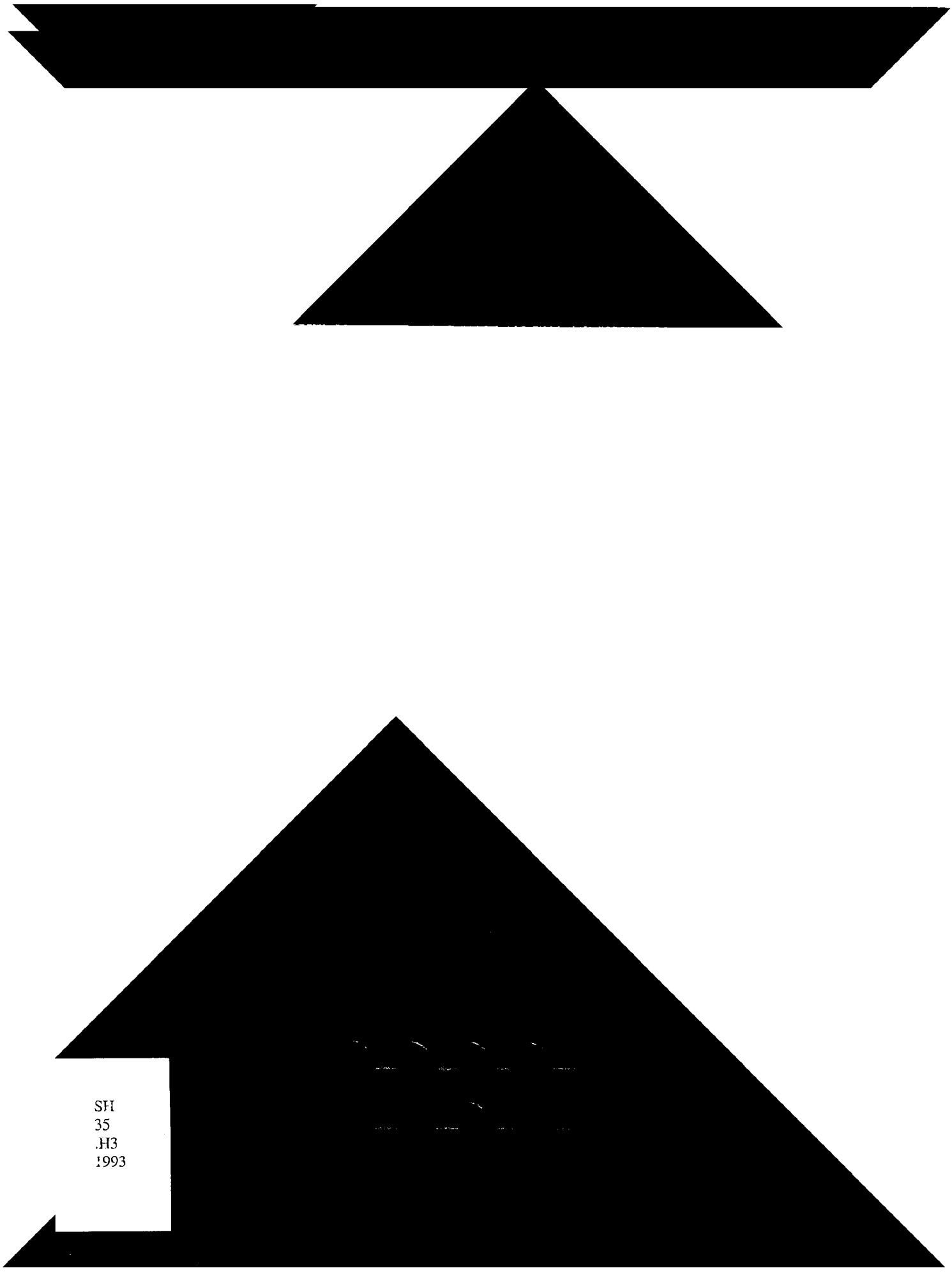

FINAL REPORT

A STUDY OF COMMUNITY-BASED HAWAIIAN FISHPOND RESTORATION AND USE ON MOLOKA'I

Prepared for:

Aquaculture Development Program
Department of Land and Natural Resources
State of Hawaii

Contract 33969

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A STUDY OF COMMUNITY-BASED HAWAIIAN FISHPOND RESTORATION AND USE ON MOLOKA'I

EXECUTIVE SUMMARY

Funding for this project was provided by the Department of Land and Natural Resources (DLNR) under Coastal Zone Management Cooperative Agreement No. NA170Z0232-01, dated 10 July 1991, granted by the National Oceanic and Atmospheric Administration of the United States Department of Commerce under Section 306 and 309 of the National Coastal Zone Management Act of 1972, Public Law No. 92-583, as amended (16 U.S.C. 1451 et. seq). The contract between MBA International (the Consultants) and the Aquaculture Development Program (ADP; the Client), DLNR, was administered by Mr. John S. Corbin, Manager, ADP.

The objective of this study was to facilitate the successful restoration and revitalization of ancient Hawaiian fishponds on Moloka'i and, ultimately, Statewide. The study addressed three broad issues which impact fishpond restoration and use: 1) community concerns, particularly those pertaining to traditional Hawaiian cultural values; 2) regulatory obstacles caused by a complex, protracted, and costly permit process; and 3) formulation of workable organizational and operational models for community-based restoration and use of Hawaiian fishponds.

Emphasis of the work in all phases was based on close interaction and coordination with the Governor's Task Force on Moloka'i Fishpond Restoration (the Task Force), the Cultural Committee of the Task Force, the respective fishpond *'ohana*, and interested members of the Moloka'i community. The overall goal of this undertaking was the development of local consensus on the methodologies, organizational, and operational models for community-based restoration, management, and use of Hawaiian fishponds.

The scope of services included eight principal tasks including:

Task 1.	Moloka'i Community Survey
Task 2.	Aquaculture Regulations Analysis
Task 3.	Conceptual Plans for Two Demonstration Ponds
Task 4.	Organizational and Operational Models
Task 5.	Environmental Assessments
Task 6.	Permit Simplification Recommendations and Master Permit Application
Task 7.	Consultant Suggested Add-Ons (market factors, socio-economic concerns, archaeological constraints, regulatory updates, and development of a hierarchical classification of Moloka'i fishponds)
Task 8.	Final Report

The following is a summary, by task, of the Consultants' findings, results, recommendations, and conclusions.

Task 1. Moloka'i Community Survey

Principal responsibility for obtaining community input resided with Ms. Berna Cabacungan, Earthplan. The major activities included in this task were: the development and implementation of a questionnaire; the planning, coordination, and development of a meeting plan for a community workshop; the preparation of a report to document and summarize the results of these activities; and the integration of questionnaire and community workshop recommendations into proposed organizational and operational models for community-based restoration and use of Hawaiian fishponds on Moloka'i.

At the onset of this study, the extent (or lack) of community consensus on key fishpond issues could not be anticipated. The essential issue was traditional versus contemporary restoration and use and it was envisioned that major disagreement would center on the preferred mode of fishpond restoration. However, questionnaire results and community workshop input suggested that a large sector of the Moloka'i community was in consensus on this and other key issues. While most respondents agreed that the traditional uses and methods of restoration should be respected, they also felt that fishponds should be restored in as efficient a manner as possible, i.e., that the use of certain types of modern heavy equipment for wall reconstruction was acceptable. There was also consensus on the aquaculture technology involved, with the majority of respondents believing that both traditional and contemporary aquaculture technologies should be used. The respondents were also in favor of the proposed development of a Moloka'i Fishpond Commission to regulate and control uses of fishponds. The proposed Commission would be responsible for processing applications for future fishpond restoration projects, and for enforcing established rules and regulations. The integration of questionnaire results and community input is further described under the proposed organizational model (Task 4).

Task 2. Aquaculture Regulations Analysis

Mr. John H. Bay, Esq., was responsible for the compilation of information required under this task. The objective of this task was to research, analyze, and report on existing Federal, State, and County laws, regulations, ordinances, and rules which regulate the acquisition, leasing, construction and reconstruction, and operation of aquaculture projects in Hawaii, including publicly and privately owned Hawaiian fishponds. In addition, this analysis updated and built upon existing information sources, and considered trends and changes in the regulatory environment affecting aquaculture development activities within the State.

This analysis resulted in the preparation of two stand-alone contract deliverables: a comprehensive report and detailed regulatory guide entitled *Permits and Regulatory Requirements for Aquaculture in Hawaii*, and a synthesis of this report into a brief, annotated, guide, *Permits and Regulations for Aquaculture in Hawaii*. It is expected that both documents will be published by the DLNR for distribution to aquaculturists and other interested parties throughout Hawaii.

Task 3. Conceptual Plans for Two Demonstration Ponds

Mr. Eugene P. Dashiell, Eugene P. Dashiell AICP Planning Services, and Mr. Craig Emberson, Amaqua Inc., provided expertise (in planning and aquaculture, respectively) for the preparation of the conceptual plans. The objective of this task was the development of conceptual plans and cost

estimates for two selected demonstration fishpond restoration projects on Moloka'i. The two candidate demonstration pond sites, Honouliwai Fishpond (fishtrap) and Kahinapohaku Fishpond, are both located in East Moloka'i. Both sites were pre-selected by the Task Force based upon the relative absence of significant land use, cultural, natural resource, or regulatory constraints. Thus, the selection of the two demonstration ponds was based upon the relative ease of obtaining permits for the sites. In addition, the *'ohana* of each pond had expressed a strong interest in the restoration, operation, and management of their respective fishponds. If other priorities had been identified, such as restoration of ponds for high aquacultural productivity, or restoring ponds with the greatest archaeological significance, then other criteria would have been applied to the selection process.

Data obtained through literature searches, and input from fishpond reconstruction experts within the Moloka'i community, were used to prepare procedures for reconstruction, materials estimates, conceptual designs, and labor requirements for each of the two demonstration ponds. Reconstruction cost estimates indicated that the Honouliwai Fishpond could be restored for approximately $10,000; the restoration of Kahinapohaku Fishpond would require approximately $22,000. These figures are based upon the use of non-professional labor, which is consistent with the willingness of the *'ohana* to perform many of the work tasks in a traditional manner, and not strictly for monetary reward.

Several aquacultural operational models and options were identified and evaluated for Kahinapohaku and Honouliwai fishponds. Operational models ranged from traditional Hawaiian to semi-intensive culture systems involving the capture and cultivation of popular local fish such as mullet, milkfish, *moi*, and *weke*, certain shellfish (clams, oysters), and various seaweeds (ogo). Kahinapohaku Fishpond could be expected to produce 300 to 500 kilograms/hectare/year (270 to 450 pounds/acre/year) of mullet or milkfish, or a combination of both, provided fry sources are available. It was recommended that the much smaller Honouliwai Fishpond should be operated in its traditional manner as a fishtrap for locally popular pelagic and reef fish; small quantities of ogo could also be cultured on racks placed within the pond walls. Productivity estimates indicated that Honouliwai Fishpond could produce approximately 250 pounds/year of marine fish.

Should the long-term goal of fishpond restoration attain such success on Moloka'i that production levels increase consistently, consideration should then be given to developing a local hatchery. The hatchery would enable fishpond producers to purchase hatchery-raised fry rather than risk the eventual depletion (through collection) of natural stocks. In addition to being a less expensive and less environmentally damaging alternative, the hatchery would also increase job opportunities for the residents of Moloka'i.

Task 4. Organizational and Operational Models

Mr. Dashiell also developed organizational and operational models for ancient Hawaiian fishponds on Moloka'i. The objective of this task was the formulation of models for the organization and operation of the two demonstration ponds specifically, and ponds on Moloka'i generally. The models included draft administrative, technical, and legal structures. Input from the Task Force, fishpond *'ohana*, and the Moloka'i community contributed to the formulation of the models and the identification of a preferred organizational and operational model.

The first candidate organizational model was based upon the existing role of the ADP. Under this model, restoration of ancient Hawaiian fishponds would represent just one of the agency's many activities. Community input would be gathered through public hearings and workshops, with standard agency administrative procedures guiding the actions of ADP including planning, administrative programming, and budgeting.

A second organizational model, one endorsed by members of the Moloka'i community and ultimately selected as the preferred model, involved the establishment of a "Moloka'i Fishpond Commission". The responsibility of this proposed Commission would be to restore, and to oversee the operation of, the fishponds on Moloka'i. The Commission, comprised of members from both the public and private sector, would be responsible for planning, programming, and budgeting for fishpond restoration and operation activities. If possible, the Commission would be partially funded from a portion of income derived from restored ponds. The Commission would also be responsible for obtaining additional funding from other sources, e.g., contributions from private foundations and the general public. Administrative linkage of the Commission to an established State agency would ensure that all legal requirements, such as those associated with the use of public funds, would be fulfilled, and would also facilitate interaction with the Governor's office.

Comparison of two candidate State agencies, DLNR and Department of Business, Economic Development, and Tourism (DBEDT), led to the conclusion that the Commission should be administratively linked to the DLNR for several reasons. Most significantly, a linkage with the Chairperson of the DLNR would reinforce the concept that fishpond planning, restoration, and operation are subsumed by the functions of aquaculture, historic preservation, and natural resource management. Either of the proposed models would require dedicated resources and staff (i.e., two additional persons assigned to the ADP) to facilitate fishpond restoration throughout the State.

The mandate of the proposed Moloka'i Fishpond Commission would not include any land use decision-making authority or zoning power as these activities would continue to be administered by existing agencies. However, the Commission would be a part of the review process for any such action affecting the proposed restoration of fishponds on Moloka'i.

It was recommended that the Commission, or unit of the Commission, should be constituted as a non-profit organization and that it operate semi-autonomously with the Commission members as a Board of Directors. This would enable the organization to enter into services or construction contracts for management, consultations, and minor construction. Non-profit status would make the organization eligible for obtaining grants from private sources or foundations.

Task 5. Environmental Assessments

The staff of MBA International, led by Mr. William A. Brewer, carried out baseline surveys and environmental assessments (EAs) for the two demonstration ponds. The objective of this task was the preparation of a draft EA for each of the two selected demonstration ponds to facilitate "fast-track" permitting at the Federal, State, and County level and to provide relevant information to the affected public. This task also included the research and preparation of a "generic" draft EA to facilitate the permitting requirements for other fishponds on Moloka'i (see also Task 6).

A draft EA was prepared for each of the two demonstration ponds following the requirements of Chapter 343, Hawaii Revised Statutes, Environmental Impact Statement Rules (Title 11, Chapter 200), and recent amendments thereto (Act 241, Session Laws of Hawaii 1992), and with input from the Task Force, the Cultural Committee of the Task Force, fishpond *'ohana*, and members of the Moloka'i community. Baseline marine biological and archaeological surveys were conducted within each pond, and in the general vicinity. There were no marine, coastal, or terrestrial resources, or archaeological or cultural sites of significance identified at either site that could be considered a constraint to development. It is also felt that any impacts anticipated at the two sites could be mitigated to the satisfaction of affected agencies and the concerned public.

Proceeding beyond the stipulated scope of work for the contract, the Consultants prepared two general permit applications to the ACOE to facilitate the fast-track permitting of the two demonstration ponds. These applications were submitted under the signature of the Chairperson of the DLNR.

Task 6. Permit Simplification Recommendations and Master Permit Application

Ms. Jacqueline A. Parnell, AICP, of KRP Information Services, led the effort to develop permit simplification strategies. The objectives of this task were: 1) to make recommendations for streamlining the permit process; 2) to designate specific laws, ordinances, rules, procedures, and permits for change; and 3) to develop a draft master permit application for low-key, community-based, traditional restoration and use of privately or publicly owned fishponds.

This task involved an analysis of regulatory obstacles to fishpond restoration and involved literature searches, agency contacts, and meetings with pond owners and operators, and pond wall restorers. The results of this effort indicated that U.S. Army, Corps of Engineers (ACOE) authority under Section 404 of the Clean Water Act, as amended, and the Conservation District Regulations of the DLNR represented the two greatest regulatory obstacles to fishpond revitalization. The County-regulated Special Management Area (SMA) ordinance was not identified as a problem since aquaculture is a permitted use within the SMA and most fishpond wall reconstruction would be directed at sites outside of the SMA.

The Consultants prepared a model "Master Conservation District Use Application" (CDUA) and a generic "master" EA for 38 fishponds on Moloka'i. The ponds were selected on the basis of their potential for restoration and absence of overriding environmental or natural resource constraints (see fishpond classification database under Task 7). The ADP was the designated "applicant" for the CDUA.

Long-term solutions for restoration of the remainder of the more "resource constrained" fishponds on Moloka'i would entail the development of a Master Plan and a Master Environmental Impact Statement. These documents would be used to satisfy regulatory requirement concerns on water quality, natural resources, endangered species, and cultural resources deemed unworkable under the CDUA permitting process. Federal funds for master planning may be available through the Special Area Management Program (SAMP) of the ACOE.

The draft master CDUA and EA being provided are intended as models and are available to be utilized to whatever extent and in whatever manner deemed appropriate by the Task Force or the proposed Moloka'i Fishpond Commission. However, prior to submittal of any formal permit application, adjustments to the list of fishponds to be covered by a master Conservation District Use permit will no doubt be required.

Adjustments to the list of included ponds may be based on one or more of the following considerations (among others):

- Lack of interest by owners of private fishponds in restoring their ponds
- Updated information on pond condition obtained through new field surveys or aerial photographs

- Acquisition of permits for restoration of certain ponds either being sought or already accomplished through avenues other than a master CDUA.

Task 7. Consultant Suggested Add-Ons

Although not specifically identified in the Client's Invitation For Bid, the Consultants proposed to address a number of additional topics because of their relevance to both short- and long-term fishpond revitalization goals. These topics included: market factors relating to fishpond products; socio-economic considerations; archaeological opportunities and constraints; regulatory updates; and development of a hierarchical classification scheme for Moloka'i fishponds.

Marketing. Marketing of fishpond products is interwoven with overriding socio-economic considerations. One theme which emerged is the concern for the preservation of the unique cultural resources the fishponds represent. Other concerns, including the potential for making the operation of fishponds a profitable enterprise, are subservient to it. In certain respects, the traditional preservation and operation of fishponds is in conflict with achievement of high productivity or profitability. Thus, the community will consider the project successful if the ponds are restored, even if they are not further developed into resources from which substantial financial gain can be achieved.

This analysis included evaluation of the potential marketability of a diverse array of products, including non-traditional marine aquarium fishes, shrimp, oysters, and seaweeds or *limu.* Specific recommendations included a general affirmation of the importance of culturing native species, both for cultural and biological reasons. It was further suggested that fishpond products should be marketed on Maui which has a resident population of over 100,000 and a higher visitor profile than does Moloka'i. Moloka'i seafood producers should also attempt to sell directly to the end customer and avoid middlemen or wholesalers. For the direct sales approach to be successful, a processing area would need to be established at either the pond or at some central location in Kaunakakai.

Archaeology. Archaeological constraints are not necessarily limiting to fishpond revitalization, provided that pond restorers adhere to the following guidelines:

- Restoration should retain the essential characteristics of the fishpond's physical structures
- The process of restoration should not damage the targeted historical resource, or other historical resources onsite
- The operation of the ponds should not detract from their historical and cultural significance.

These guidelines, together with existing archaeological information, establish a procedure which permits restoration of fishponds while giving due consideration to their unique cultural and historical significance.

Regulatory Constraints. Two Federal programs, one proposed and one implemented, could adversely impact the permitting process and associated costs of fishpond revitalization. Proposed amendments to regulations promulgated under the Clean Water Act would give the ACOE the authority to regulate dredging. Existing statutes generally provide regulatory authority for the placement of dredged or fill materials into "waters of the United States". The change in authority, if effected, will

have serious implications to the restoration effort since many of Moloka'i fishponds have been filled with silt; therefore, in order to be restored, each fishpond would need to be dredged.

On 1 October 1992, the State of Hawaii Department of Health adopted new permitting procedures under the National Pollutant Discharge Elimination System (NPDES) program to regulate the discharge of stormwater runoff into receiving coastal waters. Depending on the types of activities undertaken, and the types of discharges generated, an NPDES permit may be required for the restoration and operation of a fishpond. For instance, on-land construction activities or on-land "dewatering" of dredged materials associated with fishpond restoration may cause discharges of effluents which are regulated under the NPDES.

"Restorability" Ranking. A "Ranking Hierarchy for Moloka'i Fishponds" was developed based upon a comprehensive database. The database was compiled through review of available literature and aerial photos. Criteria employed in developing the hierarchy were prioritorized according to a numerical rating of pond condition based on aerial photographic analysis, pond area, and pond wall length. This hierarchical classification provides insight on the relative potential for restoration of Moloka'i fishponds, and will be helpful in future fishpond restoration efforts in the State.

Major Conclusions and Recommendations

The following are the major findings and recommendations to evolve from this study:

- Fishponds on Moloka'i should be restored, maintained, and operated in a manner which is culturally sensitive and environmentally sound. While use of modern techniques and equipment (e.g., backhoes) should be minimized, such use is permissible for furthering the goal of fishpond revitalization, provided that legal requirements for environmental and cultural preservation are fulfilled.

- The regulations governing aquaculture-related activities in the State are diverse and complex; the guides which accompany this report will help aquaculturists and fishpond restorers to better understand the legal complexities associated with the restoration process.

- The formation of a "Moloka'i Fishpond Commission" (as proposed) can provide the organizational structure needed to facilitate future fishpond restoration efforts on Moloka'i. Its linkage to an established State agency will facilitate interaction with the Governor's office as it relates to the allocation of State funding and project awards. As a non-profit entity, the Commission could also qualify for funding from private foundations. Its broad-based membership profile (with representation from virtually all public agencies and private parties having an interest in fishpond restoration) assures that balanced decisions will be made in the interest of revitalizing the unique fishpond resources of Moloka'i.

- The two "jump-start" demonstration ponds, Honouliwai and Kahinapohaku, are among the highest-ranking in terms of their likely ease of permit acquisition and "restorability". The permit application process for the two ponds is currently underway.

- Streamlining the permit process for Moloka'i fishponds is best accomplished through the creation of a Master Conservation District Use Application (CDUA). The

accompanying CDUA, targeting the 38 ponds on Moloka'i judged to have the fewest regulatory constraints for permitting, needs to be further refined prior to formal submittal.

To further the overall goal of restoring the ancient Hawaiian fishponds on Moloka'i, it is recommended that two persons be added to the full-time staff of ADP, and that their work be fully dedicated to various aspects of the development of the fishpond revitalization program.

Additionally, it is recommended that complete, new aerial and site surveys be done for all ponds on Moloka'i. Information gathered in such surveys will improve the accuracy of information needed for sound decision-making for future restoration efforts.

SECTION 1

MOLOKA'I COMMUNITY SURVEY

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MOLOKA'I COMMUNITY SURVEY

1.1 INTRODUCTION AND BACKGROUND

Any effort to help streamline the process of fishpond revitalization on Moloka'i must remain sensitive to cultural issues and local community needs.

Within this context, the gathering and analysis of community input was first carried out to help focus the direction for the subsequent tasks specified by this project. Three main areas of concern were addressed in the course of the community input and evaluation process:

- consideration of traditional concerns and methodologies in fishpond revitalization
- constraints associated with a protracted permit process
- workable organizational and operational models for community-based restoration of Hawaiian fishponds

1.2 METHODS

An original objective of this task was to execute a "statistically valid survey of a cross-section of the Moloka'i community to collect information on concerns, cultural sensitivities, questions, acceptable uses, needs, expectations, value judgements and opinions regarding long-term restoration of the island's publicly and privately-owned coastal Hawaiian fishponds". Further consideration, however, led to a revision of the community input aspect of the project. Although it is likely that a survey would have provided valuable information, it was felt that it could not stimulate group discussion and interaction. While there was consensus that fishponds should be restored, previous studies and efforts of the Governor's Task Force on Moloka'i Fishpond Restoration (the Task Force) indicated that there appeared to be disagreement as to how fishponds could or should be restored. As discussed in an 8 September 1992 meeting memorandum[1] of the Task Force's Cultural Committee, unresolved issues included:

- The degree to which restoration efforts should deviate from original boundaries and configuration of fishponds
- The meaning of tradition in fishpond use and restoration, and the role of traditional practices in a modern context
- The appropriateness of using machinery
- What should be covered in a general permit for fishpond restoration
- The acceptability of fee fishing

[1] Memorandum from Carol Wyban to Collette Machado.

The original objective was thus refined to include interactive community input which would allow for discussion beyond the questionnaire survey format. The overall process for community input was as follows:

1. **Questionnaire.** A draft questionnaire was prepared which requested input on unresolved issues and topics that would need to be addressed by the MBA International consultant team (the Consultants). This draft was reviewed by members of the Cultural Committee on the evening of 15 October; revisions were made, and the final questionnaire was prepared for distribution. The Cultural Committee provided a mailing list which included Moloka'i residents who had attended previous Task Force-sponsored workshops and meetings.[2]

   Ninety-five questionnaires were mailed by the Task Force on 23 October and approximately 20 more were distributed upon request; questionnaires were to be returned by 30 October.[3] The distribution list for the questionnaire is presented as Exhibit A-1 in Appendix A and results of the questionnaire are presented in Section 1.3.1.

2. **Community Meeting.** Originally, the Cultural Committee was to hold a workshop on 14 November to achieve consensus on key issues. The Consultants prepared and presented a detailed agenda for the meeting to the Cultural Committee at a 15 October meeting. Following initial evaluation of questionnaire results in early November, the Cultural Committee then decided to hold a meeting rather than a workshop as initial questionnaire results indicated community consensus on certain major issues.

   The community meeting was held at 6 p.m. on 18 November at the Kalaiakamanu Hou Church. The meeting generally followed an abbreviated format of that proposed for the workshop; the agenda is presented as Exhibit A-2 in Appendix A.

   Approximately 25 people attended the meeting; Exhibit A-3 in Appendix A contains the sign-up sheet.[4] Ms. Collette Machado (the Cultural Committee Chair) opened the meeting with a status report and a description of the fishpond study. The Consultants provided an update of progress on the study, to-date, and presented the results of the questionnaire. The Consultants then discussed preliminary recommendations in their areas of expertise.

   The Consultants responded to questions from members of the audience throughout the meeting; a summary of these discussions is provided in Section 1.3.2.

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[2] As described, the survey by questionnaire was not intended to represent a random cross-section of individuals within the Moloka'i community. Rather, the Task Force compiled a mailing list which included those individuals who had participated in a variety of community-based functions relating to fishponds. This assured that the questionnaire recipients were relatively well-informed about and interested in fishpond issues, and may account for the high response rate achieved by this questionnaire distribution.

[3] All questionnaires received by the Consultants' community specialist, regardless of receipt date, were included in the analysis.

[4] Not all individuals who attended the meeting signed the attendance sheet.

1.3 RESULTS

1.3.1 QUESTIONNAIRE

At the onset of the study, the extent (or lack) of community consensus on fishpond issues could not be anticipated. Traditional versus contemporary use and restoration was the essential issue identified and it was expected that major disagreement would evolve from the question on how fishponds should be restored. These key issues were explored in the questionnaire and a choice of responses representing a wide range of opinions was provided.

A total of 54 questionnaires (47 percent) were returned (an unusually high rate of return). The detailed results of the questionnaire are provided as Exhibit A-4 in Appendix A. The following 15 key questions are provided in summary:

1. **"Traditional" restoration and maintenance.** An effort was made to assess community sentiment about "traditional" fishpond restoration. The majority (57 percent) felt that "fishponds should be restored and maintained traditionally only if this can be done economically and in a reasonable amount of time." Twenty-four percent felt that "all of Moloka'i's fishponds should be restored and maintained traditionally".

2. **Fishpond boundaries, design, and materials.** One way of practicing tradition is in the adherence to original fishpond dimensions and materials. When asked "How should a fishpond be restored?", 61 percent felt that "the original boundaries and design should be copied as much as possible; changes in boundaries, design, and materials can be made only if conditions in the environment make it necessary". Another 18 percent felt that "it is okay to change the boundaries, design, and materials of fishponds, as long as Moloka'i has more working fishponds". Fourteen percent adhered to a more strictly traditional outlook and believed that "fishponds should be restored to their original boundaries and original design, with the same types of materials originally used".

3. **Construction methods.** Another way of practicing tradition is by constructing the fishpond without using modern technological methods. Only 14 percent felt that "only manual labor and non-motorized tools should be allowed in restoring fishponds". The majority of the respondents approved of using modern construction methods, i.e., "it is okay to use modern heavy equipment, tools, and techniques, providing appropriate regulations are followed" (45 percent), or "only certain construction vehicles and tools should be allowed in fishpond restoration and a list of allowable construction techniques should be followed" (33 percent).

4. **Allowable fishing methods and equipment.** The majority of respondents (55 percent) felt that "fishers should use whatever legal means they choose, such as fishing poles, nets, traps, and baskets". Only 18 percent preferred that "fishers should only use early Hawaiian fishing methods and equipment, such as makahas and fish traps".

5. **Funding the restoration of private fishponds.** When asked if private fishponds should be restored using government funding, private monies, or community-based help, 49 percent of the respondents felt that the restoration of private fishponds should be paid for by a combination of these sources. Eighteen percent felt that "private businesses and private

landowners should pay for the restoration of private fishponds", and 14 percent believed that "government funding should cover all expenses related to restoring private fishponds".

6. **Use of privately-owned and government-funded restored fishponds.** Sixty-five percent of the respondents felt that fishponds which are privately-owned and government-funded "should be used to feed their *'ohana* and for commercial purposes". Only 10 percent felt that "these fishponds should be used for commercial purposes only", and 2 percent said that "these fishponds should only be used to feed its *'ohana*".

7. **Management of State-owned fishponds.** A slight majority of the respondents favored an island-wide system for managing the State-owned fishponds on Moloka'i. Over half (51 percent) felt that "a community-based organization should produce a plan for managing all of Moloka'i's fishponds, and then select caretakers for each fishpond". Twenty-four percent wanted to keep the current system, whereby the State contracts a different *'ohana* on a case-by-case basis. Eighteen percent indicated "Department of Land and Natural Resources (DLNR) employees [should] manage the fishponds".

8. **Use of the restored State-owned fishponds.** Respondents were asked to identify users of the restored State-owned fishponds. They were asked to choose two from the list of alternatives provided. The following presents the order of responses by frequency:

   - Both residents and commercial enterprises should be able to lease the State-owned fishponds (53 percent)
   - Any Moloka'i family should be able to lease a State-owned fishpond for subsistence (31 percent)
   - All native Hawaiians who practice native gathering rights should be able to use the State-owned fishponds (24 percent)
   - All Moloka'i residents should have free access to, and use of, the State-owned fishponds (18 percent)
   - Only the fishpond's caretaker, *'ohana*, or manager should be able to use the State-owned fishponds (4 percent)

9. **Use of profits generated by State-owned fishponds.** Respondents were asked to think about what should happen to profits generated by State-owned fishponds if they are used for commercial purposes, including fee fishing. Forty-three percent felt that "a portion of the profits should go to a community-based organization to be used for maintenance and other uses". Twenty-nine percent preferred that the fishpond user retain the profit, and 18 percent said that "a portion of the profits should go back to the State".

10. **Acceptable uses for private fishponds.** Respondents were asked to identify acceptable uses of private fishponds that did not include subsistence and commercial uses. Choices included educational purposes, scientific studies, and tourist attractions. The majority of respondents were open to multiple-use of the fishponds and two-thirds felt that all of these uses were acceptable.

11. **Acceptable uses for State-owned fishponds.** Respondents to this question were more open to the multiple-use of restored fishponds. Seventy-three percent said that State-owned fishponds can be used for educational purposes, scientific studies, and tourist attractions.

12. **Fishpond restoration permit.** Respondents were encouraged to provide multiple responses. Over half the respondents chose the following considerations:

- Dredging Activities (69 percent)
- Construction Techniques (61 percent)
- Pond Wall Size, Dimensions, and Material (55 percent)
- Endangered Species (53 percent)
- Construction Machinery (51 percent)

13. **Lead agency/group for fishpond permits.** Respondents were asked to identify the agency (or agencies) that should be responsible for issuing fishpond restoration permits; multiple responses were encouraged. The majority of respondents selected two groups -- 73 percent selected a Moloka'i-based "Fishpond Commission"; 61 percent selected DLNR; and 29 percent selected the Moloka'i Planning Commission. Less than 10 percent selected the State Office of Hawaiian Affairs, the U.S. Army, Corps of Engineers (ACOE), or the Maui County Public Works Department.

14. **Enforcement of fishpond regulations.** Respondents were then asked to select the entity that should enforce fishpond regulations; multiple responses were possible. The majority of respondents selected the same groups as in the preceding question. The Moloka'i-based "Fishpond Commission" and DLNR received the most responses (67 and 61 percent, respectively).

15. **Stocking the fishponds.** When asked if fishponds should be stocked by "only catch from the wild, by seed-stock hatchery only, or by a combination of both methods", 76 percent of the respondents selected both methods.

1.3.2 COMMUNITY MEETING

At the 18 November community meeting, the following three topics were raised continuously and underlined much of the discussion:

1. **Sovereignty.** The topic of Native Hawaiian sovereignty and how fishpond restoration permits and procedures would fit into this larger picture was broached. Some meeting participants felt that fishponds should not be regulated by any system under the jurisdiction of the present government structure. They felt that fishponds belonged to native Hawaiians and not to the State or to any private owner other than native Hawaiians. They also questioned the necessity of developing regulations for fishpond restoration, in light of the likelihood of another governing system under sovereignty.

   It was generally acknowledged that the sovereignty issue will be resolved in a much larger arena (and over a longer period of time) than that associated with fishpond restoration issues. Fishponds will be only one of many issues which can be related to establishing sovereignty rights. It was stated that trying to address sovereignty considerations in this study would likely

cause a delay in the efforts and thus hamper the implementation of fishpond restoration plans.

2. **Distribution of the questionnaire.** One participant repeatedly questioned the manner in which the questionnaire was circulated. This participant believed that the questionnaire was not given to native Hawaiians, therefore, the findings could not be considered valid. The Cultural Committee asserted that there had been numerous opportunities for community participation in the fishpond restoration effort and that the questionnaire had been distributed to the individuals who had participated in that effort. Questionnaires were also mailed to individuals requesting same.

3. **"Easy" and "hard" fishponds.** Participants disagreed with the categorization of fishponds as "easy" or "hard" in reference to the permitting process. The Consultants suggested that the permit process for fishpond restoration could be expedited if a general permit were used for "easy" (those which would not have significant environmental impact) fishponds. Participants felt that this description was inappropriate since, in reality, the restoration process for most fishponds is difficult. Further, some participants felt the contemporary measure of environmental impacts may be inconsistent with native Hawaiian practices. For example, one person considered that protecting an endangered species, at the expense of being able to practice one's culture, as a form of "environmental racism".

The Consultants facilitated the discussion of proposed recommendations which focused on the proposed Fishpond Commission because it was felt that the makeup, purpose, and responsibilities of the Commission were key to streamlining the fishpond restoration process. It was suggested that the Fishpond Commission consist mostly of residents of Moloka'i, particularly fishpond caretakers and private landowners with ponds. Representatives from the State Land Use Commission, the Board of Land and Natural Resources, the Moloka'i Burial Council, or the Moloka'i Planning Commission would also be included. To maintain control, it was suggested that the Commission be limited in number to 10 members. The responsibilities of this Commission would be to:

- Develop a Master Plan for Management of Moloka'i Fishponds
- Implement the Master Plan
- Advocate national recognition and protection of ponds within the permitting process
- Implement an aggressive educational program

The Master Plan for Management of Moloka'i Fishponds would define "tradition" as it relates to fishpond restoration and uses; specify the process for managing State-owned ponds on Moloka'i; evaluate the use of heavy equipment and construction methods; define and regulate uses including subsistence, conservation and commercial; and define and develop enforcement guidelines.

The meeting ended with each participant sharing a "final message" (Exhibit A-5) on the fishpond restoration study and other topics of discussion. In contrast to the sometimes heated discussion which occurred earlier in the meeting, these messages were delivered in a positive and constructive manner.

1.4 DISCUSSION

The community input process described in this report has helped the Consultants establish a point of departure and clarify the direction of final recommendations for future fishpond restoration planning.

The following summarizes the analysis of input obtained from the community during the course of this task:

1. Among those who participated in the community input process, there is general consensus on major issues regarding fishpond restoration, such as the use of modern construction equipment and acceptable uses.

   As noted earlier, conflict between Moloka'i residents was expected to occur in regard to how fishponds would be restored and used. In fact, the survey results suggest that there is strong consensus for incorporating contemporary methods in the traditional context, provided that such measures are necessary. Even though a few people have expressed a desire to restore the fishponds "in the old way," it is believed that having "functional fishponds" is the priority for most people.

2. Although "tradition" is important, it is not the primary guideline for selecting methods for restoring and using fishponds on Moloka'i.

   The fishponds are part of the legacy left by ancient Hawaiians, and, without question, tradition is an important consideration in the restoration process. For many, tradition is a concept, and although respondents expressed respect for traditional practices, most were inclined to be pragmatic about restoring fishponds. For example, respondents clearly did not feel that it was necessary to use only manual labor. Construction equipment and modern techniques were acceptable, provided that guidelines regulating restoration were implemented. Further, the acceptable uses of fishponds extended beyond traditional subsistence and native gathering rights.

3. The restoration process and regulation system needs to be Moloka'i-based.

   Moloka'i residents need to maintain a strong and active role in fishpond decision-making; for the restoration permit process to be effective, Moloka'i residents need to have a sense of ownership of the process.

4. Commercial uses need to be defined.

   Although there is agreement that fishponds can be used commercially, how certain commercial-use parameters are interpreted by members of the Moloka'i community still requires clarification. Tourism, for example, means many things to different people; it is unlikely that Moloka'i residents will endorse full-scale use of the fishponds for tourism-related purposes. Residents and public agencies will need to define the types of acceptable commercial uses and to determine how these uses will be regulated.

SECTION 2
AQUACULTURE REGULATIONS ANALYSIS

The purpose of this task was to provide an up-to-date guide to the Federal, State, and County regulations which affect the establishment, operation, and maintenance of aquaculture facilities in the State of Hawaii.

The outputs consist of two documents: a stand-alone quick-reference summary; and an in-depth description of applicable regulations. In addition to citations and excerpts from existing legal statutes, several general references (Brewer 1980; DHM 1989; Ziemann et al. 1990; MacKenzie [ed.] 1991; Clay 1981; Achitoff et al. 1992; Jenkins 1991) were relied upon in assembling the guide.

As it was intended that this resource be made available to Hawaii's aquaculturists for practical use and application, it is provided as two separate, bound references entitled, "*Permits and Regulations for Aquaculture in Hawaii*" and "*Permits and Regulatory Requirements for Aquaculture in Hawaii*", which accompany this project report.

SECTION 2

AQUACULTURE REGULATIONS ANALYSIS

SECTION 3

CONCEPTUAL PLANS FOR TWO DEMONSTRATION PONDS

SECTION 3
CONCEPTUAL PLANS FOR TWO DEMONSTRATION PONDS

This section is devoted to describing general aquaculture practices and how they may apply to fishponds on Moloka'i. Specific recommendations are made for production systems for the two "jump start" ponds, Honouliwai and Kahinapohaku. In addition, plans are set forth detailing methods and costs of restoration for the two demonstration ponds.

3.1 TRADITIONAL FISHPOND CULTURE IN HAWAII

Ancient Hawaiian fishponds were part of a large, integrated, and complex Hawaiian subsistence and barter economy that included agriculture, aquaculture, and animal rearing (Costa-Pierce 1987). Large fishponds required sizeable labor forces in their construction. Labor was recruited from all sectors of each island. Redistribution of pond-cultured seafood to the inland families or *'ohana* on the *ahupua'a* land areas was a method of repaying them for their contribution of labor.

The traditional method by which the Hawaiians managed their fishponds is not clearly known. The coastal ponds were used mainly as holding areas for a variety of edible marine fish and seaweed (mullet, milkfish, and ogo). The pond systems were controlled by local *konohiki* (headman of an *ahupua'a* land division under the chief; Pukui and Elbert 1981) for the ruling *'ali'i* (chief). Most of the fish was reserved for their consumption. Furthermore, a *kapu* system was enforced by the rulers whereby commoners were prohibited from taking fish from shore ponds.

Natural productivity in Hawaiian ponds was enhanced through freshwater influence either from stream or spring point sources. Minimal external inputs such as feed were given to the ponds. Branches or rocks acted as substrate for seaweed to grow on. Ancient Hawaiian ponds were examples of extensive aquaculture systems. In extensive aquaculture, levels of production are generally low, as was the case for the ancient Hawaiian ponds (below 178 pounds/acre/year [lb/acre/yr, or 200 kilograms/hectare/year [kg/ha/yr]). The ancient Hawaiians used large areas to raise fish. Some enclosed bays, such as Maunalua on Oahu (Hawaii Kai), were over 500 acres (202 ha) in area.[1] The ponds were used to raise mullet and milkfish, which were highly prized. Predators such as barracuda and jacks were allowed to coexist in the pond. A variety of young reef fish, including eels, could pass through the fixed grate, or *makaha*. Selective stocking was not generally practiced.

Summers (1964) believes that coastal ponds (*loko kuapa*) were unique to the Hawaiian Islands, and represented the first attempt at aquaculture in Polynesia. One of the first records of fishing from Hawaiian fishponds listed 77 working fishponds on Oahu (Cobb 1902). Moloka'i had the next highest number of working ponds (58), with the total for all islands recorded at 210. These ponds produced over half a million pounds of fish per year. Oahu's population in 1900 was about 58,500. Based on these numbers, the estimated annual per capita consumption of pond fish was about 9.5 pounds, most of which was mullet.

The ancient Hawaiians constructed ponds by building stone walls on the reef flats to enclose large areas of shallow water. Most ponds had fixed grate structures (*makaha*) built into the walls which

[1] The average size of the fishponds on Moloka'i is about 18 acres (7 ha).

allowed tidal water exchange to occur. Grates were made from lashing vertical branches of wood (usually *'ohi'a*) to larger wooden crossbeams set into the walls. The vertical spaces were approximately 0.2 to 0.8 inches (in; 0.5 to 2.0 centimeters [cm]) wide (Costa-Pierce 1987). This rather primitive method of allowing water into the pond did not completely screen out predators.

Fish were caught inside the ponds or canals leading to the grate with reed (*hala*) nets or by hand. These grates were later modified and developed into a system of movable screens which could be used to isolate the fish in an enclosed area.[2]

Fishpond walls were built high enough to prevent water overflowing during high tides, but were often damaged by high waves during storms. Thus, the pond walls were in need of regular repair and maintenance. Water depth within the ponds reached a maximum of 2 to 3 feet (ft; 0.6 to 0.9 meters [m]). This allowed sunlight to penetrate to the bottom, causing a rich growth of aquatic plants and diatoms.

Sections 3.2 through 3.4 deal with modern aquaculture technologies, and how these can relate to the revitalization of traditional Hawaiian fishponds.

3.2 GENERAL PHYSICAL AND CHEMICAL PARAMETERS

Ponds covering a large surface area are generally more stable environments in which to raise fish than are small ponds. Wind can oxygenate large ponds by causing waves which increase the surface area for oxygen transfer from the atmosphere. However, excessive turbidity caused by wave action can limit the growth of algae, and thus be detrimental to pond fish culture.

Normally, sunlight penetrating to the pond bottom encourages filamentous algae to grow on rocks or pond banks. Dense algal mats provide a substrate for epiphytic diatoms, and habitat for minute crustacea and zooplankton. The entire plant-animal assemblage[3] thus formed provides an excellent food for growing fish in pond culture.

Modern fishpond culturists fertilize the water either with organic or inorganic fertilizers in order to increase primary productivity. While used in aquaculture operations in many countries, this practice may not be permitted in Hawaii, given current State and Federal environmental laws pertaining to effluent discharge (see Section 2). In a historical context, it was forbidden to use human or animal wastes to fertilize ancient Hawaiian ponds (Costa-Pierce 1987).

As algal growth is generally beneficial for fishpond culture, growth of other types of vegetation may also be of benefit. Extensive-type fishfarms in Taiwan and the Philippines are located on low-lying swampland in sheltered areas such as river mouths fringed by protective mangroves. The added nutrients from decaying vegetation enriches productivity of the water and provides a natural food source for larval fish and fry. However, excessive growth of vegetation in a pond can be detrimental.

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[2] An excellent example of a modified grate system was built by Francis Ii Brown and is still in use at Kalahuipua'a Pond at the Mauna Lani resort on the South Kohala Coast of the Island of Hawaii.

[3] The term "lab-lab", of Philippine origin, is used to describe this basic food source for pond culture.

Algal blooms may lead to oxygen depletion, and mangroves become a shelter area for predators such as crabs or nesting grounds for predatory birds. Mangrove overgrowth, in combination with silt deposition,[4] can lead to rapid filling of a pond, and reduction of effective pond area.

3.3 MODERN FISHPOND PRODUCTION AND MANAGEMENT

In Asia, application of modern technologies has produced intensive aquaculture systems. Harvest yields from tidal milkfish fishponds can be increased to over 2677 lb/acre/yr (3000 kgs/ha/yr) through fertilization or supplemental feeding (Rabanal and Shang 1979). The range of production is from 223 to 2677 lb/acre/yr (250 to 3000 kg/ha/yr) from Taiwan, Indonesia, and the Philippines. The cost of fertilization is about 40 percent of the operating cost in an intensive monoculture farm. The cost of production is reduced from $1.08/kg in the extensive system to $0.41/kg in the intensive monoculture system. The rate of return on investment from intensive ponds is double that of extensive ponds. However, intensive ponds stocked at over 0.65 fish per square meter (sq m) require greater management control, such as increased daily water exchanges in order to maintain acceptable dissolved oxygen levels.

Polyculture utilizing mullet or milkfish can also be a workable aquaculture system. Recent results of studies of polyculture from India (Mathew et al. 1987; Pillai et al. 1980) have shown production ranges similar to those cited above.

While intensive culture results in production of more biomass in the ponds, it also ends up producing greater amounts of waste material. Anoxic conditions can easily build up, causing rapid fish die-off, especially after heavy rains when stratification develops, or during periods of no wind. Pond operators using an intensive system need to have a higher level of pond management experience in order to cope with such potential problems, than do operators of extensive aquaculture systems. Semi-intensive aquaculture systems can combine some of the advantages of both extensive and intensive systems, and avoid some of these problems. Using a lower stocking density than that used for the intensive system, a semi-intensive pond would not achieve the same level of productivity, but it would also be less subject to disease problems and require less fertilization and feeding.

Production data for fishpond culture in Hawaii is limited. Recently Wyban (1992) has reported semi-intensive levels of productivity at Lokoea Pond on Oahu. Types raised included Tilapia, Oreochromis, and striped mullet, among others.

One advantage operators of extensive system fishponds have in Taiwan, Indonesia, and the Philippines which is lacking in Hawaii is the availability of wild milkfish fry. However, even these countries cannot rely on fry being available year-round. When shortages occur, the law of supply and demand drives prices up. In the Philippines, average prices for fry in 1982 was approximately $11.60 per 1,000 (Chong et al. 1982). Mortality rates can reach as high as 50 percent depending on the distance and conditions under which the fry are transported.

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[4] Silt deposition has completely covered over some old ponds on Moloka'i. At Pala'au fishpond, site of Orca Sea Farms west of Kaunakakai, the pond wall was found buried under 12 ft (4 m) of silt.

Feed inputs are a major cost consideration for any fishpond operator. There is no doubt that any fishpond operator will have to weight the economic benefits of using feeds against to the high costs involved.[5] Unless feed conversion rates remain below 2 to 1 it will not prove economical to feed.

Exhibit 3.1 presents in abbreviated form highlights of some data for modern-day aquaculture production (specifically, for mullet) from around the world.

3.4 APPLICATION OF MODERN PRINCIPLES TO HAWAIIAN FISHPONDS

The preceding discussion is based on existing aquaculture technologies, and establishes a general framework for developing matrices to analyze various production schemes which may be workable for restored fishponds on Moloka'i. This section presents the matrices, which provide more specific information on what types of production and operation formats may be feasible for ponds on Moloka'i. Additional attention is given to defining these methods for Kahinapohaku and Honouliwai, the two selected demonstration ponds. An outline of various parameters is provided in Exhibit 3.2. The matrix in Exhibit 3.3 compares extensive versus intensive culture systems as they apply in Hawaii. Exhibit 3.4 describes in further detail constraints and opportunities of extensive (traditional) aquaculture, while Exhibit 3.5 provides a description of constraints and opportunities of a semi-intensive (modern) system as it might be utilized on Moloka'i.

3.5 SITE-SPECIFIC AQUACULTURE SYSTEM AND RESTORATION PROPOSALS

3.5.1 SITE DESCRIPTIONS

Honouliwai Fishtrap Pond Description

This pond, located on eastern Moloka'i (Exhibit 3.6), is approximately one-half acre in area (Exhibit 3.7, aerial photograph). Its wall is about 360 linear feet (110 m) and about 40 percent of the original wall stones are presently estimated to remain in place. The pond is noted to have been in a deteriorated condition for some time, however. Summers (1971) notes that Cobb wrote in 1902 that the pond's walls were broken. Causes of such damage could include storm-driven waves and tsunami (see the following discussion concerning Kahinapohaku regarding tsunami).

Honouliwai had no *makaha* in the opening of the wall. The fish apparently entered the pond at high tides when the walls were submerged. The most common fish caught in the area is *weke*.

Kahinapohaku Pond Description

This pond, located on eastern Moloka'i (Exhibit 6), is about 4 acres (1.62 hectares [ha]) in area (Exhibit 3.8, aerial photograph). Its wall is about 1,100 linear feet (335 m) and about 20 percent of the original wall stones are estimated to remain in place. This wall was a "double" stone wall, that

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[5] Presently, only Waldron's feedmill on Oahu produces commercial fish feed for trout with 37 percent protein at a cost of 38 cents/lb. This is cheaper than the imported Purina trout chow (#6 growout, 40 percent protein) selling for 57 cents/lb. The Purina product is of superior quality to the Waldron's product in many ways. Purina catfish feed (32 percent protein) sells in Hawaii for 42 cents/lb and would be the better choice provided normal growth rates can be achieved.

EXHIBIT 3.1

MULLET PRODUCTION HIGHLIGHTS

CENTRAL PACIFIC	
HAWAII	Historical production yields from mullet ponds are not accurately known. Few commercial ponds are operated in Hawaii; 200 kg/ha/yr production at the beginning of the century for traditional extensive ponds (Cobb [1901] as cited in Madden and Paulsen [1977]); maximum yield of 1700 kg/ha/yr at a Keaukaha pond in Hilo (Twigg-Smith pond); this pond was well-managed, with supplemental feeding; however, water temperature is cold (20 degrees Celsius) and mullet take 5 years to reach full adult size; Kahouna pond in Kaneohe Bay yields 680 kg/ha/yr
INDO-PACIFIC	
HONG KONG	Semi-intensive ponds in Hong Kong: 2508 kg/ha/yr, with 300 days growout (Bardach et al 1972); reports of yields up to 3500 kg/ha/yr
PHILIPPINES	Polyculture in large, extensive milkfish ponds with *Tilapia*; yields of all fish combined average 336 kg/ha/yr; mullet incidental, usually less than 10 percent of crop
INDIA	Four species of mullet cultured; polyculture with other species such as milkfish, sea bass (*Lates* sp.), and shrimp; substitute feeding with rice bran; yields of 150 to 1500 kg/ha/yr
TAIWAN	Produced 1,425,217 kg of mullet in 1965; polyculture with other fish (tilapia, carp, milkfish, or eels); 6,000 ha of coastal ponds dedicated to fish polyculture; usually 50 percent of fish crop is *Tilapia*; yields up to 4,000 kg/ha/yr with multiple cropping schedule, 20 percent is mullet (750 kg/ha/yr); growth rates for mullet in Taiwan: 0.3 kg in Year 1; 1.2 kg in Year 2; 2.0 kg in Year 3
NORTH AFRICA	
EGYPT	Northern Delta Region, 50,000 hectares saline soils flooded: extensive pond culture; yields: 300 to 500 kg/ha/yr with no fertilizer or feed (Costa-Pierce 1987)
EUROPE/MIDDLE EAST	
ITALY	Modified estuaries or bays called "Valli". Fish/eel polyculture; extensive individual areas of 300 to 500 acres; yields: 90 to 200 kg/ha/yr of fish; predominant species is mullet; growers rely heavily on eel harvest to become profitable (Bardach et al 1972)
ISRAEL	Stock smaller ponds (0.8 ha) with variety of fish; one example: 214 mullet total weight 10.7 kg, stocked per hectare; weight at harvest in 110 days approximately 500 kg, equivalent to 44 percent of total yield (1155 kg/ha/crop) (Bardach et al 1972)

EXHIBIT 3.2
BASIC DIFFERENCES IN POND MANAGEMENT:
TRADITIONAL HAWAIIAN (EXTENSIVE) CULTURE
AND
MODERN (SEMI-INTENSIVE) CULTURE

	TRADITIONAL HAWAIIAN	MODERN
• Culture Type	Extensive	Semi-Intensive
• Pond Size	Large	Small
• Species	Polyculture	Monoculture
• Stocking Source	Wild	Wild + Hatchery
• Stocking Density	Low	Medium
• Acclimation	No	Yes
• Nursery	Seldom	Yes
• Transfers	Seldom	Yes
• Water Quality	Random	Controlled
• Water Exchange	Tidal	Tidal + Pumps
• Water Depth	30 to 40 cm	30 to 100 cm
• Vegetation	Moderate	Minimal
• Pond Bottom	Rocks	Sand or Mud
• Predation	Minimal Control	Controlled
• Feeding	No	Yes
• Fertilization	No	Yes
• Maintenance	As needed	Regular
• Harvesting	Incomplete	Complete

EXHIBIT 3.3
FISHPOND CULTURE SYSTEM ALTERNATIVES FOR HAWAII

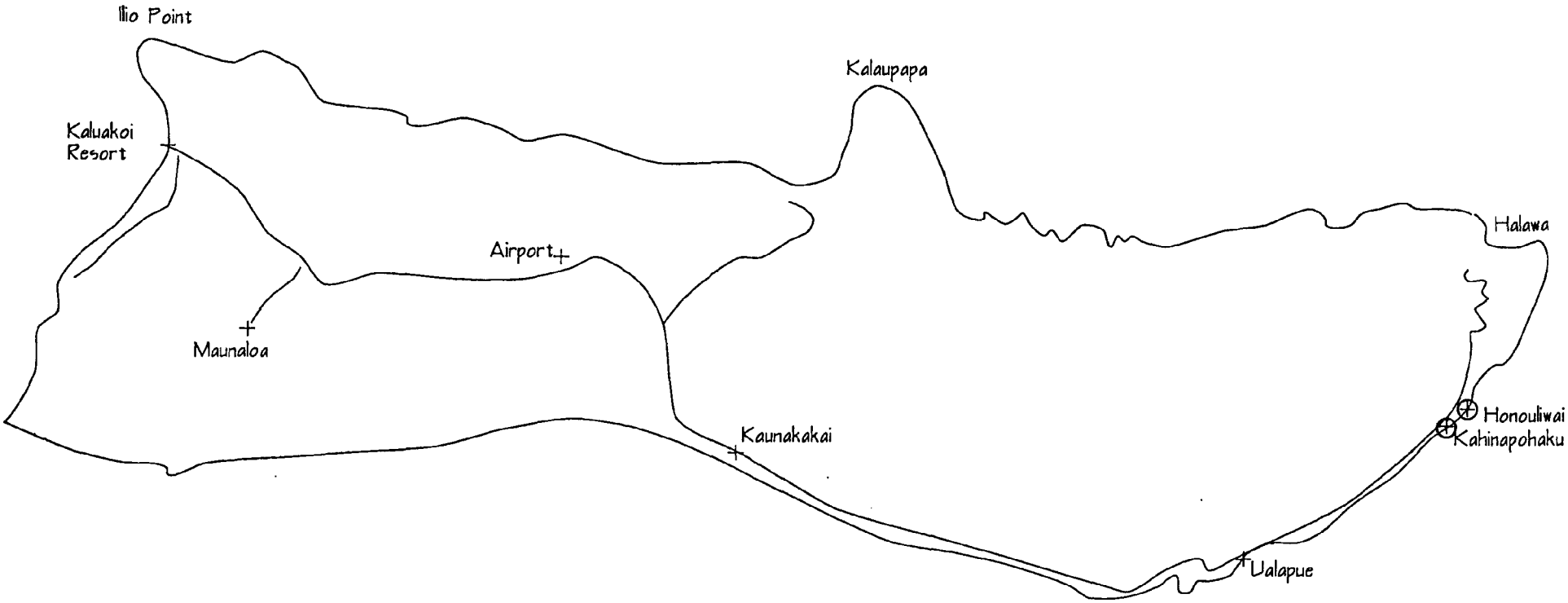
	EXTENSIVE SYSTEM	SEMI-INTENSIVE SYSTEM
Culture Type:	Polyculture with milkfish	Monoculture
Stocking Density (/ha):	500 to 1500	2500 to 5000
Pond Size (ha):	0.5 to 10	0.1 to 5
Water Management Method:	Tidal	Tidal + Pump
Aeration:	Natural Wave Action Only	Paddlewheel
Feed/Fertilizer Supplement:	None	Yes
Food Conversion Rate:	Not Applicable	1.7:1
Survival Rate:	50 to 60 percent	70 to 90 percent
Productivity (kg/ha/yr):	200 to 400	700 to 2000
Culture Period (months):	24 to 36	12 to 24
Market Size (kg):	0.5 to 1	0.5 to 1
Market Price:	$3.50/kg	$3.50/kg

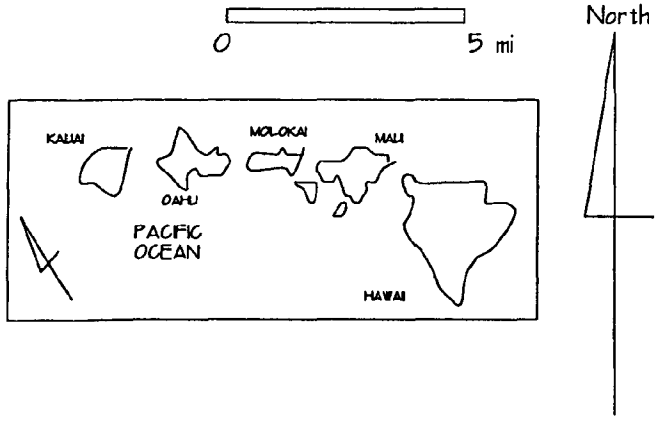
EXHIBIT 3.4
TRADITIONAL FISHPOND CULTURE (EXTENSIVE SYSTEM)

OPPORTUNITIES	CONSTRAINTS
Ponds would produce popular local fish such as mullet, milkfish, *moi*, and *weke* on a limited basis. In addition, shellfish (clams, oysters) various seaweeds (ogo) and marine shrimp could also be cultured. Crabs could become an incidental product since they occur naturally in ponds.	Numerous permits and regulations required from federal, state, and county government agencies.
Restoring the fishponds would help to preserve the traditional Hawaiian fishing practices on Moloka'i.	At present, no hatchery in Hawaii consistently produces fish fry in quantities sufficient for commercial purposes.
The ponds would produce fish in an environmentally-sound manner.	Depletion of wildstock of various species of juvenile fish could occur following the collection of stocking material. There is a need to quantify the existing supply of mullet fry wildstock on Moloka'i.
Extensive fishpond culture utilizing the tides to exchange water would be energy-efficient.	Extensive pond culture is only a marginal economical proposition; to repair the walls would require a higher financial commitment.
The extra income derived from the sale of fish would provide a boost to the Moloka'i economy.	Tidal water exchange limits the depth of water in the pond; pond depth has a direct influence on water temperatures within the pond.
Farming of seafood could be done by inexperienced residents with minimal operating capital. Training of pond staff could be accomplished given the extensive fishing knowledge already available within the Moloka'i community.	Pond walls can be damaged in storm events and may result in a loss of stock.
Fishpond walls would help to sustain the physical integrity of the shoreline.	Heavy siltation can occur in ponds which are connected to streams.
Fishponds could be considered as potential tourist attractions.	Poaching can cause significant losses in revenues. A pond caretaker living at the site is one of the better solutions to this problem.
Fishponds are a good educational tool for students and the general public. Scientific marine life displays and video presentations could be added attractions.	The task of restoring the pond walls by hand would be an arduous and time-consuming process. It is best to use heavy equipment prudently without damaging the environment.
Assessing fees to fish the fishponds could generate additional revenues.	There are few surviving records, or living *kupuna*, to educate new operators about the fishpond culture experience. A process of trial and error will occur initially.

EXHIBIT 3.5
MODERN FISHPOND CULTURE (SEMI-INTENSIVE SYSTEM)

OPPORTUNITIES	CONSTRAINTS
Limited hatchery seed stock available for mullet and milkfish from the Oceanic Institute on Oahu. Provided on a case by case basis.	Numerous permits and regulations required from federal, state, and county government agencies.
New jobs would be created for both skilled and unskilled labor during pond reconstruction phase.	Higher initial capital construction costs.
Smaller ponds could be used as nurseries and managed by a single *'ohana* who could, in turn, sell fry to other fishpond caretakers.	Greater potential for failure, i.e., human error (poor business management), natural disasters (red tides), or diseases.
Water level in ponds can be controlled and would, as such, improve overall environment for fish growth.	A higher degree of management skills and expertise required.
Higher survival rates are achieved in a controlled pond environment.	More external inputs are required, such as, the importation of feeds, fuel, fertilizers, and plastic piping.
Predators can be prevented from entering the ponds through the installation of screens at the *makaha* grates.	Additional security personnel needed to limit the potential for theft.
Higher production yields are achieved from semi-intensive ponds and a greater income potential can be derived for the respective *'ohana*.	Commercial aquaculture is scrutinized by government agencies such as the Board of Health. The question of whether or not pond effluent is considered "point discharge" has not yet been resolved.
Market a greater variety of fresh seafood products to local consumers.	Offshore reef areas may be negatively affected by silt from pond water discharge.
Culture the higher valued fish, *moi*, in pens within the ponds.	At present, no marine fish fry is sold by a commercial hatchery in Hawaii. If this supply is dependent upon capture from the wild, a possible depletion of wildstock may occur unless precautionary measures are taken in the future to enhance existing stock. Need to quantify available wildstock resources on Moloka'i.
Technology for culturing other mariculture species can be adapted to the pond system. For example, marine shrimp could be grown in pens and oysters on racks.	Traditional fishpond practices will be replaced by new technology. It is uncertain what effect this new technology will have on Moloka'i's rural lifestyle.
Overall, a faster return on initial ivestment can be achieved from a semi-intensive pond.	Difficulty of managing the ponds, e.g., if the number of unwanted fish (such as tilapia) increases, they would compete with desirable species for the dry feed.





Community-based Hawaiian Fispond Restoration and Use on Molokai

DEMONSTRATION PONDS:
Honouliwai and Kahinapohaku

Molokai, Hawaii

Exhibit 3-6

Photo Credit: Air Survey Hawaii (1987), Honolulu
Approximate scale 1 inch = 50 feet

Exhibit 3-7
Honouliwai Fishtrap
Moloka'i, Hawai'i

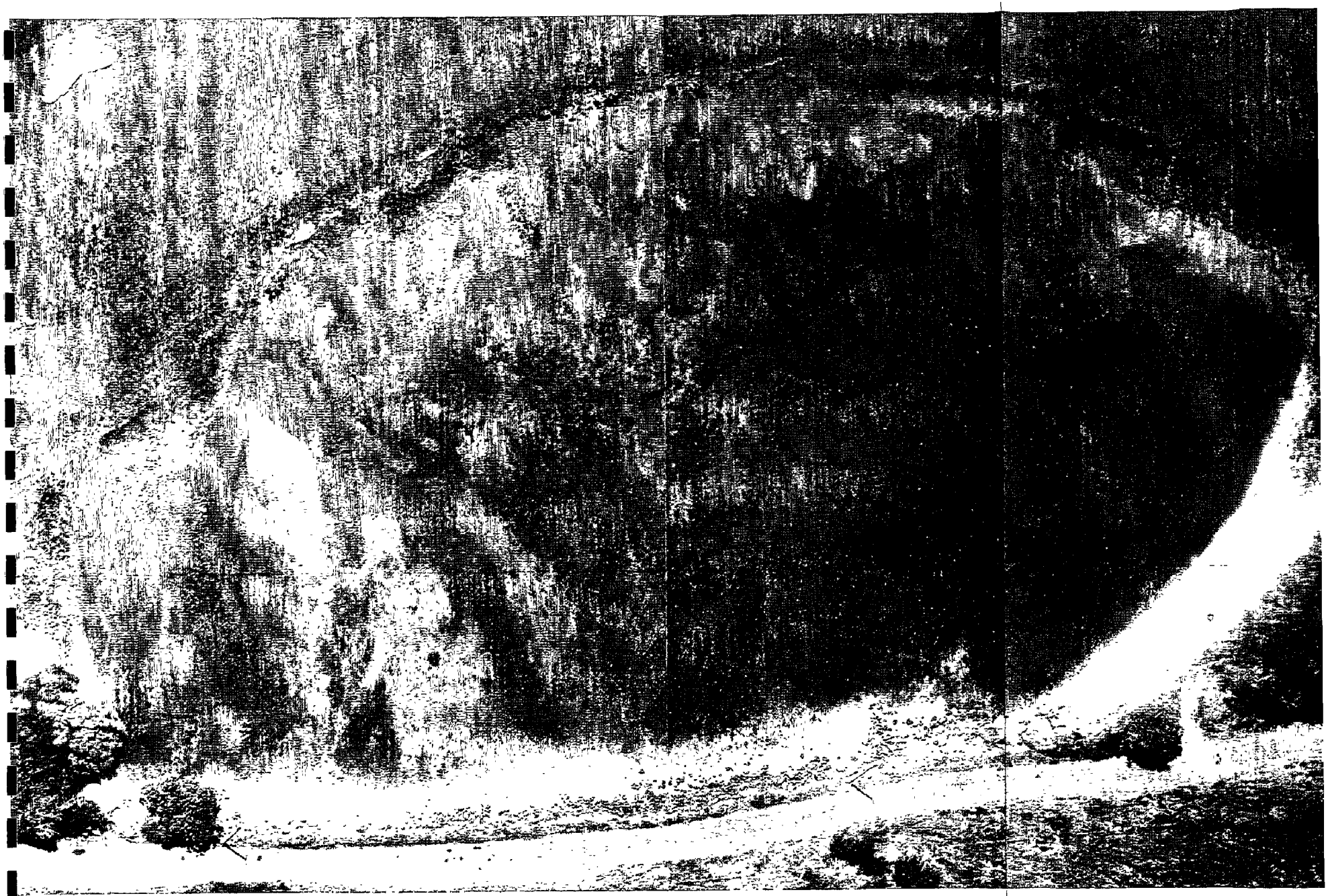


Photo Credit: Air Survey Hawaii (1987), Honolulu
Approximate scale 1 inch = 50 feet

Exhibit 3-8
Kahinapohaku Fishpond
Moloka'i, Hawai'i

is with an ocean-side and a land-side stone wall with a vertical layer of *'ili'ili*[6] between. Summers (1971) writes: "Kahinapohaku, 'The gray stone,' was a *loko kuapa* of four acres. (Cobb 1902:430). Its walls were broken in 1867 (Kanepuu 1867b) and now only the foundation stones remain". A *loko kuapa* is a pond constructed seaward of the shoreline on the reef flat with *makaha* (gates to open or close the pond waters to the ocean). It is possible that the destruction actually occurred in 1868 (April 2) when the third most severe tsunami in recorded history struck the Hawaiian Islands, causing 46 deaths (Schmitt 1977). This same event would likely have damaged Honouliwai as well because the two ponds are only about 3,500 feet apart with similar exposure and orientation along the shoreline. In any event, it would probably have taken a tsunami of major force to damage both ponds to such an extent.

A freshwater stream discharges under the highway into the ocean approximately 100 ft (30 m) from the north-east corner of the pond. The brown, cool water (23°C) contained organic debris. Cattle were observed grazing alongside this stream. The stream water is a potential source for coliform bacteria.

Water quality measurements were taken as the stream water discharged through the sand into the ocean. The stream appeared to have a significant impact on the surrounding reef judging from the brown color of the water and the silt build-up over the coral. It appears that the stream could influence salinity readings in the pond on very rainy days when the discharge from the stream increases. On the day of the site visit, salinity readings remained constant from four readings taken within the pond. There was no other evidence of freshwater intrusion into the pond from springs.

The average depth in the pond is 2 to 3 ft (0.6 to 0.9 m). The pond bottom is uneven with a layer of smooth rocks encrusted with Acanthophora sp. of seaweed. Turbidity was lower in this pond (60 to 70 cm secchi disc) due to the influence of the stream.

There was a noticeable absence of fish within the pond. One specimen of *limu kohu* (Asparagopsis taxiformis) was found.

3.5.2 AQUACULTURE SYSTEMS

A site visit was made to both ponds on 13 November 1992, and general observations of pond conditions were made for the purpose of evaluating productivity potential, and how that potential might be realized. Water quality parameters are given in Exhibit 3.9. Pond product alternatives, and related market considerations, are discussed in Section 7.2, and include detailed information on:

- potential edible fishes and other seafood crops
- local seafood market conditions
- the potential for use of ponds as hatcheries
- the potential for tropical marine aquarium fish culture

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[6] *'ili'ili* is coral or basalt rubble or rock, about 2 in. (5 cm) in diameter, used in the central section of double walled ponds to reduce water exchange and to prevent migration of small fish, also possibly because of ease of handling and ready availability.

EXHIBIT 3.9
WATER QUALITY,
TWO DEMONSTRATION PONDS

PONDS:	HONOULIWAI	KAHINAPOHAKU		
DATE:	13 November 1992	13 November 1992		
TIME:	14:30	15:30		
LOCATION:	Pond	Freshwater Stream	Stream Mouth	Pond
SALINITY, parts per thousand (ppt):	35	0	21	35
TEMPERATURE, Centigrade (°C):	27.5	23.6	25.0	27.4
DISSOLVED OXYGEN, parts per million (ppm):	7.9	4.9	6.8	6.8
pH:	8.4	--	--	8.4
TURBIDITY (Secchi, centimeters [cm]):	clear			60-70

Honouliwai Culture Alternatives

Option 1

Use the pond for a fishtrap in the traditional sense. Catch fish either by throw net or gill nets.

Option 2

Raise seaweed on racks: ogo (Gracilaria sp.) for the edible seafood market, and Eucheuma sp.[7] for the processed carrageenan market.

Existing constraints include:

- small size
- strong offshore current
- potential for damage by wave action
- no freshwater influence
- difficulty of access from the main road for machinery
- shallow pond makes it difficult to attempt cage culture

Recommendation

This pond would be best restored to its original purpose as a fishtrap. It is very small in size (0.6 acres [0.2 ha]) and located on the eastern side of Honouliwai Bay where a strong current sweeps around the point. The size of the pond would not warrant the expense of building up the pond walls or installing a *makaha* grate. If managed extensively without outside inputs, the pond could only produce 250 lbs a year valued at $750 which is not an economical level to pay back the investment or operating labor costs.

The main highway runs directly adjacent to the pond leaving no room to construct a processing/storage shed. Permission from private landowners would have to be granted in order to use their land.

Kahinapohaku Culture Alternatives

Option 1

- Repair walls and *makaha* by hand
- Stock the pond with mullet and milkfish
- Manage extensively to produce 300 to 500 kg/ha/year (268 to 446 lb/acre/yr)
- Use the *'ohana* as a labor source
- Sell the fish locally
- Grassroots approach, with some financial assistance from the State

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[7] Eucheuma is a non-indigenous seaweed introduced to Hawaii in the 1970s. As such, its culture in Moloka'i's fishponds is considered less desireable than the culture of other native species. See Section 7.2.1 for further discussion.

Option 2

- Refurbish the pond to maintain good water depths at all times
- Build *makaha* with screens and flash-boards
- Cull out predators prior to stocking
- Stock at semi-intensive levels with polyculture of both fish, shellfish, and seaweed
- Hire a pond manager
- Market products on Moloka'i and directly to retail outlets on other islands
- Build a small hatchery on Moloka'i

Option 3

- Use the pond for cage culture of the more highly valued fish, the *moi*
- Limit nutrient discharge levels with help of macroalgae
- Rear tropical marine reef fish for export[8]

Recommendation

Based on observations at the site, it is suggested that the pond should be managed at extensive levels to produce 300 to 500 kg/ha/yr of mullet or milkfish provided fry sources are available.

The existing pond wall is very wide at some points (over 24 ft [7 m]) and it would be relatively easy to work on these rocks with an excavator (backhoe on treads) which is the equipment best suited for the job.

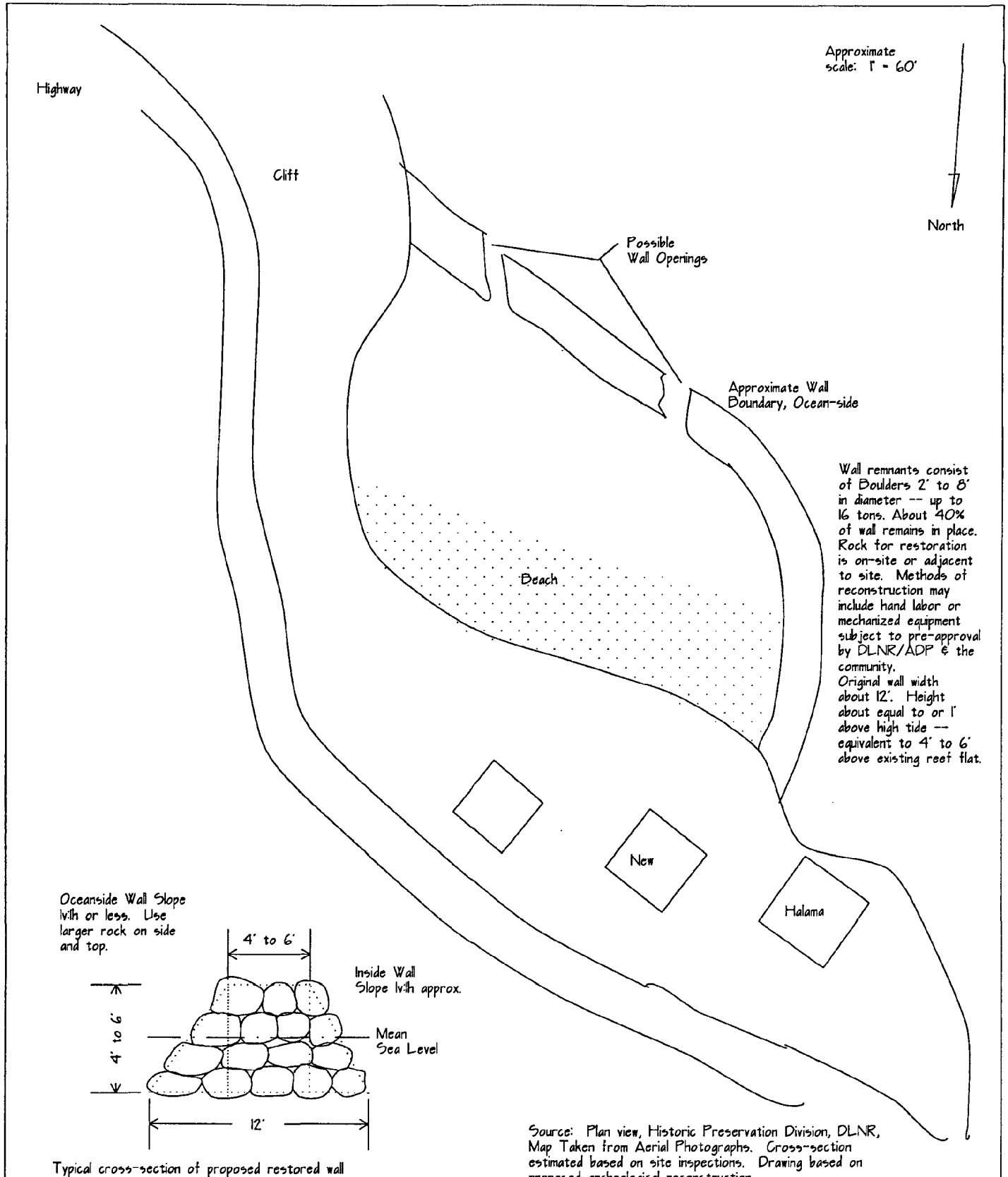
3.5.3 PROPOSED RESTORATION PLANS

Honouliwai Fishtrap

The proposed alignments of the restored walls would closely follow the footprint of the original foundations as they appear in the aerial photograph and based on field inspections. The original opening or openings in the walls are not certain although Summers quotes Mrs. Pukui as follows: "The pond was used as a trap rather than for storing fish. There was no *makaha* in the opening of the wall. When fish came around the eastern point of the bay they would go into the pond. A net was then let down over the opening, and the fish caught. The fish most often caught were the *weke*" (Pukui, personal communications 1961). The aerial photo shows two possible openings. These have been interpreted in the restoration drawing (Exhibit 3.10) as approximate and optional, depending upon the decisions of the restorers.

The wall stones range from 2 to 8 ft (0.6 to 2.4 m) in diameter. There are fairly large numbers of 6-foot (2 m) and 4-foot (1.2 m) diameter stone comprising the original wall, or laying about in the pond and along shore. In the restoration, the largest stone should be used as a foundation and on the ocean-side of the wall. Smaller stone could be used on the land-side of the wall. This would aid in strengthening the wall against wave attacks. The wall was a single wall comprised of large stones. There is no evidence that it was a double wall with a center fill of *'ili'ili*. The finished elevation of

[8] A description of the potential market for marine tropical fish is provided in Section 7.2.1.



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HONOULIWAI FISHPOND RESTORATION
AQUACULTURE DEVELOPMENT PROGRAM
STATE OF HAWAII

Exhibit 3-10

the wall is estimated to be approximately 2 ft (0.6 m) above high tide, or about 4 ft (1.2 m) above mean sea level. It is estimated that there are sufficient quantities of stone onsite to restore the wall, and there are additional suitable stones adjacent to the pond along the shore to the east. The original stones appear to be comprised of wave-washed rock or boulders. These have rounded edges and differ significantly from typical quarried stone which may have very sharp and distinct edges from blasting fracture lines. Restoration material should therefore consist as much as possible of wave-washed stone.

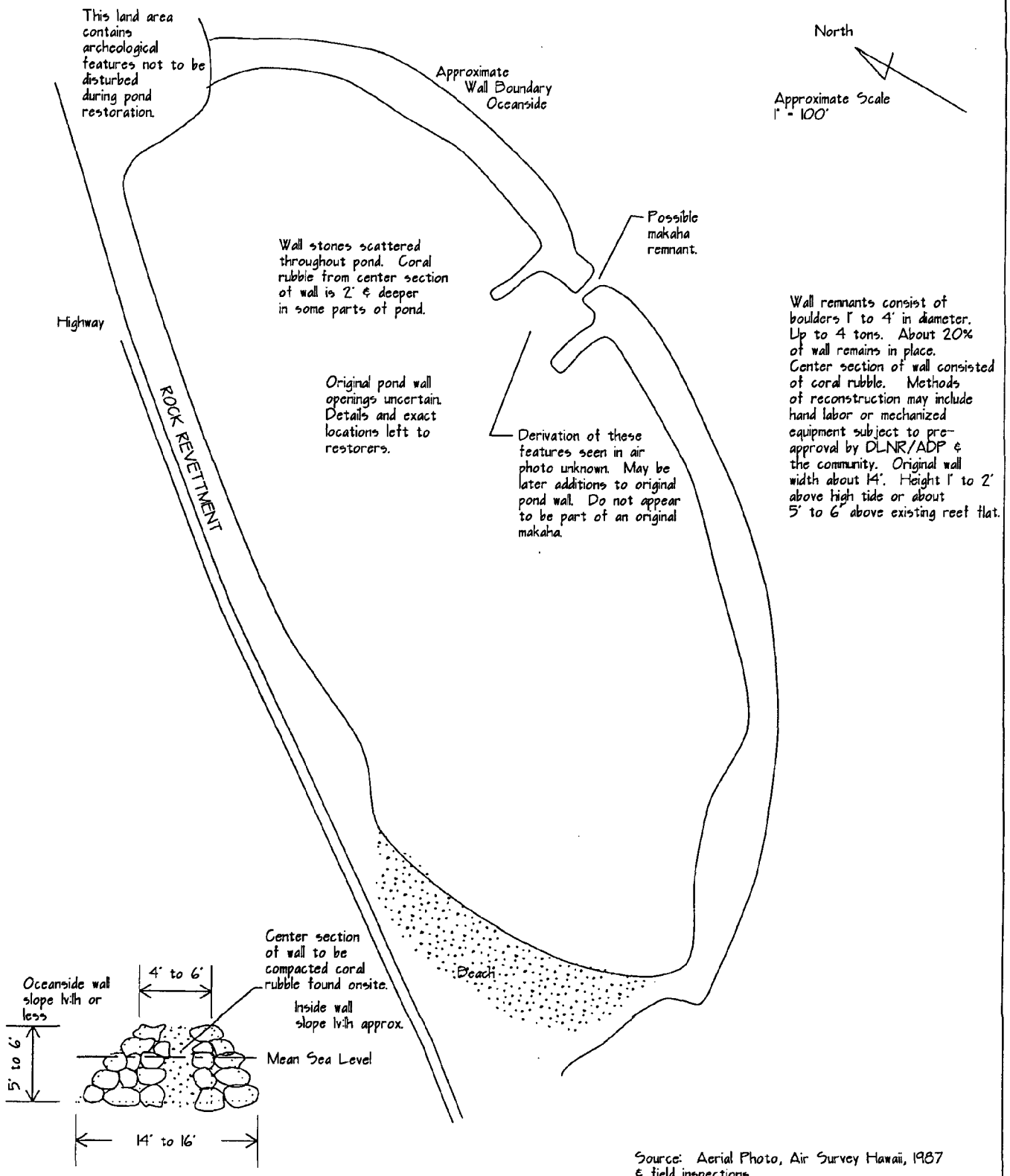
The drawing shows an optional slope of the restored walls which is less steep than may have been the case for the original walls. The reason for this is to improve the pond wall's resistance to wave attack. The gradual slope can absorb wave energy and allows for overtopping with less potential destruction of the wall. This modification is suggested because this pond is in such a highly exposed wave climate that in order for the restoration to have a better chance of survival, some changes need to be considered in the cross-sectional wall profile. The drawings show the possible original wall slopes and the suggested modifications. It is likely that the original walls were built with a steep slope similar to that drawn by Apple and Kikuchi (1975). Such steep slopes would require less material than the milder slopes proposed in the drawings for restoration and such a savings in labor and materials would be attractive to hand-laborers. Also, it is not known if there was a prehistoric knowledge of the relationship between the slope of a seawall and its ability to withstand wave attack. It may be that the benefits of mild slopes were not known then.

Details of net or closure construction are left to the restorers based on their experience and management interests.

Kahinapohaku Fishpond

The proposed reconstruction (Exhibit 3.11) would follow the original alignment of the wall which is estimated to be approximately 20 to 21 ft (6.1 to 6.4 m) in width at its base. The number or location of openings or *makaha* are not known from the historical record, and cannot be positively identified in the air photograph, although the drawing notes some possible openings and a possible *makaha* based on the site inspections and the air photo. Actual location of these openings, and the number, as well as the details of the opening devices, are left to the restorers and their operational decisions.

The size of original wall stone varies between 1 to 4 ft (0.3 to 1.2 m) in diameter. There is a large volume of stone within the pond itself and it appears that a shoreline revetment along the highway was constructed of stone which may have come from Kahinapohaku or other nearby ponds because of the uniformity of size, and the wave-washed, rounded condition evidencing that they are not quarry stone in origin. This road was improved during the 1930s and 40s and it may be that during that time the road was actually constructed somewhat seaward of an earlier shoreline which may have been in existence when Kahinapohaku was functional, probably in the mid-1800s. There appears to be a volume of approximately 3,227 cubic yards (cu yds; 2,467 cubic meters [cu m]) of *'ili'ili* within the pond. This material and the stones scattered throughout the pond could be recovered by use of a



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KAHINAPOHAKU FISHPOND RESTORATION
AQUACULTURE DEVELOPMENT PROGRAM
STATE OF HAWAII

Exhibit 3-11

"fresno" scraper,[9] or use of small tracked equipment such as a front-end loader or a backhoe, or by hand.

Sloped walls are proposed for this pond (see discussion above regarding Honouliwai) and it should be noted that the proposed slopes may be less severe than the original ones, although the original slopes cannot be positively determined.

3.5.4 TRADITIONAL AND MODERN WORK TECHNIQUES

Originally the ponds were built manually. This process would be arduous to replicate, particularly at Honouliwai with its large stone (see Exhibit 3.12 for a comparison of rock size and weight).

With this in mind, the following discussion of construction scheduling and cost estimates is based on the use of equipment to assist restorers in retrieving and placing heavy stone and large volumes of smaller rock or *'ili'ili*. There appear to be no technical reasons to deny the use of equipment for material handling, at least in the case of the two proposed demonstration ponds. However, because of cultural sensitivities, the use of equipment has been a subject of concern to the community. To some extent such concerns appear to originate because of past experiences or observations where the use of heavy equipment has resulted in damage to, or destruction of, prehistoric sites. In the case of pond reconstruction, use of equipment may be permissible if community members are participants in the approval and reconstruction process.

3.5.5 CONSTRUCTION SCHEDULE

Pond restorers have stated that they would work during the summer months, perhaps from April through September, during low tides. A review of tide charts shows that during daylight hours, there will be a period of three to four hours, under suitable weather conditions, when low tide conditions prevail. Additionally, for an average of about seven days each month there will be longer periods of low water, perhaps six to eight hours, where the work periods might continue uninterrupted. Low tide and mild sea conditions are needed, especially for the work at Honouliwai which is seriously exposed to wave action and also because of the generally large stone (2 to 6 ft [0.6 to 1.8 m] in diameter) which restorers must place. However, at Kahinapohaku, conditions may be less critical since the initial base layer of stone, approximately 2 to 3 ft (0.6 to 0.9 m) deep is still intact. This would offer protection from wave action, and some work may continue, even during high tide by working from the surface of the wall. In any event, it appears feasible to reconstruct both ponds during a period of summer months, and it would be especially desirable to complete Honouliwai during one continuous summer period so that the wall would be structurally intact for the winter storm season. Kahinapohaku may be less critical in this regard because it has somewhat greater protection from high wave action.

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[9] A "fresno" scraper could be operated in semi-manual fashion by two persons. This is a low budget technique which would probably work to "scrape" up the rocks and *'ili'ili* on the bottom of the pond. It would not be as fast as use of power equipment, but would be more efficient that hand methods.

EXHIBIT 3.12
ROCK SIZE AND WEIGHT

Diameter (ft)	Volume (cu ft)	Weight (lb)	Weight (tons)
1	0.5	65	--
2	4.2	524	--
3	14.1	1763	--
4	33.5	--	2.1
5	65.5	--	4.1
6	113.1	--	7.1
7	179.6	--	11.2
8	268.1	--	16.8

3.5.6 ESTIMATED COST OF RESTORATION

Cost Estimates

Calculations and cost estimated for the two demonstration ponds are provided in Exhibits 3.13 through 3.16. Cost estimates provided here have been prepared to reflect market rates to a certain extent. They allow for the use of non-professional workers in order to reflect the desire of *'ohana* to perform the work in traditional fashion as opposed to strictly on the basis of monetary reward. If these jobs were to be bid out to licensed contractors on a turnkey basis, the cost estimates would need to be revised, probably upward in total cost, to reflect union-scale wage rates and other increased costs. The estimates assume that there is monetary value to the labor which would go into restoration and that such labor should receive cash payment. Should workers chose an alternative means of payment, or volunteer their labor, then costs would be less. But it would be impractical and a disservice to the community, especially taking into account the general levels of household income and employment on Moloka'i to assume that projects as extensive as restoration of these two ponds would cost nothing and would be done *gratis*.

Labor

The labor cost estimates shown in Exhibits 3.14 and 3.16 reflect a monetary value of the restoration work. Such information is provided because it may be useful for budgeting or administrative purposes. However, it should be noted that the Task Force has letters of interest from two *'ohana* who have stated that they wish to restore and operate the two demonstration ponds. The implication of these letters of interest, and from discussions and meeting minutes of the Task Force, is that a substantial amount of "volunteer" labor may be available to aid in the restoration and operation activities. If this ultimately is the situation, then the cost estimate amounts shown in the Exhibits may be reduced by appropriate amounts to reflect less cash labor costs.

Material

Much of the material for reconstruction of the two demonstration ponds is available onsite or along shorelines (State-owned property) adjacent to the ponds (Exhibit 3.13 and Exhibit 3.15). The bulk of this material consists of 1) wave washed stones (cobbles and large boulders, size varying from 1 to 8 ft [0.3 to 2.4 m] in diameter) used in the walls, and 2) small material, *'ili'ili*, used in the center section of the wall at Kahinapohaku. Because this material is onsite, and is largely a remnant of the original ponds, it is available at no cash cost, except for the labor involved in moving it during reconstruction. At Honouliwai, estimates are that there is nearly enough rock available along the alignment of the pond walls, and within the pond area for reconstruction. Additional material is available along the shoreline, adjacent to the north boundary of the pond wall, should it be required.

Equipment

Exhibits 3.14 and 3.16 include a cost estimate for the use of heavy equipment. Although the ponds could be restored without the use of such equipment, its use, if financially feasible, would facilitate the work, probably reduce human injury during movement and placement of large boulders, and by allowing completion of reconstruction on a timely basis, possibly provide encouragement to the overall effort of restoring more of Moloka'i's ponds.

Exhibit 3-13: Calculations for Honouliwai Estimate

Estimate of rock in Honouliwai Pond	
area of Honouliwai (acres)	0.5
area of Honouliwai (sq ft)	21780
rocks in Honouliwai (diameter, not piled up)	4
percent coverage	50%
volume of rocks (cu yd)	151
Estimate of rock in-place or adjacent to the original Honouliwai wall alignment	
wall length (ft)	340
wall width at base	12
average height of in-place rock (ft)	3
volume of in-place rock (cu yd)	453
Estimate of available rock: sum of rock in place and in pond	
total volume of rock (cu yd)	605
Estimated rock required for Honouliwai	
total cross-section area (sq ft, see text)	45
less in-place rock (sq ft)	(24)
net cross-section of rock to be restored (sq ft)	21
length of wall (ft)	340
volume of rock required (cu yd)	264

Notes:

(1) Estimates of available rock are conservative

(2) Estimates of required rock are based on tentative reconstruction dimensions.

Exhibit 3-14
Reconstruction Cost Estimate: Honouliwai Fishtrap

Task	Cross-section area (sq ft)	Length (ft)	Quantity (Cu Yd)	Labor ($/Cu Yd)	Labor (Hrs/Cu Yd)	Hours	Rate ($/hr)	Subtotal
1. Wall: Reconstruction	21	340						
Materials (rock)			264					
Less existing rock onsite			605					
Net rock required offsite			0	$10.00				$0
Labor					0.8	212	$15.00	$3,173
Equipment Rental/with operator					0.2	53	$85.00	$4,496
2. Gate			Lump Sum		Lump Sum			$1,000
Subtotal								$8,669
Contingency							20%	$1,734
Total								**$10,403**

Assumptions:

1. Work during low tides, summer months (Apr. thru Sep.), during daylight. Finish job within 6 months if start in April.
2. Labor: 2 workers minimum assist equipment operator as riggers and spotters. Other labor as available for smaller stones.
3. Equipment: Tracked backhoe, rental with operator, available on Molokai, willing owner. Crawler crane optional or alternative.
4. Material: About 40% of the wall is in place. Reconstruction is required for the remaining 60%. Material on site, or adjacent to site is State-owned, so there may be no materials cost for rock.

Exhibit 3-15: Calculations for Kahinapohaku Estimate

Estimate of rock and coral rubble in Kahinapohaku Pond	
area of Kahinapohaku (acres)	4
area of Kahinapohaku (sq ft)	174240
rocks in Kahinapohaku (diameter, not piled up)	1
percent coverage	50%
volume of rocks (cu yd)	4840
coral rubble in Kahinapohaku (ft, depth of rubble)	1
percent coverage	50%
volume of coral rubble (cu yd)	3227
Estimate of rock in-place or adjacent to the original Kahinapohaku wall alignm	
wall length (ft)	1200
wall width at base	14
average height of in-place rock (ft)	2
volume of in-place rock (cu yd)	1244
Estimate of available rock: sum of rock in place and in pond	
total volume of rock (cu yd)	6084
Estimated rock required for Kahinapohaku	
total cross-section area (sq ft, see text)	60
less coral rubble (sq ft, see text)	(12)
net rock cross-section area (sq ft)	48
less in-place rock (sq ft)	(28)
net cross-section of rock to be restored (sq ft)	20
length of wall including 1 makaha (ft)	1200
volume of rock required (cu yd)	889
Estimated coral rubble required for Kahinapohaku	
total cross-section area (sq ft)	12
wall length (ft)	1200
volume of coral rubble required (cu yd)	533

Notes:

(1) Estimates of available rock and coral rubble are conservative.

(2) Estimates of required rock and coral rubble are based on tentative reconstruction dimensions.

Exhibit 3-16
Reconstruction Cost Estimate: Kahinapohaku Fishpond

Task	Cross-section area (sq ft)	Length (ft)	Quantity (Cu Yd)	($/Cu Yd)	Labor (Hrs/Cu Yd)	Hours	Rate ($/hr)	Subtotal
1. Wall: Reconstruction (see text for dimensions)	20	1200						
Materials (rock)			889					
Less existing rock onsite			(4,198)					
Net rock required offsite			(3,309)	$10.00				$0
Materials (coral rubble)			533					
Less existing coral rubble			(3,227)	$18.00				$0
Labor					0.6	533	$15.00	$8,000
Equipment Rental/with operator					0.1	89	$85.00	$7,556
2. Gate (Assume 2 makaha)			Lump Sum		Lump Sum			$3,000
Subtotal								$18,556
Contingency							20%	$3,711
Total								**$22,267**

Assumptions:

1. Work during low tides, summer months (Apr. thru Sep.), during daylight. Finish job within 6 months if start in April.
2. Labor: 2 workers minimum assist equipment operator as riggers and spotters. Other labor as available for smaller stones.
3. Equipment: Tracked backhoe, and small tracked loader, rental with operator, available on Molokai, willing owner.
4. Material: About 20% of the wall is in place. Reconstruction is required for the remaining 80%. Material on site, or adjacent to site & State-owned.

The estimate assumes that the equipment owner would be willing to provide the equipment and an operator, and the maintenance of said equipment knowing the difficult conditions under which it would be used. Operation of such equipment near and in salt water presents a high cost of maintenance and additional difficulties of repair and operation. Equipment and material access points have been identified for both ponds. For Honouliwai, a tracked backhoe might be used to move and place boulders. These machines are stable, relatively fast, and readily available. Because almost 40 percent of the wall material is in place, or along the reconstruction alignment, and the remaining stone is within a one-half-acre (0.2-ha) area of the pond, the machine could very quickly move all the material near the wall, and then be used to lift and place the stones with the assistance of restorers who would rig any necessary slings, and guide stone placement. The base geology of Honouliwai is unsilted reef flat which generally provides sufficient foundation to support such equipment.

At Kahinapohaku, the situation is somewhat different. This wall was a double stone wall with *'ili'ili* fill in between. Perhaps 20 percent of the wall stone are along the wall's alignment and the rest are scattered throughout the pond. Some of the original stone may have been used to construct a revetment protecting the highway. No *'ili'ili* is in place, and most of the original material appears to be scattered along the pond's bottom where there are layers up to 18 in. (0.5 m) in depth. Given these conditions, a tracked backhoe may be the best machine for the initial reconstruction work. It could be used initially to collect the larger stones and to place them. It then could assist in scraping up the *'ili'ili* and placing it between the two stone walls. An optional piece of equipment might be a small tracked loader/dozer. This machine might be better suited because it could handle the smaller sized material at Kahinapohaku, could probably scrape up material from the pond bottom more quickly than could a backhoe, and it could also be used on top of the pond wall if desired. The choice of machinery might better be made by restorers as they work and observe the conditions. The pond bottom is unsilted reef flat which is generally a suitable support for equipment.

SECTION 4

ORGANIZATIONAL AND OPERATIONAL MODELS

SECTION 4
ORGANIZATIONAL AND OPERATIONAL MODELS

4.1 INTRODUCTION

This section describes organizational and operational alternatives, and suggests the most appropriate means of restoring and operating the demonstration ponds. The recommended model could be applied to the restoration process of other ponds as well. Both of the considered alternative models include community based restoration, support, and operation, but the recommended model goes much further towards achievement of community responsibility. It is intended that the models evolve during the review process, and that any final model reflect the insight and concerns of agencies and other reviewers.

The ponds reflect ancient Hawaiian culture and an integration of the community with its environment. As such, they differ from modern aquaculture and its goal to achieve productivity rates which can yield a positive benefit to cost ratio as expressed in monetary terms. The fishponds, rather, stand for or symbolize a set of cultural values much broader than financial success alone. Recognition of this distinction seems crucial both in 1) understanding the community's dissatisfaction and impatience with the restoration efforts to date, and 2) considering different organizational and operational models for fishpond restoration and use.

This section is intended for application to the two demonstration ponds and has been prepared specifically for their "jump start" program. This section will also apply to the longer-term goal of restoration of many more ponds, but it is likely that organizational and operational factors will continue to evolve along with the restoration and operation of increasing numbers of ponds.

The two demonstration ponds were selected by the Task Force because of the probable ease of obtaining permits and the interest of *'ohana* in assuming responsibility for the ponds, thus "fast-tracking" them through the system. If other goals had been selected, such as 1) restoring a pond with the potential for high aquacultural productivity, or 2) restoring a pond with great archaeological significance, other criteria might have been used to select the demonstration ponds. The intent of the Task Force is to provide, through successful restoration of two relatively straightforward projects, a model of success for future work.

4.2 ALTERNATIVE MODELS

Two alternative organizational models are discussed below; Exhibit 4.1 compares the advantages and disadvantages of each.

4.2.1 DLNR/AQUACULTURE DEVELOPMENT PROGRAM

This model basically resembles the existing condition in which the Aquaculture Development Program (ADP), DLNR, is responsible for the promotion of aquaculture on a Statewide basis. Restoration of ancient Hawaiian fishponds in this context is only one aspect of ADP's entire program. Under this model, community input is achieved through hearings, workshops, and basic agency administrative procedures and the overlying political process. Planning, administrative programming and budgeting are carried out through standard State agency procedures. Funding is from public sources.

EXHIBIT 4.1
COMPARISON OF TWO ORGANIZATIONAL MODELS

Model	Advantages	Disadvantages
DLNR/ADP (Existing Condition)	Under this model the existing public administration (DLNR/ADP) includes the management of fishponds under its official charter. Funding is from public sources. The community participates through the political process in suggesting capital improvements and agency programs. The community also has input to management through the administrative review process including public meetings and environmental impact statement reviews.	ADP's work is focused on the development of a strong Statewide aquaculture program. This mandate differs from the apparent goals of the Moloka'i community to reconstruct fishponds because fishpond reconstruction and aquaculture development are not synonymous. Although aquaculture can occur in fishponds, it may not be as profitable or productive as aquaculture in more controlled environments which are less linked to cultural and archaeological values.
Moloka'i Fishpond Commission (Proposed)	Under this model, the community would become the primary agent in restoration and operation of fishponds, although government agencies would maintain some of their responsibilities for historic preservation and proper land use management. The community could direct primary resources such as funding and community efforts at fishpond restoration and operation. This shifts the focus somewhat away from aquaculture towards restoration of fishponds in terms of culture and tradition. This may benefit native Hawaiian culture, but it may also have a long-term economic benefit by enhancing Moloka'i as a place for visitors and residents to learn about the original structures of fishponds, and their uses.	Establishment of such a proposed Commission may require more individual effort from key members of the community to participate and to make the process successful. DLNR/ADP's role would be somewhat reduced in that fishpond restoration would be more clearly tied to cultural and historic preservation. However, the role of these agencies as developers of aquaculture could still be in place because their expertise could be accessed by pond operators, depending on the individual situation at each pond.

4.2.2 MOLOKA'I FISHPOND COMMISSION

A second model proposes that a "Moloka'i Fishpond Commission" be established with the express responsibility for restoring and overseeing operations of the fishponds on Moloka'i.[1] During a community meeting on fishponds on Moloka'i (18 November 1992), participants affirmed this concept, and suggested that the Commission consist of members of government and the public. The Commission would be responsible to plan, program, and budget for restoration and operations. If possible, it would be partially funded by a portion of income from restored ponds. The Commission would be responsible for obtaining major sources of funding, possibly from private foundations as well as from public sources. The following paragraphs offer further discussion regarding the possible range of duties and responsibilities which could be considered for Commission functions.

4.3 RECOMMENDED MODEL: MOLOKA'I FISHPOND COMMISSION

4.3.1 ADMINISTRATION

The proposed Moloka'i Fishpond Commission should be administratively linked to a State Agency so that an official conduit for use and audit of public funds and implementation of legal requirements exists. Such an arrangement provides a linkage to the Governor's office through the cabinet standing of the linked agency. During budget preparation and legislative testimony, the agency may speak on behalf of the Commission if desirable. It also lessens the potential staff burden on a newly formed Commission which allows it to direct its limited start-up resources to the primary objectives of restoring and administering fishpond use. The two agencies presently active in Moloka'i fishpond planning -- Department of Business, Economic Development and Tourism (DBEDT) and DLNR -- are the candidates considered for linkage with the proposed Moloka'i Fishpond Commission.

4.3.2 DBEDT

One of DBEDT's primary objectives is to promote economic development, both small and large scale, and especially tourism. DBEDT also has an Ocean Resources Branch with some technical expertise related to fish marketing, a link to aquaculture. DBEDT recognizes the need to protect and restore features of historic significance to native Hawaiian culture, but this tends to be conceived within their mandate of fostering improvements on behalf of the growth of the visitor industry. It is appropriate, therefore, that the mandate of DBEDT staff on Moloka'i is in line with two issues of keen interest to the Moloka'i community -- economic development and fishpond reconstruction.

4.3.3 DLNR

DLNR has a general role in the State as a caretaker of natural resources which tend to be clustered in the Conservation Land Use Districts. As such, the role of DLNR is much less assertive or growth oriented than is that of DBEDT. DLNR maintains a much larger staff on Moloka'i than does DBEDT, and DLNR's ADP has been directly involved in the demonstration pond proposals.

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[1]The Moloka'i Fishpond Commission concept is derived from responses to a questionnaire administered as part of this overall contract. The word "Commission" is used here to reflect the use of that word in both the questionnaire and community meeting discussion.

Exhibit 4.2 compares DBEDT and DLNR administrations related to fishpond restoration.

4.3.4 RECOMMENDATION

The Commission should be administratively linked to the office of the Director of the DLNR for the following reasons:

- Nearly all ponds are located within the State Conservation District, and fishpond-related uses are subject to the permit process for Conservation District Use Applications (CDUA) decided by the Board of Land and Natural Resources (BLNR).

- All ponds are culturally significant and subject to the jurisdiction of the Historic Preservation Division of DLNR.

- Within government agencies, the best aquaculture expertise resides within the ADP. If fishpond restoration is to move forward under this recommended alternative, it is further proposed that additional resources be developed and additional staff (2 persons) be hired through ADP to support this program.

The intent of placing the linkage with the office of the Director is to reinforce the concept that aquaculture, historic preservation, and natural resource management subsume the functions of fishpond planning, restoration, and operation. Exhibit 4.3 shows a typical organizational model of the proposed Commission.

4.3.5 MANDATE, RESPONSIBILITIES, AND LEGAL STRUCTURE

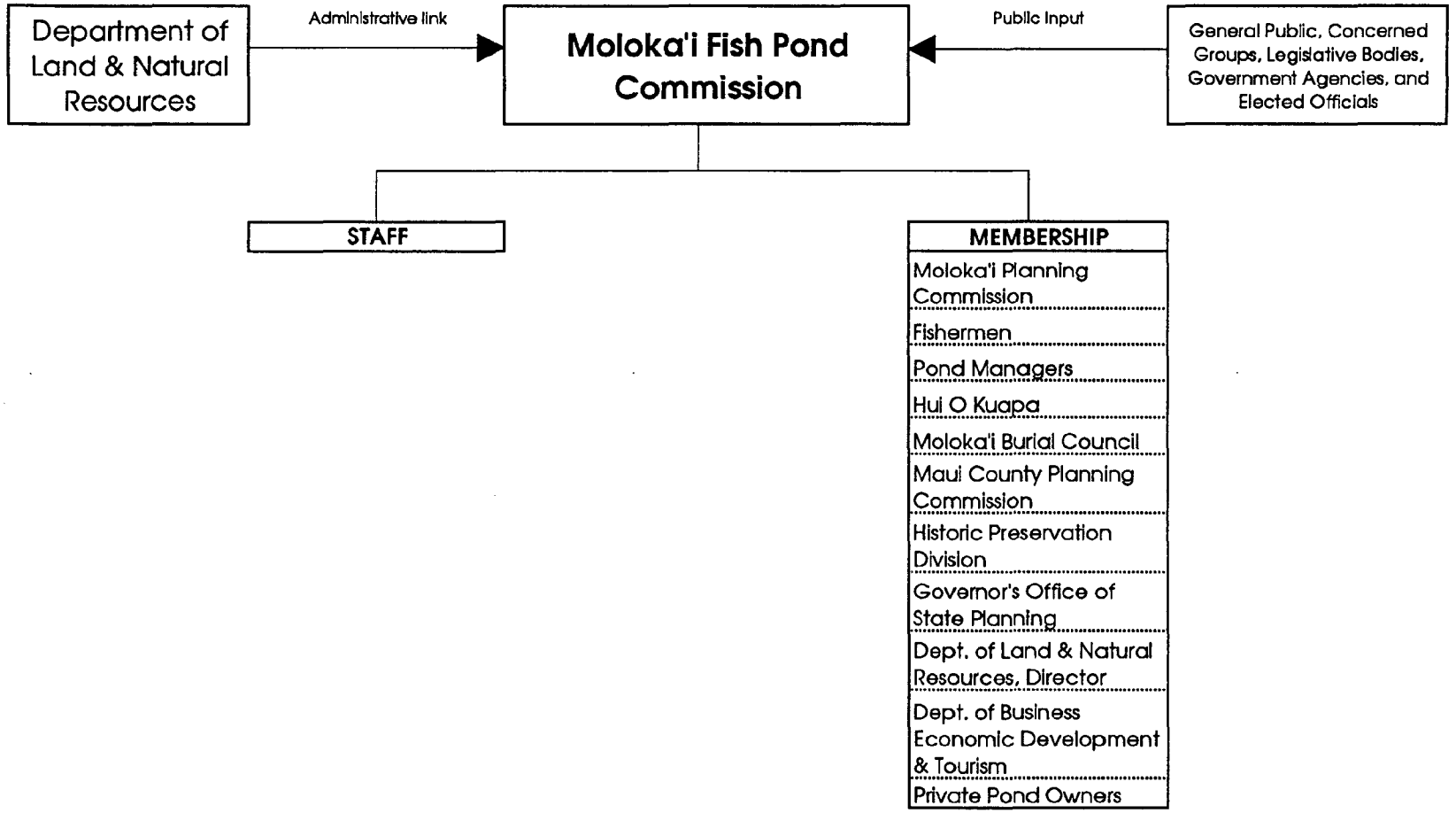
The mandate of the proposed Moloka'i Fishpond Commission would be to plan and implement restoration of fishponds, and to aid in operation of the restored ponds. This mandate would be limited and restricted to the above purposes only, and would not include any land use decision-making authority or zoning power -- these activities would continue to be administered by existing agencies. However, the proposed Commission would be a part of the review process for **any** proposed fishpond restoration. This condition would apply because it could be administratively required by BLNR during the CDUA permit process since most fishponds are in the Conservation District. In the event a proposed pond fell outside the Conservation District, the County planning and zoning authority would apply and would be activated because of the historic nature of ponds. The proposed Commission would have no authority over private ponds, except as a reviewing body of proposed restoration plans. However, the Commission could restore and manage private ponds on behalf of the owners, for a fee, if such agreements could be made.

The responsibilities of the Commission would be to aid in establishing a broad plan for fishpond restoration and operation. At the 18 November community meeting, participants felt that the State's goal should be to restore all ponds. In other words, ponds should not be used for other purposes because eventually they would be restored. The restoration plan would prioritize resources and develop a schedule of restoration. The proposed Commission would seek funding from public, private, and foundation sources. The latter two sources could potentially offer significant opportunities for restoration funding because of the cultural, historical, environmental, and artistic values of the ponds. The Commission would be responsible for reviewing fishpond restoration and use applications. The Commission would be entitled to receive a percentage of income from restored

EXHIBIT 4.2
COMPARISON OF DBEDT AND DLNR ADMINISTRATIONS
RELATED TO FISHPOND RESTORATION

Model	Advantages	Disadvantages
DBEDT	DBEDT's role within the State is assertive and action-oriented. This sort of corporate culture could aid efforts to initiate restoration of fishponds. As an example, their small office on Moloka'i has been directly involved in the demonstration pond proposals.	DBEDT's economic growth focus is not necessarily the appropriate basis for fishpond restoration or use because of the traditional and cultural values associated with the ponds. Although DBEDT has strong technical skills in economics and financing, and to some extent in the ocean sciences, few of these skills are directly related to the capabilities needed for fishpond restoration and operation.
DLNR	DLNR's divisions have mandates for preservation of historic values, and protection of natural resources including land, water, wetlands, and coastal areas -- all of which tend to be in Conservation Districts administered by DLNR. DLNR staffs the BLNR, which has decision-making authority in the Conservation Districts. The ADP has expertise in pond management at a sophisticated level. The present leadership of DLNR has assumed an active role in fishpond restoration.	DLNR's mandate to protect historic resources could conceivably be at odds with efforts to restore and operate fishponds, unless such efforts are properly guided. The Moloka'i staff tend to represent the interests of their respective divisions, of which there is none with a direct interest in fishponds.

Exhibit 4-3
Organization Chart, Proposed Commission



ponds and to charge fees for its planning, restoration, and operational services. Such fees would go towards offsetting restoration work and staff and operational costs. While it is unlikely that income from ponds would ever fully finance a complete program of restoration and operation, it is important that as a community based activity, methods of accounting and financial management be applied so that a rational program of restoration can proceed.

The proposed Commission, or unit thereof, should be constituted as a non-profit organization so that it could operate to some extent under self-supervision with the Commission members acting as a Board of Directors. This would enable the organization to enter into services or construction contracts for management, consultations, and minor construction. Non-profit status would enhance eligibility of the organization to obtain grants from private sources or foundations.

4.3.6 MEMBERSHIP

Exhibit 4.4 shows the total list of proposed members for a Moloka'i Fishpond Commission. During the 18 November community meeting, participants suggested a Commission comprised of nine members (Commission members suggested at the community meeting are marked by an asterisk in Exhibit 4.4). In one instance, the workshop participants suggested both an archaeologist and the Historic Preservation Division; those two have been combined into one position because they appear to duplicate functions. The Director of DLNR has been added as a proposed member of the Commission to connote the significant level of this Commission and in keeping with the suggested administrative linkage to the DLNR. A tenth member, DBEDT, is suggested in keeping with the view that fishpond restoration would be beneficial to Moloka'i in the long-term by adding to the resource base, thus leading to a stronger and more diversified economy. An eleventh member, a representative of private owners of ponds, should also be considered. With this configuration, it would appear that the major interests and regulatory bodies are represented, and the odd number of members aids in preventing tie votes.

4.3.7 STAFFING

If there is to be an active fishpond restoration program, there seems to be a need for staff tasked with this responsibility. At present, the responsibilities of public agency staff include preservation of ponds in their current condition, as well as the promotion of aquaculture. However, from a practical standpoint, obtaining additional staff resources, if to be paid for by public funds, presents certain budgetary obstacles. It is likely that one person could carry out the necessary actions initially if a Moloka'i Fishpond Commission were established. These duties should be focused on 1) searching for restoration funds, especially from non-public sources, 2) supporting the restoration and management of the two proposed demonstration ponds, 3) assisting in the planning and application for permits for additional ponds to be restored, and lastly, 4) acting as support to the Commission. Item 4 could easily become a full-time effort, and Commission members must act to prevent this by minimizing their expectations for paperwork support. It is likely that the public agencies on the list could provide some basic staffing, especially for administrative support. Staffing could be accomplished initially by services contracts as has been done to staff the Task Force. This would avoid the objection which would likely be raised that new positions should not be authorized because they represent long-term funding obligations.

EXHIBIT 4.4
PROPOSED COMMISSION MEMBERSHIP

Number	Members
1	*Moloka'i Planning Commission
1	*Fishermen
1	*Pond Managers
1	*Hui O Kuapa (an existing fishpond cooperative)
1	*Moloka'i Burial Council
1	*Maui County Planning Commission
1	*Historic Preservation Division, DLNR
1	Department of Land and Natural Resources, Director
1	Governor's Office of State Planning
1	Department of Business, Economic Development and Tourism
1	Private Fishpond Owners
(Total=11)	

* Denotes representation suggested at the 18 November 1992 Community Meeting on Moloka'i.

4.3.8 FINANCING AND ECONOMICS

A program of pond reconstruction and management has a broad range of benefits including potential long-term economic benefits. These benefits would accrue from: 1) an enhanced visitor environment in which Hawaii as a destination area is marketing its history and natural beauty of which fishponds are an integral part; and 2) strengthened community economic development which will occur as cash begins to flow in the small Moloka'i community from reconstruction work, and from the sale or exchange of pond products. These longer term benefits probably justify the efforts and costs to restore the ponds even though it may be unlikely that most ponds can be restored and operated in such as way as to cover all the costs of planning, reconstruction, and management strictly through revenues or income from the sale of pond-produced products. If these two longer term and broader economic objectives are taken into consideration, restoration of ponds on a Statewide basis becomes more attractive financially, especially if some of the capital and operating funds can come from foundation or private sources.

4.3.9 LAND USE AND PRESERVATION

The ponds are one of the most visual reminders of ancient Hawaiian culture and when restored they can also serve as operational examples of a community's relationship to the land and the sea. On a long-term basis fishponds are of enormous value to the State of Hawaii and their long-term value is likely far greater than has previously been estimated (i.e., when ponds were filled in or developed for non-traditional uses). Because of these values, all ponds (public or private) should be preserved and eventually restored. In some ways, the public/private distinction is somewhat artificial because the traditional use of ponds did not include a conceptual basis of private property, and the pond builders, operators, and beneficiaries transcended the physical boundaries associated with present land ownership. In this sense, the current regulatory climate which is intended to provide a legal basis for historic preservation, as well as for other modern community values (e.g., public access, rare and threatened species, etc.) does not serve the specific goal of pond preservation well. Because of this regulatory context, the following changes should be considered: 1) obtaining a broad general permit (from the ACOE) for a large number of ponds to initiate restoration; and 2) sponsoring legislation or administrative rule changes at the national level to designate Hawaiian fishponds as exempt from ACOE regulation, as are cranberry bogs and other unusual uses now so excluded.

4.4 HONOULIWAI FISHTRAP

4.4.1 ORGANIZATION

As envisioned by the Task Force, Honouliwai would be restored and operated by an *'ohana* of persons residing adjacent to the pond and within or nearby its *ahupua'a*[2]. This organizational model is based on an understanding of the traditional social and cultural influences which shaped the operation of fishponds in ancient times, and evolved through Task Force interaction with community members. This traditional model should be successful because it relies on investment by the fishpond community in its restoration and operation. The investment may not be in cash, but rather in kind (labor). The *'ohana* would operate the pond for their own subsistence. If the pond produces a

[2] Land division extending inland from the sea.

surplus, it could be bartered or sold to obtain cash for supplies, equipment, or services, such as those proposed to be offered by the Moloka'i Fishpond Commission.

4.4.2 OPERATION AND MAINTENANCE

Honouliwai, because of its original design as a fishtrap, should probably be operated as such. One technique described by nearby residents is to entice reef fish such as *weke* into the trap by regular feedings. Then when fish are accustomed to entering the trap, the opening might be closed, and some of the fish caught. This is probably typical of the way the fishtrap was operated in ancient times. It is very unlikely that Honouliwai was operated as a nursery pond because the walls constructed of large stone would have voids through which small fish could escape, or predators might enter. Requirements for routine maintenance for Honouliwai are probably minimal because it does not silt up and mangroves have not established themselves. However, there will be unscheduled maintenance required (perhaps annually, or less frequently) as a result of potential damage to the wall from storm wave or tsunami events. As evidenced by its deteriorated condition, the wall, being positioned near the reef's edge is subject to damage through high wave action. The discussion on restoration has suggested some construction methods (use of largest possible armor stone on ocean side of wall, and increased slope of walls on both sides) to reduce damage caused by storm wave, and to some extent, tsunami events.

4.4.3 LEGAL FORM

The Task Force has suggested that the pond be operated under a revocable permit. This means the *'ohana* could obtain such a permit directly from DLNR. This is an appropriate method of obtaining the use rights to the pond, at minimal cost to the government or to the *'ohana.*

4.5 KAHINAPOHAKU FISHPOND

4.5.1 ORGANIZATION

As envisioned by the Task Force, Kahinapohaku would be restored and operated by an *'ohana* of persons residing adjacent to the pond and within or nearby its *ahupua'a.* This organizational model is based on an understanding of the traditional social and cultural influences which shaped the operation of fishponds in ancient times, and evolved through Task Force interaction with community members. This traditional model should be successful because it relies on investment by the fishpond community in its restoration and operation. The investment may not be in cash, but rather in kind (labor). The *'ohana* would operate the pond for their own subsistence. If the pond produces a surplus, it could be bartered or sold to obtain cash for supplies, equipment, or services, such as those proposed to be offered by the Moloka'i Fishpond Commission.

4.5.2 OPERATION AND MAINTENANCE

Kahinapohaku offers possibly three distinct alternatives for operation: 1) production of stocked mullet and milkfish; 2) production of stocked fish, shellfish, and seaweed; and 3) production of stocked *moi.* Requirements for routine maintenance for Kahinapohaku are likely to be minimal because the pond does not silt-up and mangroves do not establish themselves. However, there will be unscheduled maintenance required (perhaps annually, or less frequently) as a result of potential damage to the wall from storm wave or tsunami events. As evidenced by its deteriorated condition, the wall, being

positioned near the reef's edge, is subject to damage through high wave action. The discussion on restoration has suggested some construction methods (use of largest possible armor stone on ocean side of wall, and increased slope of walls on both sides) to reduce damage caused by storm wave, and to some extent, tsunami events.

4.5.3 LEGAL FORM

The Task Force has suggested that the pond be operated under a revocable permit. By this means the *'ohana* could obtain such a permit directly from DLNR. This is an appropriate method of obtaining the use rights to the pond, at minimal cost to the government or to the *'ohana*.

SECTION 5

ENVIRONMENTAL ASSESSMENTS

SECTION 5
ENVIRONMENTAL ASSESSMENTS

This project has as its primary objective the facilitation of permit acquisition for fishpond restoration on Moloka'i. As part of this objective, environmental assessments (EAs) for each of the two demonstration ponds, Honouliwai and Kahinapohaku, were prepared in support of the applications for Section 404 permits from the ACOE. In order to complete the EAs, baseline marine environmental surveys and archaeological surveys of both ponds were conducted.

The two EAs describe the proposed restorations; the existing physical, biological, and archaeological conditions on both project sites; and the anticipated impacts of the proposed actions. Both EAs establish that the restorations at Honouliwai and Kahinapohaku, as proposed, will not adversely impact the physical environment; that they will not endanger wetlands, sensitive species, or other biological elements at either site; and that restoration will in fact enhance the cultural values of archaeological resources at both sites. The EAs go on to point out support for the proposed actions on the part of the Task Force, its cultural committee, and other interested parties within the Moloka'i community, as well as general consistency with other accepted Hawaii State land use and management plans.

Since these EAs serve a specific function beyond inclusion in the project report, they are being submitted as separate accompanying documents. The baseline marine environmental surveys and archaeological surveys, in turn, are incorporated as appendices in the EA documents.

SECTION 6

PERMIT SIMPLICICATION RECOMMENDATIONS AND MASTER PERMIT APPLICATIONS

SECTION 6
PERMIT SIMPLIFICATION RECOMMENDATIONS AND MASTER PERMIT APPLICATIONS

6.1 DRAFT RECOMMENDATIONS FOR SIMPLIFYING RESTORATION OF MOLOKA'I FISHPONDS

6.1.1 PROPOSED CONSERVATION DISTRICT MASTER PERMIT

A total of 69 candidate fishponds on Moloka'i have been examined and classified according to their suitability for low-key, community-based, traditional fishpond restoration.[1] Thirty-eight ponds have been identified for inclusion in a master Conservation District Use permit.[2] Twenty-nine ponds will require further study. For these ponds, individual permit applications from both the State of Hawaii and the ACOE will likely be required. Further discussion of criteria for selection of the ponds to be included under the master and general permits is provided in Section 7 of this report, and the draft Conservation District Use Application (CDUA) and draft EA submitted separately.

Only 16 of the 38 selected ponds are owned by the State. One pond is owned by Hawaiian Home Lands and the other 21 ponds are privately owned. Owners of these ponds should be contacted to see if they are interested in restoring their ponds (if so, they would be included in the master CDUA). If the owners are not interested in restoration, the ponds should then be deleted from the draft master permit application.

DLNR's ADP appears to be the logical applicant for the master CDUA. Regulatory agencies and Moloka'i community groups should be encouraged to review both the draft master CDUA and the draft EA.[3] An important part of this review will be to gain consensus on the selection of the ponds suitable for the "jump start" approach as opposed to those which fall into the "further study" category. Additional ponds could be included with, or more likely, deleted from the application as a result of the review process. Another important part of the review process is to encourage the regulatory and reviewing agencies[4] to "sign off" on the process so as to avoid future delays.

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[1] Section 7.6.4 provides a full discussion and consideration of the evaluation process and its limitations. Since the data employed in the analysis are not complete, the results presented here should be considered preliminary.

[2] The 38 ponds were selected on the basis of a cumulative "COE" rating (see Exhibit 7.5) of 2.0 or greater. The two demonstration ponds, although falling within this range, are not included in the master CDUA, since the permit process for these is already underway.

[3] The action that would trigger the preparation of an EA is ADP's application for a general Conservation District Use permit.

[4] Especially the Department of Health (DOH) Clean Water Branch, responsible for issuing water quality certification and Maui County Planning Commission, for issuing Special Management Area (SMA) permits.

A formal public hearing should be held on the application to allow fish grown in the restored ponds to be sold for profit (a public hearing is required for any "commercial" use in the Conservation District).

6.1.2 PROPOSED ACOE GENERAL PERMIT

The 38 ponds eligible for the master Conservation District Use permit will also be eligible for an ACOE general permit. The EA (and possibly a State Environmental Impact Statement [EIS]) prepared for the CDUA can also be used to support the application for the ACOE general permit.

The DLNR will be the applicant for the ACOE general permit. The ACOE will consider the State EA or EIS in preparing their EA and will make the determination requiring the preparation of a full Federal EIS. Should a Federal EIS be required, the ACOE will prepare this document.

6.1.3 RESTORATION PROCESS

Once the master and general permits are issued by the DLNR and the ACOE, the only remaining requirement would be a letter of intent and restoration plan that describe the proposed activity and restoration methods to be used. The plan should be approved by the State Historic Preservation Division (SHPD). As long as the proposed action does not vary from the permits and the plan of action is approved by the SHPD, concurrence from the Office of Conservation and Environmental Affairs (OCEA) and ACOE would complete the approval process. The letters of intent could be processed through the proposed Moloka'i Fishpond Commission (Section 4.2.2) and then forwarded to the ADP for transmittal to the SHPD, OCEA, and ACOE. This would provide interested parties with an opportunity to review the proposed work to ensure that it is in compliance with the master permit.

The master and general permits for fishpond restoration on Moloka'i could be used as a model for other islands, or could be amended to add other fishponds on other islands which met similar selection criteria.

6.1.4 OTHER MOLOKA'I FISHPONDS

Ponds not included in the general permit would be handled in the existing manner. For State-owned ponds, the ADP would apply for the CDUA and ACOE permits and individuals would apply for permits for privately owned ponds.

The proposed Moloka'i Fishpond Commission (Section 4) could also advise the ADP on appropriate permit conditions for the ponds that require separate permit applications.

It should be stressed that the draft CDUA and EA being provided are intended as models, and are not ready for submittal in their present form. Adjustments to the list of fishponds to be covered by a master Conservation District Use permit will no doubt be required.[5]

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[5] The fishpond list was originally prepared as a "surrogate" master plan for fishpond restoration in order to satisfy the requirement of the U.S. Army Corps of Engineers (ACOE) that a generic Corps permit for fishpond restoration could be issued if there was a master plan of some sort (voiced

Adjustments to the list of included ponds may be based on one or more of the following considerations (among others):

- Lack of interest by owners of private fishponds in restoring their ponds
- Updated information on pond condition obtained through new field surveys or aerial photographs
- Acquisition of permits for restoration of certain ponds either being sought or already accomplished through avenues other than a master CDUA.

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during an interview with Mr. Mike Lee, Chief, Operations Branch, ACOE, Ft. Shafter, Hawaii, 8 October 1992). After evaluation of this requirement, the contractor, in consultation with ADP, undertook to prepare a computerized database of Molokai's fishponds in order to ascertain the potential for priority ranking of fishponds for restoration. Given ACOE concerns that pond restoration would be more difficult to permit if the proposed actions involved mangroves; endangered species; wetlands; navigation features; the removal of extensive silt deposits; extensive public access and use; or, carry the possibility of causing erosion or accretion on nearby shorelines, an effort was made to screen ponds for these potential "permit" liabilities. The listed ponds have relatively fewer of these constraints associated with them, and seem unlikely to require preparation of an EIS which can be an expensive impediment to restoration.

As a result of this work, the contract-required "generic EA" was prepared in the format of an EA supporting the request of a General Conservation District Use Permit. Included in that EA is the "master" list of Moloka'i fishponds which appear to be eligible for permitted reconstruction without preparation of a detailed EIS. The EIS process, at both the Federal and State levels, could be both costly and time-consuming because of the probable need for detailed environmental measurements and investigations for each pond. Inclusion of this list of recommended ponds in the subject report does not preclude a decision to add or delete ponds from a formal application for a General CDUA, nor does it obligate ADP or the Task Force to proceed with a request for a General CDUA permit. The CDUA has been drafted in such a way that it can be used for individual pond applications if that should be the desire of the Task Force. However, it is the suggestion of the Consultant team that inclusion of the present master list (subject to public input via the normal CDUA public hearing process) in a request for a General CDUA is the most efficient method of rapidly enabling the restoration of approximately 40 ponds, and that the remaining ponds may be considered under auspices of the proposed Moloka'i Fishpond Commission (should that come into being) or by other means later. It is worth noting that the strategy to apply for and obtain an ACOE permit depends upon the successful application and granting of a General CDUA for the proposed "master" list of ponds. The Consultant team believes that the ACOE will look more favorably on a list of ponds "pre-approved" by the state in considering the granting of a permit. In this strategy, the Consultant team is attempting to set up a situation where the bare minimum of paperwork is needed to initiate restoration for the "master" list of ponds; presumably the process could be started with a letter to ADP or DLNR, statement of a restoration plan, and an inspection and approval by the Historic Preservation Division. This would be possible because the EA had basically been accepted at the time of approval of the General CDUA permit request.

SECTION 7

CONSULTANT "ADD-ONS"

SECTION 7
CONSULTANT ADD-ONS

7.1 INTRODUCTION

Certain additions beyond the requested scope of work were suggested in the Consultants' initial proposal to ADP. All of the add-on topics are broad and each could constitute a separate project spanning many months of original research effort. Because of the relatively short time frame and limited budgetary resources at hand, it was necessary to examine the available information and identify the most salient features for each topic area as they apply to fishpond restoration.

Community input gathered through review of minutes of meetings of the Task Force (Governor's Task Force on Moloka'i Fishpond Restoration 1992), responses to questionnaires, and participation in meetings with members of the Moloka'i community proved invaluable in this phase of the project. Interpreting broad issues in light of community opinion made it possible to narrow the focus for much of the discussion which follows.

7.2 MARKET FACTORS; SOCIOECONOMIC CONSIDERATIONS

General consideration is given to market factors and socioeconomic issues throughout other sections of this report. One theme which emerged as a result of feedback from the Moloka'i community is the overriding concern for the preservation of the unique cultural resources which the fishponds represent. Other concerns, including the potential for making the operation of fishponds a profitable enterprise, are subservient to it. In certain respects, the traditional preservation and operation of fishponds is in conflict with achievement of high productivity or profitability. Thus, the community will consider the project successful if the ponds are restored, even if they are not further developed into a resource from which substantial monetary gain can be achieved.

Additional information regarding marketing of specific products will be valuable in future operational planning for individual fishponds. The information which follows is presented to stimulate consideration of possible production and marketing strategies for Moloka'i's fishponds.

7.2.1 PRODUCTS

Traditionally-Utilized Fish Species

In addition to the more commonly cultured pond fish, such as mullet and milkfish, various species of pelagic and marine reef fish were used traditionally by ancient Hawaiians including: jacks (*ulua, papio*), barracuda (*kaku*), parrotfish (*uhu*), wrasse (*hinalea*), amber jack (*kahala*), convict tang (*manini*), goatfish (*kumu*), surgeonfish (*palani*), unicornfish (*kala*), moray eels (*puhi*), silver perch (*aholehole*), surmullets (*weke ula*), ten pounders (*awa-'aua*), bonefish, and ladyfish (*oi'o*). Most of these could be trapped or caught by throw-net.[1]

[1] Found at Honouliwai Fishtrap.

Marine algae or *limu* were also traditionally cultured by the ancient Hawaiians. *Limu manauea* or ogo (Gracilaria coronipifolia and G. bursapastoris) were the species most likely used for pond culture.

Non-Traditional Fishpond Products

Non-traditional products which could be raised in fishpond culture naturally fall into two distinct groups: those which are species native (indigenous or endemic) to Hawaii, but which were not traditionally cultured in ancient fishponds, and those which are neither native to Hawaii, nor were cultured in ancient fishponds.

Native Non-Traditional Products

Under this heading could be included many species of marine tropical fish used in the aquarium fish industry. The Florida ornamental aquarium fish industry is a $33 million per year business (mostly freshwater species). Marine species, being difficult to breed in confined tanks, command higher prices. In the future, legislation will prohibit the collection of reef fish for aquaria.

The following is a list of popular marine tropical fish collected in Hawaii and their export prices (Van Poolen and Obara 1984):

Common Name	Scientific Name	Price Each
Yellow tang	Zebrasoma flavescens	$ 2.15
Long-nose butterfly	Forcipger longirostris	
	F. flavissimus	3.75
Potter's angel	Centropyge potteri	3.75
Achilles tang	Acanthurus achilles	6.50
Clown tang	Naso lituratus	4.50
Four-spot butterfly	Chaetodon unimaculatus	3.50
One-spot butterfly	Chaetodon unimaculatus	3.50
Many-banded butterfly	Chaetodon multicinctus	3.50
Moorish idol	Zanclus cornutus	
	Z. canescens	4.00

Other native but non-traditional species which could be considered include two species of shrimp. One, the Hawaiian shrimp (Penaeus marginatus) has potential use as a food crop. A second, the Grass shrimp (Palaemonetes sp.; *'opae huna*) could be used for bait.

Non-Native and Non-Traditional Products

In this category fall other commercially-raised shrimp such as White shrimp (Penaeus vannamei). Other invertebrates such as the Japanese oyster (Crassostraea gigas) and Manila clam (Tapes sp.) could also be grown in pond culture. Eucheuma sp., a type of seaweed used for production of carrageenan, and introduced into Kaneohe Bay in the 1970s, could be grown in ponds, but it is

unlikely that, given world prices of roughly $200 per dry ton, it could be a commercially viable crop in Hawaii (W. Magruder, personal communication)[2].

Generally, the culturing of non-traditional products in Moloka'i's fishponds is regarded as less desirable than culturing of traditional products. Besides the obvious issue of going against traditional values, in the case of culturing non-native non-traditional species, a further problem is introduced. This relates to the potential adverse environmental impacts of accidental introduction of exotic species into fragile coastal or estuarine environments.

7.2.2 TARGET MARKETS FOR LOCALLY CULTURED FISHPOND SEAFOOD

Potential markets and clients for fishpond products are diverse; market information presented here includes general information for the State of Hawaii, as well as a specific case study on Orca Sea Farms on Moloka'i.

Statewide Seafood Marketing Information

Results of a recent survey by East West Research Institute (EWRI) on seafood consumption in Hawaii (EWRI 1989) are provided in Exhibit 7.1. As indicated in this exhibit, shrimp is still the most favored species in the home (19 percent) and in restaurants (25 percent). *Mahimahi* is second, 14 percent at home, 17 percent in restaurants. Other species of fish eaten included mullet (greater than 0.5 percent at home).

The survey estimated that Hawaii's resident home consumption accounted for 73 percent of all seafood consumed in Hawaii, whereas restaurants accounted for 27 percent. Culturally, Caucasians and Japanese are the predominant consumer groups. Heaviest consumption at home is by individuals older than 55, with annual incomes between $40,000 to $59,000. The EWRI report estimated the size of the seafood market for Hawaii's residents to be 28.5 million pounds/year (lbs/yr).

Based on the 1987 survey, the estimated resident seafood per capita consumption is 26.8 lbs, twice the national average of 14.7 lbs as reported by the National Marine Fisheries Service (NMFS 1987).

Exhibits 7.2 through 7.4 show, consecutively, commercial fishpond production figures for Oahu, and for the Big Island, and recent market prices for fresh fish in Hilo.

Case Study -- Orca Sea Farms 1986 Marketing Activities

On Moloka'i, 2.5-pound bags of fresh shrimp (head-on) were sold by the roadside in Kaunakakai. The most shrimp sold in one day was about 500 lbs (36 to 40, 31 to 35 headless class), and the best customers were pineapple plantation workers.

As one single pond could yield a total of 2400 lbs of shrimp, the excess was sold to various outer island and mainland clients (see preceding list). Shrimp was packed in 40-pound sky-pack cartons and shipped by air to the various destination points.

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[2] Dr. Magruder is a phycologist at Bernice P. Bishop Museum.

EXHIBIT 7.1
POPULARITY OF SEAFOOD SPECIES
IN HAWAII HOUSEHOLDS (1987)

TYPE OF SEAFOOD LAST EATEN	HOME %	RESTAURANT %
Shrimp	19	25
Mahimahi	14	17
Tuna (yellowfin, bigeye albacore)	11	3
Tuna (skipjack)	9	0
Crab	4	3
Fish (Unspecified)	6	3
20 Other Species	1 to 3	1 to 4

EXHIBIT 7.2
COMMERCIAL FISHPOND PRODUCTION, ISLAND OF OAHU 1982-1991

Year	MULLET			AHOLEHOLE			MILKFISH		
	Lbs sold	Value $	Ave value/lb	Lbs sold	Value $	Ave value/lb	Lbs sold	Value $	Ave value/lb
1982	1,487	$4,422	$2.97	227	$250	$1.10	1,003	$1,848	$1.84
1983	1,441	$4,975	$3.45	189	$322	$1.70	1,990	$2,720	$1.37
1984	1,439	$5,358	$3.72	203	$591	$2.91	1,821	$2,305	$1.27
1985	35	$101	$2.89	36	$40	$1.12	267	$334	$1.25
1986	126	$422	$3.35	327	$597	$1.82	368	$511	$1.39
1987	5	$15	$3.00	675	$1,623	$2.40	475	$675	$1.42
1988	556	$1,927	$3.47	1,039	$1,894	$1.82	570	$1,063	$1.87
1989	1,161	$3,753	$3.23	680	$1,224	$1.80	1,522	$2,462	$1.62
1990	395	$1,265	$3.20	197	$356	$1.81	1,903	$3,470	$1.82
1991	10	$50	$2.75	95	$180	$1.90	2,939	$5,294	$1.80
TOTAL	6,655	$22,288	$3.35	3,668	$7,076	$1.93	6,934	$12,289	$1.77

Source: Statistical Unit, Division of Aquatic Resources, Hawaii State Department of Land and Natural Resources (1992).

EXHIBIT 7.3
COMMERCIAL FISHPOND PRODUCTION, ISLAND OF HAWAII 1982-1991

	MULLET			AHOLEHOLE			MILKFISH		
Year	Lbs sold	Value $	Ave value/lb	Lbs sold	Value $	Ave value/lb	Lbs sold	Value $	Ave value/lb
1982	2,992	7963.4	2.66	97	290.5	2.99			
1983	1,825	4516.9	2.48						
1984	4,438	11532.1	2.6	52	156	3			
1985	6,437	16265.7	2.53	345	1033	2.99			
1986	1,783	5804.8	3.26	438	1341.6	3.06			
1987	1,680	5499.3	3.27	564	1558.4	2.76			
1988	218	789.2	3.62	18	32.9	1.83	233	463.4	1.99
1989	414	1747.6	4.22	184	699.1	3.8			
1990	400	1601.3	4	31	108.5	3.5			
1991	10	35	3.5				154	269.5	1.75
TOTAL	20,197	$55,755	$2.76	1,729	$5,220	$3.02	387	$733	$1.89

Source: Statistical Unit, Division of Aquatic Resources, Hawaii State Department of Land and Natural Resources (1992).

EXHIBIT 7.4
FRESH FISH MARKET PRICES, HILO - NOVEMBER 1992

FISH TYPE	WHOLESALE PRICE/LB	RETAIL PRICE/LB	COMMENTS
Mullet	$3.00	$4.50	fresh from Hilo ponds
Mullet	--	0.99	imported from Florida, frozen
Milkfish	--	2.49	imported frozen from Philippines
Moi	6.00-7.00	9.20-10.70	bag limit 15/person
Tilapia	3.50	5.00	black or red types
Aholehole	4.00	6.15	"yellow belly" preferred
Weke	1.25-1.50	1.92-2.30	from Hilo only, not Kona
Manini	2.50-3.00	3.85-4.62	over 4 inches
Palani	1.00-1.25	1.54-1.92	
Lae or Oio	1.00	1.50	

Depending on the harvest schedule, a pond was typically brought down in the early hours of the morning when the temperatures were coldest. By 9 a.m., all shrimp were harvested and placed directly into an ice slurry where they were then washed, sorted (to eliminate all non-shrimp products), bagged according to size, and stored in insulated cooler boxes on trucks. With only one store on Moloka'i selling ice, orders for ice were placed well in advance during harvesting.

Moloka'i currently has three hotels with restaurants where fishpond-produced seafood could likely be served. However, most chefs would be reluctant to list a specific seafood item as a fixed menu offering unless a consistent supply from the seafood grower or producer was assured. It is unlikely that one or two ponds producing 300 lbs/acre per year would generate a sufficient supply of seafood to be featured on menus as "fresh fish specials". An alternative sales approach that has realized recent success is the roadside sale of freshly harvested products like corn and watermelon. Seafood products from smaller production ponds could also be sold in this manner.

Most tourists who visit Hawaii prefer to eat fresh, locally caught, fish. Because of its superior taste, appearance, and overall quality, fresh fish will command a higher price in the market. The most logical target market for the Moloka'i-based fishpond producers would be the island of Maui which has a resident population of over 100,000 and a higher visitor profile than does Moloka'i.

Moloka'i seafood producers should attempt to sell directly to the end customer and avoid the middleman or wholesaler. To illustrate this point, Orca Sea Farms sold shrimp to Tamashiro's market on Oahu at $5/pound; in turn, Tamashiro's featured these same shrimp at a special sale price to the public of $6.95/pound.

For the direct sales approach to be successful, a processing area would need to be established at either the pond or at some other location in Kaunakakai. As is to be expected, Board of Health sanitation regulations for seafood processing areas are stringent and the provision of stainless steel tables, wash-down areas, cement floors, etc., would need to be considered. Future fishpond operators on Moloka'i should also make certain that they have access to a sufficient supply of ice to facilitate the processing and delivery requirements for shrimp and other seafood products.

CLIENTS (Other than Retail):

Wholesalers:

- Tamashiro's (Hawaii)
- Jordan Bow (Hawaii)
- Monterey Fish (California)
- Flying Foods (California)
- Farallon Fish (California)

Hotels:

- Sheraton Molokai
- Hotel Molokai
- Sheraton Waikoloa
- Sheraton Waikiki
- Hyatt Regency

- Hyatt-Maui
- Maui Prince
- Kauai Hilton

Restaurants:

- Kapalua Bay (Maui)
- Kapalua Grill (Maui)
- Kimo's (Maui)
- Ming Yuen (Maui)
- Bay Club (Maui)
- El Crab Catcher (Kauai and Oahu)
- Plantation Gardens (Kauai)
- Molokai Yacht Club (Moloka'i)
- The Shrimp Shop (California)

7.2.3 A UNIQUE MARKETING OPPORTUNITY: THE NEED FOR A HATCHERY FACILITY FOR SELECTED POND-CULTURED SEEDSTOCK

A number of small streams and rivers empty into Kaneohe Bay on the windward coast of Oahu. The mouths of these small streams act as natural shelters and feeding grounds which juvenile fish frequent before they begin their migration out to sea. Moloka'i's south eastern shoreline is fed with intermittent streams; there are no large river estuaries or bays where juvenile mullet could be collected. Thus there is a need on Moloka'i for increasing the hatchery capacity along this shoreline.

As more fishponds are developed on Moloka'i, growers will become more dependent upon a hatchery as the source of their fry stock. Unfortunately, the quality of purchased fry stock cannot be guaranteed, whereas wild caught fry is usually of hardier stock in that it has undergone a natural selection process through which it has adapted well to local environmental conditions. In the hatchery, fish hormones are used to induce female broodstock to artificially breed in captivity to spawn their eggs. Survival rates (to one inch fry size) in the grey mullet in Hawaii remains around 30 percent after 20 years of research efforts.

One facility capable of supplying grey mullet or milkfish fry is the Oceanic Institute (the OI) on Oahu. While the OI fish hatchery predominantly supplies seed stock for research purposes, it also produces juvenile mullet for the "Stock Enhancement of Marine Fish in the State of Hawaii" (SEMFISH) program at Hilo Bay on the Big Island and at Manalua Bay on Oahu's south shore. The OI's annual mullet fry production for selected commercial operators is between 1 to 2 million (G. Karr, personal communication[3]). Other potential hatchery sources include the Hawaii Institute of Marine Biology at Coconut Island or the Anuenue Fisheries Research Center at Sand Island.

The obvious choice of fish for pond culture in Hawaii is the grey mullet (Mugil cephalus). The technology for breeding this fish in captivity is available although improved feeding techniques will be required to increase larval survival in the hatchery. A second choice for pond fish culture in Hawaii is the milkfish (Chanos chanos) which is a more difficult fish to spawn in captivity. Adults

[3] Mr. Karr is Training Coordinator for the Oceanic Institute.

do not sexually mature until age 4 to 5 and the success of spawning captive broodstock animals has long proved inconsistent. A third potential target fish is the *moi* (Polydactylus sexfilis) whose high demand locally will command a higher market price than the other two fish. Spawning of adults and larval rearing of this species was first achieved by Dr. Robert May in 1973 at Hawaii Institute of Marine Biology (HIMB). Fish obtained from floating cages displayed spontaneous spawning and juveniles reared in captivity were conditioned to feed on dry artificial rations. Measurements in cages showed that marketable fish of 300 grams (gm) could be produced from 9 gm fry in 300 days. Further growth studies on *moi* were conducted at Coconut Island (Szyper et al. 1991) which determined that faster growth rates in pens occurred by feeding fresh fish twice daily.

Some pond growers are experimenting with cage culture of tilapia (M. Brooks, personal communication[4]). This fish is relatively easy to breed and does not require a sophisticated hatchery system. Encouraging results have also been achieved in spawning the Serrated swimming crab (Samoan crab; Scylla serrata).

Molokai Sea Farms owns and operates a commercial shrimp hatchery on Moloka'i from which shrimp post-larvae could be supplied to stock experimental pens within ponds on a limited basis. This commercial hatchery could also be adapted for larval fish rearing; however, as this is a privately owned hatchery, negotiation with Molokai Sea Farms would need to be undertaken.

As the number of restored and operational fishponds on Moloka'i increases, the next logical step would be the establishment of a fish hatchery on Moloka'i. This hatchery could be designed as a multi-purpose facility for spawning and larval rearing of a variety of fish, shellfish, or crustacea. A feasibility study to identify the ideal location for this hatchery would be initiated and candidate locations might include either the extreme eastern or western points of the south shore, or other locations away from any influence of freshwater run-off. Technical experts will be needed to operate the hatchery. In that there are no known experts currently on Moloka'i, reliable and experienced consultants would need to identified and hired from other locations. Justification for a hatchery would be based on the quantity of fry needed to stock the fishponds. This is an unknown factor at this time as the number of fishponds designated for restoration has not yet been determined.

7.3 ARCHAEOLOGICAL CONSTRAINTS

The goal of attendees at the Moloka'i community workshop on 18 November 1992 was to restore all fishponds on Moloka'i so that they could be observed, understood, and used as part of Moloka'i's native Hawaiian heritage.

The Historic Preservation Division, DLNR, is the primary agent for the determination of appropriate restoration plans for historical sites or resources. A representative of this office has participated with the Task Force, and has also accompanied the Consultants' expert archaeologist on inspections of the two demonstration ponds. The proposed restoration plans are in accordance with their findings.

[4]Mr. Brooks leases Heeia Fishpond in Kaneohe, Oahu.

Proposed restoration plans for any fishpond must be approved by the Historic Preservation Division. Critical elements of proposed restoration plans include the following guidelines:

- Restoration should retain the essential characteristics of the fishpond's physical structures, such as the alignment of the wall, the type of materials used, and the basic dimensions and cross-sectional profiles
- The process of restoration should not damage the targeted historical resource, or other historical resources onsite
- The operation of the ponds should not detract from their historical and cultural significance

In many cases, precise wall dimensions such as width, height, or slope cannot be determined from the remains at the site. This is the case at the two demonstration ponds; typical sections from other walls, evidence available onsite, and the probable original operational methods of the ponds were all considered in developing the proposed reconstruction plans. By interpreting and applying available archaeological information in this manner, a procedure for pond restoration is developed which achieves structural and operational soundness, while giving due consideration to the unique cultural and historical significance of the fishponds.

7.4 REGULATORY UPDATES

Detailed information about aquaculture- and fishpond-related regulations is provided in Section 2 and the accompanying guide entitled: "*Permits and Regulatory Requirements for Aquaculture in Hawaii*". Updates for two regulations, one recently enacted and the other still pending, may have specific implications for fishpond restoration, and are discussed below.

7.4.1 SECTION 404 -- CLEAN WATER ACT UPDATE

Under Section 404 of the Clean Water Act, the ACOE currently regulates activities involved with the discharge (filling) of material mechanically deposited into wetlands, coastal areas, and other "waters of the United States". According to proposed regulations published by ACOE and the U.S. Environmental Protection Agency (EPA) on 16 June 1992, the ACOE may also be given the responsibility and authority to regulate dredging under the Section 404 regulations. Specifically, the cited publication states that mechanized landclearing, ditching, channelization, or other excavation activities within waters of the United States would require a 404 permit, even if the excavated material were not deposited within a water of the United States but taken to an upland site for disposal. This change in authority, if effected, will have serious implications for fishpond restoration activities on Moloka'i. This is particularly true in light of the fact that many ponds on Moloka'i, having been filled with silt washed down from upland areas, would require dredging of the thick overburden of sediment in order to be restored.

7.4.2 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PROGRAM

Under this program, the State of Hawaii adopted new permitting procedures which regulate the discharge of stormwater runoff into receiving coastal waters as of 1 October 1992. In Hawaii, permitting for stormwater discharge is the responsibility of the Clean Water Branch of the DOH. Depending on the types of activities undertaken and the types of discharges generated, an NPDES

permit may be required for the restoration and operation of a fishpond. For instance, on-land construction activities or on-land "dewatering" of dredged materials associated with fishpond restoration may cause the discharge of effluents which are regulated under NPDES. In general, however, since fishponds are already located in "receiving waters", NPDES regulations would more likely apply to offsite activities which could affect water quality within the ponds, rather than activities occurring within the ponds themselves.

7.5 CRITERIA FOR CLASSIFICATION OF MOLOKA'I FISHPONDS

A wide spectrum of factors affect the "restorability" of ancient Hawaiian fishponds on Moloka'i. These range from obvious considerations of cost, to less-known concerns such as those relating to regulation of "navigational servitude" of fishponds. Many factors are interrelated, e.g., the fact that a fishpond is heavily silted (an environmental consideration) leads to a much higher cost (an economic factor) for restoration. Ideally, evaluation of fishponds on the basis of the most important criteria leads to a natural ranking of the relative ease with which they could be restored. Attention should also be given to the specific limitations which exist under the current regulatory framework.[5] Following are brief descriptions for each criterion.

7.5.1 ENVIRONMENTAL FACTORS

Mangroves

While mangroves are non-native plants in Hawaii, their presence in coastal areas of the State constitutes a natural resource recognized and regulated by the Federal government. Because of this, the presence of mangroves overgrowing fishponds which have fallen into disuse presents an obstacle to fishpond restoration.

Endangered Species

As protected by the Endangered Species Act, presence of any endangered species on a potential site for fishpond restoration would hinder the restoration process. Possible endangered species most likely to be associated with fishpond sites on Moloka'i include: the Hawaiian stilt ('ae'o; Himantopus mexicanus), the Hawaiian coot ('alae ke'oke'o; Fulica alai), and the Hawaiian gallinule ('alae'ula; Gallinula chloropus).

Siltation

Moloka'i's coastal waters are subject to the heaviest siltation found anywhere in the State. As a result, many fishponds are silted over, often to depths of several feet. The presence of heavy silt

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[5] It must be emphasized that the purpose of establishing this hierarchy is to address the question of restoration of fishponds as it could be accomplished under **the present existing regulatory framework**. Other factors take on added significance, and thus, other scenarios for restoration become possible, if the regulatory framework is changed. This could occur, for instance, if a sovereign Hawaiian nation were to be established. Community concern regarding Hawaiian sovereignty was raised during the public meeting of 18 November 1992.

poses significant problems for restoration: how is the silt to be removed, where should it be disposed of, what are the costs involved, etc.

Coastal Drift

This refers to the phenomenon whereby patterns of water circulation, altered through fishpond restoration, cause changes in the deposition of sand to, or erosion of sand from, the shoreline downcurrent from the restoration site. Drastic changes in shoreline configuration may cause equally drastic changes in the patterns of sediment deposition which occur.

7.5.2 REGULATORY FACTORS

Navigational Servitude

As is the case with most fishponds on Moloka'i which have fallen into disuse, the walls of the pond may be breached by the ocean. This may lead to the pond basin being used as a navigation channel for fishermen or other boaters. Navigation rights become an issue when the open waters of an abandoned fishpond are subsequently isolated by the building of restored walls, thus excluding that area from navigational use.

Water Quality

Not only is water quality of concern insofar as it impacts the potential operational success of a fishpond, but the effluent water generated by operation of the pond and entering the adjacent "receiving waters", or water body where the pond is located, may impact water quality. The DOH is charged with regulating and enforcing such water quality standards throughout the State.

Archaeology

While one of the objectives of pond restoration is to preserve the cultural and archaeological significance of ancient Hawaiian fishponds, it is crucial that, in the process, such restoration does not obliterate the very cultural resources which it sets out to save. Damage to, or destruction of, archaeological resources is minimized through close coordination with trained archaeologists and the Historic Preservation Division in identifying unique resources at each site, and determining the restoration methods most appropriate for each pond.

Wetlands and Special Aquatic Sites

As breeding, rearing, and feeding grounds for many species of fish and wildlife, wetlands are recognized by the federal government as a unique and protected natural resource. Wetlands are lands which are at least periodically saturated with water. In addition to wetlands, other habitats are recognized as special aquatic sites; they include, among other types of habitats or ecosystems, coral reefs, mangrove swamps, mudflats, and tidepools. The presence of any of these recognized wetland habitats on a fishpond site potentially presents regulatory obstacles to restoration.

7.5.3 SOCIOECONOMIC FACTORS

Construction/Material/Labor Costs

Virtually all of the preceding factors may potentially impact the costs of restoration of fishponds. In addition, variation will occur as to the availability of materials at or near the site, as well as the availability and costs of labor. Finally, cost of restoration is directly tied to the size of the site being restored. All other factors being equal, a pond having smaller basin area or walls of shorter length, will be easier and less costly to restore than a larger pond with a more extensive basin and longer walls.

Need for Heavy Equipment

The use of heavy equipment may be controversial for certain projects, such as fishpond restoration, which seek to maintain traditional values. However, the Moloka'i community, while favoring traditional restoration methods as far as they can be used, has expressed a willingness to utilize heavy equipment for fishpond restoration as necessary. The community recognizes that in most cases, this is the only practicable means by which restoration will succeed. However, this criterion is still useful in assessing relative ease of restoration, since ponds requiring use of more equipment will, at the very least, be more costly than ponds not requiring as much use of heavy equipment.

Community Support

While the Moloka'i community generally favors restoration of **all** ponds, there is stronger support for the restoration of certain ponds over others. For example, strong support may be the result of a specific *'ohana* wanting to restore its traditional fishpond for use in subsistence fishing. Lack of support, on the other hand, may be the result of the pond being privately owned or otherwise inaccessible to the public. The level of community support (if known) is an important factor which will help to determine which ponds stand the best chance of being successfully restored.

Property Ownership

Public ownership of fishponds appears to be a key criterion for public restoration of fishponds. Private restoration of privately owned fishponds may also occur, provided that it is carried out within an administrative framework which protects the cultural integrity of the ponds.

Coastal Access

Some publicly owned ponds do not have overland rights-of-way, although they may be approached from the sea or along the shoreline below the vegetation line. Usually, access rights can be obtained from owners of abutting private lands either through easements, or, ultimately through condemnation if the need is sufficiently urgent.

Pond Productivity Potential

While the primary impetus for fishpond restoration on Moloka'i is the desire to see a resource of historical and traditional significance preserved, an important secondary impetus is the prospect of having a restored pond operate as a viable, producing aquaculture facility. Due to the varied coastal

and water quality conditions which prevail at different sites, certain ponds offer greater productivity potential than others.

7.6 A RANKING HIERARCHY FOR MOLOKA'I FISHPONDS

The preceding section lays out in detail those factors which should be taken into consideration in order to establish a reliable system for ranking fishponds for their restoration potential. As a function of the limited time, budget, and scope of this project, not all these factors could be taken into account, since to investigate some of them would require considerable time and effort for original research. Of necessity, establishment of the hierarchy relied upon information which could be gathered from existing sources; these sources included aerial photographs (ACOE 1975), descriptions in the literature dealing with Hawaiian fishponds (DHM 1989; Estioko-Griffin 1987; Madden and Paulsen 1977; Apple and Kikuchi 1975; Summers 1971; Summers 1964), and, to a much lesser extent, site visits.

The methods employed in developing the hierarchy are described here; limitations of the analysis are discussed; the ranking of the ponds is provided in table form; and finally, conclusions and recommendations are presented. Complete data sheets for all fishponds evaluated are included in Appendix B. The compilation of information on Moloka'i fishponds proved to be useful in the formulation of master planning and master permitting strategies described in Section 6.

7.6.1 MATERIALS AND METHODS

Existing literature on the fishponds of Moloka'i was gathered and reviewed. Previous authors have attempted to establish various classifications which present a picture of the relative physical condition, production potential, or historical value of Hawaii's fishponds (DHM 1989; Estioko-Griffin 1987; Madden and Paulsen 1977; Apple and Kikuchi 1975; Summers 1971; Summers 1964). In the course of the literature review, it became apparent that not all of the criteria which might impact fishpond restoration have been researched and described. In addition, those references which emphasize certain aspects of fishpond condition, such as their productivity potential (Madden and Paulsen 1977) or archaeological value (Apple and Kikuchi 1975) do not cover all sites. The criteria which are most consistently described in the literature and available for analysis relate to the physical condition of the ponds. For the most part, these include the degree of siltation, degree of vegetation encroachment, and condition of pond walls. These features are also discernible in aerial photographs (ACOE 1975).

In attempting to organize data in a form which would permit the orderly ranking of Moloka'i's fishponds with respect to ease of restoration and permit acquisition, a decision was made to rely most heavily on an analysis of the aerial photos. This enabled the determination of physical condition of ponds, with a minimum of subjective interpretation. Some corroboration of information gained from observation of aerial photos was also obtained from written descriptions (Governor's Task Force on Moloka'i Fishpond Restoration 1992; DHM 1989; Estioko-Griffin 1987; Madden and Paulsen 1977; Summers 1971; Summers 1964). For each pond, siltation, vegetative cover, and wall condition were estimated and assigned a numeric value on a scale from 1 to 5, as follows:

- Silt: 1 = Pond covered over in silt (or silt and vegetation) to 5 = Minimal silt in pond

- Vegetation: 1 = Pond covered by vegetation (or vegetation and silt) to 5 = Pond basin and walls relatively free of encroaching vegetation

- Wall Condition: 1 = Walls not visible or covered by silt or vegetation to 5 = Walls pronounced, nearly intact

The three numbers were added and averaged to obtain a value reflective of the overall physical condition for the pond.

Other Criteria Considered

As explained above, ease of restoration is directly tied to pond acreage and pond wall length. These factors were therefore also considered in the analysis.

7.6.2 LIMITATIONS OF THE ANALYSIS

The accuracy of this analysis is limited by the fact that the aerial photographs on which data are based are outdated (taken in 1975). It is likely that, in the interim, significant changes have taken place on many, if not most, of the pond sites on Moloka'i. In addition, in the time allotted, detailed site visits were made only to the two project demonstration ponds. Interpretation of aerial photos without the benefit of "ground truthing" leaves considerable room for subjectivity. This analysis is therefore presented more as a model upon which an updated analysis could be based, rather than as a final decision-making tool.

7.6.3 RANKING OF PONDS FOR RESTORATION

Despite the limitations encountered and described above, the hierarchy constructed here provides some interesting information. Criteria employed in the analysis were prioritized in the following order: 1) numerical rating based on aerial photographs; 2) pond area; and 3) pond wall length. The results of the analysis are provided as Exhibit 7.5 and in Appendix B.

7.6.4 CONCLUSIONS AND RECOMMENDATIONS

The ultimate objective in ranking Moloka'i's fishponds in a hierarchy is to provide information as to the relative ease of restoration of the ponds. However, certain deficiencies in the data upon which the analysis are based make achievement of this goal difficult. The crucial obstacles encountered were: 1) lack of complete field surveys for all ponds, and 2) lack of up-to-date aerial photographs of fishpond sites. The following actions are therefore recommended:

1. Conduct comprehensive field surveys of all ponds. The surveys should encompass descriptions of:

- Physical condition

- Community support for, or opposition to, restoration of specific ponds

- Archaeological value

EXHIBIT 7.5
A RANKING HIERARCHY FOR MOLOKA'I FISHPONDS

Rank	GTF[1]	Fishpond Name	Site#[2]	TMK#	Ahupuaa	Owner	Rating COE[3]	Area Acres	Wall Length ft
1	**	Honouliwai	233	5-8-02:68	Honouliwai	State	3.5	0.6	360
2		Kaumanamana	77	5-1-02:4	Kaluako'i	Private	3.3	3	700
3		Kaoini	136A	5-4-03:23	Makakupaia	Private	3.3	9.3	1770
4		Kanoa	137	5-4-17:49	Kawela	Private	3.3	50	2860
5		'Ali'i	135	5-4-06:25	Makakupaia	HHL[4]	3.2	27	2700
6	*	--[5]	226B	5-7-01	Waialua	State	3	--	400
7	**	Kahinapohaku	228	5-8-01:2	Moanui	State	3	4	1100
8		Kaloko'iki	157	5-6-08:20	Wawaia	Private	3	6	1500
9		Kaina'ohe	160	5-6-05:22	Kaamola	Private	3	17	1770
10		Ka'opeahina	190	5-7-09:1	Kaluaaha	Private	3	19.7	1770
11		Kaloko'eli	133	5-4-02:14	Kamiloloa	State	3	28.2	2800
12		Keawanui	163	5-6-06:8	Kaamola	Private	3	54.5	2000
13		--	193	--	Kaluaaha	State	2.8	--	3025
14	*	--	--	5-7-03	Waialua	State	2.8	1.0?	500
15		Ualapu'e	185	5-6-01:1	Ualapue	State	2.8	22	1575
16		Naninaniku'eku'e	79	5-1-02:4	Kaluako'i	Private	2.8	22	2600
17		--	80	5-1-02:4	Kaluako'i	Private	2.8	23	--
18		Ni'aupala	192	5-7-07:8	Kaluaaha	Private	2.8	34	1975
19		--	156	5-6-09:	Wawaia	State	2.8	40	2990
20	*	'Ohalahala	231	5-8-01:3	Kumimi	State	2.7	1.5	--
21	*	Halemahana	184	5-6-03:35	Ualapue	State	2.7	3.3	725
22		Kula'alamihi	214	5-7-04:34	Honomuni	Private	2.7	4	--
23		Wehelau'ulu	170	--	Manawai	State	2.7	8	1770
24		Kaunahiko'oku	165	5-6-04:28	W. 'Ohi'a	Private	2.7	13	2000
25		Kanukuawa	148	5-5-01:12	Kapuaokoola	Private	2.7	29	2300
26		--	166	--	W. 'Ohi'a	State	2.5	8	--
27		Kawi'u	146	5-5-01:39	Makolelau	Private	2.5	12	1700
28		Kupeke	206	5-7-06:1	Kupeke	Private	2.5	34	2210
29		Panahaha	147	5-5-01:21	Makolelau	Private	2.5	36	3150
30		Waihilahila	213	5-7-06:27	Kailiula	Private	2.3	4	--
31		Kihaloko	212	5-7-06:22	Ahaino II	Private	2.3	5	--
32	*	Kalua'aha	188		Kaluaaha	State	2.3	13	2110
33		Mahilika	189	5-7-10:31	Kaluaaha	State	2.3	13.3	1760
34		Mikiawa	162	5-6-06:9	Kaamola	State	2.3	44	3100
35		-- (2ponds)	138	5-4-13	Kawela	State	2.2	--	1550
36		'Ipuka'iole	219	5-7-04:5	Kainalu	Private	2.2	3.2	590
37	*	Panahaha	202	5-7-07:22	Pukoo I	State	2.2	13.8	1600
38	*	Kainalu	220	5-7-04	Kainalu	State	2.2	19	2160
39	*	Pahiomu	149	5-5-01:10	Kapuakoolau and Keonokuino	State	2.2	20	1770
40		Pakanaka	97	5-1-02:4	Kaluako'i	Private	2.2	68.9	2000

EXHIBIT 7.5
A RANKING HIERARCHY FOR MOLOKA'I FISHPONDS
(continued)

Rank	GTF	Fishpond Name	Site#	TMK#	Ahupuaa	Owner	Rating COE	Area Acres	Wall Length ft
41		Hikauhi	78	5-1-02:4	Kaluako'i	Private	2	1.5	--
42		Kamahu'ehu'e	151	5-5-02:5	Kamalo	Private	1.8	37	3470
43		Nahiole	210	5-7-06:18	Ahaino I	State	1.7	1+	--
44		Puhaloa	179	5-6-04:25	Manawai	Private	1.7	6	1245
45		Papa'ili'ili	161	--	Kaamola	State	1.7	6.5	750
46		Kipapa	150	5-5-01:8	Keonokui'no	State	1.7	10	1371
47		Pipi'o	196	5-7-08:77	Mapulehu	Private	1.7	17	1156
48		Kalua'apuhi	104	5-2-11:25	Naiwa I	Private	1.5	19	--
49		Puko'o	203	5-7-07:21	Pukoo II	Private	1.3	25	2000
50		Kahokai	117	5-2-11:1	Kalamaula	HHL	1.2	20	--
51		Pa'ahao	105	5-2-11:25	Naiwa I	Private	1	--	--
52		--	205	--	Pukoo I	State	1	--	1225
53		Kamaloko	122	5-2-08	Kalamaula	HHL	1	0.9	--
54		Kapa'akea	132	5-4-03:9	Kapaakea	Private	1	5.45	--
55		Uluanui	145	5-5-01:31	Makolelau	Private	1	6.5	--
56		'O'o'ia	103	5-2-11:25	Kahanui I	Private	1	15	--
57		Kakaha'ia	143	5-4-01:5	Kawela	Federal	1	31	--
58		Paialoa	158	5-6-02:12	Puaahala	Private	1	35	2200
59		'Ohaipilo	118	5-2-11:1	Kalamaula	HHL	1	39	--
60		--	315	--	Halawa	Private	--	--	
61		'Umipa'a	119	--	Kalamaula	--	--	--	
62		Aipohaku	101A	--	Kahanui I	--		0.24	--
63		Kauha'a	101B	5-2-11	Kahanui I	--		0.52	--
64		Waiakea	101C	5-2-11:20	Kahanui I	State		1	--
65		--	120	5-2-9:11	Kalamaula	HHL		2	--
66		--	226?	5-7-03	Waialua			16+	--
67		Punalau	102	5-2-11:11	Kahanui I	Private	20	--	
68		--	98	5-1-01:2-4	Hoolehua	State/Private	38	--	
69		Pala'au	99	5-2-11:4	Palaau	HHL		500	6300

1. Indicates pond considered (*) or selected (**) for "jump-start" restoration by the Governor's Task Force on Moloka'i Fishpond Restoration.

2. Based on Summers (1971).

3. A composite rating based on degree of siltation, vegetative encroachment, and wall condition, as determined from aerial photographs (ACOE 1975); 1 = worst, 5 = best condition.

4. Hawaiian Home Lands.

5. -- = unknown

- Other potential regulatory or environmental constraints (e.g., navigational servitude, endangered species)

2. Implement a focused aerial photography survey of Moloka'i's fishponds. This would entail shooting regular color and infrared film at low altitude to produce photographs of sufficient detail so that features important in the context of pond restoration (walls and foundations, vegetation, substrate, etc.) are easily recognizable.

While some inaccuracies and subjectivity are to be expected in such an analysis, the information obtained is believed to be sufficiently reliable to form the basis for formulation of an initial CDUA general permit. Updated field surveys or aerial photography would provide the basis for revising or updating the CDUA as necessary.

SECTION 8

LIST OF AGENCIES, ORGANIZATIONS, AND INDIVIDUALS CONSULTED

SECTION 8
LIST OF AGENCIES, ORGANIZATIONS, AND INDIVIDUALS CONSULTED

8.1 CONSULTED PARTIES

The following agencies, organizations, and individuals were consulted during the preparation of this document:

- William Paty, Chair, Board of Land and Natural Resources
- John Corbin, Manager, Aquaculture Development Program
- Donna Hanaike, Deputy Director, Department of Land and Natural Resources
- Roger Evans, Chief, Office of Conservation and Environmental Affairs
- Steve Chang, Department of Health
- Annie Griffin, State Historic Preservation Division
- Billy Kalipi, Snr., Fishpond Restorer
- Stanley Halama, Member, *'ohana* of the Honouliwai *ahupua'a*
- Lance "Kip" Dunbar, Operator, 'Ipuka'iole Fishpond
- Members of the Governor's Task Force on Moloka'i Fishpond Restoration
- Members of the Cultural Committee (under the Governor's Task Force on Moloka'i Fishpond Restoration)

In addition to the above parties, our appreciation is also extended to certain interested members of the Moloka'i community: the 12 residents who participated in a 15 October 1992 Cultural Committee meeting; and the 19 residents who participated in the 18 November 1992 community meeting on Moloka'i.

The feedback received from each of the above listed individuals or groups has served to define the issues and shape the content of this draft EA.

SECTION 9

LIST OF PREPARERS

SECTION 9
LIST OF PREPARERS

The following firms or individuals were involved in the preparation of this environmental assessment:

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SECTION 10

LIST OF REFERENCES

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LIST OF REFERENCES

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APPENDIX A

MOLOKA'I COMMUNITY SURVEY MATERIALS

Exhibit A-1

Distribution List for Questionnaire and Meeting Notice

Adams, Cole
Adolpho, Kaeo
Adolpho, Mathew
Akutagawa, Katherine
Akutagawa, Myron
Akutagawa, William
Albino, Louella
Alcain, Robert
Aluli, Dr. Emmett
Anderson, Kathlen
Apple, Russ
Aquino, Dan
Bicoy, Fred
Bonk, Lyn
Brandt, Nani
Bryan, Janie
Caikin, Steve
Camara, Linda
Caparida, Judy & Cappy
Caparida, Lani
Castanira, Pauline
Castanira, Samuel
Coelho, Keala
Colon, Uilani
Crivello, Stacy
Curtis, Dorothy
De Freitas, Wendell
Dunbar, Kip
Dunbar, Leslie
Dunbar, Vera
Dunbar, William
Dunnam, Darlene
English, Sahoni
Enos-Ku, Rose Mae
Fairbanks, Keoni
Gabas, John
Glenn, Dr. Ed
Goodhue, Anna
Goodhue, Edward
Grambusch, Wilma
Halama, Stanley
Hamakua, Luana
Hodgins, Aka
Hodgins, Pearl
Holt, Karen
Hustace, Maria
Joy, Noelani
Kalilikane, John Jr.
Kalipi, Barbara
Kalipi, Billy Jr.
Kalipi, Billy Sr.
Kamakana, Rachel
Kaopuiki, Halona
Kapuni, Kupuna Lani
Kapuni, Zelda
Kaulia, George
Kaupu, Julie
Kawano, Pat
Kealoha, Sam
Keawe, Kupuna Minerva
Kee, Isaac Lin
Kennedy, Joe
Kim, Moke
Kina, Miles
Ku, Kupuna Clara
Lee, Jane
Lee, Wayde
Lenwai, Glen Kaleo
Lester, Kui & Kurt
Liku'a, Lyle
Logan, Dwayna
Lopes, Puanani
MacDonald, Virginia
Machado, Leslie
Mahiai, Kalani
Makiao, Henrietta
Mawae, James
Meyer, Wayne
Miranda, Edwin
Mowat, Karl
Naehu, Guy
Naki, Raymond
Naki, Walter
Napoleon, Sherman Jr.

Distribution List for Questionnaire and Meeting Notice
(continued)

Hanakahi, Vanda
Heen, Thomas
Helm, Adolph
Helm, Kupuna Mae
Pedro, Candace
Pedro, Edmund
Pedro, Leimomi
Pedro, Obay
Pedro, Samuel
Phifer, Russell
Place, Marie & Damien
PoePoe, Mac
Puailihau, Danny
Ramos, Kaipo
Rawlins, August
Reich, Joe
Ritte, Anne
Ritte, Walter & Lori
Santos, Joe
Napoleon, Sherman Sr.
Nip, Clifford
Pagsdale, Walter
Peabody, George
Sawyer, Richard
Schonely, Barbara
Schonely, Richard
Schonely, Stephen
Schonely, Yolanda
Seals, Charlotte
Shoemaker, Scott
Simms, Howard
Takamiya, Ted
Tanaka, Eddie
Tollefsen, Richard
Wescoatt, Wren
Wond, Edmund
Wond, Eleanor

Exhibit A-2

Agenda for November 18th Meeting

Governor's Task Force on Moloka'i Fishpond Restoration

Cultural, Historic and Community Committee

Meeting on the

Moloka'i Fishpond Study on Restoration and Use

November 18
Kalaiakamanu Hou Church
6:00 P.M.

1. Welcome, Introduction and Meeting Purpose

2. Status of the Fishpond Study

3. Results Of Questionnaire

4. Consultant Presentation Of Preliminary Recommendations

5. Discussion Of Recommendations

6. Understanding Of Agreements

7. Next Step

Exhibit A-3

List of People Who Signed the Attendance Sheet (*)

Governor's Task Force on Moloka'i Fishpond Restoration
Cultural, Historic & Community Committee
November 18, 1992

Adams, Cole
Adams, Scott
Ayase, Henry
Colon, Juanita N.
Colon, Nilani
Colon, Phyllis U. Jr.
Dunbar, Kip
Halama, S.K.
Hodgins, Pearl A.
Joy, Noelani
Kealoha, Sam
Machado, Colette Y.
Nalco, Ray K.
Phifer, Russel K.
Sabas, Clara B.
Satatareo, Pilipo
Takamiya, Ted K.

(*) A few meeting attendees did not sign the attendance sheet.

Exhibit A-4

Moloka'i Fishpond Study on Restoration and Use

Responses to Questionnaire

(Unless otherwise indicated, people were asked to make one selection per question.)

1. Of the total number of fishponds on Moloka'i, what portion should be restored and maintained as "traditional?"

57% **Fishponds should be restored and maintained traditionally only if this can be done economically and in a reasonable amount of time.**

25% Other

24% All of Moloka'i's fishponds should be restored and maintained traditionally.

0% None of the fishponds need to be restored and maintained traditionally.

2. How should a fishpond be restored?

61% **The original boundaries and design should be copied as much as possible. Changes in boundaries, design and materials can be made only if conditions in the environment make it necessary.**

18% It's okay to change the boundaries, design and materials of fishponds, as long as Moloka'i has more working fishponds.

14% Fishponds should be restored to their original boundaries and original design, with the same types of materials originally used.

12% Other

3. What construction methods are acceptable for fishpond restoration?

45% **It's okay to use modern heavy equipment, tools and techniques, providing appropriate regulations are followed.**

33% Only certain construction vehicles and tools should be allowed in fishpond restoration, and a list of allowable construction techniques should be followed.

14% Only manual labor and non-motorized tools should be allowed in restoring fishponds.

12% Other

4. Who should pay for the restoration of private fishponds?

49% **The restoration of private fishponds can be paid for by a combination of government funding, private monies and community-based help.**

18% Private businesses and private landowners should pay for the restoration of private fishponds.

14% Government funding should cover all expenses related to restoring private fishponds.

0% A community-based not-for-profit organization should pay for the restoration of private fishponds.

12% Other

5. How should privately-owned and government-funded restored fishponds be used?

65% **These fishponds should be used to feed their ohana and for commercial purposes.**

24% Other

10% These fishponds should be used for commercial purposes only.

2% These fishponds should only be used to feed its ohana.

6. Who should manage the State-owned fishponds?

51% **A community-based organization should produce a plan for managing all of Moloka'i's fishponds, and then select caretakers for each fishpond.**

24% On a case-by-case basis, the State should contract different ohana to be caretakers of the State fishponds.

18% State Department of Land and Natural Resources' employees should manage the fishponds.

12% Other

7. **Who should use the restored State fishponds?** *(Respondents were asked to make two choices.)*

53% **Both residents and commercial enterprises should be able to lease the State-owned fishponds.**

31% Any Moloka'i family should be able to lease a State fishpond for subsistence.

24% All native Hawaiians who practice native gathering rights should be able to use the State fishponds.

18% All Moloka'i residents should be able to have free access to, and use of, the State-owned fishponds.

4% Only the fishpond's caretaker ohana or manager should be able to use the State fishponds.

12% Other

8. **If the State fishponds are used for commercial purposes, including fee fishing, what should happen to the profits?**

43% **A portion of the profits to go to a community-based organization to be used for maintenance and other uses.**

29% The fishpond user should retain all of the profit.

18% A portion of the profits should go back to the State.

16% Other

9. **What types of fishing methods and equipment should be allowed in a fishpond?**

55% **Fishers should use whatever legal means they choose, such as fishing poles, nets, traps and baskets.**

18% Fishers should *only* use early Hawaiian fishing methods and equipment, such as makahas and fish traps.

27% Other

10. **Not including subsistence and commercial uses, what other uses may be acceptable for private fishponds?**

67% **All of the above.**

37% Educational purposes.

35% Scientific studies.

8%. Tourist attractions.

8% Other

0% None of the above.

11. **Not including subsistence and commercial uses, what other uses may be acceptable for State fishponds?**

73% **All of the above.**

29% Educational purposes.

27% Scientific studies.

6%. Tourist attractions.

6% Other

0% None of the above.

12. **What should the permit(s) for fishpond restoration regulate?** *(Respondents could have chosen as many as they liked.)*

69% **Dredging activities.**

61% **Construction techniques.**

55% **Pond wall size, dimensions and material.**

53% **Endangered species.**

51% **Construction machinery.**

45% Short-term and long-term water quality.
43% Public access
39% Removal of mangroves.
37% Management
35% Other
31% Navigation

13. **To whom should you apply for fishpond permits?** *(Respondents could have chosen as many as they liked.)*

73% **A Moloka'i-based "Fishpond Commission"**

61% **The State Department of Land and Natural Resources**

29% Moloka'i Planning Commission

12% Other

8% State Office of Hawaiian Affairs (OHA)

8% U.S. Army Corps of Engineers

4% Maui County Public Works Department

14. **Who should enforce fishpond regulations?** *(Respondents could have chosen as many as they liked.)*

67% **A Moloka'i-based "Fishpond Commission"**

61% **The State Department of Land and Natural Resources**

31% Moloka'i Planning Commission

14% Other

6% U.S. Army Corps of Engineers

4% State Office of Hawaiian Affairs

2% Maui County Public Works Department

15. **How should we stock our fishponds?**

76% **Both of the above**

8% Only catch from the wild

6% Seed-stock hatchery only

10% Other

"Other" Responses

1. Of the total number of fishponds on Moloka'i, what portion should be restored and maintained as "traditional"?	
If it's possible to do "traditionally", if not then by whatever means. The difficulty in obtaining numerous permits from numerous agencies deter the restoration & revitalization program - it must be modified & made clean. And no loss of beach access, no navigation loss, no creation of private beach or reef area by wall, no erosion. All of Molokai's fishponds should be restored and maintained as closely to our Hawaiian Traditions as possible. Restored if economical to do so but should not be rezoned for higher use. A Molokai commission should oversee restoration on a case by case basis. Each pond should have a restoration & maintenance plan which will fill its economical needs. 2 or 3 traditional. All others leased for commercial operation. Those fishponds which will serve economic, cultural, and/or educational purposes should be restored in a planful manner.	Fishponds should be restored as long as their is somebody willing to restore it, can find the funds to do so and follows the guidelines prescribed. Some "C", and others restored to working ponds. Traditionally speaking, all fishponds are sacred. Only after a petition, a hookupu, and an offering of thanksgiving is given then the way is open. I would like to see modern technology used with the traditional where it is environmentally and economically beneficial. To do everything "just as the ancestors did" is called "tribal thinking" and emanates from a position of ignorance; i.e. "I must do it this way for the sole reason thay my ancestors did it this way." Or "If it was good enough for my father it's good enough for me." Or "I must beat my children because that's how my parents disciplined me. Tribal thinking is balderdash! If and when ponds could be restored traditionally by all means, but if the rocks are too large for individuals to move safely, common sense dictate the more efficient use of machinery.
2. How should a fishpond be restored?	
Use only on-site rocks, original width, height, length. Commission oversite review - all ponds are too different to "blanket statement" future. A historical survey should be done to insure the original design then a restoration plan can be made.	After all traditional acknowledgements are made, then and only then the restoration based upon its original plan begin. As capable as the original pond builders were times have changed, the surrounding areas and many of their changes are beyond our control. Again, common sense and scientific data should prevail.

3. What construction methods are acceptable for fishpond restoration?	
Mechanized-assisted restoration permitted provided conditions & proposed activity support. I am in favor of utilizing heavy equipment but an assessment should be made of the restoration/revitalization needs of each pond, including impact on environment with use of heave equipment. One has to realize that the old Hawaiians had manpower. In other words, the bigger the rocks, the more people were used, like the Egyptians and their pyramids. If the area has strong currents and subject to offshore pounding, then bigger rocks have to be ____ to ensure stability. Lease equipment as the situation and environment require.	We should not use modern tools we should do it as our forefathers did and prosper Hire a professional private construction firm, then hire Molokai people for Labor, keep construction money in Molokai. This will put Molokai people to work and liability & injuries to be absorbed by the company. Also firm to supply tools and equipment. It's quite important as to whom the individual in charge. Knowing what to use in restoring the pond. A,B,C, depending on ownership - state, public, private & whos to do work.
4. Who should pay for the restoration of private fishponds?	
Only Hawaiians & part Hawaiian families should own fishponds - therefore Govt. should pay for restoration. Only if the pond will provide continuous jobs and food (fish) for the community and keeping it economic for our economy. Private pond, private pay, unless for public use. Gov't. pond, Gov't. pay unless lease for private use. If "d" is the case, then in the by-product and end product, the public has to receive benefit, and one way of doing it is camping fees, fishing license, R&D for students and private industries that have public benefit.	With a short or long term plan you could probably be anybody. Government funding & community based non- or profit entities. State and Government funding, these lands were put in trust for the betterment of the Hawaiians. In regards to something sacred, then no mention of pay to be mentioned, rather respect the private party be totally responsible. OHA, Alu Like, Sovereignty for Native Hawaiians

5. How should privately-owned and government-funded restored fishponds be used?

No government funded for private fish ponds.

Used to feed Ohana, commercial purpose to provide operational expenses, and used for educational & cultural purpose.

Open Market

These fishponds should be used to feed their Ohana only & possible educate other Hawaiians.

I believe that the Ohana's thats working that particular fishpond should decide.

Home use, commercial use,experimentation and research. Don't limit.

Have one plan for use before this decission can be made.

Supplement Native Hawaiians diet for free. 1 lb. per person per week or 2 lb. per person per week, 10 lbs. per week, whatever possible.

Practice Management.

Confusing question - not clear

Question not understandable.

There are no privately-owned and government-owned fishponds. Since when we humans claim ownership to what the almighty God has made. Fishponds were created for the sole purpose of economic subsistence for the people.

Native Hawaiians with help from OHA or Hawaiian Homeseader monies would be helpful.

Because the ponds were not self-sufficient, maintenance and repairs were neglected. Govt. can't be expected to be the unlimited "deep pocket."

6. Who should manage the State-owned fishponds?

All open to public.

It should go to the families who used to care for them during the King's time. Handed down generation after generation. If the original families aren't interested then it should go to other Hawaiians interested.

A Molokai Base "Fishpond Commission"

Ohana caretakers, community organization or surrounding land owners should produce management plan and be protected by DLNR's regulations.

DLNR unless leased to (question 7) then primary management lies with lessee

C looks good but, in my view the Hawaiians should have the last say.

Traditionally speaking it remains in the care of the families of that ahupua'a. If they are not there then make an effort to find them.

All three of the above plans can be worked out. If only a ohana concpet is used for ___, this will create conflict because not every person or ____ belongs to one ohana. If it is a State pond, the options are varied, from leasing to outright ___. Private ponds should never lose its private rights, but it they choose to go public, so be it. Ponsds should be for all to share, but with enforceable guidelines.

State should let the Hawaiians of the ohana system plan the fishpond management.

7. Who should use the restored fishponds?	
Molokai residents & those commercial interests which are "homegrown" on Molokai should be allowed to lease the ponds. If closed to private party, pay rent to ___ costs of rebuilding. The selected caretakers should determine who uses - especially those who practice native gathering rights. Surrounding land owners and its district residents should be able to lease and have its say on its use.	Families and Ohana from within the ahupuaa the fishpond is located in. All Hawaiians should malama their fishponds in their own ahupuaa areas. A, B, & C Traditionally speaking, the fishponds are sacred; it remains to the descretion of the Konohiki, or Ohana. Perhaps one of the best ways of ___ is for the community where the ponds are located are voted in by the community as "fishpond trustees." By the democratic process, trustees could be voted according to their integrity.
8. If the State fishponds are used for commercial purposes, including fee fishing, what should happen to the profits?	
Lessee pay rental fee to cover public expenses. Will there be profits during the start-up phase?? Profits should be kept as use will be paying for lease. All profits should go to a community-based organization to be used for maintenance, etc. of the fishponds - only! Molokai Fishpond Commission. Lease rent goes to state with portion funneled back for community based use-profit to leasee.	Surrounding land owners and its district residents should have say on any profits if any. Bad choices - find more options looking to ____ rules. The profits should be used to help other Hawaiians who need help to build and restore. Wrong. No politicalization and profitability is to be taking place. it's like prostituting the fishponds. If a community based CO is used for management, then under a percentage base, R&D maintenance, repair, and the profits used as scholarships for students in marine science, etc.

9. What types of fishing methods and equipment should be allowed in a fishpond?	
All in a plus makahas & fish traps if necessary. Fishing methods which are not destructive to the walls & infrastructure of the ponds, also limit the catch. This is the twentieth century - use what works best! Fishers should use whatever legal means they choose but the amount they catch should be limited to only what they can use. No over fishing! It should be the Ohana's thats caring for said pond to decide. All ponds are different in size and depth. Case by case commission determination following pond restoration & intended use. Legal means as well as early Hawaiian fishing methods.	Commercial operations should use whatever is economical, Traditional more selective methods. Harvesting should be governed by the management, preferably traditional with certain times allowed for other methods. Any methods and equipment not hostile to the environment. Depending on Ownership, control, & access fees, A & B. B. makes best sense. Early Hawaiians respected the fishponds, they took only enough for food. Undecided -- don't know pros and cons Since the ponds are for everybody and different people find pleasure in different methods, allow this, but there has to be a bag limit.
10. Not including subsistence and commercial uses, what other uses may be acceptable for private fishponds?	
Windsurfing, sailing, small boats, kayaks, canoes. Owners Rights #10 question no appropriate Commerical uses and tourist attractions are the same Hawaiian gathering rights, no commerical uses Native Hawaiian studies Educational purposes based on survival.	Allow residents to camp for a small fee and if water, portable, chemical toilets and space are available. Aquaculture exchange programs with other countries. Israel, Thailand, Philippines and many other countries are heavy into aquaculture and they may have people that can head our aquaculture programs. Stock enhancement (release) Cultural Center.

11. Not including subsistence and commercial uses, what other uses may be acceptable for State fishponds?	
Open to public at all times & beach access not impeded. Substinence & commercial should be included. And the betterment of the Hawaiian people	What? How come State fishpond? No! Belong to OHANA. Use for Educational purposes based on survival. Recreational, R&D, campsites, fly casting and related sports fishing
12. What should the permits for fishpond restoration regulate?	
None of the above Completion date Environmental protection, erosion, shoreline processes. I believe all aspects regarding fish-ponds be regulated except navigation. Drag line. Whatever Anything that may cause problems later on. Overall environmental impact	All of the Above. Hawaiians no need permits whatsoever! No can regulate! Responsibility remains with OHANA! Regulations are a must, but more efficient regulation paperwork must be in place. Red tape causes delay. Monies and job base should be given to the Hawaiians Historic site preservation & intended use. Dept. of Ag. quarantine rules need to be adhered to.
13. To whom should you apply for fishpond permits?	
Neighbor property owners 1/4 mile. A 1 stop process, to get all paperwork done. Public hearing. Native Hawaiian Fishpond Commission. To the Native Hawaiian	How come! All above corporate entity no own. A bonafide body that has representation from all segments and those who are not "special interest" groups. Home rule is essential and if this could be realized, then this is a way to go.

14. Who should enforce fishpond regulations?	
All Molokai residents Maui county land use & codes. Community & the public. Native Hawaiian FishPond Commission. Vague suggestion that the private lab should monitor long term environmental impacts.	The Native Hawaiian again. OHANA maka ala so there is enough for eat. The same group as the one forming the Fishpond Board of Trustees. Those that lived in the area should maintain fishponds. Ohana and Native Hawaiian families.
15. How should we stock our fishponds?	
Experimentation by permit with U.H. Marine Opp. approval. Utilizing other ponds or a open makaha system. (Depends on Mgmt.) B sounds good, but can cut down the Hawaiian way. Replenish of fishpond may start with hatchery, then from wild or traditional speaking keep some young ones for breeding	The makaha-gate technique, by hatchery and the "wild method." The "wild method" develops a stronger breed of fingerlings as they went thru the "survival of fittest" natural way, therefore having smaller death rate; but the hatchery method is more efficient and can be controlled scientifically. However, too highly efficient techniques upsets the traditional methods of ecosystems and create other by-products. For example, taape is a highly efficient fish in terms of adaptability procreation, and aggresive, free-for-all survival. But they have ventured into opakapaka and ehu grounds and have harnessed these expensive fishes.

Exhibit A-5

Final Messages of the November 18 Meeting

Community Input

* I'm listening
* Native Hawaiians should get hands-on experience at the fishponds- if they work on fishpond, they'll get self esteem
* I'm a beach landowner fronting an old fishpond
* Permit under traditional system
* I wanna go home
* Streamline permit process to restore & revitalize fishponds
* Same as above with emphasis on Fishpond Commission - Let's establish parameters to start Commission
* Use all bad buzzwords positively
  e.g. Traditionally fishponds do little to impact coastal drift, but may actually accelerate sediment around the re-established pond wall
* Not want Fishpond Commission invested in the Moloka'i Planning Commission - beyond its capabilities
* We want the world to know - especially regulators -- we are Hawaiians trying to develop fishponds; we are not typical developers. They should know differences

Consultant Input

* Important to Present Fishponds From Positive Aspects:
  1) Environment
  2) Culture
  3) Economics
* Listen to community & not assume agencies will tell us what to do
* Recommendations for followup more important then what contract told us to do
* There are short & long term goals to final destination of Fishponds - Long Term Goals = Traditional
* Permit Process Streamlined For All Ponds whether easy or hard
* Community-based planning & enforcement is always best for the community, but it is very difficult to achieve
* "IMUA" - Go forward

APPENDIX B

MOLOKA'I FISHPOND DATA SHEETS

MOLOKA'I FISHPOND DATA SHEETS

The accompanying data sheets were developed to provide guidelines for the restoration of ancient Hawaiian fishponds on Moloka'i. They are based on a compilation of existing data in a computer database which has been sorted according to several parameters. These, in order of their priority, are:

- A rating of condition (based on "COE", see below)
- Pond acreage
- Pond wall length

The rationale for selection of these criteria is that, of all the factors which might be considered in terms of pond "restorability" (see discussion in Section 7 of final project report), these are the ones which have the most direct impact on ease of permit acquisition and cost of restoration. In addition, these parameters are known for the majority of ponds, which is not the case for many parameters which might otherwise be considered.

The above criteria determine the order in which the ponds are ranked, and in which the data sheets appear. The information provided on each page, however, goes well beyond these criteria. Following is a brief explanation of the headings in the accompanying data sheets:

(Number): Gives the ranking of the pond in the hierarchy.

FISHPOND NAME: (self-explanatory)

GTF SELECTION: * = Pond identified by Governor's Task Force (1992) as a candidate for restoration;
** = Pond identified as "jump start" demonstration pond by Governor's Task Force
(A blank indicates that the pond was not selected by the Task Force for the jump-start program).

TMK #: Tax Map Key number.

SITE #: Identifying number for fishpond sites as provided in Summers (1971).

ACREAGE: Pond basin area, in acres.

AHUPUA'A: *Ahupua'a* (traditional Hawaiian land division) in which pond is located.

OWNER: Shows ownership of the fishpond property.

ACOE PHOTO #: Gives identifying number of aerial photo(s) which show the referenced pond as they appear in *Moloka'i Coastal Resources Atlas* (ACOE 1984).

TYPE: Provides the Hawaiian descriptive term defining the type of pond.

DHM TYPE: Provides the designation which describes the pond type, as given by DHM (1989).

KIKUCHI TYPE: Provides the designation which describes the pond type, as given by Kikuchi (1973).

WALL LENGTH: Shows pond wall length, in feet.

MAKAHA: Gives the number of *makaha* (sluice grates) or related structures.

GRIFFIN ARCHAEOLOGICAL GROUPING: A numerical assignment reflective of the archaeological value or significance of specific ponds according to Estioko-Griffin (1987).

- I = significant for information content and as excellent example of a site type or construction;
- II = significant for information content;
- III = pond destroyed.

HISTORIC REGISTER RATING: Evaluates (in sequence) the following criteria:

- Association with events or broad patterns important in the history of an area.
- Association with the lives of persons significant in our past.
- Sites representing significant architectural achievement.
- Sites having yielded, or having the potential to yield information significant for our understanding of traditional culture, history, prehistory, and foreign influences on traditional culture and history.

A "Y" indicates presence of the criterion; "N" indicates absence.

MADDEN PRODUCTIVITY RATING: Based on Madden and Paulsen (1977), various factors such as water quality, biological criteria, and existing management for aquacultural production, are considered. The numeric scale used is as follows: 1) excellent, 2) good, 3) fair, 4) poor.

RATINGS SECTION

This section deals with an interpretation of photographic information, written descriptions, or numeric values which are presented by various researchers in documenting pond condition. The ratings consist of a **cumulative** rating which describes overall pond condition and **specific** ratings which deal with

certain aspects of pond condition. Specific ratings are provided for degree of siltation, degree of vegetative encroachment (mostly by mangrove), and condition of pond walls. The specific ratings, when given, are on a scale from 1 to 5, with 5 being the condition closest to optimum (needing least work for restoration). The following descriptions apply to the ratings obtained from each source:

- **COE**: Values presented here indicate a cumulative average based on degree of siltation, degree of vegetative encroachment, and wall condition for each pond. Determinations are based on visual interpretation of 1975 aerial photographs (ACOE 1984). In some instances, interpretation is also guided by descriptive legends supplied on the photographs. 1=poorest overall condition;5=best overall condition.

- **DHM**: Values presented as cumulative are based on the classification by DHM (1989) as follows:

  I: Wall good to excellent, minimal siltation, at least 3 National Register criteria.

  IIA: Wall fair to good, moderate siltation, moderate vegetative encroachment, 3 or less National Register criteria.

  IIB: Wall fair to poor, heavy siltation, or completely filled, vegetation encroaching on most or all of fishpond, 3 or less National Register criteria.

  III: No visible surface remains, but location known.

  IV: Reported in literature, but no location known.

  The values presented under specific parameters are derived by assigning a numeric value to these parameters based on written descriptions, where given.

- **SUMMERS**: Values presented are based on interpretation of written descriptions provided in *Moloka'i: A Site Survey* (Summers 1971).

- **APPLE/KIKUCHI**: Values are those assigned by Apple and Kikuchi (1975) to reflect level of pond integrity. They are based on adding numeric ratings of overall condition of pond **basin** (including pond walls), **contents** (referring to water characteristics, sediment, etc.) and **setting**, or ecological habitat, for each pond. Numbers assigned for each criterion vary on a scale of 0.1 to 1.0; addition of ratings for the three criteria gives a maximum possible rating of 3.0 representing the condition closest to ideal.

- **GRIFFIN**: The values presented for the three specific criteria are the result of assigning numeric values to each parameter, based on written descriptions in Estioko-Griffin (1987). The cumulative values are simply the averages of the specific values.

- **MADDEN/PAULSEN**: Note that this differs from the productivity rating presented above. The authors (Madden and Paulsen 1977) group ponds according to the amount of restoration which would be required. Their numeric assignments are organized as follows: 1) no modifications required, 2) maintenance required, 3) major maintenance or repair required, 4) reconstruction required, and 5) unavailable.

COMMENTS

Additional miscellaneous information of interest on specific ponds is provided under this heading.

1 -

FISHPOND NAME : Honouliwai
TMK # : 5-8-02:68
SITE # : 233
ACREAGE : 0.6
`AHUPUA`A : Honouliwai
OWNER : State
ACOE PHOTO # : 1-202

GTF SELECTION : **

TYPE : loko `ume`iki
DHM TYPE : V
KIKUCHI TYPE : Vd1
WALL LENGTH (FT) : 360
MAKAHA : 0

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	3.5	2B	1.5		2	
SILT	3.5	2			--	
VEGETATION	4	2			--	
WALL CONDITION	3	2			2	

COMMENTS:
Wall damaged

FISHPOND NAME : Kaumanamana GTF SELECTION :
TMK # : 5-1-02:4
SITE # : 77
ACREAGE : 3
`AHUPUA`A : Kaluako`i
OWNER : Private
ACOE PHOTO # : 1-311

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE :
WALL LENGTH (FT) : 700A
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	3.3	2B			1.8	
SILT	3	2			2	
VEGETATION	5	2			--	
WALL CONDITION	2	2			1.5	

COMMENTS:
Wall basalt with coral pebble core

FISHPOND NAME : Kaoini
TMK # : 5-4-03:23
SITE # : 136A
ACREAGE : 9.3
`AHUPUA`A : Makakupaia II
OWNER : Private
ACOE PHOTO # : 1-263;1-261

GTF SELECTION :

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : 1770
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING : YNYY
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	3.3	2B	1.5		1.5	
SILT	3.5	3.3			--	
VEGETATION	5	3.3			--	
WALL CONDITION	1.5	3.3	1.5		1.5	

COMMENTS:

FISHPOND NAME : Kanoa GTF SELECTION :
TMK # : 5-4-17:49; or 5-4-03-23??
SITE # : 137
ACREAGE : 50
`AHUPUA`A : Kawela
OWNER : Private
ACOE PHOTO # : 1-261;1-259

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : 2860
MAKAHA : 2

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING : 4

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	3.3	2B	2	1.20	2	4
SILT	4	3.5			--	
VEGETATION	3.5	3.5			--	
WALL CONDITION	2.5	3.5	2		2	

COMMENTS:
Core-filled construction

---

5 -

FISHPOND NAME : `Ali`i
TMK # : 5-4-06:25
SITE # : 135
ACREAGE : 27 (16MADD)
`AHUPUA`A : Makakupaia I
OWNER : HHL
ACOE PHOTO # : 1-265;1-263

GTF SELECTION :

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : 2700
MAKAHA : 2

GRIFFIN ARCHAEOLOGICAL GROUPING: I
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING : 3

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	3.2	2A	2	1.70	2.3	3
SILT	3.5	3	2		1.5	
VEGETATION	2.5	3	2		1.5	
WALL CONDITION	3.5	3			4	

COMMENTS:
Wall 4 ft. wide, 3.5 ft high; part of west wall rebuilt in recent years; pond in good condition despite encroachment by mangrove and filling by silt, which greatly reduces usable area

---

FISHPOND NAME : --
TMK # : 5-7-01
SITE # : 226B
ACREAGE : --
`AHUPUA`A : Waialua
OWNER : State
ACOE PHOTO # : 1-208;1-206

GTF SELECTION : *

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE :
WALL LENGTH (FT) : 400
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	3		1		1	
SILT	3				--	
VEGETATION	3				--	
WALL CONDITION	3				1	

COMMENTS:
Totally submerged

FISHPOND NAME : Kahinapohaku GTF SELECTION : **
TMK # : 5-8-01:2
SITE # : 228
ACREAGE : 4
`AHUPUA`A : Moanui
OWNER : State
ACOE PHOTO # : 1-206;1-204

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : 1100
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	3	2B	1		1	
SILT	2	2			--	
VEGETATION	4	2			--	
WALL CONDITION	3	2	1		1	

COMMENTS:
Only foundation remains

FISHPOND NAME : Kaloko`iki
TMK # : 5-6-08:20
SITE # : 157
ACREAGE : 6
`AHUPUA`A : Wawaia
OWNER : Private
ACOE PHOTO # : 1-236;1-234

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia1
WALL LENGTH (FT) : 1500
MAKAHA : 0

GRIFFIN ARCHAEOLOGICAL GROUPING: I
HISTORIC REGISTER RATING : YNYY
MADDEN PRODUCTIVITY RATING : 3

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	3	2A	1.5	<1.00	2.3	2
SILT	1	3.5	2		2	
VEGETATION	4	3.5			--	
WALL CONDITION	4	3.5	1		2.5	

COMMENTS:
Wall core-filled construction

---

9 -

FISHPOND NAME : Kaina`ohe
TMK # : 5-6-05:22
SITE # : 160
ACREAGE : 17?
`AHUPUA`A : Kaamola
OWNER : Private
ACOE PHOTO # : 1-234;1-232

GTF SELECTION :

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia1
WALL LENGTH (FT) : 1770
MAKAHA : 2

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING : YNYY
MADDEN PRODUCTIVITY RATING : 4

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	3	2A	2.5	2.05	3	3
SILT	3	3.5			3.5	
VEGETATION	3	3.5			--	
WALL CONDITION	3	3.5			2.5	

COMMENTS:
Wall core-filled construction

---

10 -
FISHPOND NAME : Ka`opeahina GTF SELECTION :
TMK # : 5-7-09:1
SITE # : 190
ACREAGE : 19.7
`AHUPUA`A : Kaluaaha
OWNER : Private
ACOE PHOTO # : 1-223

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ic
WALL LENGTH (FT) : 1770
MAKAHA : 0

GRIFFIN ARCHAEOLOGICAL GROUPING: I
HISTORIC REGISTER RATING : YNYY
MADDEN PRODUCTIVITY RATING : 2

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	3	1	1.5	1.60	3.8	
SILT	2	4.3			3.5	
VEGETATION	4	4.3			--	
WALL CONDITION	3	4.3			4	

COMMENTS:
Minimal silt, minimal vegetation; excellent wall, 4-7 ft. wide, 5-8 ft. high, rebuilt after 3 tsunami

---

11 -
FISHPOND NAME : Kaloko`eli GTF SELECTION :
TMK # : 5-4-02:14
SITE # : 133
ACREAGE : 28.2
`AHUPUA`A : Kamiloloa
OWNER : State
ACOE PHOTO # : 1-269

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : 2800
MAKAHA : 2

GRIFFIN ARCHAEOLOGICAL GROUPING: I
HISTORIC REGISTER RATING : YNYY
MADDEN PRODUCTIVITY RATING : 3

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	3	2A	1.5	2.00	5	3
SILT	3	3			--	
VEGETATION	3	3	2.5		--	
WALL CONDITION	3	3	2		5	

COMMENTS:
Small wall breaches at low tide, moderate silt, one-third of walls (eastern portion) overgrown; wall rebuilt twice; bordered by residential development

---

12 -

FISHPOND NAME : Keawanui GTF SELECTION :
TMK # : 5-6-06:8
SITE # : 163
ACREAGE : 54.5 (73.0, Griffin)
`AHUPUA`A : Kaamola
OWNER : Private
ACOE PHOTO # : 1-228;1-232

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : 2000
MAKAHA : 3

GRIFFIN ARCHAEOLOGICAL GROUPING: I
HISTORIC REGISTER RATING : YYYY
MADDEN PRODUCTIVITY RATING : 4

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	3	1	3	1.45	3.7	3
SILT	2	3.7			3.5	
VEGETATION	4	3.7			4	
WALL CONDITION	3	3.7			3.5	

COMMENTS:
Built by Lohelohe ca. 1575; being restored by Kamehameha Schools: largest existing pond on Molokai

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13 -

FISHPOND NAME : --
TMK # : --
SITE # : 193
ACREAGE : --
`AHUPUA`A : Kaluaaha
OWNER : State
ACOE PHOTO # : 1-223;1-221

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE :
WALL LENGTH (FT) : 3025
MAKAHA : 1

GTF SELECTION :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.8	2B	1		1	
SILT	3	2			--	
VEGETATION	4	2			--	
WALL CONDITION	1.5	2			1	

COMMENTS:

14 -
FISHPOND NAME : -- GTF SELECTION : *
TMK # : 5-7-03
SITE # : --
ACREAGE : 1.0?
`AHUPUA`A : Waialua
OWNER : State
ACOE PHOTO # : 1-206;1-204

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE :
WALL LENGTH (FT) : 500
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.8				1.5	
SILT	2				--	
VEGETATION	4				--	
WALL CONDITION	2.5				1.5	

COMMENTS:
Although no site number assigned, wall foundation present, visible in 1975 photo; adjoins Kahinapohaku

---

FISHPOND NAME : Ualapu`e
TMK # : 5-6-01:1
SITE # : 185
ACREAGE : 22 (15.5MADD)
`AHUPUA`A : Ualapue
OWNER : State
ACOE PHOTO # : 1-225

GTF SELECTION :

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia1
WALL LENGTH (FT) : 1575
MAKAHA : 2

GRIFFIN ARCHAEOLOGICAL GROUPING: I
HISTORIC REGISTER RATING : YNYY
MADDEN PRODUCTIVITY RATING : 2

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.8	2A	2.5	2.05	1.3	2-3
SILT	2	3.2	2.5		1.5	
VEGETATION	3.5	3.2	2.5		--	
WALL CONDITION	3	3.2			2.5	

COMMENTS:
Wall good; 8 to 19 ft. wide, 4 ft. high; vegetation minimal in pond, extensive on wall; class AA waters; freshwater springs occur in pond and benefit productivity; pond being restored by Oceanic Institute

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16 -

FISHPOND NAME : Naninaniku`eku`e GTF SELECTION :
TMK # : 5-1-02:4
SITE # : 79
ACREAGE : 22
`AHUPUA`A : Kaluako`i
OWNER : Private
ACOE PHOTO # : 1-309;1-307

TYPE : loko ume`iki
DHM TYPE : V
KIKUCHI TYPE : Vc
WALL LENGTH (FT) : 2600
MAKAHA : 8 lanes

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.8	2B			2	
SILT	2	2			2	
VEGETATION	3.5	2			--	
WALL CONDITION	3	2			2	

COMMENTS:

---

17 -
FISHPOND NAME : --
TMK # : 5-1-02:4
SITE # : 80
ACREAGE : 23
`AHUPUA`A : Kaluako`i
OWNER : Private
ACOE PHOTO # : 1-307;1-305

GTF SELECTION :

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.8	2B	1.8		1.3	
SILT	3	2	1		1	
VEGETATION	2	2	1		1.5	
WALL CONDITION	3.5	2	3.5		1.5	

COMMENTS:

---

18 -
FISHPOND NAME : Ni`aupala GTF SELECTION :
TMK # : 5-7-07:8 or 5-6-08:8??
SITE # : 192
ACREAGE : 34
`AHUPUA`A : Kaluaaha
OWNER : Private
ACOE PHOTO # : 1-223;1-221

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : 1975
MAKAHA : 2

GRIFFIN ARCHAEOLOGICAL GROUPING: I
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING : 2

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.8	2B	1.5	1.80	2.8	2-3
SILT	2	3			2	
VEGETATION	3.5	3			--	
WALL CONDITION	3	3			3.5	

COMMENTS:
Core-filled wall construction; pond still in use (as of '74)

---

19 -
FISHPOND NAME : --
TMK # : 5-6-09:
SITE # : 156
ACREAGE : 40
`AHUPUA`A : Wawaia
OWNER : State
ACOE PHOTO # : 1-236

GTF SELECTION :

TYPE : loko umeiki
DHM TYPE : V
KIKUCHI TYPE : Vb1
WALL LENGTH (FT) : 2990
MAKAHA : 8+ lanes

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.8	2B			1	
SILT	1	2			--	
VEGETATION	4	2			--	
WALL CONDITION	3.5	2	.5		1	

COMMENTS:

---

20 -
FISHPOND NAME : `Ohalahala GTF SELECTION : *
TMK # : 5-8-01:3
SITE # : 231
ACREAGE : 1.5
`AHUPUA`A : Kumimi
OWNER : State
ACOE PHOTO # : 1-204

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.7	2B	1		1	
SILT	3	2			--	
VEGETATION	4	2			--	
WALL CONDITION	1	2			1	

COMMENTS:
Pond destroyed, not visible in aerial photo

---

21 -
FISHPOND NAME : Halemahana GTF SELECTION : *
TMK # : 5-6-03:35
SITE # : 184
ACREAGE : 3.3
`AHUPUA`A : Ualapue
OWNER : State
ACOE PHOTO # : 1-225

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia2
WALL LENGTH (FT) : 725
MAKAHA : 2

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.7	2B	1		1	
SILT	2	2			--	
VEGETATION	4	2			--	
WALL CONDITION	2	2			1	

COMMENTS:
Pond wall destroyed, only some foundation visible; pond used commercially in 1901

---

22 -

FISHPOND NAME : Kula`alamihi GTF SELECTION :
TMK # : 5-7-04:34
SITE # : 214
ACREAGE : 4
`AHUPUA`A : Honomuni
OWNER : Private
ACOE PHOTO # : 1-215;1-214

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : --
WALL LENGTH (FT) : --
MAKAHA : 0

GRIFFIN ARCHAEOLOGICAL GROUPING: I
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING : 4

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.7	2B	2	1.25	1.3	4
SILT	2	2	2		1.5	
VEGETATION	3.5	2			--	
WALL CONDITION	2.5	2			2.5	

COMMENTS:
Wall is multiple stacked construction

---

23 -

FISHPOND NAME : Wehelau`ulu GTF SELECTION :
TMK # : --
SITE # : 170
ACREAGE : 8
`AHUPUA`A : Manawai
OWNER : State
ACOE PHOTO # : 1-228;1-227

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : 1770
MAKAHA : 3

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.7	2B	1		1.5	
SILT	2.5	2			--	
VEGETATION	4	2			--	
WALL CONDITION	1.5	2			1.5	

COMMENTS:

FISHPOND NAME : Kaunahiko`oku GTF SELECTION :
TMK # : 5-6-04:28
SITE # : 165
ACREAGE : 13
`AHUPUA`A : W. `Ohi`a
OWNER : Private
ACOE PHOTO # : 1-228;1-227

TYPE : loko umeiki
DHM TYPE : V
KIKUCHI TYPE : Vb
WALL LENGTH (FT) : 2000
MAKAHA : 11 lanes

GRIFFIN ARCHAEOLOGICAL GROUPING: I
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.7	2B	1		2	
SILT	2	2			--	
VEGETATION	4	2			--	
WALL CONDITION	2	2	1		2	

COMMENTS:

FISHPOND NAME : Kanukuawa
TMK # : 5-5-01:12
SITE # : 148
ACREAGE : 29
`AHUPUA`A : Kapuaokoolau
OWNER : Private
ACOE PHOTO # : 1-249;1-247

GTF SELECTION :

TYPE : loko umeiki
DHM TYPE : V
KIKUCHI TYPE : Vb
WALL LENGTH (FT) : 2300
MAKAHA : 14 lanes

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.7	2B	1		1.5	
SILT	1.5	2			--	
VEGETATION	4	2			--	
WALL CONDITION	2.5	2	1		1.5	

COMMENTS:

---

26 -

FISHPOND NAME : --
TMK # : --
SITE # : 166
ACREAGE : 8
ʻAHUPUAʻA : W. ʻOhiʻa
OWNER : State
ACOE PHOTO # : 1-228;1-227

GTF SELECTION :

TYPE : ?
DHM TYPE :
KIKUCHI TYPE : --
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.5	3	1		1	
SILT	2.5	1			--	
VEGETATION	4	1			--	
WALL CONDITION	1	1			1	

COMMENTS:

---

27 -

FISHPOND NAME : Kawi`u
TMK # : 5-5-01:39
SITE # : 146
ACREAGE : 12
`AHUPUA`A : Makolelau
OWNER : Private
ACOE PHOTO # : 1-251;1-249

GTF SELECTION :

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : 1700
MAKAHA : 2

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.5	2B			2	
SILT	1.5	?			--	
VEGETATION	4	?			--	
WALL CONDITION	2	?			2	

COMMENTS:

---

28 -

FISHPOND NAME : Kupeke
TMK # : 5-7-06:1
SITE # : 206
ACREAGE : 34 (MADD 25)
`AHUPUA`A : Kupeke
OWNER : Private
ACOE PHOTO # : 1-217

GTF SELECTION :

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia1
WALL LENGTH (FT) : 2210
MAKAHA : 1

GRIFFIN ARCHAEOLOGICAL GROUPING: I
HISTORIC REGISTER RATING : YNYY
MADDEN PRODUCTIVITY RATING : 2

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.5	2A	3.5	1.90	3.3	2-3
SILT	1.5	3.5			3	
VEGETATION	3.5	3.5			--	
WALL CONDITION	2.5	3.5			3.5	

COMMENTS:
Freshwater stream east of pond, wall fair to good; silt minimal to moderate; vegetation minimal; AA waters; still in use; one of 3 best ponds in Hawaii (Summers 71); wall is multiple stacked construction

---

29 -

FISHPOND NAME : Panahaha
TMK # : 5-5-01:21
SITE # : 147
ACREAGE : 36
`AHUPUA`A : Makolelau
OWNER : Private
ACOE PHOTO # : 1-249;1-247

GTF SELECTION :

TYPE : loko umeiki
DHM TYPE : V
KIKUCHI TYPE : Vb
WALL LENGTH (FT) : 3150
MAKAHA : 9 of 17 lanes reported by Summer

GRIFFIN ARCHAEOLOGICAL GROUPING: I
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.5	2B	1.5		2.5	
SILT	1.5	2			--	
VEGETATION	4	2			--	
WALL CONDITION	2	2	1.5		2.5	

COMMENTS:
Wall extensively collapsed and only about .5 m above water at minus tides; stacked `a`a construction

---

30 -

FISHPOND NAME : Waihilahila GTF SELECTION :
TMK # : 5-7-06:27
SITE # : 213
ACREAGE : 4
`AHUPUA`A : Kailiula
OWNER : Private
ACOE PHOTO # : 1-215;1-214

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia3
WALL LENGTH (FT) : --
MAKAHA : 0

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING : 4

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.3	2B		1.25	2	4
SILT	2	3.3			2	
VEGETATION	2	3.3			--	
WALL CONDITION	3	3.3			2	

COMMENTS:

---

31 -

FISHPOND NAME : Kihaloko GTF SELECTION :
TMK # : 5-7-06:22
SITE # : 212
ACREAGE : 5
`AHUPUA`A : Ahaino II
OWNER : Private
ACOE PHOTO # : 1-215;1-214

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : II
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING : 4

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.3	2B		1.25	1.5	4
SILT	2	3.2			1.5	
VEGETATION	2.5	3.2			1.5	
WALL CONDITION	2.5	3.2			1.5	

COMMENTS:
Multiple-stacked wall construction

---

32 -

FISHPOND NAME : Kalua`aha GTF SELECTION : *
TMK # :
SITE # : 188
ACREAGE : 13
`AHUPUA`A : Kaluaaha
OWNER : State
ACOE PHOTO # : 1-225;1-223

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : 2110
MAKAHA : 4

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.3	2B	1		1.5	
SILT	1	2			1.5	
VEGETATION	3.5	2			--	
WALL CONDITION	2.5	2	1		1.5	

COMMENTS:
Only foundation remains; submerged

---

33 -
FISHPOND NAME : Mahilika GTF SELECTION :
TMK # : 5-7-10:31
SITE # : 189
ACREAGE : 13.3
`AHUPUA`A : Kaluaaha
OWNER : State
ACOE PHOTO # : 1-223

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia2
WALL LENGTH (FT) : 1760
MAKAHA : 3

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.3	2B	1		1.5	
SILT	1	2			--	
VEGETATION	3.5	2			--	
WALL CONDITION	2.5	2			1.5	

COMMENTS:
Used commercially in 1901

---

34 -

FISHPOND NAME : Mikiawa GTF SELECTION :
TMK # : 5-6-06:9
SITE # : 162
ACREAGE : 44
`AHUPUA`A : Kaamola
OWNER : State
ACOE PHOTO # : 1-228;1-227

TYPE : loko umeiki
DHM TYPE : V
KIKUCHI TYPE : Vb
WALL LENGTH (FT) : 3100
MAKAHA : 26 lanes

GRIFFIN ARCHAEOLOGICAL GROUPING: I
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.3	2B			2	
SILT	2	2			--	
VEGETATION	4	2			--	
WALL CONDITION	1	2			2	

COMMENTS:
Shown as "Kalaeloa Pond" in '75 photo and USGS map; used by 2 different `ahuapua`a -- one on ingoing tide, other on outgoing

---

35 -
FISHPOND NAME : -- (2ponds) GTF SELECTION :
TMK # : 5-4-13
SITE # : 138
ACREAGE : --
`AHUPUA`A : Kawela
OWNER : State
ACOE PHOTO # : 1-255

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia2
WALL LENGTH (FT) : 1550
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: III
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.2	3				
SILT	1.5	1				
VEGETATION	4	1				
WALL CONDITION	1	1				

COMMENTS:
Not indicated on ACOE photo

---

36 -

FISHPOND NAME : `Ipuka`iole
TMK # : 5-7-04:5
SITE # : 219
ACREAGE : 3.2
`AHUPUA`A : Kainalu
OWNER : Private
ACOE PHOTO # : 1-212

GTF SELECTION :

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia2
WALL LENGTH (FT) : 590
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.2	3	1		1	
SILT	1.5	1			--	
VEGETATION	3.5	1			--	
WALL CONDITION	1.5	1			1	

COMMENTS:
Dunbar reconstruction

---

37 -
FISHPOND NAME : Panahaha GTF SELECTION : *
TMK # : 5-7-07:22
SITE # : 202
ACREAGE : 13.8
`AHUPUA`A : Pukoo I
OWNER : State
ACOE PHOTO # : 1-219

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia1
WALL LENGTH (FT) : 1600
MAKAHA : 1

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.2	2B	1		1.5	
SILT	2.5	2			1.5	
VEGETATION	3	2			--	
WALL CONDITION	1	2			1.5	

COMMENTS:
Silt; broken wall, partial foundation, concrete construction at one end

---

38 -

FISHPOND NAME : Kainalu GTF SELECTION : *
TMK # : 5-7-04
SITE # : 220
ACREAGE : 19
`AHUPUA`A : Kainalu
OWNER : State
ACOE PHOTO # : 1-212

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia2
WALL LENGTH (FT) : 2160
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.2	2B	1		1.5	
SILT	1.5	2			--	
VEGETATION	3.5	2			--	
WALL CONDITION	1.5	2			1.5	

COMMENTS:
Destroyed except for intact wall foundation; listed as unnamed by Griffin

---

39 -

FISHPOND NAME : Pahiomu GTF SELECTION : *
TMK # : 5-5-01:10
SITE # : 149
ACREAGE : 20
`AHUPUA`A : Kapuakoolau and Keonokuino
OWNER : State
ACOE PHOTO # : 1-247;1-245

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : 1770
MAKAHA : 1

GRIFFIN ARCHAEOLOGICAL GROUPING: I
HISTORIC REGISTER RATING : YNYY
MADDEN PRODUCTIVITY RATING : 4

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.2	2A	3.25	1.35	2.2	4
SILT	2	3	3		1.5	
VEGETATION	1.5	3	3.5		1.5	
WALL CONDITION	3	3			3.5	

COMMENTS:
Class AA waters: unusual notched walls

---

40 -

FISHPOND NAME : Pakanaka GTF SELECTION :
TMK # : 5-1-02:4
SITE # : 97
ACREAGE : 68.9
`AHUPUA`A : Kaluako`i
OWNER : Private
ACOE PHOTO # : 1-301;1-299

TYPE : loko ume`iki
DHM TYPE : V
KIKUCHI TYPE : Vc
WALL LENGTH (FT) : 2000A
MAKAHA : 20+ lanes

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2.2	2B	2		1.2	
SILT	2	2			1	
VEGETATION	1.5	2	2		1	
WALL CONDITION	3	2	2		1.5	

COMMENTS:
Coralline algae (used in wall construction?) cement wall together

---

41 -
FISHPOND NAME : Hikauhi GTF SELECTION :
TMK # : 5-1-02:4
SITE # : 78
ACREAGE : 1.5
`AHUPUA`A : Kaluako`i
OWNER : Private
ACOE PHOTO # : 1-311

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : --
MAKAHA : 1

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	2	2B	1		2	
SILT	3	2			2	
VEGETATION	1	2			1	
WALL CONDITION	2	2			3	

COMMENTS:
Basalt w/coral pebble core

---

42 -

FISHPOND NAME : Kamahu`ehu`e GTF SELECTION :
TMK # : 5-5-02:5
SITE # : 151
ACREAGE : 37
`AHUPUA`A : Kamalo
OWNER : Private
ACOE PHOTO # : 1-243;1-242

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : 3470
MAKAHA : 2

GRIFFIN ARCHAEOLOGICAL GROUPING: I
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING : 4

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1.8	2B	1	<1.00	1.5	3
SILT	1.5	2	1		1	
VEGETATION	1	2			1	
WALL CONDITION	3	2	1		2.5	

COMMENTS:
Basalt capstones similar to those at Kipapa; used commercially in 1091

---

43 -
FISHPOND NAME : Nahiole GTF SELECTION :
TMK # : 5-7-06:18
SITE # : 210
ACREAGE : 1+
`AHUPUA`A : Ahaino I
OWNER : State
ACOE PHOTO # : 1-215

TYPE : loko puuone
DHM TYPE : II
KIKUCHI TYPE : II
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: III
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1.7	3				
SILT	1	1				
VEGETATION	3	1				
WALL CONDITION	1	1				

COMMENTS:
Not shown on ACOE photo

---

44 -

FISHPOND NAME : Puhaloa
TMK # : 5-6-04:25
SITE # : 179
ACREAGE : 6
`AHUPUA`A : Manawai
OWNER : Private
ACOE PHOTO # : 1-227;1-225

GTF SELECTION :

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : 1245
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING : 4

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1.7	2B	1.5	<1.00	1.5	3/5
SILT	1.5	2			1	
VEGETATION	1.5	2	1.5		1	
WALL CONDITION	2	2			1.5	

COMMENTS:
Threatened by encroaching development

---

45 -
FISHPOND NAME : Papa`ili`ili GTF SELECTION :
TMK # : --
SITE # : 161
ACREAGE : 6.5
`AHUPUA`A : Kaamola
OWNER : State
ACOE PHOTO # : 1-232

TYPE : loko umeiki
DHM TYPE : V
KIKUCHI TYPE : Vb2
WALL LENGTH (FT) : 750
MAKAHA : 8 lanes

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1.7	3	1		1	
SILT	1	1			--	
VEGETATION	3	1			--	
WALL CONDITION	1	1			1	

COMMENTS:
Not shown on ACOE photo

FISHPOND NAME : Kipapa GTF SELECTION :
TMK # : 5-5-01:8
SITE # : 150
ACREAGE : 10
`AHUPUA`A : Keonokui´no
OWNER : State
ACOE PHOTO # : 1-245

TYPE : loko umeiki
DHM TYPE : V
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : 1371
MAKAHA : (1-) 3

GRIFFIN ARCHAEOLOGICAL GROUPING: I
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING : 4

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1.7	2B	1.5	1.15	1.8	4
SILT	2	2	1		1	
VEGETATION	1	2	1.5		1	
WALL CONDITION	2	2	2		3.5	

COMMENTS:
Unique basalt capstones (only other ponds having them is Kamahuehue)

---

47 -

FISHPOND NAME : Pipi`o
TMK # : 5-7-08:77
SITE # : 196
ACREAGE : 17
`AHUPUA`A : Mapulehu
OWNER : Private
ACOE PHOTO # : 1-221

GTF SELECTION :

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia2
WALL LENGTH (FT) : 1156
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING : 4

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1.7	2B	1	<1.00	1.8	3
SILT	2	1.5			--	
VEGETATION	1	1.5			1.5	
WALL CONDITION	2	1.5	1		2	

COMMENTS:
Used commercially in 1901 for `awa and mullet

---

48 -

FISHPOND NAME : Kalua`apuhi
TMK # : 5-2-11:25
SITE # : 104
ACREAGE : 19 (3.5MADD)
`AHUPUA`A : Naiwa I
OWNER : Private
ACOE PHOTO # : 1-288;1-286

GTF SELECTION :

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia1
WALL LENGTH (FT) : --
MAKAHA : 2

GRIFFIN ARCHAEOLOGICAL GROUPING: I
HISTORIC REGISTER RATING : YNYY
MADDEN PRODUCTIVITY RATING : 3

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1.5	2A			2.8	3
SILT	1.5	3.2			3	
VEGETATION	1.5	3.2			1	
WALL CONDITION	1.5	3.2			4.5	

COMMENTS:
East wall excellent, others overgrown; minimal silt, water clear; heavy mangrove encroaching on pond wall structure

---

49 -

FISHPOND NAME : Puko`o
TMK # : 5-7-07:21
SITE # : 203
ACREAGE : 25
`AHUPUA`A : Pukoo II
OWNER : Private
ACOE PHOTO # : 1-219

GTF SELECTION :

TYPE : ?
DHM TYPE :
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : 2000
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: III
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1.3	3				
SILT	1	1				
VEGETATION	2	1				
WALL CONDITION	1	1				

COMMENTS:
Looks filled in photo; area dredged for Pukoo Harbor and filled for beaches

---

FISHPOND NAME : Kahokai GTF SELECTION :
TMK # : 5-2-11:1
SITE # : 117
ACREAGE : 20
`AHUPUA`A : Kalamaula
OWNER : HHL
ACOE PHOTO # : 1-286

TYPE : loko puuone
DHM TYPE : II
KIKUCHI TYPE : II
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1.2	2B?	1			
SILT	1	2			1	
VEGETATION	1	2			1	
WALL CONDITION	1.5	2			--	

COMMENTS:

---

51 -

FISHPOND NAME : Pa`ahao GTF SELECTION :
TMK # : 5-2-11:25
SITE # : 105
ACREAGE : --
`AHUPUA`A : Naiwa I
OWNER : Private
ACOE PHOTO # : 1-286

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia2
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: III
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1	3	1			
SILT	1	1				
VEGETATION	1	1				
WALL CONDITION	1	1				

COMMENTS:
Not indicated on ACOE photos

---

52 -
FISHPOND NAME : --
TMK # : --
SITE # : 205
ACREAGE : --
`AHUPUA`A : Pukoo I
OWNER : State
ACOE PHOTO # : 1-217

GTF SELECTION :

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE :
WALL LENGTH (FT) : 1225
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1	2B	1		1	
SILT	1	2			--	
VEGETATION	1	2			--	
WALL CONDITION	1	2			1	

COMMENTS:
Not shown in ACOE photo; filled and used for cultivation?

---

53 -

FISHPOND NAME : Kamaloko GTF SELECTION :
TMK # : 5-2-08
SITE # : 122
ACREAGE : 0.9
`AHUPUA`A : Kalamaula
OWNER : HHL
ACOE PHOTO # : 1-277

TYPE : loko puuone
DHM TYPE : II
KIKUCHI TYPE : II
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: III
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1	3				
SILT	1	1				
VEGETATION	1	1				
WALL CONDITION	1	1				

COMMENTS:
Filled and built over -- residential area; not indicated on ACOE photos

---

54 -
FISHPOND NAME : Kapa`akea GTF SELECTION :
TMK # : 5-4-03:9
SITE # : 132
ACREAGE : 5.45
`AHUPUA`A : Kapaakea
OWNER : Private
ACOE PHOTO # : 1-271

TYPE : loko puuone
DHM TYPE : II
KIKUCHI TYPE : II
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: III
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1	3	1			
SILT	1	1				
VEGETATION	1	1				
WALL CONDITION	1	1				

COMMENTS:
Filled; not indicated on ACOE photos

---

55 -

FISHPOND NAME : Uluamui
TMK # : 5-5-01:31
SITE # : 145
ACREAGE : 6.5
`AHUPUA`A : Makolelau
OWNER : Private
ACOE PHOTO # : 1-251

GTF SELECTION :

TYPE : loko puuone
DHM TYPE : II
KIKUCHI TYPE : II
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: III
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1	3	1			
SILT	1	1				
VEGETATION	1	1	1			
WALL CONDITION	1	1				

COMMENTS:
Now used for taro; not shown on ACOE photo

---

56 -

FISHPOND NAME : `O`o`ia GTF SELECTION :
TMK # : 5-2-11:25
SITE # : 103
ACREAGE : 15
`AHUPUA`A : Kahanui I
OWNER : Private
ACOE PHOTO # : 1-290;1-288

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1	2B	2		1	
SILT	1	2	2		1	
VEGETATION	1	2	2		1	
WALL CONDITION	1	2			--	

COMMENTS:

FISHPOND NAME : Kakaha`ia GTF SELECTION :
TMK # : 5-4-01:5
SITE # : 143
ACREAGE : 31
`AHUPUA`A : Kawela
OWNER : Federal
ACOE PHOTO # : 1-253

TYPE : loko puuone
DHM TYPE : II
KIKUCHI TYPE : II
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1	2A			2.5	
SILT	1	3			2.5	
VEGETATION	1	3	2		--	
WALL CONDITION	1	3			--	

COMMENTS:
In use since 1500AD; presently wildlife reserve

---

58 -

FISHPOND NAME : Paialoa GTF SELECTION :
TMK # : 5-6-02:12; 5-6-07:1
SITE # : 158
ACREAGE : 35
`AHUPUA`A : Puaahala
OWNER : Private
ACOE PHOTO # : 1-234

TYPE : loko kuapa
DHM TYPE : I
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : 2200
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: III
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING : 5?

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1	3	2			4/5?
SILT	1	1				
VEGETATION	1	1				
WALL CONDITION	1	1				

COMMENTS:
Great discrepancy between photos of 1960 and 1975. '60 photo (Summers) shows int act pond; '75 photo shows area as filled; not indicated on ACOE photo, but "Paiaha" pond is shown; '74 inventory found pond destroyed by developers

---

59 -

FISHPOND NAME : `Ohaipilo GTF SELECTION :
TMK # : 5-2-11:1
SITE # : 118
ACREAGE : 39
`AHUPUA`A : Kalamaula
OWNER : HHL
ACOE PHOTO # : 1-286

TYPE : loko puuone
DHM TYPE : II
KIKUCHI TYPE : II
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: III
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:	1	3	2			
SILT	1	1	1			
VEGETATION	1	1				
WALL CONDITION	1	1	3			

COMMENTS:
Completely filled fastland

---

60 -

FISHPOND NAME : `Umipa`a GTF SELECTION :
TMK # : --
SITE # : 119
ACREAGE : --
`AHUPUA`A : Kalamaula
OWNER : --
ACOE PHOTO # : ---

TYPE : loko puuone
DHM TYPE : II
KIKUCHI TYPE : II
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: III
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:		3	1			
SILT		1				
VEGETATION		1				
WALL CONDITION		1				

COMMENTS:

---

61 -
FISHPOND NAME : --
TMK # : --
SITE # : 315
ACREAGE : --
`AHUPUA`A : Halawa
OWNER : Private
ACOE PHOTO # :

GTF SELECTION :

TYPE : loko wai
DHM TYPE : III
KIKUCHI TYPE : IIIb
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING:
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:		2B?				
SILT		2				
VEGETATION		2				
WALL CONDITION		2				

COMMENTS:

FISHPOND NAME : Aipohaku GTF SELECTION :
TMK # : --
SITE # : 101A
ACREAGE : 0.24
`AHUPUA`A : Kahanui I
OWNER : --
ACOE PHOTO # : ---

TYPE : ?
DHM TYPE :
KIKUCHI TYPE : III
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING:
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:		4	1			
SILT		0				
VEGETATION		0				
WALL CONDITION		0				

COMMENTS:

FISHPOND NAME : Kauha`a GTF SELECTION :
TMK # : 5-2-11
SITE # : 101B
ACREAGE : 0.52
`AHUPUA`A : Kahanui I
OWNER : --
ACOE PHOTO # : ---

TYPE : loko puuone
DHM TYPE : II
KIKUCHI TYPE : II
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: III
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:		4	1			
SILT		0				
VEGETATION		0				
WALL CONDITION		0				

COMMENTS:

FISHPOND NAME : Waiakea GTF SELECTION :
TMK # : 5-2-11:20
SITE # : 101C
ACREAGE : 1
`AHUPUA`A : Kahanui I
OWNER : State
ACOE PHOTO # : ---

TYPE : loko puuone
DHM TYPE : II
KIKUCHI TYPE : II
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:		2B?	1		1	
SILT		2			1	
VEGETATION		2			1	
WALL CONDITION		2			--	

COMMENTS:

---

65 -
FISHPOND NAME : --
TMK # : 5-2-9:11
SITE # : 120
ACREAGE : 2
`AHUPUA`A : Kalamaula
OWNER : HHL
ACOE PHOTO # : ---

GTF SELECTION :

TYPE : loko puuone
DHM TYPE : II
KIKUCHI TYPE : II
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:		2B?			1	
SILT		2			--	
VEGETATION		2			1	
WALL CONDITION		2			--	

COMMENTS:

---

66 -
FISHPOND NAME : --
TMK # : 5-7-03
SITE # : 226?
ACREAGE : 16+
`AHUPUA`A : Waialua
OWNER :
ACOE PHOTO # :

GTF SELECTION :

TYPE : loko kuapa
DHM TYPE :
KIKUCHI TYPE : Ia
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:					1	
SILT					--	
VEGETATION					--	
WALL CONDITION					1	

COMMENTS:

FISHPOND NAME : Punalau GTF SELECTION :
TMK # : 5-2-11:11
SITE # : 102
ACREAGE : 20
`AHUPUA`A : Kahanui I
OWNER : Private
ACOE PHOTO # : ---

TYPE : loko puuone
DHM TYPE : II
KIKUCHI TYPE : II
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:		2B?	1		1	
SILT		2			1	
VEGETATION		2			1	
WALL CONDITION		2			--	

COMMENTS:

---

68 -

FISHPOND NAME : --
TMK # : 5-1-01:2-4
SITE # : 98
ACREAGE : 38
`AHUPUA`A : Hoolehua
OWNER : SPtaterivate?
ACOE PHOTO # : ---

GTF SELECTION :

TYPE : loko ume`iki
DHM TYPE : V
KIKUCHI TYPE : Va
WALL LENGTH (FT) : --
MAKAHA :

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:		2B	1		1	
SILT		2	1		1	
VEGETATION		2			--	
WALL CONDITION		2			--	

COMMENTS:

---

69 -

FISHPOND NAME : Pala`au
TMK # : 5-2-11:4
SITE # : 99
ACREAGE : 500
`AHUPUA`A : Palaau
OWNER : HHL
ACOE PHOTO # : ---

GTF SELECTION :

TYPE : loko ume`iki
DHM TYPE : V
KIKUCHI TYPE : Vc1
WALL LENGTH (FT) : 6300
MAKAHA : 27 lanes

GRIFFIN ARCHAEOLOGICAL GROUPING: II
HISTORIC REGISTER RATING :
MADDEN PRODUCTIVITY RATING :

	COE	DHM	SUMMERS	APPLE/ KIKUCHI	GRIFFIN	MADDEN/ PAULSEN
CUMULATIVE RATINGS:		2B	1		1	
SILT		2	1		1	
VEGETATION		2			--	
WALL CONDITION		2			--	

COMMENTS:
Originally largest of Moloka`i fishponds