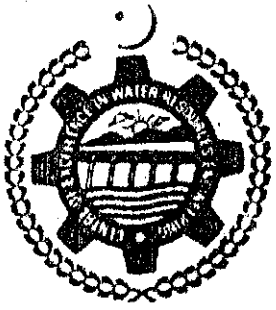
THESIS

EVALUATION OF ADEQUACY AND PERFORMANCE OF DRAINAGE INLETS OF SURFACE DRAINS



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ABSTRACT

Drainage Inlets are used to admit agricultural run off from the catchment area into a surface drain. Many operational conditions undermine the proper functioning of inlets and reduce its operational flexibility. The causes of improper working of inlets included silt deposition, vegetation growth, inappropriate location, crest level of the inlet being above the N.S.L of the service area, physical deterioration of the inlet and inadequate number of inlets. The objective to carry out this research is to study the present yardstick for the drainage inlets design being practiced by WAPDA and PID, evaluate the causes of malfunctioning of the drainage inlets under field conditions, study the adequacy of drainage inlets before and after the rehabilitation under National Drainage Program (NDP), identify the improvement required to ensure the functioning of the drainage inlet and to suggest improved yardstick for the drainage inlets.

Ten drains were surveyed in four districts of Punjab, and (total length surveyed = 68.2 miles, number of inlets surveyed = 148). Information was noted for silt spread, silt depth, location of silt cover, stiffness of vegetation, vegetation height and density of vegetation was recorded from limited measurements and engineering judgment. Number of drainage inlets provided and number of cuts and breaches were recorded to determine inlets per mile length of the drain and evaluate the adequacy of inlets. Drainage inlets were also evaluated for crest level vs. N.S.L and topological suitability of the location of drainage inlet.

Silt deposition (comprising of spread, location of the silt deposition, slit depth) was scaled from 0 to 10 (0 best, 10-worst). Vegetation growth (comprising of height of vegetation, density of vegetation, stalk stiffness etc) was scaled from 0 to 10 (0-best, 10-

worst). Physical Integrity of the structure was scaled from 0 to 10 (0 complete deterioration, 10-no deterioration) considering barrel, culvert, wing walls, chute and trough. Hydraulic performance (i.e. the ability of the drainage inlet to pass design discharge into the drain under present condition) was scaled from 0 to 10 (0 – no flow passes through the inlet, 10-full flow can pass) and was evaluated by engineering judgment by considering the following factors: crest level vs. N.S.L of the service area, suitability of inlet location. vegetation growth/silt cover and physical integrity of the structure. Over all performance of drainage inlet is scaled from 0 to10 and represent the weighted factor for vegetation growth, silt cover, physical integrity and hydraulic performance.

Ninety five (95) inlets (66% of the total inlets) were having problem of silt deposition. Average overall silt cover of all the inlets surveyed was 3.5. Twenty percent (20%) of the inlets were totally blocked (overall silt cover in the range of 8-10) by silt deposition (worst situation), and of these 50% were blocked intentionally by human interventions. Fourteen percent (14 %) of the total inlets were having overall silt cover in range of 5-7 (bad condition), where as 11% of total inlets were having overall silt cover in the range of 3-4 (unsatisfactory condition) and 55% of the total inlet were having overall silt cover in the range of 0-2 (satisfactory condition).

One hundred and one (101) inlets (68%) were having problem of vegetation. Average overall vegetation cover of all the inlets surveyed was 2.3. 11% of the inlets have vegetation cover equal or greater than 7 (severe condition), and 14% of the inlets have over all vegetation cover in range of 4-6 (bad condition). Whereas 75% inlets were having overall vegetation cover less than 4 (un-satisfactory condition).

Of the total 148 inlets surveyed 48 inlets (32%) have problem of inappropriate location, 25 inlets (17%) were having crest level above the N.S.L of the service area.

Of the total148 inlets surveyed, 49 inlets (33%) were partially destroyed and 21 inlets (14%) were completely destroyed. Average overall physical integrity of all the inlets surveyed was 4.6, whereas 24.3% of the total inlets have overall physical integrity in range of 8-10 (satisfactory condition). Twenty three percent of the total inlets have overall physical integrity in range of 5-7 (unsatisfactory condition). Twenty six percent of the total inlets have overall physical integrity in range of 3-4 (bad condition) and 26.7% of the total inlets have overall physical integrity in range of 0-2 (worst condition).

Average hydraulic performance of all the inlets surveyed was 4.0, whereas 24.3%of the total inlets have hydraulic performance in range of 8-10 (satisfactory condition). Thirty one percent of the total inlets have hydraulic performance in range of 5-7 (unsatisfactory condition). Fourteen percent of the total inlets have hydraulic performance in range of 3-4 (bad condition) and 31 of the total inlets have hydraulic performance in range of 0-2 (worst condition).

Average overall performance of all the drainage inlets surveyed was 5.4, whereas 25.6% of total inlets have over all performance in range of 8-10 (satisfactory condition). Forty percent of total inlets have overall performance in range of 5-7(unsatisfactory condition). Twenty two percent of total inlets have overall performance in the range of 3-4 (bad condition) and 12 % of total inlets have overall performance in range of 0-2 (worst condition).

Miana Gondal and TBM were among those drains which were/are being rehabilitated under NDP. There was no problem of vegetation growth, silt cover and

physical deterioration in rehabilitated drainage inlets, but only two rehabilitated drainage inlets were observed over a length of 5.4 miles in Miana Gondal drain, indicatng severe inadequacy. In TBM drain, inlets which were not rehabilitated were totally blocked by silt deposition, indicating severe problem of inadequate maintenance as for other drains.

During survey of 10 drains, 68.2 miles distance was covered and 148 inlets were observed and number of inlets provided per mile length of the drain varies from < 1 to 4 on (average 2) indicating that present criteria laid by WAPDA is not followed. In addition a total of 88 cuts were also observed, and 20 pipe inlets were constructed by the farmers to provide adequate drainage. Lead channel have improved the drainage opportunity. It is envisaged that 3 to 4 inlets should be provided on each side of the drain in conjunction with lead channel and raised embankments to improve runoff drainage capacity of the system and restrict flow of runoff over the drain bank everywhere exfept the inlet.

From the field experiments it is recommended that periodic cleaning of the drainage inlets should be done particularly before rain season in order to get rid of silt deposition and vegetation growth. Care should be taken at the construction stage, so as to establish crest level of the drainage inlet to be at 15-30 cm below the N.S.L of the service area.