

PREPARATION OF LARKANA WASTEWATER MANAGEMENT STRATEGIC ACTION PLAN AND PRIORITY INVESTMENT PROGRAM

TERMS OF REFERENCE

A. OBJECTIVE

1. The main objective of the assignment is to prepare a Drainage and Sewerage Strategy and accompanying Action Plan and Priority Investment Program for Larkana (urban areas only), encompassing stormwater, sullage, drainage and wastewater disposal and management. This task entails identifying the worst affected areas and the cause of flooding, poor wastewater disposal, and evaluating options for mitigation. The assignment will provide the proposed North Sindh Urban Services Corporation (NSUSC)¹ and the Larkana Taluka Municipal Administration (TMA) with an assessment of the municipal sewerage and drainage system in Larkana, including a planning tool for NSUSC to prioritize sewerage and drainage works in consultation with the TMA. Strategic recommendations for prioritized investments will be developed for financing under the proposed Sindh Cities Improvement Investment Program (SCIP or the Investment Program).

B. SCOPE OF WORK

2. The work will be divided into two stages. During Stage 1, the consultant will carry out the following tasks:

- (i) On the basis of the existing ER Solutions map, reproduced at a suitable scale and 'windscreen surveys', identify the limits of built-up areas and map existing main drain and sewer routes; identify the extent of existing drainage and sewerage systems and facilities, including pumping stations, and wastewater treatment facilities; and approximate existing drainage area boundaries. Physical features such as canals and the railway, which are likely to effect present and future drainage arrangements, should also be shown on the base map.
- (ii) Identify different categories of development (higher income development, commercial areas, unauthorized land subdivision and *katchi abadis*) and identify the approximate limits of areas covered by each type of development.
- (iii) Identify any areas in which the ground water level is high which may create problems in laying sewers; provide representative information on the depth of the water table in different parts of the town.
- (iv) Prepare an overlay, showing the location of main roads and identifying any roads that are likely to be upgraded in the near future. (This may influence priorities for improvement since it will be best if drainage improvements take place before or in conjunction with road improvements).

¹ The NSUSC is expected to be incorporated by September 2008 and operationalized in the succeeding months. The Provincial Government's Program Support Unit for SCIP will be backstopping NSUSC prior to its operationalization.

- (v) Carry out a qualitative assessment, based on this initial survey, to identify problem areas, any physical issues such as canals and other obstructions blocking natural drainage routes. Where necessary carry out additional surveys to determine levels and clarify other issues.
- (vi) On the basis of this assessment, and taking into account the proposals in other sectors, (particularly roads) identify priority areas for action.
- (vii) Assess options for dealing with priority areas, presumably covering sanitation, wastewater disposal and storm water disposal, and the ways in which they would be combined or separated as appropriate.
- (viii) On the basis of the work carried out to this point, produce a strategy and action plan for the town.

3. The work should draw upon existing reports and the outputs from any previous mapping exercises, for instance those carried out by the Consultant RCC while preparing previous drainage improvements for Larkana

4. During Stage 2, the consultant will produce detailed designs and contract documentation for priority projects included in the Action Plan.

5. Throughout both stages of the task and especially during Stage 1, the consultants should liaise closely with the TMA, particularly the Taluka Officer Infrastructure and Services (TO I&S), the NSUSC and the SCIP Program Support Unit (PSU).² Initial meetings should be used to identify the TMA's drainage concerns and obtain copies of town maps and drainage and sewerage records. At succeeding meetings, the TMA and NSUSC, and the District Coordination Officer should be kept informed of the consultant's work progress.

C. DETAILED TASKS

1. Stage 1: Assessing Current Situation

6. When plotting facilities, a clear distinction should be made between open drains, closed drains and sewers. The diameters of all sewers and the sizes of main drains should be recorded. This may be done directly onto maps but it will probably be better to include this information in a data-base linked to the sewers and drains shown on the plan. Any permanently flooded areas should be shown, together with any that are periodically inundated. In the case of the latter, any information on the frequency and length of flooding events should be recorded.

7. The overall strategy should take account of existing legislation and the estimated scale and location of future population growth.

8. As much as possible, initial plans should be prepared on the basis of existing information and likely drainage routes and possible pumping facilities should be identified on the basis of observation. Proposals can be worked up with full surveys later, in Stage 2 for schemes

² The SCIP Program Support Unit will be the primary Provincial Government contact with the Consultants. The Consultants should also liaise with the District Coordination Officer, whose office oversees, among others, new investment in road works in the Larkana urban area.

identified for immediate action. Where the feasibility of a proposed activity, for instance, linking two pumping stations with a gravity sewer, is not clear, sufficient levels should be taken to clarify the situation and identify what is and is not feasible. Ideally, levels should be tied in to the Survey of Pakistan datum but if this is not possible, a permanent benchmark should be established and used as a local datum point. Clear information on the location of this benchmark should be provided by the consultants.

9. Phase 1 should include an initial assessment of the options for attenuating storm flows through the use of stormwater retention facilities, provision for infiltration and the use of trapezoidal and other drain sections with sufficient capacity to provide some storm detention within the drainage system. Approximate calculations should be provided, sufficient to show whether or not a particular option might be feasible but detailed designs will not be required at this stage.

10. Consideration should be given to the options for alternative routing of drains to avoid channelling large quantity of water through densely populated areas. The capacity and condition of existing sewers and drains should be taken into account when developing proposals and the overall Strategy should aim to retain and make use as much as is possible of existing drainage systems. However, facilities that are expensive or difficult to operate should be replaced. As far as is possible, drainage routes should be chosen to make use of the natural fall of the land and sewers and drains should only be laid against the natural fall where absolutely necessary, for instance to transfer flow from one catchment to another.

11. The overall strategy and subsequent designs should aim to minimize the need for pumping and also take account of the likely ability of NSUSC to implement, operate and maintain the system with respect to any institutional, technical and financial constraints. Proposals should take account of the importance of efficient drain cleaning and planned operation and maintenance in reducing future flood damage and drainage costs.

12. Where drainage systems extend beyond the urban boundary, the impact of any flows from outside Larkana Town on conditions within the town should be considered. Investigations should also cover what happens to wastewater flows after they have left the town itself. Questions such as: (i) What watercourses do they discharge to and are they used directly or indirectly (after transport through an agricultural drain or canal) for crop irrigation; (ii) What are the implications of current and probable future disposal and/or reuse arrangements and how will they affect the wastewater disposal strategy must be addressed.

2. Strategy and Action Plan

13. The strategy should include the following:

- (i) A statement of the planning principles and assumptions
- (ii) A statement of design standards, including standards for minimum sewer sizes and slopes.
- (iii) A recommended approach to combining or separating different types of flow
- (iv) A recommended approach to attenuating flows so as to minimise the size of drains and sewers required. Consideration should also be given to the options for minimising the need for pumping.
- (v) Recommendations as to quality standards for wastewater discharged to watercourses and used for crop irrigation, together with an indication of how those standards might be achieved and the land, management and financial

implications of different treatment options. When considering wastewater treatment options, preference should be given to low maintenance options such as waste stabilization ponds, constructed wetlands, baffled anaerobic reactors etc.

- (vi) An overall drainage plan, showing existing and proposed main drain and sewer routes, catchment boundaries and pumping station and treatment works site. Where possible, treatment works should be sited on land that already belongs to government. Where suitable government land is not available, the Strategy should indicate the possible cost of acquiring land and should suggest alternative sites for treatment facilities, on the basis that the first choice site may not be available.
- (vii) Based on the foregoing, identify priority projects and provide preliminary details and cost estimates for those projects.
- (viii) Outline management proposals for proposed facilities.

Stage 2

14. During Stage 2, detailed designs will be required for selected drains and drainage areas. Specific activities to be undertaken for these areas include the following:

- (i) Assessment of future population to be served, on the basis of likely development patterns and population growth rates.
- (ii) Based on estimated population figures and projected per-capita water consumption, estimate likely domestic sewage flows.
- (iii) Based on information on the location and types of industry and institutions and the wastewater that they generate, estimate probable industrial and institutional wastewater flows.
- (iv) Assessment of likely storm run-off, based on catchment area, estimated storm intensity and estimated run-off coefficient.
- (v) Based on the above, estimation of design flow for each length of main sewer/drain.
- (vi) Based on the above, for all proposed major sewers and drains, determine invert elevation and minimum and recommended cross-sectional flow area for each section of drain duly considering existing culverts. (Taking account of the need to maintain minimum self-cleansing velocities).
- (vii) Provide full calculations, detailed design drawings, specifications and contract documents, sufficient to allow construction of priority schemes after carrying out any further topographical, ground and other surveys required to finalise the schemes.
- (viii) Undertake more detailed surveys to provide the information required for detailed design of these priority projects.

15. When calculating design flows, rainfall-intensity curves should be used to calculate storm flows, if available. As a general rule, open drains should be designed for a fairly low return period, typically 1 or 2 years but a longer return period should be used if there is a danger that overtopping of drains will lead to flooding of houses and/or prolonged flooding of road surfaces. Culverts and other openings should be designed to carry higher flows, typically those resulting from a 1 in 10 year return period storm.

16. In the event that rainfall intensity-duration curves are not available, the Consultant shall clearly set out the basis on which he has completed his design and explain the reasons for adopting the parameters used.

17. When estimating drain sizes to carry storm flows, care should be taken in using the rational method, which makes no allowance for storage and so can result in overestimates of required drain sizes. Return periods also need to be seriously considered to ensure economic drain sizes and variations from those suggested earlier in these ToRs can be put forward if sufficient justification can be provided.

D. OUTPUTS/REPORT REQUIREMENTS

18. During the assignment, the consultant shall submit the following:

For Stage 1:

- (i) **Inception Report** to be submitted within 2 weeks from commencement, detailing study methodology, providing a detailed work plan, outline information on later inputs and identifying any critical issues.
- (ii) **Existing Situation Report**, including a layout plan showing the existing topography and urban features, existing collector sewers and drains in the TMA, drainage area boundaries, the extent of areas served by sewers and drains respectively and highlighting the worst flood or pollution-affected areas, to be submitted within 5 weeks from commencement of the assignment
- (iii) **Sanitation, Drainage and Sewerage Strategy and Prioritised Action Plan** to be submitted after 8 weeks. The Strategy and Action Plan shall be presented in a workshop given to the relevant TMA, NSUSC, District and Provincial staff. Before the workshop, the consultant should prepare a PowerPoint presentation setting out the main features of the Strategy and the schemes to be included in the Action Plan

For Stage 2

- (iv) **Design Report on identified Priority Investments** to be submitted after 12 weeks, including supporting calculations, drawings and justifications. In addition to 5 hard copies of the report, the consultant shall submit 3 sets of all the electronic data on CD-ROM.
- (v) **Full documentation for prioritized schemes**, including drawings, specifications, conditions of contracts, instructions to tenders etc, to be submitted by the end of Week 18

D. EXPERTISE AND INPUTS

19. A national engineering consulting firm experienced in urban sewerage and drainage engineering is required to prepare the Strategy and Action Plan and prepare designs and contract documents for priority investments, under the overall guidance by an international sanitation and wastewater management expert.

20. While engineering skills and experience are required as the backbone of this work, a general understanding of the economic, financial, social and environmental issues related to sewerage and drainage is also essential. A total of 10 person months of inputs over a period of

4 calendar months from the national engineering consulting firm (4 person months for Stage 1 and 6 person months for Stage 2) is required for the assignment.