PROCEDURES AND PROGRAMS TO ASSIST IN THE ENVIRONMENTAL IMPACT STATEMENT PROCESS

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SG-PUB-no 27 USC-SG-AS2-73

This work is a result of research sponsored by NOAA Office of Sea Grant, Department of Commerce, under Grants # 04-3-158-22 and # 04-3-158-45 to the University of California and the University of Southern California respectively. The U.S. Government is authorized to produce and distribute reprints for governmental purposes notwithstanding any copyright notation that may appear hereon.

This work is published jointly by the University of California and the University of Southern California and distributed by the California Marine Advisory Programs.

SG-PUB NO 27 USC-SG-AS2-73

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INTRODUCTION

The environmental impact statement, as required by the National Environmental Policy Act and several state acts, offers great promise as a vehicle for introducing environmental considerations into the programs and policies of public agencies. It represents an attempt to modify or replace the traditional decision-making criteria of public sector bureaucracies by requiring consideration of the environmental impacts of their actions. Whether this new tool for environmental planning and management will actually fulfill its potential will be determined by a number of factors, including: judicial interpretation of the provisions of the National Environmental Policy Act (NEPA), the institutional adaptations which public agencies devise from meeting this new requirement, the development of procedures and programs for preparing and reviewing the impact statement.

Federal and state requirements for environmental impact statements have stimulated the development of a number of techniques and methods for impact assessment.* The techniques display great variety in their conceptual framework, data format, and technical sophistication. Given the complexity of environmental systems and the specialized functions of public agencies, there is little likelihood that one universal method will ever be appropriate. The present diversity of assessment methods is therefore likely to continue and should be considered as a "healthy condition" in a newly-formed and growing discipline. In this paper we shall consider issues which arise in impact assessment processes and also examine alternative methods for preparing and reviewing impact statements.

Impact assessment may be considered as a three stage process: (1) identification of the environmental, social and economic conditions that may be changed by the project;** (2)

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* -The emergence of state legislation requiring impact statements for public, and in some cases, private projects provides an excellent opportunity for research and experimentation with the institutional arrangements regulating impact statements. In this context, the states can serve as laboratories for testing rules and procedures for meeting environmental impact requirements. For a general discussion of the role of states and localities as laboratories for policy experimentation, see (1).

** -To identify what constitutes a project entity is a problem in itself. Projects are often interdependent and integral components of larger programs (particularly water resource projects). Council on Environmental Quality (CEQ) guidelines recommend that impact statements be prepared for programs as well as projects. In California, the Environmental Defense Fund is seeking to enjoin the Corps from constructing New Melones Dam on grounds that the impact statement did not consider the Bureau of Reclamation's project to use the Dam's water for irrigation. (2)

prediction of the intensity and spatial dimensions of the changes likely to occur, and (3) evaluation of the costs and benefits of the condition changes. We shall discuss impact assessment methods according to these three steps.

1.0 IMPACT IDENTIFICATION

Impact identification involves a systematic means of relating a particular project's actions or activities (e.g., grading, production of nitrous oxides, or removal of housing) to a potential impact (e.g., stream sedimentation, smog, or reduction of available housing stock). The primary purposes of impact identification procedures are to ensure the consideration of all potentially significant impacts, and to focus attention on the most significant impacts of a project.

The value of any procedure for the identification of environmental impacts will be substantially determined by two factors: (1) the scope of the considerations included in the impact identification process, and (2) the extent to which a method allows information on a project's impacts to be gathered and organized in a technically accurate and comprehendable form.

1.1 Scope of Impacts Considered

A fundamental dilemma in dealing with environmental impact identification is the determination of what does and does not constitute the "environment." Guidelines issued by the Council on Environmental Quality define the environment in such general terms that almost any effect of any action could be considered a legitimate factor to be included in an impact statement.* Much of the initial impetus for NEPA was based on the need to introduce physical and natural environmental factors into public decision-making; however, in the implementation of the Act, the definition of the term "environment" has been enlarged to take into account almost all elements of the human environment.** There are a number of reasons for the expanded definition. Public agencies are now considering beneficial social effects in their environmental impact statements in order to "balance" the

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* -According to the General Accounting Office's report on NEPA, " . . . Little guidance has been provided to the agencies on the range of impacts to be considered in environmental impact statements." (3)

** -An amendment to the California Environmental Quality Act represented a retreat from a broad definition of the term "environment" and stated that only physical impacts were required to be described. (4) However, the California Act stipulates that growth inducing impacts be included in the statement; therefore, social and economic aspects may still be required to be taken into account.

adverse physical and natural effects of their projects. (5) When the socio-economic effects of a project can be used to support the position of an agency advocating a project, then substantial attention will be given to these benefits.

A number of organizations are also expressing concern about the effects of a project on social and economic systems. Citizens' groups have recently raised environmental issues as a means to protect a particular "way of life" under the guise of maintaining the integrity and character of the existing environment. (6) In addition, labor union officials have proposed that economic impact statements accompany environmental impact statements, in order to allow explicit consideration to such socio-economic factors as employment, income, and community development. (7)

One of the first governmental agencies to explicitly state that economic factors must be included in the impact statement was the Department of Agriculture, which prescribed that:

> In addition to the project's impact on the physical environment, economic factors must also be known for the complete assessment and are to be included as part of the environmental statements. Significant economic impacts on the public are to be described, such as employment, unemployment, and others. (8)

The Environmental Protection Agency has also set forth guidelines which indicate that the social effects of a project be incorporated in the impact statement:

> It shall include specifics of the area, the resources involved, physical changes, alterations to ecological systems, and changes induced by the proposed action in population distribution, population concentration, the human use of land (including commercial and residential development), and other aspects of the resource base such as water and public services. (9)

Despite such official statements, it is by no means certain that such aims will actually be achieved.

Several institutional constraints are likely to limit the inclusion of accurate and comprehensive information on the socio-economic impacts and also restrict the range of natural and physical effects which are considered in the assessment process. Historically, administrative and functional agencies have been created to achieve certain specific missions and thus their competence is often limited to a few, highly technical fields, related to their statutory authority.

Such agencies may not have the staff capability to deal with a broad range of environmental issues and are often unfamiliar with the type of data needed for assessing impacts.

The agency staff, assigned to prepare an impact identification procedure, will naturally tend to focus on those considerations with which they are familiar because of their professional training and on-the-job experience. Thus, it is reasonable to expect a staff of water quality engineers, in preparing an impact checklist, to emphasize water quality parameters and neglect social equity or visual considerations. A common means of preventing professional bias in the preparation of methodologies, such as impact checklists or networks, is to assemble an interdisciplinary team or to hire outside consultants.* However, interdisciplinary teams or outside consultants will still have to contend with the agency's own inherent bias toward fulfilling its assigned mission (as the agency perceives it).** Project-proponent agencies will not want procedure to enable the identification of so many adverse effects and/or so few beneficial effects that it would significantly jeopardize the future mission of the agency to plan and execute projects. Conversely, resource conservation agencies (EPA, BSFW, NPS) will not want their impact identification procedures to consider so many beneficial effects and/or so few adverse effects that the planning and execution of resource degrading projects by other agencies would be encouraged.

1.2 Organization and Format

In addition to such institutional constraints, the nature of the data required to evaluate or predict impacts can also restrict the scope of impacts included in the impact statement.

There is a consistent tendency in the formulation of impact identification procedures to favor the selection of quantifiable impacts vs. secondary or indirect impacts. Agencies, particularly those with project planning and engineering missions, will tend to focus on impacts that are readily quantified, such as sound, water and air quality parameters, capital and maintenance expenses, visitor days, and give a brief treatment to the impacts that are not easily measurable or measurable on convention terms, such as aesthetic displeasure, quality of recreational experience, and fear of hazards or of

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* -For a discussion of the difficulties of consultants providing agencies with unbiased advice on impact assessment, see (10).

** -An example of agency bias to impact considerations is the disregard of water resource development agencies for expanding the range of costs considered in their cost/benefit analysis (e.g., recreation benefits foregone by the project).

crime. Many of the most important environmental impacts are not easily quantified and, thus, if only information for which quantitative values and measures can be obtained is included in the statement, only a narrow range of environmental impacts will be taken into account or certain important impacts might not be given their proper weight.

Direct impacts of the project--such as erosion and turbity caused by site preparation, preemption of existing uses from site, employment generated by construction and operation--are usually given more visibility in impact identification procedures than the indirect impacts (e.g., surrounding land use change, population growth in region). Direct impacts are easier to measure than indirect impacts*, particularly in terms of measurement costs and time periods required to make the measurement. It has also been difficult for agencies to distinguish which indirect impacts should be assessed.** The ambiguous terms used in section 102c of NEPA, and the subsequent guidelines issued by CEQ, do not adequately define which indirect impacts agencies should consider in the preparation of impact statements.

Another major problem involves determination of the level of detail necessary for making accurate, scientific judgments while also providing information that is sufficiently general so that the impact statement can be understood and evaluated

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* -In a separate paper on Environmental Impact Assessment, direct and indirect impacts were categorized as follows:

. . . Direct:

- preemption or denial of use existing on project site or desiring project site.
- relocation of uses preempted from project site, or denied future use of project site.
- impacts on environmental conditions-systems.
- adverse impacts which the project would be subjected to by existing environmental and/or social conditions.
- public service facility requirements.
- socio-economic impacts.
- access circulation, transportation modes impacts.

. . . Indirect:

- surrounding land use change.
- projects impacts on population in region.
- cumulative impact: potential impacts of development or anti-development trend project is establishing or reinforcing for political jurisdictions or environmental systems (watersheds, air basins, lakes, embayments). (11)

** -A thorough discussion of the significance of secondary impacts stemming from public projects is contained in (12).

by public officials and affected parties. The information base must not only be precise enough to allow accurate judgment to be made, but it must also provide a basis for public discussion and debate if there is disagreement over the interpretation of the data. Therefore, if impacts are merely described in brief and general terms, such as "loss of wildlife," "degradation of aesthetic qualities," or "changes in surrounding land use," the absence of substantive information will limit both the responses of reviewing agencies and groups and the degree of informal public debate.* The description of an impact must be specific enough to clearly indicate how, and by what means, a project could actually affect societal values, (e.g., degrade visual attraction of a recreation area). The intermediary condition changes between a project and an ultimate impact on societal values must be clearly and specifically stated so that the reader will understand the sequence and the transition of events well enough to make his own judgment as to the nature and significance of the relationships.

Impact identification can also be overly detailed with very specific information and infinite interrelationships to the degree that the whole procedure becomes cumbersome, confusingly complex, and extremely time consuming. Often the detail in the impact description becomes so specialized that it is unintelligible to the general public and difficult to understand for experts in other fields. In fact, much of the scientific information now appearing in impact statements is technical "window dressing" included to give the aura of validity.** Producing technically accurate and comprehensive information which can also provide a basis for decision-making by public officials is not an easy task. However, if the information cannot be understood by those who seek to analyze the project, then the impact statement is not likely to improve our capacity to make informed and rational decisions.

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* -According to the report, "Highways and the Environment: How State and Federal Officials Assess the Impact of Urban Highways," officials put together environmental impact statements devoid of data and replete with interchangeable pro forma phraseology. (13) A similar observation is made in a review of 76 highway impact statements, ". . . The survey uncovered the repetition of identical phrases, paragraphs, and even pages in impact statements for different urban highways." (14)

** -A tactic that is becoming increasingly common is to use scientific data and background information only indirectly relevant to the project impacts to expand the statement into a massive report (e.g., Transalaska Pipeline, Oilshales Mining), or to compile many individual statements. "DOT has tried to thwart NEPA by snowing us (CEQ) under with mountains of paper on every six-block paving project in the country." (13) The apparent intent of the many agencies employing this practise is to minimize close scrutiny and critical analysis of adverse impacts and project alternatives by overwhelming reviewers with stacks of material.

1.3 Matrices

Perhaps the best known method of impact identification is the matrix procedure published by the U.S. Geological Survey in June, 1971. (15) One axis of the matrix lists projects' actions and activities, the other side lists the environmental conditions that might be affected. A fundamental weakness of the matrix format is that it cannot depict the network of interrelationships that actually develop between a project's action-activity and the consequent environmental impacts. The matrix indicates that a relationship between a project action and an environmental impact exists, but it does not indicate the nature or extent of the relationship. For example, the matrix relationship between dredging and water quality might be due to turbidity or release of toxic materials or several other intermediary condition changes. It is well understood that the environment operates as a complex system and cannot accurately be characterized by direct cause and effect relationships. Environmental systems operation might be more correctly described as a cause-condition-effect network. That is to say, an action causes one or more environmental condition changes, which in turn will produce one or more subsequent condition changes, that will ultimately result in one or more terminal effects. An example might be highway cuts or fills that could cause erosion of soil off slopes into a stream course. The added soil material could increase stream turbidity, shoal the channels, alter stream channel regime, and these, in turn, could increase flood potential, block passage of acquatic biota, or degrade stream habitat for aquatic biota.

1.4 Networks

The construction of cause-condition-effect networks for impact identification appears to have been suggested first in the Travelers Research Corporation's* study, "The Development of a Procedure and Knowledge Requirements for Marine Resource Planning, Step One, 1969." (16) Only one network was developed by the Travelers' study--the impacts of dredging. The network format was elaborated upon in Fall, 1970 in a study for the California Comprehensive Ocean Area Plan (COAP). (17) Control of adverse environmental impacts was one of the main goals of the COAP planning program. The planning staff thought cause-condition-effect networks could be constructed to identify the adverse impacts of all major coastal resource uses. The networks were constructed by relating known examples of adverse impact to the condition changes which produced them, and then tracing these condition changes back to project actions. The

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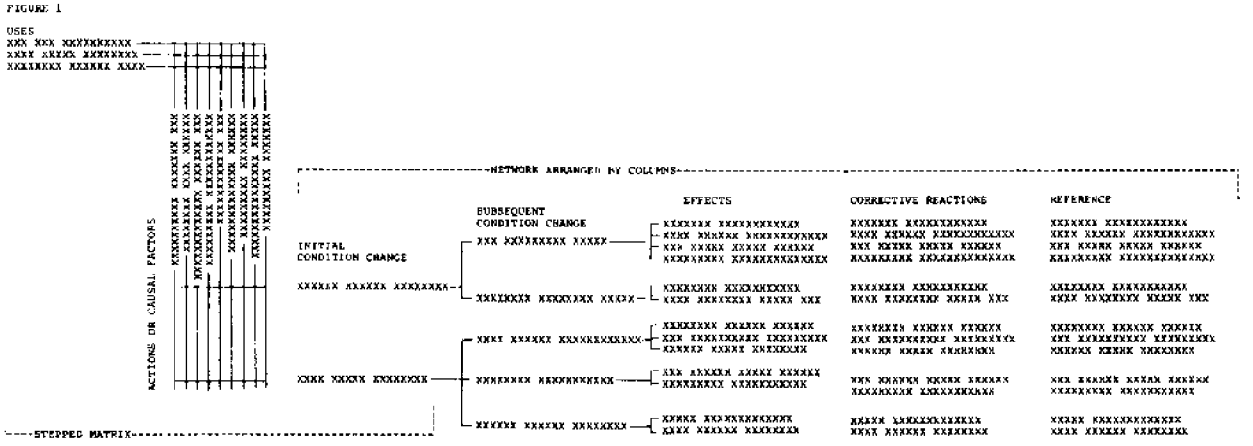
* -Now the Center for Environment and Man.

format used to display the interrelationships is a stepped matrix attached to networks arranged by columns. Figure 1 illustrates the component parts and the format.



The stepped matrix relates coastal resource uses (e.g., residential development) to actions generated (e.g., impervious surfacing) to initial environmental condition changes (e.g., increased fresh water flow into estuary). The networks are then developed from the initial condition changes (again, increased fresh water flows into estuary) to consequent condition changes (reduction of estuarine salinity), and then effect (decreased growth rate and size of commercial shellfish). The networks developed for the California Ocean Area Plan were limited to three steps of condition change as a matter of administrative convenience. A more detailed explanation and full display of the networks constructed for identification of potential impacts in California's coastal zone has been published by the author. (18)

One of our current research projects (19) is to further develop the cause-condition-effect networks constructed for the California Ocean Area Plan. The principal research objectives are to improve the information content of the networks' statements and interrelationships, and to program the networks for computer automation. We have already computer automated networks for hydrologic and geological condition changes. Yet to be completed are networks for atmospheric, biologic, access, and visual impacts.

Computer automation will allow us to continuously update and correct the information, as well as to organize an information system on coastal impacts. The primary advantage of computer automation is that it allows the person preparing or reviewing an impact statement to select and receive a printout display of the networks directly relevant to a particular project's actions and activities. It is also possible to increase the specifity of information portrayed by coding into the computer the project's location (e.g., open coast vs. estuary watershed). The printout of impact networks would relate to general site conditions.

The major problem in constructing cause-condition-effect networks for impact identification is achieving the degree of detail necessary for informed decision-making. Obviously, the networks will have little information value if environmental condition changes and interrelationships are only described in general terms. However, it appears more likely that the reverse situation will be the case. If the environmental condition changes are described in detail and all possible interrelationships are included, the resulting impact networks can be so extensive and complex as to discourage anyone from reading through them.* It is important, therefore, to determine how far the sequence of environmental condition changes should be carried before arriving at the final impact.

There are two questions to be asked when constructing impact networks: What is the probability that an identified condition change will produce a further condition change? Is the additional condition change that might be produced, regardless of low or high probability of occurrence, of enough significance to include in the impact network?

For example, a waste water treatment project may release a highly nutrified effluent (project action) into an estuary. The increase in nutrient concentration (initial condition change) will stimulate phytoplankton blooms in the estuary. Conceivably, a potential impact of the phytoplankton blooms could be increased sedimentation of the estuary from the accumulation of dead organisms. Sedimentation of the estuary could then be traced to decreased water depth. Decreased water depth, in turn, could produce a myriad of impacts (increased penetration of sunlight, increase of bottom plant growth, increased temperature of estuary, decreased flushing of the estuary--to list but a few). The key question is whether blooms of phytoplankton have been known to increase the sedimentation rate of an estuary to the extent that there will be a significant decrease in the water depth. If the effect of sedimentation from dead plankton is an imperceptible decrease in water depth over a period of a few years, the impact should not be included in the network.

1.5 Project-Type Checklists

A problem common to both the USGS matrix and the COAP stepped matrices-network combination is the inability of either format to include all major project types, associated actions,

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* -Our first printout of all the hydrologic impact networks consisted of 350 pages (10" x 14" page size). Much of the bulk of the printout was attributable to the generation of circular and "endless" chains of impact, e.g., watershed erosion - to increased sediment load in stream - to alternation of channel - to erosion of stream banks - to increased sediment load - to alteration of channel, etc.

and the vast number of potential environmental condition changes that could be generated. Any single format that attempts to include all projects, actions, and environmental conditions is likely to be very large, cumbersome to use, and to contain information too generalized to adequately describe the nature of the impacts. It is now generally recognized that impact identification procedures should be specific to a particular project type (e.g., housing, highways, sewage treatment).* Agencies obviously know the kind of action-activities that compose the type of projects they routinely design or review. Agencies should also know from past experiences or research programs, the kinds and nature of the impacts that can be generated by each of the actions-activities of their projects. It is apparent that any agency could prepare, without great difficulty, a systematic procedure for identifying impacts, simply by relating the actions-activities of a project type to potential changes in environmental conditions (as shown by past occurrences or research findings).

In May of this year, the Council on Environmental Quality finally recommended that:

> Agencies should develop a list of the full range of impacts likely to be involved in the typical types of actions they undertake. This will require a listing both of typical agency actions affecting the environment, as well as a list of related potential impacts. (20).

It is unfortunate that two years elapsed before CEQ recommended that agencies list impacts according to the typical types of actions the agency undertakes. The preparation, review, and evaluation of impact statements would have been far less confusing and unproductive and far more efficient and effectual if agencies that routinely proposed or approved projects had prepared and published project-type impact checklists. But it is quite understandable that agencies with project development missions (Corps, SCS, Bureau of Reclamation, AEC, Forest Service, FPC, FHWA) have been reluctant to prepare and publish definitive listings of the impacts their project types might generate, particularly the adverse impacts.

There are a number of reasons why it is not in the self-interest of agencies to fully disclose to critics and opponents of their projects what might be the adverse impacts of a project's actions. For one, agencies would be obliged to explain to other agencies or the reviewing public why certain impacts listed in the project-type impact checklist published by the agency were not included in the statement. Agencies publishing project-type impact checklists will go on record as recognizing certain impacts and ignoring or neglecting others. Specification of a wide range of adverse impacts will provide opponents and critics with ammunition to use in discrediting,

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* -This point was also noted in the summary recommendations made by the General Accounting Office in their analysis of NEPA. (3)

altering, or defeating a proposed project. Furthermore, an agency that ignored or neglected to identify certain adverse impacts would be exposed to criticism for failing to consider a larger spectrum of issues, for possessing tunnel vision, or advocating single purpose planning.

Nevertheless, several project-type impact checklists have recently been developed for or by agencies.* In the Fall of 1971, the San Francisco Region of the Environmental Protection Agency developed "Environmental Impact Review Guidelines for Sewerage Facilities." (21) Battelle Columbus Laboratories have prepared at least two impact identification checklists; one for water impoundment projects planned by the Bureau of Reclamation, (22) and the other for waste water treatment plants funded and approved by the Environmental Protection Agency. (23) In June, 1972, the Corps of Engineers published an analysis of environmental impacts that they had prepared through August, 1971. (24) The report was not intended to be a checklist of impacts according to project actions; however, the method of analysis does, in fact, analyze the various types of Corps projects (dredging, spoil disposal, breakwaters, jetties and groins, revetments, channelization, dams and reservoirs, levees) into a catalog of associated impacts.**

One of the more recent impact checklists, and perhaps the most comprehensive to date, is contained in the AEC's "Guide to the Preparation of Environmental Reports for Nuclear Power Plants." (25) The AEC form relates a nuclear power plant's typical actions-activities to: (1) population or resources affected; (2) a description of condition changes; (3) unit of measure of the conditon changes, and (4) method of computation. The impacts listed are then to be related to the various components of a nuclear power plant (i.e., facility and transmission hook-ups, cooling systems, biocide systems, sanitary waste systems, gaseous radwaste systems, liquid radwaste systems, transmission routes).

Project-type checklists should also assist the agencies and organizations that are routinely requested to review impact statements. Most of the agencies preparing statements, however, have not yet developed procedures that would assist reviewers in identifying omissions or inadequate descriptions of impact. One example of a checklist developed by a review

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* -The authors have not surveyed agencies to determine how many have developed project-type checklists, so our listing is not assumed to be complete.

** -One of the Report's suggestions to the Corps for improving their Environmental Impact Statements was to use the catalog of impacts developed for the analysis as a starting point in formulation of a more complete list of possible potential impacts.

agency is the Bureau of Sport Fisheries and Wildlife (Atlanta Region) catalog of impacts associated with Corps projects (dredging, soil disposal, port development, beach protection). (26)

The authors recently completed a study for a regional clearinghouse* on the application of impact checklists to the review of housing and highway projects.** (28) The impact checklist developed for the Association of Bay Area Governments (ABAG) is actually a network arranged in an outline format (Appendix A). Actions or activities that could generate an initial change in an environmental condition are placed in brackets above the respective condition. The listing of condition changes for each of the impact categories is organized according to sequence of occurrence. The initial condition changes are indicated by black triangles. Secondary condition changes (if they occur) are indented and listed beneath each initial condition change. Condition changes were stated in a manner to permit description of all impacts within a three step sequence. It should also be noted that all the condition changes listed describe adverse impacts (a sort of doomsday listing). However, another listing of conditions could be developed for describing beneficial impacts of a project-type. In many cases it is simply a matter of switching the verb or adjective to its antonym to convert an adverse condition change to a beneficial condition change. In our research, we have found it desirable to prepare separate checklists for adverse and beneficial impacts. By keeping them separate the tradeoffs that will have to be made between a project action's costs and its benefits can be clearly discerned.

One aspect of the ABAG checklists that may be particularly applicable to other identification procedures is the division of impacts into major categories. The major impact categories for housing projects and highway projects are listed in the Appendix B. It should be noted that eight of the ten categories listed are approximately the same. It appears that all the major project-types will have, to a varying degree, an effect on (or be affected by) each of the eight impact categories. Often the effect will be insignificantly minor, but, nevertheless, an impact will occur. Additional categories are added to the basic eight to include impacts produced by a project type's unique characteristics.

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* -Under directive A-95 of the Bureau of Management and Budget, regional or metropolitan clearinghouses are to examine the content of a Federal agency's impact statement to determine if all impacts of regional significance have been adequately identified, and how the impacts identified relate to regional plans, programs, and policies. (27)

** -The next phase of this study will include the development of checklists for waste water treatment facilities, water supply facilities, flood control projects, and port facilities.

2.0 PREDICTION OF IMPACTS

The identification of potential social, economic, or environmental impacts is a relatively simple process when compared to the task of predicting the probable degree and dimension of change.

The first step of impact prediction is the determination that the potential impacts identified by the matrix, network, or checklist procedures could actually occur on or within the environs of the project site. Usually, the impact identification procedure is developed by an agency at the national or regional office level. Since the procedure is to apply on a national or multi-state wide basis, the identification method cannot be specifically related to the particular environmental conditions of a geographic area. Therefore, many of the potential impacts indicated by an identification procedure will not occur because the environmental, social, and economic conditions necessary for their occurrence do not exist in the area where the project will actually be located. For example, the impact identification procedure might relate a project's site preparation activities to potential sedimentation of an estuary. Sedimentation would only occur if the project were, in fact, located in the immediate watershed of an estuary. If the project were located on the open coast, it is very unlikely that a project's site preparation actions would have any effect on the sedimentation of an estuary.

The identification procedure can be designed to at least partially filter out those impacts which will not be relevant to the specific conditions characterizing the project location. If the identification procedure is a standardized display, such as a matrix or a checklist form, graphic symbols can be used to designate the general environmental conditions that would have to be present for a particular impact to occur. If the identification procedure is computer automated, such as the impact networks we are now constructing, input of project actions and site descriptors will result in the selection and print out of only those impacts that are relevant to conditions that actually exist on or surround the proposed location of the project.

To date, most of the impacts cited in an agency's draft or final statement are described in general, non-specific language. Rarely does the agency make a quantified prediction of the degree of dimension of an impact (e.g., the number of water fowl that will be lost from estuary filling or the air space that will be covered by visible smoke from a power plant). Quantified prediction of impacts tends to be limited by three apparent constraints: insufficient information, failure to use existing information, and lack of predictive methods.

2.1 Insufficient Information

According to the agencies, almost all impact statements are prepared under severe time and budget constraints. Time, budget, and staff constraints require the collection of data and information to be made at a very gross scale during a short period of time.

Rarely is time-series data collected over a long enough time period to adequately describe the baseline conditions of the environmental and socio-economic systems on the site and environs of the project. Without knowledge of the baseline conditions, it is exceedingly difficult to predict how the project will interact with natural and socio-economic systems. The problem of having insufficient time to collect baseline information should diminish in the future. Now that NEPA has been in effect for three years, agencies are now aware at the earliest stages of project planning that they will eventually have to prepare an impact statement. A program for collection of data and information necessary for baseline determination and impact prediction can, therefore, be drawn up and initiated during the first steps of project planning. Governmental units with control over land use planning should make projections of the probable location of specific project-types and encourage the timely collection of (or collect) the data and baseline information necessary for impact statement preparation.

Even if the time constraint is removed by extending impact assessment over the planning period of the project, there will still be budget limitations. The cost of the information collection and research necessary to conduct a thorough analysis of the impacts related to a particular project may well be greater than the potential societal costs of the adverse impacts identified. Agencies should compare the costs of impact prediction with the anticipated societal costs of the adverse impacts.* Costly research and information collection are probably justified if the adverse impacts would be "costly" to society. Conversely, it might be reasonable to just estimate the effects of adverse impacts with low societal costs.

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* -There is often a disparity between the scale of the project and the scale of the project's impact. Sponsors of small scale projects with large scale impacts may not be able to afford the cost of preparing an adequate impact assessment.

Obviously, agencies will either require additional appropriations to take on the added burden of impact assessment* or be forced to divert funds budgeted for other functions. One solution to the budgetary constraint could be a joint effort by project proponent agencies and, perhaps, private developers into a task force to collect the regional data and information that is common to all their projects. This could be accomplished with or without the assistance of local government.

2.2 Failure to Use Existing Data and Information

Agencies and organizations often fail to utilize existing data and information that could be directly or indirectly applied to impact assessment, even though its existence may be known. Several factors may be responsible for this seeming contradiction, such as prohibitive costs or time periods involved in acquisition or unsuitable scale of mapping or recording. In addition, staff inability to adapt or interpret data gathered for one purpose to another purpose and the lack of training needed to integrate and manipulate unfamiliar sources of data and information may also limit use of available information.

In other cases, agencies preparing or reviewing statements are simply unaware of existing data or information. Lack of communication between sources of data and potential users of information is a continuing, and perhaps, irresolvable dilemma. It is improbable that any one entity will ever be in a position to know the location and nature of all the environmental data which exists within a large metropolitan region. Data producers such as universities and research organizations, often have information which could be of great value to information-users, such as governmental agencies with responsibility for preparing impact statements. Consequently, efforts to improve the institutional arrangements for the distribution and dissemination of scientific data should be part of any program.

In the San Francisco Bay Area, several attempts are being made to establish region-wide data and information location centers to assist in the preparation and review of impact statements. The Environmental Protection Agency (Region IX) is attempting to coordinate all Federal agencies in the Bay

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* - Andrews' study of Federal Agency response to NEPA, notes that the Corps requested budget increases for Fiscal Year 1972 in 140 of its 142 general investigations, averaging 10 percent per survey specifically attributed to new studies necessitated by NEPA. It was also noted that SCS requested no increases whatsoever in staff or budget to fulfill responsibilities imposed by NEPA. According to testimony, administrative costs due to NEPA in Fiscal Year 1971 were roughly $93,000.00, or two percent of its planning budget. (29)

Area that have "activities with environmental impact." The EPA is preparing a directory of functional and administrative responsibility by agency according to activities with environmental impact (aesthetics, oil spills, solid waste, water pollution, etc.). (30) Another group, the Environmental Information Clearinghouse, consists of representatives from government, industry, and conservation organizations. This private, non-profit organization provides assistance to those seeking to determine the existence of information or special expertise on an environmental topic or location within the Bay Area.

The Association of Bay Area Governments (ABAG) is considering the establishment of an information center to assist its staff in the review and comment of California* and Federal impact statements as well as to coordinate the impact statement review process within the nine-county Bay Area.**

The primary capability of a regional information center would be the systematic means for depicting the location of spatially defined data or information known to exist within the region. All the spatially definable environmental and socio-economic information that is significant for impact assessment could be computer mapped or portrayed on a series of conventionally drafted maps.

There are many problems inherent in using the conventional map reference technique for impact prediction, particularly in the assessment of cumulative impact of individual projects. Map overlays can only indicate where a very limited number of factors occur and cannot predict cumulative impacts that will occur over a period of time. The effective prediction of cumulative impacts usually requires a computer-automated information bank that will store and retrieve spatially defined data and information according to map cell or point reference. For example, all projects within a watershed that create impervious surfaces can influence peak flow (flood) characteristics of a stream. An automated monitoring and mapping of watersheds' impervious surfacing would aid in determining how future projects in the watershed would increase the stream's peak flow.

The regional information center should also be able to forecast how any one project may be establishing a precedent for public services and infrastructure systems. A housing unit

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* -The California Environmental Quality Act (CEQA). It is patterned after NEPA. The California Supreme Court has ruled that all public agencies would have to prepare impact statements on private projects seeking a permit, if the projects might have significant environmental imapcts. (31) The legislature amended the original act to reflect this decision. (4)

** -The recommendation for the establishment of a regional information center is explained in the report prepared by the authors for ABAG. (28)

of twenty-five units may not significantly tax existing public services and infrastructure systems. However, if all similarly situated land in the area were developed for the same purpose and at the same density, the demands on public services and infrastructure could far exceed their design capacity.

It is not suggested, however, that automated regional information banks be created just to assist in the prediction of environmental impacts. Such an information bank would have numerous other applications to regional planning.*

2.3 The Lack of Predictive Methods

A colleague at the University of California has recently reviewed the application of predictive methods to impact assessment. (33) The review indicates that there are few predictive methods available that can make an accurate estimation of many important impacts at a reasonable cost, (time as well as money).

Accurate empirical models exist for a few relatively uncomplex impacts that have been quantitatively measured, on many test sites, over a period of years. Some examples are: the peak flow discharge model, (34) the oxygen sag curve model developed for the Delaware Estuary Comprehensive Study, (35) and the mass movement models. (36)

Physical or iconic models have been developed to predict those few impacts that can be duplicated on small scale physical representations. The best known are the physical models of rivers, lakes, estuaries, and coastlines constructed by the Corps of Engineers to duplicate flooding, current movement, shore erosion, longshore transport, and wave dynamics. Visual impacts can be very effectively shown by physical models of the proposed project and the surrounding landscape. Cameras can be used to film what an observer would actually see when traveling through or by the project. (37)

Mathematical theorems have been used to construct models to simulate the occurrence of a wide range of impacts. The accuracy of these mathematical models has not been validated by comparing the predictions against data compiled by actually monitoring the generation of an impact. Examples are models for estuary dynamics, (38) traffic emission of carbon monoxide, (39) land use, and transportation. (40)

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* -A detailed description of how an automated information bank was successfully applied to impact assessment and regional planning (Lake Tahoe Region) is contained in (32).

The two models for economic prediction are input-output and materials balance analyses. Input-output analysis has been successfully applied to the Philadelphia Region. (41) Materials balance models have been suggested for use in the Delaware Estuary Study to set effluent charges. (42)

Because environmental effects are difficult to predict with accuracy, it may be advisable for society to forego the possibility of such a small gain in social welfare to avoid the possibility of irreversible or otherwise serious losses in environmental quality. Ciriacy-Wantrup has correctly explained that this social strategy against uncertainty is much like the purchase of an insurance policy. The net gain in social benefit foregone by rejecting a questionable project is the premium and the elimination of risk of environmental damage from the project is the social gain. (43)

3.0 EVALUATION

Perhaps the most difficult part of the impact assessment process concerns the evaluation of a specific impact in terms of its costs and benefits to different groups of society. Merely stating that a proposed marina will result in the destruction of 500,000 little neck clams does not actually explain the implications of permanently removing clam beds. Are those clams vital to the socio-economic or ecological well-being of the region? Should a decision-maker be concerned about their destruction or not?

The process of evaluation is designed to identify the specific costs and benefits associated with each impact, in a manner that will explicitly distinguish the type and dimension of the tradeoffs in the approval, denial, and modification of a project. The evaluation should also outline the incidence of those costs and benefits, (i.e., Who bears the costs? Who obtains the benefits?). To date, the incidence of the costs and benefits of particular impacts have been largely ignored in the evaluation of environmental impacts. (44)

Even where agencies have attempted to evaluate the impact of their projects, problems have arisen in the choice of methods used in the evaluation process. Thus, as Gilbert White wisely points out, when water resource agencies were faced with the requirement of evaluating impacts "for which it was difficult or immediately impossible to offer precise measurement," they often utilized the simplest and most readily available method.

> Thus, when faced with the need to assign values to the recreational use of a new reservoir they adopted a universal figure for the dollar value of one user-day and were slow to apply more sophisticated measures. As soon as agreement has been reached on a valuation measure or method of analysis there is strong resistance to retain it. (45)

3.1 Aggregate vs. Discrete Measurement

Agencies have exhibited a strong tendency to aggregate a project's impacts within a single value structure to provide a single, clear-cut rating for evaluating a project as a whole. An example of the tendency to use one over-all rating is provided in a recent report for the Bureau of Reclamation.* (22)

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* -Another example of aggregate rating of environmental conditions is the environmental quality rating system prepared by the Bureau of Outdoor Recreation (N.E. Region). (46)

> ... the process of choosing between alternatives can be improved by relating all environmental impacts to a single set of units. By expressing parameters in common units, the net environmental impact of any project is stated as a single value. This value represents, in relative terms, the nature of a project's impact on an area and the importance of the impact. Because net environmental impact is expressed as a single value, it is easily compared to other alternatives to determine the most environmentally sound approach to development of a particular resource. (47)

When organizing environmental impacts into such a single index, there is a high probability that certain factors, which are neither quantitative nor easily converted into quantitative terms, will be severly distorted or masked. Valuation, according to monetary values, may be possible for particular impacts, but certain environmental effects may simply not be susceptible to quantitative or monetary measures. Where intrinsically non-quantifiable impacts are given numerical values and then incorporated into a single index, the impact evaluation serves as a basis for disguising and masking the discrete impacts and inhibits, rather than encourages, public discussion of the project's specific effects.

We believe that an evaluation framework should be organized to allow environmental impacts to be judged on an individual basis, or according to common categories (e.g., water quality, air quality). In this context, different units of measure which most accurately reflect the particular costs or benefits of an identified impact or type of impacts could be used.* The evaluation of individual impacts or impact groups permits more flexibility in decision-making. Rather than just offering a "yes" or "no" choice, the evaluation of specific impacts allows and encourages alterations in particularly objectionable aspects of a project. A project could thus be approved on the condition that certain modifications or mitigation measures were incorporated in the design.

3.2 Public Review

If the evaluation process is to be seriously undertaken, then methods must be devised which will allow affected persons and groups to evaluate the project's impacts in terms of their own values and interests. The primary methods of obtaining citizen involvement in administrative decision-making processes have traditionally been limited to public hearings and informal discussions with citizen groups. Unfortunately, such methods

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* -The Water Resources Council's recommendation of a multiple accounts system for program and project evaluation represents a larger extension of this disaggregation concept. (48)

are rarely sufficient to allow citizens to articulate their preferences and have their values reflected in decision-making. At the present time, impact statements are made available to affected parties at a point when the basic plans and commitments for a public project have already been made and, thus, it is difficult to achieve any substantial changes or modifications in the project. Frequently, the only option available to citizens who are opposed to certain aspects of a project is to attack the entire project with legal challenges. If citizens were involved in the planning process at an early stage, there would be a greater possibility to have their interests reflected in the design of the project, when modifications could be most easily made.

Even if earlier opportunities for public review existed, not all potentially affected groups would necessarily be involved because not all are immediately capable of perceiving the effects of a project upon their communities and of organizing themselves for involvement in decisional processes. Certain highly-organized groups regularly monitor the activities of public agencies and articulate their preferences at an early stage of the decision-making process. These groups are regularly contacted by public agencies for their review and comments on impact statements. If affected parties are not well-organized or highly visible, there is a strong tendency to omit them from involvement in the evaluation process, despite the fact that such groups may be significantly affected by a project.*

Efforts to improve the representation of affected parties can take different forms. One strategy would be the support of educational programs to inform community groups of NEPA and state acts administrative procedures and sources of information to assist in the review of the statement. Another means would be to fund public interest law firms to provide assistance to private groups in the review of impact statements. Persons who would otherwise be unable to afford legal counsel would thus be able to challenge the proposed project. Although such advocates would not be able to provide regular review of impact statements, the existence of such external organizations and their capacity to pursue litigation should be sufficient to modify Federal agency behavior in the preparation of environmental impact statements.

The content and organization of impact statements often do not help the affected groups and decision-makers to clarify

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* -A constant issue for agencies involved in public review programs is to determine how much effort should be spent to identify and seek out the reactions of affected parties. Is notice in the local public paper sufficient, or should the agency seek out each affected party and explicitly set forth the potential impacts and the possible tradeoffs?

the issues and delineate the tradeoffs associated with a project. Two common approaches to drafting impact statements effectively thwart the accomplishment of thorough and critical public evaluation. The statement (or many individual, yet interconnected, statements) may overwhelm the reviewer with vast amounts of poorly organized, indirectly relevant, and often repetitious information. By making it difficult for the reviewer to effectively and expeditiously assess impacts, a thorough review is thereby discouraged. On the other extreme are statements that provide insufficient information, often just a parroting of NEPA's Section 102c. Obviously, incomplete or inadequate information also prevents the reviewer from making an independent evaluation of the impacts. CEQ could considerably improve the effectiveness of the public review process by issuing more specific guidelines on what should be the content and organization of the impact statement, and still allow agencies to exercise sufficient freedom in making individual judgments responding to the myriad variety of projects within NEPA's purview.*

It has been often noted that the public review of impact statements is usually a futile exercise. There is no administrative mechanism to guarantee a thorough and impartial review of statements. Other than the courts, there is no means to assure that the negative comments made by the public and government agencies will be reasonably considered by the project proponent.

Two institutional arrangements have been frequently mentioned as a means of improving the review process. An administrative unit could be created to monitor, regulate, and enforce compliance with the act. Whether such a new Federal agency would be able to exercise a great amount of influence over well-established and powerful Federal agencies is questionable. Over the long run, such a new agency would probably be forced to reach accommodations with the already existing agencies which could conceivably rationalize the form but not the substance of compliance.

Another possible arrangement is establishment of independent review boards consisting of professional experts from the various disciplines involved in impact assessment. Such interdisciplinary boards could be organized for review of specific project types (e.g., power plants, highways) or for all major projects within a region. The review boards would have to be adequately staffed and funded. Funds could come

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* -An outline for organization and content of impact statements to improve the specificity and relevance of the information presented, is provided in a separate work by the authors. (11)

from charges paid by the sponsors of projects being reviewed, or taxing the project type (e.g., Maryland's surtax on electric energy production to fund the power plant's environmental research program and site acquisition).

3.3 Plan Compliance-Conflict

An effective procedure for evaluation is to determine what will be the degree of convergence of a proposed project's impact with regional planning programs and elements. Where a community has already identified and expressed its collective goals in a community plan, then the impact statement can be evaluated in terms of its relationship to the existing planning program. It should be recognized that the use of a plan or program as a method of evaluation is valid if only it reflects the full range of community values and does not solely reflect the values of professional planners or vested interest groups.

The plan compliance process affords several advantages to the agency sponsoring a project. Where the proposed project is clearly at conflict with the plan, then it can prevent the allocation of resources to a project that is likely to arouse substantial local opposition. Conversely, if the proposed project is compatible with the plan elements, opposition to the project will be considerably reduced or eliminated. The impact statement for a project that is in compliance with an adopted and well supported comprehensive plan could be quite specific and easy to process. Such a statement would describe the degree of compliance and detail the localized impacts of the project's particular actions on the proposed site. It is evident that there is a tradeoff between efforts that must be spent on preparing individual impact statements and the preparation of comprehensive plans (or plan elements).

The length and complexity of impact statements can often be attributed to the attempt to deal with broad policy issues in the evaluation of a single project. Such policy issues as energy needs and low-income housing involve basic value conflicts which can only be effectively resolved through political and planning processes. In the long run, it appears that one of NEPA's most significant contributions will be to force the development of effective planning programs, for example, a National Land Use Plan or a National Energy Plan.

Plans that are developed to replace or assist the impact statement process should give particular attention to the determination of limiting factors and environmental quality indicators. In many regions, there is a strong public consensus for retaining the existing state of particular environmental or social conditions. The particular environmental or social conditions then become the limiting factor for the development of a region.

Development is controlled to prevent the cumulative impact of all projects from adversely affecting, or exceeding, the particular social or environmental conditions. The blueness of Lake Tahoe, the traffic capacity of the California coast highway, and the desirable population level for the Bay Area are examples of limiting factors to regional development. Projects are evaluated according to the potential contribution they will make to the region-wide cumulative impact on the limiting factors. The development of a plan based on limiting factors is particularly important because impact statements are usually incapable of determining how a proposed project will contribute to eventual region-wide cumulative impacts. Since the preparation of an environmental impact statement is an incremental exercise, the impact assessment will likely fail to perceive the threshold point when many apparently insignificant condition changes will cumulatively combine to irreversibly degrade a resource system.

Ideally, impact budgets would be established for component areas of the region to assure that the cumulative impact will not exceed, or significantly degrade, the capacity of the limiting factor. For example, the land use plan and zoning ordinances developed for the Lake Tahoe Region are based on run-off and sediment budgets for each watershed within the Lake's drainage basin. (49)

The Association of Bay Area Governments recently proposed a regional growth policy directed toward constraining the population of the nine counties to or below five and a half million* in 1980. (50) The five and a half million population in 1980 represents a half million decrease from the State Department of Water Resources projections, and 200,000 decrease from the State Department of Finance projections. Whether the Bay Area's population growth can be slowed to meet the 1980 target level is uncertain. Perhaps the 1980 target is too high, especially if growth is concentrated in certain areas that are environmentally sensitive or already degraded. The ABAG policy does admit that "some control on economic growth will be necessary," a position that has been viewed with alarm by business interests and the more populous, older jurisdictions such as San Francisco and Alameda County. It is questionable whether such limited economic growth will be politically feasible, particularly if highly desirable social benefits are attached to economic growth. But the 1980 population level proposed by ABAG, at least, presents a criterion that can be used to evaluate the growth-inducing impacts of any major project proposed within the Bay Area.

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* -1970 population level of the Bay Area was 4.6 million.

3.4 Balancing and Benefit/Cost Analysis

Section 102 (8) of NEPA directs Federal agencies to: "identify and develop methods and procedures, in consultation with the Council of Environmental Quality established by Title II of this Act, which will insure that presently unqualified environmental amenities and values may be given appropriate consideration in decision-making along with economic and technical considerations ['balancing'] ." (51) Unfortunately, Section 102 (c), the impact statement directive, did not clearly require the inclusion of this balancing in the actual statement. The court decisions in Calvert Cliffs Coordinating Committee v. AEC (52) and Natural Resources Defense Council v. Morton (53) both strongly supported the interpretation that environmental costs must be balanced against economic and technical benefits and that the agency must incorporate the findings into its decisions.* CEQ, in its May, 1972 memorandum, recommends: "Agencies that prepare cost-benefit analysis of proposed actions should attach such analysis to the environmental impact statement." (20)

At this point it is not clear what new form a merged benefit/cost analysis (in the traditional economic sense) and environmental statement might take. One strategy could be to combine both into an expanded benefit/cost analysis that tabulates all environmental costs and benefits. This system would have the advantage of concise organization in a single document. Double counting and cost exclusion would be easier to discern and analysis teams would more clearly understand their content responsibility.

Another strategy would be to conduct a benefit/cost analysis during the first stage of project review and to undertake environmental impact analyses only on those projects that "pass" the economic analysis. It is assumed that a project will be examined in its most feasible technological form (i.e., if the mitigation measures are less costly than the damage without the mitigation, the cost of mitigation would be included, not the benefits from damage prevented). It is also assumed that weight given to the environmental impact statement is at least equal to the benefit/cost analysis. The environmental impact statement should not be viewed as an afterthought once economic feasibility has been determined.

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* -It is still an open question on whether the impact statement is the decision document in project approval. "The environmental impact statement is not the decision document . . . Rarely will new and original data be developed for the environmental impact statement. The environmental impact statement is a summarization of the environmental effects and impacts considered in the course of the study." (54)

Since environmental analysis is generally more expensive than economic analysis, a two-stage process would result in cost savings by early project rejection. This would also allow for more detailed environmental studies of the remaining economically feasible projects. Certain projects will have benefits which would exceed their costs by a wide margin. Other projects would be marginal even without accounting for environmental costs. A simple, conservative estimate of unavoidable environmental costs and the costs of required mitigation measures would find many of these marginal projects economically and/or environmentally unfeasible.

It should be noted that many water resource projects now being vehemently opposed because of adverse environmental impacts would have negative benefit/cost ratios if the discount rate were raised from the 1950's level used in the calculation to the 1970 cost of government borrowing.* Even without an unrealistically low discount rate, many of these water resources projects would have a negative benefit/cost ratio if calculations were made to more accurately reflect current values and costs. The Melones Dam suit brought by the Environmental Defense Fund against the Corps of Engineers is a good example of using the benefit/cost analysis to argue against a project. (2)

For those effects which are quantifiable, the analyst can choose among a variety of valuation techniques. (56) These procedures include the resource input method, the cost savings method, the analogous market method, the expenditures method, and the direct survey method. Whether the benefit/cost study is an integral part of the impact statement or not, it is absolutely critical that the source of the data used in the analysis, the techniques applied, and the conclusions reached, be explicitly listed and open to review.

There is a serious danger that the Federal experience with benefit/cost studies and coordinated review procedures in the water resources field may be duplicated as agencies attempt to comply with impact statement requirements. Gilbert White has noted that the long history of water resource planning may provide clues to the behavior of administrative agencies in meeting new information and review requirements. White points out that within a few years after the Federal and State agencies were required to review each other's projects, they worked out accommodations that obscured or submerged the major points of difference among them.

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* -The Water Resources Council has recommended that a 7% discount rate be used in benefit/cost analysis; a rate which would eliminate many of the water resource projects now being proposed. (48) For a critical discussion of the assumptions underlying the discount rate, see (55).

> Organizations within the Federal structure strive to reduce conflict situations and work out agreements and coalitions—some tacit and some formal--to avoid open confrontation. It seems likely that similar forms of accomodations are taking shape under the Section 102 procedures and that the newer agencies, such as the Environmental Protection Agency, are slower to forge such understandings. (45)

3.5 Post-Approval Monitoring

Despite the intense and varied efforts which are being exerted to develop new methods of impact assessment, little attention has been given to evaluating the accuracy and reliability of these methods. Apparently, the test of an impact statement is whether or not it successfully withstands challenges from project opponents. In this context, the information base and methodology are thus evaluated according to political criteria; success being measured by the extent to which the impact statement provides an information base comprehensive enough to allow the project to be undertaken. If, though, we are to seriously improve our capacity to predict the environmental and socio-economic effects of public projects, audits and analyses of projects must be undertaken as they are being constructed and after completion. Only by monitoring the impacts that actually occur will we be able to discover the specific gaps and weaknesses of currently-used methodologies.

The virtual absence of post-project evaluations has been discussed by White, who notes:

> One of the remarkable aspects of natural resource management is that immense stocks of money and time are expended upon preparation of plans while pitifully small amounts are spent on finding what actually happened after the plans were adopted. (45)

Public agencies could considerably improve their impact assessment methods by comparing the actual environmental and socio-economic effects of a project with those impacts that were identified in the project's impact statement. The data derived from monitoring projects can thus assist in the development of better predictive methods and provide a new indication of baseline conditions for future impact assessment.

4.0 CONCLUSION

The development of methods for assessing environmental impacts is in a rather young and primitive stage. To the extent that public agencies get committed to particular methods and measurement techniques for use in their impact statements,

there is a strong possibility that certain methods will be adopted in administrative operations, long before they have been thoroughly tested and evaluated. Where particular techniques have been successful in guiding agency projects to approval, there is even a greater likelihood that agencies will get "locked in" to assessment methods, thus making subsequent changes in impact processes even more difficult.(45) Therefore, it is important that agencies subject their assessment procedures to continuous analysis, and that new methods be sought out and tested. With the growing use of the environmental impact statement, it should be possible to undertake research which would allow assessment methods to be refined, modified, and in some cases, discarded.

As impact assessment methods are developed and refined, consideration must also be given to the question of how the information contained in the impact statement can be utilized in decision-making processes. The possibility exists that an over-emphasis on technical sophistication in impact assessment methodologies may ultimately reduce the capacity of citizens to effectively participate in the environmental impact statement review process. This would be particularly unfortunate, since the legal requirement for environmental impact statements has been a major vehicle for citizens to gain access to decisional processes that deal with environmental issues. As we improve our technical skills at impact assessment, it is equally important that the data produced permit citizens' groups and public officials to effectively analyze the information, and thus, to have it taken into account in decisional processes.

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ABAG Plans, Policies, Programs	Condition Change	Agencies or groups with designated authority or expertise.	
	irrigation saturation of topsoil impervious surfacing recontoured slopes drainage channelization vegetation clearing (C) embankments		
	1 → Blockage of groundwater recharge	USGS	DWR
	1.1 .Decrease groundwater supply - overdrafting of supply .Salt water intrusion and contamination of groundwater supply. .Decrease water supply available to surrounding groundwater users.		
	impoundments impervious surfacing drainage diversions embankments landscaping recontoured slopes		
	2 → Reduce natural erosion from watershed of beach material	USGS, CE	DMG, DNOR
	.Reduce watershed's contribution of beach sand to the coast's littoral system.		
	2.1.1 .Stimulate or accelerate beach and sea cliff erosion - imperil cliff edge or beach edge development. .Reduce beach area available for public recreation - concentrate use to remaining beaches, overcrowding and overuse of area, degrade site condition plus area's recreational values.		
	septic tanks		
	3 → Seepage from septic tanks into ground or surface water bodies.	USGS, SCS	WQCB
	.Contamination of groundwater supply.	EPA, DPH,	WQEB, DWR
	.Contamination of public water supply.	EPA, DPH,	WQEB, DWR
	.Increase cost of water purification for domestic or industrial use.		DPH, DPR
	.Contaminate water body for recreational contact uses.		DFG
	.Degrade quality of water as fish or wildlife habitat.		DPH, WQCB
	.Stimulate eutrophic conditions in water bodies downstream of project site. (refer to 7.1)		
	wells		
	4 → Overdrafting of groundwater supply (withdrawl greater than replenishment).	USGS	DWR
	.Salt water intrusion and contamination of groundwater supply.	USGS, EPA	DWR, DPH
	.Differential subsidence of groundlevel. .Structural damage .Salt water penetration of estuarine or freshwater habitats - degradation of habitat quality.		DFG
	fertilizer application		
	5 → Fertilizers or nutrients carried by runoff into water body.	DA, EPA, ASA	WQCB
	.Stimulate eutrophic conditions in water bodies. (refer to 7.1)		

APPENDIX B

Impact Review Form For Housing Developments _____

Impact Categories

I. Displacement or Preemption of Existing Uses and/or Users from Site

II. Relationship of New Residents to Community and Region

III. Modification of Access Patterns - Circulation

IV. Relationship Between Housing Development and Underlying Earth Conditions, Site Vegetation Conditions

V. Relationship Between Housing Development and Watershed

VI. Relationship Between Housing Development and Airshed

VII. Relationship Between Housing Development and Area with View of or From Development

VIII. Relationship Between Housing Development and Area with Sound of Resident's Activities, Development Construction, Sound of Surrounding Activities

IX. Infrastructure and Public Service Requirements of Project, Influence on Surrounding Land Use

X. Context with Regional Housing Programs

Impact Review Form for Highways _____

Impact Categories

I. Displacement or Preemption of Existing or Potential Uses and/or Users

II. Relocation of Uses and/or Users from Right of Way Location

III. Modification of Access Pattern - Circulation

IV. Relationship Between Highway and Underlying Earth Conditions

V. Relationship Between Highway and Watershed

VI. Relationship Between Highway and Airshed

VII. Relationship Between Highway and Area with View of Right of Way and Traffic Movement or Area Viewable from Highway

VIII. Relationship Between Highway and Area Within Sound of Traffic

IX. Implications on Alternative Transportation Systems, Influence on Surrounding Land Use

X. Context with Regional Transportation Programs