RG:0020

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MEMORANDUM

TO: Manabu Tagomori, HWRRS

FROM: Doak C. Cox

Hawaii Water Resources Regional Study
Preliminary Overall Report
2nd Draft

This memo results from your solicitation of individual comments on the above document. The structure of the Environmental Center enables it to provide reviews representing the coordinated views of people with diverse disciplines, background and outlooks. Considering the stress laid on individual responses to the Water Resources Study, we have not attempted such a coordinated review, and the comments provided herein are personal. You might find a full Center review useful later in the study process.

I regret that time commitments did not permit my review of the first draft report, and have not yet permitted my review of the second draft subregion reports. As time allows I will look at the latter.

Before addressing myself to detailed commentary which is identified here by page (p) and paragraph (P) citations, I have a few general comments.

1. Scope and detail

After completing the review of details, I am left with a general dissatisfaction whose roots I am not sure I can pin down. It may be simply that the level of presentation of water resources understanding and the level of consideration of related problems does not seem consistent with the effort that I understand has been put into the report thus far.

Before I got to the last section, I was preparing to say that:

a) The report should be modestly helpful in its identification of water resources problems, and even more to the extent that it also identifies alternative actions toward solving the problems.

b) It would be enormously more helpful if it had gone a step further to indicate criteria and suggest directions of procedure as to the choices among alternatives.

c) The greatest help would come from actual choice among alternatives. This might have been considered too much to expect, but it should be recognized that, year by year, we do go on making the choices implicitly and thus reducing the future options.

When I got to chapter 4, however, I saw that the entire process of evaluation of alternatives is to come later. The public involvement in the study I believe to be highly appropriate, but coming quite late in the process, and hence much rushed and hence less than ideal. Public help, however, depends on public understanding, and I think here is where I have the greatest dissatisfaction. The level of presentation of our present hydrologic and water resources understanding in this report, although somewhat variable chapter to chapter, seems superficial, providing a quite inadequate base for the formulation of opinion by the previously uninformed but interested segment of the public.

2. Conservation

I regard the term conservation as including wise use as well as preservation. Wise use is implied throughout the present report, and preservation or restoration of natural qualities appears as a goal in a number of respects. However, the rationale for present preservation for the sake of retaining options to meet long-term future and now unforeseen needs does not seem adequately stressed.

This rationale is not as strong for a renewable resource like water as for non-renewable resources. The flow of a stream diverted for water supply, for example, can be turned back into the stream. Even the diversion structure might be demolished. However some water-related processes would be difficult, impractical, or even impossible to reverse. Restoration of the original assemblage of species in a stream might not be possible. Eradication of channelization structures would be extremely costly, and eradication of their effects impossible. Restoration of beaches in natural form is not practicable. Undoing the effects of mixing of groundwater may take centuries or longer, etc.

Most decisions we make with respect to water resources involve reductions in the scope of options for the future. I do not see adequate recognition of this displayed in the report.

3. Research

In my detailed comments I have remarked, at several points, on needs for research. I am deeply appreciative of the basis for the common claim that what we need now is action, not more studies. We have had in Hawaii a superabundance of studies inadequately linked to planning and action programs. However, over and over again we are faced with critical inadequacies of information. The information in many cases is of the sort to be supplied by surveys or monitoring.

A survey can be made at the time the need arises, but the needs for monitoring to establish long-term statistics, of the sort commonly demanded in water resources planning, cannot be satisfied by a short-term survey. Survey and monitoring results are useless, in any case, unless they fit utilitarian models of hydrologic and water supply systems. It is the function of research to supply these models.

Throughout the draft report I have found evidences of the use of inadequate models even when better models are available. An example is the failure to recognize the importance of hydrologic subcycles and the recycling of water with each island subregion. Even if the best available models were used, however, their inadequacies would be apparent. I have pointed out, for example, the inadequate quantitative understanding of bottom storage lags in Herzberg lenses.

I recognize that this pitch for more emphasis on research comes from a source biased by an academic special interest in research. I hope you will recognize, that the academic community has a larger share of the competence for judging research needs than in the case of other competences, and I would be remiss if I did not make the pitch.

4. Information sources, accuracy, and reliability

It is inevitable that in a report such as this, use must be made of information varying considerably in accuracy and even in reliability. Limitations as to accuracy and reliability must be kept in mind as the information is used. There is, however, no discussion in this report as to accuracy of data, there is not even discussion of the means of estimation employed, and the report fails even to cite the sources of information. The result is that readers may be either unduly suspicious of all the information, or uncritical in accepting it.

pp. 21-22. Rainfall--general comment. Raincatch as a form of water development is mentioned, yet caught and stored rainfall in some areas is the only source of domestic water and in other areas the only source of water for cattle.

Rainfall is not discussed as a source of water for maintenance of vegetation and not even as a source of water for agriculture. Yet rainfall is the only water resource for maintenance of wild-land vegetation and for unirrigated agriculture.

p. 23, P.3. Kona is not the only exception to the seasonal comment. Mordy found that high-rainfall areas, and hence areas dominated by trade-wind rainfall had three maxima during the year, Nov., Feb., and July, if I remember right.

p. 23, P.4. This para. does not deal with rainfall but with other precipitation. Clouds not only enshroud peaks and provide moisture to vegetation but provide additional water as fog-drip. Lanai experience indicates significant rate. Significant quantity, however, depends on the area of significant rate. The area, on Lanai, for example, is of unknown extent. The effect may be significant only on the ridge crest.

p. 24, P.5. Evapotranspiration in the wetter areas is probably not reduced so much by frequent showers and high humidity as by low solar energy incidence resulting from high cloudiness.

p. 25. Hydrologic cycle--general comment. This discussion would more usefully precede the climatology section.

I would expect to find in this report a level of discussion of general hydrology and general means of water development at least equivalent to that in a little paper I wrote on water development for sugar-cane irrigation a good while ago (Cox, D. C. 1954. Water development for Hawaiian sugar cane irrigation. Hawaiian Planters Record, vol. 54, pp. 175-197). The level in the report falls far short of this, however.

p. 25, P.1. It is the flux magnitude in the cycle rather than the cycle itself that varies seasonally and annually. The variation also has obvious and very important shorter term components. Certainly rainfall and stream flow vary hour to hour.

p. 25, P.4. The total quantities (by island) shown in fig. 2.2. are produced, not by measurement but by estimation. The estimation of total rainfall is fairly good, because of a fairly good distribution of fairly representative raingages. The estimation of total runoff is less good, being based on discharges of only parts of some drainage basins with perennial streams. The estimation of evapotranspiration and recharge are distinctly less good.

Evapotranspiration estimates must be based on some model that uses generally available data such as rainfall (correlated with cloudiness or with EP itself), pan evaporation (not generally available but useful in establishing the rainfall-EP correlation), etc. Recharge can only be estimated by subtraction, or by estimation of ground-water discharge (and the relation between recharge and discharge is generally used the other way round).

The means for estimation in all cases, particularly in the case of evapotranspiration and recharge, really should be explained in the study report.

In Fig. 2.2 has careful distinction been made between runoff and groundwater recharge? Is the runoff confined to pure surface runoff, excluding groundwater recharge returned to streams by springs and seeps? Or is there a double counting?

p. 25, P.5. The explanation of water budgeting completely overlooks internal cycles of water, natural and artificial, present and potential. It neglects, for example, ground water discharge in springs becoming part of surface water runoff. It overlooks irrigation excess forming part of recharge. The hydrologic cycle description should be expanded considerably to discuss these cycles within the major cycle.

p. 27, P.3. Among perennial streams, those that "gain" are a good deal commoner than seems suggested. No mention is made of loosing streams, but these occur also.

p. 27. Surface storage--general comment. Mention might be made here of the lack of significant natural fresh water lakes in Hawaii.

p. 28, P.7. "Thrust and pull of tides" (not a very accurate expression), do not directly cause mixing but cause displacements of the salt-fresh interface which result in mixing. Seasonal changes in recharge and draft also result in such displacements and hence result in mixing.

p. 29, P.1. Shafts do not develop water. The Maui wells that do are combination of shafts and tunnels, and it is the tunnels that develop the water.

p. 29, P.2. "Salt water intrusion" is a very poor term to apply to the usual Hawaiian situation, implying as it does intrusion along a more-or-less horizontal aquifer. The salt-water is already present below a Herzberg lens. All that is required is mixing to bring it up.

The reason given for lack of excessive drawdowns suggests reference to the lack of experience here with trends of falling water tables found in some continental areas. What is an excessive drawdown depends on many factors. An excessive drawdown may be one that results in salt-water coning. If we don't have more problems with this it is because we have learned generally to avoid them.

It is true that permeabilities in general are high in Hawaiian aquifers compared with mainland aquifers. The term transmissibility includes aquifer depth in a way rarely well thought through as applied to a Herzberg lens.

p. 29, P.3. Interference between wells is a hydraulic effect that has no relation to the water quality effect. The salinity increase results from the salt-fresh mixing which in turn results from the pumping pattern of the upstream well.

p. 29, P.5. This discussion does not even mention the question as to the extent of which tunnel development may increase surface availability of water beyond original spring discharges, nor the possibility of redevelopment of dike storage by bulk heading.

p. 29, P.6. "Tunnelling at the sites of former springs" may be misleading. Springs have certainly been used as guides to tunnelling for perched-water development, but the tunnels have generally been begun above and sometimes quite a distance from the springs.

p. 30, P.1. The water is derived from the streams, and merely transported by ditches (and incidentally tunnels and pipelines).

pp. 28-30. Ground water--general comment. No discussion is provided of the three functions of ground water aquifers; the storage function (making water available for times of need), the "pipeline" function (delivering the water from catchment areas closer to points of use), and the "filter function" (removing suspended solids and certain dissolved solids).

p. 30. Water use--general comment. Again no distinction is made between initial water development, redevelopment from water returned to streams and groundwater, and water use. The total use would be more than 100% of that initially developed, because of reuse with or without return to streams or groundwater. The percentages shown appear to relate to the total of initial development and redevelopment.

p. 32, P.4. Tidal effects are not restricted to zones very close to shore. Waves include sea (effects of local winds) and swell (effects of distant storms). Sea and swell are not sources of waves.

p. 32, P.5. If terraces are to be mentioned, why not other features such as the shallow platform between the islands of Maui County, and especially Penguin Bank extending SW from Molokai.

p. 33, P.4. What organic compounds from non-point sources threaten the biosystems of coastal waters. Nutrients are certainly a threat locally, especially semi-enclosed bodies, but where can it be determined that organic compounds from non-point sources represent a significant threat.

p. 34, P.1. Is there any land in Hawaii (or anywhere else) that is not water-related land by this definition?

p. 34, P.4. I am under the impression that many soils are regarded by agronomists as difficult to till because they do not scour.

p. 37, P.4. Effects of paving and roofing should be mentioned.

p. 41,P.1. All lava is igneous, and all basalt is lava. Not all the sea cliffs are basalt except in the broadest sense of that term. Reduce to "lava cliffs" or just "cliffs."

p. 41, P.4. Shallow marine sediments include mud, silt, sand, and gravel of terrestrial origin and marl, calcareous sand, coral, beachrock, and fragmented calcareous material of marine origin.

Surely the predominant ordinary coral must be mentioned, and indeed coral reefs. The ordinary corals are far more important than the precious corals.

p. 43, 1st. problem. I doubt that by 2020 firm water demands will exceed reasonable supplies. The demands in some areas will exceed supplies recoverable at what are now considered reasonable costs and indeed this is already the case.

p. 43, 2nd problem. In the light of increasing world population, decreasing land availability for agriculture world-wide, undiminishing reasons for seeking a better approach to local self-sufficiency in agricultural production, and the continuing need for exportable products, on the one hand; and the increasing demands for water for non-agricultural use on the other; will a lessening of the competition between agricultural and other uses for water supplies occur after 2000? It may be that agricultural needs will not increase after that, but the problem of continuing to meet stable needs will continue severe or increase.

p. 43, 3rd problem. What are the chances that the level of absurdity in water quality standards stringency will be reduced in the future instead of increased?

p. 44, fig. 3.1. What is identified as "Supply-year 1970" appears to be essentially safe yield or long-term recoverable supply. The derivation of the numbers in this figure is nowhere explained. Are the figures explained in the individual island reports? If so should those not be cited. I do not even find a reference to the figure in the text.

A figure lumping together various supplies and various demands may be quite misleading. The water quality requirements, for different uses, for example, may be very different. A more than abundant supply of low quality water is of little use if there is a shortage of high-quality water.

p. 45, 5th problem. The problem isn't just with inadequate data but with inadequate understanding. No amount of data can make up for the lack of valid models for its analysis. Indeed data collection without a model is likely to result in a whole lot of waste.

For example, important limitations to the accuracy of the data in fig. 3.1 must result from our still inadequate quantitative knowledge as to: a) the importance of bottom storage lag in Herzberg lenses; b) the extent to which salinity mixing may be reduced by control of well location and pumping fluctuation; c) the extent to which spring discharge of Herzberg lenses can be reduced by head-lowering without causing excessive salinity in water recovered from wells or impairing long-term storage.

p. 45. 2nd Muni. & Ind. Alt. No problem/issue was identified related to storage and transmission capacities. Overall supply problems will not be solved by improvements in storage and transmission.

p. 45. 8th Muni. & Ind. Alt. Direction and control of growth will make water supply easier, and direction may solve important potential problems of shortage, but cannot solve overall supply problems. Improved efficiency of use will not result from growth control.

p. 46. 3rd Polln. Control Alt. The quotations around "zero-discharge" may indicate tongue-in-cheek usage. The usage in federal law is either misleading or misguided. Zero pollutant discharge is not only quite impractical but would be environmentally deleterious.

p. 46. 3rd Data Base Alt. Is the "development of interpretive information" a circumlocution for research? Is research in such bad repute that a circumlocution must be used? There is certainly a very great need for research transfer that might be considered interpretive. There is also a need for research itself.

p. 47, P.2. Needs for recreation in such areas as watersheds are not generally mutually conflicting. What is meant is that they might conflict with watershed usage. There are not just possible conflicts but actual ones by present official concepts. I believe that in part the official concepts are erroneous.

p. 48, 1st problem. Increasing demand is by itself not a problem. The problem is with increasing demand relative to the supply and even the potential supply.

p. 48. Problems--general comment. The tabulation does not include the problem of the perceived conflict between recreational and water supply uses of land.

p. 48. Increasing recreational demand, alt.--general comment. What are tabulated are not alternatives to increase recreational demand but alternative means, other than access, to meet increasing demands. This listing should include possible opening of additional watershed areas to recreation.

p. 47-50. Recreation--general comment. Research needs are at best inadequately recognized. See pertinent comments on water supply.

This chapter is devoted entirely to what might be called the active use of waters for recreation. It neglects the passive use, and the passive use is not considered elsewhere in the report. By passive use I mean esthetic uses, particularly visual ones--the simple enjoyment of vistas in which water is the important component. Even these uses have their economic side--our tourist industry depends very largely on them, but sound economic evaluation would be difficult and in any case quite inadequate.

There are important conflicts between passive recreational uses and other uses, and hence problems. When we take water from a stream for irrigation or for power generation we may dry up waterfalls downstream, for example. There are even conflicts between passive and active recreational uses. A beach crowded with sunbathers and swimmers loses its untrammelled attractiveness, for example.

p. 50. Fig. 3.2. What is the "People acre" column? I figured S = swimming not south, and NS = non-swimming, not north-south.

p. 51, 1st 4 problems. Isn't it optimistic to think that stresses on fish and wildlife will be moderate in the future?

p. 51-2. Problems--general comment. The tabulation does not recognize the effects on fish and other aqueous biota flow diversions, stream channelization, etc.

p. 51-54. Fish and Wildlife--general comment. Research needs are at best inadequately recognized. See pertinent comments on water supply.

p. 60. Fig. 3.5. Does the size of the circles have some significance? What is source of data? Are there no flood problems in Waianae? Are there no tsunami problems in South Kohala, North & South Kona, Kau, and SE Puna other than those at Kawaihae, Kailua, and Naalehu, even with increased shoreline development? What about Maui coast from Kihei to Makena? What about Mahaulepu coast on Kauai?

p. 61. Urbanization alternatives--general comment. Flood insurance ought to be mentioned.

p. 62, 3rd problem. Probably underestimated, especially for future considering retreat trend on most beaches.

p. 63, Fig. 3.6. Source of data? Means of estimation?? Treatment assumed???

p. 64, Shoreline protection--general comment. Relocation of existing structures and prevention of future structures should not be restricted to those that interfere with natural (not national) shoreline processes, but include also those that will be threatened by natural shoreline processes.

p. 65. Problems--general comment. The present problem of coastal water pollution by sewage effluents may be met by 1990, but certainly cannot be omitted from the tabulation for the period 1975-1990.

p. 65, P.2. Zero pollutant discharge is either misguided or misleading.

p. 66, Fig. 3.7. "Water quality segment" means nothing except in the context of the DOH water pollution control plan. Explanation is needed.

p. 70, 2.3, #1. Why 12 mile? Why not 3 mile? Has Federal policy changed?

p. 73, 3.6--general comment. Legal concepts and laws related to shoreline use and protection are inadequate.

No attention seems to have been given to institutional responsibilities or their potential revision and improvement.

Doak

Doak C. Cox, Director

cc: L. S. Lau, WRRC
R. Gay, Botany