

10. Consideration (either in method or cost) was not given in the scope of work or in our proposal as to reproduction of maps and photographs required for the documentation in the reports. Map reductions to the size which could be bound in a report would not show sufficient detail to be of value in locating the discharge points. The costs for color xerox to document the unpermitted discharges are approximately \$1.20 per page with two sites per page. We have estimated for future projects that \$100 per report copy be budgeted to cover color xerox of the photographs and reproduction of the maps.
11. The use of key maps (Key Maps, Inc., Houston) proved to be invaluable for pinpointing the location of many permitted discharges as described from the actual permits and also in locating unpermitted discharges where densities were too high and map resolution too low for latitude and longitude to be of value. As an example, street drains can be delineated by description such as "at the end of 10th Street at the intersection of H Avenue".
12. As an aid to locating positions on the myriad of storm and street drains and bulkhead or lawn drains along the western shore of Galveston Bay (or similar shorelines), it would be beneficial for a shorebased observation team to follow the boat survey crew from the highway paralleling the shoreline. Communicating by walkie talkie with the boat, the shore observation crew could document the location of these type discharges by house number or street intersection. They also would be in a better position in some cases to detect the presence of storm drains entering the bay.

6.0 RECOMMENDATIONS FOR COMPREHENSIVE SURVEYS

6.1 Design

The design of a comprehensive survey for unpermitted discharges should address entire areas surrounding Galveston Bay in order to eliminate the ambiguity and uncertainty of defining the study area. We recommend that such a survey be performed as a single project and not divided into smaller projects to be performed sequentially as funds or interest becomes available. Subsequent to submission of this report in draft form, it was learned that there are other regulatory agencies in the state of Texas which have need of similar information and pursue its acquisition in similar ways. The General Land Office utilizes aerial surveys in keeping track of new construction and the Texas Department of Health has used aerial surveys to locate aggregations of septic tanks which would influence their closure zones for shellfishing. With information and shared need, it would seem advantageous for any subsequent comprehensive survey design to incorporate this need and shared sponsorship.

As a plan for conducting such surveys is formulated, it should be kept in mind that our study covered the broadest spectrum of shoreline types, and our estimate for performing further studies is based on that mix of shoreline types. A change in the mix of shoreline types would necessarily affect the cost and approach to conducting that survey. For example, to survey the Galveston and Houston ship channels and Clear Lake only, would be labor intensive on the boat survey aspects. Similarly, a survey of West Bay could be done quickly and efficiently by the method employed here. Thus, a comprehensive survey would encompass both ends of the difficulty spectrum and would tend to average out the costs. A select survey of particular segments may vary significantly in both directions from the estimated costs we have developed here.

6.2 Methodology

The methodology we recommend for performing a comprehensive survey of the Galveston Bay system is the same as we employed in this pilot study with the modifications as addressed in Section 5.0. Multiple boat surveys (and land surveys where the aerial survey indicates such a need) could be conducted simultaneously on the same or nearby shorelines or stream segments as the logistical plan and time constrains would require. Without having to redevelop methodology and techniques as was done in this study, a single comprehensive study could be done in a shorter period of time than our efforts in this study would indicate.

6.3 Cost

We have estimated the cost to perform a survey as described and performed in this study (Table 6-1). The task numbers are those identified and described in our study work plan. Our cost estimate does not include tasks which were part of this pilot project and would not be required to be repeated for a comprehensive study to be conducted. The estimate does not include labor or costs for Tasks 10 (developing clearance and priority ranking criteria), 11 (developing survey reporting forms), 17 (conducting calibration/efficiency surveys), or 20 (this section of this report), as these were part of the development process. Nor does the estimate allow any expense to become familiar with the project objectives, techniques, data base management system, or in general to "gear up" for such an undertaking. The estimates of time and materials are what we estimate it would take for us to repeat, based on what we have learned and done to date, an equivalent survey on a similar amount and makeup of shoreline miles. Two cost areas of our estimate which show significant costs that are reflected in our pilot study are costs for reproducing maps and color prints for the report, and accurate costs for aircraft charters for the aerial surveys to be performed by anyone. These are included in the costs estimates which follow.

Table 6-1. Estimated Survey Budget

| | Senior Staff | Field Assistant | Staff | Travel | Supplies | Equipment Use |
|--|--------------|-----------------|-------|-----------------|----------------|----------------|
| Data Acquisition & Processing | | | | | | |
| Task 1 | | | 1 | | \$360 | \$0 |
| Task 2 | | 4 | | | \$0 | \$0 |
| Task 6 | 0 | 4 | | \$75 | \$0 | \$52 |
| Task 7 | 4 | 6 | | \$300 | \$0 | \$156 |
| Task 9 | 1 | 6 | 15 | | \$0 | \$525 |
| Task 13 | 2 | 14 | 3 | | \$0 | \$425 |
| Task 19 | 2 | 20 | 3 | | \$0 | \$575 |
| Man Days | 9 | 54 | 22 | | | |
| Subtotal Data Acquisition and Processing | | | | \$375 | \$360 | \$1,733 |
| Field Surveys, Air & Boat | | | | | | |
| Task 12 | 4 | 8 | | \$2,100 | \$360 | \$60 |
| Task 15 | | 36 | | \$800 | \$540 | \$3,168 |
| Man Days | 4 | 44 | | | | |
| Subtotal Field Surveys | | | | \$2,900 | \$900 | \$3,228 |
| Reporting & Project Management | | | | | | |
| Task 4 | 5 | | 5 | | \$0 | \$0 |
| Task 8 | 1 | | 1 | | \$0 | \$0 |
| Task 16 | | 6 | | \$150 | \$0 | \$0 |
| Task 14 | 1 | 3 | | | \$0 | \$0 |
| Task 18 | 2 | 8 | 15 | | \$0 | \$200 |
| Task 19 | 1 | 1 | 3 | | \$1,000 | \$0 |
| Task 22 | 2 | | 1 | \$75 | \$0 | \$65 |
| Task 24 | 5 | | 10 | \$75 | \$0 | \$0 |
| Man Days | 17 | 18 | 35 | | | |
| Subtotal Reporting & Project Management | | | | \$300 | \$1,000 | \$265 |
| Category Total | | | | \$3,575 | \$2,260 | \$5,226 |
| Salaries, Fringe, Indirect | | | | \$36,247 | | |
| Project Total | | | | \$47,308 | | |

The cost estimates given here are based on nine different shorelines totaling approximately 160 linear miles of stream or shoreline. The estimates can be extended proportionally to arrive at an estimate for the entire bay once the number, location, and length of the streams and shorelines are defined.