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Agency

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EPA

Clean Water and the Cane Sugar Industry

This booklet is about the cane sugar industry and water pollution. It is intended to help you understand how this industry—and all other industries—are affected by a law passed by Congress to reduce and eventually eliminate water pollution.

There are approximately 20,000 men and women employed in the mills and refineries of the cane sugar industry—about 8,000 in mills and 12,000 in refineries. The 29 cane sugar refineries discharge approximately 276 million gallons of waste water daily, while the 74 raw cane sugar mills currently discharge approximately 1.13 billion gallons of waste water daily.

This booklet describes what these plants must do to keep their wastes from polluting the Nation's waters.

In non-technical language, this booklet explains that:

- The technology exists to reduce water pollution from cane sugar plants to safe levels.

- Applying that technology costs money—but the majority of cane sugar plants can afford to make the necessary investments to control pollution.

- Such pollution control investments will not unduly affect the financial condition of the plants, or the price consumers pay for the sugar.

This booklet also describes why a few cane sugar plants may not be able to comply with pollution control standards and, unfortunately, may have to shut down, with the subsequent loss of jobs.

In brief, this booklet discusses the facts of life about water pollution —how it affects all of us, why it must be controlled, and what the law requires the cane sugar industry to do as its part of the national program to clean up our Nation's waterways.

The Problem

You and millions of other Americans have probably seen the warning signs: "No Fishing," "No Boating," "Beach Closed," or "Danger, Do Not Drink the Water." The signs are there because the water is polluted with raw or poorly treated human wastes, with runoff from city streets, farmlands, animal feedlots, and mines; with leaks and spills from ships. And with waste from industries—including the cane sugar industry.

Each year, some 402 million tons of pollutants from human activities enter the Nation's waters. That's almost two tons for every man, woman, and child in the United States. The pollutants include bacteria, viruses, organic materials, animal fats, oil, acids, metals, pesticides, a myriad of other chemicals, and hot water from power plants and industrial boilers.

Not only do the pollutants make our waters unsightly, but without expensive purification they can make the water unfit for drinking, for irrigation, and for industrial use. They contaminate fish and shellfish, making them unpalatable or actually unsafe to eat. Some pollutants endanger reproduction, causing deformities and even death in various life forms.

It is impossible to put a precise price tag on the cost of water pollution. But there is no doubt that water pollution exacts a heavy toll. It's estimated that dirty water costs the American people at least $13 *billion* a year—in water purification bills, in damage

to fishery resources, in lost recreation.

In short, water pollution is a major national problem.

How did so many of our waterways become open sewers? For many years we thought the waste products of human activities dumped in our waterways would decompose and disappear harmlessly. But we learned otherwise. We learned that we had overburdened the capacity of water to cleanse itself, to assimilate the sewage discharges from increasing numbers of people and the increasing wastes discharged from industry, agriculture, and mining.

Finally, after more than two decades of generally ineffective attempts to control water pollution, we realized that a completely new approach was needed.

To Solve the Problem

In response to widespread public concern about the sad condition of the Nation's waterways, Congress, building upon the experiences of earlier water pollution control laws, enacted the Federal Water Pollution Control Act Amendments of 1972. It brought dramatic changes.

What the 1972 law says, in essence, is that nobody—no city or town, no industry, no government agency, no individual—has a right to pollute our water. The free use of our waterways as dumping grounds for our wastes is no longer permitted. From now on, under the 1972 law, we must safeguard our waterways, even if it means fundamental changes in the way we manufacture products, produce farm crops, and carry on the economic life of our communities.

Congress declared that the objective of the 1972 law is "to restore and maintain the chemical, physical, and biological integrity of the Nation's water."

The 1972 law has two goals: First, whenever possible by July 1983, achieve water quality that's clean enough for recreational use, and clean enough to protect fish, shellfish, and wildlife. Second, by 1985, no more discharges of pollutants into our waters.

To achieve these goals the law set in motion a new national system of uniform controls on the discharge of pollutants, to be carried out by the U.S. Environmental Protection Agency (EPA) in cooperation with State and local governments:

- The law requires EPA to establish national "effluent limitations" for industrial plants—including cane sugar plants. An "effluent limitation" is simply the maximum amount of a pollutant that anyone may discharge into a water body.

- By July 1, 1977, the law requires existing industries to reduce their pollutant discharges to the level attainable by using the "best practicable" water pollution control technology (BPT). BPT is determined by averaging the pollution control

effectiveness achieved by the best plants in the industry.

• By July, 1983, the law requires existing industries to reduce their pollutant discharges still more—to the level attainable by using the "best available" pollution control technology (BAT). BAT is based on the best pollution control procedures economically achievable. If it is technologically and economically feasible to do so, industries must completely eliminate pollutant discharges by July 1, 1983.

• The law requires *new* industrial plants to limit pollutant discharges to the level attainable by meeting national "standards of performance" immediately, without waiting for 1977 or 1983. These new plant standards may require greater reduction of pollutant discharges than the 1977 and 1983 standards for existing plants, or zero discharge where applicable.

• The law requires industrial facilities that send their wastes to municipal treatment plants—as some cane sugar plants do—to make sure the wastes can be adequately treated by the municipal plant and will not damage it. In some industries, discharges to municipal plants may thus have to be "pre-treated." That is, the portion of the industrial waste that would not be adequately treated or would damage the municipal plant must be removed from the waste water before it enters the municipal system.

• The law does *not* tell any industry what technology it must use. The law requires only that industries limit pollutant discharges to levels prescribed by law.

• The law also says that if meeting the 1977 and 1983 requirements is not good enough to achieve water quality standards, even tougher controls may be imposed on dischargers.

• And while the law requires industries to meet the national discharge standards set for 1977, 1983, and for new plants, the law also allows a State or community to impose stricter requirements if it wishes. The national standards are thus *minimum* requirements that all industries must meet.

Setting limits on industrial discharges is only the first step in controlling water pollution, of course. The next step is to make sure those limits are met. This law provides the mechanism to do that.

Permits

The key to applying the effluent limits to industries—including the cane sugar industry—is the national permit system created by the 1972 law. (The technical name is the "National Pollutant Discharge Elimination System," or NPDES.)

Under the law, it is illegal for any industry to discharge any pollutant into the Nation's waters without a permit from EPA or from a State that has an EPA-

approved permit program. Every industrial plant that discharges pollutants to a waterway must, therefore, apply for a permit. Essentially, all have done so.

When issued, the permit regulates what may be discharged, and the amount of each identified pollutant from a plant. The discharger must monitor its wastes and report on such pollutant discharges. The discharger must comply with all applicable national effluent limits and with any State or local requirements that may be imposed. If the plant cannot comply immediately, the permit contains a compliance schedule of firm dates by which the pollutants will be reduced or eliminated.

The permit, in essence, is a contract between a company and the government.

This combination of national effluent standards and limits, applied to specific sources of water pollution by individual permits, with substantial penalties for failure to comply, constitutes the first effective nationwide system of water pollution control.

Now, what does this mean to the cane sugar industry?

The Cane Sugar Industry's Pollution Problems

Both segments of the cane sugar industry's operations—milling and refining—may give rise to pollution. There are pollution problems unique to each segment, and others common to both. The first step in applying

the 1972 law to the cane sugar industry was to identify these problems and determine how to solve them.

The Environmental Protection Agency conducted an exhaustive review of available literature on the industry, reviewed applications to the Corps of Engineers for permission to discharge effluents into public waters, and made on-site inspections of various factories and refineries in operation. Personal and telephone interviews were conducted, and the results of a voluntary questionnaire of the industry were closely studied. In addition, information from samplings of selected plants were taken to verify the accumulated data. Finally, a contractor's study was prepared under EPA supervision to provide a basis for evaluating the potential economic impact of effluent limitations guidelines and standards of performance established by EPA.

With this broad base of data, EPA was able to identify the raw waste characteristics, including analyses of the source and volume of water used in the process employed, and plants were grouped in subcategorizations to better evaluate particular problems of waste water. The constituents of waste water which should be subject to the effluent limitations guidelines were identified. Existing control and treatment technologies were identified along with the problems, limitations, and reliability of each, and the costs and time required to implement them were also defined.

From all this emerged the following facts:

- The 74 raw cane sugar mills discharge approximately 1.13 billion gallons of waste water daily. The 29 cane sugar refineries discharge approximately 276 million gallons of waste water.

- The waste water from cane sugar refineries contains 3.5-8.5 pounds of oxygen-robbing organic materials and about 18 pounds of suspended solids per ton of raw sugar melted, while the waste water from cane sugar mills contains 4.2-21 pounds of organic matter and 35-200 pounds of suspended solids per ton of sugar cane processed.

- A major pollutant in both cane sugar milling and refining is organic material. The measurement of these oxygen-consuming pollutants in water is called "biochemical oxygen demand," or BOD. (This is usually expressed in terms of the amount of biochemical oxygen demand in five days, or BOD5.) When dumped untreated into a stream or river, the organic material is decomposed by micro-organisms which consume oxygen in the water, eventually depleting the oxygen content to the extent that aquatic animal and plant survival is menaced. Even when all the oxygen in a body of water has been used, the decay of organic matter continues, producing noxious gases, such as hydrogen sulfide and methane.

- Another major pollutant from

the cane sugar industry is suspended solids, both organic and inorganic. Among the inorganics are silt, sand, and clay. The organic components include such things as bagasse, boiler ash, and so forth. These pollutants are collectively called "total suspended solids," or TSS. Suspended solids discolor and cloud water, impairing photosynthesis in aquatic plants. If pollutants containing organic matter settle on the bottom, they become sludge beds that further deplete the water's oxygen content, and create gases toxic to aquatic life. In addition to esthetic and ecological considerations, suspended solids in water from streams used by industry can interfere with many industrial processes. They can cause foaming in boilers, damage equipment, and impose high purification costs on industries that need water to make their products.

There are two key points to keep in mind: *Raw wastes from cane sugar mills and refineries contain unacceptable amounts of organic materials and suspended solids. Therefore, the wastes must be treated before they can be discharged into a water body.*

and

The cane sugar industry can successfully control these two major water pollutants.

- Other identified pollutants in cane sugar industry wastes include coliform bacteria, nitrogen, phosphorus, dissolved solids, and heat.

- Another consideration is the acid or alkali content of liquid wastes. This is called the "pH" of the mixture. (Pure distilled water has a pH of about 7, a strong acid solution has a pH of 1, and a strong alkali solution has a pH of 14.) Extremes of pH or rapid pH changes can create stress conditions on aquatic life, or kill it outright. Even moderate changes from "acceptable " criteria limits of pH are deleterious to some species. In general, however, the pH of wastes from cane sugar plants can be easily adjusted where necessary.

- In raw cane sugar milling, the reduction of waste waters or waste water pollutants can be effected by such in-plant control measures as recirculation of barometric condenser cooling water through cooling towers, ponds, or canals; dry hauling of filter mud; recirculation of cane wash water; and reducing the amount of sucrose in barometric condenser cooling water.

- For the cane sugar refineries, waste water or waste water pollutants can be reduced by in-plant control measures such as recirculation of barometric condenser cooling water, dry hauling of filter mud, recovery of floor drainage, and reduction of sucrose entrainment in barometric condenser cooling water. A primary portion of in-plant control is to prevent sugar loss.

- Finally, the EPA study determined that the process waste waters from cane sugar

refining contain sufficiently low concentrations of water pollutants to allow them to be discharged to publicly owned treatment plants. Moreover, where such treatment plants are available, there should be no problem in introducing cane sugar milling waste waters directly into them.

In sum, the water pollution problems of the cane sugar industry were identified, and it was determined that water pollution from the industry can be controlled by use of machinery and methods already in use. In other words, the technology to do the job already exists.

The Law and the Industry

Having assembled these facts, EPA's next step was to prepare standards for cane sugar mills and refineries under the 1972 law. Many factors were considered: the age and size of the facilities, the quality and nature of raw materials used, raw waste characteristics, existing control and treatment technologies, with their attendant problems, limitations, and reliability of each. The energy requirements and costs of each control and treatment technology were also studied.

For the purposes of developing these guidelines, the cane sugar refining segment was divided into two subcategories—liquid cane sugar refining and crystalline cane sugar refining. The cane sugar milling segment was divided into five subcategories determined primarily by differences in waste water characteristics due to different harvesting methods and conditions, manufacturing processes, and treatment technology. The subcategories are I (comprised of factories located within the state of Louisiana); II (factories located in Florida and Texas); III (factories located on the Hilo-Hamakua Coast of the Island of Hawaii); IV (factories located in Hawaii other than those in subcategory III); V (factories located on the Island of Puerto Rico).

The proposed regulations were issued December 7, 1973 for cane sugar refineries, and February 27, 1975 for cane sugar mills. They were sent to the industry and other interested organizations for review and comment. When the comments were received, EPA carefully analyzed them and made appropriate changes in the standards.

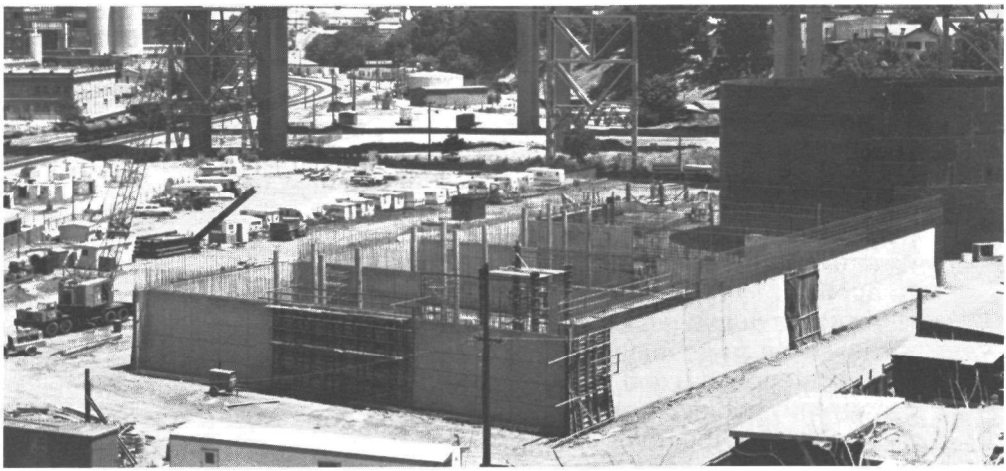
On March 20, 1974, EPA issued the final standards for cane sugar refining the industry must meet to comply with the requirements of the 1972 law. Similar final standards will be issued for the milling segment.

In brief, the regulation:

- Establishes the limits to be met by July 1, 1977 through the best practicable control technology currently available.

- States the limits to be met by July 1, 1983, using the best available technology economically achievable.

- Establishes the requirement that all new cane sugar mills and



refineries, at the time they are built, must meet the standards that existing plants must meet by July 1, 1983, and, wherever possible, should have zero discharge of pollutants.

- Identifies the major cane sugar industry pollutants, and establishes maximum limitations for BOD and TSS that cane sugar plants can discharge during any one day on an average over a 30-day period.

- Requires that the pH (acidity or alkalinity) of cane sugar industry plant discharges be within the range of 6.0 to 9.0.

- Explores the costs of attaining the required effluent reductions.

- States that waste waters from cane sugar mills and refineries are not harmful to municipal treatment plants.

- Allows flexibility in applying pollution controls to meet the 1977 standards in special cases.

- Does *not* tell cane sugar plants what technology to use to meet the regulations. The standards require cane sugar mills and refineries to limit pollutant discharges to levels found attainable by using best practicable control technology.

What does all this mean—to cane sugar companies, to those of you who work in cane sugar mills and refineries, and to the public?

Impact of the Guidelines

Let's consider some questions you may very well be asking yourself at this point about the impact of pollution control on the cane sugar industry.

1. Can cane sugar mills and refineries meet the 1977 limitations? That is, *technologically,* can they reduce their discharges of pollutants to the levels required by 1977?

The answer is *yes.* All existing cane sugar mills and cane sugar

refineries *can* meet the 1977 standards. While there is no single treatment process (impoundment, waste stabilization, irrigation, or—in refineries—biological treatment) which is universally applicable in achieving reduction of pollutants in waste waters, the technologies already exist which can be applied to any given plant to meet the guidelines limitations. Raw cane sugar milling plants in Subcategories II and IV are currently achieving zero discharge. Other mills in Subcategories I and V are meeting or doing better than BPT. In addition, urban refineries, representing approximately three-fourths of all American cane sugar refinery production, discharge process water and in some cases barometric condenser cooling water directly to municipal sewage treatment plants. Many refineries are currently attaining BPT.

2. Can cane sugar plants meet the 1983 limitations? That is, *technologically,* can they reduce their pollutant discharges to the levels required by 1983?

Again, the answer is *yes,* although some development work may possibly be required in some cases. Five refineries are presently achieving zero discharge of pollutants to navigable waters, two discharge all process waste waters to municipal treatment systems, and ten or more currently discharge all wastes except barometric condenser cooling water to municipal systems. Many cane sugar mills are already attaining BAT in Subcategories I, II, IV, and V.

3. Can new plants meet the new source performance standards?

Yes. In all five categories of raw cane sugar milling, where new plant construction is likely, and in raw cane sugar refining, new plants, using the best available control technology, can meet the required standards.

4. Can the cane sugar industry *afford* to meet the 1977 water pollution control requirements?

The answer is *yes.* It's estimated that meeting the 1977 standards will cost the cane sugar milling segment $9.8-10.4 million, with annual operating costs estimated at $2.8-4.03 million. It is estimated that meeting the 1977 standards will cost the cane sugar refining segment approximately $5.9 million, representing approximately 2 percent of the total investment needed to build a typical refinery.

5. Can the cane sugar industry *afford* to meet the 1983 water pollution control requirements?

Yes, in most cases. The total capital cost to the cane sugar refining segment in meeting the 1983 guidelines is estimated at approximately $17 million. This is approximately 3.5 percent of the total investment needed to build the typical refinery. To meet the 1983 standards should cost the milling segment an investment of $11.6-14.2 million, with estimated total annual costs of $2.9-4.3 million.

So far, we've talked about cane

sugar mills and refineries that can—technologically and financially—meet the 1977 and 1983 standards. Now a tougher question:

6. What about cane sugar plants that cannot financially meet the 1977 standards? What will happen to them?

The 1977 standards will probably cause one plant closure in the cane sugar milling segment. However, the economic analysis of cane sugar refining indicates that three to five plants will close by the time of implementation of the 1977 standards, or due to the incremental costs of meeting both 1977 and 1983 standards. Two to three of these plant closures are in Puerto Rico where lost production can be absorbed by other Puerto Rican refineries which have unused capacity. EPA is very much aware of the impact these closures will have on the men and women employed by the plants. It will mean relocating to another job in the cane sugar industry, perhaps involving a move to another community. Some people may find it necessary to enter a totally new career, or accept early retirement. But to lower the 1977 standards any further to prevent these closures would mean continuing discharges of raw wastes into our public waters, a practice no longer environmentally tolerable. It should be noted that the " regulation will create new jobs in construction and maintenance of new pollution control facilities.

In sum, if a plant can only operate by polluting our public waterways, it must close down for the benefit of us all.

7. What about the 1983 standards? Will any more cane sugar mills and refineries have to close because of those standards?

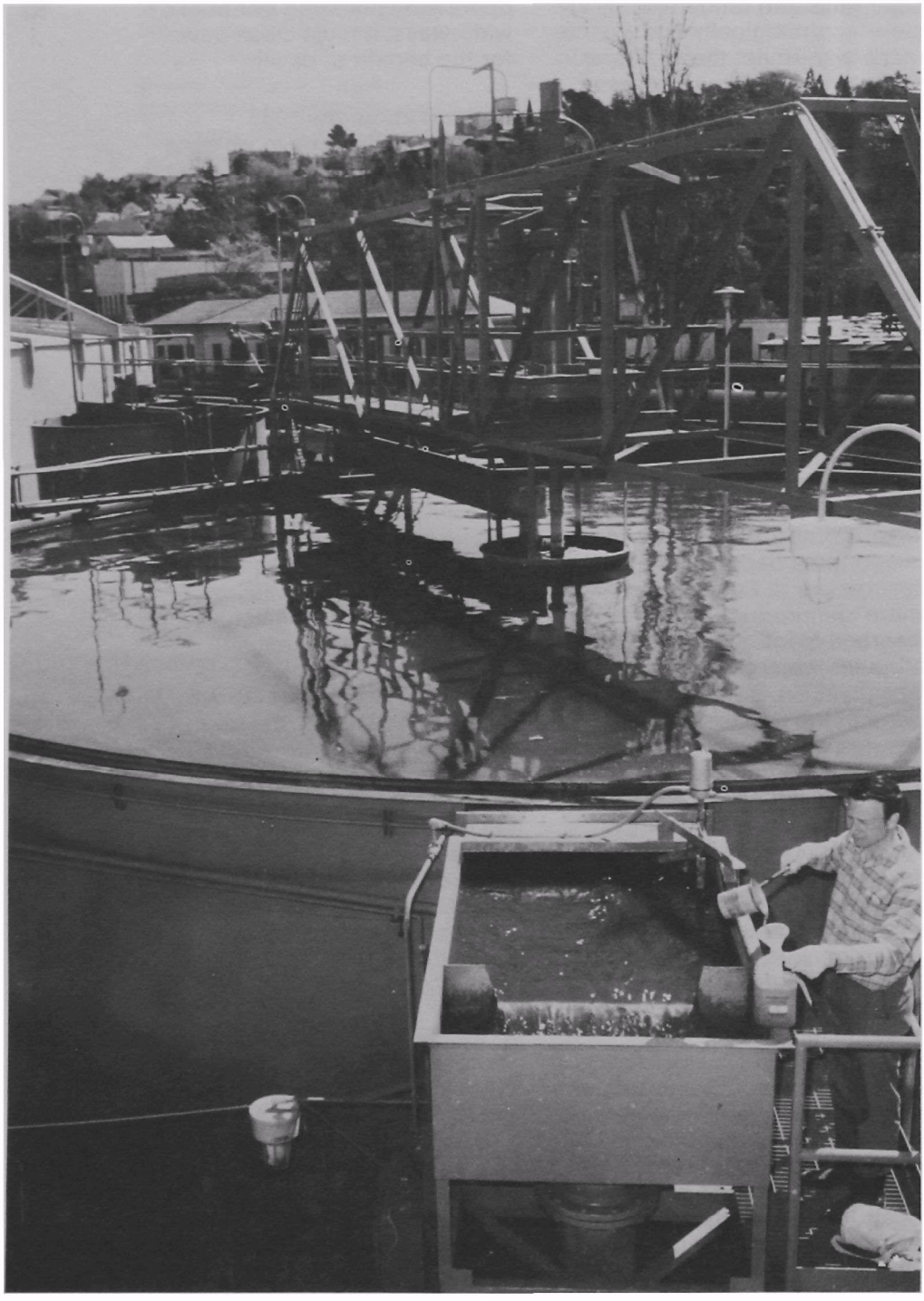
Unfortunately, one raw cane sugar processing plant in Louisiana may have to close due to the costs of meeting the 1983 standards. This closure would affect no more than 300 employees.

There should be very good chances for re-employment in Louisiana. Some small mills may decide to consolidate into larger ones, creating new jobs. Also, the general economic development along the Mississippi River suggests the creation of new jobs within the general area.

Closing cane sugar plants could definitely affect farmers. At current price levels, the loss of sugar cane as a crop would greatly reduce farm income. However, alternative uses of land in Louisiana could include soybean and pasture. While these crops would produce a smaller farm income, reducing the economic base of the community, that base would at least not be eliminated.

8. How will the 1977 and 1983 standards affect consumers? What impact will they have on the price of cane sugar?

It is generally thought that the cost of pollution control will not be passed on to the consumer. The household consumption of sugar remains relatively stable and



industrial users appear to be very price-conscious. If substitute sweeteners continue to be available, it is unlikely that there will be any significant price increases. Any price adjustments that might include incremental cost of pollution control would most likely be intertwined with the economics of the entire domestic sugar industry, which includes both cane and beet sugar. It is also felt that any losses in U.S. production due to pollution control would not influence world prices of sugar.

9. What about the productive capacity that will be lost if some cane sugar plants do shut down?

Based on consideration of excess capacity in various plants, the possibility of new plants in some regions, and the availability of imported sugar and substitute sweeteners, the overall supply of sugar would probably not be affected in the event of actual plant closings.

Thus, water pollution control requirements for the cane sugar industry will have no long-range repercussions in terms of supplies of sugar, or industry growth. The standards will have a negligible effect on the Nation's balance of trade with other countries or exports of cane sugar.

In summary, with just a few exceptions, the cane sugar industry can meet the water pollution control requirements mandated by the 1972 law. The result will be cleaner water for all of us to enjoy and less waste for the cane sugar industry.

Some Final Words

The effluent guidelines for the cane sugar and other industries are only part of the comprehensive program set in motion by the 1972 law. Among other things, municipal treatment plants must meet certain discharge standards by 1977 and 1983. The law increased Federal aid to local governments to help build sewage treatment facilities, and established planning procedures for State and local governments to control water pollution from all sources more effectively, in cooperation with the Federal Government. The law also streamlined and strengthened the enforcement provisions of the water pollution control program.

Some water quality control problems are so complex that they cannot be solved by using technology alone. For this reason the Act included an areawide waste treatment management planning process under Section 208. This areawide planning brings together several aspects of water pollution control, including treatment of municipal and industrial wastes, the issuing of discharge permits to industry, and the ways of dealing with "nonpoint" sources of pollution such as stormwater runoff, in a comprehensive approach. Emphasis is placed upon planning by local governments.

To help pay for this cleanup, Congress set up a construction grants program in which the Federal Government will pay up to 75 percent of construction costs for treatment plants. The funding for this program is

expected to rival the Federal highway program in magnitude. In fact, costs from the beginning of the program through 1982 are expected to total $50 billion, or an average of $5 billion per year—compared to the $13 billion a year that water pollution now costs the American people. Congress felt that expenditures under the construction grants program were essential to deal with a significant and pressing environmental problem.

With the cooperation, hard work, and investment of considerable amounts of money from industries and all levels of government, progress has already beeen made toward reducing—and eventually eliminating—pollution in our Nation's waterways. But much remains to be done. Still more money and effort will have to be invested if the clean water program is to be successful—if we are to have water that is safe and healthful for drinking, for use by industry and agriculture, for swimming and boating, for fish and wildlife.

For additional copies of this booklet, write: Public Information Center (PM-215). EPA, Washington, D.C. 20460.

Some Suggestions on How to Improve Pollution Control in Plants

In-plant control measures are essential in the total effort to control pollution in the cane sugar industry. There are several ways in which individual plants can reduce pollutants in cane sugar waste waters.

Two of the major waste sources in cane sugar milling—cane wash water and filter muds—are directly affected by harvesting techniques. There are several mechanical harvesting systems currently being evaluated which should significantly reduce the total amount of extraneous material entering a cane sugar factory. The goal is to lower the extraneous material to such a level that cane washing is not necessary.

The mills and refineries can also reduce waste waters or waste water pollutants by such control measures as dry hauling of filter mud, reducing the amount of sucrose in barometric condenser cooling water, and the recirculation of that water through cooling towers, ponds, or canals. In addition, mills can also recirculate cane wash water to further reduce waste water discharges.

In another effort to reduce waste, some refineries recover water from nearly all floor wash drains as sweet water for reuse. To prevent untoward sugar loss, most refineries *sweep up* as much spilled sugar as possible before washing down the receiving area.