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Data Processing Analysis and Recommendation for the Papio Natural Resources District

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DATA PROCESSING ANALYSIS AND RECOMMENDATION
FOR THE PAPIO NATURAL RESOURCES DISTRICT

Center for Applied Urban Research
University of Nebraska at Omaha

April, 1984

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DATA PROCESSING ANALYSIS AND RECOMMENDATION
FOR THE PAPIO NATURAL RESOURCES DISTRICT

I. Scope and Purpose

This report presents an analysis of and recommendations on the data processing needs of the Papio Natural Resources District (N.R.D.). The analysis was undertaken pursuant to an agreement dated December, 1983 between the Center for Applied Urban Research (CAUR) of the University of Nebraska at Omaha and the Papio N.R.D.

This report will provide the Papio N.R.D. with information on the current status of data processing in their organization and the N.R.D.'s information management data processing needs. The report will also discuss the applicability of computer technology, the probable configuration and cost of a computer system to meet the N.R.D.'s needs, and recommendations concerning future action by the N.R.D. in the area of data processing.

II. Contemporary Computer Technology

Recent advances in technology have brought computers within the reach of many small organizations and agencies in America. These advances have substantially reduced the cost of computer systems and have also made possible effective computer use by agency personnel who are not data processing experts.

The first advance has been a tremendous reduction in the physical size and cost of computers coupled with dramatic increases in their functional capabilities.

Second, the current generation of application programming or software available to local governments is characterized by flexibility and "user-friendliness." That is, the programming is designed for interactive use on video terminals by personnel who have little or no knowledge of computer technology or programming. One result of these changes is that small organizations today can acquire and use computer systems to aid in performing everyday activities and can do so with a high degree of confidence and at relatively low cost.

III. Acquiring the Technology

Regardless of the type of hardware, a computer system should be viewed as a tool to be used like any other piece of office equipment. It is an integral part of the work routine, just like the typewriter, the telephone, the adding machine, or the filing cabinet.

Computer usage is technically feasible in almost all organizations. Technical feasibility, however, is often less important to organizations than several other factors, including:

- * Cost. Cost is perhaps the best understood and most definitive means of determining the feasibility of any new system. Is the new system more or less expensive than current methods? Although cost may be the best understood criterion for determining feasibility, accurate cost estimates are often difficult to obtain, especially in cities with limited current data processing capabilities.

A word of caution is in order here. Few small agencies that implement computer technology can expect to reduce overall costs. Thus, a strict cost justification for an electronic data processing system may be impossible. At best, a small agency can anticipate cost displacement (e.g., the moving of costs from one place in the budget to another), cost avoidance (e.g., the use of more efficient technology to prevent, avoid, or move into the future costs that would otherwise occur), and/or service improvements.

- * Ease of Operation. Some computer systems can be operated only by technically trained personnel. A factor in favor of the current technology, especially the present generation of mini- and microcomputers, is that agency personnel who are not trained in the technology can easily operate these systems in many cases, and a technical staff of programmers is not required.
- * Available Programming. The availability of proven, easy-to-use software or programming to make a computer system do what an organization wants, when it wants, and how it wants is crucial to system feasibility. Without adequate software, a computer is only an expensive box that fulfills no useful purpose. Software is available in many functional areas from a variety of sources and needs to be considered prior to hardware considerations.
- * Growth. An important factor in the feasibility of an electronic data processing system is the extent to which it

can grow to meet future requirements. Not only should the system be capable of accepting more sophisticated uses and equipment (hardware) but also of accommodating normal growth in the volume of agency activities.

* Staff Considerations. The degree of acceptance of computer technology within an organization is a significant consideration in system feasibility. Similarly, the degree of staff ability to perform specific functions (e.g., payroll, utility billing, etc.) and staff aptitude and enthusiasm for the use of computers can be constraints on system effectiveness. To put it more plainly, staff support for computerization, competence in positions that will rely on computer technology, aptitude for using automated equipment, and interest or enthusiasm for automation are most important to the effective implementation of a computer system in an organization.

* Political Feasibility. Finally, political feasibility may well be the single most critical element in the success of computerization in public organizations and the most difficult factor to deal with. Political feasibility means the extent to which elected officials and administrators understand and support the need for an electronic data processing system. In the absence of such support, a public organization would be well advised not to proceed with system procurement. On the other hand, the support of these persons can help immeasurably to ensure the smooth acquisition, installation, and operation of a system.

Once an organization has reviewed these factors and determined both the need for and feasibility of acquiring new or enhancing existing automated technology, a step-by-step procurement plan should be adopted. This study of the Pappo N.R.D.'s current data processing requirements is the first step in such a plan. It will, in turn, lead to the following activities, in order of occurrence:

- * A decision by officials of whether to pursue acquisition of a computer system based on the recommendation contained in this report. This decision should follow shortly after review of this report by N.R.D. officials.
- * In the event the N.R.D. decides affirmatively, CAUR can assist in development and submittal to data processing vendors of a Request for Proposal (RFP) for a system to meet the requirements identified in this study.
- * Proposals received by the N.R.D. will be evaluated, and two or three finalists will be selected for additional consideration from among all of the proposals.
- * N.R.D. officials will be asked to approve the selection of finalists and to authorize further evaluation of these proposals, including visits to or other organizations having systems installed by the finalists.
- * CAUR will conduct a detailed evaluation of the remaining proposals and will recommend a system vendor for consideration by the N.R.D.

* Negotiation of a contract with the selected vendor will follow.

* Finally, system installation, testing, and acceptance will complete the procurement plan.

This step-by-step plan outlined here is recommended for use by the Papio N.R.D. as a method proven effective for computer system acquisition in numerous public organizations throughout the country.

IV. N.R.D. Activities by Department and Function

The Papio Natural Resources District is one of Nebraska's 24 N.R.D.'s. It was created in 1969 by L.B. 1356 and is governed by a 21 member elected board of directors.

The Papio N.R.D. encompasses an area of approximately 1,000 square miles. It includes all of Douglas, Sarpy, and Washington Counties, and the southeast area of Dodge County. Its jurisdiction includes portions of the Missouri, Elkhorn, and Platte River basins.

The district's primary functions are to protect, manage, and develop the soil, water, forest, and wildlife resources of the area. According to its recent annual report, the N.R.D.'s seven major program areas include: erosion prevention and control, flood prevention and control, pollution control, water supply, forestry and range management, drainage, and recreation and wildlife development.

The N.R.D. has four office locations: district headquarters in Omaha, a Douglas-Sarpy County field office in Papillion, a Washington County field office in Blair, and a maintenance facility in Papillion.

A. General Manager

The Papio N.R.D.'s general manager directs the day-to-day operations of the district in accordance with the policies established by the Board of Directors. The manager would like to develop both short- and long-term priorities for automating the organization. He views office functions and engineering applications as high priorities for automation. In addition, he sees data base management, record maintenance, and access to other physical data bases (discussed under the Project Services Section) as a part of these first priority applications.

The general manager considers the financial management, payroll/personnel, and inventory and equipment functions as a slightly lower priority for automation due to the relatively lesser volume of records and the adequacy of current operations.

The general manager is open to consideration of both in-house and service bureau approaches to automation or some combination of the two. If in-house the main location of equipment would be in the district headquarters facility.

B. Office Management/Operation

The administrative secretary and bookkeeper were interviewed by the study team to gather information on the five office management/operation functions--financial management, payroll/personnel, water billing and collections, equipment inventory, and word processing. Four staff personnel are employed to deal with these day-to-day functions, not including the general manager.

1. Financial management

The Papio N.R.D. operates with a current budget of \$2.6 million. The budget year is from July 1 to June 30. Revenues originate primarily from a property tax in Douglas, Sarpy, Washington, and a portion of Dodge Counties. Dodge County provides funds annually, but the other counties forward funds monthly to the N.R.D. In addition, specific projects receive state funding. While field offices sell various products (e.g. gopher bait) and rent out equipment, receipts from these are minimal and are managed by the individual field offices. Revenues are deposited as they are received and a summary report furnished the district headquarters once a month.

The Papio N.R.D. uses cash accounting and does not use any requisition, purchase order, or encumbrance systems. The N.R.D. has 50 expenditure funds and approximately 150 to 175 line items (accounts) in their budget. The N.R.D. currently uses one checking and one savings account.

Cash collections are primarily from water billing but also from minor items such as trees, gopher bait, aerial photography, and equipment rental.

The N.R.D. makes approximately 1,000 purchases per month. The N.R.D. maintains an alphabetical list of several hundred vendors, and issues 250 to 300 vendor checks per month. Invoices are paid once per month. Water purchased from the Metropolitan Utilities District for distribution via the N.R.D. water system is paid for once per month and within five days of billing. Payroll taxes are paid by deadline dates.

The N.R.D. employs a service bureau, Boyle and Hess Accounting, at a cost of \$275 per month or \$3,300 per year. The service bureau is provided revenue reports, expenditures reports, and copies of checks by the N.R.D. The service bureau returns several monthly reports to the N.R.D., including budget comparisons by account, revenues, cash disbursements, payroll, check vouchers, trial balances, and outstanding checks. After receipt of reports, the N.R.D. posts trial balances to the general ledger and reconciles checks manually. A time lag of several days occurs between submissions to the service bureau and receipt of reports.

The administrative secretary and bookkeeper view automation very favorably. They wish to automate their accounting and financial management functions including budgeting and investment management. They desire information management capabilities, particularly for budgeting. They would also like to integrate accounting for the N.R.D.'s conservation assistance (CAP) and wildlife habitat programs with other accounting. Record keeping for these programs is currently accomplished on the word processing system (see below).

2. Payroll/personnel

Payroll checks are issued twice per month for up to 30 employees, including seasonal and part-time help. Currently 15 salaried and nine hourly persons are employed with one additional employee planned in each category. The N.R.D. also issues per diem payroll checks quarterly to its 21 directors.

Time records for each employee are maintained by the N.R.D. Workers self-record their hours and supervisors check entries and report hours to the bookkeeper. The time records are maintained by Douglas County (with inventory) at a cost varying from \$100 to \$200 per month. Deductions are computed and paychecks are prepared manually. Payroll records are then sent to the service bureau (Boyle and Hess) where reports are generated. Reports include payroll totals by individual and by deductions. Payroll is posted bi-monthly with an approximate three-day lag between posting and entry in the accounts payable ledger and departmental budgets.

The payroll includes six deductions: federal taxes, state taxes, F.I.C.A., medical insurance, retirement annuity, and miscellaneous deductions. Types of pay include regular and overtime. Travel reimbursements are issued separately.

The Papio N.R.D. uses a step-in-grade payroll system based on job description and performance/merit. Evaluations are made by department heads and maintained by the administrative secretary. The present system has been in place since 1982. Personnel records are maintained manually for all employees. Personnel records are not integrated with the payroll system.

The administrative secretary and bookkeeper want to automate check printing and payroll and personnel record keeping. They are concerned that the content and format of reports meet their needs.

3. Water billing and collections

The Papio N.R.D. has operated a water distribution system for four years. Water is purchased from the Metropolitan Utilities District and distributed to 65 individual customers and the City of Ft. Calhoun.

Billings are monthly to all individual customers, and to the city of Ft. Calhoun, which bills its own residents. Individual customers read their own meters and mail in their readings and payments each month. The N.R.D. randomly checks meters for accuracy. It estimates that most payments are made by check (99 percent) and the remainder are in cash. Most payments are received during the first half of the month, with the peak period being between the 5th and 15th. Water collections total between \$3,000 and \$9,000 per month (with approximately \$1,500 to \$2,000 of that from Ft. Calhoun). Delinquencies are very few (perhaps three per month).

Payments are posted to the customers' accounts as they are received, posted to the revenue journal daily, and the revenue journal is posted to the general ledger and balanced monthly. All revenue is posted manually.

The administrative secretary and bookkeeper would like to automate their water billing and collections system.

4. Equipment inventory

The Papio N.R.D. maintains a manual system-wide capital assets inventory for insurance purposes. Four categories of equipment are inventoried: vehicles, equipment, buildings, and land. The inventory is audited once per year and currently includes 24 licensed vehicles and approximately 40 pieces of

large equipment. A listing of vehicles and major construction/maintenance equipment by I.D. number is maintained for the N.R.D. by the Douglas County data processing department for a very minimal fee included in the time records charges (cited above).

5. Word processing

The Papio N.R.D. office currently owns two Lanier "No-Problem" word processors with dual floppy disk drives which are connected to a single Qume printer. The equipment was purchased in 1980 for \$20,946.45 with programming. The N.R.D. also carries an annual hardware maintenance agreement on all equipment. The cost of maintenance was \$1,410 during 1980-81 but rose to \$2,086 by 1983-84. This amounts to a 48 percent increase over three years or an annual increase of approximately 14 percent during the period. The N.R.D. can expect maintenance costs to continue to increase. Though future maintenance agreements could be avoided, the word processing system has required attention due to failure four times during the four years it has been operated, and repairs at time of failure without an agreement are costly.

The N.R.D. employs two full-time secretaries who are trained as word processing operators and has a third person trained to operate the system. One word processor is in operation 100 percent of the work day, and the second is used approximately 80 percent of the time.

The word processors are currently used for word processing and limited accounting/financial management. Word processing activities include: daily memos, correspondence for approxi-

mately 11 personnel, mass mailings, job descriptions, board of directors' minutes, departmental minutes, and legal descriptions of land parcels (tracts). Accounting/financial management activities include record keeping for expenses of and payments to members of the board, and record keeping for the wildlife habitat and conservation assistance programs. The word processors are used to post the monthly balance sheets for the conservation assistance program. The wildlife habitat program requires that the cost of farm participation (including land set-asides) in the program be billed to the state four times per year and that payments be disbursed to the participants. This is accomplished on the word processors.

C. Project Services Section

The project services section of the Papio N.R.D. employs 13 full-time and three part-time personnel, including the following functions: construction maintenance and engineering, equipment operations, special projects, and natural resources planning. The personnel are responsible for various water resources engineering, operation and maintenance, and resource functions of the N.R.D.'s approximately 1,000 square-mile jurisdiction.

The section designs and/or constructs water resource facilities such as channels and levees, but not dams and reservoirs. It is also responsible for watershed oversight and maintenance of waterway channels and small reservoirs, the collection and reporting of field data (such as rainfall and streamflow), monitoring and management of water resource programs (discussed below), and technical assistance to land holders in the basin.

The section has intermittent though extensive interaction with the Corps of Engineers (for technical design), Soil Conservation Service (for soil data), the Natural Resources Commission (for water and resource data), and Douglas County data processing (for use of hydrologic models).

The section is involved with many different programs each with its own responsibilities. The rural water supply program requires the maintenance of the N.R.D.'s water distribution and supply system. The watershed small dam project, established by P.L. 566, requires the N.R.D. to acquire right of way and to maintain post-construction structural inspection and testing of retaining structures. The Elkhorn River improvement project requires a land based benefit-cost assessment for 40 miles of riverway, whereby assessments to landowners are based on benefits expected. The Fish Creek drainage program requires management of three miles of waterway.

The section also shares the cost of the operations of four programs. The road structure program deals with county bridge replacement and grade stabilization of retention structures within the area of the N.R.D.'s watershed. The urban conservation assistance program deals with the maintenance of channels and one small dam. The conservation assistance program deals with maintenance of terraces and waterways outside urban areas, and the wildlife habitat program involves the setting aside of land for natural habitats.

The project services section also collects and records many types of hydrologic data. A simple file of precipitation amounts

at various sites in the basin is constructed from approximately 35 volunteer "cooperators" who report monthly to the N.R.D. Groundwater volume is monitored and reported for eight different sites in the basin. Stream flow volumes are also recorded from approximately 36 sites through the bridge staff gauge program. Data gathered are incorporated into various hydrologic models of water flow and channel maintenance.

The section currently handles several calculations manually. These include cut and fill calculations, hydraulic and structural design for pipes, curve analysis for road construction and levee use, watershed runoff computations, open channel hydraulics, and indexing of data and collection points. It also occasionally uses the Douglas County data processing department (on their IBM 3031) for operations of the COGO (coordinate geometry/traverse closure) and HEC 2 (water surface profile) models. Frequency of use varies over time with the individual model, with natural events, and with workload. Payments for use vary widely, normally from \$25 to \$100 per month but as high as \$200 per month. The Douglas County system can only be accessed by traveling to its offices, but arrangements may be possible in the future for shared terminal(s) in the Douglas County special services office located in office space adjacent to the N.R.D.

The section would like to incorporate several other models into its operations. These include the HEC 1 (surface run off) and SWMM (storm water management model) models developed by the Army Corps of Engineers and the TR-20 and TR-60 (hydrology)

models developed by the Soil Conservation Service. A graphics printer or plotter would be needed for any in-house hydrologic mapping capabilities. The section would like to automate its equipment maintenance, scheduling, and cost management (by project and equipment used) procedures. It would also like to access other agencies' data bases, such as soils records from the Soil Conservation Service.

D. Information and Education Department

The Papio N.R.D. has an in-house public relations and resources department staffed by one full-time and one part-time personnel, plus a librarian who works approximately four weeks per year. It differentiates its varied activities into informational and educational functions. Among its informational activities are publications, workshops, news media contacts, television programming, and maintenance of a traveling display. Its educational activities include public meetings and hearings, annual youth contest, mini-grants program, teachers' scholarships, slide programs and speakers bureau, and maintenance of an in-house library.

Publications include Spectrum, a bi-monthly newsletter; Profile, an annual report; and brochures. The newsletter is hand-typed, edited, and then delivered to the N.R.D.'s printer, Publication Printing of Waterloo, Nebraska. Approximately 3,600 newsletters are printed at a total cost of \$1,000 per issue with \$240 of that amount spent on mailing costs. The mailing list is periodically updated manually and is under control of the printer.

Workshops include land owner tours and demonstrations of conservation techniques. News media contacts include the release of single page bulletins each month and an annual release. Television programming includes a monthly Cox Cable program and public service messages. The N.R.D. has in-house play-back capabilities (four years old) on recording equipment.

The mini-grant program awards up to 25 \$10 to \$50 prizes each year for environmental education projects by local school teachers. The teachers' scholarship program provides approximately three \$200 awards each year for teachers to attend summer courses on environmental or conservation issues.

The N.R.D.'s in-house library houses approximately 300 books, around 20 periodicals (kept for five years), and numerous pamphlets and brochures. A local news release and clippings file is maintained. In addition, the library houses a small videotape collection (half-inch VHS), including the 12 Cox Cable tapes generated each year, and an extensive photo slide collection generated at a rate of 250 rolls of film per year. All library indexing is currently accomplished manually using a 3 X 5 inch card file.

The information and education department works with both the Soil Conservation Service and Extension Service. It services all other N.R.D. personnel.

Current record keeping, all manual, includes a mini-grant and scholarship file, printings file, news release file, and library collections file. In-house word processing is used for correspondence, speech writing, news releases, and media scripts.

The department would like to automate their record keeping (such as for mini-grants and teachers' scholarships) and their index of library holdings (particularly slides). In particular, they wish to gain mailing list update and printing capabilities. A caution is in order here: the automation of library holdings (indexing) will only be as good as the index system designed (whether manual or computerized) and as good as library operations (such as refiling and sign-outs).

E. Field Representative Offices

The two field offices are established to administer the district's programs and provide services at convenient locations. Each field office has two staff members: a field representative and secretary. The field office personnel deal with land owners individually to provide services, equipment, and information. They administer wildlife habitat, soil, and land conservation, and sales and rental programs.

The wildlife habitat program is administered locally but records are kept at the district headquarters office. The cost is shared with the Nebraska Game and Parks Commission. Begun in 1976, it currently involves 118 separate landowners with multi-year contracts, and the program's maximum capacity is 150 participants.

The field offices rent out three gopher machines (approximately 20 times per year), four grass drills (10 times per year), and two tree planters. They also sell gopher bait (30 times per year) and trees (approximately 6,000 trees at \$40 per 100 in 1983 sold to 50 to 100 customers, mostly in the spring).

The field offices maintain all sales records and bill for materials and services manually. Sales are reported once per month to the district headquarters. An equipment inventory (by date of purchase) is maintained by the maintenance facility and the district headquarters. Word processing is used only twice a year for the field office's financial reports. The field office superintendent sees no urgent or immediate need for automation for his functions because of the relatively low volume of record keeping at the field offices (though he is supportive of district automation).

F. Summary of Current Data Processing Costs and Expenditures

Current N.R.D. operations include several rudimentary data processing activities. Word processing is accomplished on an in-house system owned and operated by the N.R.D. In addition, two service bureaus (Boyle and Hess, and Douglas County data processing) are employed to perform various parts of four functions: accounting/financial management, payroll, inventory, and engineering.

Costs of in-house word processing include an initial investment in hardware and software and an annual maintenance cost. Word processing and service bureau costs are itemized below, using current and projected five-year costs (based on current rates).

Purchase Cost/Investment

Lanier Word Processing System*	\$20,946.45	\$20,946.45
<u>Annual costs:</u>		
	Current Annual	Projected 5 Year (at current rates)
	_____	_____
Service bureau charges:		
Boyle and Hess	\$ 3,300	\$16,500
Douglas County data processing		
Office operations	\$ 1,800	\$ 9,000
Engineering	<u>\$ 1,200</u>	<u>\$ 6,000</u>
Subtotal	\$ 6,300	\$31,500
Maintenance of word processing system:	<u>\$ 2,086</u>	<u>\$10,430</u>
Total	<u>\$ 8,386</u>	<u>\$41,930</u>
	=====	=====
Grand Total (investment and current costs projected over 5 years)	\$29,332.45	\$62,876.45

*Twenty percent of the purchase price or \$4,189, would be allowed currently on a non-trade-in buy-back by Lanier.

V. Basic Applications to Consider for ComputerizationA. Introduction

The use of automated data processing by the Papio N.R.D. is relatively limited. This is understandable if for no other reason than the size of the organization and its operational requirements.

The current generation of data processing technology permits a wide variety of functions to be automated and encourages both

functional and data base integration. The type of system that should be considered by Papio N.R.D. should have the following characteristics:

Transaction oriented--When a transaction such as updating the accounts receivable file is made, the system accepts the transaction and automatically updates all affected ledgers and funds. This would, for example, permit automatic distribution of the entry throughout the system and would also provide for an audit trail of the transactions.

On-line--Computer terminals and printers in one or more physical locations in the district headquarters would be connected to the computer central processing unit.

Real time--Processing on the system occurs at the time a user begins to work at a terminal, and no need exists to create punch cards, ledger cards, computer coding forms, or other input type documents to run through the system at a later time.

Interactive--This means that users communicate directly and immediately with the computer through video display terminals.

User-friendly--Computer programming or software is written in such a way that the programming itself instructs users in its operation. At the minimum, user-friendly software is "menu driven," meaning that hierarchical lists of choices of actions appear on the video monitors, and users instruct the system in the completion of required actions by selecting the correct choices.

Multiprogramming--This means that the computer is capable of accommodating the performance of several functions by several users at the same time. For example, the bookkeeper could enter revenue data at one terminal, an engineer could enter stream gauge data at another terminal, and the printer could print payroll checks all at the same time.

Inquiry/Report Generator--The system should include software that will enable users to make unique inquiries across all data bases, to create unique files, to combine data from various files, and to generate unique (not pre-programmed) reports, all using standard English language commands.

B. Applications

All persons interviewed at the Papio N.R.D. were very helpful to the study team. They not only provided clear and concise information about existing activities but also demonstrated that they had given serious consideration to the N.R.D.'s future data processing and information management needs. Many of the suggestions made by personnel regarding future automation are reflected in this report.

The analysis of Papio N.R.D.'s current data processing activities and knowledge of available cost-effective automated data processing systems for small organizations suggest that the following functions be given consideration for automation on a modern computer system. They are listed by N.R.D. offices.

1. Office management

a. Integrated financial management, including:

general ledger accounting

budgetary accounting

budget preparation

vendor accounting

accounts payable

check reconciliation

cash handling

b. Payroll/personnel

c. Accounts receivable (for water billing and accounting)

d. Data base and file management (for inventory, equipment management, and inquiry)

e. Word processing

This function may be maintained on the Lanier word processing system currently used or integrated with the other office management functions, depending on the alternative configuration selected (discussed below).

A fully integrated computer system is recommended for office management use. Should a fully integrated system be solicited, activity in one programming system would automatically update the other relevant and subsidiary subsystems. For example, activity in the accounts payable system would automatically update the general ledger and all subsidiary ledgers and the budgetary accounting system.

2. Project services/engineering section

This office has many and varied applications focusing primarily on civil engineering, hydraulics, hydrology, and water resources development. Among the functions they want to automate are:

- * a. Coordinate geometry/traverse closure (such as the COGO and APL packages)
- b. Pipe hydraulics and structural analysis
- c. Slope/curve analysis (such as the SLOPE package)
- d. Storm water management (such as the SWMM package)
- e. Surface runoff (such as the HEC 1 package)
- f. Water surface profile (such as the HEC 2 package)
- g. Open channel hydraulics (such as Mannings equation)
- h. Graphics and mapping capability.

These functions are performed occasionally and irregularly but are performed repeatedly. The functions must be performed relatively rapidly, and automation would decrease the time and increase the efficiency of performing the functions. In-house performance of (or linkage to) the automated functions is desirable.

Many of the packages providing engineering/hydrology functions were developed by public agencies (such as the Army Corps of Engineers, Soil Conservation Service, etc). Although that software is considered non-proprietary, most of this programming was initially developed for mainframe and/or minicomputer systems. When such programming is modified to operate on relatively smaller systems, the organization responsible for modifi-

cations may charge for its purchase and/or usage. Thus, the Papio N.R.D. should expect to incur a cost for this programming, whichever allocation alternative is selected.

3. Information/education department

A word of caution must be reiterated here. As discussed above in Section IV.D., automation of files and indexing for the information and education office will only be as adequate as the pre-automation design of the file/index system implemented. Automation will not insure good management of holdings but will only facilitate information management. In addition, the efficient maintenance of the collection (sign-outs, refiling, etc.) is essential to adequate information maintenance, whether manual or automated. Automation alone will not solve current management problems.

With these cautions in mind, the applications appropriate to the functioning of the information and education office are:

- a. Data base and file management
- b. Word processing.

VI. Alternative System Configurations and Costs

Several alternatives for automation of Papio N.R.D. functions are explored here. Available alternatives vary by N.R.D. offices/functions and are based on the needs of four office areas--office management, word processing, project services/engineering, and information/education. (The field offices have no immediate need for automation.)

A single solution is offered for the data processing needs of the information/education office. Separate and joint options are

offered for the word processing and office management functions. The widest variety of alternatives is available for the project services/engineering office functions.

A. Alternatives by Office/Functions

1. Office management--Two alternatives are offered here, based on two different approaches to office automation. The first alternative is a single-user microcomputer to meet the needs of current office operations, with record keeping by a single person and separate from word processing. (Future expansion would be limited to the purchase of separate but compatible additional stand-alone microcomputer(s).)

The second alternative allows for a multi-user microcomputer system that integrates word processing with office management. Integration of the two functions is not necessary to office operations but would allow word processing operators to share in office management record entry and operations.

The second alternative is initially more costly but may prove to be cost-effective in the long term, if future expansion (addition of work stations) is being considered and/or if management wishes to have personnel share in a variety of functions.

a. Alternative # 1--Stand-alone, single user microcomputer

Hardware--microcomputer with single work station, 256K of memory, dual floppy disk drives (floppy disk capacity of ½ MB) and single dot matrix printer

\$3,500 to \$5,000

Software--include financial management, payroll/personnel, accounts receivable (for water accounts), and data management (for inventory).

\$2,500 to \$4,000

Total \$6,000 to \$9,000

b. Alternative # 2--Integrated multi-user microcomputerHardware--microcomputer with:

3 work stations--one each for bookkeeper and two word processing operators	
1 disk storage unit	
1 tape backup (or alternative)	
1 word processing printer	
1 dot matrix printer	
Purchase price	\$21,000 to \$40,000
Disk maintenance cost	<u>1,500</u> to <u>3,000</u>
Subtotal	\$22,500 to \$43,000

Software--all functions

included under 3a (above) plus word processing	
Purchase price	\$ 5,000 to \$15,000
Software support	<u>2,500</u> to <u>7,500</u>
Subtotal	\$ 7,500 to \$22,500

<u>Training</u> -- Varies widely in avail- ability and cost	0 to \$ 1,500
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<u>System Total</u>	<u>\$30,000 to \$67,000</u>
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Lanier Word Processor Buy-back

(Lanier estimates it will pay 20 percent of the word processor purchase price to the Papiro NRD for a non-trade-in buy-back; allowance for trade-in or for sale of private sale of the system could amount to 50 per- cent of the purchase price (20 percent is used here.)	-\$ 4,189 to -\$ 4,189
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Net System Cost	<u>\$ 25,811 to \$62,811</u>
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2. Word processing--

- a. Alternative # 1--Maintain the currently used Lanier system, although the system is three years old and maintenance costs are likely to rise over the next several years.

Maintenance Costs for Word Processing System

	<u>Former Cost</u>	<u>Increase Over Previous Year</u>	<u>Projected Costs</u>
1980-1981	\$1,410		
1983-1984	\$2,086	(14 percent annually)	
1984-1985		\$209 (10 percent)	\$ 3,295
1985-1986		\$230 (10 percent)	\$ 3,525
1986-1987		\$253 (10 percent)	\$ 3,778
1987-1988		\$278 (10 percent)	\$ 3,056
1988-1989		\$306 (10 percent)	<u>\$ 3,362</u>
		(over five years)	\$14,016

Using conservative (10 percent) rates of increase, maintenance costs for the Lanier word processing system are projected to be \$14,016 over the next five years (a time period used to allow comparison with other figures).

- b. Alternative # 2--Integrate word processing function with office management function (explored under Alternative # 2, office management, above).

3. Program services/engineering section

The configuration and cost of a solution to the data processing needs of this department are most difficult to determine for a variety of reasons. Foremost among these is the fact that most relevant software has been developed for mainframe and/or minicomputers (costly systems requiring the employment of programmer/operators at additional cost). Only recently has any of this software become available for microcomputer processing, and many programs are still in the process of being adapted to microprocessor technology. Thus, in-house capabilities at a reasonable cost are, as yet, limited.

In addition, the need for a variety of software that is operational on a single system may be difficult to achieve. Various programs have been developed by an assortment of agencies on different operating systems. For example, the United States Geologic Survey has committed itself and its programs to an extensive communications network on PRIME computer hardware (PRIMOS operating system), while the Hydrologic Engineering Center (HEC) of the Army Corps of Engineers is encouraging those acquiring microcomputers to select UNIX-based systems compatible with its Harris minicomputer systems.

Finally, the requirements of some programs for address space, data path width, register size, and computational complexity currently limit the availability of certain applications to operation on the larger 32-bit super-micros.

In-house programming is possible for certain simple procedures currently hand-computed by staff with engineering/programming ability. Automation of these procedures on microcomputers using simple calculations packages can be fairly easy. However, an organization must remain cautious in using this approach to automation. First, in-house programming can prove costly if the hours devoted to programming become excessive. Second, this approach can be inefficient if "canned" programming is unavailable or if programming is not well documented. (With turnover of personnel, knowledge of how to operate "home-grown" programs is often lost; thus, the wheel must be reinvented.)

Two alternatives are offered here based on different approaches to acquiring automation of engineering functions. The first solution is to acquire several single-user microcomputers with connect capabilities to other computer systems. This solution enables the performance of simple in-house functions but commits the N.R.D. to performing major, complex functions through the use of a service bureau or bureaus. The microcomputers would be used to input data. Computer analysis would be accomplished by programming available at other agencies/organizations at a cost. The N.R.D. would then receive output from those agencies/organizations via linkages to those other external systems. Costs of such external services are usually computed as a combination of processing (CPU) time, communications costs, storage costs, miscellaneous services, and discounts for government agencies. An option may also involve time-sharing with other agencies for services.

The second solution is to acquire an integrated multi-user microcomputer system. This solution enables the performance of most or all functions in-house but allows a remote connect to other systems for additional data or services. Independence of operations is maximized under the second solution, though at a significantly greater cost.

a. Alternative # 1--Stand-alone, single-user microcomputers

Hardware--three separate, stand alone microcomputers with single-user work stations, 256K of memory, dual floppy disk drives (floppy disk capacity of $\frac{1}{2}$ MB), and single matrix printers (costs ranging from \$3,500 to \$5,000 each).

\$10,500 to \$15,000

Plus three modems (or comparable connect ability) to access external systems and data bases (Costs ranging from \$700 to \$900 each).

\$ 2,100 to \$ 2,700

\$12,600 to \$17,700

Software--Assumes initial purchase of five packages of lower capacity programs (best estimates suggest that packages range from \$50 to \$1,500 each).

\$ 2,500 to \$ 7,500

Service Bureau Charges--Costs are typically based on CPU time, communications, storage, and miscellaneous costs. Vendors contacted could not or would not cite estimates of cost because estimates require firm knowledge of volumes and frequencies of data to be run and extent of models to be operated.

\$? to \$?

Systems Total

\$15,100 to \$25,200

b. Alternative # 2--Integrated, multi-use "super" microcomputer

Hardware--microcomputer with:

- 3 work stations
- 1 disk storage unit
- 1 tape backup (or alternative)
- 1 system printer
- 2 matrix printers

Purchase price \$30,000 to \$45,000

Maintenance cost \$ 6,000 to \$12,000

(Disk and system printer)

Subtotal

\$36,000 to \$57,000

Software--Indeterminate. Assume initial purchase of five packages including COGO, HEC 1, HEC 2, STORM, and FLW (Figures used are an estimate based on a single vendor's programming)

Purchase price	\$20,000 to \$26,000
Maintenance cost	<u>\$10,000 to \$13,000</u>
Subtotal	\$30,000 to \$39,000
	<u> </u> <u> </u>
<u>System Total</u>	\$66,000 to \$96,000

4. Information/education department-- The needs of the information/education department are limited to file creation and maintenance, inquiry, and data base management. A single, stand-alone microcomputer system will meet those needs, as described below.

Hardware--microcomputer with single work station, 128K of memory, dual floppy disk drives, and dot matrix printer (system should be compatible to other N.R.D. equipment for backup purposes)

\$3,000 to \$4,500

Software--data base management programming

\$ 500 to \$ 600

Total \$3,500 to \$5,100

B. Summary of Alternatives

Alternatives and associated costs are summarized for each office function below. A recommended combination of alternatives is also shown. The recommendation is based on an attempt to minimize costs while selecting appropriate data processing alternatives.

<u>Department</u>	<u>Least Costly Alternatives</u>	<u>Most Costly Alternatives</u>	<u>Recommended Alternatives</u>
Office management, separate	\$ 6,000 to \$ 9,000	— —	\$ 6,000 to \$ 9,000
Word processing, separate	\$14,016 — \$14,016	— —	\$14,016 — \$ 14,016
Combined word processing/office management	— —	\$25,811 to \$ 62,811	— —
Program services/engineering	\$15,100 to \$25,200 <u>plus</u> service bureau charges	\$66,000 to \$ 96,000	\$66,000 to \$ 96,000
Information/education	<u>\$ 3,500 to \$ 5,100</u>	<u>\$ 3,500 to \$ 5,100</u>	<u>\$ 3,500 to \$ 5,100</u>
Total five -year costs	\$38,616+ to \$53,316+	\$95,311 to \$163,911	\$89,516 to \$124,116
Annual costs (over five years)	\$ 7,723+ to \$10,663+	\$19,062 to \$ 32,782.20	\$17,903 to \$ 24,823
Average annual cost	\$9,193	\$25,922.20	\$21,363

VII. Alternative Methods of Acquiring Computer Technology

A. Alternatives

The Papio N.R.D. can acquire the required computer technology by one of three alternative methods:

1. Rely on outside service bureaus for data processing. These agencies can be used to provide either "batch" or "on-line" data processing services.
2. Acquire in-house computer hardware and also develop application software (programming) for the system.
3. Acquire a fully programmed and supported system, including both in-house computer hardware and packaged application software. Such a system would be operated by existing personnel.

B. Evaluation of Alternatives

1. Service bureaus

a. Advantages

- Software and hardware are maintained by the service bureau.
- A qualified staff is available in certain functional areas.
- The transition to automation from current operations would be relatively easy.

b. Disadvantages

- Limits are imposed by cost and expertise available at service bureaus regarding initiation of additional or more sophisticated data processing capabilities.

- Service bureau software may not provide much flexibility for the local user.
- Communication breakdowns and attendant costs can occur, and communication costs can be high if an on-line connection to the service bureau is used.

2. In-house hardware/in-house software development

This alternative is not deemed acceptable for the following reasons:

- The length of time required to create the required software will be excessive.
- The personnel and cost requirements of in-house software development and support are excessive.
- The limited availability of qualified programmer/analysts with experience would result in difficulty in hiring and retaining a qualified programmer(s).

This alternative would take too long, cost too much, and involve too much risk for a small organization to implement a data processing system.

3. In-house computer and packaged software

a. Advantages

- The N.R.D. would own and control its own system.
- The software is tested and reliable, and most packages can be modified by the vendor to meet the N.R.D.'s specific requirements.
- The system can be operated easily by existing personnel.

- The system provides a relatively easy transition and introduction to electronic data processing.
- A procurement contract can be executed under which a vendor is fully responsible for system (hardware and software) performance according to the N.R.D.'s specifications.

b. Disadvantages

- Certain problems are associated with ownership and control of a computer system, including system depreciation and obsolescence, equipment failure, and use scheduling.
- Unanticipated vendor problems can occur.
- Personnel problems can arise involving both training of personnel and personnel fear of and/or opposition to a system.

C. Recommendations

This study recommends that a Request for Bid or Proposal (RFP) be developed to solicit proposals for in-house computer hardware and packaged software according to some combination of the alternatives outlined in this report. The RFP should place particular emphasis on in-house microcomputer systems, although the use of service bureau programming for engineering should be allowed under either alternative.

Three reasons exist for the Papio N.R.D. to proceed with this recommendation. First, current office management operations are either accomplished manually or (for those automated) lack

integration. Economies can be realized by automating/integrating those functions. The same can be said for engineering functions.

Second, the current generation of computer technology is relatively inexpensive, highly reliable, and easy to use.

Third, the N.R.D. can proceed with the recommendation made to submit RFP's for microcomputer systems at virtually no risk. That is, no decision regarding acquisition of a system need be made until bids have been received and evaluated and cost comparisons made.