CHAPTER THIRTEEN
ENVIRONMENTAL MANAGEMENT FOR GALVESTON BAY

Our review of the Action Plan Topics has provided readers with an understanding of the regulatory framework for protecting Galveston Bay. This chapter focuses on management issues, cutting across the information provided earlier in a different way. The Management Committee of the Galveston Bay National Estuary Program identified eight management issues of concern:

1. Environmental planning;
2. Environmental permitting;
3. Environmental monitoring;
4. Environmental enforcement;
5. Pollution prevention programs;
6. Non-regulatory environmental management, such as technical assistance programs and grants;
7. Economic development financial assistance programs that support or conflict with bay goals; and
8. Research funding and recipients for projects potentially related to the bay.

Each is treated in turn, drawing on the information presented earlier in the report. Following a discussion of the first four issues, which together encompass the phases of environmental regulation, we interject an overview of barriers to regulation that cut across the four elements. In addition, a separate section considers data management, a particularly important and troubling component of overall management.

ENVIRONMENTAL PLANNING

Virtually every federal and state agency directly involved in managing the environment of Galveston Bay must undertake some form of planning. The National Environmental Policy Act (NEPA), which applies to all federally funded or permitted projects, requires proposers of projects to consider their environmental effects and to prepare an Environmental Impact Statement if those effects will be significant. Among other major environmental planning activities we have reviewed are state and local nonpoint source reduction plans, fisheries and wildlife conservation plans, the state water plan, and various smaller habitat conservation plans. Localities undertake planning through their planning and zoning processes, which are discussed in Chapter 8.

The primary difficulty with current environmental planning is its project-by-project or agency-by-agency nature. By definition, planning should be comprehensive, yet the regulatory framework for protecting Galveston Bay is extremely fragmented. This report has described important roles for 6 federal agencies, 9 state agencies, several agencies in each of 5 counties and 18 cities, and numerous regional agencies, in addition to the minor roles of many other federal

and state agencies and more than 500 utility districts. Each of these units undertakes some kind of planning relevant to environmental protection of Galveston Bay; for example, units operating wastewater treatment plants must plan for adequate capacity in light of population projections. Even where planning is required, it is often implemented in a still more incremental way. Issuing each permit separately prevents cumulative effects from being considered.

The Galveston Bay National Estuary Program (GBNEP) is itself one of the most comprehensive of the planning efforts and planning mechanisms available. The various steps involved in becoming part of the Coastal Zone Management Program (CZMP) also constitute an important effort at environmental planning; in contrast to GBNEP, where members of the public and many different agencies are represented on active committees, however, the CZMP is conducted largely by a single agency—the General Land Office—in consultation with other agencies as needed or desired.

Another hopeful trend towards comprehensive planning is embodied in EPA's watershed initiative and Texas Senate Bill 818, which requires a regional assessment of water quality in each watershed or river basin. All permits within a single watershed will expire on the same date, allowing for review and permit renewal on a regional basis. Although the details, both scientific and managerial, for effecting environmental protection through watershed management have not been worked out, the approach could well have the effect of improving the effectiveness of environmental planning.

Planning is also constrained by its purpose: if the environment is not the focus of planning, then it will be affected as a byproduct just as if there were no planning. For example, in 1985, the Texas Legislature mandated the state's first comprehensive water plan. The purpose of the plan is to provide a comprehensive review of present and future water resources, taking into account public and private interests and institutions in Texas and environmental factors to promote economic welfare (Texas Water Development Board, 1990). While environmental protection is included in the purpose, it is not the primary focus. Thus the bulk of the document concerns planning to meet projected needs, while the section on balancing water resources development with environmental concerns occupies less than three pages. The absence of a planning agency at the state level whose primary purpose is environmental protection limits the likelihood that a strong environmental plan will ever be developed. (The issue of conflicting agency mandates is considered further in chapter 14.) Only the CCMP for Galveston Bay and the CZMP are likely to focus fully on environmental concerns.

The most important difficulty is implementing the plan without authority; unless there is some means of ensuring that all those affected will comply, the plan is a hope rather than a guideline. Among possible methods of ensuring compliance are funding and regulation. The federal government frequently uses funding as a means for ensuring compliance with a plan: funding for NPS protection is contingent upon having a plan and acting within it, as is funding for many other water and air quality programs. Similarly, the Texas Water Development Board

will not provide loans to local governments for wastewater treatment systems that do not meet environmental standards. Regulation threatens penalties in contrast to the incentives provided by funding. If the CZMP is adopted, the Coastal Coordination Council will be able to prevent federal projects not consistent with the plan from going forward; it already has some authority to prevent inconsistent state and local plans. In contrast, the CCMP developed under a National Estuary Program can only require federal consistency, relying primarily on development of new institutional arrangements (discussed in Chapter 14) and agency coordination.

From this brief description, it is easy to see why environmental plans often sit on the shelf instead of providing guidance to real-world actions. We can also see that the CZM Plan and the CCM Plan, presently being developed under two different federal laws by different groups, complement each other nicely because each has desirable features the other does not have. The CZM Plan has enforcement authority, which is good for implementation, while the CCMP has multi-agency participation, which is good for ensuring that the plan is both comprehensive and largely acceptable to all affected parties. We know that plans are virtually never implemented by people who have no part in their design; GBNEP's planning process helps to overcome that difficulty. Below, however, we will suggest that some important affected parties, notably local governments, are not participating as fully as they should and that this may undermine the effectiveness of the plan.

Another important consideration is that the CZM Program requires other agencies' projects to be consistent with the plan. Thus the success of the program in protecting the environment depends on the plan itself. A strong plan that includes land acquisition, prevents disturbance of habitat, and prohibits shoreline development will help Galveston Bay's environment, backed by the available consistency requirement. A weak plan that "encourages" people to take good steps, "balances" economic development with environmental protection criteria, or "recommends" acquiring land "when possible" will not be inconsistent with any proposed development projects and will contribute to environmental degradation under the guise of protecting it.

One form that planning may take is development of a "vision" that guides other individual decisions. With the vision in mind, each permit, land use, or other decision can be evaluated by asking the question "Will this decision take us closer to achievement of the vision?" While this yardstick does not have the specificity of water quality standards or even of neighborhood compatibility criteria, it does help ensure that individual decisions and decisionmakers can still operate within the framework of the plan and work towards its achievement. In addition to the specific goals and objectives outlined in the CCMP, we believe that it would be useful for the document to describe a (realistic) vision of Galveston Bay and its environs in the year 2005 or so. In addition to providing a yardstick for measuring the myriad individual decisions taken by the several agencies, a vision offers an attractive means for mobilizing the public. Whereas a bone-dry list of objectives may be of little interest, a "story" describing how the bay will look, what animals and plants will be there, and what economic activities it will support could well create interest. In addition, such a vision is often general enough that it can

obtain support from divergent interests. When these interests question particular decisions, the dialog can focus on the question of whether the decision advances us towards the vision. Thus a vision, while not as specific as a plan, may facilitate planning in a way not otherwise possible.

ENVIRONMENTAL PERMITTING

Permitting is the most common technique for ensuring that facilities do not harm the environment. A related mechanism regulates individuals through licensing their skills or activities. A permitting or licensing program should be consistent, should impose criteria related to the environmental purpose, should not cause undue delays, should offer procedural guarantees for affected parties, and should protect the environment. Here we comment briefly on each of these desired characteristics of a permitting program. Readers may wish to consult Tables 13-1and 13-2, which display some of the primary characteristics of the most important permitting programs affecting environmental management of Galveston Bay.

Desired Characteristics of Permitting

Consistency. Every entity in similar circumstances should be treated similarly; for example, the same effluent limits should be imposed for facilities manufacturing the same product and releasing wastewater into segments with similar uses. Consistency is important both from the standpoint of regulated entities, who must be treated equally, and for the agency, which will avoid lawsuits and be able to process permits more quickly if similar circumstances are treated similarly. Many of the programs have guidelines or criteria built in to ensure consistency; the water quality criteria used by the TWC are a good example. However, even these allow for variation, and some programs, notably the RRC's water quality permitting program and the Corps' dredge and fill permit program, do not exhibit such constraints. In these programs, each permit is reviewed on a case-by-case basis, allowing for considerable internal variation among permits. Since the definition of "similar circumstances" is often a very technical one, concerning industrial processes as well as characteristics of the waterbody, we recommend that at least some of the permitting programs be examined in more detail for consistency.

Relation to environmental purpose. Permits should place constraints on permittees that will protect the environment. Again, a full evaluation of this issue requires a technical study. Even from a procedural standpoint, however, we can see that the environmental criteria in many of the permit programs are imposed after the initial permit review is conducted: in the dredge and fill permits and water use permits, agencies or teams concerned about environmental issues *comment* on proposed permits rather than participating directly in the permitting process. Only in the water quality permits are the environmental criteria built directly into the permit review; even here, however, there are problems. For example, local governments evaluate new projects according to neighborhood compatibility criteria that may or may not be relevant to environmental protection.

Table 13-1
Environmental Permits--Permitting Procedures

Permit	Agency Issuing	Description	Public Hearing for Issuance	Time to Obtain Fee	Comments
NPDES	EPA	Parameters for discharges based	If requested.		
Water qual.	TWC	on water uses and allowed discharges.	If notified party requests.	6 mo-several yrs.; $150 new;	
Water qual.	RRC	Fewer parameters; only oil and gas	If notified party requests.	$115 renewals	
Water rights	TWC	Water use in gallons.	If notified party requests		
Septic tanks	TDH (delegated to counties)	Kind of septic tank allowed depending on conditions	No	$100 indiv $250 more complex	Must follow state guidelines. Intended to protect public health.
Dredge/fill	Corps	Amount, location wetlands mitigation federal projects.	Comments by several agencies and public allowed.	50% < 60 days 25% >120 days $10/100	Permit reviewed by other agencies but not vetoed.
Dredge/fill	GLO	Same as for federal if affect state-owned land.			
Land use	City	Consistent with zoning ordinance if extant.	Zoning committee & City Council review. Usually a public hearing	None	Varies with city. Bay area cities have no environmental criteria Unincorporated areas unregulated.
Pumping of Groundwater	HGCSD*	Permit water withdrawal to limit subsidence	No	Fee proportional to water use	Only Harris and Galveston Cos.

Source: Compiled by authors.

*HGCSD = Houston Galveston Coastal Subsidence District.

Table 13-2
Environmental Permits--Enforcement Procedures

Permit	Agency Issuing	Reporting Requirements	Enforcement	Fines
NPDES	EPA	Self-reporting on all parameters	Inspections	
Water qual.	TWC	Self-reporting on all parameters	Inspections--annual ($10,000 fee)	Up to $10,000/day/violation. few imposed; 1991 average under $20,000 total.
Water qual.	RRC	Self-reporting		Up to $10,000/day/violation usually $5000-6000.
Water rights	TWC	Water use in gallons annually		
Septic tanks	TDH (delegated to counties)	None	Citizen complaints.	$50-100 first offense; $125-500 later JPs and county officials seldom impose.
Dredge/fill	Corps	None		
Dredge/fill	GLO	None		
Land use	City	None	Varies with city.	Bay area cities have no environmental criteria.

Source: Compiled by author.

This element is perhaps the most important of all, yet in many ways it is the most difficult to evaluate. That is because there is no absolute level of environmental protection defined in the statutes or, indeed, possible to set. Instead, goals include improving water quality, preventing degradation of air quality, or no net loss of wetlands. Once these goals are determined through the political process, technical experts can help determine specific criteria for reaching these goals. Originally, EPA hoped to develop criteria for water quality permits that took overall water quality into account, but the scientific underpinnings of the necessary model were simply not available. Moreover, this approach would have required each permit to be assessed in such a way that it would take years of labor to complete an assessment. With about 1000 water quality permits in the Galveston Bay area alone, this would have toppled environmental protection. The approach adopted, therefore, was the one described in chapter 3: a combination of wasteload levels acceptable for certain uses, determination of the appropriate use for a particular segment, and models designed to determine effluent limits that would probably maintain acceptable loadings in the segment. As our scientific knowledge has increased, the cost of issuing permits more closely attuned to the protection of larger bodies of water has declined; this advance partly underlies the watershed initiatives mentioned above. However, the relationship between specific permitting criteria and maintenance of the general environment will always be somewhat tenuous. Some technical studies concerning current effluent limits might suggest ways of improving the system; surely Texas' recent move to include limits on more kinds of toxics in the permits is a step towards improving the congruence between permit limits and environmental quality.

Delays. Table 13-1 displays the major permitting programs affecting environmental management of Galveston Bay. It shows that the time to get a permit can range up to years. One important cause of the lengthy times involved in permitting is simply the procedural requirements that governments have applied to ensure equity. Requirements for notification, public comment, review, and appeal all help ensure that affected parties have an opportunity to participate while treating applicants for permits fairly. If permits were issued at the end of the minimum period necessary, taking into account all the procedural requirements, applicants would be overjoyed: it is the uncertainty of the additional delays that creates problems. Unfortunately, efforts to streamline the permitting process, such as the one proposed by the Army Corps of Engineers for CWA Section 404 dredge and fill permit review, are likely to reduce the effectiveness of the process in ensuring protection of the environment. This is especially true in cases which, like the 404 permits, do not have environmental protection as their primary goal, but only as one of several goals to be balanced.

Procedural guarantees. Both the federal and the Texas Administrative Procedures Acts provide a range of procedural guarantees for affected parties. All of the permitting processes reviewed at the federal and state levels require affected parties to be notified, offer them an opportunity to protest, allow for public hearings and even rehearings, and require both staff review and final approval by responsible authorities such as the Texas Water Commissioners. Permittees are also given procedural guarantees; agencies review applications for completeness

and provide reasonable periods for providing additional information. They usually work informally directly with the permittee to devise a permit acceptable to both sides. Permittees may appeal unfavorable agency decisions.

Despite the many careful procedures, however, the public often cannot participate in permit proceedings to the extent it would wish. For example, the public notice and comment period may be unduly short (only 2-4 weeks for dredge and fill permits), especially taking into account the difficulty of learning that a permit application has been filed. More important, those wishing to participate in a public hearing about a permit application must demonstrate that they have a specific interest unique to them, not shared by the public in general, that could be affected if the permit is approved. This criterion limits participation, since many of the environmental problems associated with permits are general rather than specific. Comments from the public, which are allowed during the hearing, must consist of a brief oral or written statement which is *not* considered as evidence by the hearing examiner, in contrast to the statements by affected parties and experts. We have also noted the tendency for public hearings to be held in Austin, no matter the locale of the permitted facility. This constitutes a very serious limitation on public input, requiring citizens not only to learn about the hearing but to travel to Austin during the working day to offer their comments.

Other Characteristics

In addition to these desirable characteristics of a permit, we should comment on another feature that often escapes notice:

• Equitable costs. At present, most of the permits for activities that stress the environment of Galveston Bay cost very little: water quality permits cost $150 or less, dredge and fill permits cost $10 for individuals and $100 for commercial entities, and septic tank permits for most individuals cost $100. These fees do not begin to cover the costs of issuing the permit, much less the cost of rectifying any stress they place on the environment. Commercial entities applying for permits must pay for other resources they use, including machinery, land, and labor. Permit fees should be raised substantially, at least enough to pay for the cost of issuing the permit, and probably enough to pay for the costs of continued monitoring and oversight. The new permit fees for solid waste disposal are determined by the volume disposed; this patterns offers two benefits: incentives to minimize disposal and higher fees to support the program. The Texas Legislature should consider allowing agencies to retain permit fees, at least in part; this ensures permittees that their fees are not subsidizing other governmental activities while providing agencies with adequate budget to meet the requirements of issuing permits and monitoring permittees.

• Licensing is another form of permitting, often used when it is too difficult to monitor an activity. Instead, government attempts to ensure that the individuals conducting the activity are qualified. Among the licenses required for activities with an environmental impact on Galveston Bay are those for wastewater treatment facility operators (especially important for small package treatment

plants such as those operated by many MUDs), applying certain pesticides, and piloting ships through the Ship Channel.

If permits are an imperfect instrument of environmental protection, in many cases they are still remarkably effective. Many people we interviewed in the course of this study commented on the strong improvement in many aspects of Galveston Bay's environment, especially water quality. This finding is confirmed by GBNEP's study of ambient water and sediment quality in the bay, which concludes:

> Perhaps unexpectedly, the quality of the bay is generally good, and where it is degraded there is a trend of improvement, in many cases substantial (Ward and Armstrong, 1992).

This improvement can be traced directly to the success of the point source management program. However, there are also instances in which permits are not and perhaps never can be effective. In the section on non-regulatory environmental management, we discuss methods of protecting the environment that differ from the command-and-control style of permits and regulation.

ENVIRONMENTAL MONITORING

Environmental monitoring can be divided into two major categories: compliance and ambient. While the former, as its name indicates, is intended to ensure that particular entities comply with various rules and regulations, perhaps embodied in a permit, ambient monitoring keeps track of the general state of the environmental medium. It may be used as part of a compliance program, for research, for developing new standards, or for any number of similar purposes.

Virtually all the agencies and programs conduct one or both of these kinds of monitoring. In addition, the requirement that all water discharge permittees, including municipal wastewater treatment plants, report their own discharges elicits monitoring from these individual entities. (Self-reporting of water use appears not to elicit such monitoring—people just report what is allowed.) However, these agencies monitor for different purposes, use different monitoring parameters, use different monitoring protocols rendering even apparently similar data incomparable, and may report the data in different formats. Even agencies using the same laboratories to analyze samples often require analyses to be conducted in different ways, losing the internal consistency that might otherwise be gained.

GBNEP's data inventory project and water quality studies found that, in addition to the loss of older data that could serve as a baseline, many important parameters are being undermonitored or not monitored at all. These include monitoring of sediments both for contaminants and inherent characteristics such as texture; intratidal and diurnal measurements of dissolved oxygen, temperature, and salinity; and general monitoring of suspended solids. In other bay areas, citizens have expressed interest in hot spots, especially toxic hot spots.

The concerns with monitoring are illustrated by a more detailed review of programs for monitoring water, the most frequently sampled medium. No less than eight governmental agencies conduct routine water sampling procedures in the Galveston Bay system (see Table 13-3). Additionally, the Texas Railroad Commission (RRC) collects water sampling information (oil and grease) through its self-reporting system, but the RRC is not included in the chart because it does not conduct routine sampling itself. None of the agencies coordinates the use of such data with other agencies, although the Texas Water Commission's (TWC) State Wide Monitoring Network (SMN) does include some data from the United States Geological Survey (USGS), the Texas Water Development Board (TWDB) and some data collected in non-governmental studies.

Perhaps the largest monitoring program is TWC's statewide monitoring network (SMN), which collects water quality data from about 700 sites statewide. Locations are sampled at varying frequencies, mostly annually, for physiochemical, biological, toxic substances, and hydrological data. Unfortunately, there does not seem to be an element of unifying control governing the SMN from sampling collection to final data entry. Data collected at the TWC field office level is processed through the Texas Department of Health's laboratory. Subsequently, the results of such lab work are returned to the TWC in Austin, where it is transcribed for data entry. The multi-step process moves data progressively away from those most able to detect or explain discrepancies, i.e., those persons conducting the original sampling operations. The end result is a system which permits errors to creep in at every level of the process.

It would seem especially important to improve this data management system in light of the fact that the SMN represents one of the single largest sources of water sampling data. The fact that the frequency of sampling performed by the TWC has declined in recent years further emphasizes the importance that those samples that are conducted should contain a high degree of accuracy in their final form. Although accuracy is important regardless of the size of the data set, accuracy arguably becomes increasingly important if that data set is declining in size.

Three additional problems of data management surfaced in our investigation. First, sampling data collected by the Harris County Pollution Control Department is not maintained in duplicate, and must be reviewed on-site under staff supervision. Such data is often the basis of litigation, thus explaining the tight control of the information. Unfortunately, such control provisions have the effect of precluding integration of the data for use either by other agencies or by the public in general. Data collected by the Galveston County Health District (GCHD) is generally maintained on raw data sheets due to the lack of a reliable digital data management system. The state of such information makes its utilization rather cumbersome and generally prohibits further integration with other data collection systems such as the SMN.

It is noteworthy that air sampling efforts conducted by the GCHD are integrated with the Texas Air Control Board (TACB). This integration may be explained, in

Table 13-3
Monitoring of Water Quality Indicators by Texas and Local Agencies

INDICATORS	AGENCY								
	TWC Self*	TWC Compliance	TWC Statewide Monitoring Network	TWDB	TPWD	HCPC**	GCHD	CORPS	TDH
Nutrients	X	X	X	X	***	X	X	X	***
Inorganics	X	X	X	X	***	X	X	X	***
Organics	X	X	X	X	***	X	X	X	***
Toxicity	X	X	X	***	***	***	***	X	***
Metals	X	X	X	***	***	***	***	X	***
Pathogens	X	X	X	***	***	X	X	***	X
Water Quality Indicators	***	X	X	X	X	X	X	X	X
Monitoring Characteristics									
Purpose	C	C	WQ	NMP	M	C	M	Dredge/Fill	Shellfish
Frequency	Monthly	Annual	Varies	Bi-monthly	Varies	Monthly	Monthly	Varies	Varies
Format	Digital	Written	Digital	Digital	Digital	Both	Written	Digital	Digital
Period	1969 -	1963 -	Varies	1975 -	1975 -	1970 -	Varies	1960s -	1950s -

Source: Compiled by authors

*Self-reporting
**Harris County Pollution Control District
***Agency does not monitor this indicator

Monitoring Characteristics
C = Compliance
M = Monitoring
WQ = Water Quality
NMP = National Monitoring Program

part, by the fact that automated air monitoring procedures may be more easily coordinated than manual water sampling procedures. Furthermore, the air monitoring section of the GCHD seems to have enjoyed a more cooperative history with the TACB than the GCHD's water sampling section has had with its state agency counterpart (the TWC). Establishment with industry assistance of a means for reporting air emissions directly to TACB provides a model that water quality monitoring might attempt to emulate.

Finally, the fact that TWC compliance inspection data is not digitalized restricts efficient analysis of such information. Compliance information would seem to be especially useful to outside parties interested in the performance of various discharges, and therefore, any process which would better facilitate access to such data would seem welcome.

Arguably, the single most expensive element of water sampling is the actual field collection. Thus, our project team initially viewed the overlaps in sampling as a possible opportunity to better coordinate such efforts in an attempt to reduce costs of redundant procedures. However, given the large geographical area entailed in the Galveston Bay system, and the fact that recent TWC water sampling frequency is on the decline, it would appear that such redundancy provides a much needed safeguard by filling in days or times or areas that would otherwise be missed (although none of the other agencies monitors as many parameters). Furthermore, the fact that a portion of the data now being collected for inclusion in the SMN contains a degree of inaccuracy in its final form constitutes another reason for reservation concerning a possible consolidation of such procedures. Improved data management does, however, represent an opportunity to improve the utilization of and access to data currently being collected. Digitalization or duplication of final data sheets would facilitate such management efforts. Additionally, it would seem necessary to institute a more unified process to improve the integrity of the data maintained in the State Wide Monitoring Network.

ENVIRONMENTAL ENFORCEMENT

Enforcement of environmental regulation in Galveston Bay is accomplished at two levels: inspections and oversight to detect violations, and prosecution of violators. Table 13.2 summarizes some information about enforcement.

Oversight

In every case where self-reporting is required, these data are used to help detect violations. Water quality inspections are conducted annually for large point sources, less frequently for small. Virtually no post-issuance inspections are conducted for other kinds of permits. Thus detecting violations, except for water quality permits issued by TWC and EPA, is largely a matter of chance: if a knowledgeable staff person happens by in the course of other duties or if a citizen registers a complaint. With this minimal level of detection, it is not surprising that few violations are found. One would think that those few violations that are

detected by this method must be egregious, leading to sure prosecution and fines or other penalties. This is not always the case.

Prosecution of Violators

Working with identified problems occurs through three primary means: warning letters and informal negotiation, fines assessed by the agency, and lawsuits.

Informal negotiation. For obvious reasons, informal negotiation is the most frequently used method of enforcing against violators. Agencies save time and money and accomplish the primary purpose—protecting the environment—if they can just get a violator to change his ways. The disadvantage of informal negotiation is that it has little deterrence value, since no additional costs are imposed for the period preceding detection and rectification of the violation. Moreover, the lack of publicity attending such negotiations leaves other violators under the impression that they are safe. Finally, the very informality of the proceedings leave them open to control by the violator, whose higher stake and larger relative resources allow him to continue dickering and drag on the proceedings until the agency staff just give in to a relatively minor penalty.

Fines assessed by agencies. Fines can be assessed as civil or criminal penalties, depending upon the provisions of the relevant statute. In recent years, the Texas Legislature has increased many of the fines to reasonable levels for deterrence—up to $10,000 per day per violation for water quality violations, for example. However, assessed fines are usually much lower. Agencies typically take violators' past records into account along with other mitigating factors. In the case of septic tank violations, fines are low and local JPs or County Commissioners generally decline to impose them. Perhaps an increase in the fine, with some of it kept by the jurisdiction, would lead to more aggressive enforcement as well as signaling the importance of the problem.

It is possible to use the settlement process, whether formal or informal, to impose additional conditions on violators. As we shall discuss below, EPA has recently used a settlement to force violators to install pollution prevention measures. This approach should receive attention in Texas.

Lawsuits. Because they are the most time-consuming, complex, and expensive method of enforcement, lawsuits are conducted rarely. Most state agencies must send suits to the Attorney General's Office.

Readers will note that this section is considerably briefer than those on planning, permitting, or monitoring, the other components of the regulatory process. That is because enforcement is the big gap in Texas environmental management. Post-permit review is virtually nil, the few detected violations are settled informally, and the minuscule number of cases settled more formally involve relatively small fines. Industry representatives suggested to us that agencies faced with evidence of continued environmental problems tend to increase the stringency of regulations (a relatively low-cost activity that can usually be

undertaken with existing staff) rather than enforcing the existing ones (more expensive and staff-intensive activity). They believe that the regulatory process is better served by more adequate enforcement, at least in part because it makes the system more equitable.

Some brief notes on enforcement at the federal level:
1) EPA has attempted to increase its use of fines recently.
2) Two recent changes may increase the consistency of federal enforcement: First, in July 1991, the U.S. Department of Justice issued guidelines to be used in determining whether to prosecute environmental violations. Among the factors suggesting relative leniency are voluntary disclosure, cooperation, preventive measures, and internal disciplinary actions. Since these are guidelines, they may differ from prosecutor to prosecutor. Second, on November 1, 1991, the Federal Sentencing Guidelines were revised to include sentencing of organizations, which prior to that time had been considered individuals. Organizations violating transport of hazardous materials may be fined as little as $250 and as much as $290 million; they must remedy any harm caused by the offense (costs of remedy not to be counted toward the fine); and their culpability will be determined by steps taken beforehand to prevent and detect violations and organizational tolerance of them. Other environmental statutes were excluded from these sentencing guidelines because of the potential for much longer-lasting environmental harm; further guidelines of more stringency are expected for the remaining environmental statutes. (Waska and Monck, 1992)

INTERLUDE: GENERAL PROBLEMS OF THE REGULATORY PROCESS

We cannot leave our discussion of the regulatory process without noting several interrelated themes that were echoed by virtually everyone, both in government and out: the low salaries paid by agencies leads to high staff turnover, which in turn leads to poorer quality environmental regulation and more public/industry discontent. Agencies are also hindered by lack of personnel and other resources: remember, for example, that it is more expensive in both money and staff time to conduct post-permit inspections, and it is easy to see why enforcement of this type is so rare. Below we comment further on some of the ramifications of these problems:

Staff turnover: Training of new employees to replace those who have left the unit depletes resources and time of more senior staff. High turnover also leads to a loss of consistency from one year to the next. The 1992 Performance Review of TWC by the Comptrollers Office identified the high turnover rate as a contributing factor to the persistent backlog of enforcement cases. Cynics believe that the government gets the less qualified among the available pool, precisely because of the low wages. Our experience suggests otherwise, but we do not believe that state employees should forever be consigned to wages 25 percent or more lower than those offered in the private sector.

Complications of hiring. Hiring new employees for vacant positions is a long process, often taking more than 2 months. Continual hiring freezes frequently keep offices at below staffed levels.

Too few staff people. Even when fully staffed, most offices are too small to accomplish their duties. Notably, permit offices tend to be better staffed than enforcement or compliance offices. When the Legislature increases the stringency of environmental laws, it frequently forgets to include money to implement them.

Poor regulation. Like permits, regulation itself should be consistent, accurate, and timely. Without adequate staff, regulation is none of these: it cannot be timely because of the backlogs that develop, it cannot be consistent because there is so much staff turnover, and it cannot be accurate because new staff do not know all the complexities of the rules. (For some years, we have been advocating the use of computerized expert systems to help overcome some of these problems. Agency staff embrace the idea with enthusiasm, but managers seem to think the time and money spent developing such systems are wasted.)

In addition, we note the extraordinary extent to which the effectiveness of environmental management depends on the particular people who are there. While we expect policy changes with changes in political administration, our comment extends beyond that phenomenon. On the one hand, the regulatory process cannot be so constrained that it would operate exactly the same no matter who was doing the work: this would be government by robot. On the other hand, major policy trends may be determined by the particular people or combination of people who hold certain positions. For example, several people mentioned the responsive attitude of the then-incumbent head of the district office of the Army Corps of Engineers as an important factor in improved efforts to save Galveston Bay's wetlands. Should this important decision depend upon a single man, or should the outcome be built more clearly into the process itself? We think that procedural safeguards are the surer and more equitable method.

POLLUTION PREVENTION

Preventing pollution is better than cleaning it up afterwards. It certainly protects the environment more, and, if all the costs to others are included, it is doubtless cheaper as well. Like preventive health care, it usually requires developing good habits and persisting with them, despite the minor discomforts entailed.

Until recently, polluters have often had little incentive to consider the costs they impose on others, so prevention seemed a burdensome approach. Gradually, however, many commercial facilities have come to realize that prevention is indeed cheaper as well as more effective. It is more than an apocryphal story that one well-known U.S. company with major facilities dispersed around the nation was shocked when, forced by requirements of SARA Title III to collect data on how many pounds of CFCs it was emitting to the atmosphere, realized that all the facilities taken together were wasting chemicals worth millions of dollars. The company immediately initiated a program to capture the CFCs and reuse them. In short, the company discovered that environmental wastes are literally that—a waste of resources. Unfortunately, the benefits to individuals to modify their

behaviors are not as clear, and individual pollution prevention is difficult to engender.

Pollution prevention is now the program of choice for most environmentalists and, at least in part, for EPA. The pollution prevention statutes of many states focus on or are limited to toxic substances. The Texas Water Commission has an Office of Pollution Prevention established as a result of S.B. 1099 to reduce toxics and contaminants in Texas through source reduction and waste minimization. The Office, which reports directly to the Executive Director, has a staff of 10 which helps industries that report toxics emissions develop plans for reducing pollution, conducts audits of specific industries, and conducts workshops on preparing pollution prevention plans. The office is responsible for an assessment of the potential for pollution prevention; the first report is due in 1993. GBNEP is funding TWC to conduct a demonstration project on industrial waste minimization in the Houston Ship Channel.

Many of the projects of the nonpoint source reduction program also have pollution prevention as a goal. Thus municipalities are also involved in pollution prevention, which is, as we have noted, the most effective means for reducing the problems associated with NPS.

One Texas facility, the FMC Corporation, a chemical manufacturing company in the Pasadena area, received a NICE3 grant under the National Industrial Competitiveness through Efficiency: Energy, Environment, Economics program. This program, funded by EPA, the Department of Energy, and the Department of Commerce, demonstrates new technologies for pollution prevention and energy efficiency and tries to break down barriers to industrial pollution prevention. FMC developed a method for recycling methanol; thus far, under the project, 69,000 gallons of that substance were not incinerated but were recycled, an energy savings of 43,000 BTUs and a dollar savings of nearly $60,000 in one quarter.

Industrial Pollution Prevention

Pollution prevention means eliminating or reducing pollution at the source. Some steps for pollution prevention are relatively simple, such as covering containers of volatile chemicals more carefully. More complex responses include capturing emissions and reusing them, substituting raw inputs for others less toxic or more efficient, redesigning manufacturing process, increasing production efficiency, or redesigning and reformulating products. These more complex steps often require research or capital investments that small and even middle-sized companies often cannot afford. One important role for government is to provide technical assistance and perhaps loans to companies unable to take major pollution prevention steps unaided. EPA is developing guidance for particular industries about pollution prevention and has awarded grants to 31 small businesses for demonstration projects. One of the 1992 awards went to the Environmental Pesticides Group in Pasadena for developing a natural fire ant killer.

In addition to these costs and the lack of scientific knowledge about what might constitute effective pollution prevention, there are other barriers built into the present regulatory system. As we have seen, the system tends to focus on a particular medium (such as water or air) and, because of the number of affected entities, on easily quantified evaluation criteria such as the quantity of a pollutant emitted. In contrast, pollution prevention often affects several media at once and is difficult to monitor and evaluate, especially because it may be specific to a particular facility. The multimedia focus of pollution prevention is a particular problem in Texas, where environmental regulation is divided among several agencies. Even when the Texas Air Control Board becomes part of the new Natural Resources Commission, it will remain a nearly separate entity for some years. Yet providing incentives and recognizing pollution prevention efforts, no matter which medium they benefit, is a necessary element of an effective prevention program.

Because pollution prevention often entails fundamental changes in a facility's operation, it must have support from top management as well as the environmental staff. Management often fear loss of market share, changes in product, and interruption of production that may occur if these changes are made, and therefore they tend to avoid pollution prevention, especially if the benefit/cost ratio is about 1:1. In addition, American managers are notoriously focused on the short-term, while the benefits of pollution prevention often accrue over a longer time. Despite these problems, 734 companies nationwide (35 in Texas) have joined EPA's 33/50 program, promising to reduce their releases and transfers of the 17 high priority toxic chemicals by 33 percent by 1992 and 50 percent by 1995.

One solution to this problem is to create market signals that reflect the true costs of polluting; i.e., larger fees for permitting, monitoring, and violating the existing regulatory regime. Since this same approach is useful for making the present system more effective, it can serve a dual purpose. EPA has adopted this strategy in part by including pollution prevention provisions in settlements with violators.

Pollution prevention is not the only or even the primary means for reducing pollution. Human activity generates pollution, and there are limits on what any prevention program can accomplish. Lack of knowledge about alternative processes and substitute products, uncertainty about whether these alternatives might create different kinds of problems as yet unknown, and lack of resources for making the sometimes fundamental changes that pollution prevention entails are all limitations of the pollution prevention approach. As more knowledge is gained and as the costs of disposing of all kinds of wastes continue to rise, however, pollution prevention will surely become more important.

Individual Pollution Prevention

Nonpoint source pollution is largely created by individuals; thus there is a role for the public in pollution prevention. Unfortunately, while the decisions that face individuals are similar to those facing companies, it is harder to devise market incentives that encourage sound individual behaviors. In short, the costs of not

polluting are higher than the costs of polluting for most individuals, who cannot easily assess the indirect costs of everyone else's polluting too. That is why chapter 4 on nonpoint source pollution stressed education.

Family farmers fall between the two categories, acting on an individual basis but with a more clearly-defined set of costs and benefits to consider. Iowa has developed a program to help farmers reduce use of both diesel and fertilizer, the cause of unacceptably high nitrogen levels in many rural and urban water supplies in the state. Programs included one-to-one education programs, field days, public meetings, and marketing campaigns to show farmers how to reduce use of nitrogen and pesticides. Many farmers had simply been applying too much nitrogen to their crops; although the state spent $11 million on training over the course of a decade, farmers together saved more than $88 million in fertilizer in the same period.

NON-REGULATORY ENVIRONMENTAL MANAGEMENT

In addition to the kind of command-and-control regulation exemplified by the permitting processes considered in the first four subsections of the chapter, there are many other means for accomplishing environmental protection. Among them are:

Information provision.

This form of environmental management assumes that if people have the proper information, they will act accordingly—in the case of the environment, they will act in socially beneficial ways. The most common example of an information provision program is the labels on food, pharmaceuticals, and hazardous consumer products. These labels give people information that allows them both to understand the risks presented by the product and what actions to take to avoid the risk; for example, by storing a pressurized can away from heat. Labels are effective because the individual bearing the risk can take action to reduce it.

Pesticides also bear labels that describe both appropriate conditions for applying them and environmentally sound disposal methods. The risks posed by pesticide application (except for acute exposure to the applicator) are very different from those posed by most labeled consumer products: they are borne by the harvesters and eaters of the crop and perhaps neighbors and the environment, and they accrue over the long term. The costs of applying and, especially, disposing of them in a sound manner are borne by one person, while the bulk of the benefits of these actions accrue to others. (The label does note that it is a violation of the law to use pesticides in a manner conflicting with the label, but enforcement is virtually impossible.) In such cases, people have much less incentive to pay attention to information.

In the case of pesticides, states and EPA have taken additional steps to try to ensure compliance: Many pesticides may be applied only by a licensed applicator, who must undergo some training, and agricultural extension agents often work

directly with farmers to explain sound pesticide use. However, these methods affect only some of the users and some of the pesticides.

Education is another form of information remedy. In contrast to labels, public education campaigns tend to be expensive and, in part because they cannot be closely targeted to relevant people, to have a relatively low payoff. However, for certain kinds of problems, such as nonpoint source pollution, there are few options other than public education (but see incentives, below). Training programs for specific groups, such as pesticide applicators or harbor pilots, are more expensive per person but tend to be more effective, especially if accompanied by the power to take away a license.

Incentives/inducements.

Governments may offer people, companies, or other governments money upon condition that they act as desired. We have seen a variety of such programs: grants to states for NPS pollution reduction if states have developed an appropriate plan; loans for properly constructed wastewater treatment plants; loans or grants to farmers who do not drain wetlands; even tax abatements for facilities that fulfill certain conditions, which could, although seldom do, include measures for protecting the environment. Table 13-4 lists a series of federal programs that offer such inducements to individuals; programs offering incentives or inducements to states are not listed, nor are specific EPA programs, which are presumed to aid the environment. The table also includes a notation concerning grants in the 5-county area. This information includes grants in the first half of 1991, the latest information on the Congressional Database when we consulted it through the generosity of the staff of Congressman J.J. Pickle of Austin. What is striking is how many of these incentive programs have made no grants near Galveston Bay. Although the on-line program descriptions may not have included any geographical limitations excluding our study area, we attempted to select from among the thousands of grant programs listed those clearly related to our concerns. A more detailed review of awards under these programs might highlight these indirect means for enhancing environmental protection efforts in the bay area.

Technical assistance.

This is simply an in-kind form of incentive or inducement. Technical assistance programs identified earlier in this document focus especially on farmers for various aspects of soil conservation and minimizing NPS pollution. TWDB offers some technical assistance to cities trying to upgrade their wastewater and stormwater collection and treatment systems. The Chemical Manufacturers Association has established a technical assistance program in which large companies participating in the Responsible CARE program offer aid to smaller companies in reducing emissions, especially toxic emissions. EPA and TWC require training for wastewater treatment plant operators. The Houston-Galveston Area Council (HGAC) offers technical assistance for this and many other environmental programs, especially to the small cities in the bay area.

Table 13-4
Federal Financial Assistance Programs With Positive Environmental Effects

Agency	Office	Program	Purpose	Local Awards, 1991 (in $000)*
USDA	Agricultural Stabilization and Conservation Service	#Feed Grain Product Stabilization	Ensure adequate production, conserve natural resources.	B400 C 200 G85 H248 L500
USDA	Agricultural Stabilization and Conservation Service	#Wheat Production Stabilization	Adequate production, conserve natural resources.	B 7 (3) C40 (4) G 2 (2) H 25 (3) L 70 (4)
USDA	Agricultural Stabilization and Conservation Service	Conservation Reserve Program	Reduce Soil Erosion and sedimentation; curb surplus.	No awards
USDA	Agricultural Stabilization and Conservation Service	Water Bank Program	Conserve surface waters, improve wetlands.	No awards
USDA	Agricultural Stabilization and Conservation Service	Rural Clean Water Program	Control agri. nonpoint source pollution.	No awards
USDA	Agricultural Stabilization and Conservation Service	Agri. Conservation Program	Control erosion and sedimentation.	B 2.5 (2) C 9 (2) G.8.5 (3) L 4.5 (3)
USDA	Agricultural Stabilization and Conservation Service	#Rice Product Stabilization	Ensure adequate production, conserve natural resources.	B 7000 (5) C8000 (5) G1000 (5) H 275000 (5) L 6000 (5)
USDA	Soil Conservation Service	Resource Conservatn and Development	Improve capability of rural areas to conserve natural resources.	awards used in other cos.
USDA	Soil Conservation Service	Soil and Water Conservation	National soil and water conservation program.	No awards
USDA	Soil Conservation Service for Conservation	Plant Materials	Promote use of new plant materials for resource conservation.	No awards in Texas
USDA	Soil Conservation Service	River Basin Surveys	Planning assistance for agri	No awards in Texas

		and Investigations	NPS and water management.	No awards
USDA	FHA	Soil and Water Loans	Soil /water resource conservation; pollution abatement. (also drainage)	
USDA	FHA	Water/Waste Disp. Syst. -Rural Areas	Improved rural water and waste disposal faciities.	No awards
USDA	FHA	#Watershed Protectn + Flood Prevention Loans	Loan assistance to local organizations.	No awards
USEPA	Office of Water	Construction Grants-Wastewater Treat.	Construct municipal wastewater wks. to meet w. q. standards.	B$105000 H 7 $450K
Commerce	Economic Development Administration	Ec. Development - Public Wks Impact	Promote ec. dev. and immed. work to unemployed; construct sewers.	No awards.
DOD	Department of the Army	Beach Erosion Control Projects	Control beach and shore erosion.	No awards
Interior	Fish and Wildlife Service	Environmental Containment	Info and tech assist. on pesticide	
Interior	Geological Survey	Water Resources Research Institutes	$$ to water research institutes	Tx A&M 103,000
Interior	Geological Survey	National Water Resources Research	$$ to needed water research	2 awards to UT, not coastal
Energy	Conservation Energy	Industrial Energy conservation	Reduce waste generation, increase recycling. Energy eff.	H (3) : $225,000

Source: Compiled by authors.

* grants/loans in $000 unless otherwise noted, followed in () by number of grants.
Abbreviations: B=Brazoria County; C=Chambers; G=Galveston; H=Harris; L=Liberty.
means that the program could also have deleterious effects.

Market mechanisms

Although grants and loans appeal to people's economic instincts, market mechanisms constitute a somewhat different means for tapping normal economic behaviors to achieve environmentally productive results. Market mechanisms operate by creating a framework or set of market rules within which people can simply behave as economic maximizers. Thus under different conditions, affected parties respond differently, but efficiently for themselves. Among the market mechanisms in place are pollution charges, marketable permits, deposit-refund systems, market-barrier reductions, and elimination of government subsidies (Fiorino, forthcoming).

Pollution charges. This mechanism makes polluters pay a fee for each unit of pollution, thus accounting directly for the costs of their activities. Pollution charges rest on the assumption that some polluters can control emissions more cheaply than others. Thus polluters will control emissions to the point that the marginal cost of control equals the amount of the fee. Less controls will cost more in fees than they would spend for controls; conversely, more controls will cost more than the fees. Each polluter acts efficiently internal to his own system and at the same time pays society for the costs of such pollution as is generated. The trick, of course, is to set fees at a level that will induce economically rational behavior that is at the same time consistent with environmental protection. Setting fees too high or too low will hurt one or the other of these goals.

Pollution charges are not in widespread use, although there is considerable discussion of a "carbon tax" on fuels of all kinds, combustion of which contributes to global warming. These fees are imposed on the raw materials likely to cause an environmental problem; fees may also be imposed directly on emissions. These fees, unknown in the United States although proposed in 1972 by the Nixon Administration to be applied on sulfur oxides to reduce air pollution, may be either flat or increasing as the costs of reduction increases. The increasing fee is more consistent with economic theory, which recognizes the increasing costs— both for polluters and for society generally— of reducing ever more units of pollution.

User fees. Another form of pollution tax tied to use of a particular resource. Hunting licenses are a user tax that also serves to control the number of hunters. The gasoline tax is an indirect user tax, since the quantity of gasoline purchased is only an indirect indicator of road use; road tolls are a direct user fee. Note that in both these cases, the fees are dedicated to road maintenance. In devising user fees for environmental goods, more could be accomplished if at least some of the revenues were dedicated to the environmental purpose.

Marketable Permits. Policymakers set a total level of acceptable emissions, then allocate permits allowing discharge or use of pollutant up to that level. Although setting the total accurately requires considerable scientific understanding and allocating initial permits requires considerable political acumen and will, once established, the market will take care of itself. Those who need more discharges

will buy the rights from those who need less. Efficiency is achieved with respect to the social costs spent reducing the particular pollutant(s) covered by the market, although it may encourage inter-media transfers of pollution. The Clean Air Act of 1990 has established exactly such a market for emission of sulfur dioxide, and the first purchase of pollution rights under the law occurred in May, 1992. The total established in the law is intended to achieve an overall reduction in emissions. A similar program might, if allowed under present federal legislation, be consistent with the new watershed approach to controlling water pollution.

Deposit-refund. A refundable surcharge or products or their residuals (containers, wastes) whose improper disposal causes environmental problems should induce people to return the offending material for proper disposal. Many other U.S. states have "bottle bills," which impose a fee of 5 to 10 cents per bottle, refunded at the grocery store when the bottles are returned. A similar system has been adopted in a few states, including Maine and Rhode Island, for lead-acid batteries. This system not only reduces the introduction of lead into the environment through disposal in landfills or incinerators, but by allowing recycling it reduces the demand for virgin lead and thereby slows the increase in the total lead loading. A deposit-refund program for plastic containers, an important component of bay debris, would work in the same way if an adequate demand were generated for recycled plastic. Perhaps a similar program could be instituted for used motor oil.

Subsidy reduction. Subsidies distort markets. They make it cheaper to undertake some action than would be possible in the unconstrained market. While subsidies (called incentives or inducements above) may encourage people to take otherwise costly behaviors that promote environmental protection, they may also make it easier to harm the environment than would otherwise be the case. These programs are discussed in more detail in the following section.

It would take legislative action (possibly at both federal and state levels) in most cases for Texas to make use of the market mechanisms; the other remedies are already available although perhaps not utilized as fully as they might be.

PROGRAMS CONFLICTING WITH BAY GOALS

A number of financial assistance programs conflict with bay goals, especially those relating to economic development. We discussed tax abatements and related tools used by local governments in chapter 8 on shoreline development. We also mentioned there the ironic role of the National Flood Insurance Program, premiums for which are paid by people living in flood-prone areas. Because more claims are made each year than premiums are paid, the program effectively subsidizes people to live on the coast and in erosion-prone areas. Limiting the availability of insurance to people living in areas that need to be protected would be a useful step.

Perhaps the largest program conflicting with environmental needs is crop subsidies, which, by raising the price farmers can get for crops encourage them to plant on marginal lands and to over-crop. As noted in the chapter on erosion, such subsidies are increasingly dependent upon complying with new laws to minimize erosion and even withdraw land from production.

Throughout this report we have also mentioned a number of federal water management projects that have at least some effects conflicting with bay goals. The Wallisville Reservoir, widening and deepening of the Houston Ship Channel, Gulf Intracoastal Waterway maintenance, and other channelization projects all may contribute to erosion, sedimentation, disturbance of the bay bottom and associated wildlife, and disturbance or loss of wetlands. Because these projects have already been considered and because they do not constitute general grant programs, we do not include them in Table 13-5, which lists a variety of federal programs that appear to offer incentives to take actions that could harm the environment, using the Congressional Database described above. We challenge readers to develop a similar list for state programs; a related problem is discussed in chapter 14 under the heading "Conflicting Agency Goals."

RESEARCH

Scientific research plays an important role in environmental management. It forms the basis for models that predict or describe ecosystem functioning, justifies standards, and undergirds every aspect of the regulatory process. Although science alone cannot determine regulatory policy, without it there is no reasonable basis for regulation.

Galveston Bay has been the subject of many studies. These seem to come in waves as interest focuses on the Bay and then turns elsewhere. In the late 1960s and early 1970s, for example, the Galveston Bay Project and related studies were conducted in response to EPA's concern about water quality degradation in the bay. GBNEP now serves as the motivation for a new set of studies, not all of which are funded by the program itself.

Research is conducted both within agencies and by independent researchers. For example, the National Marine Fisheries Service operates the Southeast Fisheries Center Galveston Laboratory. Along with research conducted in the Gulf of Mexico, the Center sponsors scientific research on biological and ecological components of the estuarine environment. Among current projects are marshgrass restoration studies, benthic community studies, and studies of by-catch, and marshgrass restoration. The Center would like to conduct additional studies to fill important information gaps, especially those with direct implications for managing habitat: the relative productivity value of different estuarine habitats, the limiting factors for seagrass survival, and the effect of trawling on benthic communities.

Table 13-5
Federal Financial Assistance Programs With Potentially Negative Environmental Effects

Agency	Office	Program	Purpose	Local Awards, 1991
USDA	Agricultural Stabilization and Conservation Service	Feed Grain Product Stabilization	Ensure adequate production, conserve natural resources.	B400 C 200 G85 H248 L500
USDA	Agricultural Stabilization and Conservation Service	Wheat Production Stabilization	Adequate production, conserve natural resources.	B 7 (3) C40 (4) G 2 (2) H 25 (3) L 70 (4)
USDA	Agricultural Stabilization and Conservation Service	Rice Product Stabilization	Ensure adequate production, conserve natural resources.	B 7(5) C8 (5) G1 (5) H 275 (5) L 6 (5)
USDA	Farmer's Home Administration	Farm Operating Loans	Enable small farmers to use resources.	B1.4m (8) C 170(3) G60(1) H-1.2 m (2)L550K(5)
USDA	Farmer's Home Administration	Industrial Devt Grants	Help SMEs, boost rural employment	no awards
USDA	FHA	#Watershed Protection/ Flood Prevention Loans	Loan assistance to local organizations.	No awards
USDA	Rural Electrification Administration	Rural Economic Development	Promote rural economic development	No awards
Commerce	Economic Development Administration	Business Development	Sustain commercial viability in rural areas.	Assistance
DOD	Department of the Army	Aquatic Plant Control	Control obnoxious water . plants in rivers and harbors	No awards
Interior	National Park Service	Outdoor Recreation Acquisition Devt/ Planning	Financial aid for developing outdoor recreation areas	12 awards; e.g B $500,000 x2 for a jetty park with picnic areas, sports, playgrounds

Source: Compiled by authors.
* grants/loans in $000 unless otherwise noted, followed in () by number of grants. B=Brazoria County; C=Chambers; G=Galveston; H=Harris; L=Liberty. # means that the program could also have beneficial effects.

Most research on Galveston Bay is conducted by university-based researchers funded by various agencies. Among the research funders are:

U.S. Fish and Wildlife Service. USFWS funds studies on threatened, endangered and candidate species and their habitats through section 6 of the ESA. Studies of the needs and distribution of these critical species associated with Galveston Bay are needed.

Texas Water Development Board. Virtually all of the funded research has been for the bays and estuaries studies mandated by the legislature. Since FY 1986, TWDB has spent more than $2.7 million on the outside portion of these studies, conducted by several federal and state agencies and many universities, in addition to in-house research. The research fund has been raided by the Legislature several times and is nearly depleted.

Texas Parks and Wildlife Department. TPWD conducts in-house research on a range of topics relating to the action plan topics.

Texas Water Commission. GBNEP, a program of TWC, has funded a range of scientific research on all aspects of the bay.

Texas Sea Grant. Funded two-thirds by federal money and one-third with matching state funds, Sea Grant projects comprise research related to coastal management and the ocean. Projects of special interest to Galveston Bay for 1991-92 include modeling salinity intrusion and toxic materials in the bay; other projects of a more general nature, especially concerning fisheries, are also directly relevant to the bay.

We are certainly not in a position to assess the validity, cost-effectiveness, or even scientific interest or necessity of the studies that have been funded. We are, however, able to consider their policy relevance. In writing this report, we had hoped to introduce each chapter with a brief problem statement supported by quantitative data. For example, we would like to have introduced chapter 10 on habitat with a table describing the acres of wetlands around the bay in some base year and the (presumably fewer) acres now extant. Similarly, the introduction to the chapter on point source pollution would be effective if we could show the change in certain key parameters over the last decade or so.

Even more important than the problem description are studies relating changes to particular policy choices. Are the present permit criteria for point sources adequate to maintain or even improve water quality? What kinds of (scientifically sound) sediment standards would allow TWC to control the dredge and fill process more fully? What, if any, are the health effects of regularly eating fish containing small amounts of heavy metals (or other bay contaminants)?

The good news is that such information is being developed. GBNEP's nonpoint source study provided us with the land use and pollutant loads tables. Even

where old baseline data have been lost, new data are being gathered that can serve as a baseline for future studies trying to determine whether policies are working.

The bad news is that even this data is not as policy-relevant as it might be: we noted in chapter 4 that the table described NPS from various kinds of land uses is not normalized to allow a policymaker to see which kinds of pollutants are most likely from a particular land use—information necessary if the policymaker is to use scarce resources to achieve the maximum possible level of environmental protection. Thus, we believe a conscious effort must be made to identify areas where policy decisions need to be made and ensure that scientific research is conducted to fill the most egregious of the gaps identified by that process. GLO will have to identify some gaps in developing the plan for CZM.

One approach is to ensure that decisions about funding specific research projects are made by those with technical competencies, but decisions about research priorities are made by those familiar with policy. At the present time, we believe that these different goals are confounded in the research-grant-making process. The Coastal Coordination Council might serve as a priority-setting body for all the state agencies; an appropriate MOU might make the priorities apply to some federal research funding as well. The CCMP and its implementing agency could serve this function for research Galveston Bay.

We also note that much of the research that needs to be conducted is not primarily scientific at all, but rather economic and policy-related. Are the costs for cities to treat NPS pollution after stormwater is collected greater or less than the costs for individual construction sites and NPS generators to abate NPS one by one? How much behavioral change is elicited by different kinds of public education programs? Can one devise incentive programs that will cause individuals, however unwittingly, to act in an environmentally sound manner? With the exception of GBNEP, few agencies are sponsoring such research. Yet ultimately it will determine the effectiveness of governmental action just as much as sound technical information.

Finally, it is important to remember that research results must be fed into the policy process. Because the results are technical, the report may seem boring or useless to policymakers. Conversely, the implications may be all too clear, and policymakers hide behind the technical nature of the report to avoid taking unpleasant political actions. For example, The Clean Houston Task Force conducted an engineering study on nonpoint source pollution which was presented to Mayor Whitmire in November 1990. The study, sponsored by the Clean Bayou Committee, contained information about the sources of nonpoint pollution in Houston and suggested Best Management Practices which could be implemented. Unfortunately, the study has been sitting on a shelf since it was published and little has been done with the information. We must develop ways to ensure that policymakers understand and use the research that is conducted along with mechanisms for publicizing the research so that policymakers cannot avoid acting upon it.

CONCLUSION

Reviewing various components of the management process allows us to identify similarities and differences across agencies that need to be considered in developing a comprehensive management plan. One important lesson we can draw is that when the regulatory framework is strong, agencies develop greater capacities. For that reason, water quality regulation is exemplary among the many regulatory programs considered, although not without its own flaws. Thus a long-term goal should be to develop strong legislation at all levels of government.

Second, enforcement is the weakest point of all the regulatory procedures. Without enforcement, we can never gauge the effects of existing environmental regulations nor assess the need for new or different ones. Enforcement is the most resource-intensive part of the regulatory process and causes the most tension; no wonder agencies avoid it. In addition to new staff, perhaps some revisions in the enforcement procedures could be devised that would encourage agencies to undertake more enforcement actions.

Third, the entire regulatory process is undermined by low pay and understaffing. Together, these factors encourage turnover and increase the likelihood of poor regulation.

Fourth, the activities that underlie and support regulation, including monitoring and research, have their own problems. Research is probably inadequately funded and not always directed towards regulators' needs, while monitoring is uncoordinated and characterized by mistrust among agencies. Monitoring, another activity poorly understood by the public, is also chronically underfunded.

Finally, there are many incentives in the form of economic development programs that encourage people and institutions not to heed the environmental needs of Galveston Bay. Our greatest and most immediate challenge is to devise regulatory mechanisms that use people's own self-interest to get them to take actions that support the environment; while minimization of NPS, which otherwise requires vast public education efforts to change lifestyles, is the most obvious area for applying these new tools, virtually every other problem facing Galveston Bay may also be amenable to these alternatives to command-and-control regulation.

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