. "Water Quality, Ambient Toxicity and Biological Investigations in the Houston Ship Channel and Tidal San Jacinto River." United States Environmental Protection Agency, Region 6, Dallas, Texas. October 1991.

Garrett, Truett. City of Houston Department of Public Utilities. Interview. June 1, 1992

Marrick, David. Audubon Society. Interview. May 27, 1992.

Teller, Joe. Gulf Coast Waste Disposal Authority. Interview. June 1, 1992.

Flores, Manuel. Exxon Chemical Americas. Interview. July 10, 1992.

Greene, Don. Bayou Preservation Association. Interview. July 1992.

Asin, Stephanie. "Resurging Bayous: Image -Poor Waterways get Cleaner, More Recreation." Houston Chronicle. April 5, 1992. p. 2C.