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By David M. Freeman,
Max K. Lowdermilk and
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Water Management Research Project
Colorado State University
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VOLUME VI
APPENDICES

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Abstract

The Volume VI contains a wide range of information, background and raw data which is supportive of the discussion of farmer constraints and responses as presented in the first five volumes. Clearly this volume is not intended to be read as a whole but the reader will want to consult specific appendicies for elaboration of points raised in the foregoing volumes.

Water Management Research Project
Engineering Research Center
303/491-8216

Colorado State University
Fort Collins, Colorado
80523

September 11, 1978

Mr. Mian Mohammad Ashraf
Chief Engineer
Master Planning and Review Division
Water and Power Development Authority
Lahore, Pakistan

Dear Mr. Ashraf:

We are transmitting herewith our final reports in six volumes on the watercourse survey entitled "Farm Irrigation Constraints and Farmers' Responses: Comprehensive Field Survey in Pakistan." These volumes represent a tremendous amount of work by your organization, the U.S. Agency for International Development and Colorado State University. We have enjoyed the long standing working relationship and diligent efforts of your staff in completing this task.

As you are well aware, numerous members of your staff participated in the field data collection program report in these six volumes. At the same time, our field staff in Pakistan has spent numerous man-months in cooperatively accomplishing the field work and some of the initial data analysis. Most of the analysis has been done on the campus of Colorado State University in Fort Collins. Besides the authors of these reports, numerous university staff members have participated in the data reduction and analysis, as well as drafting the preparation of tables.

This study has consumed tremendous resources of this project, but we have felt the effort was worthwhile. Hopefully, your staff will also feel proud of this particular effort.

We sincerely appreciate your leadership in facilitating the completion of this effort and we look forward to continued cooperation in seeking to improve on-farm water management in Pakistan.

Sincerely,

Gaylord V. Skogerboe
Project Codirector

John O. Reuss
Chief of Party

W. Doral Kemper
Project Codirector

UF-80

PAKISTAN

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MASTER PLANNING & REVIEW

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Date September 24, 19

Mr. Mohiuddin Khan,
General Manager,
MP&RD., WAPDA,
WAPDA House, LAHORE

Subject: Report on "Farm Irrigation Constraints and Farmers' Responses".

I have the honour to transmit herewith the final report of comprehensive field survey carried out on 40 sample water-courses in Pakistan, jointly by Survey and Research Organization, WAPDA and Colorado State University. The survey work was under-taken under the provision of the Agreement No. 204-76-1 dated Nov. 7, 1975 signed between the Government of Pakistan & USAID.

The report presented under the title, "Farm Irrigation Constraints and Farmers' Responses: Comprehensive Field Survey in Pakistan" spreads over six volumes and is in fact a continuation of research work at Mona Reclamation Experimental Project on a wider area covering the entire irrigated area of Indus plains. The findings of this report further elaborate the new strategy that along with the development of present water resources, the prevailing wasteful irrigation practices beyond the outlet must be improved. This report contributes towards highlighting the social constraints in the field of water management thus providing sound guidelines for future planners.

Contd../2.

It would not be out of place to mention that this survey made useful contribution in providing guidelines for the main Watercourse Chak Farming Survey Project to organize its activities in addition to providing trained staff and necessary equipment.

Nevertheless I wish to place on record my appreciation and thanks for CSU Field Party as well as Campus Staff, U.S. Agency for International Development who provided funds for this study and the staff of Watercourse Chak Farming Survey Project who made this monumental task a reality. I avail this opportunity to express my thanks for the interest and valuable guidelines provided by you from time to time without which it would have not been possible to accomplish this arduous task.

24-1-78

(Mohammad Ashraf)
Chief Engineer,
Survey & Research Organization

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Initiating, conducting, analyzing and reporting results of a field study of this size requires the skill and active cooperation of a large number of individuals. It is estimated that more than 30 man-years of planning, training, field work, data reduction, analysis, drafting and reporting have been contributed by Pakistani cooperators with the Water and Power Development Authority, Pakistani staff of Colorado State University in Lahore, part time staff of Colorado State University in Fort Collins, and Colorado State University principal investigators.

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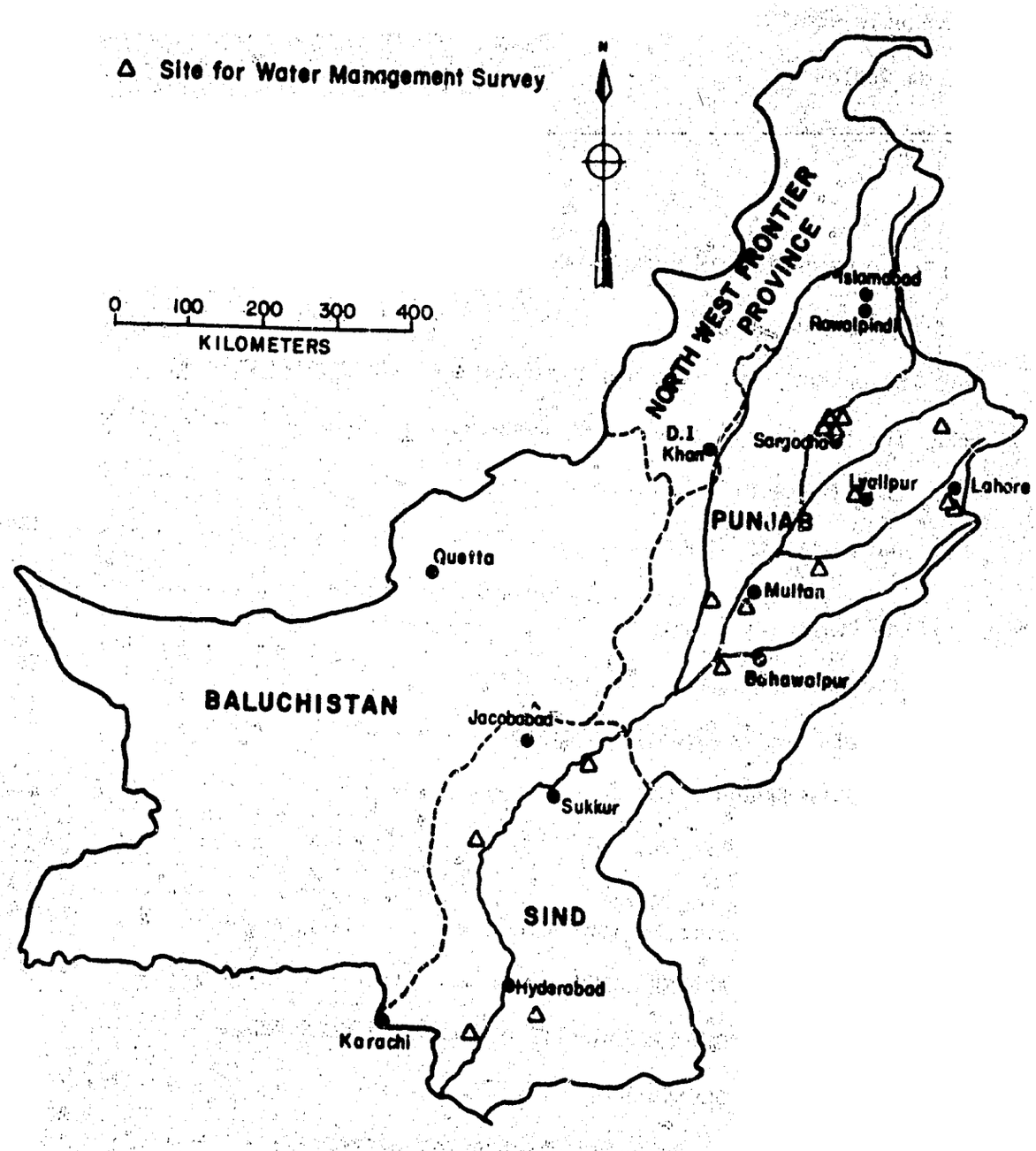

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APPENDIX I

Part A

DISCUSSION OF METHODS AND SAMPLE

I. STUDY DESIGN

Several important underlying principles were of paramount importance in the design of this farm water management research. The single most important philosophical tenet was to emphasize the farmer-client as the subject of the study and as the target recipient of programs and policies. The farmer-client was treated as an important and rational human being. His permission was sought before conducting the survey, the researchers designed approaches to build credibility with the farmers, and they lived in villages during the survey in order to increase informal interaction with farmers and make observations of subtle factors that might have importance to understanding the total farming picture. Informal discussions with farmers and observations were noted by field workers who maintained daily diaries which were checked by supervisors.

A second important design principle was that a multi-disciplinary approach to irrigation water management is essential. Our approach to problem identification is based on the view that solutions to farmers' problems require a complex interwoven fabric of policies and programs and that only an integrated multi-disciplinary approach can yield minimally adequate understandings. An important realization of earlier CSU research in Pakistan has been that what appears to be physical and agronomic problems of water losses and low crop yields have much more complex economic, sociological and legal roots, which require a multi-disciplinary team effort for identification and solution.

A third design premiere was that actual measurements are required to quantify and determine interrelations of complex farm management problems.

While farmers and key informants must be questioned as to their perceptions of selected problems, it is extremely important that field topography, watercourse profiles, social attributes of farmers and their networks of interaction, field sizes, cropping patterns, and water conveyance be measured in the field. This placed a heavy assignment on the field workers. Following the warabundi schedule alone, means measuring features of day and nighttime irrigations on 168 hour cycles.

A fourth important guiding principle was that most of these field efforts should be conducted by "host country nationals." Since there is a dearth of emphasis on field observations and measurements in collegiate academic programs, the survey involvement of expatriate personnel was largely for management, training, reliability checking and supervisory purposes. Young Pakistani engineers, agronomists and sociologists trained in this survey effort were funneled directly to a larger and longer duration study expanding on the methodologies developed herein. Our philosophical stance, that carefully selected young Pakistanis are fully capable of conducting such research under very difficult conditions, given proper training, support, surveillance, and incentives, has been vindicated.

A principle consideration in the design of the study was the objective of obtaining wide coverage to determine on-farm water management conditions throughout the irrigated cropping districts of the Punjab and in the Sind. A primary consideration for selection of sample watercourses was to give importance to zones in the country which grow a preponderance of particular crops or have a primary cropping sequence through the rabi (cool) and kharif (hot) seasons. These zones have a particular crop ecological relationship to the environment, including the soils, depth to water table, climate, latitude, and elevation. These are discussed in detail along

with the reporting of data. Another consideration was to gain coverage over a range of canal command systems as supplied by various barrages on the Indus River System.

The primary design of the research called for three basic approaches to data collection. First, interviewing of farmers and key informants was undertaken with structured schedules and a daily diary of notes maintained by each field worker. Secondly the research team surveyed and mapped fields, outlets, crops and watercourses using surveying instruments. Third, watercourse conveyance losses and field application efficiencies were measured using Cutthroat flumes and soil sampling tubes. These methodologies evolved from the approaches used in an earlier exploratory study reported by Lowdermilk et al., 1975.[1/] The techniques used in interviewing, mapping farmers' fields, and measuring irrigation efficiencies were made explicit in a special handbook designed for field worker use by Early et al., 1975.[2/]

An important factor in the design of the study was the short time available for the data collection. This restriction mandated a short time in each village. For the first phase, in the northern and central Punjab, a team of approximately 10 members collected data in a village for as many weeks as there were watercourses studied in that village. For the southern Punjab and Sind Province, denoted as the second phase of the study, a much larger team of researchers spent 6 to 10 days in a given village

1/Lowdermilk, M. L., Wayne Clyma and A. C. Early. 1975. "Physical and Socio-Economic Dynamics of a Watercourse in Pakistan's Punjab: System Constraints and Farmers' Responses." Water Management Technical Report No. 42, Colorado State University, Fort Collins, Colorado.

2/Early, A. C., M. K. Lowdermilk and Wayne Clyma. 1975. "Watercourse Survey Handbook," Colorado State University Field Research Team in Pakistan, Water Management Research Methodology Series No. 10. Mimeograph.

to collect data on two to six watercourses, as the particular village case dictated. Some return trips to various villages were made to obtain missing data. This type of study yields point data for one particular time and water supply situation. This point data applies only for that crop or only to that particular irrigation evaluation. The irrigation field application efficiencies are expected to be time dependent, varying with season, atmospheric demands for water, and water supply adequacy. This lack of time series data provides one of the primary limitations of this study.

II. SELECTION, TRAINING AND EVALUATION OF THE RESEARCH TEAM

Particular importance was placed on recruitment of surveyors with desirable personality traits. It was necessary to have workers who were primarily from agricultural backgrounds. Young Pakistanis were chosen with small farm backgrounds in an attempt to recruit surveyors with empathy for the small farmer. It was necessary that these young men be respectful and appreciate farmers, be honest in their interpersonal dealings, conduct quality interviews, record data objectively, make reliable measurements, possess sufficient physical stamina and commitment to work long hours and make nighttime evaluations, possess sufficient intelligence and desire to learn the field techniques required. The field workers also had to be adaptive and resourceful in meeting contingencies and unexpected occurrences which are commonplace in most field survey situations.

A three-stage selection procedure was devised to meet these personnel requirements. As a first step, the individual completed a personal data form and an attitudinal questionnaire designed to put the individual into hypothetical difficult job situations to test his reactions and predicted performance. Second was to interview the individual on his background,

attitudes, and gain some knowledge of his technical competence. If the first two steps were successfully accomplished, the individual was invited to a field trial. During the field trial he was placed in many difficult situations which were intentionally designed to be both physically and mentally stressful. During this week in the field his performance and reactions were evaluated by a senior agricultural engineer, using a specially prepared form. The individual also completed a self-evaluation form before and after the week in the field. After the field evaluation all three types of information were combined and evaluated to provide a composite rating for each candidate. Those with a certain stipulated threshhold score or higher were selected for membership on the survey team.

The field trial, therefore, was the initial period of training for successful applicants. The field trial was a training exercise in actual data collection under farm conditions. When the field survey was initiated two of the senior investigators--Lowdermilk and Early--spent at least 90 percent of their time with the survey team in day-to-day training, surveillance, and evaluation of the on-the-job training effort. Periodically, evaluation forms were completed by the supervisors, trainers, and trainees to ascertain progress in skill acquisition and development of interpersonal relations with team members and farmers. The primary purpose of these evaluations was to help each team member to identify and improve his strengths and mitigate weaknesses and not as a device to use as a threat. This approach, along with others, proved useful in maintaining team morale and good quality of data throughout the survey.

III. THE SAMPLE AND SAMPLING PROCEDURES

The major criterion for the regional selection of village sites was geographical coverage of major cropping zones and major command areas of

the barrages, subcomponents of the irrigation sy tem. Four of the sites in Punjab were chosen for other reasons such as previous research-development activities. The survey of these four watercourses included an additional diagnostic exercise to determine farmer responses to an applied research/implementation program conducted by the CSU Pakistan program.

Six of the remaining 12 village sites were chosen to have one or more watercourses in common with the studies of the Upper and Lower Indus reported in 1966. The remaining six villages were chosen to be representative of a geographical area with the additional requirement that there be no exceptionally large landlords present. The sample was intentionally biased toward the small farmer who ultimately was intended to be the target of a pilot implementation scheme to improve watercourses, level land, and extend improved water management technologies.

The primary sample village selection criterion was the agro-climatic zone, a combination of environmental influence and predominant agricultural crop sequence. The principal influence of climate on crops is the demand for water that the atmospheric conditions extract as evapotranspiration as modified by the rainfall that falls in the vicinity. The water balance[3/] of mean annual evaporation minus mean annual rainfall provides the moisture deficit for a given cropping environment and is directly related to the amount of water that must be supplied in irrigation. Data were taken from Gibb et al.[4/] on mean monthly pan evaporation and rainfall to

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[3/] Water balance defined as per modified definition of Thornwaite, C. W., and J. R. Mather. 1955. "The Water Balance." Drexel Institute of Technology, Laboratory of Climatology. Publications in Climatology, Volume VIII, No. 1.

[4/] Gibb, Sir A. and Partners, International Land Development Consultants N. V., and Hunting Technical Services Limited. 1966. Programme for the Development of Irrigation and Agriculture in West Pakistan. Comprehensive Report, Volume 3. Annexure 4, Climate and Hydrology

calculate a mean annual moisture deficit for 11 meteorological stations in the Punjab and Sind and plotted on the map in Figure 2. Then zones of equal moisture deficit were located with respect to the irrigated lands of those provinces, and delineated on the map. The four important zones for this study are shown in Figure 3 and are categorized as follows:

Low moisture deficit < 45 inches/annum
Medium low moisture deficit = 45 to 55 inches/annum
Medium high moisture deficit = 55 to 65 inches/annum
High moisture deficit > 65 inches/annum

The 16 village sites are indicated in their appropriate location in Figure 3.

The principal crops grown in the Punjab and Sind in the kharif (warm) season include rice, cotton and fodder; in the rabi (cool) season include wheat and fodder; and during both seasons are orchard tree crops (primarily citrus and mangos) and sugarcane, a perennial crop grown for 1 to 3 rotations after a plant crop. These crop categories for kharif/rabi were used to categorize types of crop regions within the climatic zones. The crop category for the sample villages are shown on the village classification chart in Figure 4.

Other important characteristics of the villages which played a role in the selection procedure included the presence of tubewells, and animal powered lifts or wells, the caste distribution or concentration and the origin of the inhabitants. The tubewell classificaton included public SCARP (Salinity Control and Reclamation Project) large output tubewells, privately owned small output tubewells and villages without tubewells. The water lift classification included the presence of jhallars for raising the water less than 3 feet from watercourse branch to high fields and Persian wells for irrigating from a large open well in lifts of more than 10 feet (see Volume 1, Photo Glossary Figure 6 D). Caste dominance was a characteristic

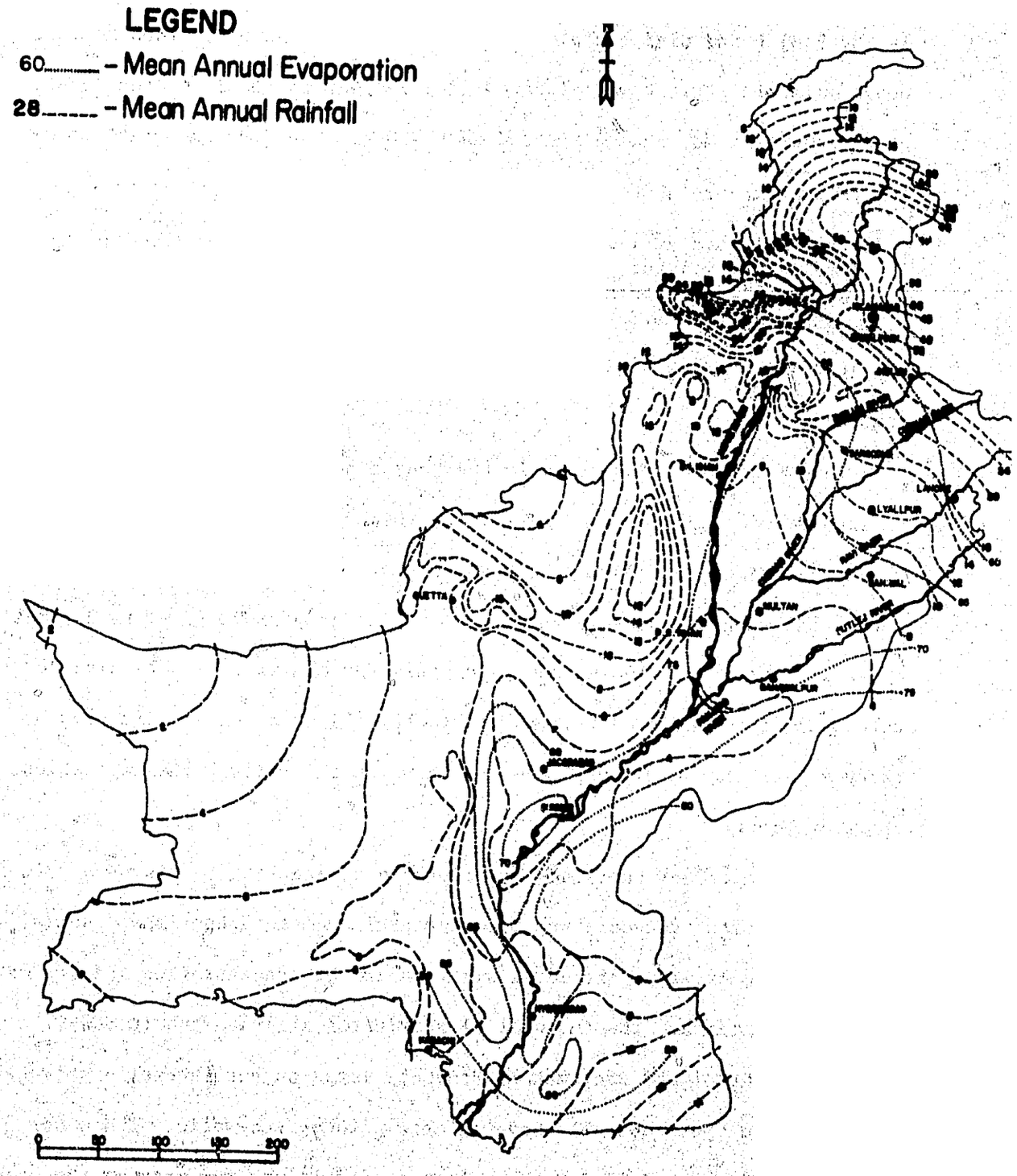


Figure 2. Contours of Mean Annual Evaporation and Mean Annual Rainfall in Pakistan (after Sir A. Gibb et.al., Programme for the Development of Irrigation and Agriculture in West Pakistan, 1966)

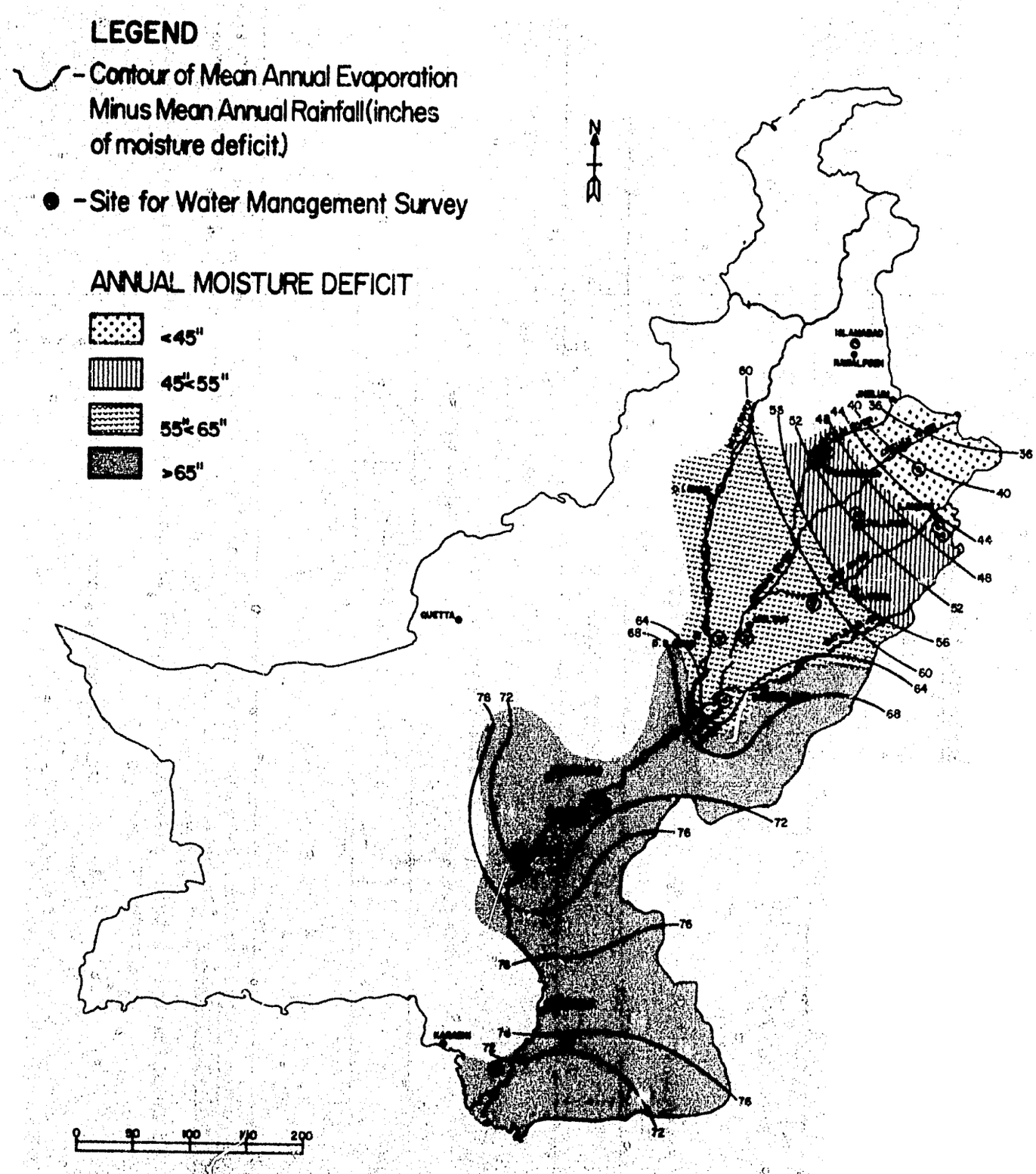
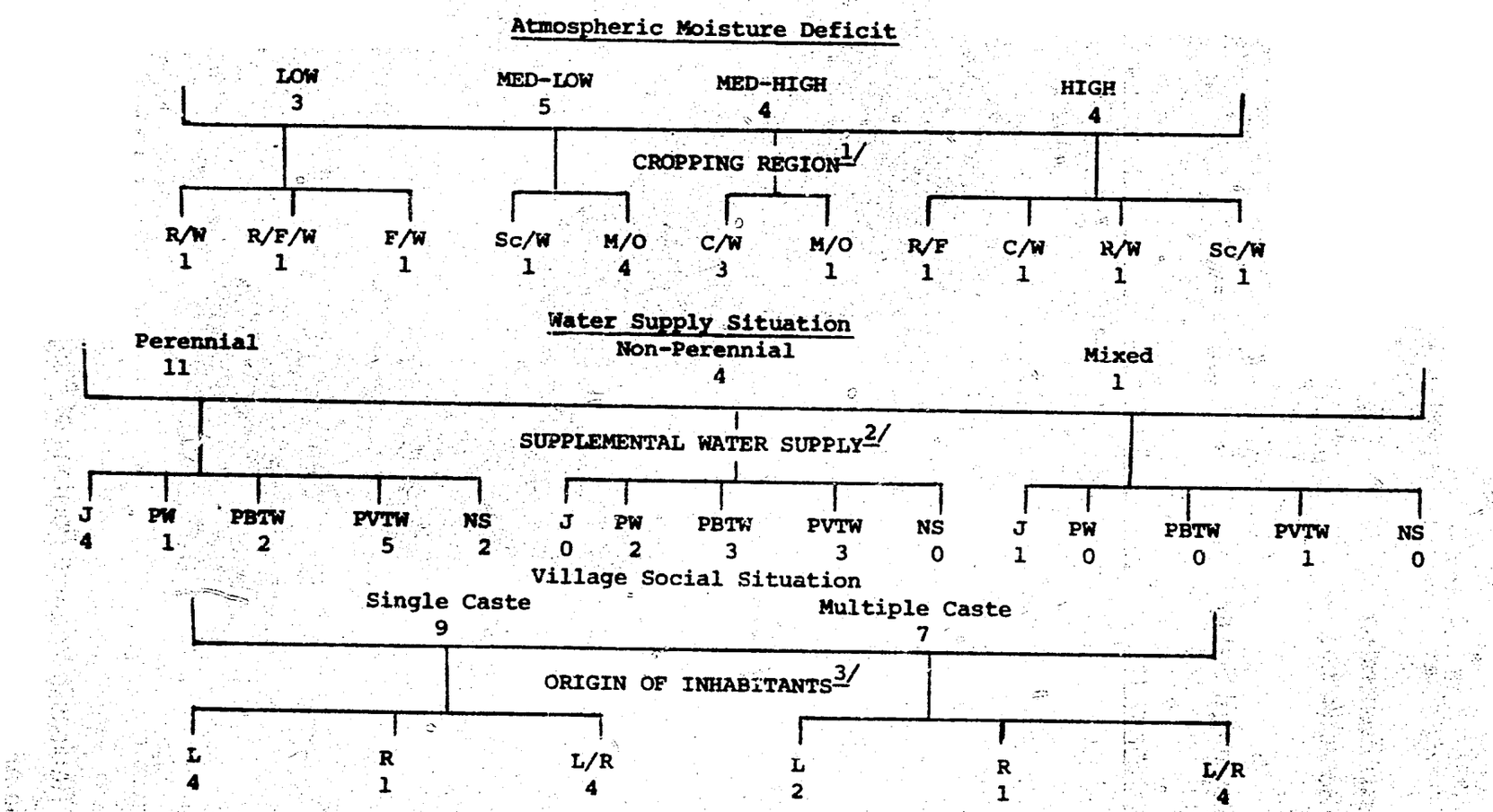


Figure 3. Climatic Regions in Irrigated Portions of Punjab and Sind Provinces of Pakistan, Based on Annual Moisture Deficit.



1/Cropping Region Crops: R=Rice, F=Fodder, W=Wheat, Sc=Sugar Cane, MF=Mixed Cropping, O=Orchard, C=Cotton

2/Supplemental Water Supply: J=Jhallar Water Lift, PW=Persian Well, PBTW=Public Tubewell, PVTW=Private Tubewell, NS=No supplementary supply or effort

3/Origin of Inhabitants: L=Local resident since before Partition, R=Refugee from India, R/L=Both groups present

Figure 4. Village sample characteristics.

of a village that potentially could play a crucial role in the possibilities for village organization to control, improve, and manage collective or community goods such as watercourses. The villages were classified as to whether there was a simgle dominant caste or multiple castes without a single dominant group. In the Pakistan social context, caste refers to ancestral, tribal, occupational linkage rather than to strict cleanliness and social position. The origin of the people in the village, reflecting time of village settlement, migration from outside areas, and entrenchment of village powers was another important characteristic affecting the sample. All of these characteristics were considered in selecting sample villages. In any one case, one or more of these characteristics played the dominant role in the selection procedure. All of these features of the sample are delineated in Figure 4.

The sampling problem is one of conducting a study of watercourses that are known to be representative of the larger population of over 78,000 watercourses in the Punjab and Sind. We would like to make statements to the effect that, in 95 (or 99) of 100 samples like the one reported in this study, the true population value is within a specified estimated range of values. It is fundamental that this kind of inference from sample to population can only be made with validity within a sampling frame reflecting population distributions on key parameters. Unfortunately, no sampling frame for types of watercourses was available to the researchers. The researchers did their best to reflect the major watercourse parameters within the sample (see Figure 4) but no way was available to determine the distribution of the watercourse population on these variables and to reflect those distributions in the sample of watercourses chosen. Therefore, findings of the survey cannot be inferred within calculable limits of error to the wider watercourse population.

Within a given village sample farmers were chosen at random but stratified according to watercourse position--the head, middle and tail thirds. During the first phase of the study, a census of all farmers on a watercourse was completed and the primary decision makers' names were listed on small pieces of paper drawn from a hat to obtain a sample farms and farmers. Sample farmers were then interviewed, their farm land surveyed and mapped, and on their warabundi irrigation turn, evaluations of irrigations were conducted. In the second phase of the study, sample farmers were selected simply by evaluating the irrigation of whoever was irrigating at a given time and conducting the interview and mapping after his evaluation was completed. The first approach had resulted in many missed evaluations and required many costly return trips to villages in an attempt to collect that information. Therefore, approximately 32 percent of cases of sample farmers interviewed were left without irrigation evaluations. These farmers were not found to be irrigating during their warabundi turn in 2 to 4 visits to the site.[5/] The second procedure yielded only 4 percent of the total number of farmers for whom there was missing irrigation data.

Key informants were chosen in each village based on several criteria. First, they had to be long term residents of the area with a knowledge of the people and their activities. Second, they had to be representative of one of the major social groups or brotherhoods in the area studied. Another key informant was also chosen in each village from the local shop keepers and artisans. A final key informant was chosen as a person marginal to the existing social system in the village but also with long residence in the area. This marginal individual, who was often a tenant, landless laborer, and/or a person of a different social group, proved to be able to

[5/] This alone is substantial support of our findings reported in detail in Volume II that trading of irrigation turns is a widespread practice throughout the sample watercourses.

provide important information in group structures and especially conflict patterns regarding water distribution (see Volume I, Photo Glossary 3H).

IV. DATA COLLECTION INSTRUMENTS

A. Types of Instruments

The field survey employed four general types of data collection instruments. These were the questionnaires, the irrigation evaluation booklets, the maps and general notes, daily diaries and other miscellaneous methods of recording pertinent information supplied by key informants and official sources. These instruments were of major importance to accomplishing the research objectives.

1. Questionnaires

The collection of general information through a photographic record of problem areas of the watercourse command, tabulation of location factors and information from key village informants comprised the first questionnaire. The photographic record started at the mogha and proceeded down the watercourse to indicate watercourse alignment, silt maunds along the watercourse, buffalo wallows, crossing points for wheeled carts and vehicles, grass and weeds in the watercourse, trees growing along the edge of watercourses, leaky nakkas or field outlets, evidence of waterlogging and salinity, crop stands, evidence of unlevel fields, the size of a sample of bunded irrigation units, elevation of the watercourse with respect to the elevation of the fields, major leaks and spills, presence of tubewells, Persian wells and jhallars, and various other features of the village, watercourse command areas, and farmer's irrigation behavior.

Location factors included distances to paved roads, bus stop railway stations, towns or cities, market centers, schools of various

categories, health services, post offices, police posts, fertilizer agencies, and the offices of various Agriculture and Irrigation Department functionaries.

Key informants were a source of information about various Agriculture Department functionaries' names and location of their offices, general information about watercourse cleaning, practices with regard to illegal means of obtaining more water, watercourse maintenance leadership, sanctions imposed against those not participating in cleaning and maintenance, the degree of influence of village leaders with the police and various irrigation and revenue officials, and general information regarding informal cooperation in matters of maintaining village Mosques and schools (see Vol. I, photo glossary Figure 3H).

The second questionnaire focused on cohesion and conflict in the village. First, each sample farmer was asked to estimate the degree of influence of each member of the watercourse with respect to decisions about watercourse cleaning and maintenance, and the influence of the numbardar(s), panchayat, large landlord(s), village committee, caste groups, and brotherhoods in watercourse cleaning with respect to settling disputes and conflicts primarily related to land and water issues.

Second, the sample farmer was asked from whom he sought advice regarding a range of activities: farming matters, water thefts, borrowing money, individuals who accompany him to visit various irrigation functionaries, trading irrigation turns, trading labor, watercourse matters and collective activities related to the Mosque.

Third, other sociometric information about cohesion and cooperation in the village was sought in regard to the Mosque and religious matters, the school, and various arrangements and celebrations including weddings and other ceremonies.

Fourth, the sample farmer was asked to list major conflicts that had occurred in the village in the last five years. In particular the individual was asked the source of the conflict, its intensity, the groups involved, its duration, and the degree and agency of resolution.

The third questionnaire was the basic sample farmer interview schedule[6/] which contained four major headings or categories of items pertinent to his personal farming and family situation. These items included the personal characteristics of the respondent, his land use patterns including the types of holding, the degree of fragmentation, and his cropping patterns and intensity, the availability of agricultural inputs, credit and sources of credit, estimated yields, for selected crops and fertilizer use by sample farmer.

The fourth questionnaire was specifically concerned with irrigation and adoption behavior, patterns of cooperation and the utilization of institutional services by the farmer respondent. Specific items included: personal information regarding the farming operation, land owned and land operated and location of the land with respect to position on the watercourse, the irrigation schedule or warabundi, the farmer's water purchase and trading frequency and pattern, and the farmer's preference for regulated or unregulated warabundi irrigation schedules.

Items also probed the farmer's assessment of the power structure--advance information regarding canal closures, water rationing and rotation of watercourse/distributary turns. The reader is referred to Appendix I of this report for reproductions of the four questionnaires employed, pp. 41.

6/ A 25 percent stratified random sample of all farms on the watercourse command was taken. This sample was stratified on the basis of location on the watercourse reach as head, middle and tail.

2. Irrigation data[7/]

The irrigation evaluation booklet that evolved during the course of this study is presented in Appendix I-B. Irrigation data collected included general information as to the farmer, his kinship group, his farm location on the watercourse, the team members making the evaluation, the distributary and the canal on which the evaluation was made. The booklet contains charts for recording pertinent data taken as flume measurements for nakka field inlet discharge and mogha distributary outlet discharge, charts for recording dimensions of the field, crop information, irrigation intervals, and field layout.

3. Map data[8/]

Three general techniques were used in the collection of map data. First, an engineering level and staff rod were used for the measurement of the watercourse profile and preparation of the topographic map. These data were collected in field pocket-sized record books wherein a sketch of the field layout or tracing of an authoritative map for bunded units was attached and used as an index for the data.

Second, a plane table, alidade, and staff rod were used for the mapping of actual field units dimensionally to scale and the position and lengths of watercourses. Also, added to this map while being prepared in the field were the crops growing in the field at that time and the position of the nakka cuts into all the fields mapped.

Third, was the compilation of an ownership map which in Phase I of the study included all farmers on the given watercourses and in Phase 2 included only the sample farmers. These data were obtained via

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7/ See Vol. I, Photo Glossary Figures 1A to I.
8/ See Vol. I, Photo Glossary Figures 2A, C and D, and Figures 3E and F.

reconnaissance methods and field interviews of the farmers so they could indicate actual boundaries.

4. General data

General data were important to fully understand the village or watercourse command area situation. This information came from unstructured conversations with farmers, shop keepers, the Maulvi, chowkidars, officials from the Agriculture Department and the Irrigation Department. The information ranged from how much damage was caused by the most recent flood to who steals water from whom. This information was recorded in a daily diary which every surveyor was encouraged to maintain. In some cases, the information included publications or maps from official sources, and in many cases, the information came from people outside the village.

a. Approaches to Data Collection

The approaches used for collection of the field data on this survey emphasized the importance of the farmer client as an individual and approaching the farmer with courtesy and respect. Research team members engaged the farmer only when his work permitted and followed his irrigation turn whether it came at day or night. It was also emphasized that all the survey members would observe a "no promises made" rule in return for a farmer's cooperation. The following subsections describe the important approaches which are specific to the type of information collected.

(1) Questionnaire data collection

Questionnaire data were collected by structured pretested instruments from carefully selected key informants which usually numbered four to six well informed farmers representing major social groups and a

25 percent random sample of all farm decision makers on the command area of each watercourse. Interviewers were given intensive training in approaching farmers, gaining their confidence, administering the schedules, cross checking responses, and recording of data. Each interview was conducted no longer than one and a half hours so as not to tire the respondent. Given the number of interviews to complete, one farmers would often be interviewed on two or more occasions at his convenience. Our time schedule was that of the farmer, and, while we tried to interview him each time in the field, some interviews were conducted at night at the end of a work day. It was often impossible to gain interviewer isolation; therefore, we utilized the presence of other farmers at the interview situation to confirm or deny some of the information reported. Various methods of quality control of the data are discussed in the succeeding section.

Interviewers were trained and reminded throughout the survey about the special code of ethics printed in the survey handbook which was developed to guide our behavior and actions in village living and in data collection. This code of conduct includes some of the following principles:[9/] "As a guest, be mindful of the Islamic code of ethics in all relationships, gain credibility by personal friendliness, honesty, and competent hard work; make absolutely no false promises about what government might do or not do for securing data; never ask for free food, lodging, etc., and take no fruit, vegetables, sugarcane, etc., from farmers' fields unless it is a gift; pay all bills in village shops and take no loans from villagers in cash or kind, identify closely with villagers by your manner, language, and dress; when there is free time, identify closely with villagers such as attendance at Friday prayers and the Mosque on a regular basis and

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9/ See Vol. I, Photo Glossary Figures 3C, D, F and I.

participation in religious and social functions; answer all farmers' questions about your work openly and honestly and always explain the purpose of your research when it is not understood; make it a policy to know the leaders of all major social groups and never show favoritism to any one or two; never take sides in sensitive arguments about religion and politics--always remain neutral; never become involved or even suspect in respect to women; and finally learn all you can about farmers who are the pillars of your nation."

While these principles may appear to be unrelated to team morale, productivity, and the quality of data, our experience suggests otherwise. Our whole approach was based upon high respect and appreciation for farmers as human beings and in evaluations of field data collectors we were especially strict on these points. For the duration of the survey we faced few social problems which often occur between field workers and farmers; especially when the former act as "officers" demanding information from farmers--not an uncommon practice in many field surveys. Farmers responded to our particular approaches positively by providing not only data which were checked and cross-checked for validity and reliability, but also by returning our courtesy with friendships, feasts, farewell functions and, for several of our team members, special requests for Friday sermons in the village Mosque. For all team members it was a learning experience, and, upon completion of the survey, participants felt they had learned much from farmers. A by-product of this survey will be a special publication on proven and appropriate methodologies for quality data collection from Pakistani farmers.

(2) Irrigation data collection

In collecting the irrigation evaluation data, an attempt was made to represent the efficiency of the system as it was without modification.

If a leak was detected in the watercourse or in a bund between fields it was not pointed out to the farmer and our evaluators made no effort to close leaks. The important technique for completion of irrigation data was following the water from mogha to field and recording physical data as well as behavioral information on what the irrigator did during the evaluation. A young villager was usually hired as an assistant to provide information during the evaluation.

(3) Map data collection

In surveying village and watercourse command areas, villagers were again hired as rod men for topographic as well as plane table surveying and to provide information about the people and the village. All main watercourses and major branches were surveyed in profile. All fields were mapped and four topographic shots were taken in every small irrigation unit. Special efforts were made to obtain the farmers' consent to the survey and to answer all questions about our efforts while working in the field.

(4) General data collection

General data collection approaches were to move about in the village, purchase our food locally from village shops, hire local people as helpers, frequent the Mosque and observe Juma prayers. To facilitate our entry and possible future reentry to these villages a sound movie was presented the first and last nights of our stay. During this program one of our senior field workers would describe our work to the audience and the objectives we hoped to accomplish with their cooperation. Usually we left each village some sort of collective gift ranging from a copy of the Holy Quran to a hand pump for a village school.

(5) Approaches to completion of general data

In addition to questionnaire, irrigation, and map data collection procedures, several types of supplementary general data were collected. These include the construction of a complete list of warabundi turns for all farmers of a command area which is used for selecting the random sample of farms and for developing a time budget for the allocation of minutes per acre of canal water for all farm units. Daily diaries were maintained by each field worker who noted significant conversations with farmers and observations of farmers' behavior which related to the purpose of the survey. This information, while qualitative, helped to clarify certain issues and proved useful at points in cross-checking the accuracy of some data. The major purpose of this device was to sensitize all field personnel to the importance of using all occasions possible for observations of farmers.

Visits to Irrigation Offices were important to secure information about regulated mogha discharge, authorized cultivated command acreages, and permissible cropping intensities. Key informants also provided historical information related to village and canal system establishment. In village 107 with three moghas and a private jointly owned tubewell for each 75 acres of land, a special study was devised to identify small farmers' methods of planning, installation, and operation of their private tubewells established without government involvement. A sample of the discharges of the 26 private tubewells of this village were measured using the Purdue coordinate method.[10/] Also the size of pumping unit, horsepower, type and make of diesel engines were recorded. Field research team members also had an opportunity for discussions with local level

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10/ See Vol. I, Photo Glossary Figures 2E to J.

irrigation officials about problems, such as the incidence of court cases resulting from water disputes.

V. DATA QUALITY CONTROL

Special procedures were developed for data quality control which include data management in the field, checks for validity and reliability of data, and the management of data for coding and computer analysis.

A. Data Management Procedures in the Field[11/]

Field methods have been described which were utilized in data collection. Several management procedures were followed in the field to assure good quality of data. Field investigators worked in teams with specified responsibilities for mapping, irrigation evaluations and interviews with key informants and sample farmers. Each team was supervised by an engineer with prior experience in the utilization of all methodologies. All watercourse profile maps, topographical maps, bunded units and nakka cut maps, the crop survey maps, and the land ownership maps were developed in the field and spot checked by supervisors each day. When the general features map was completed, it became the map on which all others were based. All survey data including benchmarks were entered in survey field books and each survey was properly closed at the end of the day. The work of surveyors was checked often in the field and evaluated. Where errors were identified, the job was done over under careful supervision. The engineers conducting evaluations on field application efficiencies had specially designed summary forms in field booklets for all measurements. The supervisor checked the installations of flumes and a sample of the readings made from flumes to assure accuracy in measurements. The flumes

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11/ See Vol. I, Photo Glossary, Figures 2E to J.

at the mogha with automatic stage recorders were checked carefully by the chief investigator at time of installation and periodically during the full weekly warabundi period. Irrigation evaluation field booklets and maps were collected daily by the team leaders and all calculations were double checked and then entered on special evaluation summary forms. Likewise, all interview schedules were checked by the team leaders to ascertain if all questions had been answered. Caution was taken to see that all schedules, engineering field books, maps, etc., had proper identifiers including the village site, mogha number, farmer's name, farm unit location and date of the data collection. The individual who was responsible for the data collections wrote his full name on each form turned over to the team leader on a daily basis. Two methods were used to ascertain soil moisture deficiencies which were the "feel method" and the gravimetric method. These two methods were compared to determine measurement reliability. Before leaving a watercourse command area, all data were again checked for accuracy and completeness, labeled, and carefully stored in special metal trunks which were in the care of a designated individual.

B. Validity

Methods used in measurements had previously been tested over a period of time before the survey began. For example, an exploratory study had been previously conducted in the Lahore region of one watercourse for the purpose of testing methodologies in relationship to the interview schedules, all of which were in the Urdu language. The following questions had been answered to our satisfaction: 1) are the questions on the subject clear and unambiguous; 2) are the questions tapping something typical in the situation; 3) will the questions be answered by a large enough proportion of the sample farmers to have validity; 4) do the

questions give responses with an expected and reasonable range of variation; 5) do the questions cover the phenomena to be investigated. The information received from respondents was also checked against dependable outside sources for accuracy. For example, the farmer's reports of land area cultivated, parcels of land, crops cultivated, tubewells, farm equipment, etc., were confirmed by observation of these items or information collected by other investigators such as those mapping fields and farm units. The Revenue Patwaris map was also used for checking accuracy of the data we collected on ownership, field location, size of holding, fragmentation, etc. The initial information collected from key informants was also used in the field for cross checks against the information reported by the sample farmers. When discrepancies were found in the data, these were further cross-checked with other farmers. Daily diaries maintained by field workers of observations and conversations with farmers often provided information which helped to clarify problematic data reported earlier by farmers in interviews. Mileage to institutional services such as markets, banks, etc., were checked by drivers of the five survey mini-bus vans. When there were problems with the flume measurements due to damage in transport other flumes were brought in to check for accuracy and damaged instruments were repaired or replaced. Transits and telescopic alidades for field surveying were checked daily and corrected if they were not accurate. When found out of adjustment the survey work was redone.

Farmers' reports of the warabundi schedule were checked several times using groups or panels of farmers. Likewise, farmers' reports of the regulated discharge of moghas was checked externally with Irrigation Department records.

C. Reliability

A number of measures were taken to assure a high standard of reliability. For example, a 10 percent reliability check was designed into the survey for interview data. In actual practice, 19 percent of all sample farmers were reinterviewed for selected items by an interviewer other than the field worker who conducted the first interview. The check-recheck results were compared statistically using a reliability coefficient and the results appear in Appendix I, Part B, p. 39.

In the reading of flumes, two engineers made individual readings as a check against each other. Likewise, with soil moisture samples the two engineers both made estimates using the two methods described earlier. In order to achieve greater accuracy in the topographical survey for all watercourses in the second phase (22 command areas) four readings were taken per bunded unit. In the first phase for 18 watercourses, four shots were taken per sample farmer bunded unit with one shot per bunded unit for nonsample farmers. Likewise three soil moisture samples were taken for each bunded unit and estimated by both the "feel" and the gravimetric methods.

A major problem confronted in the Sind Province was that of language. Therefore, only our Sindhi speaking staff could conduct interviews with key informants and sample farmers except in two village sites settled by farmers from the Punjab. This slowed the work considerably and interviewers had to return on several occasions to complete missing interviews or complete gaps in the data.

The field work for this survey required about 20 man years not including the time of the chief investigator's which was over a man year.

D. Data Management in the Office[12/]

Once the data were collected it was again evaluated in the office in Lahore before coding was begun. Though care had been taken in the field, inevitably data gaps were identified and some cases of questionable information appeared. In these cases a team of at least two experienced field workers was sent back to sites in the Punjab and Sind to complete these data gaps. All field maps were checked against data entered in the field books and drafters, working for several months, developed new maps. All irrigation evaluations and other data were rechecked and summarized on special forms.

The data with all field books, maps, questionnaires and daily diaries were sent to the Colorado State University for further evaluation and reduction. Two Pakistanis and one American, proficient in the Urdu language, prepared the data for coding with the help of a special staff. The period required for coding and analysis of data required 10 man years plus about 2 man years of the principal investigator's time.

The Statistical Package for the Social Sciences computer programs were used for the analysis due to its flexibility and availability of many types of statistical analysis. The data, stored on tapes in our files, comprises a data bank to which comparative data will be added in the years ahead.

VI. LEVELS AND METHODS OF ANALYSES

The levels of analysis for the survey data from the most specific to the most general were the bunded unit, the farm, the watercourse, command area, the village, the cropping region and the climatic zone.

12/ See Vol. I, Photo Glossary 3L.

A. The Bunded Unit

The bunded unit is the smallest field that is irrigated as a single unit. Most of the irrigation evaluations were conducted on individual bunded units, whereas only a small percentage were conducted on a series of bunded units, or were called a block evaluation. In most of the cases of block evaluation, the farmer irrigated one plot first, then opened a nakka to an adjacent field and allowed water to irrigate the second field. The topographic information on the bunded unit is in two intensities, one elevation shot per bunded unit in Phase 1 and four shots per bunded unit in Phase 2. The nakka and crop maps (see Appendix IV) contain information on individual bunded units. The bunded unit map indicates the size of the individual bunded units and the watercourse map indicates the proximity of the main watercourse and branches to the bunded unit. The general features map indicated the relationship of all four of the above factors to one another on one map. All this information was taken off the maps and tabulated by the office staff. Areas were measured using a planimeter.

B. The Farm

The ownership map was placed on a light table to overlay the ownership boundaries on the crop, bunded unit, nakka and topographic maps to provide a tabulation of crop acreages, distribution of bunded unit sizes, nakka count, and elevation differences across the farm parcel. In Phase I of the survey this process was done for each farmer for the entire site, while in Phase 2 this was accomplished for only sample farmers. Sample farmer data on crops, nakkas, bunded units, topography and the estimated volume of excavation for leveling that farmers' largest parcel of land was tabulated, coded and entered into the master file for analysis. Each farmers' parcel was also measured with a planimeter to determine area of each.

Questionnaire data were available on only a sample farmer basis. Irrigation data for one or more bunded units per farm were weighted on the basis of the mogha discharge and tabulated on the farm basis in the master file as mean values for application, delivery and farm irrigation efficiencies and loss rates as percent loss and cubic feet per second per thousand.

C. Watercourse Command

Watercourse maps were used to delineate watercourse command areas for the 11 sites which had more than one watercourse. This map was then used as an overlay to separate the farmers' parcels into separate watercourses. The watercourse command areas were also used to delineate boundaries on crop, nakka and bunded unit maps to permit the tabulation of crop acreages, number of nakkas. Watercourse command maps were planimetered to obtain area and checked versus the aggregate crop survey totals for reliability.

Farm level socio-economic and irrigation data were aggregated to provide watercourse level data.

D. The Village

Village level information on nakkas, crops, watercourse length, farmers parcels, bunded units and topography were obtained merely by aggregating the watercourse command area information for the 11 village sites. On six of the ownership maps of Phase 1 the farmers' ownership/brotherhood units were delineated to show position relationships. The other four cases were complicated by the presence of 80 to 200 farmers and complete delineation was not possible in the available time as in Phase 2, where ownership was only available for sample farmers.

Certain watercourse command area socio-economic and irrigation data were aggregated to produce village level data.

E. The Cropping Zone

Seven cropping zone sequences were the primary bases for the initial coverage started by the survey. These were the kharif/rabi sequence of crops. Three of these were only represented once in the sample. These cases were rice/fodder, rice/fodder/wheat and fodder/wheat. Cotton/wheat occurred four times in the sample of 16 sites; rice/wheat occurred twice; sugarcane/wheat occurred twice; and mixed cropping and orchard occurred five times. Village level data on crops, nakkas, bunded units, topography, watercourse lengths, ownership parcels, and areas were aggregated to obtain cropping zone information.

Village level socio-economic data and irrigation data were aggregated within common cropping zones to provide cropping zone level data comparisons.

F. The Climatic Region

Four climatic regions in terms of moisture deficit ranges were delineated. Village level data common to a region were aggregated to provide comparison across the regions. This was especially done for the sites with a specific cropping zone classification.

APPENDIX I

Part B

CONCEPTS AND MEASURES

Part B

CONCEPTS AND MEASURES

The following concepts and measures used in the study which require explanation are given below with definitions:

1. Delivery efficiency (E_d) is defined as the steady state rate of water delivered at the field divided by the steady state rate of water delivered at the watercourse outlet from the canal distributary. It is multiplied by 100 to make it a percentage value.

$$E_d = \frac{\text{discharge at farm outlet (Nakka)}}{\text{discharge at canal outlet (Mogha)}} \times 100$$

1a. Percentage loss per 1000 feet (% loss rate) is defined as the loss with respect to the mogha discharge divided by the length of watercourse over which the measurement was made expressed in 1000's of feet, multiplied times one hundred to make it a percentage.

$$\% \text{ Loss Rate} = \frac{\text{Mogha discharge-Nakka discharge}}{\text{Mogha discharge} \times \frac{\text{length}}{1000}} \times 100$$

2. Field application efficiency is defined as the average soil moisture deficiency of the root zone moisture storage reservoir in the field irrigated divided by the total quantity of discharge applied to the field outlet.

$$E_a = \frac{\text{soil moisture deficiency in depth of water equivalent}}{\text{depth of water equivalent of discharge at field outlet}} \times 100$$

3. Percent irrigation completion (%C.) is a variable to estimate the degree of under irrigation by a farmer. It is used only for irrigations that were not over irrigations which is the measure for application efficiency. The %C is the discharge at the farm outlet divided by the soil moisture deficiency of the root zone times 100 for the percentage.

$$\%C - \frac{\text{field discharge depth equivalent}}{\text{soil moisture deficiency in depth equivalent}} \times 100$$

4. "Head" and "tail" positions on the watercourse. The watercourse was measured and demarcated into three equal sections. The "head" is that one-third area beginning at the distributary outlet and the "tail" is the one-third portion farthest from the outlet.

5. Public and private tubewell watercourses. Public tubewell watercourses are those with large delivery public wells; private tubewell watercourses are those where farmers have installed their own private tubewells.

6. Cropping intensity is defined as the total acres of crop for both seasons in acres divided by the farm acreage of culturable land times 100 for the percentage as below:

$$100 \times \frac{\text{total acres of crops for both seasons}}{\text{cultivated acreage}}$$

7. Joint farm for the purposes of this study is defined as any farm where father and married sons (or other relatives) use a common hearth, share all farm expenses and income.

8. Farm management knowledge index. This index includes eight recommended farm practices for a high yielding wheat variety, Chenab 70. Farmers were asked to give the recommended range of sowing dates, methods of seedbed preparation, seeding depth, seed rate, nitrogen inputs, phosphorus inputs, and split applications of fertilizer.

The following values were used for scores.

a. Recommended range of sowing date

Does not know	= 0
Knows within 4 days	= 2
Knows correct range	= 4

b. Recommended seedbed preparation

Local plow	= 1
Bullock mouldboard plow	= 2
Tractor mouldboard plow	= 3

c. Recommended seed depth

Does not know	= 0
Knows within one half inch	= 1
Knows correct depth	= 4

d. Recommended seeding method

Broadcast	= 1
Kera	= 2
Pora	= 3
Automatic drill	= 4

e. Recommended level of nitrogen when wheat crop follows cotton or rice with no green manure or organic fertilizer.

Less than 75 lbs	= 1
75-99 lbs of N	= 2
100-114.5 lbs of N	= 3
115 lbs plus	= 4

f. Recommended level of phosphatic fertilizers (with conditions explained under e above).

Less than 24 lbs	= 1
25-49 lbs	= 3
50 lbs plus	= 4

g. Recommended split application of nitrogen fertilizer.

No	= 0
Yes	= 2

h. Recommended seed rate for late sowing

Less than 40 seer/acre	= 1
40-49 seer/acre	= 2
50 seer/acre	= 4

A possible total score of 29 can be achieved by the respondent.

9. Farm management utilization index. It is composed of the same items as the above farm management knowledge index. Respondents were asked about the extent of use of each item. This index has a maximum value of 29.

10. Adoption of farm technology index. This index includes improved technologies and cultural practices which have been incorporated into the farm operation on a regular basis. The following innovations are given a score of one each: Two high yielding wheat varieties, a high yielding rice variety, use of pN fertilizer, wheat drill, mouldboard plow, bullock cultivator, bar harrow, line planting of cotton, rice seedlings, insecticides for rice, insecticides for cotton, split applications of nitrogen for wheat, rubber tire, trolley bullock cart, fodder chopper, and use of tractor. The remaining innovations were given the following values: seedbed preparation with mouldboard plow (1); and with tractor (2); proper depth of seed placement for wheat (2); and within .5" (1); proper seed rate for wheat (2); and within 8 lbs. (1); proper level of nitrogen for dwarf wheat (2); and within 15 lbs. (1); ownership of tractors or regular rental of tractors for farm work was scored as one point. A total score of 23 is possible for the adoption index.

11. Access to canal information is a measure of the frequency with which farmers receive information from the irrigation department about canal closures for cleaning, repairs, and rationing and about expected seasonal supplies of canal water. "Usually" received information is weighted as 4; "sometimes" weighted as 2; and "never" is weighted as 0. A total score of 16 is possible.

12. Local institutional development initiative index is used as a measure of the number of the following formal institutions located in the village. These are given with the weights in parentheses. Boys primary school (2); girls primary school (4); boys middle school (4); girls middle school (8); boys high school (8); girls high school (16); post office (4); fertilizer agency (4); bank (4). A total score of 54 is possible.

13. Institutional use index. Farmers were asked to give the names, locations of office or residence and number of purposeful contacts with 10 local officials or agencies. A value of 2 was given for knowledge of the official's name; a value of 1 was given for knowledge of the official's location; values for contacts were assigned as: 2 for 1 to 2 contacts, 4 for 3 to 4 contacts, 6 for 5 to 6 contacts, and 8 for more than 6 contacts over a three month period. Using the above values a score of 110 is possible for a respondent.

14. Mass media exposure index. This index is composed of times listened to radio programs, television programs, times read newspapers or magazin for at least 30 minutes duration over the last week. For each of the types of media the following scores are given: none = 0; 1 to 2 times = 2; 3 to 5 times = 4; and 6 or more times = 6. Another measure of listening to the regular farm radio program was combined with the above with the following values: none = 0; "yes" = 1; "yes" plus correct time of program = 2; "yes" plus time plus knowledge of station = 3; and "yes" plus time, station and knowledge of a program subject during last week = 4. A score of 22 is possible for a respondent.

15. Mass media access index. This index is combined from the following items: ownership or listening to the radio; ownership or watching a TV; obtains newspapers or magazines or reads in village. A score of 7 is possible.

16. Degree of individual farmer influence on the watercourses--a score revealing each farmer's influence relative to that of every other farmer on the watercourse. The score is obtained by the following procedures:

    a. A 25 percent sample of farmers on the watercourse ranked all farmers on the watercourse and assigned a value of 0 = no influence; 1 = little influence; 2 = some influence; and 4 = very much influence.

    b. The highest score which a given farmer could potentially obtain is secured by multiplying the value of 4 (the highest score any single judge can give) by the number of respondent judges in the 25 percent sample.

    c. The actual influence score obtained by a given farmer was computed simply by summing the judges' scores actually given to each farmer.

    d. Each farmer influence score is then "normed" vis-a-vis all other scores by deriving its percentage value of the potential score.

       Example: For a farmer to obtain an influence score of zero, all farmer judges would have to grant zeroes which would sum to zero and be zero percent of the potential score which could have been obtained if all judges had awarded the value of 4.

    This method of computing influence scores is also applied to biradari groups.

17. Centrality of farmer influence on the watercourse--a second dimension of influence/power relationships which reveals what percentage of all farmers on the watercourse obtained scores of 90+ percent, 80+ percent, 70+ percent, 60+ percent, and 50+ percent of their potentially highest score. This measure reveals something about the centralization or dispersion of influence/power among watercourse farmers.

Conceivably many farmers could be powerful or powerless. For example, a score of 31 in the 80+ percent category means that 31 percent of all the watercourse farmers obtained 80 percent or more of their potential influence score. This score is a statement about the power constellation of the watercourse as a whole and cannot be imputed as the property of any individual farmer.

18. Equality of farmer influence on the watercourse--a third dimension of farmer power/influence relationships which reveals what percentage of watercourse farmers, proceeding downward from the top of an influence score, frequency distribution, it takes to account for 50 percent of the sum of all the influence/power scores attributed by the sample of judges to all farmers. The equality ratio reveals the extent to which power/influence is distributed equally or unequally among watercourse farmers. If power/influence is exactly equal in distribution, then it will take 50 percent of all watercourse farmers to account for 50 percent of the sum of all farmer scores. For example, if the concentration score is 10 then it means that it only takes the top ten percent of the influentials to account for 50 percent of the total influence--a highly unequal power distribution.

The concentration value is a statement about the power constellation of the network of farmers on the watercourse as a whole and cannot be imputed as the property of any individual farmer.

19. Biradari Boundedness Index.

Farmers were asked as to whether they would request assistance from a nonbiradari member with respect to the following:

1. Farming problems
2. Watercourse cleaning problems
3. Water theft problems
4. Going to petition the Subdivisional Officer (SDO)
5. Going to petition the Overseer
6. Going to petition the patwari
7. Trading water
8. Borrowing tools or implements
9. Borrowing money
10. Putting in a joint tubewell
11. Hiring a tractor

Items were weighted equally. A farmer who indicated that he would not go beyond his biradari for any item would score 100% on the biradari boundedness index. A farmer who would go beyond his biradari on all items would score zero percent.

20. Irrigation Responsibility Index. Farmers were observed by engineers on the research team as farmers irrigated their basins for a full turn. The irrigation behavior of farmers was unobtrusively recorded and score were allocated to the 195 farmers on which data was gathered as follows:

	Points
1. Inspects for leaks in close proximity to basin	1
2. Stays in field during irrigation	1
3. Makes repairs along watercourse	2
4. More than irrigates (one in basin; one or more repairing watercourse leaks)	2
5. Inspection of watercourse all the way to the mogha	2
TOTAL	8

21. Topographic elevation difference. Maximum elevation difference across farmers largest parcel, in feet.

A measure of topographic relief across a farm.

22. Volume of land leveling needed

Product of 1/8 times the maximum elevation difference across farmers largest parcel (feet) times the size of that parcel in acres equals the acre feet of soil required to move to bring that largest farm parcel to dead level.

$V = 1/8\ (\Delta H)\ (\text{Area})$ in acre feet.

23. Watercourse slope

Elevation of bed of mogha minus elevation of bed of watercourse at nakka divided by the distance between two points.

A dimensionless number which can be positive (slope toward nakka) or negative (slope away from nakka down to mogha) should be in the range

Min = .0003	to	.0010 = max
siltation		erosion

24. New weighted Ea

Weighted mean application efficiency includes Ea = 100 under irrigations weighted on the basin size elevated-farmer, level, variable.

25. New weighted %C = renamed Irrigation Water Adequacy

New weighted percent completion does not include the over irrigation where % $\geq$ 100

26. Adjusted minutes/acre

$$\frac{\text{time of irrigation} \times 60}{\text{area of basin}}$$

27. Weighted SMD

Weighted mean SMD weighted on the size of the basin unit.

28. New weighted mean - Farm Delivery Efficiency

Farm delivery efficiency weighted on the time duration of each evalution = farmer level

29. New weighted mean - Farm Efficiency

Farm irrigation efficiency weighted on the time duration of each evaluation.

APPENDIX I

Part C

TEST-RE-TEST RELIABILITY OF SELECTED MEASURES

Appendix I

TEST RE-TEST RELIABILITY OF SELECTED MEASURES

Item	N	Pearson Product-Moment Correlation r	% of Sample Re-Tested
Total Acres Owned	75	.996	19.3
Acres Cultivated This Watercourse	76	.978	19.6
Cropping Intensity (Kharif + Rabi)	74	.814	19.1
Nitrogen Fertilizer Applied to Wheat	73	.680	18.8
Wheat Yields (Maunds/Acre)	69	.840	17.8
Trading Full Irrigation Turns (Rabi + Kharif)	74	.926	19.1
Nitrogen Fertilizer Applied to Berseem	74	.686	19.1
Availability of Inorganic Fertilizer	74	.74*	19.1
Percent Increase in Wheat Yields	75	.926	19.3
Percent Increase in Wheat Acreage	72	.846	18.6
Availability of Credit for Fertilizer	70	.77*	17.1

* Value represents, not an r coefficient, but a simple percentage of the re-test items identical in value to the original values. This procedure is necessitated by virtue of the type of nominal data gathered for these two items.

Appendix I

Summary of differences in percent cropping intensity for major crops between crop survey and farmers' reports.

Type command area, village with number of watercourses	Season** of crop survey	Number of farm units	No. of sample farm units	(%) Wheat		(%) Rice		(%) Cotton		(%) Sugarcane		(%) Fodder		(%) Polyculture	
				crop survey	farmer report	crop survey	farmer report	crop survey	farmer report	crop survey	farmer report	crop survey	farmer report	crop survey	farmer report
Perennial															
101-1,2	R/K	88	15	NA	41.4	NA	2.9	NA	2.4	24.2	23.8	12.2	21.8*	NA	20.7
102-1	R/K	34	9	NA	47.5	0	1.8	NA	59.5	1.7	14.5*	13.3	17.4	4.2	14.2*
103-1	R	17	16	73.4	57.4*	0	7.3*	NA	12.0	0.9	3.6	11.6	24.2*	0	9.1*
104-1,2,3	R	22	30	48.4	36.8*	NA	19.2	NA	0.2	0.6	1.7	30.5	42.2*	2.8	3.3
106-1	R	51	12	41.5	45.0	NA	10.3	NA	11.1	7.8	11.5	8.6	19.4*	8.3	4.8
107-1,2,3	K	424	55	NA	53.0	1.4	0.6	31.4	41.0*	10.7	11.0	32.0	18.7*	1.7	18.3*
109-1,2	R	46	14	27.7	24.3	NA	2.1	NA	9.1	11.6	24.8*	12.8	15.2	20.4	57.4*
110-1,2,3	K	107	20	NA	57.9	51.5	65.0*	0.7	0.1	5.0	3.9	7.0	3.9	0.1	0.4
112-1,2,3	R	NA	34	33.9	56.8	NA	0.2	NA	31.5	7.3	7.5	8.1	9.0	2.5	0.8
113-1,2,3	R	NA	26	26.6	28.1	NA	0.9	NA	2.5	20.2	23.3	16.7	19.3	9.7	13.6
116-1,2,3,4	R	NA	26	17.1	32.4	NA	86.5	NA	0	0	0	38.1	46.9*	1.7	0
Nonperennial															
105-1	K	36	8	NA	31.8	22.3	21.7	4.1	6.2	12.8	16.2	18.7	22.1	5.9	4.8
108-1	K	28	9	NA	22.7	5.3	5.6	10.3	7.9	12.3	15.8	19.1	14.7	3.2	0.9
111-1,2	R	NA	24	41.3	41.7	NA	8.0	NA	5.9	1.6	3.7	8.4	9.9	28.9	43.5*
114-1,2,3,4	R	NA	38	39.2	42.1	NA	1.1	NA	31.5	1.0	0.4	13.6	14.0	3.3	5.3
115-1,2,3,4,5,6	R	NA	39	36.9	48.8	NA	3.8	NA	9.6	2.2	2.9	5.7	7.7	6.1	9.8

*More than 5% difference between crop survey and farmer's report.
**Season of crops mapped in field.
NA indicates absence of crops in fields during season the survey was conducted.

APPENDIX I

Part D

RESEARCH SCHEDULES

SCHEDULE I

PAKISTAN WATERCOURSE SURVEY

Schedule I: Photographic documentation, location factors and information from key informants.

Note: After the purpose of the survey has been properly explained to village leaders and permission has been granted the investigators with interested village leaders make a walking tour of the watercourse from the mogha outlet to the last farm to document visible problems. Also use this time to gain general information about the watercourse and the village.

A. Document the following problems with photographs.

1. Mogha outlet
2. Watercourse alignment
3. Silt maunds and sedimentation
4. Ponds in watercourse area for animals
5. Grass and trees along watercourse
6. Watercourse outlets
7. Evidences of waterlogging and salinity
8. Crop stands and plant population
9. Unlevel fields
10. Size of some fields
11. Elevation of watercourse in relationship to fields
12. Dead storage
13. Spills and leaks
14. Tubewells and jhallars
15. Farmers' irrigation behaviors

Note: If documentation of physical conditions is not completed on this reconnaissance complete the work later in the week.

B. Location factors

Determine the distance from the village to the following institutional services and enter the miles below: (Use odometer of vehicle if possible.)

Institutional Services	Miles from	Institutional Services	Miles from
1. Paved road	____	6. Schools	
2. Railway station	____	a. Boys primary	____
3. Bus stop	____	b. Girls primary	____
4. Town or city	____	c. Boys middle	____
5. Market centers	____	d. Girls middle	____
a.	____	e. Boys high	____
b.	____	f. Girls high	____
c.	____	7. Post office	____

Institutional Services	Miles from	Institutional Services	Miles from
8. Police post	_____	14. Field assistant's residence	_____
9. Health center	_____	15. Land and revenue patwari	_____
10. Fertilizer agency	_____	16. Canal patwari	_____
11. Agricultural assistant's office	_____	17. Canal	_____
12. Agricultural assistant's residence	_____	18. Canal pansal nawees	_____
13. Field assistant's office	_____	19. Canal overseer	_____

C. Choice of key informant

Note to interviewer: A key informant is selected initially for general information about several aspects of the village and the watercourse. You should keep in mind the following criteria in the selection of four or five key informants.

- Individuals who have had long residence in the village and are knowledgeable about the village and the watercourses.
- Persons who are leaders of caste, brotherhood or other predominant social groups in the village.
- Village numbardars or leading chaudreys.
- If there are minority groups in the village consider the reported leader.
- If sharp factions exist in the village attempt to choose a leader from each group.

1. Information about key informant

   a. Name_____ son of_____

   b. Caste group_____

   c. Brotherhood group_____

   d. Major reason he was chosen as key informant_____

   _____

2. Ask the key informant to give the following officials' names and their offices.

   a. Agricultural assistant_____

   b. Field assistant_____

   c. Development assistant (if any)_____

   d. Agricultural engineer (if any)_____

3. Information about the village

a. Tubewells in village: Private _____ Diesel _____

Joint _____ Electric _____

b. Type warabundi: Kutcha _____ Pucci _____

Was warabundi ever changed? _____ When? _____ Why? _____

c. Type canal system: Perennial _____ Nonperennial _____

Uncommanded _____

Tubewell scheme: Public _____ Private _____

d. When was canal established? Year _____

e. What river or link system supplies canal water?

_____

f. What year was first settlement in village? _____

g. Majority of settlers came from what areas? _____

_____

1) Is this village made up of locals only? _____

Locals and Refugees? _____

Refugees only? _____

h. Number of mosques in village and names: _____

_____

i. Names of brotherhood and caste groups in village and recognized leaders of each:

Caste groups	Recognized Leaders
1)	
2)	
3)	
4)	
5)	

Describe function of committee and officers

4. Information about watercourse cleaning:

a. Estimated times the main watercourse cleaned per year_____

b. Last date the main watercourse was cleaned_____

c. From the mogha, how much of the watercourse is cleaned collectively (number of squares of land)_____

d. Estimated number of farmers who collectively clean watercourse main_____

e. Estimated hours and days required for a cleaning_____

f. What sections are cleaned by separate groups. Describe groups and draw a rough map demarcating the areas each group cleans. (If there are stipulated karams per unit of water (hour or phar) state this.)

g. Usual practices regarding water matters.

1) To have mogha enlarged

2) Giving of fasalana

To whom_____Usual rate_____

3) Ways to reduce abiana payments. (Describe)

4) Payments to gate keeper on minor canals.

5) When there is stealing of water what sanctions are applied. (Describe)

6) Methods of stopping water thefts.

h. Determine from the key informant his degree of satisfaction with usual watercourse cleanings.

Good_____Somewhat_____Poor_____

i. Is the cleaning of the main watercourse regular or not?

Yes_____Somewhat_____No_____

j. Who usually calls watercourse members for cleaning?

_____

k. What fines for watercourse members who do not participate in cleaning

None_____Some_____Type of fine_____

Who usually applies the sanction or fine?_____

l. If there are sanctions applied for nonparticipation in operating (raising funds, repairs, maintenance, etc.) schools and mosques describe.

1) School

2) Mosque

Who can escape from these sanctions or to whom do they not apply?

None	Brotherhood/caste	Size of land holding

Brotherhood groups	Recognized leaders
1)	
2)	
3)	
4)	
5)	

m. If any watercourse committee for cleaning and/or settling water disputes, give names of members with caste and brotherhood. (Use your code for caste and brotherhood.) Describe location of each watercourse.

Name	S/O	Caste	Brotherhood
WC#1 Committee			
1.			
2.			
3.			
4.			
5.			
WC#2			
1.			
2.			
3.			
4.			
5.			
WC#3			
1.			
2.			
3.			
4.			
5.			

Name	S/O	Caste	Brotherhood

WC#4

1.
2.
3.
4.
5.

n. Name of wandara, if any _____

o. Estimated population of village _____

Separate households _____ Individuals _____

p. Names of numbardars, caste and brotherhood

q. Estimated squares of land in village _____

r. Mosque committee members

Mosque #1	#2	#3
1)	1)	1)
2)	2)	2)
3)	3)	3)
4)	4)	4)
5)	5)	5)

(If more than three mosques use blank pages.)

s. Other committees in village, if any, and members

Committee (name)	Committee (name)
1)	1)
2)	2)
3)	3)
4)	4)
5)	5)

5. **Influence in the village**

a) If there are major village disputes leading to fights or clashes who usually calls the police?

b) What individuals have the best linkages and most influence with the following officials?

Official	Names of villagers (use code number for names from warabundi list)
Police	
Canal SDO	
Canal overseer	
Canal zilladar	
Canal patwari	
Revenue patwari	
Pansal nawees	

6. Usual practices related to mosque and school.

a) Number of	What brotherhood/caste groups participate (use code)
Mosques	
Schools	

b) Presence or absence of committees for

Mosque_____ School_____

c) Methods for collecting funds for

Mosque_____,_____,_____,_____

School_____,_____,_____,_____

d) Who collects funds for

Name	Caste/brotherhood	Age	Land holding (acres)
Mosque			
School			

e) What groups or individuals were instrumental in building: (That is, who were the key individuals or what groups?)

	Name	Caste/brotherhood	Age	Land holding (acres)
Mosque				
School				

SCHEDULE II

COHESION AND CONFLICT

1. Ask each sample farmer chosen to estimate the degree of influence all other watercourse members have in relationship to decisions about cleaning and maintenance.

Response:
None = 0
Very little = 1
Some = 2
Much = 4

Enter response by each member's name in the grid.

25% sample farmers	Caste and brotherhood	Names of all watercourse members																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	+
Names																		
1																		
2																		
3																		
4																		
5																		
6																		
7																		
+																		

2. Of the following individuals and groups how would you estimate their degree of influence over watercourse cleaning? (Enter response in grid below: None = 0; very little = 1; some = 2; much = 4)

25% sample farmers' names	You	Numbardar 1	Numbardar 2	Panchgat	Large landlord	1.	2.	3.	Village Comm.	Caste 1	Caste 2	Caste 3	Caste 4	Brotherhoods 1	Brotherhoods 2	Brotherhoods 3	Brotherhoods 4	Brotherhoods 5	Brotherhoods 6	Brotherhoods 7	Brotherhoods 8	Brotherhoods 9
1																						
2																						
3																						
4																						
5																						
6																						
7																						

3. Of the following individuals and groups how would you estimate their degree of influence in helping settle disputes? (None = 0; very little = 1; some = 2; much = 4) Enter below in grid at proper place.

25% sample farmers' names	You	Numbardar 1	Numbardar 2	Panchgat	Large landlord	1.	2.	3.	Village Comm.	Caste 1	Caste 2	Caste 3	Caste 4	Brotherhoods 1	Brotherhoods 2	Brotherhoods 3	Brotherhoods 4	Brotherhoods 5	Brotherhoods 6	Brotherhoods 7	Brotherhoods 8	Brotherhoods 9
1																						
2																						
3																						
4																						
5																						
6																						
7																						

4. From whom do you usually seek advice or assistance for the following matters? (To be placed on matrix).

   a. Farming matters

   b. Watercourse cleaning

   c. Canal water thefts

   d. To accompany you on important visit to SDO canals

   e. Borrowing money

   f. To accompany you on visit to oversee canals

   g. To accompany you on visit to canal patwari

   h. To accompany you to land revenue patwari

   i. To visit pansal nawees

   j. Trading irrigation turns

   k. Advice about farming

   l. "Wangar" or "seri" relationships

   m. Problems with watercourse committee, if any

   n. Mosque matters
      At which mosque do you pray?

(Note) Be sure to record the name given and his father's as well as caste and brotherhood. (For each village a caste code should be developed. Example, Arian = A; Kumbo = K, etc. Likewise a brotherhood code must be used. Example for listing of a name: Mohd. Ali S/O Barkat Ali; (A) (BD) where A is the caste and BD is code for brotherhood.

5. Other information about cohesion and cooperation.

   a. Mosque

      1) At which do you say prayers?

      2) What methods are used to support the mosque? (describe)

      3) What methods are used to convince those who are unwilling to contribute? (describe)

b. School

1) What methods are used to support the school? (describe)

2) What methods are used to convince those who are unwilling to contribute? (describe)

c. (With) what groups (caste, brotherhood, "party") would you not

1) Seek a marriage relationship

2) Invite to celebrate
Circumcision ceremony

Birth of a son

Other family ceremonies

6. Conflict intensity, etc.

a. Describe any major conflicts in the past five years which have taken place in the village?

Type conflict L = land W = women M = money P = property	Intensity* F = fight VF = village fight P = police CC = court case M = murder	Between what groups (write in)	Year begun/ finished (dates)	Degree Resolution None Some Full	Agency for Resolution
1.					
2.					
3.					
4.					
5.					

*None; verbal dispute; hooka pawnee bund; sporadic fighting; frequent fighting; murder/killing.

SCHEDULE III

FARMER INTERVIEW SCHEDULE

Interviewer_____

Farmer's Name_____son of_____

Respondent's Brotherhood_____Tubewell Farm_____

Type TW_____Size_____Tractor_____

Canal Type: Perennial_____Nonperennial_____Uncommanded_____

I. Personal Characteristics of Respondent:

a. Residence: 1. in village abadi_____2. on farm land_____

3. other ( )_____

b. Age at last birthday_____

c. Education: 1. Years completed formal schooling_____
2. Literate_____Nonliterate_____
3. Education of family members using one chula

a. No. in family_____

b. No. in family under 6 years_____

c. No. 6 years and over with some education_____

d. No. with some primary education_____

e. No. with some middle education_____

f. No. with matric education_____

g. No. Matric pass_____FA pass_____

BA/BS pass_____

d. Type farming:

1. Full time_____2. Part-time_____3. Joint_____

4. No. and names of persons in joint farming_____

_____

5. If part-time farming, type of other business_____

6. History of any nonfarm business/occupation?_____yes_____no

a. Type of nonfarm business, etc._____
years_____

II. Land Use Patterns (center on map of holdings also)

Item	On this WC	On other WC in village	In other Villages	TOTAL
Total acres owned	1.____	1.____	1.____	____
2. Located in Square	2.____	2.____	2.____	
3. Total acres Nonculturable	3.____	3.____	3.____	3.____
a. Area buildings	a.____	a.____	a.____	a.____
b. Kapra/sanddunes	b.____	b.____	b.____	b.____
c. Other	c.____	c.____	c.____	c.____
4. Total culturable land owned	4.____	4.____	4.____	4.____
5. Land rented from others	5.____	5.____	5.____	5.____
6. Land rented to others	6.____	6.____	6.____	6.____
7. Total acres self-cultivated	7.____	7.____	7.____	7.____

8. If cash tenant or contractor state which_____Rent/acre_____

9. If share tenant? yes____no____State tenant's share of:_____

a. Abiana____b. TW water____c. Land Revenue____d. Seed_____

e. Fertilizer____f. Insecticides____g. Tractor hire_____

h. Share of crop____i. Share of fodder for tenant's animals_____

10. If share tenant, cash tenant, or contractor: Residence of owner_____

_____Residence of manager_____

11. Fragmentation of holdings:

Place	No. of Parcels	Located in Squares	TOTAL ACRES
a. Along same WC	____	____	____
b. In same village other WC	____	____	____
c. In other villages	____	____	____
d. TOTAL	____	____	____

12. Cropping patterns/intensity. (Go with farmer to fields, use grid, enter crops, area in gardens, fallow, wasteland.) (A grid divided into units of one acre is to be used. This is on a separate sheet.)

a. From grid calculate:

1) Cropping intensity: Total acres utilized Rabi/Kharif x 100 = _____

Total cultivated area in acres _____

2) Land use intensity: Total acres utilized for Rabi/Kharif x 100 = _____

Total land in cultivation, fallow, wastelands, land in buildings = _____

b. Crop rotations: (Go to selected fields with farmers and ask what crops were cultivated in each of four different seasons.)

Fields (Write in year, season)	Season 1	Season 2	Season 3	Season 4
1.	_____	_____	_____	_____
2.	_____	_____	_____	_____
3.	_____	_____	_____	_____
4.	_____	_____	_____	_____

c. Ask farmers: What are the major factors which help you decide what cash crops to cultivate:

1. Price_____ 2. Water availability_____ 3. Rain_____

4. Tradition_____ 5. Other (write in)_____

d. What was the major factor in your decision to cultivate?

_____acres of wheat_____of rice_____acres of fodder

_____of SC this year? (Write reasons he gives.) Enter the acres for each crop from the cropping grid.)_____

_____

e. Do you have any idea of the canal water supply this season before cultivating crops? _____good_____poor_____very poor

From where did you get your information?_____

_____

f. Suppose you had double the current supply of canal water, how would you change your acreage of:

Present acres in crops (Enter from the crop grid the actual acres of each crop below.)	Would change to acres in crops if double water	% increase or decrease
1. Wheat		
2. Rice		
3. Cotton		
4. Fodder		
5. Sugarcane		
6. Other		
7. Other		

III. Availability of Inputs, Credit and Sources of Credit
(Availability code: Easily = E; Not easily = NE; Not available = NA)

	Availability inputs	Availability credit (For each input and items)	Source Credit			
			Self	Shop	Friend/R	Govt.
1. Fertilizer						
2. Seed						
3. TW Water						
4. Insecticides						
5. Other						

Other Credit Items:

1. Bullocks						
2. Land-leveling						
3. Tractor cultivating						
4. Family needs						

IV. Estimated yields for selected crops and fertilizer use.

1. Item	Selected Crops: Wheat	Cotton	S. Cane	Rice	Fodder	Other
a. Acres						
b. Total yield						
c. Kind payments						
1. Cutting						
2. Winnowing						
3. Cartage						
4. Carpenter						
5. Lohar						
6. Barber						
7. Mouchi						
8. Fasalana						
9. Maulvi						
10. Wandara						
11. Other (write)						
d. Home use						
e. Marketed						
f. TOTAL (add 1-11)						
g. DIVIDE BY ACRES FOR YIELDS						
2. Fertilizer Inputs/Acre						
a. AN bags						
b. AS bags						
c. Urea bags						
d. DAP bags						
e. TSP bags						
f. SSP bags						
g. Carts manure						
h. Carts city sweeping						

NOTE: INTERVIEWER: Be sure to note weight of bags and % NPK, and type - i.e. Esso, Dawood-Hercules, Multan, etc., to double-check amounts of NPK. (Calculate the units of N and P applied/acre.)

TOTAL N APPLIED						
TOTAL P APPLIED						

WATERCOURSE SURVEY SCHEDULE IV

Irrigation and adoption behaviors; patterns of cooperation and utilization of institutional services.

I. Personal Information:

1. Farmer's name_____ Son of_____

   Total land owned_____ Land owned on WC_____

   Owner-cultivator_____ Land cultivated
   Owner-cum-tenant_____ on watercourse_____
   Tenant_____

2. Land located on watercourse

   _____acres on tail Land located on map at:_____
   _____acres in middle _____
   _____acres nearer mogha

II. Irrigation schedule:

1. Day of week_____ Total hours/min_____
2. Turn starts at_____ Ends at_____
3. Day of week on jhallar (check to see if same)_____
4. Time on jhallar_____day_____start_____end_____
5. Has turn on warabundi been changed?_____last year,____last two years,_____last five years?
6. If turn runs dry?
   a. Misses that turn_____ b. Can make up that turn_____

III. Trading - Buying of Water:

Type	Times in last Kharif	Times in last Rabi	Usually with whom/Rel.
1. Trade part turn	_____	_____	_____/____
2. Trade full turn	_____	_____	_____/____
3. Trade TW water for canal water	_____	_____	_____/____
4. Trade canal water for TW water	_____	_____	_____/____
5. Bought TW water	_____	_____	_____/____
6. Bought canal water	_____	_____	_____/____
7. Had part of turn stolen	_____	_____	_____/____

IV. Which system is best; the kutcha or the pucca warabundi? Why?

1. Kutcha_____Reasons:
2. Pucca_____Reasons:

V. Reputational Index: Power structure-leadership patterns
Name three individuals on this watercourse with the most influence:

Name	Why?
1. _____	_____
2. _____	_____
3. _____	_____

VI. Farmer's knowledge about water use and requirements?

1. What are major sources of water losses on this watercourse?
   a. Spills and leaks _____ How to solve _____
   b. Seepage _____
   c. Water standing in ditches _____
   d. Vegetative growth on canals _____
   e. Unlevel fields _____
   f. Evaporation _____
   g. Silt _____
   h. (Other) _____

   *Have farmer rank three most important by entering I, II, III.

2. How do you decide when to irrigate a particular field?
   a. Date from last irrigation _____
   b. Appearance of soil surface _____
   c. Appearance of plants _____
   d. Size of plants _____
   e. Examination of sub-surface soil (digging down) _____
   f. When water comes _____
   g. Guess work _____
   h. God's will _____
   i. Don't know _____
   j. Other _____

   *Have farmer rank most important by entering I, II, III.

3. Assume you have sufficient water for irrigation of the following crops, how many irrigations would you apply? How many do you usually apply with insufficient water? (TW and canal)

Crop for season	Optimum No. to apply	Usually apply No. of irrigations
a. Cotton		
b. HYV wheat		
c. Local wheat		
d. Basmati rice		
e. Maize (grain)		
f. Maize fodder		
g. Berseem		
h. Oats (dry)		

4. Amounts of water to apply per irrigation:
   a. Can you show me on your hand about how much water you try to apply per irrigation? _____ inches. Why?
   b. How do you know when you have applied enough water to a field fo an irrigation? That is when it is time to stop the water?

      1) When water covers all of the high spots _____
      2) When water reaches the far border _____
      3) When water appears to be a certain depth on field _____
      4) Certain number of minutes per field known _____
      5) (Other) _____

   c. In this picture are four cotton plants showing 4 stages of growt Please tell me if you would apply more, less, or same water in an irrigation at each stage of growth?

Stages	More	Less	None
1) Seedling stage/May	____	____	____
2) Square stage/June	____	____	____
3) Boll formation/August	____	____	____
4) Bolls fully formed/September	____	____	____

      Why do you give these answers?

      When is the most important stage to apply water to wheat?

   d. Can you tell me how plants "drink" water?
   e. How deep does the moisture go when you apply a 5 inch irrigation?
   f. What depths would you estimate the following roots of crops grow down into the soil?

      1) Cotton _____ ft/in. 4) Sugarcane _____ ft/in.
      2) Wheat _____ ft/in. 5) Berseem _____ ft/in.
      3) Rice _____ ft/in.

   g. Which crops consume more water for a complete crop season?

      Wheat or cotton _____ Cotton or Berseem _____

VII. Can you tell me if you ever get advance information on the following activities?

Activities	Never	Sometimes	Often	Source
1. Closure of main canal for repairs	____	____	____	____
2. Closure of main canal for cleaning	____	____	____	____
3. Schedule or rotation of canals when water rationed by Pansali	____	____	____	____
4. Notice in advance for Khal cleaning	____	____	____	____
5. Notice of seasonal expected volume	____	____	____	____

VIII. Would you consider that your fields are sufficiently level now?_____

When was the last time you used a krah or tractor blade for leveling your land?_____

How often do you have to level your land?_____after one crop
_____after two crops
_____once a year
_____once two years

Do you get the cooperation of other farmers and teams to level?_____

IX. Which system would you prefer for the distribution of canal water on your watercourse?

1. Pucca warabundi_____why?
2. Kutcha warabundi_____why?
3. Present system supplemented by a cooperative TW_____
4. WC purchase of water at mogha on volume and distribute it?_____
5. Demand system when crops need water_____

X. Will you cooperate with other members of watercourse in building a pucca watercourse here? How should farmers best organize for this?

_____;_____

Who would be your local leaders? Name three: 1. _____
2. _____
3. _____

XI. Purchase of water for Rabi 1973-74 and Kharif 1975.

Source	Type TW	Size TW	Hours for Rabi	for Kharif	Rate/hr.
1._____					
2._____					
3._____					
4. Canal water					

XII. Solutions to Water Problems

Problem	Farmer's reports of ways to solve problem
1. Someone steals your water	
2. False entry in Khasrah.	
3. Request for increased fasalana	
4. Canal officers say mogha too large; want to add a brick to decrease outlet	
5. Forgiveness of part of abiana	
6.	
7.	

XIII. Adoption Behaviors of Farmers and Institutional Services

1. Adoption Behaviors:

Innovations	Knowledge	Source	Trial	Source	Adoption	Source
a. Chenab 70 wheat						
b. SA 42 wheat						
c. Improved rice						
d. Improved Bajra						
e. Line planting rice						
f. Line planting cotton						
g. Spraying rice						
h. Spraying cotton						
i. DAP or Phosphorus						
j. Rabi drill						
k. Ridging sugarcane						

2. Farmer's Utilization of Improved Technologies for HYV Wheat

a. HYV wheat_____desi wheat_____

b. Correct sowing dates of HYV wheat_____dates

c. Speedbed preparation: _____Tractor_____Raja hul_____desi hul

d. Depth of seeding: _____HYV wheat_____desi wheat

e. Seeding method: _____Pora_____Keria_____broadcast_____Rabi drill

f. Seed rate _____

g. Split fertilizer application wheat: _____one appli._____two___more

h. Amount of nitrogen/acre HYV wheat: _____bags_____type_____

i. DAP or phosphorus_____bags _____type

3. Farmer's Use of Improved Implements and Source

Use of	Yes	No	Owned by family	Borrows	Rents	Rate
a. Cultivator						
b. Raja Hul						
c. Rabi drill						
d. Tractor plow						
e. Trolley/tractor						
f. Thresher						
g. Tubewell						
h. Tractor blade for leveling						

4. Knowledge of Recommended Practices for HYV Wheat Janab 70:

a. Correct range of dates for sowing_____(response)

b. Depth of seeding_____inches depth. Seeding method_____

c. Nitrogen per acre when no green manure, farmyard manure, no city waste used and following cotton, maize, or paddy_____bags_____type

d. Amount of DAP or phosphorus/acre_____bags, type_____

e. Seed rate if sown late_____seer/acre

f. Method sowing_____

g. Split applications of nitrogen_____

XIV. Communication

1. Urban Orientation:

a. Trips to market, towns or cities_____last three months.

b. Family member's trips to towns or cities_____last three months.

c. Family members working in towns or cities but reside in village _____number

d. Family members reside in town _____number

2. Mass Media Information:

a. Family owns or receives

1) radio_____2) T.V._____3) Newspaper_____4) Magazine regularly_____

b. Times listened to radio programs for periods of up to 30 min.

_____last week_____last two weeks_____3 weeks_____month

c. Times read or had read: Newspapers, magazines No._____last week

d. Times listened to farm radio program: _____last week

What is name of station?_____What time is daily program?_____

Subject recall_____date

e. Radio listening preference (rank only three of below as most preferred 1, 2, 3.)

1) Musical programs_____

2) Poetry/drama _____

3) Farm News _____

4) World News _____

5) Local News _____

6) Religious programs_____

XV. Knowledge and Use of Institutional Services

Department/Personnel	Knows office location	Knows officer name	Contacts in 3 months	Type of service
1. Agriculture Asst.				
2. Field Assistant				
3. Devel. Assistant				
4. Agri. Engineer				
5. Project Manager				
6. Bank/credit				
7. Cooperative Dept.				
8. Fertilizer Agent				
9. Patwari				
10. Zilladar				
11. Overseer				
12. SDO canal				

XVI. Information about land leveling and watercourse improvement: Have you heard about land leveling program?_____ watercourse improvement program?_____

LL Program WC Program

Source _____

When _____

Benefits of _____

Costs your share_____ What is it? _____

XVII. List your three most important present farming problems in order:

1. _____ 2. _____ 3. _____

and explain why?

ATTITUDINAL QUESTIONNAIRE

FOR TRAINING OF FIELD INTERVIEWERS

The following are descriptions of actual work situations. You are asked to mark (✓) the statement that best represents your true feelings about the situation or the statement that is closest to what you would do under these circumstances. There are no really correct answers, as each individual will have his own set of attitudes and foreseeable actions.

1. The following situation applies: you have been given a job to measure all the irrigation applications for a given warabundi; yet an important holiday, Eid, is going to fall during the warabundi, but the farmer still intends to irrigate on his regular turn of which falls on the holiday.

_____a. I would instruct the field assistant and beldar to remain and make the measurements.

_____b. I would make arrangements with my superiors to postpone the measurements until after Eid when I return from my home.

_____c. I would stay to make the measurements as instructed.

_____d. None of the above describe my foreseeable actions.

_____e. I would do the following: _____

_____

_____

2. My superiors have instructed me to collect a set of data using a prescribed procedure. This approach according to my knowledge is very likely to insult the farmers to the point of seriously jeopardizing all future work on the watercourse.

_____a. I would follow my superior's instructions completely.

_____b. I would follow my intuition and modify the approach to avoid the insult, at the risk of not collecting all the data or of not getting exactly the right kind of data.

_____c. I would discuss the matter with my superior.

_____d. None of the above describe my foreseeable actions

_____e. I would do the following: _____

_____

_____

3. My superiors have instructed me to do a certain job on the watercourse that I am assigned to; attaching a staff gauge to the

mogha in order to obtain a rating curve for the discharge of the mogha. The farmers do not wish to have me do this because this might draw attention to the fact that they have paid to have the mogha modified from its original design specification.

_____a. I would follow my superior's instructions without delay.

_____b. I would explain the problem to my superior so that he would make the decision.

_____c. I would explain my mission to the farmers and promise complete confidentiality about the data collected.

_____d. None of the above describe my foreseeable actions.

_____e. I would do the following: _____

_____

_____

4. I have been assigned to work directly with farmers on a given watercourse for the entire kharif season. This involves being on the watercourse often at night to measure irrigation applications and on weekends to observe and record farmer production inputs.

_____a. I would prefer to rent a room in the village served by the watercourse.

_____b. I would prefer to live with the farmer whose actions I am studying.

_____c. I would prefer to live at the Mona Colony and commute to my work as the work requires my presence.

_____d. None of the above describe my foreseeable preferences.

_____e. I would do the following: _____

_____

_____

5. I have been assigned to work on a given watercourse to observe the farmer's inputs to crop production.

_____a. I feel that farmers are basically very trusting and that I can tell them most anything or do anything that will get my assignment completed.

_____b. I know the farmers difficulties, and I will attempt to understand him, to teach him, and help him when I can.

_____c. I realize that farmers are really quite clever, and I must be very careful so that they don't use me for their purposes.

_____d. None of the above describe my attitudes.

_____e. I would do the following: _____

_____

_____

6. I have been assigned to live and work on an experimental watercourse. I realize the farmers are very hospitable toward me because I have won their confidence.

_____a. I really do expect to be taken care of while working in the field and have the farmers bring me tea or lassi whenever available.

_____b. I really don't expect too much, so I will only help myself to radishes, or sugarcane or fruit on limited occasions.

_____c. I really don't want any material thing from the farmers, but on occasion I will accept some refreshment only out of courtesy on my part as a response to their courtesy.

_____d. None of the above would describe my foreseeable feelings or actions.

_____e. I would do the following: _____

_____

_____

7. In my work on the watercourse I have been assigned several pieces of expensive equipment or measuring devices.

_____a. I will assign the field assistant or beldar working with me to look after the maintenance and security of these items.

_____b. I will personally be responsible for the security and maintenance of this equipment.

_____c. I know the farmers and that they won't harm my equipment, so security for the equipment wouldn't be a problem for me.

_____d. None of the above describe my attitude.

_____e. I would do the following: _____

_____

_____

8. Much of my work on the watercourse involves measuring water and soil moisture. Both of these jobs can be quite tedious and dirty.

_____a. I will assign my field assistant to make these measurements, after all I have trained him to do a good job.

_____b. I will personally supervise my field assistant's work to ensure precision in measuring.

_____c. I will make all measurements in the field personally and if necessary I will wade into the water to install a flume.

_____d. None of the above describe my foreseeable actions.

_____e. I would do the following: _____

_____

_____

9. In accepting a job to work with an organization, I am faced with a conflict between choosing a position which will ultimately lead me to a long career up the organizational ladder or between a job which has a short longevity but which has many opportunities for me to learn new things and increase my engineering skills.

_____a. I would accept only those positions which are sure to get me promoted in the organization.

_____b. I would accept any position however short in duration, in order to increase my skills and knowledge.

_____c. I would only want to work and to be paid for it; these other considerations don't matter to me.

_____d. None of the above describe my attitude about these matters.

_____e. I would do the following: _____

_____

_____

10. I face the problem of learning to determine soil moisture depletion by touch and feel method. After considerable experience I am still not confident.

_____a. I will continue to make measurements as directed by my superior.

_____b. I will explain my problem to my superiors and ask for guidance.

_____c. I will make gravimetric soil moisture measurements to check my touch and feel technique.

_____d. None of the above describe my actions.

_____e. I would do the following: _____

_____

_____

11. In accepting a job, I am faced with the problem of accepting a position of lower qualification and pay with the possibility of early promotion to the grade corresponding to my skills and qualifications or waiting for the right job to appear.

_____a. I would take any job now because I don't know how long it would take for the right job to come along.

_____b. I am fully willing to work hard at a job for which I am over qualified, knowing that hard work is readily repaid in promotions.

_____c. I am worried that in accepting the job with the lower qualification, I will face ridicule from my classmates and professors and will hurt my professional image.

_____d. None of the above apply to my attitude.

_____e. I would do the following: _____

_____

_____

12. A group of farmers on the watercourse to which I am assigned have come to me for help. They want me to accompany them to a local irrigation supervisor to plead their case for increased water supply from their mogha.

_____a. I should help the farmers all I can.

_____b. I should express concern for the farmer's complaints and handle the matter by myself.

_____c. I should hear the grievances but should remain outside of the controversy.

_____d. I should do none of the above.

_____e. I would do the following: _____

_____

_____

13. I am working for an organization which is very powerful and has a reputation of harboring many corrupt officials.

_____a. I should be willing to criticize the organization when others do so.

_____b. I should be willing to defend the organization with my loyalties in most circumstances.

_____c. I should not criticize, for every organization has its despicable persons, but I should try to influence others by my reputable behavior.

_____d. None of the above would be my course of action.

_____e. I would do the following: _____

_____

_____

14. I have a co-worker who is not doing his job properly and recording fictitious data from no measurements.

____a. I should convince him of his predicament and cause him to correct his behavior.

____b. I should not talk to him but should report him immediately to my superiors since incorrect, fictitious data is unforgiveable in research activities.

____c. I should do nothing as everybody eventually gets his due reward.

____d. I would do none of the above.

____e. I would do the following: _____

15. A dispute has arisen on the watercourse where I work. Two families which have traditionally been fighting are now at odds over an irrigation turn.

____a. I should listen to the case and try to convince the guilty party to change his actions before I go to the police.

____b. I should listen to the case and help the two parties to come to some reasonable agreement.

____c. I should remain out of the proceedings as my job is not to settle disputes on the watercourse.

____d. I should do none of the above.

____e. I would do the following: _____

Name of Evaluator_____

Name of Person Evaluated_____

EVALUATION OF WORK PERFORMANCE OF

ENGINEERS, AGRONOMISTS, AND SOCIOLOGISTS

Watercourse Survey

Date_____

Place_____

Purpose: To improve methods of training for improved skills acquisition of persons participating in the watercourse survey team and arrive at more sound criteria for making judgments about the progress of each trainee.

Note: This is a first approximation of some evaluative points that can be utilized for the persons involved in this on-the-job training in watercourse survey methods and approaches. This is to be utilized primarily as a tool to improve the training and to improve the skills acquisition of the trainees during the field experience.

Evaluation then is necessary to help trainees to know how well they are doing. Trainees will be involved in self-measurement and the two trainers will also evaluate each trainee. The feedback from this process should be useful in improving our training methods. Evaluation is necessary only for those tasks included in the job description: Engineer, Agronomist, or Sociologist.

Evaluative Points	Scale of Accomplishment (check only one)			
	Very Adequate Very Good	Somewhat Adequate Good	Need Much More Experience Fair	Still Very Weak Poor
1. Job Performance				
A. Installing flumes	_____	_____	_____	_____
B. Reading flumes	_____	_____	_____	_____
C. Topographical surveys	_____	_____	_____	_____
1) Bench marks	_____	_____	_____	_____

Job Performance Evaluation (continued)

	Very Adequate / Very Good	Somewhat Adequate / Good	Need Much More Experience / Fair	Still Very Weak / Poor
2) Reading instruments				
3) Closing survey				
4) Recording data				
5) Map design to scale				
D. Evaluation of ditch losses				
1) Correct location				
2) Correct length of time				
E. Field Efficiency				
F. Notes on irrigation behavior of farmers				
G. Accuracy				
H. Checking instruments for level accuracy				
I. Crop surveys				
J. Field geometry				
K. Regular daily diary of work and observations				
L. Moisture samples				
M. Approach to farmers				
N. Problem solving				
O. Care in interviewing				
P. Care in data recording and promptness				
Q. Writing of data legibly				
R. Organizes work daily				

Job Performance Evaluation (Continued)

	Very Adequate Very Good	Somewhat Adequate Good	Need Much More Experience Fair	Still Very Weak Poor
S. Interviewing techniques	_____	_____	_____	_____
T. Farmer credibility	_____	_____	_____	_____
U. Working overtime to finish a job	_____	_____	_____	_____
V. Makes special notes in field books about questions	_____	_____	_____	_____
W. Observation of farmer irrigation behavior	_____	_____	_____	_____
X. Speed in work	_____	_____	_____	_____
Y. Arrives at location on time to set up instruments	_____	_____	_____	_____
Relationships with Team Members:				
A. Sharing work-helpfulness	_____	_____	_____	_____
B. Cooperation with others	_____	_____	_____	_____
C. Group decision making	_____	_____	_____	_____
D. Sharing leadership	_____	_____	_____	_____
E. Follows instructions of leader	_____	_____	_____	_____
F. Solving team problems	_____	_____	_____	_____
G. Management of team activities when in role of leader	_____	_____	_____	_____
General Attitudes about:				
A. Extra work, long hours, etc.	_____	_____	_____	_____
B. Pride in work	_____	_____	_____	_____

Job Performance Evaluation (Continued)

	Very Adequate Very Good	Somewhat Adequate Good	Need Much More Experience Fair	Still Very Weak Poor
C. Modesty	_____	_____	_____	_____
D. Frankness	_____	_____	_____	_____
E. Positive attitudes about farmers	_____	_____	_____	_____
F. Field hardships	_____	_____	_____	_____
	None	Some	Much	Very Much
G. Chapulusi or deference to trainers	_____	_____	_____	_____
H. Chumcha Gheri extreme deference to trainers	_____	_____	_____	_____

Other (Have each trainee to answer the following questions.)

1. Write a brief statement below in the space provided which will sum- the importance of the work you are now doing for yourself and for the Pakistani farmers.

2. Write a brief statement about the general areas in which you would like to have more training and experience.

3. State very frankly how you think we can improve the following:

   a. Survey approaches

   b. Methods of on-the-job training.

4. Why is the farmer himself the most important component of the irrigation system in Pakistan? (Any new insights?)

5. State very frankly your honest feelings when someone criticises your work, which you have conducted with real sense of dedication and professional integrity.

Job Performance Evaluation (Continued)

6. State briefly what you would do if a farmer does not agree with you and tries to pull out your flume from the watercourse and threatens to kick you and all of your equipment from his fields.

7. Please be very frank and honest in stating your personal attitudes towards survey team members if you were a farmer. Especially when you have real shortage of water and they come and install a flume in your watercourse.

APPENDIX II

Part A
Section I

PHYSICAL SUMMARY WATER DATA

TABLE 1

VILLAGE LEVEL WATERCOURSE LENGTH SUMMARY STATISTICS FOR

HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON VILLAGE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range
101	17	2253	2300	2600	1700	900	26	4052	3850	5660	3000	2660	25	7465	7700	8720	6200	2520
102	3	1500	1500	1600	1400	200	1	2000	2000	2000	2000	0	7	4300	4000	4800	4000	800
103	0	-	-	-	-	-	9	1374	1200	1295	1200	95	17	2330	2243	2651	2153	498
104	12	953	1075	1570	10	1560	11	2837	3156	3450	1800	1650	6	4117	3800	5100	3500	1600
105	3	560	350	980	350	630	5	4234	3972	5280	3972	1308	5	7560	7700	7920	7260	660
106	1	1560	1560	1560	1560	0	2	2550	2550	2700	2400	300	3	3880	3520	4700	3420	1280
107	56	4092	2050	5800	700	5100	22	7570	7600	9000	5390	3610	9	12355	13200	14000	9400	4600
108	3	2123	1650	3070	1650	1420	-	-	-	-	-	-	3	9120	8030	11300	8030	3270
109	10	2902	3545	3700	1700	2000	6	6567	6600	7700	5500	2200	1	14000	14000	14000	14000	0
110	23	1188	910	2398	100	2298	8	3919	3674	4800	3454	1346	6	5878	5779	7206	4950	2256
111	7	1165	1100	1555	800	755	15	2365	2434	3000	1800	1200	10	4161	1850	5300	3765	1535
112	19	1788	1500	9000	660	8340	21	4553	4500	6400	3350	3050	13	8378	8345	9790	6610	3180
113	8	1386	1250	1800	950	850	21	2904	2800	3800	1980	1820	17	4913	4880	5931	4000	1931
114	58	1185	880	3600	150	3450	9	4711	4400	6000	3500	2500	2	11000	11000	11600	10400	1200
115	30	657	700	1500	10	1490	12	2175	2150	3000	1600	1400	4	3750	3650	4500	3200	1300
116	12	1066	1107	1900	20	1880	9	2670	2800	3200	2173	1027	5	5104	4750	5920	4550	1370

TABLE 2

VILLAGE LEVEL IRRIGATION DELIVERY EFFICIENCY SUMMARY PERCENTAGES FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON VILLAGE BASIS

Village	Head (%)						Middle (%)						Tail (%)					
	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range
101	16	70	66	93	53	40	23	72	77	87	61	26	25	64	61	78	43	35
102	3	71	68	87	57	30	1	82	82	82	82	0	7	55	61	61	43	18
103	0	-	-	-	-	-	7	50	46	62	46	16	5	73	70	84	61	23
104	12	60	63	100	31	69	11	48	47	79	16	63	6	44	47	61	20	41
105	3	78	84	93	58	35	5	49	47	62	41	21	5	60	61	61	58	3
106	1	41	41	41	41	0	2	38	38	49	27	22	3	51	60	66	28	38
107	48	64	63	92	41	51	18	50	47	66	41	25	7	40	39	43	37	6
108	3	67	58	85	58	27	-	-	-	-	-	-	3	36	46	51	12	39
109	10	50	60	72	33	39	6	41	43	70	17	53	1	11	11	11	11	0
110	23	69	73	91	47	44	8	56	49	95	38	57	7	54	61	78	28	50
111	7	46	51	62	29	33	15	38	38	90	2	88	10	51	58	69	22	47
112	19	58	54	82	32	50	20	54	54	80	27	53	13	49	47	90	17	73
113	8	65	62	87	44	43	21	57	55	84	15	69	17	59	51	100	23	77
114	58	67	61	100	23	77	9	30	30	51	15	36	2	16	16	18	13	5
115	29	63	67	100	32	68	12	53	51	91	13	78	4	24	18	55	6	49
116	11	46	30	100	9	91	9	23	21	50	6	44	5	14	13	25	7	18

TABLE 3

VILLAGE LEVEL IRRIGATION APPLICATION EFFICIENCY SUMMARY PERCENTAGES FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON VILLAGE BASIS

Village	Head (%)						Middle (%)						Tail(%)					
	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range
101	16	82	86	100	46	54	26	73	67	100	25	75	25	76	76	100	39	61
102	3	100	100	100	100	0	1	100	100	100	100	0	7	77	61	100	61	39
103	-	-	-	-	-	-	9	100	100	100	100	0	17	100	100	100	100	0
104	12	89	100	100	56	44	11	96	100	100	77	23	6	98	100	100	88	12
105	3	28	24	43	17	26	5	45	51	65	26	39	5	50	51	90	20	70
106	-	-	-	-	-	-	1	72	72	72	72	0	2	61	61	66	56	10
107	54	97	100	100	45	55	22	93	100	100	33	67	5	94	100	100	71	29
108	2	87	87	98	76	22	0	-	-	-	-	-	1	100	100	100	100	0
109	10	66	60	100	17	83	6	57	56	100	36	64	1	16	16	16	16	0
110	19	85	100	100	42	58	8	44	47	100	13	87	6	70	63	100	57	43
111	7	96	100	100	83	17	15	93	100	100	57	43	10	93	100	100	45	55
112	17	89	100	100	24	76	20	71	97	100	15	85	13	98	100	100	81	19
113	8	68	81	100	31	69	21	81	89	100	36	64	17	83	100	100	45	55
114	58	94	100	100	27	73	9	76	100	100	39	61	2	100	100	100	100	0
115	29	92	100	100	15	85	11	92	100	100	38	62	4	100	100	100	100	0
116	11	52	61	100	3	97	9	72	86	100	22	78	5	44	21	100	9	91

TABLE 4

VILLAGE LEVEL PERCENT IRRIGATION COMPLETION SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON VILLAGE BASIS

Village	Head (%)						Middle (%)						Tail (%)					
	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range
101	7	73	74	87	57	30	9	80	89	100	48	52	5	82	83	95	59	36
102	3	65	58	93	44	49	1	58	58	58	58	0	7	16	100	100	35	65
103	0	-	-	-	-	-	9	51	44	85	20	65	17	49	51	96	28	68
104	10	44	40	66	21	45	10	61	53	89	16	73	5	62	55	91	36	55
105	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
106	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
107	48	57	55	99	18	81	17	62	63	97	28	69	3	51	55	62	36	26
108	0	-	-	-	-	-	0	-	-	-	-	-	1	67	67	67	67	0
109	4	75	81	85	52	33	2	52	52	65	39	26	0	-	-	-	-	-
110	12	53	61	78	19	59	1	49	49	49	49	0	1	43	43	43	43	0
111	5	51	46	92	27	65	11	50	46	98	5	93	8	73	87	91	17	74
112	14	55	60	96	12	84	10	65	65	87	51	36	11	63	66	97	21	76
113	1	86	86	86	86	0	9	31	74	89	39	50	9	78	78	97	45	52
114	47	49	35	98	17	81	5	63	72	84	29	55	2	74	74	81	67	14
115	24	64	67	100	26	74	7	52	54	80	19	61	4	48	21	80	17	63
116	1	80	80	80	80	0	3	53	61	73	24	49	1	76	76	76	76	0

TABLE 5 VILLAGE LEVEL PERCENT LOSS RATE PER THOUSAND FEET OF WATERCOURSE SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON VILLAGE BASIS

Village	Head (%)						Middle (%)						Tail (%)					
	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range
101	16	13	13	22	4	18	22	7	7	12	4	8	25	5	5	8	2	6
102	3	20	22	30	8	22	1	9	9	9	9	0	7	10	10	12	9	3
103	0	-	-	-	-	-	7	42	45	45	32	13	5	11	13	16	6	10
104	11	49	45	99	27	72	11	19	20	38	6	32	6	14	14	23	8	15
105	3	52	19	121	17	104	5	12	13	15	10	5	5	52	5	6	5	1
106	1	38	38	38	38	0	2	24	24	27	21	6	3	13	12	20	7	13
107	48	21	18	71	4	67	18	7	7	10	4	6	7	5	5	6	4	2
108	3	26	26	26	5	21	0	-	-	-	-	-	3	7	7	8	6	2
109	10	18	16	37	11	26	6	9	9	13	4	9	1	6	6	6	6	0
110	23	52	21	171	6	165	8	11	14	15	1	14	6	10	12	13	5	8
111	7	49	29	88	23	65	15	29	26	54	19	35	10	12	11	17	8	9
112	19	38	29	103	5	98	20	10	10	19	5	14	13	6	7	9	1	8
113	8	25	23	43	14	29	21	15	14	31	5	26	16	9	11	19	3	16
114	58	47	31	127	0	127	9	15	15	23	11	12	2	8	8	8	7	1
115	26	88	75	478	11	467	12	22	23	42	4	38	4	20	21	23	14	9
116	10	50	51	86	9	77	9	30	27	43	19	24	5	17	18	20	13	7

TABLE 6 VILLAGE LEVEL CUBIC FEET PER SECOND LOSS PER THOUSAND FEET OF WATERCOURSE SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON VILLAGE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range
101	16	31	31	54	9	45	23	16	12	28	9	19	25	10	11	16	4	12
102	3	20	20	28	12	16	1	9	9	9	9	0	7	14	14	17	11	6
103	0	-	-	-	-	-	7	15	17	17	9	8	5	3	3	5	1	4
104	11	37	28	92	8	84	11	24	25	48	5	43	6	22	19	46	5	41
105	3	191	68	443	61	382	5	24	26	29	19	10	5	10	10	11	10	1
106	1	208	208	208	208	0	2	133	133	149	118	31	3	58	39	110	25	85
107	48	32	27	160	8	152	18	13	13	21	5	16	7	8	8	12	6	6
108	3	16	17	17	14	3	0	-	-	-	-	-	3	15	16	18	12	6
109	10	49	43	100	26	74	6	26	25	43	7	36	1	24	24	24	24	0
110	22	51	38	150	5	145	8	11	8	25	1	24	6	15	19	25	4	21
111	7	57	59	129	19	110	21	49	32	160	10	150	12	20	15	68	9	59
112	18	40	18	228	4	224	21	20	15	61	1	60	12	12	13	21	2	19
113	8	45	30	181	9	172	21	22	10	78	3	75	16	24	12	193	3	190
114	57	19	6	146	1	145	9	25	24	44	15	29	2	18	18	18	18	0
115	28	54	23	549	3	546	11	29	19	82	4	78	4	32	39	40	11	29
116	11	41	22	182	3	179	9	31	10	109	4	105	5	9	10	15	3	12

TABLE 7 VILLAGE LEVEL DEPTH OF IRRIGATION APPLICATION SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON VILLAGE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range
101	17	3.5	2.5	8.0	1.4	6.6	26	3.9	3.6	8.5	.9	7.6	25	3.4	3.4	8.2	1.4	6.8
102	3	2.7	3.0	3.1	2.2	.9	1	2.9	2.9	2.9	2.9	0	7	2.5	2.1	4.3	1.4	2.9
103	0	-	-	-	-	-	9	1.6	1.7	2.5	.6	1.9	17	1.7	1.6	3.1	.9	2.2
104	12	2.7	1.7	6.1	.8	5.3	11	2.5	2.1	4.1	1.0	3.1	7	2.0	2.3	3.5	.7	2.8
105	3	5.3	5.4	6.5	4.0	2.5	5	2.3	2.0	3.4	1.8	1.6	5	2.5	2.0	3.5	1.8	1.7
106	1	1.8	1.8	1.8	1.8	0	2	3.3	3.3	4.6	2.0	2.6	3	4.5	4.4	4.9	4.3	.6
107	54	2.0	1.7	4.2	.7	3.5	22	2.3	2.0	4.5	.7	3.8	9	2.9	3.4	5.0	.1	4.9
108	3	2.4	1.7	4.1	1.3	2.8	0	-	-	-	-	-	3	3.1	3.4	5.0	1.0	4.0
109	10	3.8	3.2	7.6	1.3	6.3	6	3.1	2.7	5.1	2.0	3.1	1	2.7	2.7	2.7	2.7	.0
110	22	2.3	2.2	5.3	.7	4.6	8	2.7	2.8	4.5	.7	3.8	6	2.1	1.9	3.3	1.6	1.7
111	8	2.9	1.9	7.7	.8	6.9	19	2.7	2.9	5.4	.1	5.3	12	2.1	1.9	4.3	.6	3.7
112	18	3.4	2.2	19.8	.4	19.4	21	4.0	2.7	17.0	.7	16.3	13	2.0	1.8	4.3	1.2	3.1
113	8	2.1	2.1	3.1	1.0	2.1	21	1.8	1.6	3.5	.8	2.7	17	2.7	2.5	3.8	1.5	2.3
114	58	2.4	1.7	12.8	.6	12.2	9	2.9	2.8	5.1	.9	4.2	2	1.8	1.8	2.2	1.3	.9
115	31	3.0	2.1	19.7	.3	19.4	12	3.7	2.4	12.6	.9	11.7	4	2.3	1.9	4.3	.9	3.4
116	12	2.0	2.0	3.5	.6	2.9	9	1.7	1.2	6.8	.1	6.7	5	1.5	1.3	2.3	.6	1.7

TABLE 8. VILLAGE LEVEL ESTIMATED SOIL MOISTURE DEFICIENCY BEFORE IRRIGATION SUMMARY STATISTICS

FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON VILLAGE BASIS

	Head						Middle						Tail					
	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range
101	16	2.9	2.4	4.0	1.9	2.1	26	2.7	2.2	4.9	1.6	3.3	25	2.4	2.5	3.1	1.9	1.2
102	3	4.5	5.0	5.2	3.3	1.9	1	5.0	5.0	5.0	5.0	0	7	3.9	3.9	4.9	3.4	1.5
103	0	-	-	-	-	-	9	3.5	3.3	4.5	3.0	1.5	17	3.4	3.5	4.6	2.3	2.3
104	12	3.7	3.7	5.6	2.4	3.2	11	3.9	3.8	6.3	2.3	4.0	6	2.7	2.8	4.1	1.2	2.9
105	3	1.4	1.3	1.7	1.1	.6	5	1.0	1.0	1.2	.6	.6	5	1.1	1.0	1.8	.7	1.1
106	0	-	-	-	-	-	1	3.3	3.3	3.3	3.3	0	2	2.7	2.7	2.8	2.5	.3
107	56	3.3	3.1	5.4	.9	4.5	22	3.2	3.2	5.5	1.2	4.3	5	3.9	3.1	5.9	2.4	3.5
108	2	1.3	1.3	1.3	1.3	.0	0	-	-	-	-	-	1	1.5	1.5	1.5	1.5	.0
109	10	2.4	2.7	3.1	1.0	2.1	6	2.5	1.7	5.1	1.4	3.7	1	.4	.4	.4	.4	0
110	19	2.9	3.0	3.9	1.5	2.4	8	1.5	1.5	4.1	.2	3.9	5	1.2	1.1	1.9	1.0	.9
111	7	3.1	3.2	3.9	1.7	2.2	20	3.0	3.0	4.0	1.2	2.8	11	2.4	2.1	3.5	.7	2.8
112	16	3.5	3.3	5.9	1.3	4.6	21	3.0	3.0	5.4	.9	4.5	13	3.3	2.7	5.9	2.1	3.8
113	8	1.5	1.4	3.3	.8	2.5	21	1.7	1.7	3.7	.5	3.2	17	2.5	2.7	4.1	1.3	2.8
114	58	3.2	3.2	4.6	1.7	3.1	9	2.3	2.1	3.3	1.6	1.7	2	2.3	2.3	2.7	2.0	.7
115	31	3.2	3.0	6.6	.6	6.0	11	4.0	4.2	7.2	1.9	5.3	4	4.7	4.7	5.5	4.0	1.5
116	12	.8	.8	1.8	.1	1.7	9	.9	.9	1.8	.1	1.7	5	1.3	.5	1.8	.1	1.7

TABLE 9 VILLAGE LEVEL DAYS SINCE LAST IRRIGATION SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON VILLAGE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range
101	17	24	15	60	7	53	26	34	16	90	7	83	25	38	21	90	7	83
102	3	72	60	150	7	143	1	150	150	150	150	0	7	19	17	35	7	28
103	0	-	-	-	-	-	9	33	7	85	7	78	17	28	14	104	7	97
104	12	16	11	32	8	24	11	11	8	24	7	17	7	10	8	28	1	27
105	3	16	7	34	7	27	5	18	14	33	14	19	5	23	20	30	21	9
106	1	7	7	7	7	0	2	24	24	33	15	18	3	27	15	60	7	53
107	49	12	7	48	3	45	22	17	14	45	3	42	7	14	8	45	7	38
108	3	11	15	15	4	11	0	-	-	-	-	-	3	8	5	14	5	9
109	10	24	23	60	7	53	6	51	31	105	7	98	1	365	365	365	365	0
110	22	25	13	60	4	56	8	36	39	75	6	69	6	27	35	37	7	30
111	8	22	21	52	7	45	21	16	15	37	3	34	12	15	9	46	6	40
112	18	21	15	52	6	56	21	18	15	59	6	53	13	29	22	60	12	48
113	8	17	15	22	14	8	21	16	14	34	4	30	17	21	17	60	8	52
114	58	39	32	120	1	119	9	16	15	60	7	53	2	55	55	92	19	73
115	27	62	41	153	8	145	12	49	26	152	2	150	4	259	47	912	31	881
116	9	13	14	23	5	18	8	16	15	21	11	10	5	14	16	16	7	9

TABLE 10 VILLAGE LEVEL NAKKA DISCHARGE IN CUBIC FEET/SECOND SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON VILLAGE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range
101	17	1.7	1.6	2.3	1.3	1.0	26	1.8	1.7	2.7	1.1	1.6	25	1.4	1.3	1.9	.9	1.0
102	3	.8	.6	1.2	.5	.7	1	.8	.8	.8	.8	0	7	.8	.9	.9	.6	.3
103	0	-	-	-	-	-	9	.2	.2	.2	.1	.1	17	.2	.2	.3	.1	.2
104	12	.5	.6	.7	.1	.6	11	.6	.5	1.1	.1	1.0	7	.5	.4	1.1	.3	.8
105	3	2.9	3.1	3.4	2.1	1.3	5	1.0	.9	1.2	.7	.5	5	1.2	1.2	1.2	1.1	.1
106	1	2.3	2.3	2.3	2.3	0	2	2.1	2.1	2.7	1.5	1.2	3	2.1	1.5	3.6	1.3	2.3
107	54	.9	.9	2.0	.4	1.6	22	.9	.8	1.3	.4	.9	9	.7	.7	.8	.4	.4
108	3	1.1	.4	2.5	.4	2.1	0	-	-	-	-	-	3	.9	1.3	1.4	.2	1.2
109	10	1.5	1.5	2.2	.2	2.0	6	1.1	1.1	1.6	.5	1.1	1	.4	.4	.4	.4	0
110	22	.7	.7	1.9	.1	1.8	8	.7	.7	1.1	.2	.9	6	.5	.5	.6	.1	.5
111	8	.9	.6	2.7	.2	2.5	20	.6	.7	1.3	.0	1.3	12	.7	.8	1.1	.3	.8
112	18	.6	.4	1.7	.1	1.6	21	1.1	.9	3.3	.1	3.2	13	.9	.9	1.8	.3	1.5
113	8	.9	.8	1.9	.4	1.5	21	.6	.6	1.4	.2	1.2	17	.8	.8	1.3	.4	.9
114	58	.4	.3	1.0	0	1.0	9	.5	.5	1.1	.1	1.0	2	.4	.4	.5	.3	.2
115	31	.3	.3	1.0	0	1.0	12	.5	.4	1.3	.1	1.2	4	.3	.3	.5	.1	.4
116	12	.2	.1	.4	0	.4	9	.1	.1	.3	.0	.3	5	.1	.1	.1	0	.1

TABLE 11 VILLAGE LEVEL AREA OF BASIN (INDIVIDUAL BUNDED UNIT) IRRIGATED SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON VILLAGE BASIS

Village	Head						Middle											
	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range
101	13	.4	.4	1.4	.1	1.3	26	.3	.3	.6	.1	.5	23	.2	.2	.5	.1	.4
102	2	.9	.9	1.0	.9	.1	1	.9	.9	.9	.9	0	7	.7	.5	.9	.5	.4
103	0	-	-	-	-	-	9	.1	.1	.2	.1	.1	17	.2	.1	.4	.1	.3
104	9	.4	.4	.8	.1	.7	9	.7	.7	1.0	.2	.8	7	1.1	.7	3.4	.4	3.0
105	1	1.1	1.1	1.1	1.1	0	3	.3	.3	.5	.3	.2	5	.5	.5	.6	.5	.1
106	1	.5	.5	.5	.5	0	1	.5	.5	.5	.5	.0	3	.7	.6	1.0	.5	.5
107	54	.6	.3	1.0	.1	.9	20	.3	.3	.5	.1	.4	9	.3	.3	.5	.2	.3
108	2	.4	.4	.4	.3	.1	0	-	-	-	-	-	2	.4	.4	.4	.3	.1
109	9	.5	.4	1.0	.3	.7	5	.3	.3	.6	.2	.4	1	.5	.5	.5	.5	.0
110	21	.6	.5	1.7	.2	1.5	6	.6	.5	1.0	.3	.7	5	.6	.4	1.1	.2	.9
111	8	.6	.6	1.0	.3	.7	15	.5	.4	2.0	.1	1.9	9	.7	.5	1.6	.3	1.3
112	18	.7	.5	4.0	.1	3.9	18	.6	.5	1.3	.1	1.2	10	.7	.7	1.1	.5	.6
113	6	.5	.5	.8	.4	.4	19	.6	.5	2.0	.3	1.7	16	.5	.5	.9	.2	.7
114	48	.4	.3	2.0	.0	2.0	8	.4	.4	.6	.1	.5	2	.7	.7	.9	.5	.4
115	26	.3	.2	1.6	0	1.6	12	.4	.4	.7	.2	.5	4	.5	.3	1.0	.2	.8
116	11	.6	.3	2.5	.1	2.4	6	.7	.4	1.4	.4	1.0	5	.2	.3	.3	.1	.2

TABLE 12

VILLAGE LEVEL AREA OF BLOCK OF BUNDED UNITS IRRIGATED SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON VILLAGE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range
101	4	1.5	1.1	3.4	.3	3.1	0	-	-	-	-	-	2	.4	.4	.5	.3	.2
102	1	.8	.8	.8	.8	0	0	-	-	-	-	-	0	-	-	-	-	-
103	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
104	3	.8	.5	1.3	.5	.8	2	.9	.9	1.0	.7	.3	0	-	-	-	-	-
105	2	.5	.5	.6	.3	.3	2	.2	.2	.3	.1	.2	0	-	-	-	-	-
106	0	-	-	-	-	-	1	1.1	1.1	1.1	1.1	.0	0	-	-	-	-	-
107	2	.6	.6	.8	.3	.5	2	.4	.4	.5	.3	.2	0	-	-	-	-	-
108	1	3.3	3.3	3.3	3.3	0	0	-	-	-	-	-	1	.9	.9	.9	.9	0
109	1	.5	.5	.5	.5	0	1	.8	.8	.8	.8	.0	0	-	-	-	-	-
110	1	.6	.6	.6	.6	0	2	.3	.3	.5	.2	.3	1	1.7	1.7	1.7	1.7	0
111	0	-	-	-	-	-	5	1.2	1.1	2.5	.5	2.0	3	2.6	3.0	3.5	1.2	2.3
112	0	-	-	-	-	-	3	.8	.9	1.1	.3	.8	3	1.1	1.0	1.1	1.0	.1
113	2	.7	.7	.9	.5	.4	1	.4	.4	.4	.4	.0	1	.4	.4	.4	.4	.0
114	10	.4	.5	1.0	.0	1.0	1	.9	.9	.9	.9	0	0	-	-	-	-	-
115	6	.5	.5	.9	.2	.7	0	-	-	-	-	-	0	-	-	-	-	-
116	1	1.3	1.3	1.3	1.3	.0	3	.3	.3	.3	.2	.1	0	-	-	-	-	-

TABLE 13 VILLAGE LEVEL TIME OF IRRIGATION OF INDIVIDUAL BUNDED UNIT SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON VILLAGE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range
101	13	.8	.7	1.7	.3	1.4	26	.7	.6	1.8	.2	1.6	23	.6	.5	2.9	.3	2.6
102	2	3.1	3.1	3.7	2.5	1.2	1	3.2	3.2	3.2	3.2	0	7	2.1	2.0	3.7	1.1	2.6
103	0	-	-	-	-	-	9	1.1	.9	2.2	.5	1.7	17	1.9	1.3	5.5	.6	4.9
104	9	2.6	1.7	8.5	.1	8.4	9	3.6	2.7	9.7	1.2	8.5	7	3.4	2.5	7.1	2.2	3.9
105	1	2.3	2.3	2.3	2.3	0	3	.8	.5	1.6	.4	1.2	5	1.1	1.1	1.5	.8	.7
106	1	.4	.4	.4	.4	0	1	.9	.9	.9	.9	0	3	1.9	2.0	2.8	.8	2.0
107	54	.6	.5	2.2	.2	2.0	20	.8	.8	1.8	.2	1.6	9	1.1	.9	2.7	.6	2.1
108	2	1.4	1.4	1.9	1.0	.9	0	-	-	-	-	-	2	1.7	1.7	1.7	1.7	0
109	9	1.4	1.3	2.9	.7	2.2	5	1.0	1.1	1.5	.4	1.1	1	3.7	3.7	3.7	3.7	0
110	21	2.2	1.8	7.3	.4	6.9	6	2.8	1.6	7.6	.4	7.2	5	2.6	2.8	4.0	1.4	2.6
111	8	2.1	2.1	4.1	.8	3.3	15	2.3	1.7	9.8	.9	8.9	9	2.1	1.9	4.2	.5	3.7
112	18	3.7	2.7	11.2	.8	10.4	18	2.2	1.4	9.7	.5	9.2	10	1.8	1.1	6.5	.5	6.0
113	6	1.4	1.8	2.4	.3	2.1	19	2.2	1.5	7.3	.7	6.6	16	1.9	1.9	2.9	.6	2.3
114	48	4.5	3.5	12.9	.9	12.0	8	2.3	2.5	3.4	.3	3.1	2	3.2	3.2	4.1	2.3	1.8
115	26	2.6	2.3	10.7	.3	10.4	12	3.2	3.0	8.2	.7	7.5	4	2.7	2.7	4.5	1.1	3.4
116	11	5.9	4.4	15.0	1.7	13.3	6	7.8	4.1	25.0	1.8	23.2	5	4.1	3.5	7.2	2.7	4.5

TABLE 14 VILLAGE LEVEL TIME OF IRRIGATION OF BLOCK OF BUNDED UNITS SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON VILLAGE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range
101	4	2.1	1.6	4.5	.5	4.0	0	-	-	-	-	-	2	1.2	1.2	1.6	.9	.7
102	1	3.7	3.7	3.7	3.7	.0	0	-	-	-	-	-	0	-	-	-	-	-
103	0	-	-	-	-	0	0	-	-	-	-	-	0	-	-	-	-	-
104	3	4.7	4.5	5.3	4.3	1.0	2	5.4	5.4	6.0	4.8	1.2	0	-	-	-	-	-
105	2	.8	.8	1.1	.5	.6	2	.5	.5	.6	.4	.2	0	-	-	-	-	-
106	0	-	-	-	-	-	1	1.5	1.5	1.5	1.5	0	0	-	-	-	-	-
107	2	1.2	1.2	1.3	1.2	.1	2	.7	.7	1.0	.5	.5	0	-	-	-	-	-
108	1	5.4	5.4	5.4	5.4	.0	0	-	-	-	-	0	1	2.3	2.3	2.3	2.3	0
109	1	.7	.7	.7	.7	.0	1	2.9	2.9	2.9	2.9	.0	0	-	-	-	-	-
110	1	1.2	1.2	1.2	1.2	.0	2	1.7	1.7	2.7	.7	2.0	1	8.3	8.3	8.3	8.3	0
111	0	-	-	-	-	-	5	4.5	2.8	9.7	1.3	8.4	3	7.7	8.7	12.1	2.4	9.7
112	0	-	-	-	-	-	3	2.7	1.9	4.3	1.8	2.5	2	1.4	1.4	1.5	1.3	.2
113	2	3.4	3.4	4.9	1.9	3.0	1	1.9	1.9	1.9	1.9	0	1	2.0	2.0	2.0	2.0	0
114	10	2.2	1.7	6.5	.5	6.0	1	.9	.9	.9	.9	.0	0	-	-	-	-	-
115	6	3.7	4.6	6.5	.3	6.2	0	-	-	-	-	0	0	-	-	-	-	-
116	1	7.5	7.5	7.5	7.5	.0	3	6.3	4.3	10.5	4.1	6.4	0	-	-	-	-	-

APPENDIX II

Part A
Section 2

WATERCOURSE LEVEL

SUMMARY

STATISTICS

TABLE 1 WATERCOURSE LEVEL WATERCOURSE LENGTH SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON WATERCOURSE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range
101/1	5	2100	2100	2100	2100	0	22	3186	3100	4300	2500	1800	12	6137	6200	6500	5340	1160
101/2	6	2000	2000	2300	1700	600	8	4625	5000	5000	3500	1500	16	8083	8360	8720	7260	1460
102/1	3	1500	1500	1600	1400	200	1	2000	2000	2000	2000	0	7	4300	4000	4800	4000	800
103/1	0	-	-	-	-	-	9	1374	1200	1295	1200	95	17	2330	2243	2651	2153	498
104/1	0	-	-	-	-	-	3	2468	2449	3156	1800	1356	4	3887	3500	5100	3450	1650
104/2	9	873	850	1300	10	1290	6	3058	3200	3300	2200	1100	3	4200	4000	5000	3600	1400
104/3	1	500	500	500	500	0	0	-	-	-	-	-	3	1690	1570	2000	1500	500
105/1	3	560	350	980	350	630	5	4234	3972	5280	3972	1308	5	7560	7700	7920	7260	660
106/1	1	1560	1560	1560	1560	0	2	2550	2550	2700	2400	300	3	3880	3520	4700	3420	1280
107/1	17	2329	2800	4200	1200	3000	3	5861	5390	6790	5400	1390	7	13200	14000	14000	10000	4000
107/2	11	2055	2300	2600	700	1900	4	5200	5800	5800	3400	2400	10	7977	7600	9000	7570	1430
107/3	23	1576	1296	2100	1014	1086	3	4000	4000	4000	4000	0	8	8825	9000	9400	7600	1800
108/1	3	2123	1550	3070	1650	1420	0	-	-	-	-	-	3	9120	8030	11300	8030	3270
109/1	5	2540	2000	3700	1700	2000	3	6167	5500	7500	5500	2000	1	14000	14000	14000	14000	0
109/2	1	1920	1920	1920	1920	0	4	3600	3600	3600	3600	0	3	6967	6600	7700	6600	1100
110/1	1	650	650	650	650	0	3	3187	3454	3806	2800	1006	5	5048	4800	6020	4070	1950
110/2	3	1866	1694	2398	1506	892	3	3542	3542	3542	3542	0	4	5874	5669	7206	4950	2256
110/3	7	263	200	700	100	600	5	866	910	910	800	110	6	2100	2100	2100	2100	0
111/1	5	1171	1400	1555	300	1255	9	2303	2434	2594	1890	704	2	4550	4550	4800	4300	500
111/2	3	867	800	1000	800	200	12	2536	2567	3265	1800	1465	9	4146	3850	5300	3765	1535
112/1	2	1925	1925	1600	1250	350	9	4129	4500	6000	3600	2400	6	8567	8900	9790	6820	2970
112/2	7	964	770	1450	550	900	4	2925	3100	3350	2150	1200	7	4063	3621	5400	3520	1880
112/3	6	1180	870	2000	660	1340	2	5135	5135	5170	5100	70	9	7882	8330	9000	6400	2600
113/1	0	-	-	-	-	-	9	2411	2700	2800	1800	1000	4	4113	4175	4300	3800	500
113/2	2	950	950	950	950	0	5	1939	2365	2365	1200	1165	4	3246	3430	3575	2550	1025
113/3	1	1300	1300	1300	1300	0	7	2973	3135	3564	1980	1584	14	5050	5200	5931	4000	1931
114/1	13	715	880	920	209	711	2	2474	2474	2700	2249	451	2	5300	5300	5800	4800	1000
114/2	19	629	625	1200	310	890	2	4200	4200	4400	4000	400	2	11000	11000	11600	10400	1200
114/3	5	900	900	1400	230	1170	1	2300	2300	2300	2300	0	11	2932	2500	4400	1970	2430
114/4	4	375	350	650	150	500	7	2567	2500	3400	2200	1200	2	5750	5750	6000	5500	500
115/1	7	769	850	1161	280	881	2	1800	1800	1800	1800	0	1	4500	4500	4500	4500	0
115/2	2	537	537	800	275	525	3	1300	1200	1500	1200	300	2	2450	2450	2800	2100	700
115/3	4	120	110	250	10	240	1	1600	1600	1600	1600	0	3	2800	3000	3200	2200	1000
115/4	3	593	350	1200	230	970	1	2400	2400	2400	2400	0	2	3650	3650	4100	3200	900
115/5	1	700	700	700	700	0	3	1083	1000	1400	850	550	3	2267	2300	2500	2000	500
115/6	3	113	10	320	10	310	4	500	700	700	600	100	1	1600	1600	1600	1600	0
116/1	3	543	525	950	155	795	1	1675	1675	1675	1675	0	5	2574	2800	3200	2185	1015
116/2	3	1140	1500	1900	20	1880	1	2173	2173	2173	2173	0	5	5104	4750	5920	4550	1370
116/3	0	-	-	-	-	-	1	1200	1200	1200	1200	0	3	2995	3000	3185	2800	385
116/4	1	225	225	225	225	0	1	1015	1015	1015	1015	0	2	1812	1812	1825	1800	25

TABLE 2 WATERCOURSE LEVEL IRRIGATION DELIVERY EFFICIENCY SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSE ON WATERCOURSE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range
101/1	5	53	53	53	53	0	18	69	66	87	57	30	12	74	76	85	64	21
101/2	6	87	87	93	80	13	8	78	77	80	77	3	16	56	58	64	43	21
102/1	3	71	68	87	57	30	1	82	82	82	82	0	7	55	61	61	43	18
103/1	0	-	-	-	-	-	7	50	46	62	46	16	5	73	70	84	61	23
104/1	0	-	-	-	-	-	3	47	45	56	41	15	4	40	42	56	20	36
104/2	9	63	63	100	31	69	6	49	46	79	16	63	3	51	57	61	35	26
104/3	1	67	67	67	67	0	0	-	-	-	-	-	3	47	50	57	33	24
105/1	3	78	84	93	58	35	5	49	47	62	41	21	5	60	61	61	58	3
106/1	1	41	41	41	41	0	2	38	38	49	27	22	3	51	60	66	28	38
107/1	9	57	52	92	46	46	2	49	49	52	47	5	5	38	38	41	37	4
107/2	11	66	61	81	50	31	4	44	44	46	41	5	10	51	51	66	33	33
107/3	23	66	69	80	41	39	3	61	59	65	59	6	5	49	43	61	43	18
108/1	3	67	58	85	58	27	0	-	-	-	-	-	3	36	46	51	12	39
109/1	5	42	65	69	19	50	3	47	52	55	34	21	1	11	11	11	11	0
109/2	1	72	72	72	72	0	4	55	60	61	39	22	3	36	20	70	17	53
110/1	1	86	86	86	86	0	3	65	75	78	42	36	5	64	61	95	38	57
110/2	3	83	88	91	77	14	3	48	49	49	45	4	4	42	37	68	28	40
110/3	7	74	74	89	55	34	6	63	61	86	47	39	6	61	61	61	61	0
111/1	5	62	62	100	30	70	9	24	23	41	2	39	2	38	38	57	19	38
111/2	3	37	32	51	29	22	12	53	53	90	18	72	9	51	59	69	23	46
112/1	2	68	68	82	54	28	9	55	64	66	19	47	6	60	64	90	17	73
112/2	7	69	74	78	38	40	4	53	53	58	49	9	7	54	57	80	31	49
112/3	6	43	42	54	32	22	2	39	39	51	27	24	9	42	45	57	18	39
113/1	0	-	-	-	-	-	9	45	54	64	15	49	4	42	32	80	23	57
113/2	2	85	85	87	83	4	5	73	70	83	61	22	4	47	48	50	42	8
113/3	1	44	44	44	44	0	7	66	73	84	16	68	14	66	73	100	38	62
114/1	13	82	87	100	47	53	2	27	27	28	27	1	2	29	29	43	15	28
114/2	19	65	63	87	49	38	2	41	41	51	30	21	2	15	15	18	13	5
114/3	5	63	70	98	23	75	1	60	60	60	60	0	11	56	60	76	10	66
114/4	4	77	82	89	53	36	7	47	37	69	30	39	2	17	17	19	16	3
115/1	7	62	67	90	33	57	2	37	37	50	25	25	1	11	11	11	11	0
115/2	2	59	59	75	43	32	3	53	58	68	33	35	2	61	61	76	46	30
115/3	4	46	61	100	50	50	1	53	53	53	53	0	3	53	55	60	43	17
115/4	3	58	47	85	43	42	1	75	75	75	75	0	2	16	16	26	6	20
115/5	1	40	40	40	40	0	3	65	80	82	32	50	3	47	39	91	13	78
115/6	3	83	100	100	48	52	4	64	64	92	36	56	1	70	70	70	70	0
116/1	3	69	77	87	44	43	1	11	11	11	11	0	5	15	17	30	6	24
116/2	3	46	20	100	18	82	1	23	23	23	23	0	5	14	13	25	7	18
116/3	0	-	-	-	-	-	1	30	30	30	30	0	3	35	34	50	21	29
116/4	1	28	28	28	28	0	1	90	90	90	90	0	2	12	12	15	9	6

TABLE 3 WATERCOURSE LEVEL IRRIGATION APPLICATION EFFICIENCY SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON WATERCOURSE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range
101/1	5	91	100	100	75	25	22	77	82	100	34	66	12	66	63	100	25	75
101/2	5	81	79	100	62	38	8	67	60	89	53	36	16	80	79	100	38	62
102/1	3	100	100	100	100	0	1	100	100	100	100	0	7	77	61	100	61	39
103/1	0	-	-	-	-	-	9	100	100	100	100	0	17	100	100	100	100	0
104/1	0	-	-	-	-	-	3	93	100	100	80	20	4	95	100	100	88	12
104/2	9	85	100	100	56	44	6	97	100	100	77	23	3	100	100	100	100	0
104/3	1	100	100	100	100	0	0	-	-	-	-	-	3	100	100	100	100	0
105/1	3	28	24	43	17	26	5	45	51	65	26	39	5	50	51	90	20	70
106/1	0	-	-	-	-	-	1	72	72	72	72	0	2	61	61	66	56	10
107/1	15	88	100	100	45	55	3	55	60	71	33	38	3	90	99	100	71	29
107/2	11	100	100	100	100	0	4	100	100	100	100	0	10	100	100	100	100	0
107/3	23	100	100	100	96	4	3	100	100	100	100	0	8	93	100	100	81	19
108/1	2	87	87	98	76	22	0	-	-	-	-	-	1	100	100	100	100	0
109/1	5	76	100	100	35	65	3	52	54	58	43	15	1	16	16	16	16	0
109/2	1	17	17	17	17	0	4	67	60	100	48	52	3	79	100	100	36	64
10/1	0	-	-	-	-	-	2	13	13	20	19	1	4	60	55	80	49	31
10/2	1	42	42	42	42	0	3	66	53	100	45	55	3	60	58	65	57	8
10/3	7	78	77	100	46	54	6	88	100	100	45	55	6	100	100	100	100	0
11/1	5	78	100	100	88	12	9	83	95	100	36	64	2	100	100	100	100	0
11/2	3	94	100	100	83	17	12	89	100	100	57	43	9	92	100	100	45	55
12/1	2	65	65	100	30	70	9	79	100	100	33	67	6	97	100	100	81	19
12/2	7	84	100	100	24	76	4	100	100	100	100	0	7	69	85	100	15	85
12/3	4	100	100	100	100	0	2	97	97	100	94	6	9	99	100	100	90	10
13/1	0	-	-	-	-	-	9	71	78	100	31	69	4	79	34	100	49	51
13/2	2	63	63	71	54	17	5	66	57	94	36	58	4	72	74	100	39	61
13/3	1	100	100	100	100	0	7	99	100	100	89	11	14	83	91	100	45	55
14/1	13	96	100	100	83	17	2	71	71	100	42	58	2	71	71	100	42	58
14/2	19	98	100	100	59	41	2	47	47	55	39	16	2	100	100	100	100	0
14/3	5	66	71	100	27	73	1	48	48	48	48	0	11	91	100	100	50	50
14/4	4	100	100	100	100	0	7	100	100	100	100	0	2	100	100	100	100	0
15/1	7	93	100	100	49	51	2	100	100	100	100	0	1	100	100	100	100	0
15/2	2	100	100	100	100	0	3	100	100	100	100	0	1	100	100	100	100	0
15/3	4	100	100	100	100	0	1	99	99	99	99	0	3	79	100	100	38	62
15/4	3	100	100	100	100	0	1	76	76	76	76	0	2	100	100	100	100	0
15/5	1	100	100	100	100	0	3	87	95	100	66	34	3	100	100	100	100	0
15/6	3	72	100	100	15	85	4	86	100	100	43	57	1	99	99	99	99	0
16/1	3	69	93	100	13	87	1	63	63	63	63	0	5	75	86	100	22	78
16/2	3	34	5	94	3	91	1	53	53	53	53	0	5	44	21	100	9	91
16/3	0	-	-	-	-	-	1	67	67	67	67	0	3	75	86	100	38	62
16/4	1	50	50	50	50	0	1	48	48	48	48	0	2	45	45	61	29	32

TABLE 4

WATERCOURSE LEVEL PERCENT IRRIGATION COMPLETION SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON WATERCOURSE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range
101/1	3	71	74	83	57	26	9	82	87	96	58	38	2	73	73	93	52	41
101/2	1	77	77	77	77	0	0	-	-	-	-	-	4	80	83	95	59	36
102/1	3	65	58	93	44	49	1	58	58	58	58	0	7	16	100	100	35	65
103/1	0	-	-	-	-	-	9	51	44	85	20	65	17	49	51	96	28	68
104/1	0	-	-	-	-	-	2	61	61	63	58	5	3	76	86	86	55	31
104/2	7	47	56	66	21	45	6	65	70	89	32	57	3	57	43	91	36	55
104/3	1	34	34	34	34	0	0	-	-	-	-	-	3	32	37	43	16	27
105/1	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
106/1	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
107/1	10	68	74	91	30	61	0	-	-	-	-	-	1	62	62	62	62	0
107/2	11	55	55	90	18	72	4	72	93	97	38	59	9	65	65	96	28	68
107/3	22	53	53	99	25	74	3	51	58	58	36	22	7	44	36	84	26	58
108/1	0	-	-	-	-	-	0	-	-	-	-	-	1	67	67	67	67	0
109/1	3	71	81	81	52	29	0	-	-	-	-	-	0	-	-	-	-	-
109/2							1	85	85	85	85	0	2	52	52	65	39	26
110/1	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
110/2	0	-	-	-	-	-	1	49	49	49	49	0	0	-	-	-	-	-
110/3	3	72	71	78	68	10	4	58	61	66	43	23	6	39	31	73	19	54
111/1	3	62	47	92	46	46	4	38	41	65	5	60	2	82	82	90	74	16
111/2	3	35	35	43	27	16	7	56	47	98	42	56	7	70	86	91	18	73
112/1	1	41	41	41	41	0	5	65	65	87	51	36	5	69	67	97	45	52
112/2	5	57	67	94	20	74	4	44	47	70	12	58	2	86	86	87	85	2
112/3	4	79	78	96	63	33	1	65	65	65	65	0	8	51	45	89	29	60
113/1	0	-	-	-	-	-	2	85	85	86	83	3	2	78	78	78	78	0
113/2	0	-	-	-	-	-	0	-	-	-	-	-	1	69	69	69	69	0
113/3	1	86	86	86	86	0	6	70	71	89	39	50	7	78	78	97	45	52
114/1	9	70	64	98	51	47	1	97	97	97	97	0	1	53	53	53	53	0
114/2	18	35	27	97	17	80	0	-	-	-	-	-	2	74	74	81	67	14
114/3	2	76	76	86	67	19	0	-	-	-	-	-	8	69	75	94	29	65
114/4	4	35	23	79	18	61	7	39	32	65	23	42	2	75	75	77	72	5
115/1	6	72	69	81	67	14	2	67	67	80	54	26	1	17	17	17	17	0
115/2	2	66	66	87	45	42	3	53	39	83	38	45	1	65	65	65	65	0
115/3	4	67	39	94	32	62	0	-	-	-	-	-	2	62	62	80	44	36
115/4	3	72	91	99	27	72	0	-	-	-	-	-	2	48	48	71	25	46
115/5	1	61	61	61	61	0	1	100	100	100	100	0	3	39	37	62	19	43
115/6	3	60	56	84	29	55	3	46	56	56	26	30	0	-	-	-	-	-
116/1	1	80	80	80	80	0	0	-	-	-	-	-	2	49	49	73	24	49
116/2	0	-	-	-	-	-	0	-	-	-	-	-	1	76	76	76	76	0
116/3	0	-	-	-	-	-	0	-	-	-	-	-	1	61	61	61	61	0
116/4	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-

TABLE 5 WATERCOURSE LEVEL PERCENT LOSS RATE PER THOUSAND FEET OF WATERCOURSE SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON WATERCOURSE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range
101/1	5	22	22	22	22	0	18	10	10	13	4	9	12	4	4	7	2	5
101/2	6	6	6	7	4	3	8	5	5	6	5	1	16	5	5	8	4	4
102/1	3	20	22	30	8	22	1	9	9	9	9	0	7	10	10	12	9	3
103/1	0	-	-	-	-	-	7	42	45	45	32	13	5	11	13	16	6	10
104/1	0	-	-	-	-	-	3	22	23	24	19	5	4	16	17	23	9	14
104/2	8	51	38	99	29	70	6	18	17	38	6	32	3	12	11	18	8	10
104/3	1	66	66	66	66	0	0	-	-	-	-	-	3	32	27	45	25	20
105/1	3	52	19	121	17	104	5	12	13	15	10	5	5	52	5	6	5	1
106/1	1	38	38	38	38	0	2	24	24	27	21	6	3	13	12	20	7	13
107/1	9	21	19	33	4	29	2	85	85	10	7	3	5	5	5	6	4	2
107/2	11	23	15	71	8	63	4	11	10	16	9	7	10	6	6	8	4	4
107/3	23	22	24	29	10	19	3	10	10	10	9	1	5	6	6	6	5	1
108/1	3	26	26	26	5	21	0	-	-	-	-	-	3	7	7	8	6	2
109/1	5	23	21	37	15	22	3	9	9	9	8	1	1	6	6	6	6	0
109/2	1	15	15	15	15	0	4	12	11	17	11	6	3	10	12	13	4	9
110/1	1	21	21	21	21	0	3	11	10	15	7	8	5	6	7	13	1	12
110/2	3	9	8	13	6	7	3	15	14	15	14	1	4	12	13	13	10	3
110/3	7	116	111	171	65	106	5	45	47	58	18	40	6	19	19	19	19	0
111/1	4	36	28	64	26	38	9	33	35	51	23	28	2	13	13	17	10	7
111/2	3	65	85	88	23	65	12	23	22	54	8	46	9	12	11	17	8	9
112/1	2	24	24	37	11	26	9	10	10	18	5	13	6	5	4	8	1	7
112/2	7	34	39	45	19	26	4	17	15	24	13	11	7	11	12	19	4	15
112/3	6	62	83	103	28	75	2	12	12	14	9	5	9	7	8	9	5	4
113/1	0	-	-	-	-	-	9	23	24	31	16	15	4	14	16	19	5	14
113/2	2	16	16	18	14	4	5	18	15	33	7	26	4	17	15	23	14	9
113/3	1	43	43	43	43	0	7	11	9	29	7	22	13	7	7	15	3	12
114/1	13	36	16	127	0	127	2	29	29	33	27	6	2	13	13	15	12	3
114/2	19	63	65	107	11	96	2	14	14	17	11	6	2	8	8	8	7	1
114/3	5	56	57	111	2	109	1	17	17	17	17	0	11	15	14	23	9	14
114/4	4	65	60	95	44	51	7	21	16	28	12	16	2	14	14	15	13	2
115/1	7	55	50	95	15	80	2	35	35	42	28	14	1	20	20	20	20	0
115/2	2	82	82	93	71	22	3	37	28	56	26	30	2	15	15	19	11	8
115/3	3	303	245	478	200	278	1	29	29	29	29	0	3	18	14	26	13	13
115/4	3	88	65	151	48	103	1	10	10	10	10	0	2	23	23	23	23	0
115/5	1	86	86	86	86	0	3	37	18	80	14	65	3	23	31	35	4	31
115/6	1	164	164	164	164	0	4	31	11	91	11	80	1	19	19	19	19	0
116/1	3	63	59	86	44	42	1	53	53	53	53	0	5	34	33	43	25	18
116/2	2	48	48	53	43	10	1	36	36	36	36	0	5	17	18	20	13	7
116/3	0	-	-	-	-	-	1	58	58	58	58	0	3	22	21	27	19	8
116/4	1	320	320	320	320	0	1	9	9	9	9	0	2	49	49	50	47	3

TABLE 6 WATERCOURSE LEVEL CUBIC FEET PER SECOND LOSS PER THOUSAND FEET OF WATERCOURSE SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON WATERCOURSE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range
101/1	5	54	54	54	54	0	18	23	26	31	10	21	12	9	9	9	9	0
101/2	5	13	14	15	9	6	8	11	11	12	11	1	16	12	12	16	9	7
102/1	3	20	20	28	12	16	1	9	9	9	9	0	7	14	14	17	11	6
103/1	0	-	-	-	-	-	7	15	17	17	9	8	5	3	3	5	1	4
104/1	0	-	-	-	-	-	3	44	45	48	39	9	4	32	32	46	17	29
104/2	8	46	35	92	28	64	6	16	13	35	4	31	3	12	8	22	5	17
104/3	1	20	20	20	20	0	0	-	-	-	-	-	3	9	8	13	5	8
105/1	3	191	68	443	61	382	5	24	26	29	19	10	5	10	10	11	10	1
106/1	1	208	208	208	208	0	2	133	133	149	118	31	3	58	39	110	25	85
107/1	10	37	35	56	8	48	2	17	17	19	14	5	5	9	9	12	8	4
107/2	11	52	31	160	20	140	4	23	21	32	19	13	10	12	12	15	9	6
107/3	23	23	24	32	11	21	3	11	11	11	10	1	5	6	6	6	5	1
108/1	3	16	17	17	14	3	0	-	-	-	-	-	3	15	16	18	12	6
109/1	5	58	50	100	26	74	3	26	26	27	24	3	1	24	24	24	24	0
109/2	1	29	29	29	29	0	4	43	38	59	37	22	3	27	30	43	7	36
110/1	0	-	-	-	-	-	3	5	5	7	4	3	5	5	4	9	1	8
110/2	3	15	8	32	6	26	3	20	20	25	16	9	4	21	21	25	16	9
110/3	7	96	120	150	10	140	5	57	58	78	19	59	6	20	20	20	20	0
111/1	4	62	51	129	19	110	9	75	64	160	25	135	2	43	43	68	19	49
111/2	3	50	60	63	27	36	12	22	23	42	10	32	10	16	14	30	9	30
112/1	2	16	16	23	9	14	11	30	26	61	2	59	6	10	9	21	2	19
112/2	7	15	16	20	8	12	4	6	5	10	4	6	5	5	5	9	1	8
112/3	6	128	145	228	20	208	2	21	21	26	17	9	8	14	15	16	9	7
113/1	0	-	-	-	-	-	9	39	42	55	22	33	4	67	32	193	9	184
113/2	2	11	11	13	9	4	5	10	5	22	3	19	4	9	8	14	7	7
113/3	1	181	181	181	181	0	7	23	10	78	8	70	13	10	5	19	3	16
114/1	12	27	11	146	2	144	2	52	52	68	36	32	2	17	17	19	15	4
114/2	18	11	4	84	1	83	2	34	34	44	24	20	2	19	19	20	17	3
114/3	5	41	27	103	2	101	8	10	9	22	3	19	4	19	18	28	11	17
114/4	4	2	2	3	1	2	7	12	13	20	4	16	2	29	29	30	28	2
115/1	6	34	21	113	3	110	2	56	56	82	29	53	1	40	40	40	40	0
115/2	2	45	45	50	39	11	3	23	13	50	7	43	2	7	7	10	4	6
115/3	3	207	68	549	4	545	1	19	19	19	19	0	3	12	11	15	11	4
115/4	3	79	75	151	10	141	1	18	18	18	18	0	2	39	39	40	39	1
115/5	2	27	27	50	4	46	3	29	10	68	9	59	2	54	54	57	51	6
115/6	1	14	14	14	14	0	4	23	7	71	7	64	1	24	24	24	24	0
116/1	3	17	15	29	8	21	1	57	57	57	57	0	5	49	20	109	4	105
116/2	2	22	22	29	15	14	1	8	8	8	8	0	5	9	10	15	3	12
116/3	0	-	-	-	-	-	1	72	72	72	72	0	3	9	10	12	4	8
116/4	1	182	182	182	182	0	1	3	3	3	3	0	2	21	21	22	20	2

TABLE 7

WATERCOURSE LEVEL DEPTH OF IRRIGATION APPLICATION SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON WATERCOURSE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range
101/1	5	2.1	2.0	2.5	1.6	.9	22	4.0	3.5	8.5	1.4	7.1	12	3.8	3.7	8.1	.9	7.2
101/2	5	4.1	4.2	6.0	2.5	3.5	8	3.4	3.2	5.0	2.2	2.8	16	3.3	3.0	8.2	1.4	6.8
102/1	2	2.7	3.0	3.1	2.2	.9	1	2.9	2.9	2.9	2.9	.0	7	2.5	2.1	4.3	1.4	2.9
103/1	0	-	-	-	-	-	9	1.6	1.7	2.5	.6	1.9	17	1.7	1.6	3.1	.9	2.2
104/1	0	-	-	-	-	-	3	2.7	2.1	4.1	1.8	2.3	4	2.7	3.3	3.5	.7	2.8
104/2	9	3.1	2.5	6.1	.8	5.3	6	2.5	2.4	3.7	1.4	2.3	3	1.5	1.3	2.4	.9	1.5
104/3	1	1.3	1.3	1.3	1.3	.0	0	-	-	-	-	-	3	1.5	1.4	2.1	1.0	1.1
105/1	3	5.3	5.4	6.5	4.0	2.5	5	2.3	2.0	3.4	1.8	1.6	5	2.5	2.0	3.5	1.8	1.7
106/1	1	1.8	1.8	1.8	1.8	.0	2	3.3	3.3	4.6	2.0	2.6	3	4.5	4.4	4.9	4.3	.6
107/1	16	2.2	1.9	4.2	.9	3.3	3	2.7	2.2	4.3	1.7	2.6	7	3.3	3.4	5.0	1.7	3.3
107/2	11	2.4	2.5	3.4	.7	2.7	4	2.5	2.7	3.4	1.5	1.9	10	2.0	1.8	3.2	.9	2.3
107/3	23	1.8	1.5	4.7	.8	3.9	3	1.1	1.1	1.1	1.1	0	8	2.0	1.6	4.5	.7	3.8
108/1	3	2.4	1.7	4.1	1.3	2.8	0	-	-	-	-	-	3	3.1	3.4	5.0	1.0	4.0
109/1	5	2.5	2.5	3.5	1.3	2.2	3	3.1	2.9	3.9	2.6	1.3	1	2.7	2.7	2.7	2.7	0
109/2	1	7.6	7.6	7.6	7.6	0	4	4.6	5.0	5.8	2.6	3.2	3	3.1	2.1	5.1	2.0	3.1
110/1	0	-	-	-	-	-	3	1.5	1.1	2.5	1.0	1.5	5	2.5	1.9	4.5	1.0	3.5
110/2	3	2.4	2.2	3.5	1.4	2.1	3	2.4	3.2	3.2	.7	2.5	4	2.3	2.0	3.3	1.8	1.5
110/3	7	2.7	2.6	4.6	1.8	2.8	5	3.1	2.5	5.3	2.3	3.0	6	1.3	1.1	2.5	.7	1.8
111/1	5	3.3	2.2	7.2	.8	6.9	7	2.9	2.9	5.4	.1	5.3	2	2.1	2.1	2.7	1.6	1.1
111/2	3	2.1	1.5	3.8	1.0	2.8	12	2.5	1.9	5.1	1.3	3.8	10	2.1	1.9	4.3	.6	3.7
112/1	2	2.6	2.8	4.3	1.3	3.0	11	2.5	2.6	3.9	.7	3.2	6	2.1	1.9	3.3	1.1	2.2
112/2	7	5.7	4.5	19.8	.9	18.9	4	1.5	1.6	2.3	.4	1.9	5	9.3	11.4	17.0	2.7	14.3
112/3	6	2.2	2.2	2.7	1.6	1.1	2	2.3	2.3	2.7	1.8	.9	3	2.0	1.6	4.3	1.2	3.1
113/1	0	-	-	-	-	-	9	2.2	2.0	3.5	1.0	2.5	4	3.1	3.3	3.7	2.1	1.6
113/2	2	2.7	2.7	3.1	2.3	.8	5	1.7	1.5	2.2	.9	1.3	4	1.3	1.2	2.2	.9	1.3
113/3	1	2.9	2.9	2.9	2.9	.0	7	1.5	1.3	2.2	.8	1.4	14	2.6	2.4	3.8	1.5	2.3
114/1	13	2.1	2.2	3.1	.6	2.5	2	3.7	3.7	3.9	3.4	.5	2	3.1	3.1	4.9	1.3	3.6
114/2	19	1.4	.9	6.9	.6	6.3	2	4.8	4.8	5.1	4.5	.6	2	1.8	1.8	2.2	1.3	.9
114/3	5	6.5	5.9	12.8	2.1	10.7	8	3.0	2.8	5.8	.8	5.0	4	2.8	3.0	4.1	.9	3.2
114/4	4	1.0	.7	1.8	.6	1.2	7	1.4	1.4	2.1	.5	1.6	2	1.5	1.5	1.8	1.1	.7
115/1	6	2.0	1.9	3.0	1.5	1.5	2	2.3	2.3	2.8	1.9	.9	1	.9	.9	.9	.9	0
115/2	2	2.8	2.8	3.5	2.1	1.4	3	2.3	2.4	3.0	1.6	1.4	2	3.4	3.4	4.7	2.1	2.6
115/3	4	2.3	2.3	3.8	1.1	2.7	1	1.8	1.8	1.8	1.8	0	3	6.2	4.3	12.0	1.9	10.7
115/4	3	1.7	2.0	3.2	.7	2.5	1	5.7	5.7	5.7	5.7	0	2	1.9	1.9	2.9	1.0	1.9
115/5	2	1.8	1.8	1.8	1.8	.0	3	3.7	3.1	4.9	3.0	1.9	3	1.6	.9	2.9	.9	2.0
115/6	3	7.3	1.8	19.7	.3	19.4	4	2.5	1.4	6.3	.8	5.7	1	6.5	6.5	6.5	6.5	.0
116/1	3	1.9	1.9	3.1	.6	2.5	1	2.0	2.0	2.0	2.0	0	5	2.3	1.2	6.8	.1	6.7
116/2	3	2.1	1.8	3.5	1.0	2.5	1	.7	.7	.7	.7	0	5	1.5	1.4	2.3	.6	1.7
116/3	0	-	-	-	-	-	1	1.3	1.3	1.3	1.3	0	3	1.2	1.3	1.8	.5	1.3
116/4	1	2.6	2.6	2.6	2.6	0	1	2.1	2.1	2.1	2.1	0	2	1.7	1.7	2.2	1.3	.9

TABLE 8 WATERCOURSE LEVEL ESTIMATED SOIL MOISTURE DEFICIENCY BEFORE IRRIGATION SUMMARY STATISTICS

FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON WATERCOURSE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range
101/1	5	2.3	2.4	2.8	1.9	.9	22	2.9	2.4	4.9	1.6	3.3	12	2.2	2.2	2.5	1.7	.8
101/2	4	3.8	3.8	3.9	3.7	.2	8	2.0	2.0	3.7	1.7	2.0	16	2.5	2.6	3.1	2.0	1.1
102/1	3	4.5	5.0	5.2	3.3	1.9	1	5.0	5.0	5.0	5.0	0	7	3.9	3.9	4.9	3.4	1.5
103/1	0	-	-	-	-	-	9	3.5	3.3	4.5	3.0	1.5	17	3.4	3.5	4.6	2.3	2.3
104/1	0	-	-	-	-	-	3	3.2	3.3	3.4	3.1	.3	4	3.0	3.4	4.1	1.2	2.9
104/2	9	3.5	3.7	4.1	2.4	1.7	6	3.7	3.8	4.6	2.3	2.3	3	2.8	2.6	3.8	2.1	1.7
104/3	1	3.8	3.8	3.8	3.8	0	0	-	-	-	-	-	3	5.0	5.6	6.3	3.2	3.1
105/1	3	1.4	1.3	1.7	1.1	.6	5	1.0	1.0	1.2	.6	.6	5	1.1	1.0	1.8	.7	1.1
106/1	0	-	-	-	-	-	1	3.3	3.3	3.3	3.3	.0	2	2.7	2.7	2.8	2.5	.3
107/1	18	2.5	2.3	4.3	.9	3.4	3	1.3	1.3	1.4	1.2	.2	3	4.4	4.9	5.9	2.4	3.5
107/2	11	4.5	4.9	5.4	2.9	2.5	4	3.6	3.5	3.8	3.5	.3	10	2.9	2.9	3.2	2.3	.9
107/3	23	3.2	2.8	5.0	2.5	2.5	3	4.4	4.8	5.3	3.2	2.1	8	4.0	4.0	5.5	2.0	3.5
108/1	2	1.3	1.3	1.3	1.3	.0	0	-	-	-	-	-	1	1.5	1.5	1.5	1.5	0
109/1	5	2.2	2.5	3.1	1.0	2.1	3	1.6	1.7	1.7	1.4	.3	1	.4	.4	.4	.4	0
109/2	1	1.3	1.3	1.3	1.3	.0	4	3.0	3.0	3.1	2.8	.3	3	3.4	3.2	5.1	1.8	3.3
110/1	0	-	-	-	-	-	2	.3	.3	.5	.2	.3	5	1.0	1.0	1.8	.5	1.3
110/2	1	1.5	1.5	1.5	1.5	0	3	1.5	1.5	1.7	1.5	.2	3	1.4	1.2	1.9	1.1	.8
110/3	7	2.3	2.1	3.0	1.9	1.1	5	3.3	3.9	3.9	2.4	1.5	6	3.4	3.4	3.4	3.4	0
111/1	4	2.8	2.8	3.9	1.7	2.2	8	3.0	2.8	4.0	1.9	2.1	1	2.1	2.1	2.1	2.1	0
111/2	3	3.5	3.6	3.8	3.2	.6	12	2.9	3.1	3.4	1.2	2.2	10	2.4	2.1	3.5	1.4	2.1
112/1	2	2.2	2.2	3.2	1.3	1.9	11	2.3	2.5	3.3	.9	2.4	6	2.7	2.6	3.3	2.4	.9
112/2	7	4.4	4.5	5.9	3.3	2.6	4	3.2	3.3	3.4	2.8	.6	5	4.1	4.0	5.4	2.6	2.8
112/3	4	2.9	2.8	3.3	2.8	.5	2	2.9	2.9	4.2	1.7	2.5	9	3.9	3.8	5.9	2.1	3.8
113/1	0	-	-	-	-	-	9	1.7	1.1	3.7	.8	2.9	4	2.7	2.5	4.1	1.8	2.3
113/2	2	1.7	1.7	1.7	1.6	.1	5	1.1	.8	1.7	.8	.9	4	1.1	.8	2.1	.5	1.6
113/3	1	3.3	3.3	3.3	3.3	.0	7	2.0	1.8	3.0	1.2	1.8	14	2.4	2.6	3.3	1.3	2.0
114/1	13	2.7	2.4	3.7	2.1	1.6	2	2.6	2.6	3.5	1.7	1.8	2	2.2	2.2	2.4	2.1	.3
114/2	19	3.5	4.1	4.8	1.8	3.0	2	2.3	2.3	2.5	2.0	.5	2	2.3	2.3	2.7	2.0	.7
114/3	5	3.4	3.4	4.2	3.0	1.2	8	3.3	3.3	4.2	2.8	1.4	4	2.8	2.9	3.3	2.1	1.2
114/4	4	3.0	3.1	3.6	2.2	1.4	7	2.9	2.8	4.0	2.0	2.0	2	1.9	1.9	2.3	1.6	.7
115/1	6	2.9	2.4	4.4	2.1	2.3	2	3.5	3.5	3.5	3.5	0	1	5.5	5.5	5.5	5.5	0
115/2	2	4.3	4.3	4.7	4.0	.7	3	4.6	4.0	6.3	3.6	2.7	1	7.2	7.2	7.2	7.2	0
115/3	4	3.9	3.4	6.6	2.1	4.5	1	1.9	1.9	1.9	1.9	0	3	4.8	4.8	5.3	4.2	1.1
115/4	3	2.6	2.5	3.2	2.2	1.0	1	4.3	4.3	4.3	4.3	0	2	4.0	4.0	4.0	4.0	.0
115/5	2	3.4	3.4	3.8	3.0	.8	3	3.1	3.0	3.2	3.0	.2	3	3.9	4.5	4.7	2.5	2.2
115/6	3	2.0	2.1	3.0	1.0	2.0	4	2.8	3.0	4.5	.6	3.9	1	2.7	2.7	2.7	2.7	0
116/1	3	1.0	.8	1.8	.4	1.4	1	1.3	1.3	1.3	1.3	0	5	1.1	1.4	1.8	.1	1.7
116/2	3	.4	.2	.9	.1	.8	1	.4	.4	.4	.4	0	5	.7	.5	1.8	.1	1.7
116/3	0	-	-	-	-	-	1	.9	.9	.9	.9	0	3	.9	.9	1.1	.7	.4
116/4	1	1.3	1.3	1.3	1.3	.0	1	1.0	1.0	1.0	1.0	0	2	.7	.7	.8	.6	.2

TABLE 9 WATERCOURSE LEVEL DAYS SINCE LAST IRRIGATION SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON WATERCOURSE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range
101/1	5	7	7	7	7	0	22	36	16	90	7	83	12	42	23	90	7	83
101/2	5	36	45	45	7	38	8	29	14	90	7	83	16	31	17	90	7	83
102/1	3	72	60	150	7	143	1	150	150	150	150	0	7	19	17	35	7	28
103/1	0	-	-	-	-	-	9	33	7	85	7	78	17	28	14	104	7	97
104/1	0	-	-	-	-	-	3	10	8	14	7	7	4	11	12	15	7	8
104/2	9	13	8	32	8	24	6	11	9	24	7	17	3	14	8	28	5	23
104/3	1	13	13	13	13	0	0	-	-	-	-	-	3	23	30	30	8	22
105/1	3	16	7	34	7	27	5	18	14	33	14	19	5	23	20	30	21	9
106/1	1	7	7	7	7	0	2	24	24	33	15	18	3	27	15	60	7	53
107/1	14	19	16	48	7	41	3	35	45	45	15	30	5	17	8	45	7	38
107/2	11	12	8	30	6	24	4	21	25	25	8	17	10	11	8	30	3	27
107/3	23	7	7	30	5	25	0	-	-	-	-	-	8	12	7	30	7	23
108/1	3	11	15	15	4	11	0	-	-	-	-	-	3	8	5	14	5	9
109/1	5	21	14	60	7	53	3	90	105	105	60	45	1	365	365	365	365	
109/2	1	14	14	14	14	0	4	30	30	30	30	0	3	12	7	21	7	14
110/1	0	-	-	-	-	-	3	30	7	75	7	68	5	18	10	38	6	32
110/2	3	19	10	36	10	26	3	40	40	40	40	0	4	35	35	37	35	2
110/3	7	12	10	19	8	11	5	11	4	30	4	26	6	60	60	60	60	0
111/1	5	16	16	29	7	22	9	13	10	37	3	34	2	19	19	31	8	23
111/2	3	32	22	52	22	30	12	20	19	37	7	30	10	14	9	46	6	40
112/1	2	15	15	15	14	1	11	18	15	59	7	52	6	17	15	30	12	18
112/2	7	32	30	62	14	48	4	11	11	13	9	4	5	17	22	22	6	16
112/3	6	14	14	21	6	15	2	23	23	24	21	3	9	32	30	60	7	53
113/1	0	-	-	-	-	-	9	16	14	31	14	17	4	27	31	36	8	28
113/2	2	22	22	22	22	0	5	11	8	15	8	7	4	12	13	16	7	9
113/3	1	16	16	16	16	0	7	18	16	34	4	30	14	20	16	60	8	52
114/1	13	46	31	120	26	94	2	13	13	21	6	15	2	15	15	16	15	1
114/2	19	35	32	92	3	89	2	7	7	7	6	1	2	55	55	92	19	73
114/3	5	31	47	47	1	46	8	47	47	69	31	38	4	24	15	60	7	53
114/4	4	26	21	48	12	36	7	49	48	91	30	61	2	11	11	15	7	8
115/1	4	31	27	60	8	52	2	13	13	16	10	6	1	32	32	32	32	0
115/2	2	61	61	92	31	61	3	62	29	148	8	140	2	67	67	132	3	129
115/3	4	64	59	122	15	107	1	40	40	40	40	0	3	82	92	92	61	31
115/4	3	77	50	149	31	118	1	152	152	152	152	0	2	471	471	912	31	881
115/5	2	92	92	92	92	0	3	58	11	153	11	142	3	14	4	36	2	34
115/6	3	62	17	153	15	138	3	75	62	152	11	141	1	12	12	12	12	0
116/1	2	14	14	14	14	0	1	13	13	13	13	0	5	15	15	21	11	10
116/2	3	11	6	23	5	18	1	21	21	21	21	0	5	14	16	16	7	9
116/3	0	-	-	-	-	-	1	15	15	15	15	0	2	15	15	16	15	1
116/4	0	-	-	-	-	-	0	-	-	-	-	-	2	12	12	14	10	4

TABLE 10 WATERCOURSE LEVEL NAKKA DISCHARGE IN CUBIC FEET/SECOND SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON WATERCOURSE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range
101/1	5	1.3	1.3	1.3	1.3	.0	22	1.8	1.6	2.7	1.5	1.2	12	1.5	1.4	1.8	1.1	.7
101/2	5	1.9	1.9	2.0	1.8	.2	8	1.6	1.8	1.8	1.7	.1	16	1.2	1.3	1.5	.9	.6
102/1	3	.8	.6	1.2	.5	.7	1	.8	.8	.8	.8	0	7	.8	.9	.9	.6	.3
103/1	0	-	-	-	-	-	9	.2	.2	.2	.1	.1	17	.2	.2	.3	.1	.2
104/1	0	-	-	-	-	-	3	.9	.9	1.1	.9	.2	4	.8	.8	1.1	.4	.7
104/2	9	.6	.6	.7	.2	.5	6	.4	.4	.5	.1	.4	3	.4	.4	.4	.4	0
104/3	1	.2	.2	.2	.2	.0	0	-	-	-	-	-	3	.1	.1	.2	.1	.1
105/1	3	2.9	3.1	3.4	2.1	1.3	5	1.0	.9	1.2	.7	.5	5	1.2	1.2	1.2	1.1	.1
106/1	1	2.3	2.3	2.3	2.3	.0	2	2.1	2.1	2.7	1.5	1.2	3	2.1	1.5	3.6	1.3	2.3
107/1	16	1.0	1.0	1.8	.9	.9	3	1.0	1.0	1.1	.9	.2	7	.7	.7	.8	.7	.1
107/2	11	1.5	1.3	2.0	1.2	.8	4	.9	.9	1.0	.8	.2	10	1.0	1.0	1.3	.7	.6
107/3	23	.7	.7	.9	.4	.5	3	.7	.7	.7	.7	0	8	.5	.5	.7	.4	.3
108/1	3	1.1	.4	2.5	.4	2.1	0	-	-	-	-	-	3	.9	1.3	1.4	.2	1.2
109/1	5	1.1	.9	2.2	.2	2.0	3	1.4	1.5	1.6	1.1	.5	1	.4	.4	.4	.4	0
109/2	1	1.4	1.4	1.4	1.4	0	4	1.9	2.1	2.1	1.4	.7	3	.8	.6	1.2	.5	.7
110/1	0	-	-	-	-	-	3	.3	.4	.4	.2	.2	5	.7	.6	1.1	.4	.7
110/2	3	1.2	.9	1.8	.9	.9	3	.7	.7	.7	.6	.1	4	.4	.5	.6	.1	.5
110/3	7	.6	.6	.9	.1	.8	5	.7	.7	.9	.6	.3	6	.7	.7	.7	.7	0
111/1	5	1.2	1.0	2.7	.4	2.3	8	.6	.6	1.3	.0	1.3	2	.9	.9	1.1	.8	.3
111/2	3	.3	.2	.6	.2	.4	12	.5	.6	.9	.1	.8	10	.7	.8	1.1	.3	.8
112/1	2	1.5	1.5	1.7	1.4	.3	11	1.6	1.7	3.3	.5	2.8	6	1.3	1.4	1.8	.3	1.5
112/2	7	.3	.3	.4	.1	.3	4	.2	.2	.2	.2	0	5	.3	.3	.4	.2	.2
112/3	6	.8	.8	1.3	.4	.9	2	.7	.7	.9	.5	.4	9	.7	.7	1.0	.3	.7
113/1	0	-	-	-	-	-	9	.8	.9	1.1	.3	.8	4	.8	.7	1.4	.4	1.0
113/2	2	.6	.6	.6	.6	.0	5	.4	.3	.4	.3	.1	4	.3	.3	.3	.2	.1
113/3	1	1.9	1.9	1.9	1.9	0	7	.8	.9	1.1	.1	1.0	14	.8	.6	1.3	.4	.9
114/1	13	.7	.7	1.5	0	1.5	2	.5	.5	.6	.4	.2	2	.4	.4	.6	.2	.4
114/2	19	.2	0	.9	0	.9	2	.9	.9	1.1	.8	.3	2	.4	.4	.5	.3	.2
114/3	5	.5	.6	.9	0	.9	8	.4	.4	.8	.2	.6	4	.5	.6	.9	.1	.8
114/4	4	0	0	0	0	0	7	.3	.2	.5	.1	.4	2	.4	.4	.4	.3	.1
115/1	5	.4	.5	.8	0	.8	2	.5	.5	.5	.5	0	1	.2	.2	.2	.2	0
115/2	2	.3	.3	.3	.3	0	3	.3	.3	.3	.1	.2	2	.3	.3	.3	.2	.1
115/3	4	.3	.2	.6	0	.6	1	.3	.3	.3	.3	.0	3	.4	.4	.5	.3	.2
115/4	3	.5	.5	1.0	.1	.9	1	1.3	1.3	1.3	1.3	.0	2	.3	.3	.5	.1	.4
115/5	2	.3	.3	.4	.2	.2	3	.4	.5	.5	.3	.2	3	.3	.2	.7	.1	.6
115/6	3	.4	.3	.8	.0	.8	4	.2	.2	.3	.1	.2	1	.9	.9	.9	.9	0
116/1	3	.2	.3	.3	.1	.2	1	.1	.1	.1	.1	0	5	.1	.1	.1	0	.1
116/2	3	.2	.1	.4	.1	.3	1	.1	.1	.1	.1	0	5	.1	.1	.1	0	.1
116/3	0	-	-	-	-	-	1	.4	.4	.4	.4	0	3	.1	.1	.3	.1	.2
116/4	1	.2	.2	.2	.2	0	1	.3	.3	.3	.3	0	2	.1	.1	.1	0	.1

TABLE 11 WATERCOURSE LEVEL AREA OF BASIN (INDIVIDUAL BUNDED UNIT) IRRIGATED SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON WATERCOURSE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range
100/2	2	1.0	1.0	1.4	.6	.8	22	.3	.3	.6	.1	.5	12	.3	.3	.4	.1	.3
101/2	4	.3	.3	.5	.3	.2	8	.4	.4	.6	.3	.3	14	.2	.2	.5	.1	.4
102/2	2	.1	.1	1.0	.9	.1	1	.9	.9	.9	.9	0	7	.7	.5	.9	.5	.4
103/2	0	-	-	-	-	-	9	.1	.1	.2	.1	.1	17	.2	.1	.4	.1	.3
104/2	0	-	-	-	-	-	3	.9	.9	1.0	.9	.1	4	.9	.7	1.5	.7	.8
105/2	6	.4	.3	.8	.1	.7	4	.5	.5	.8	.2	.6	3	1.5	.7	3.4	.4	3.0
106/2	1	.6	.6	.6	.6	0	0	-	-	-	-	-	3	.5	.4	.6	.4	.2
107/2	1	1.1	1.1	1.1	1.1	0	3	.3	.3	.5	.3	.2	5	.5	.5	.6	.5	.1
108/2	1	.5	.5	.5	.5	0	1	.5	.5	.5	.5	0	3	.7	.6	1.0	.5	.5
109/2	17	.4	.4	1.0	.2	.8	3	.3	.3	.5	.2	.3	7	.3	.3	.5	.2	.3
110/2	10	.4	.5	.6	.3	.3	4	.2	.1	.5	.1	.4	8	.3	.3	.5	.2	.3
107/2	23	.2	.2	.3	.1	.2	3	.2	.2	.2	.1	.1	8	.3	.3	.5	.2	.3
108/2	2	.4	.4	.4	.3	.1	0	-	-	-	-	-	2	.4	.4	.4	.3	.1
109/2	5	.5	.5	1.0	.3	.7	3	.3	.2	.6	.2	.4	1	.5	.5	.5	.5	0
110/2	1	.6	.6	.6	.6	0	3	.3	.3	.4	.3	.1	2	.3	.3	.3	.3	0
111/2	0	-	-	-	-	-	2	.6	.6	.7	.5	.2	3	.9	1.0	1.0	.6	.4
112/2	2	.7	.7	1.0	.5	.5	3	.3	.3	.4	.3	.1	4	.5	.4	1.1	.2	.9
113/2	7	.5	.5	1.0	.2	.8	5	.8	.5	1.7	.5	1.2	6	.5	.4	1.1	.4	.7
114/2	5	.6	.6	1.0	.3	.7	7	.4	.4	.7	.1	.6	1	1.6	1.6	1.6	1.6	0
115/2	1	.8	.8	.8	.5	.1	7	.6	.3	2.0	.1	1.9	8	.6	.5	1.2	.3	.9
116/2	2	1.0	1.0	1.0	1.0	0	10	.7	.7	1.3	.4	.9	4	.7	.7	1.1	.5	.6
117/2	7	.5	.3	1.0	.3	.7	4	1.7	1.0	4.0	.5	3.5	4	.1	.1	.3	.1	.2
118/2	6	.4	.5	.5	.1	.4	1	.5	.5	.5	.5	0	8	.7	.5	1.0	.5	.5
119/2	0	-	-	-	-	-	8	.4	.4	.6	.4	.2	4	.7	.7	1.0	.3	.7
120/2	0	-	-	-	-	-	5	.4	.3	.5	.3	.2	4	.9	.5	2.0	.5	1.5
121/2	1	.8	.8	.8	.8	0	7	.6	.6	.9	.4	.5	13	.5	.5	.9	.2	.7
122/2	6	.5	.5	.7	.1	.6	2	.5	.5	.7	.4	.3	2	.3	.3	.5	.1	.4
123/2	10	.2	.1	1.0	.0	1.0	2	.3	.3	.3	.3	0	2	.7	.7	.9	.5	.4
124/2	5	.4	.3	.7	.2	.5	7	.5	.5	.9	.3	.6	4	.4	.4	.5	.3	.2
125/2	1	.1	.1	.1	.1	0	5	.8	.5	2.0	.3	1.7	1	.6	.6	.6	.6	0
126/2	5	.4	.3	.8	0	.8	2	.6	.6	.6	.6	0	1	1.0	1.0	1.0	1.0	0
127/2	2	1.2	1.2	1.6	.8	.8	2	.5	.5	.5	.4	.1	2	.5	.5	.5	.5	0
128/2	3	.2	.3	.4	0	.4	1	.7	.7	.7	.7	.0	3	.4	.4	.6	.2	.4
129/2	2	.1	.1	.2	.1	.1	1	.3	.3	.3	.3	0	2	.2	.2	.2	.2	0
130/2	2	.2	.2	.3	.1	.2	2	.2	.2	.3	.1	.2	3	.3	.3	.4	.2	.2
131/2	3	.2	.1	.4	.1	.3	3	.1	.1	.2	0	.2	1	.2	.2	.2	.2	0
132/2	1	.5	.3	.9	.3	.6	1	.3	.3	.3	.3	0	4	.6	.4	1.2	.4	.8
133/2	3	.3	.4	.5	.1	.4	0	-	-	-	-	-	5	.2	.2	.3	.1	.2
134/2	0	-	-	-	-	-	1	.5	.5	.5	.5	0	2	.9	.9	1.4	.4	1.0
135/2	1	2.5	2.5	2.5	2.5	0	0	-	-	-	-	-	2	.3	.3	.3	.3	0

TABLE 12 WATERCOURSE LEVEL AREA OF BLOCK OF BUNDED UNITS IRRIGATED SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON WATERCOURSE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range	# of Cases	Mean	Median	Maxi-mum	Mini-mum	Range
101/1	3	.8	.5	1.7	.3	1.4	0	-	-	-	-	-	0	-	-	-	-	-
101/2	1	3.4	3.4	3.4	3.4	.0	0	-	-	-	-	-	2	.4	.4	.5	.3	.2
102/1	1	.8	.8	.8	.8	0	0	-	-	-	-	-	0	-	-	-	-	-
102/2	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
102/3	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
103/2	3	.8	.5	1.3	.5	.8	2	.9	.9	1.0	.7	.3	0	-	-	-	-	-
103/3	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
105/1	2	.5	.5	.6	.3	.3	2	.2	.2	.3	.1	.2	0	-	-	-	-	-
106/1	0	-	-	-	-	-	1	1.1	1.1	1.1	1.1	0	0	-	-	-	-	-
107/2	1	.3	.3	.3	.3	0	0	-	-	-	-	-	0	-	-	-	-	-
107/2	1	.8	.8	.8	.8	0	0	-	-	-	-	-	2	.4	.4	.5	.3	.2
107/3	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
108/1	1	3.3	3.3	3.3	3.3	0	0	-	-	-	-	-	1	.9	.9	.9	.9	0
109/1	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
109/2	0	-	-	-	-	-	1	.5	.5	.5	.5	0	1	.8	.8	.8	.8	0
110/1	0	-	-	-	-	-	1	.5	.5	.5	.5	0	2	.9	.9	1.7	.2	1.5
110/2	1	.6	.6	.6	.6	0	0	-	-	-	-	-	0	-	-	-	-	-
110/3	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
111/1	0	-	-	-	-	-	1	1.5	1.5	1.5	1.5	0	1	3.5	3.5	3.5	3.5	0
111/2	0	-	-	-	-	-	5	1.2	1.1	2.5	.5	2.0	2	2.1	2.1	3.0	1.2	1.8
112/1	0	-	-	-	-	-	1	1.1	1.1	1.1	1.1	0	2	1.1	1.1	1.1	1.0	.1
112/2	0	-	-	-	-	-	0	-	-	-	-	-	1	.3	.3	.3	.3	.3
112/3	0	-	-	-	-	-	1	.9	.9	.9	.9	0	1	1.0	1.0	1.0	1.0	0
113/1	0	-	-	-	-	-	1	.4	.4	.4	.4	0	0	-	-	-	-	-
113/2	2	.7	.7	.9	.5	.4	0	-	-	-	-	-	0	-	-	-	-	-
113/3	0	-	-	-	-	-	0	-	-	-	-	-	1	.4	.4	.4	.4	0
114/1	7	.4	.5	.5	.1	.4	0	-	-	-	-	-	0	-	-	-	-	-
114/2	1	0	0	0	0	0	0	-	-	-	-	-	0	-	-	-	-	-
114/3	0	-	-	-	-	-	1	1.0	1.0	1.0	1.0	0	0	-	-	-	-	-
114/4	1	.1	.1	.1	.1	0	1	.3	.3	.3	.3	0	1	.9	.9	.9	.9	.0
115/1	1	.2	.2	.2	.2	0	0	-	-	-	-	-	0	-	-	-	-	-
115/2	0	-	-	-	-	-	1	.3	.3	.3	.3	0	0	-	-	-	-	-
115/3	1	.7	.7	.7	.7	0	0	-	-	-	-	-	0	-	-	-	-	-
115/4	1	.2	.2	.2	.2	0	0	-	-	-	-	-	0	-	-	-	-	-
115/5	0	-	-	-	-	-	1	.9	.9	.9	.9	0	0	-	-	-	-	-
115/6	0	-	-	-	-	-	1	.8	.8	.8	.8	0	0	-	-	-	-	-
116/1	0	-	-	-	-	-	0	-	-	-	-	-	1	.3	.3	.3	.3	0
116/2	0	-	-	-	-	-	1	.3	.3	.3	.3	0	0	-	-	-	-	-
116/3	0	-	-	-	-	-	0	-	-	-	-	-	1	.2	.2	.2	.2	0
116/4	0	-	-	-	-	-	1	1.3	1.3	1.3	1.3	0	0	-	-	-	-	-

TABLE 13 WATERCOURSE LEVEL TIME OF IRRIGATION OF INDIVIDUAL BUNDED UNIT SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON WATERCOURSE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range
101/1	2	1.4	1.4	1.7	1.1	.6	22	.6	.5	1.6	.3	1.3	12	.6	.6	1.3	.2	1.1
101/2	4	.8	.6	.9	.6	.3	8	.9	.7	1.8	.3	1.5	14	.7	.5	2.9	.3	2.6
102/1	2	3.1	3.1	3.7	2.5	1.2	1	3.2	3.2	3.2	3.2	.0	7	2.1	2.0	3.7	1.1	2.6
103/1	0	-	-	-	-	-	9	1.1	.9	2.2	.5	1.7	17	1.9	1.3	5.5	.6	4.9
104/1	0	-	-	-	-	-	3	2.5	2.5	3.2	1.8	1.4	4	2.7	2.5	3.5	2.2	1.3
104/2	6	1.3	1.3	2.8	.1	2.7	4	4.1	2.8	9.7	1.2	8.5	3	3.9	2.3	7.1	2.3	4.8
104/3	1	3.9	3.9	3.9	3.9	.0	0	-	-	-	-	-	3	5.9	6.0	8.5	3.3	5.2
105/1	1	2.3	2.3	2.3	2.3	0	3	.8	.5	1.6	.4	1.2	5	1.1	1.1	1.5	.8	.7
106/1	1	.4	.4	.4	.4	0	1	.9	.9	.9	.9	0	3	1.9	2.0	2.8	.8	2.0
107/1	17	.7	.7	2.2	.3	1.9	3	.8	1.0	1.1	.4	.7	7	1.2	.9	2.7	.6	2.1
107/2	10	.7	.6	1.4	.3	1.1	4	.5	.4	.8	.3	.5	8	.7	.6	1.2	.2	1.0
107/3	23	.5	.5	1.0	.2	.8	3	.6	.6	1.0	.3	.7	8	1.1	1.2	1.8	.3	1.5
108/1	2	1.4	1.4	1.9	1.0	.9	0	-	-	-	-	-	2	1.7	1.7	1.7	1.7	.0
109/1	5	1.3	1.3	2.0	1.0	1.0	3	.8	.5	1.4	.4	1.0	1	3.7	3.7	3.7	3.7	.0
109/2	1	2.9	2.9	2.9	2.9	.0	3	1.0	.8	1.4	.7	.7	2	1.3	1.3	1.5	1.1	.4
110/1	0	-	-	-	-	-	2	2.6	2.6	3.3	1.9	1.4	3	3.7	2.7	7.6	.8	6.8
110/2	2	1.9	1.9	2.3	1.6	.7	3	1.2	1.4	1.7	.4	1.3	4	2.6	2.5	4.0	1.4	2.6
110/3	7	2.5	2.3	4.0	1.5	2.5	5	3.3	2.5	7.3	1.7	5.6	6	1.0	.8	1.8	.4	1.4
111/1	5	1.5	1.5	2.3	.8	1.5	7	1.6	1.2	3.2	.9	2.3	1	3.3	3.3	3.3	3.3	.0
111/2	3	3.0	2.5	4.1	2.4	1.7	7	3.3	2.1	9.8	1.4	8.4	8	1.9	1.3	4.2	.5	3.7
112/1	2	1.7	1.7	2.5	.9	1.6	10	1.2	1.1	2.3	.5	1.8	4	.9	.9	1.2	.5	.7
112/2	7	4.9	4.0	11.2	1.5	9.7	4	7.5	8.2	9.7	3.7	6.0	4	3.1	3.0	4.5	2.0	2.5
112/3	6	1.3	1.2	2.3	.8	1.5	1	3.0	3.0	3.0	3.0	0	8	2.1	1.6	6.5	.9	5.6
113/1	0	-	-	-	-	-	8	1.3	1.3	2.4	.3	2.1	4	2.7	2.7	2.9	2.3	.6
113/2	0	-	-	-	-	-	5	2.0	2.3	2.4	1.1	1.3	4	3.8	3.6	7.3	.8	6.5
113/3	1	1.7	1.7	1.7	1.7	.0	7	1.5	1.2	4.2	.7	3.5	13	1.7	1.7	2.9	.6	2.3
114/1	6	4.2	3.5	9.0	.9	8.1	2	4.2	4.2	4.9	3.6	1.3	2	3.2	3.2	3.4	3.0	.4
114/2	18	4.8	2.7	24.0	1.2	22.8	2	2.0	2.0	2.3	1.6	.7	2	3.2	3.2	4.1	2.3	1.8
114/3	5	6.1	5.1	12.9	2.8	10.1	7	3.5	3.4	7.0	1.5	5.5	4	1.7	1.7	2.9	.3	2.6
114/4	3	2.7	2.3	4.0	2.0	2.0	6	4.7	3.5	8.8	1.4	7.4	1	2.8	2.8	2.8	2.8	.0
115/1	5	2.5	2.9	3.0	1.3	1.7	2	2.6	2.6	3.3	2.0	1.3	1	4.5	4.5	4.5	4.5	.0
115/2	2	9.9	9.9	10.7	9.0	1.7	2	3.1	3.1	3.6	2.7	.9	2	6.2	6.2	8.2	4.3	3.9
115/3	3	2.3	2.3	2.5	2.0	.5	1	4.0	4.0	4.0	4.0	.0	3	4.5	4.3	5.0	4.0	1.0
115/4	2	.9	.9	1.5	.3	1.2	1	1.4	1.4	1.4	1.4	0	2	1.2	1.2	1.3	1.1	.2
115/5	2	1.2	1.2	1.2	1.1	.1	2	2.3	2.3	2.6	2.0	.6	3	1.8	1.5	2.8	1.0	1.8
115/6	3	1.8	1.7	3.1	.7	2.4	3	2.5	2.8	3.5	1.3	2.2	1	.7	.7	.7	.7	.0
116/1	3	4.0	3.0	4.8	3.3	1.5	1	4.4	4.4	4.4	4.4	0	4	8.7	13.3	25.0	1.8	23.2
116/2	3	4.5	3.5	8.0	2.0	6.0	0	-	-	-	-	-	5	4.1	3.5	7.2	2.7	4.5
116/3	0	-	-	-	-	-	1	1.7	1.7	1.7	1.7	0	2	5.9	5.9	8.5	3.3	5.2
116/4	1	11.7	11.7	11.7	11.7	0	0	-	-	-	-	-	2	10.9	10.9	15.0	6.8	8.2

TABLE 14 WATERCOURSE LEVEL TIME OF IRRIGATION OF BLOCK OF BUNDED UNITS SUMMARY STATISTICS FOR HEAD, MIDDLE AND TAIL POSITIONS ON WATERCOURSES ON WATERCOURSE BASIS

Village	Head						Middle						Tail					
	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range	# of Cases	Mean	Median	Maximum	Minimum	Range
101/1	3	1.2	.8	2.3	.5	1.8	0	-	-	-	-	-	0	-	-	-	-	-
101/2	1	4.5	4.5	4.5	4.5	0	0	-	-	-	-	-	2	1.2	1.2	1.6	.9	.7
102/1	1	3.7	3.7	3.7	3.7	0	0	-	-	-	-	-	0	-	-	-	-	-
103/1	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
104/1	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
104/2	3	4.7	4.5	5.3	4.3	1.0	2	5.4	5.4	6.0	4.8	1.2	0	-	-	-	-	-
104/3	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
105/1	2	.8	.8	1.1	.5	.6	2	.5	.5	.6	.4	.2	0	-	-	-	-	-
106/1	0	-	-	-	-	-	1	1.5	1.5	1.5	1.5	0	0	-	-	-	-	-
107/1	1	1.3	1.3	1.3	1.3	0	0	-	-	-	-	-	0	-	-	-	-	-
107/2	1	1.2	1.2	1.2	1.2	0	0	-	-	-	-	-	2	.7	.7	1.0	.5	.5
107/3	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
108/1	1	5.4	5.4	5.4	5.4	0	0	-	-	-	-	-	1	2.3	2.3	2.3	2.3	0
109/1	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
109/2	0	-	-	-	-	-	1	.7	.7	.7	.7	0	1	2.9	2.9	2.9	2.9	.0
110/1	0	-	-	-	-	-	1	2.7	2.7	2.7	2.7	0	2	4.5	4.5	8.3	.7	7.6
110/2	1	1.2	1.2	1.2	1.2	0	0	-	-	-	-	-	0	-	-	-	-	-
110/3	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-
111/1	0	-	-	-	-	-	2	6.0	6.0	9.7	2.3	7.4	1	8.7	8.7	8.7	8.7	0
111/2	0	-	-	-	-	-	5	4.1	2.8	9.7	1.3	8.4	2	7.3	7.3	12.1	2.4	9.7
112/1	0	-	-	-	-	-	1	1.9	1.9	1.9	1.9	0	2	1.4	1.4	1.5	1.3	.2
112/2	0	-	-	-	-	-	0	-	-	-	-	-	1	4.3	4.3	4.3	4.3	0
112/3	0	-	-	-	-	-	1	1.8	1.8	1.8	1.8	0	0	-	-	-	-	-
113/1	0	-	-	-	-	-	1	1.9	1.9	1.9	1.9	0	0	-	-	-	-	-
113/2	2	3.4	3.4	4.9	1.9	3.0	0	-	-	-	-	-	0	-	-	-	-	-
113/3	0	-	-	-	-	-	0	-	-	-	-	-	1	2.0	2.0	2.0	2.0	0
114/1	7	1.6	1.4	2.7	.5	2.2	0	-	-	-	-	-	0	-	-	-	-	-
114/2	1	1.6	1.6	1.6	1.6	0	0	-	-	-	-	-	0	-	-	-	-	-
114/3	0	-	-	-	-	-	1	6.5	6.5	6.5	6.5	0	0	-	-	-	-	-
114/4	1	2.7	2.7	2.7	2.7	0	1	2.7	2.7	2.7	2.7	0	1	3.5	3.5	3.5	3.5	0
115/1	1	.7	.7	.7	.7	0	0	-	-	-	-	-	0	-	-	-	-	-
115/2	0	-	-	-	-	-	1	5.3	5.3	5.3	5.3	0	0	-	-	-	-	-
115/3	1	4.1	4.1	4.1	4.1	0	0	-	-	-	-	-	0	-	-	-	-	-
115/4	1	.3	.3	.3	.3	0	0	-	-	-	-	-	0	-	-	-	-	-
115/5	0	-	-	-	-	-	1	5.2	5.2	5.2	5.2	0	0	-	-	-	-	-
115/6	0	-	-	-	-	-	1	6.5	6.5	6.5	6.5	0	0	-	-	-	-	-
116/1	0	-	-	-	-	-	0	-	-	-	-	-	1	10.5	10.5	10.5	10.5	0
116/2	0	-	-	-	-	-	1	4.1	4.1	4.1	4.1	0	0	-	-	-	-	-
116/3	0	-	-	-	-	-	0	-	-	-	-	-	1	4.3	4.3	4.3	4.3	0
116/4	0	-	-	-	-	-	1	7.5	7.5	7.5	7.5	0	0	-	-	-	-	-

APPENDIX II

Part A
Section 3

WATERCOURSE PROFILE

FIGURES

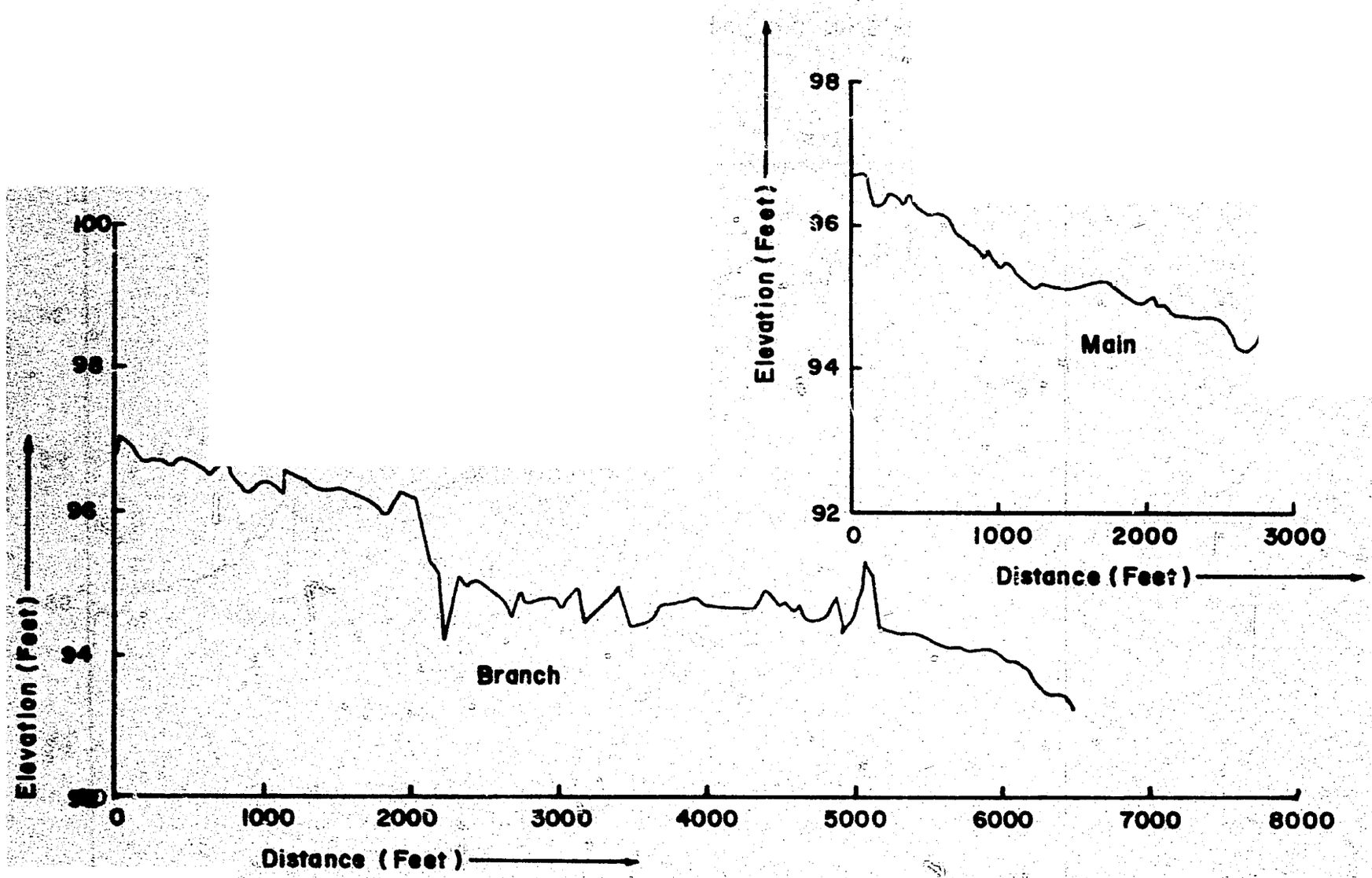


Figure 1. Watercourse Profile – Lyallpur W.C. No. 1. – Village No. 101

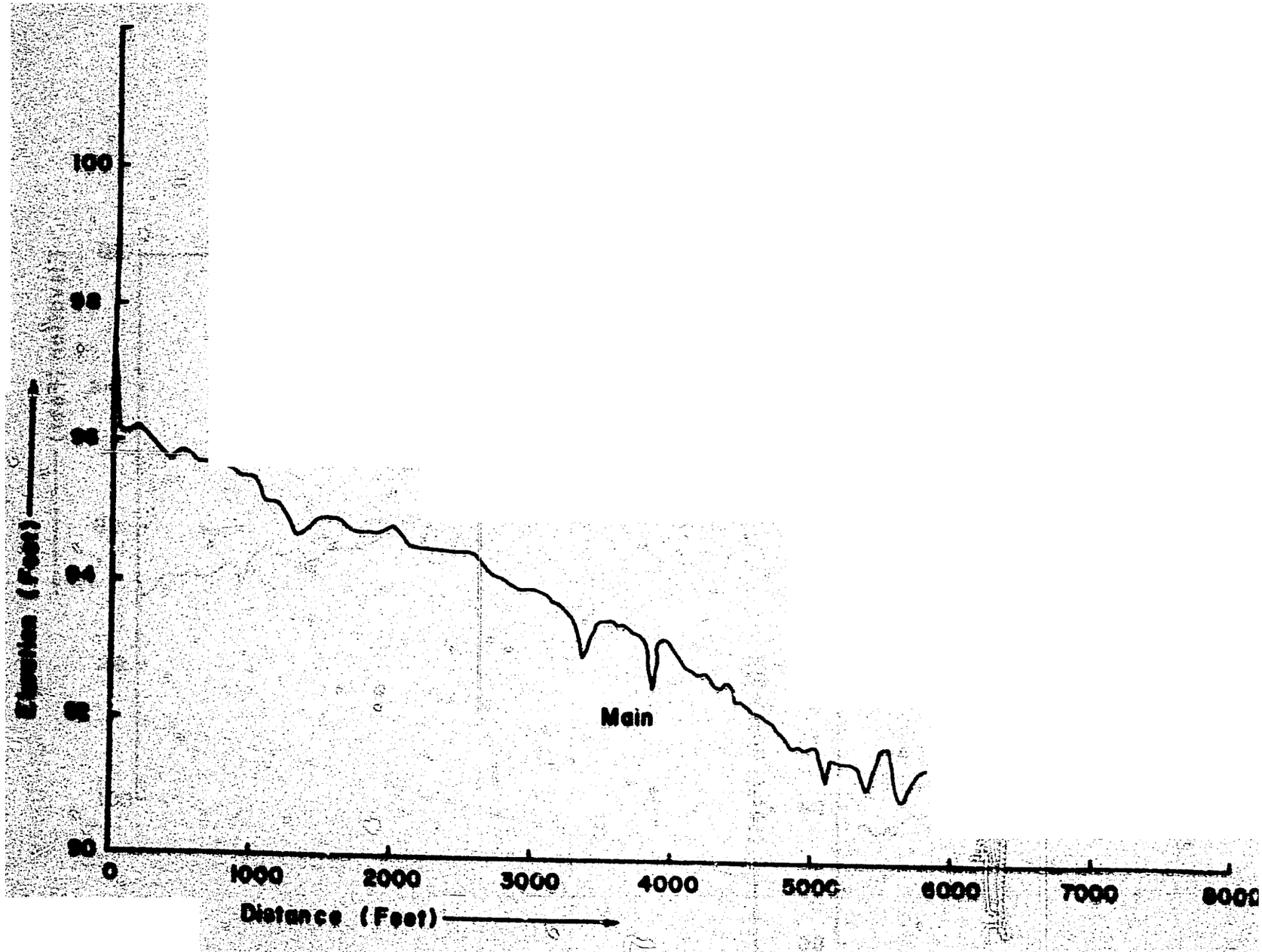


Figure 2. Watercourse Profile—Lyallpur W.C. No. 2.—Village No. 101

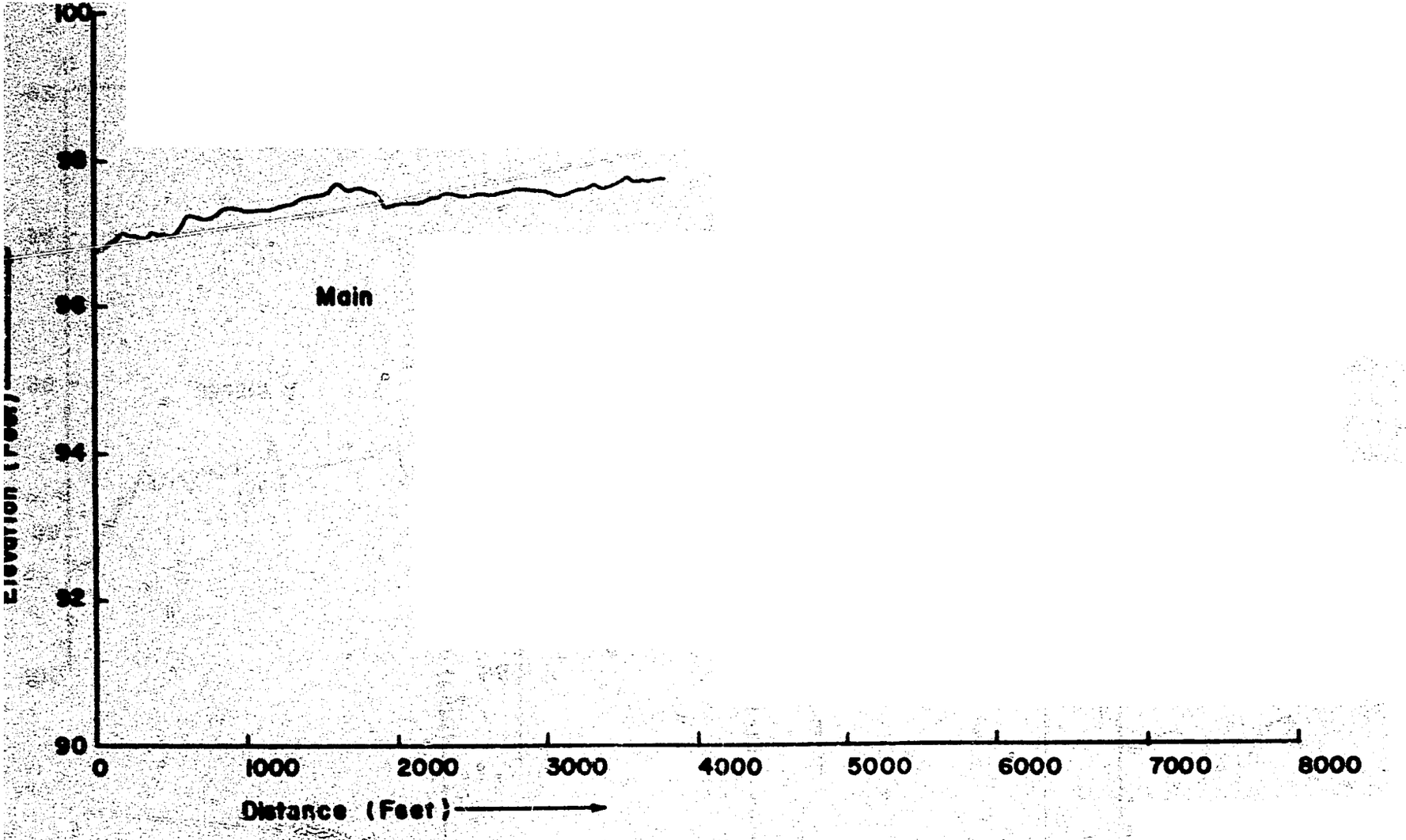


Figure 3. Watercourse Profile—Multan W.C. No. 1 – Village No. 102

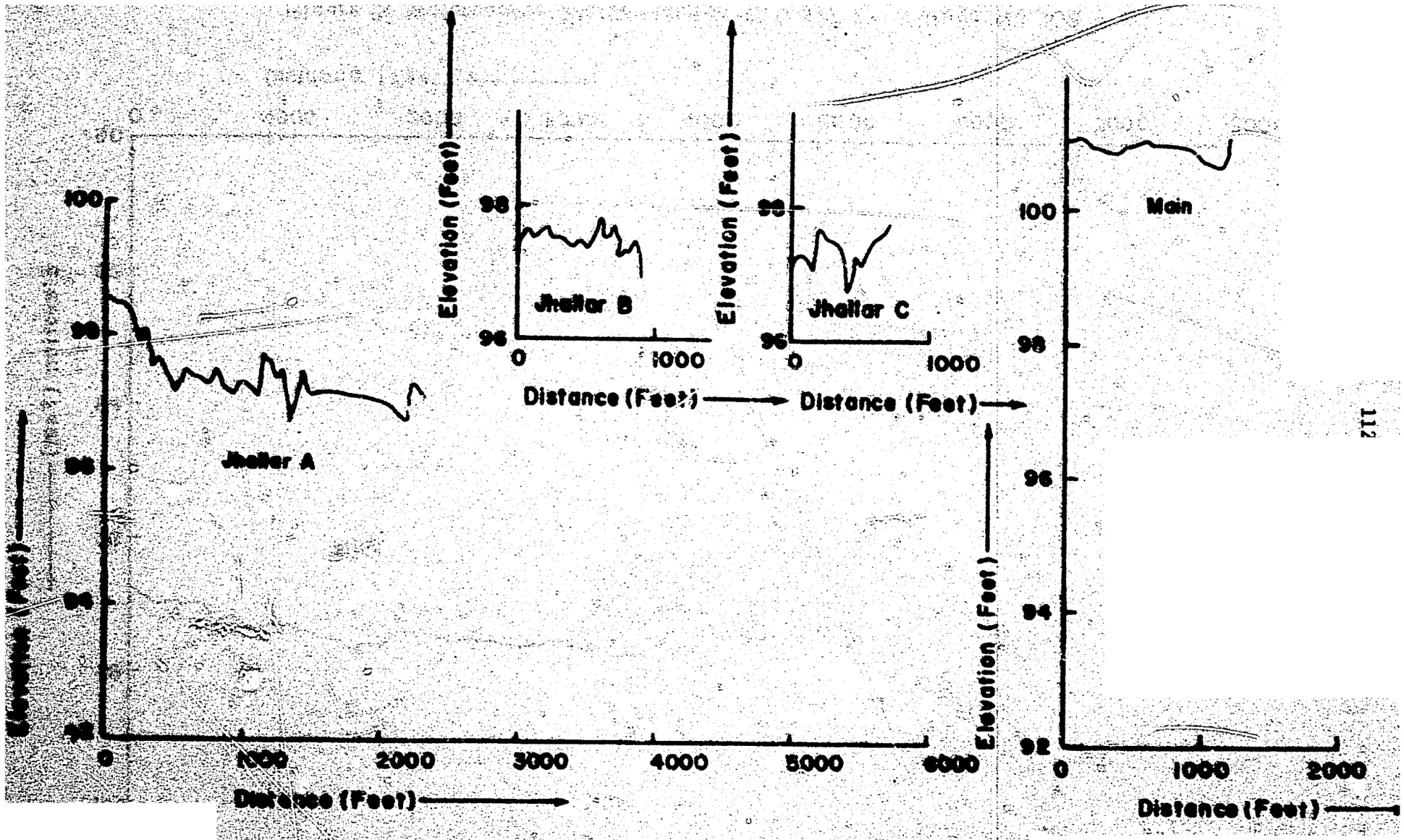


Figure 4. Watercourse Profile—Lahore W.C. No. 1 — Village No. 103

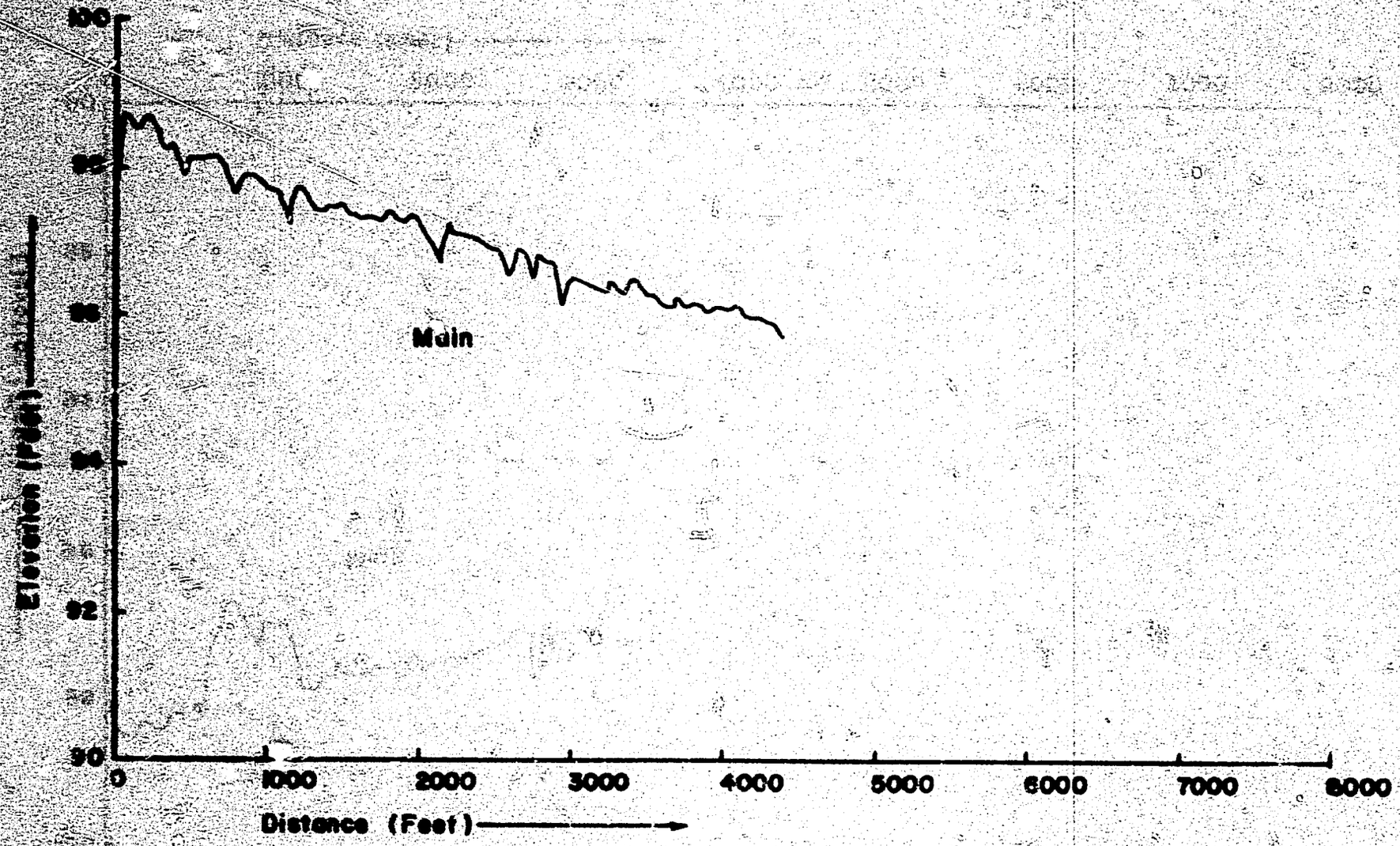


Figure 5. Watercourse Profile—Lahore W.C. No.1 — Village No. 104

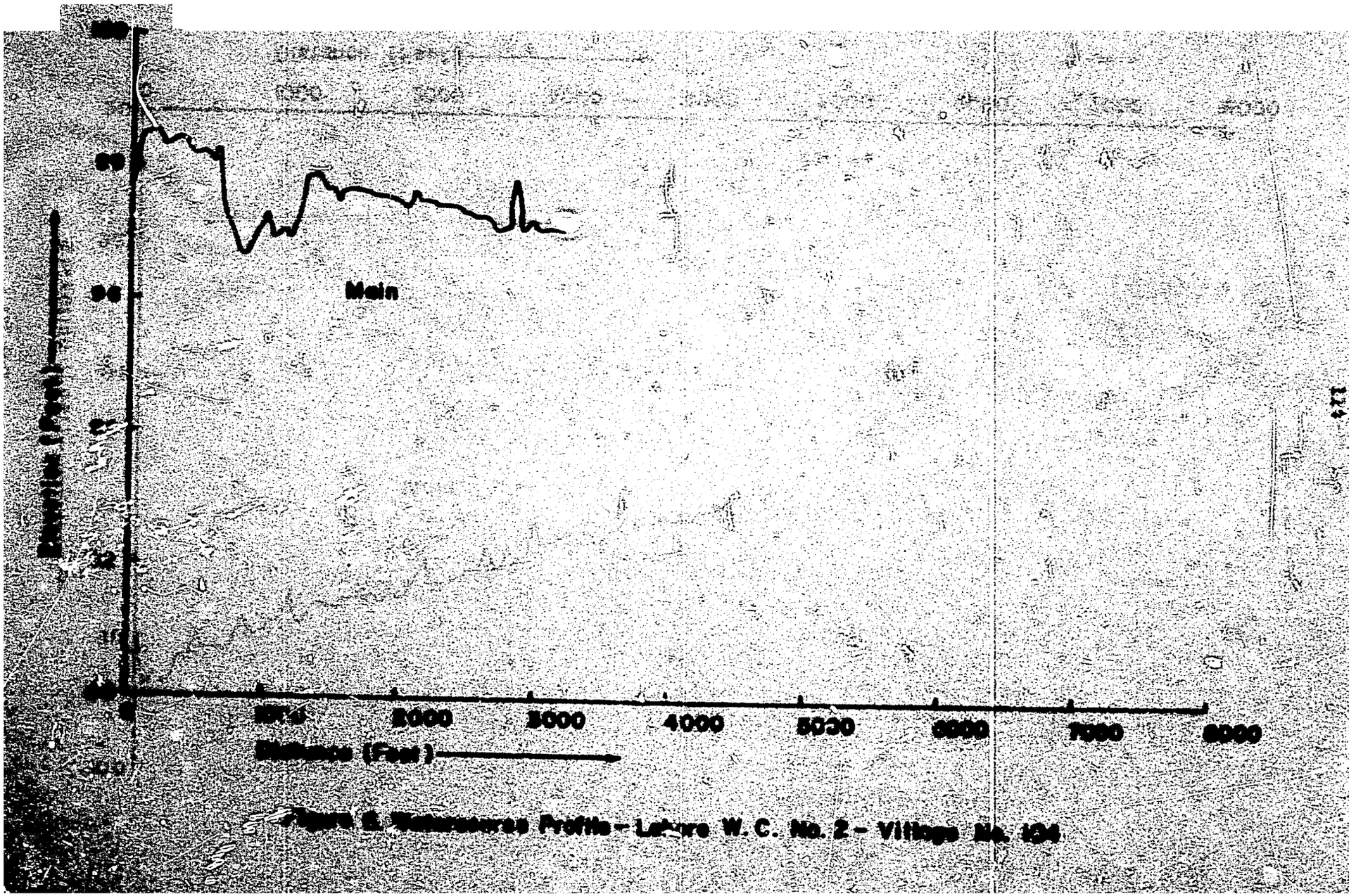


Figure 6. Watercourse Profile - Lahore W.C. No. 2 - Village No. 104.

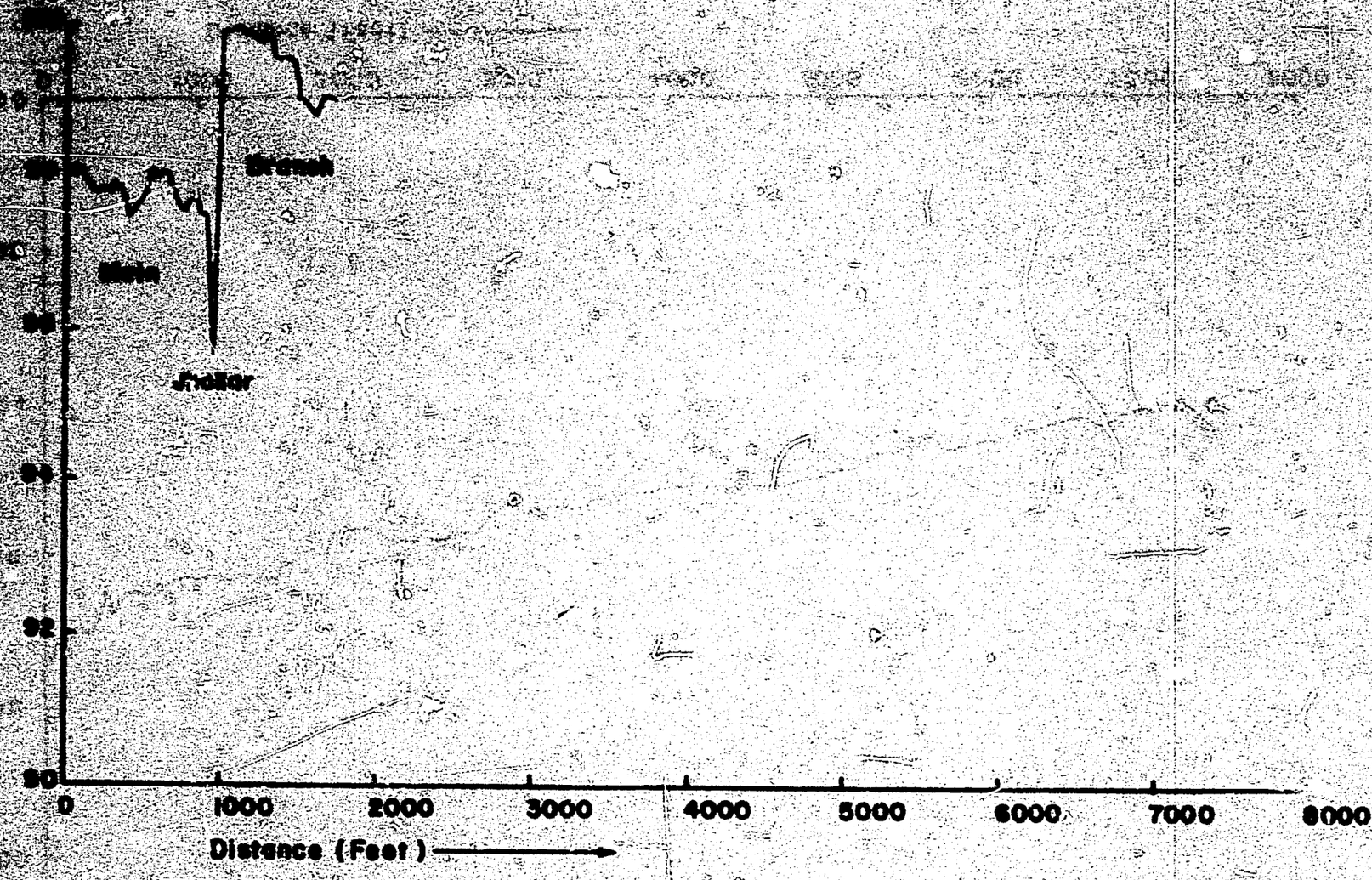


Figure 7. Watercourse Profile –Lahore W.C. No. 3– Village No. 104

Figure 8. Watercourse Profile – Sargodha W.C. No.1 – Village No.105

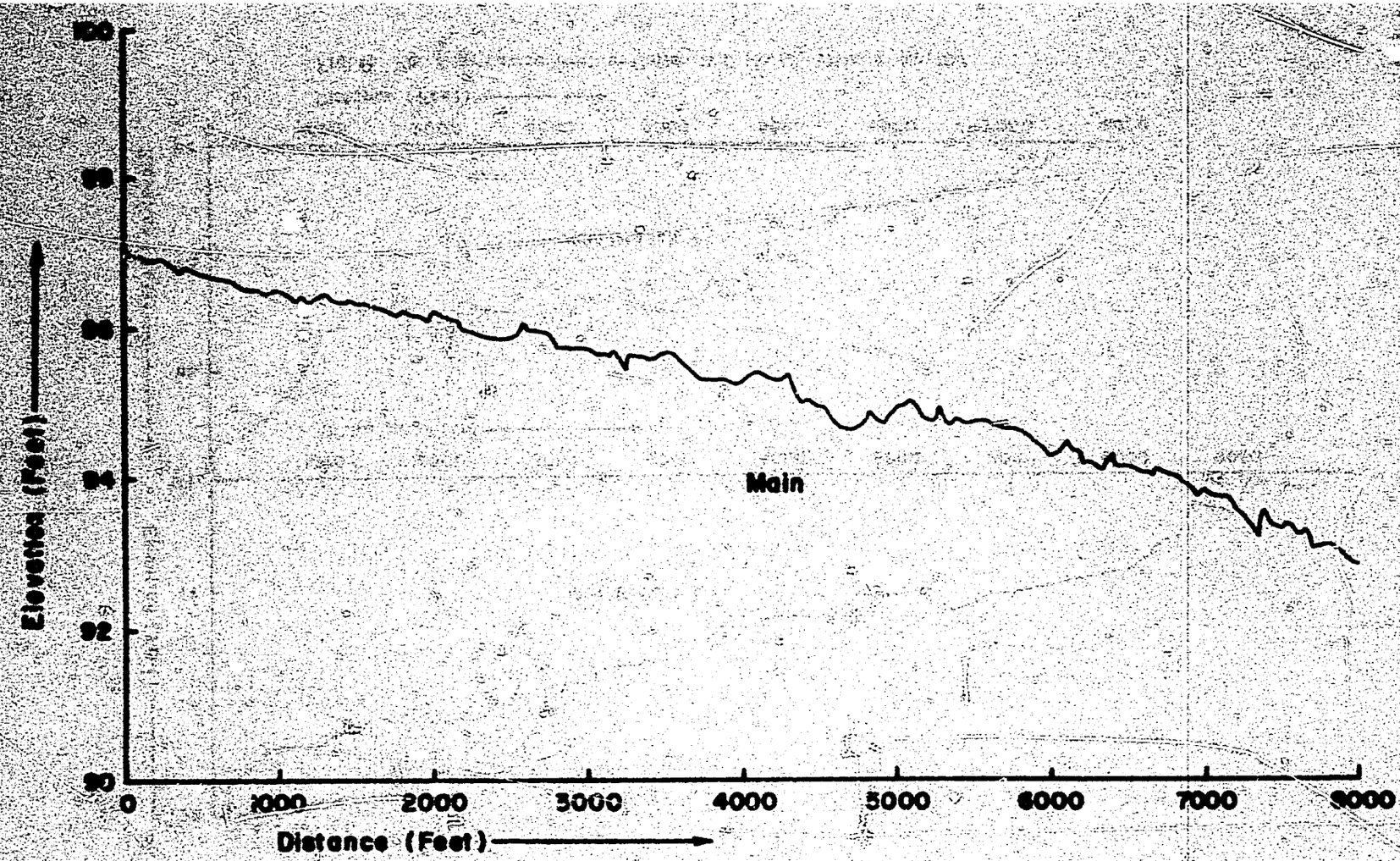


Figure 9. Watercourse Profile - Sargodha W.C. No.1 - Village No. 106

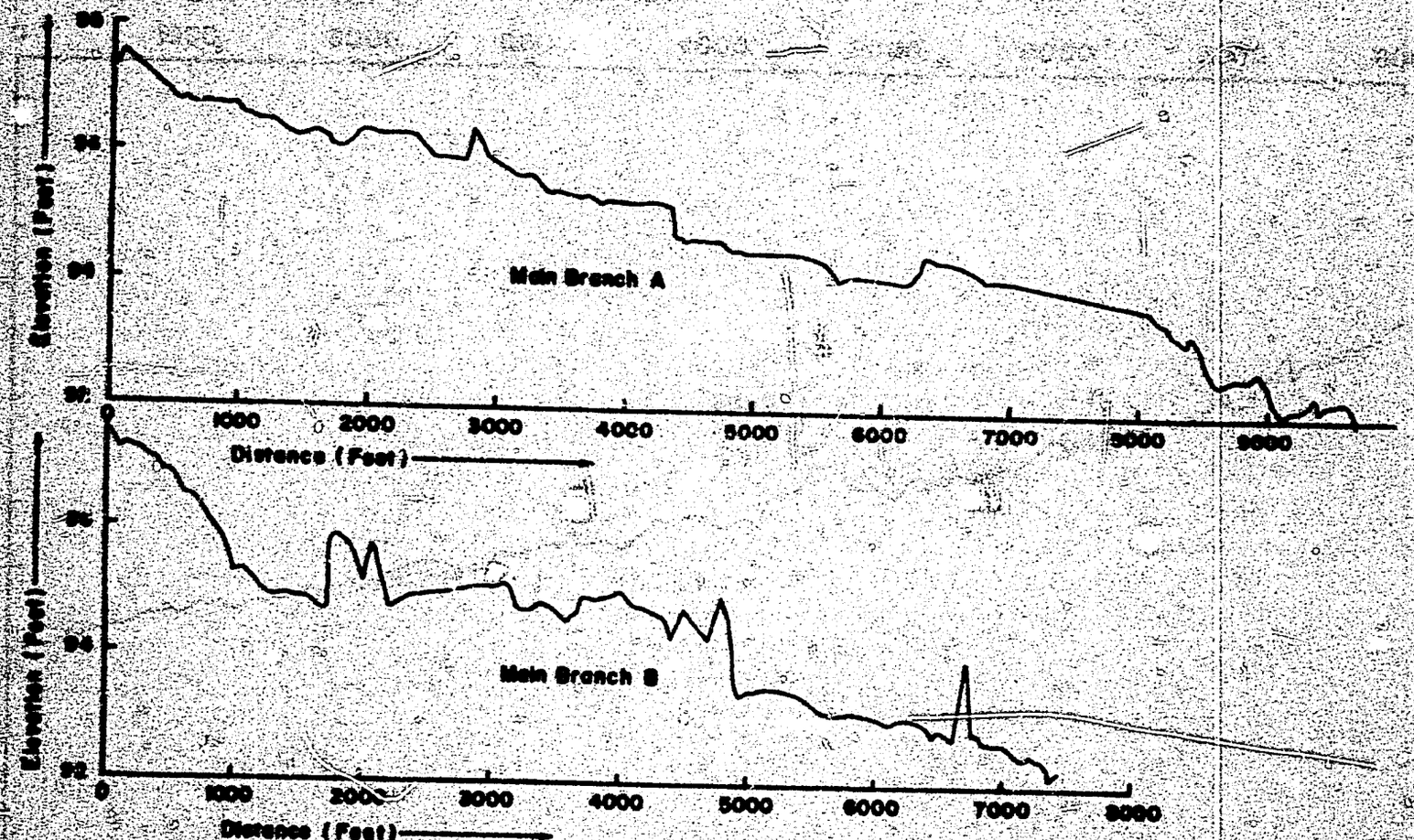


Figure 10. Watercourse Profile-Multon W.C. No. 1. – Village No. 107

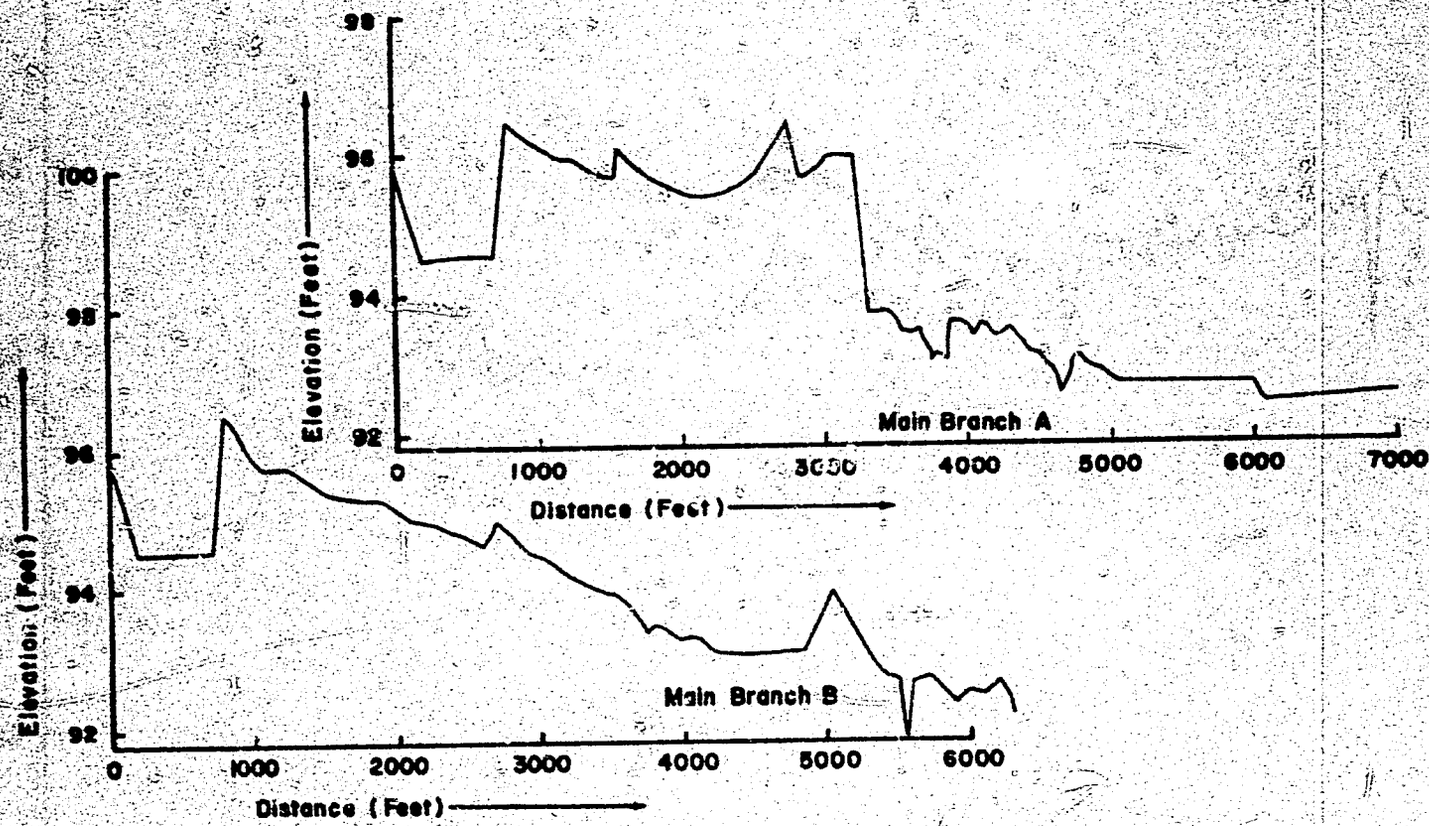


Figure 11. Watercourse Profile— Multan W.C. No. 2 - Village No. 107

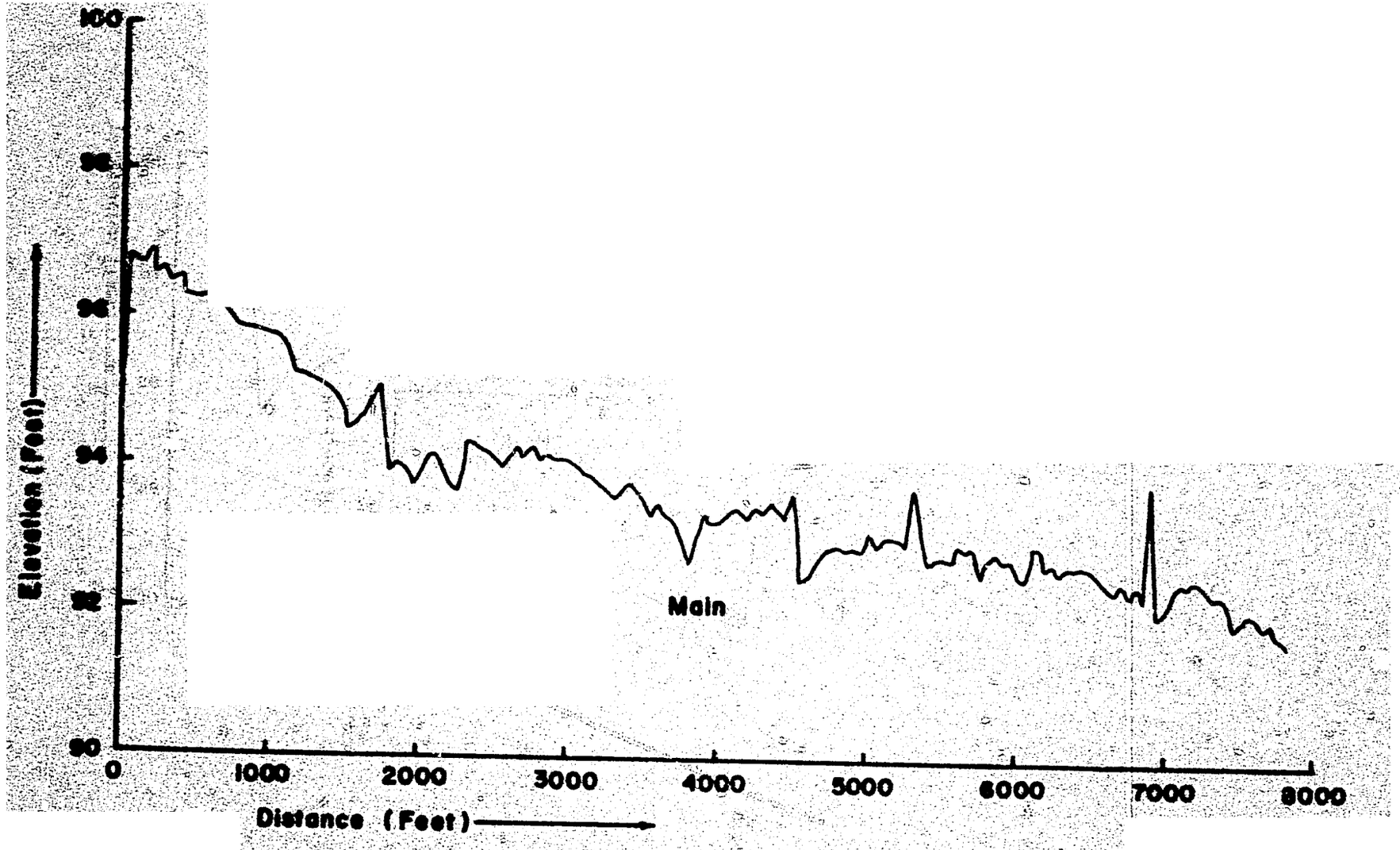


Figure 12. Watercourse Profile—Multan W.C. No. 3 - Village No. 107

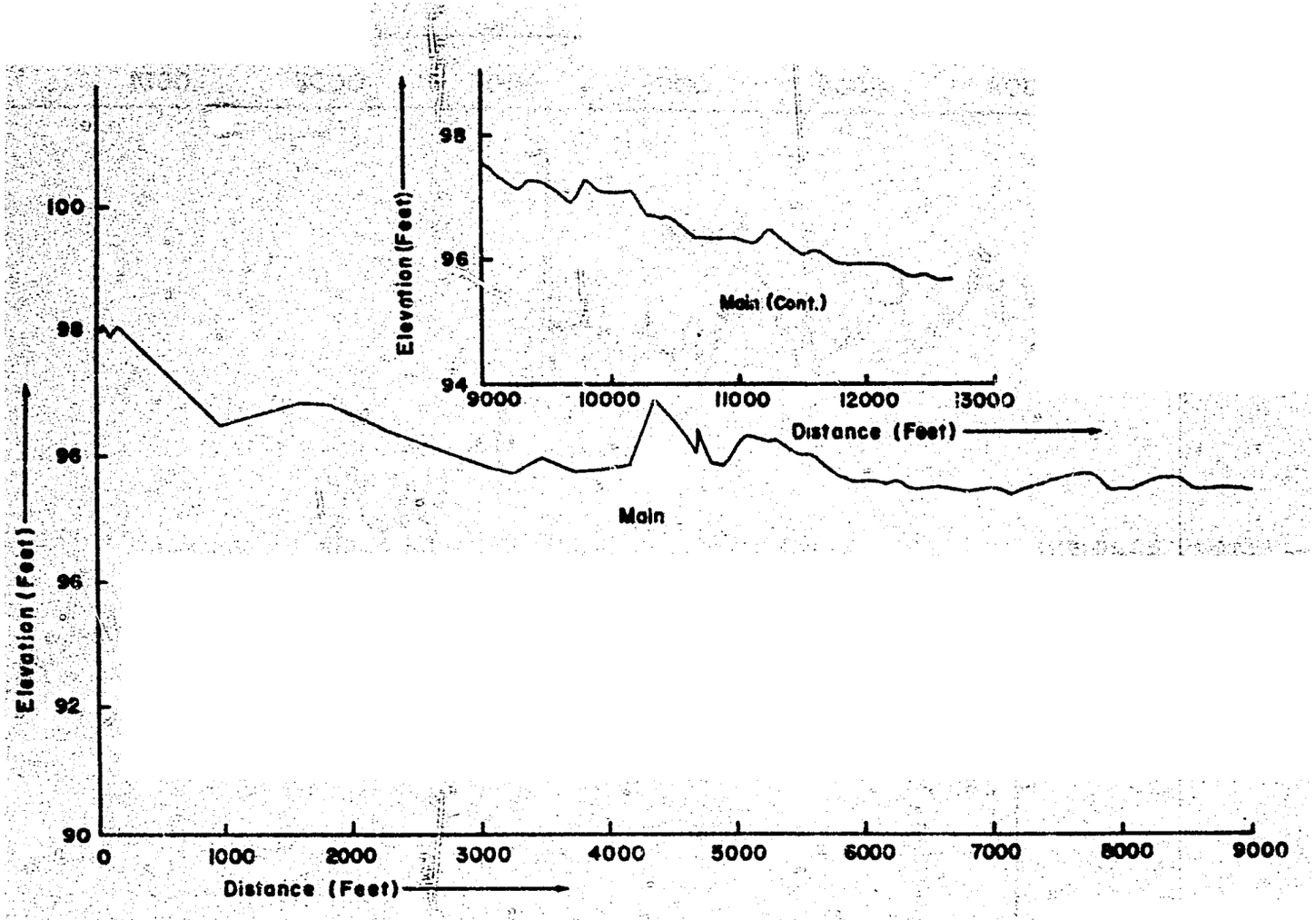


Figure 13. Watercourse Profile–Sargodha W.C. No. I – Village No. 108

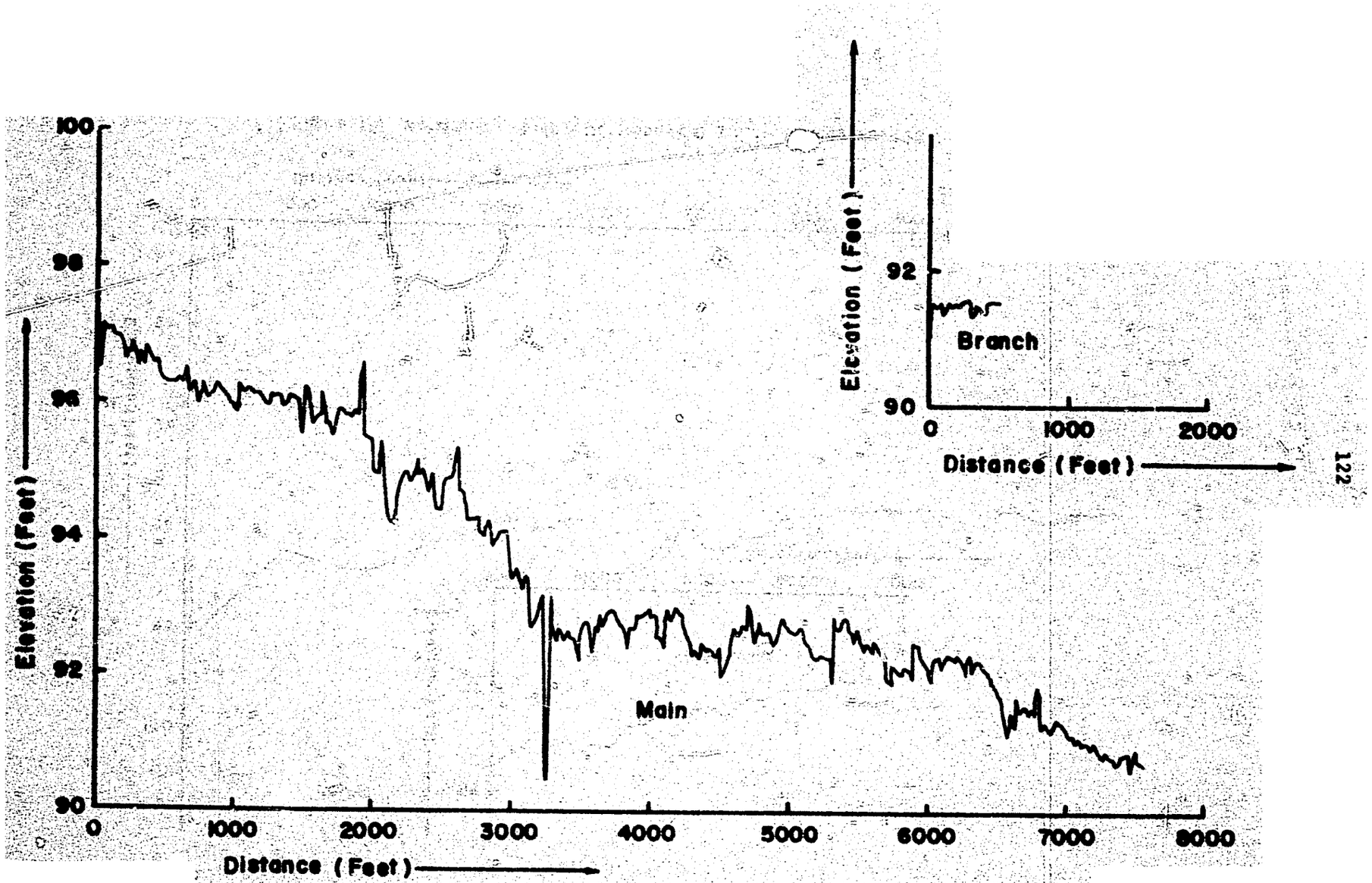


Figure 14. Watercourse Profile – Sargodha W.C.No. I. – Village No. 109

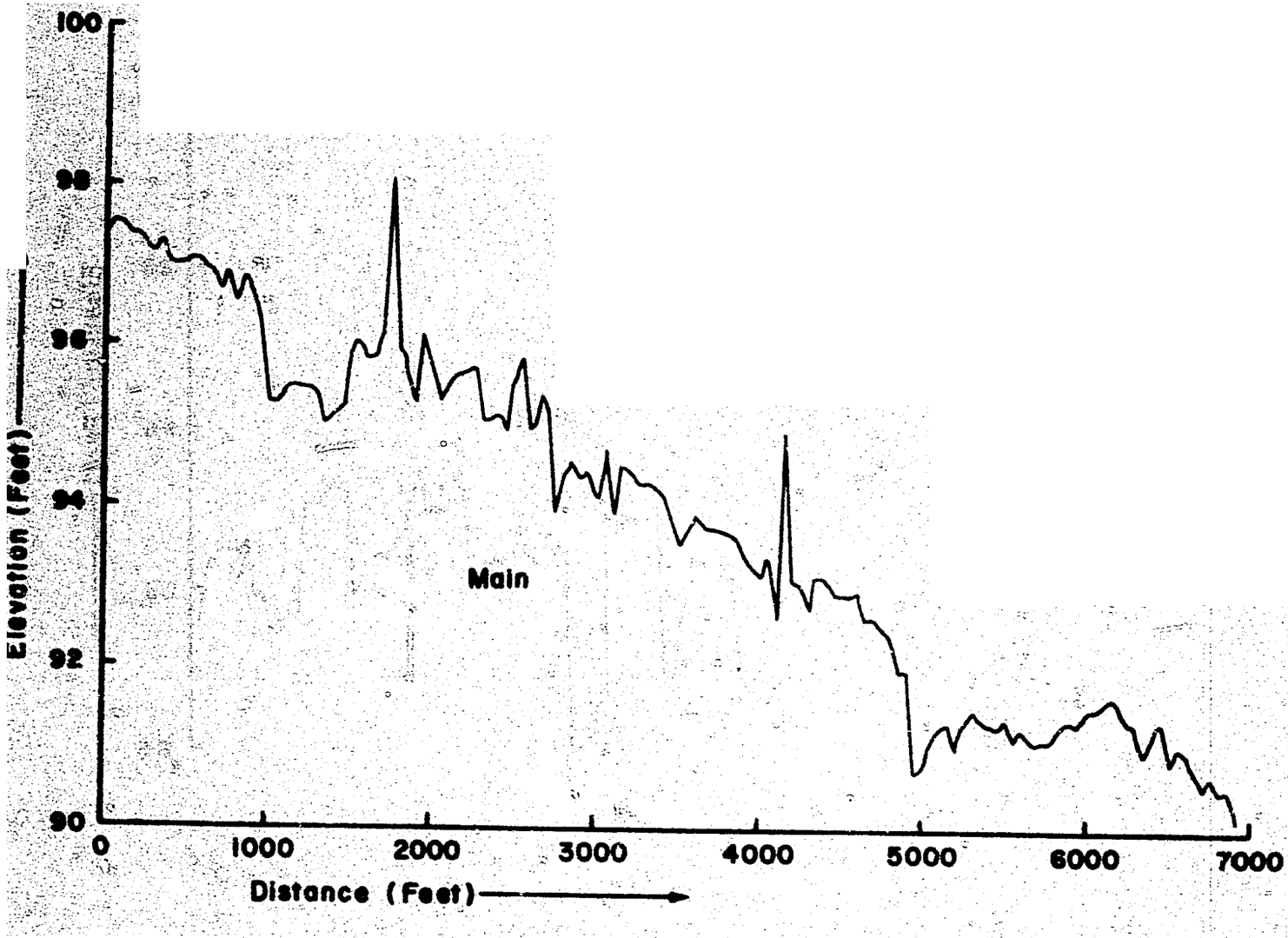


Figure 15. Watercourse Profile – Sargodha W.C. No. 2 – Village No. 109

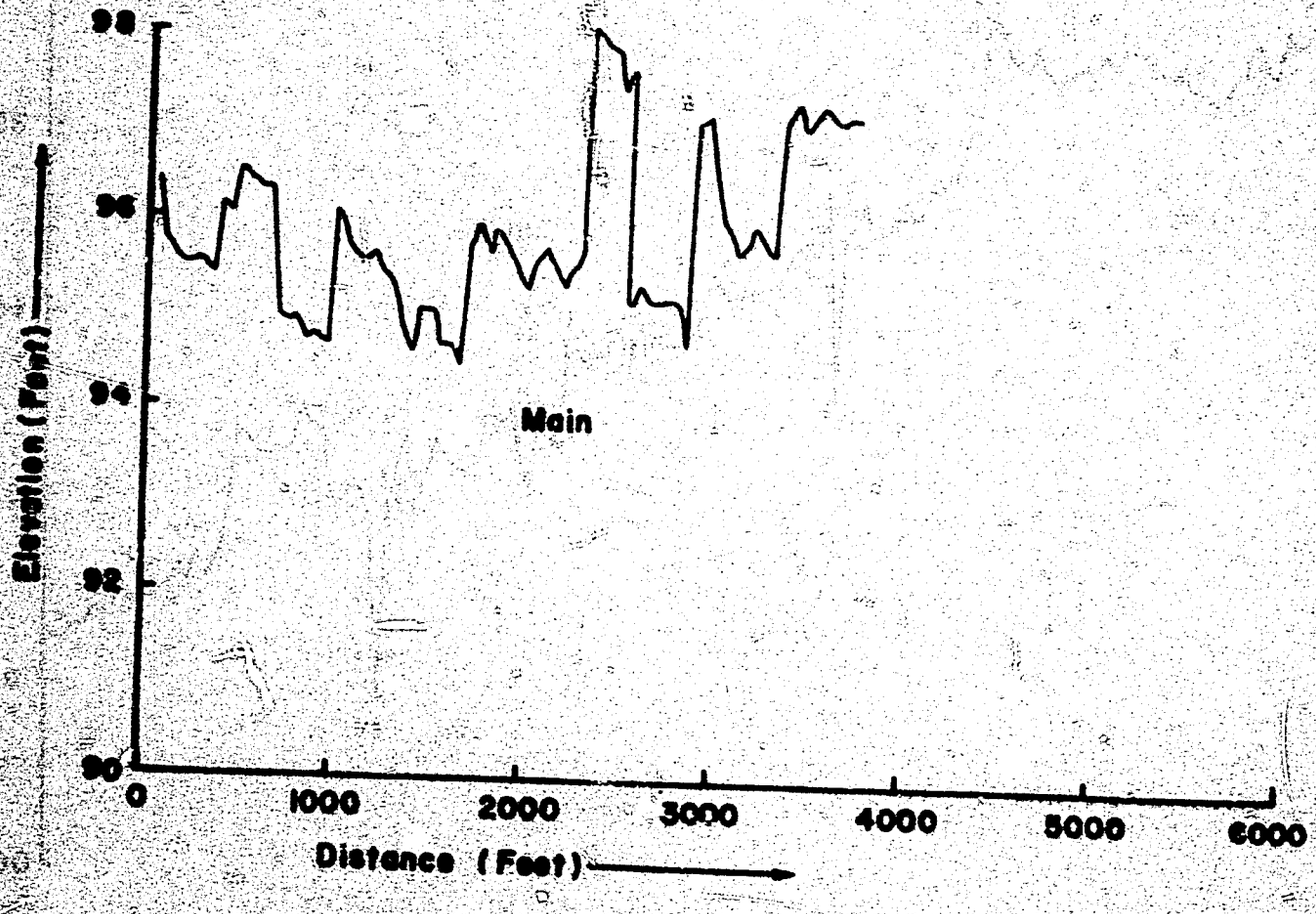


Figure 16. Watercourse Profile—Gujranwala W.C. No. 1.—Village No. 110

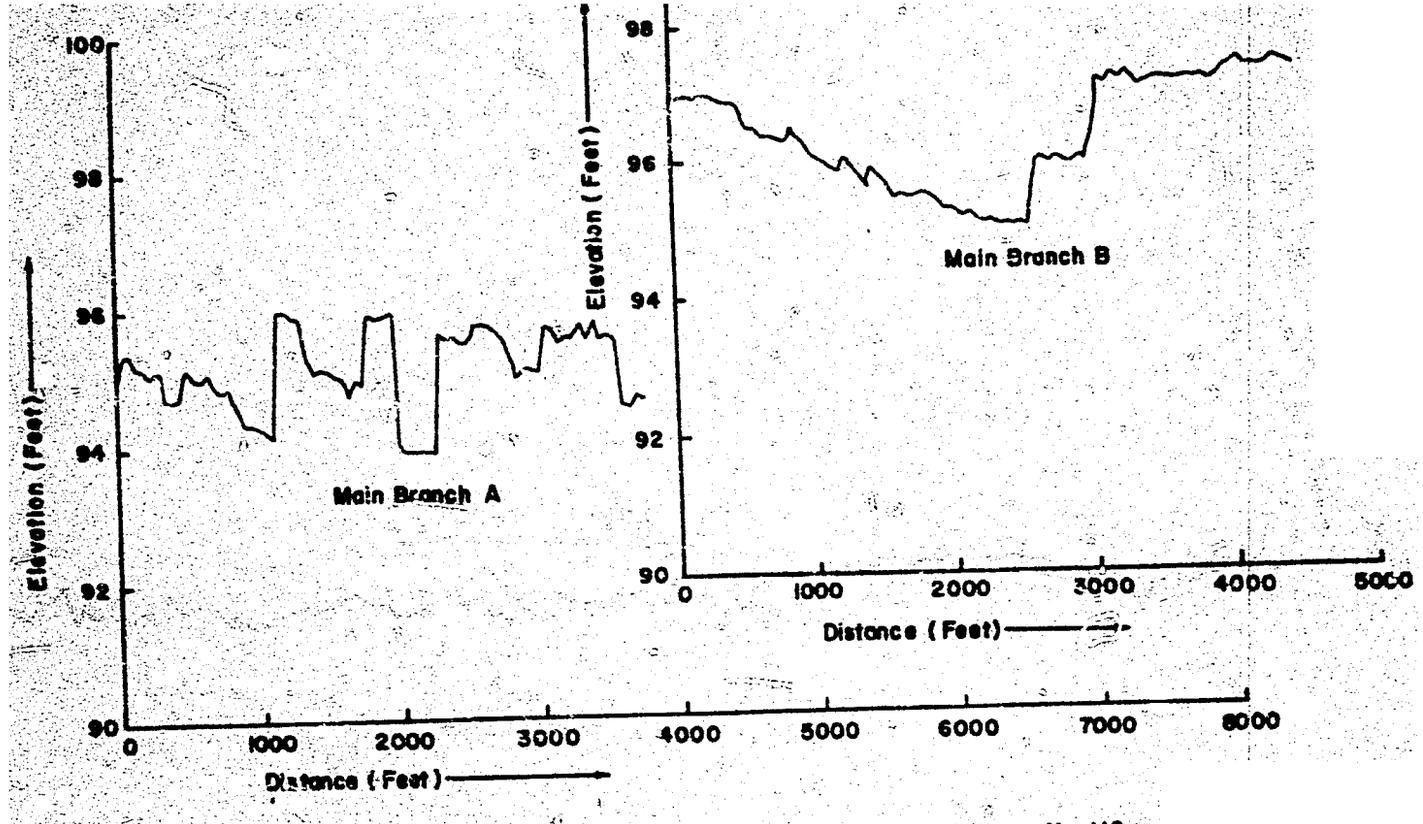


Figure 17. Watercourse Profile – Gujranwala W.C. No. 2. – Village No. 110

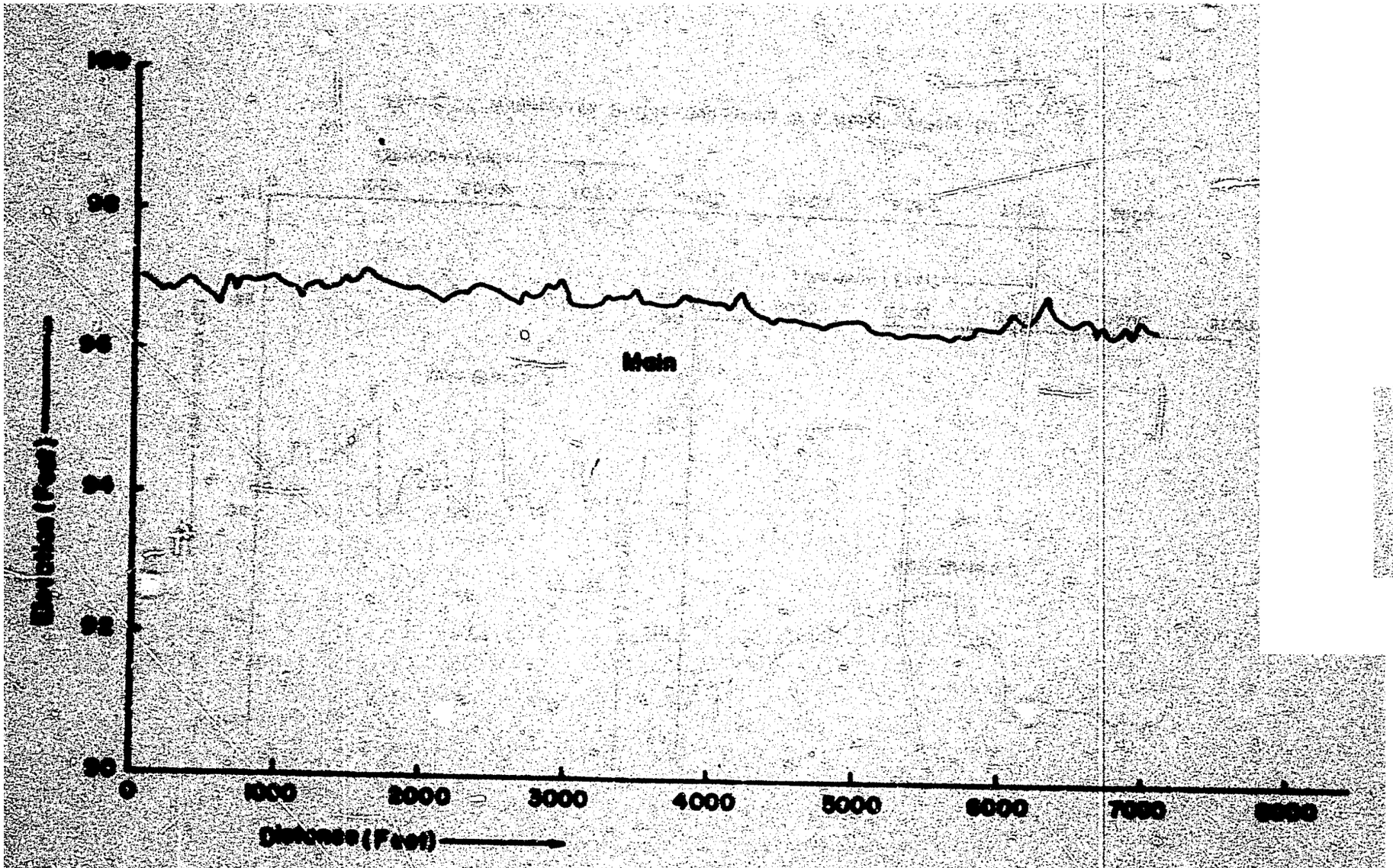


Figure 18. Watercourse Profile—Gujranwala W.C. No. 3—Village No. 110

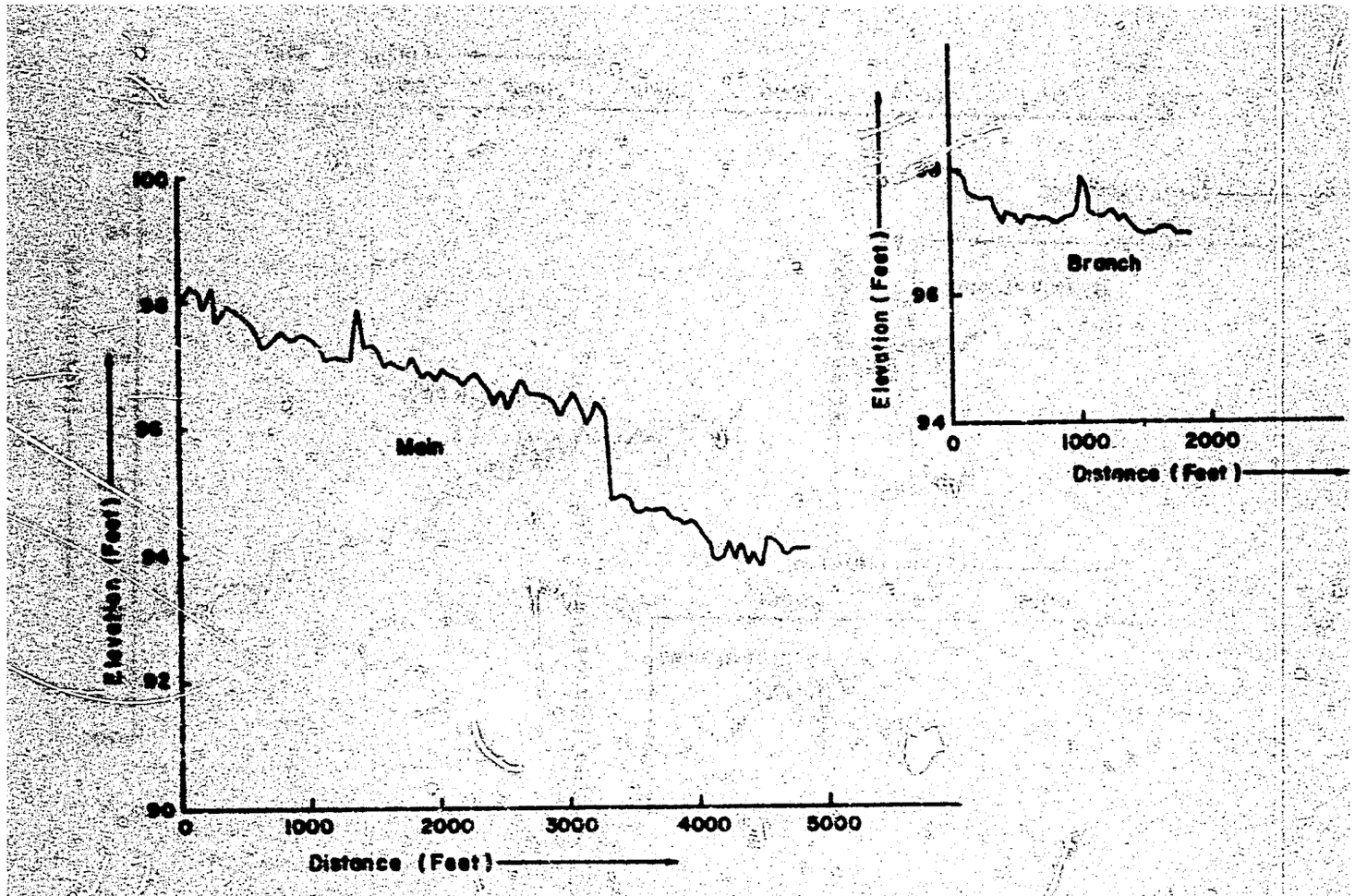


Figure 19. Watercourse Profile– Muzaffargarh W.C. No. I. – Village No. III

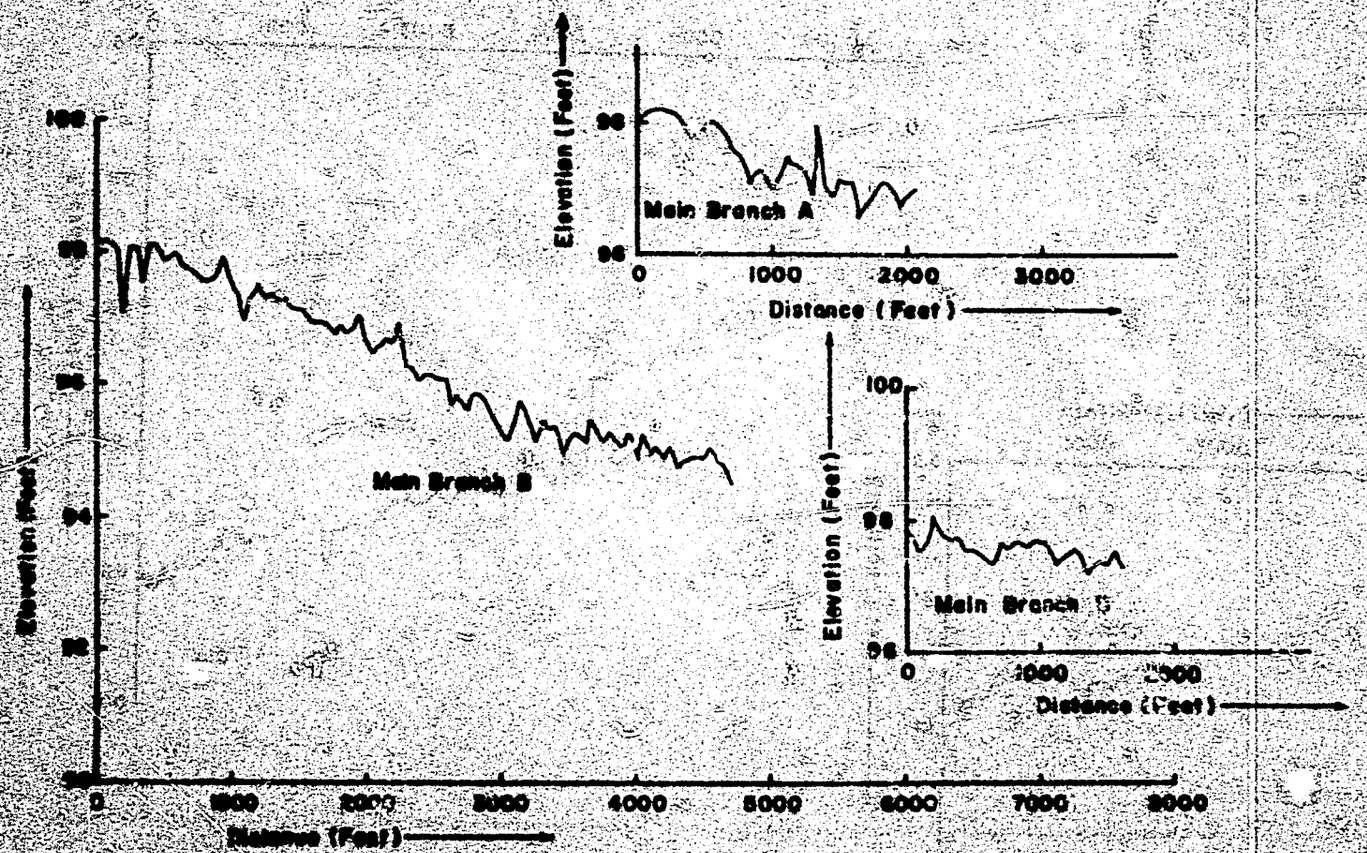


Figure 20. Watercourse Profile – Muzaffargarh W.C. No. 2 – Village No. 111

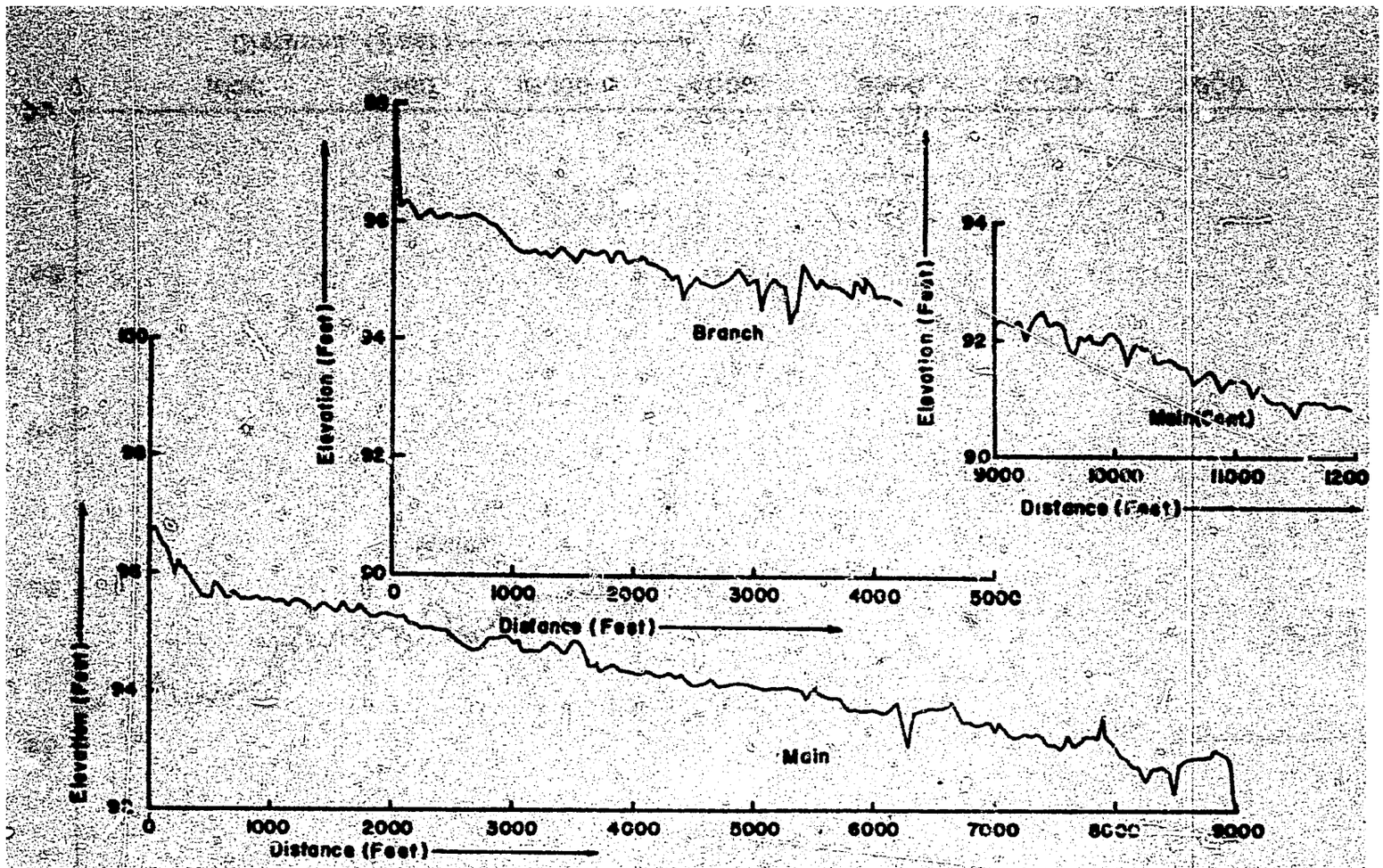


Figure 21. Watercourse Profile – Tharparkar W.C. No. I. – Village No. 112.

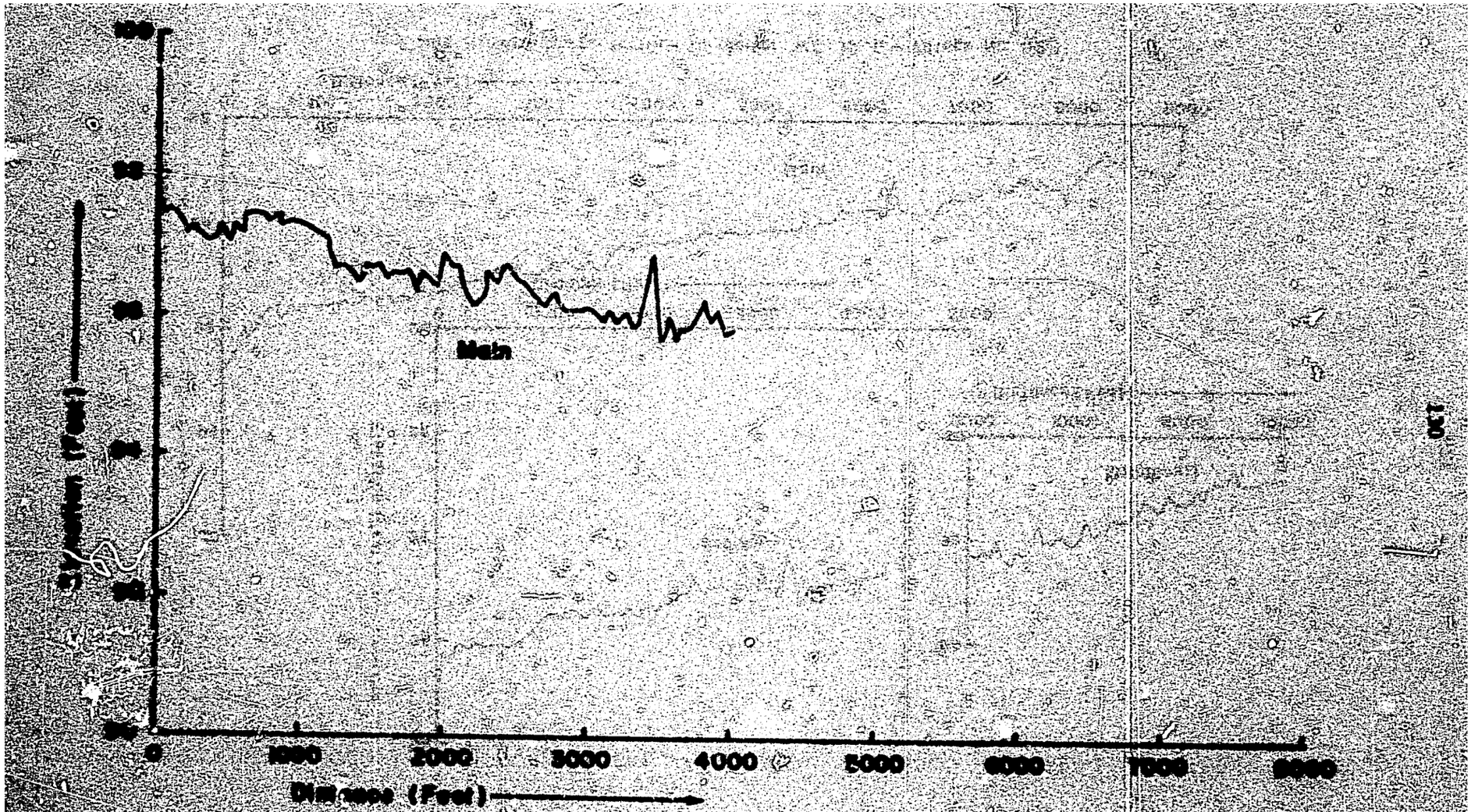


Figure 22. Water Course Profile – Thorpeker W.C. No. 2. – Village No. 112

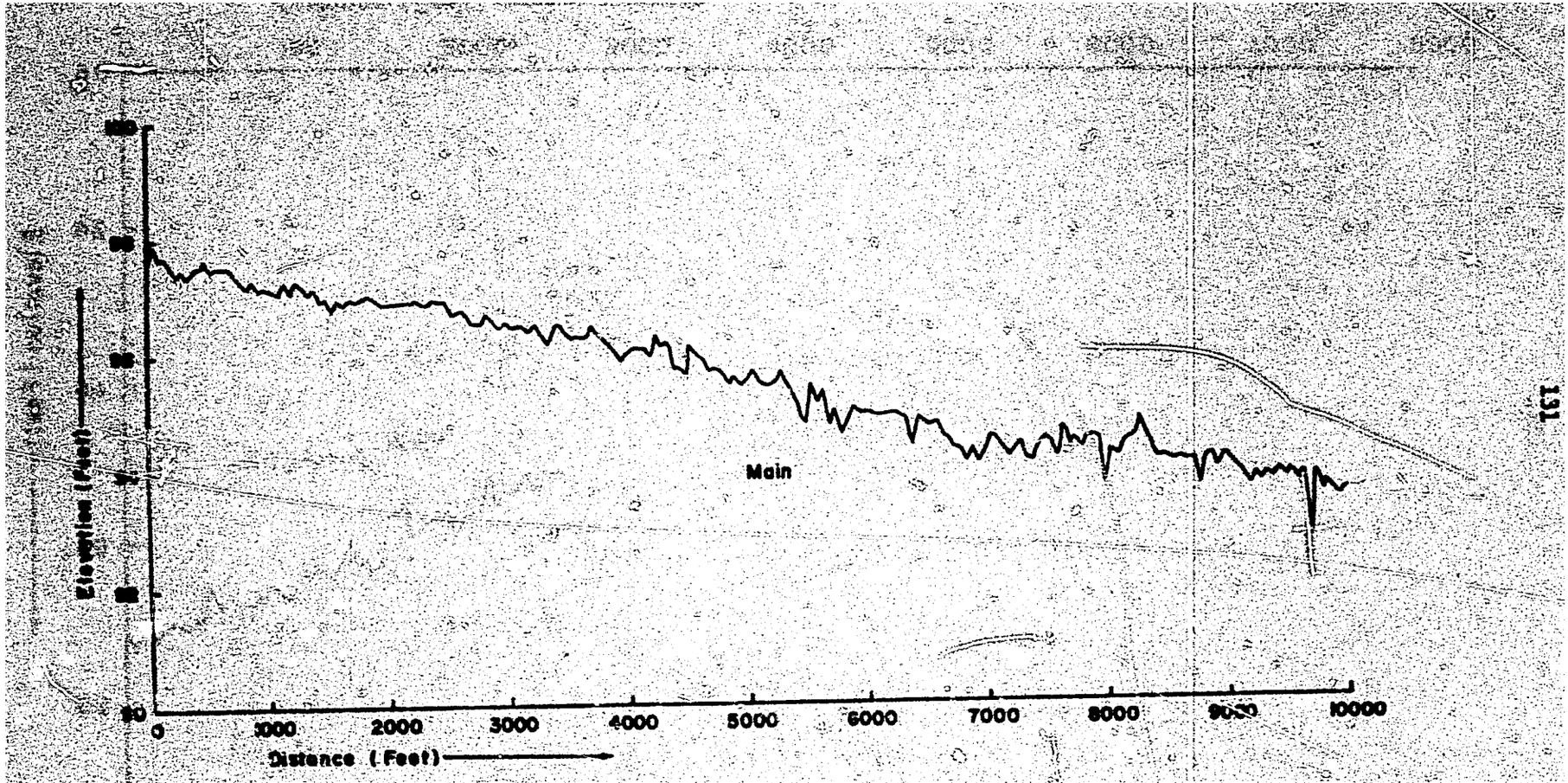


Figure 23. Watercourse Profile - Tharparkar W.C. No. 3. - Village No. 112

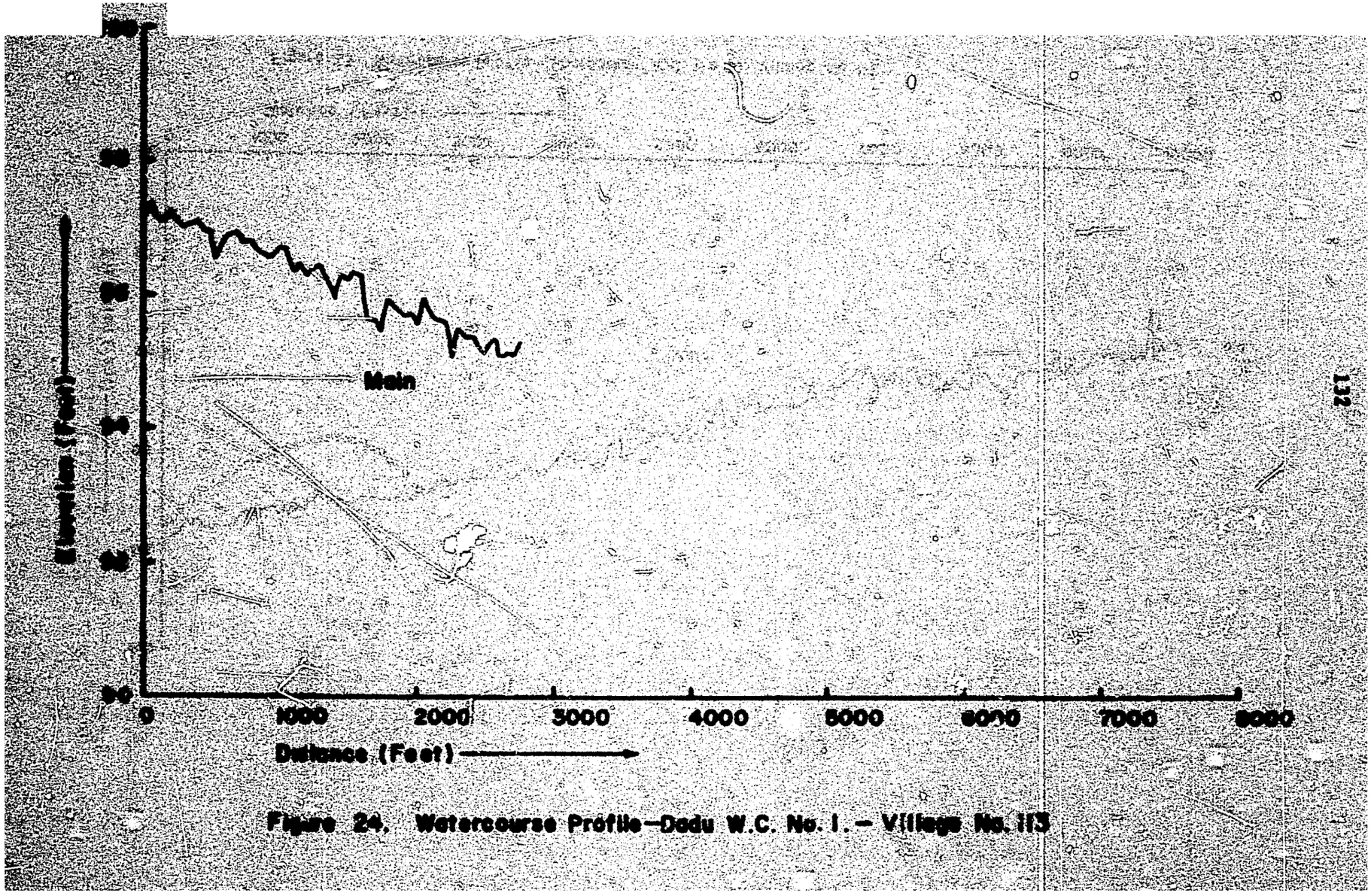


Figure 24. Watercourse Profile—Dadu W.C. No. 1. — Village No. 113

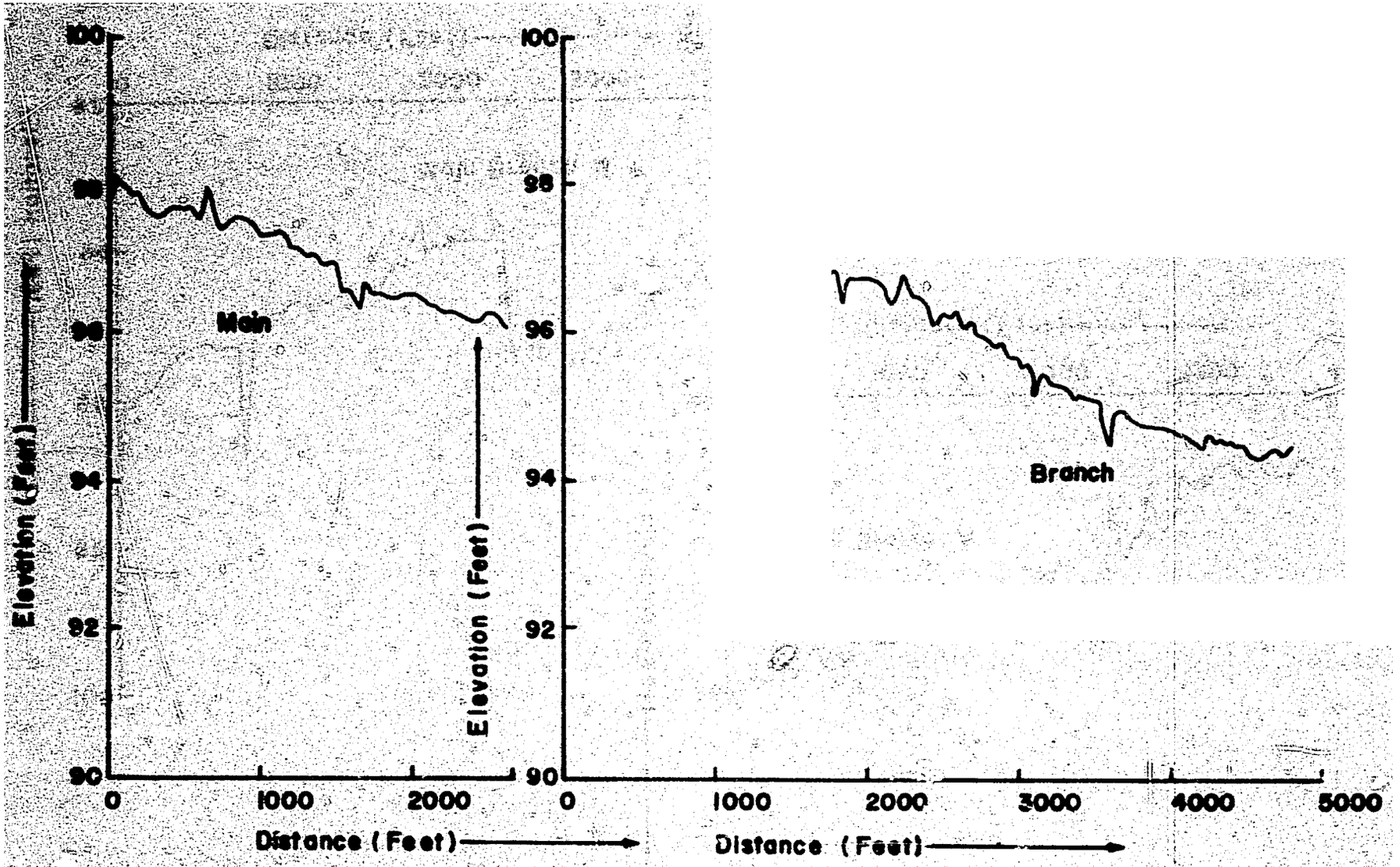


Figure 25. Watercourse Profile–Dadu W.C. No. 2.–Village No. 113.

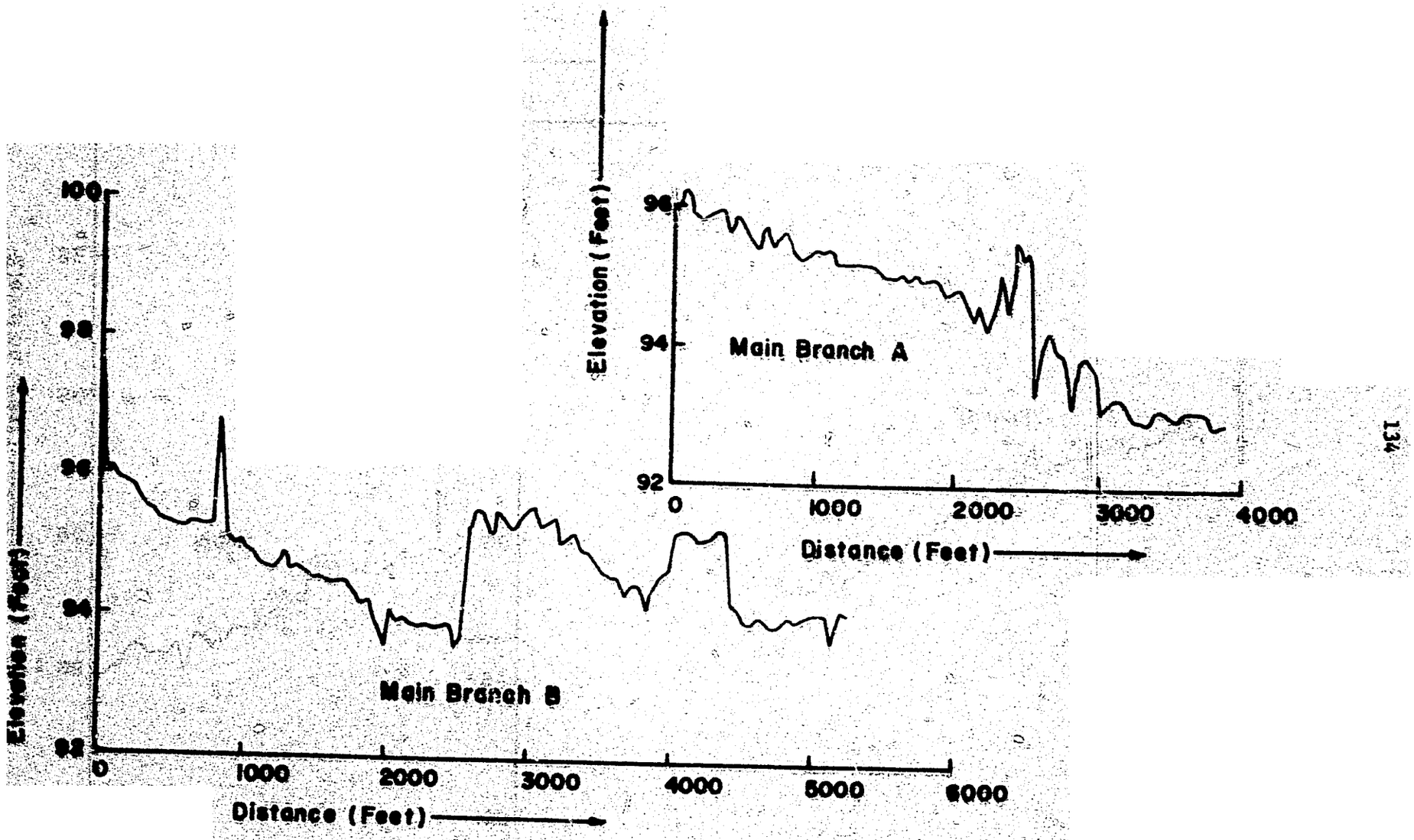


Figure 26. Watercourse Profile—Dadu W.C. No. 3. — Village No. 113

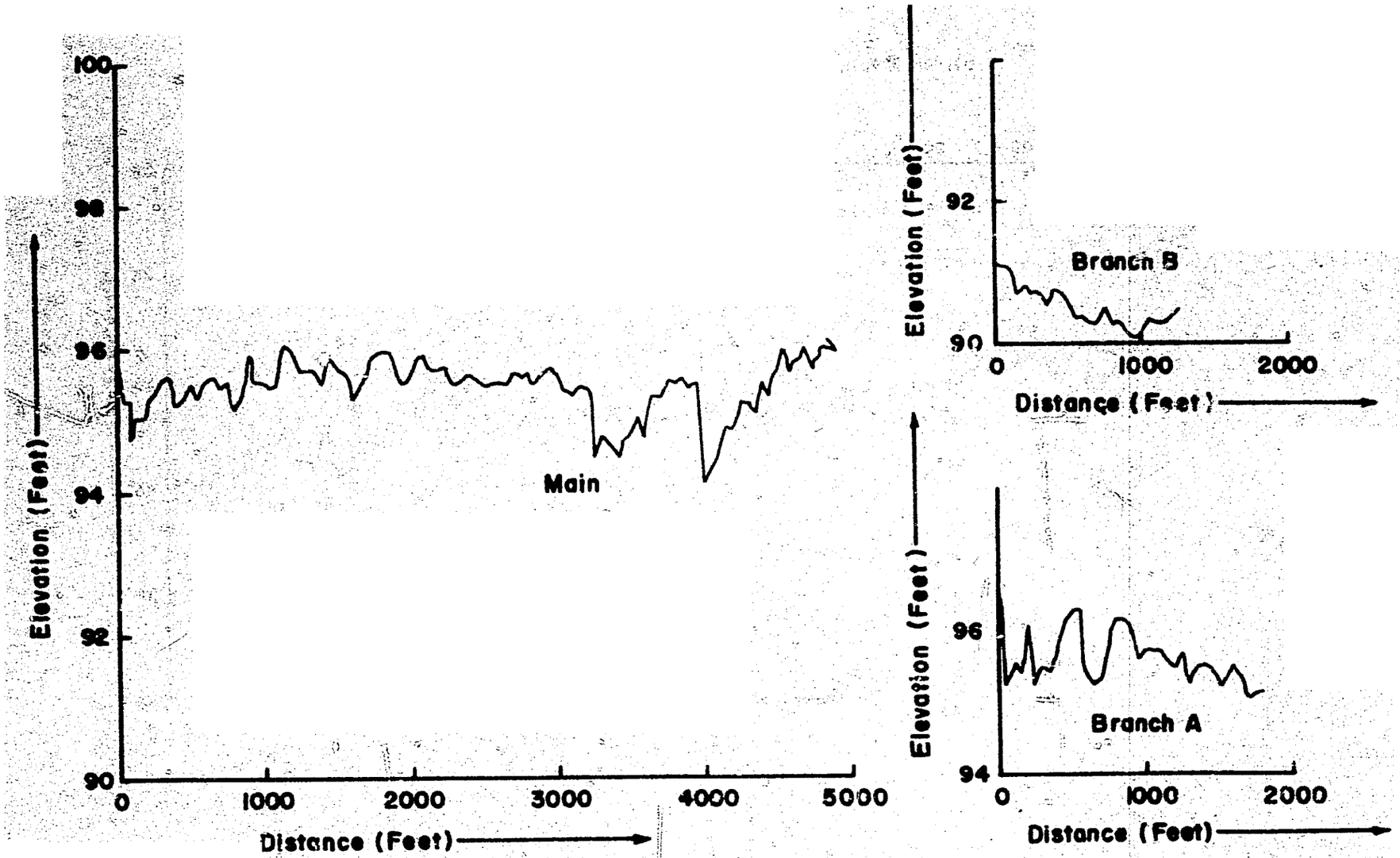


Figure 27. Watercourse Profile—Bahalwalpur W.C. No. I.—Village No. 114

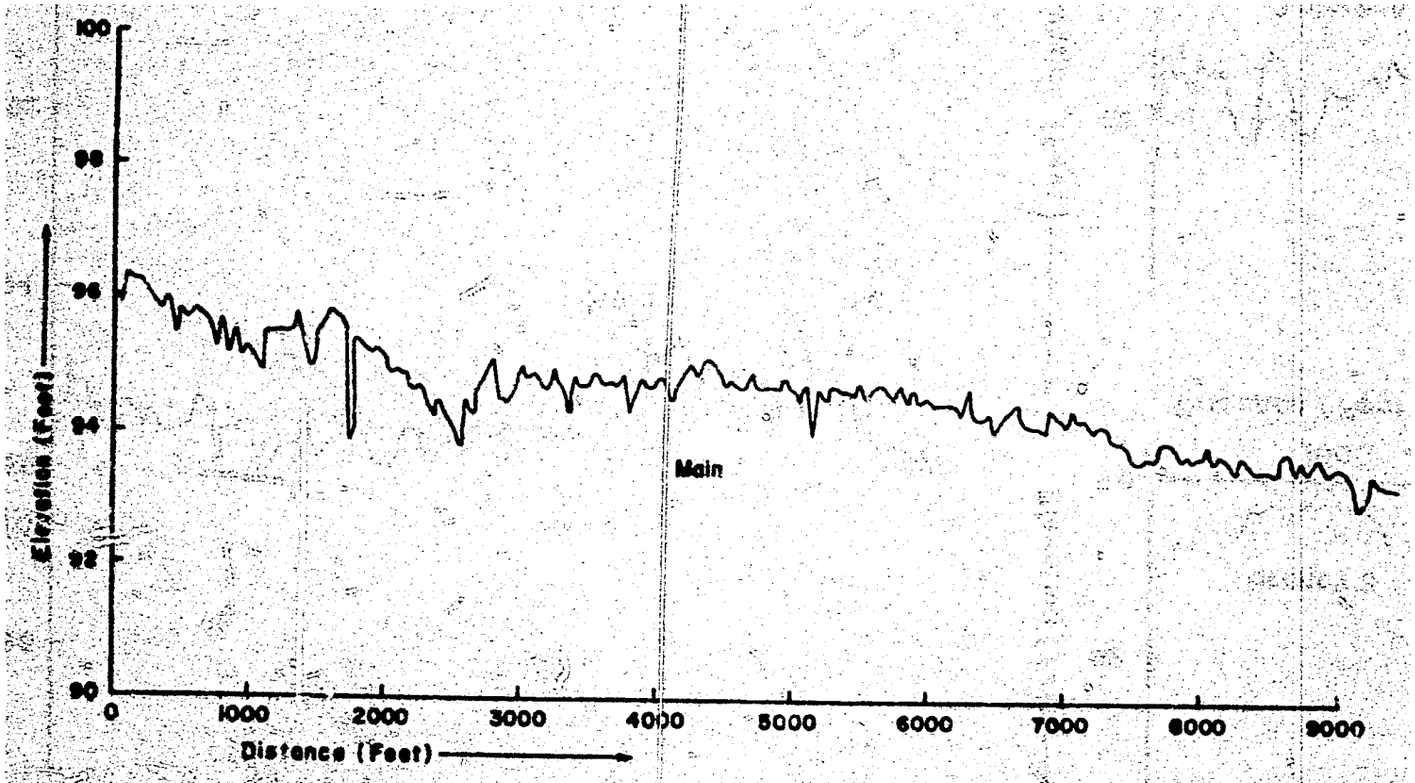


Figure 28. Watercourse Profile—Bahalwalpur W.C. No. 2. - Village No. 114

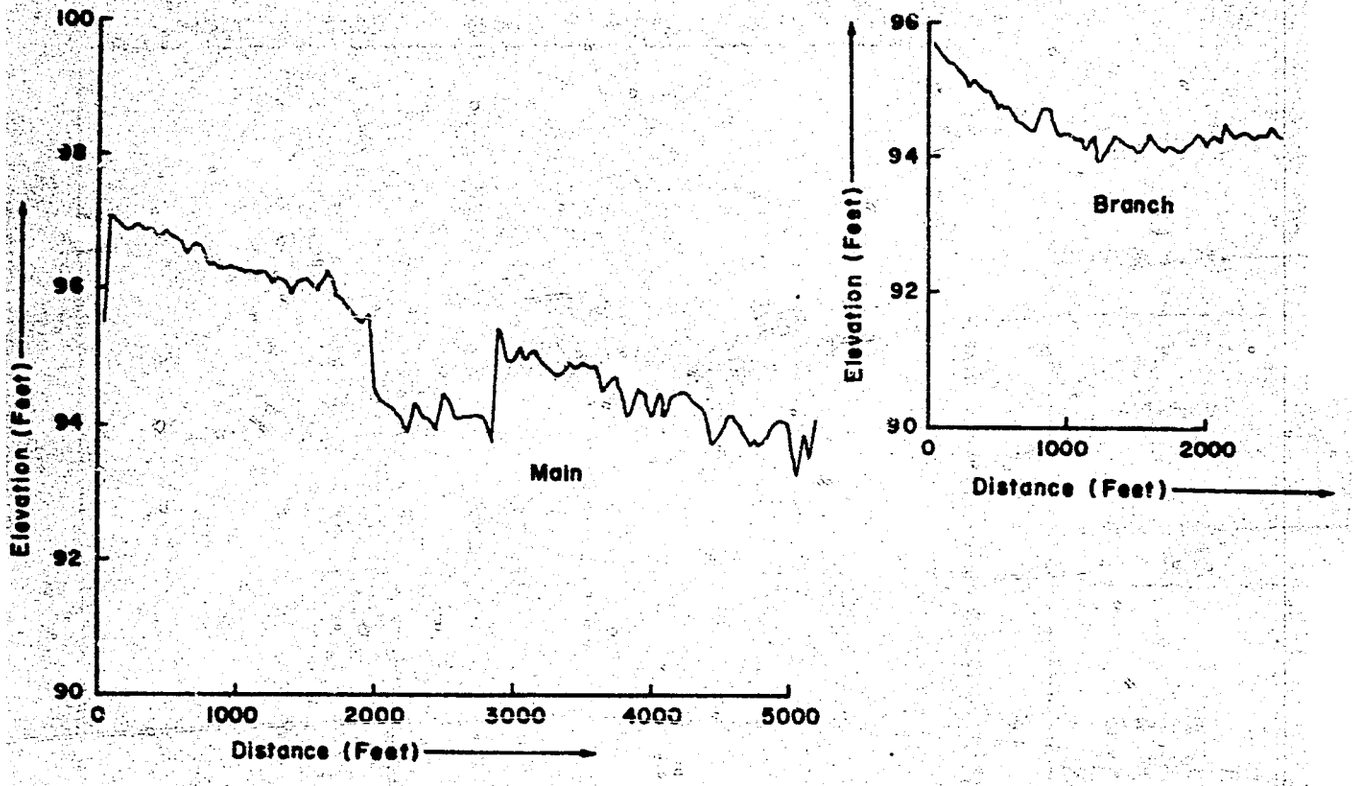


Figure 29. Watercourse Profile—Bahalwalpur W.C. No. 3.—Village No. 114

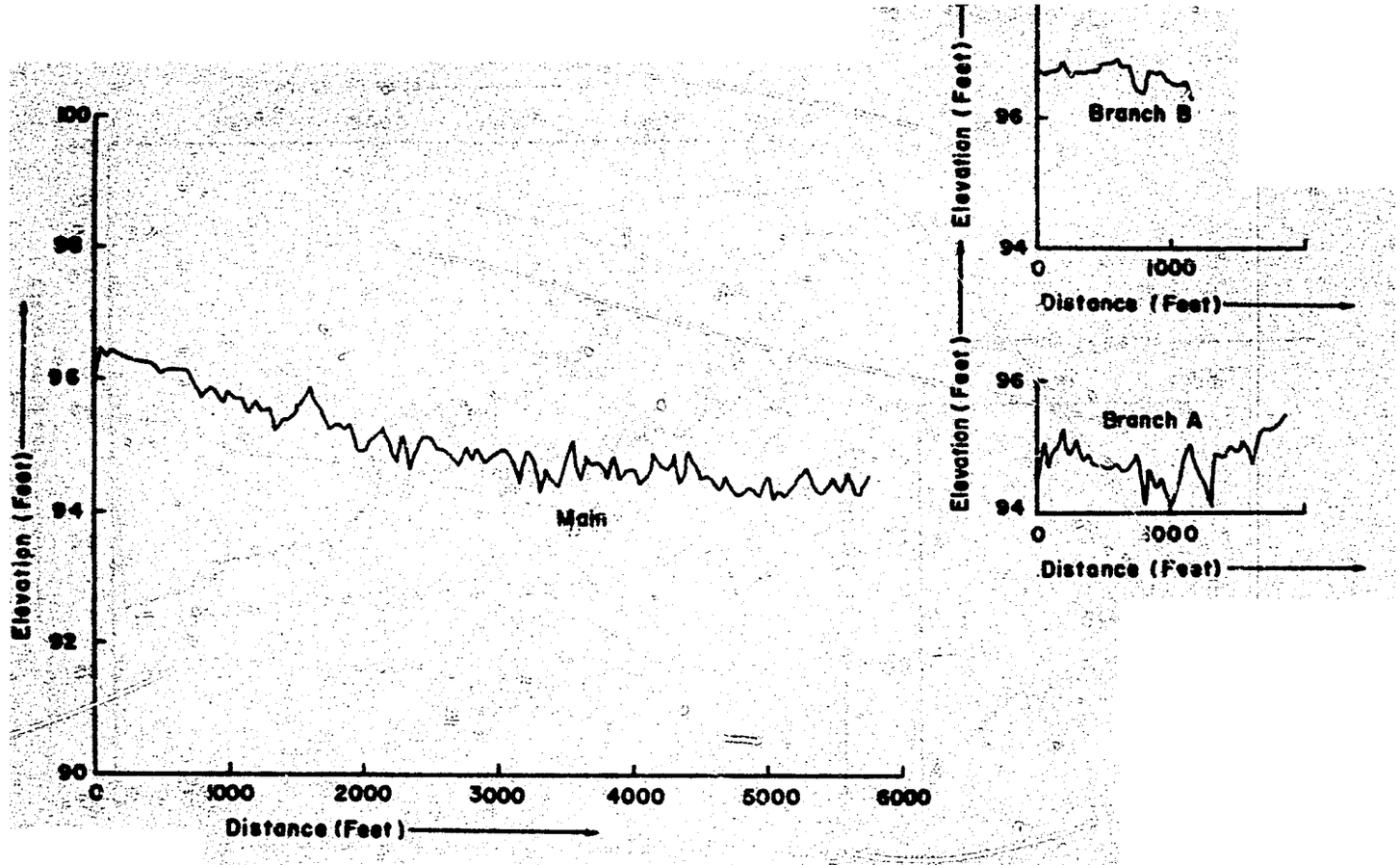


Figure 30. Watercourse Profile—Bahalwalpur W.C. No. 4.—Village No. 114

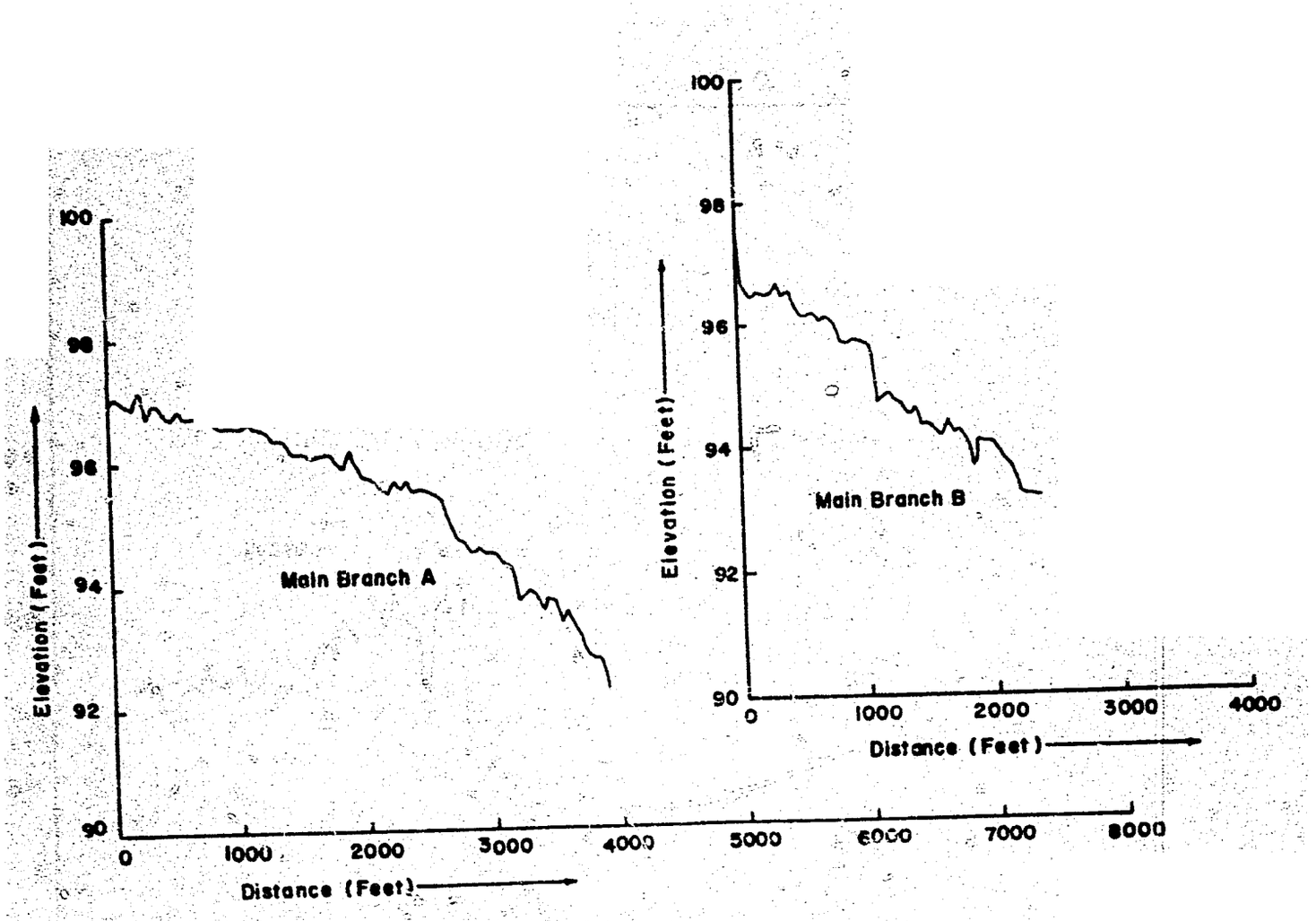


Figure 31. Watercourse Profile-Sukkur W.C. No. 1. - Village No. 115

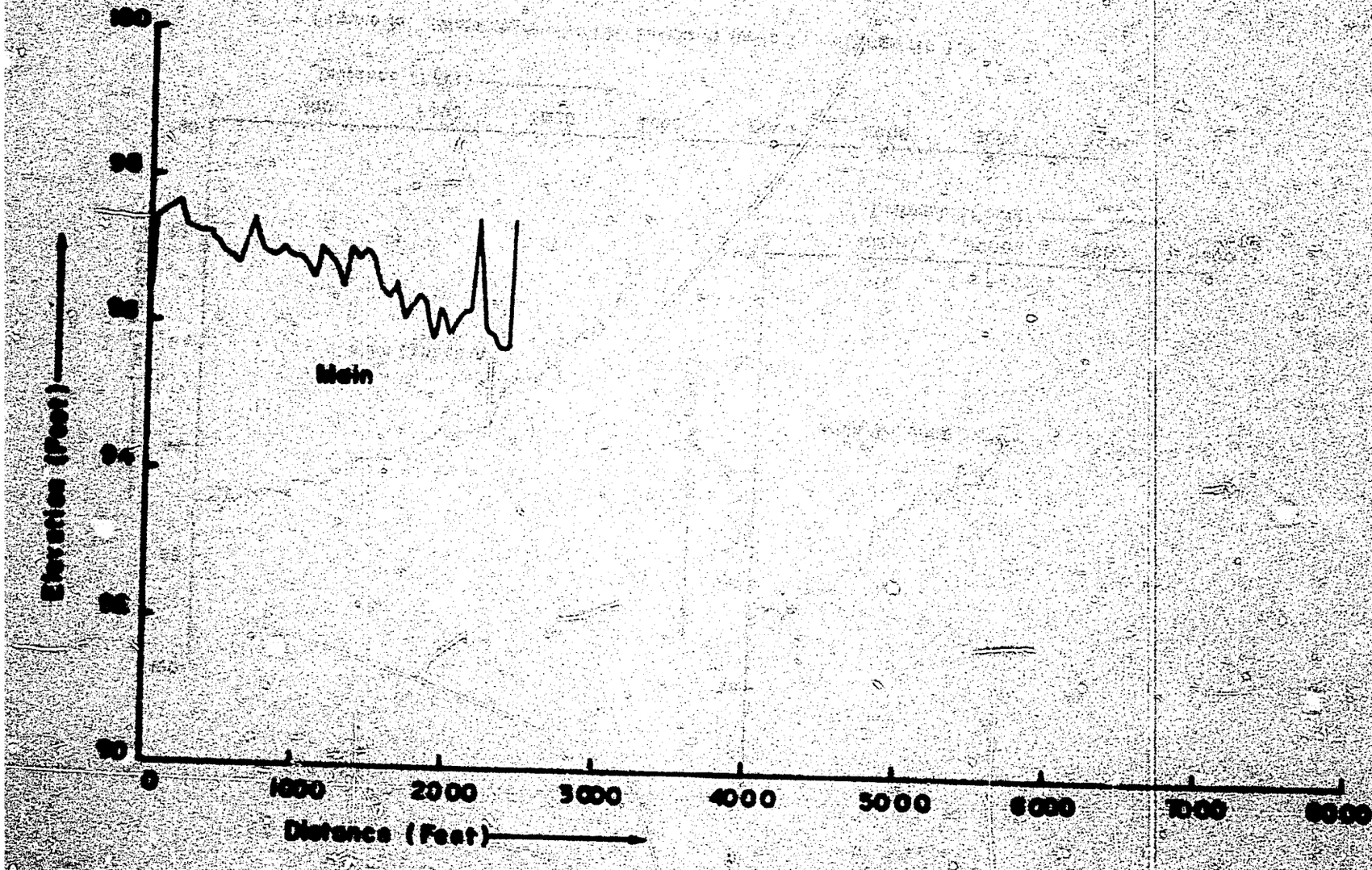


Figure 32. Watercourse Profile—Sukkur W.C. No. 2.—Village No. 115

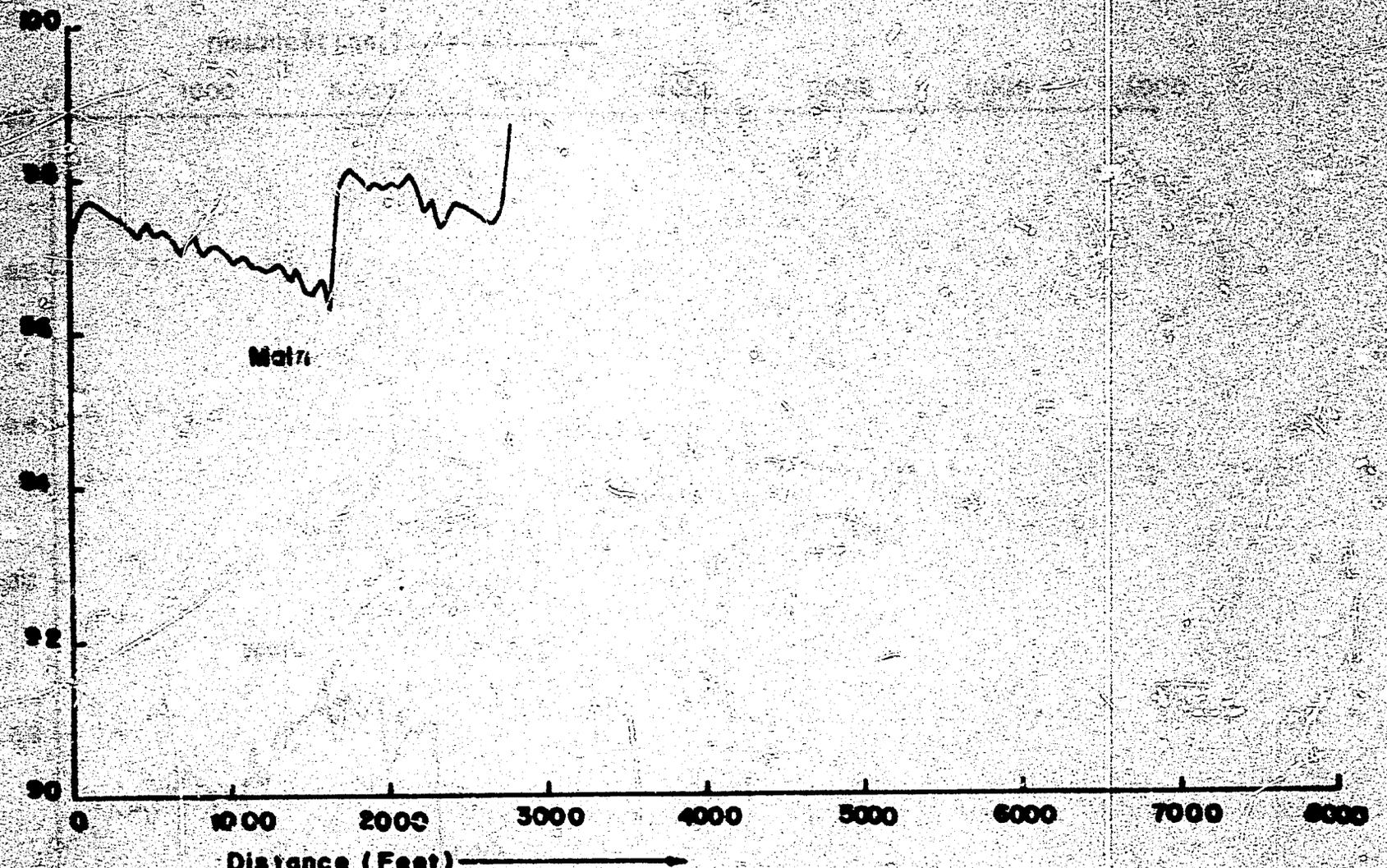


Figure 33. Watercourse Profile - Sukkur W.C. No. 3 — Village No. 115

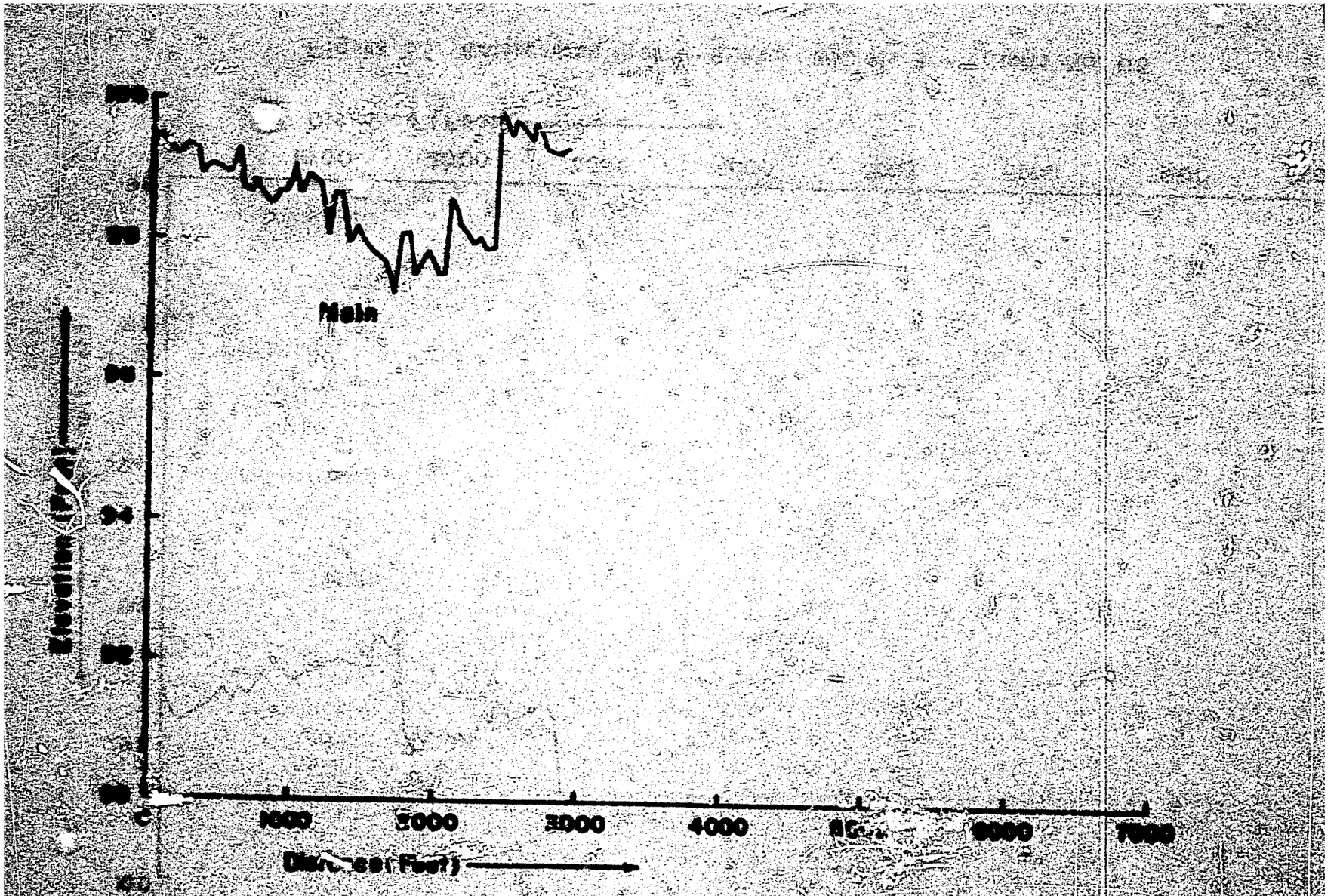


Figure 34. Waterscape Profile – Sakkur W.C. No. 4 – Village No. 115

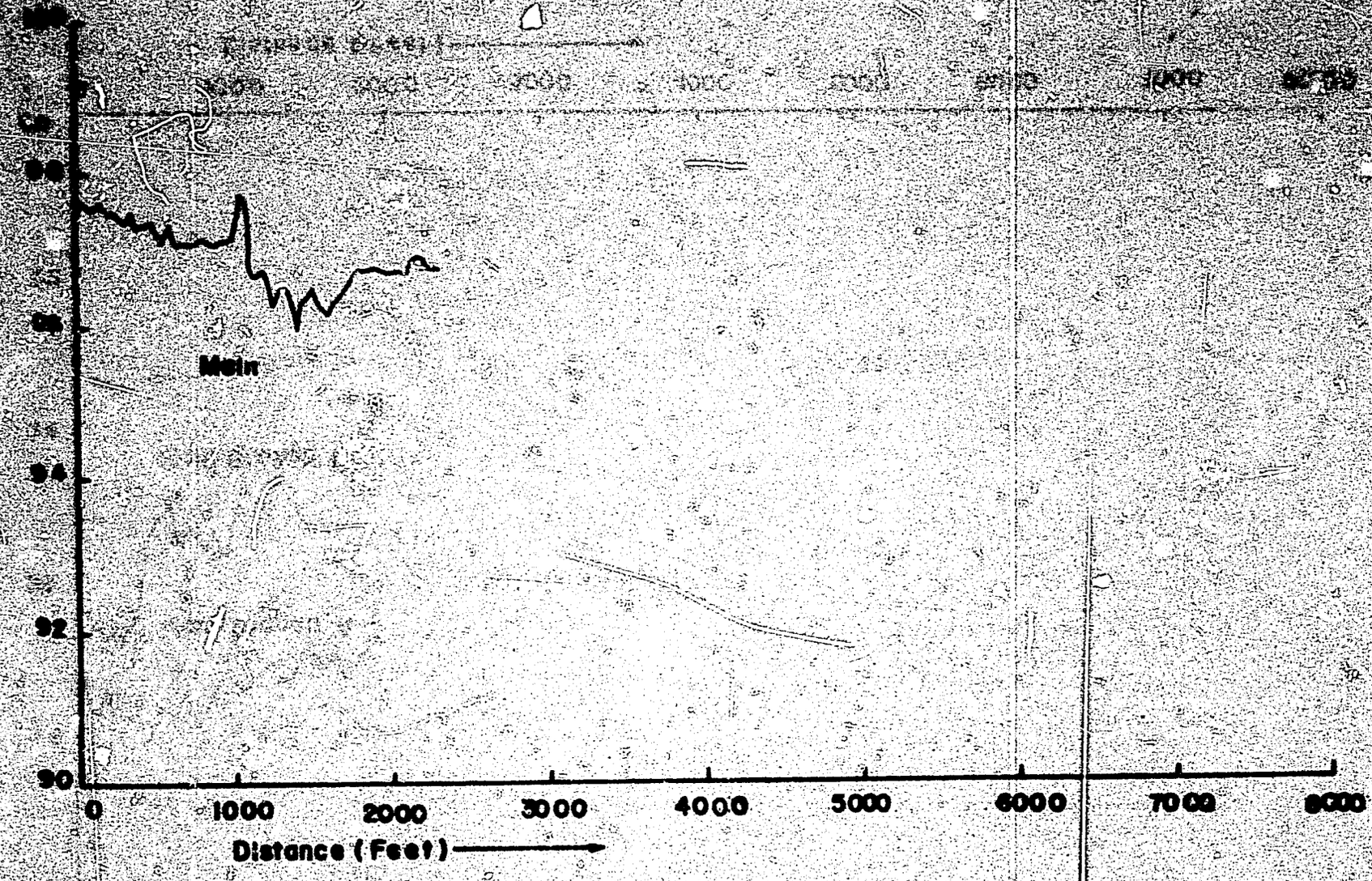


Figure 35. Watercourse Profile—Sukkur W.C. No. 5 —Village No. 115

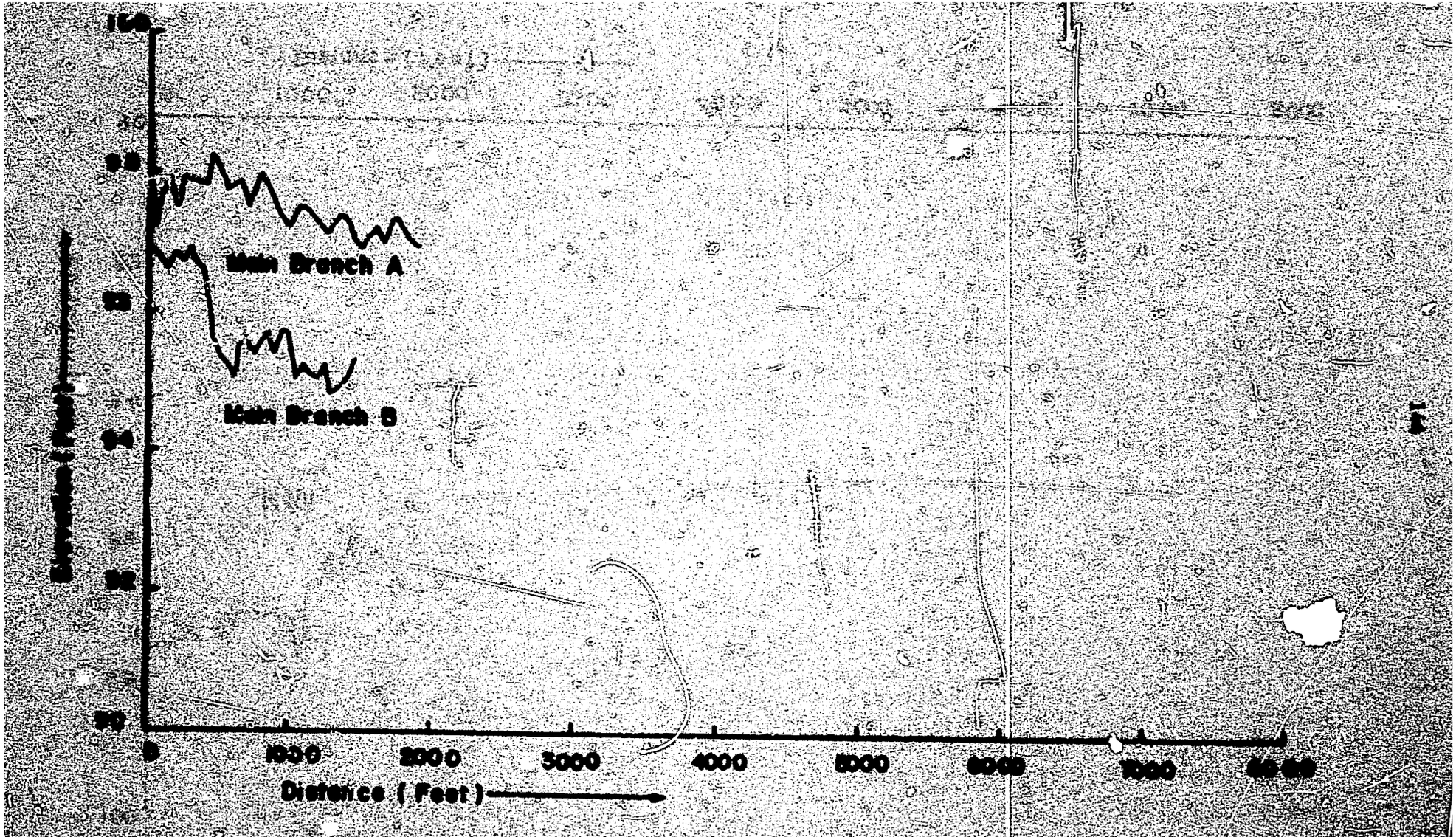


Figure 36. Watercourse Profile – Sukkur W.C. No. 5. – Village No. 115

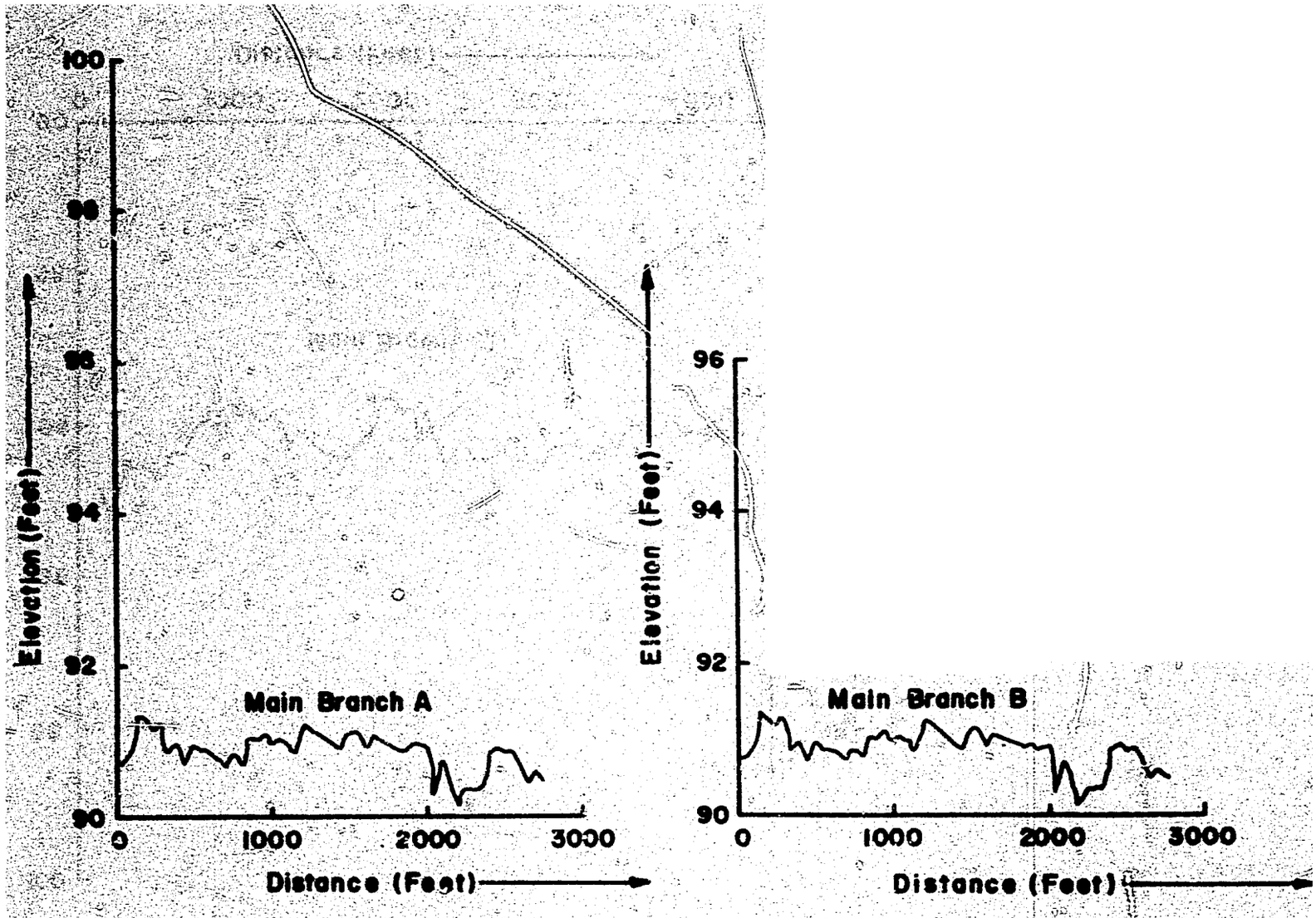


Figure 37. Watercourse Profile – Thatta W.C. No. I. – Village No. 116.

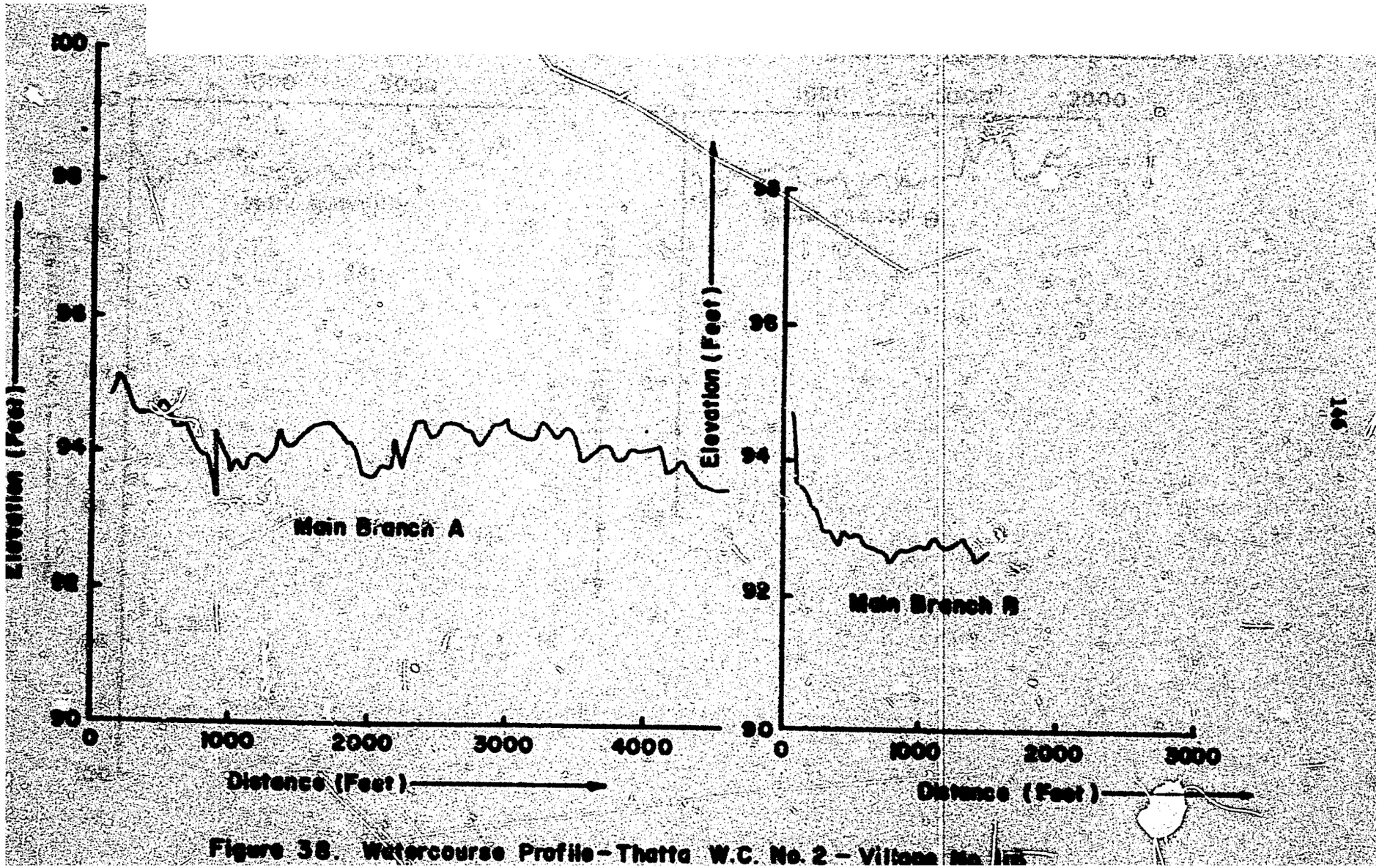


Figure 38. Watercourse Profile - Thatta W.C. No. 2 - Viltana Main

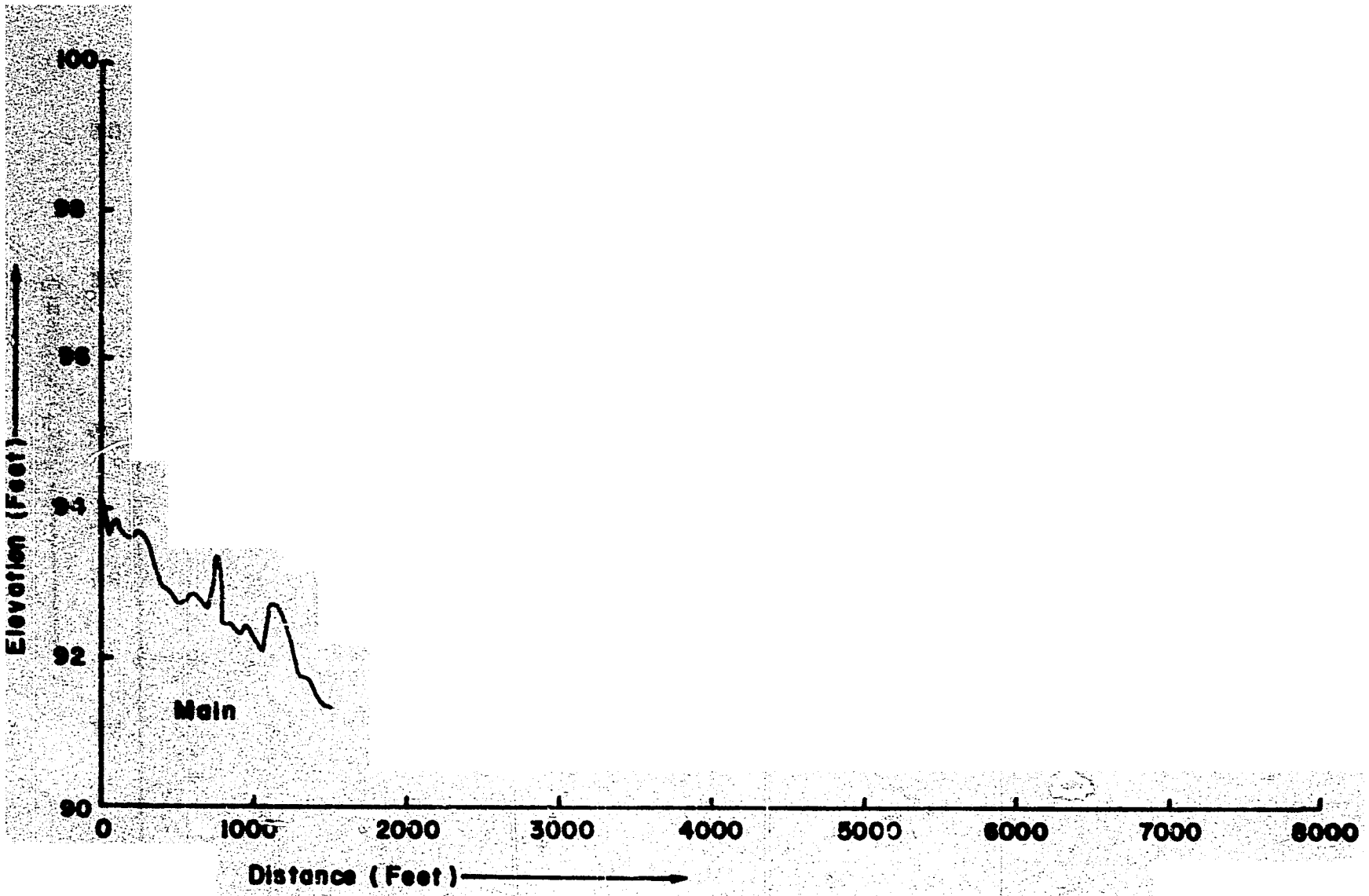


Figure 39. Watercourse Profile– Thatta W.C. No. 3.– Village No. 116.

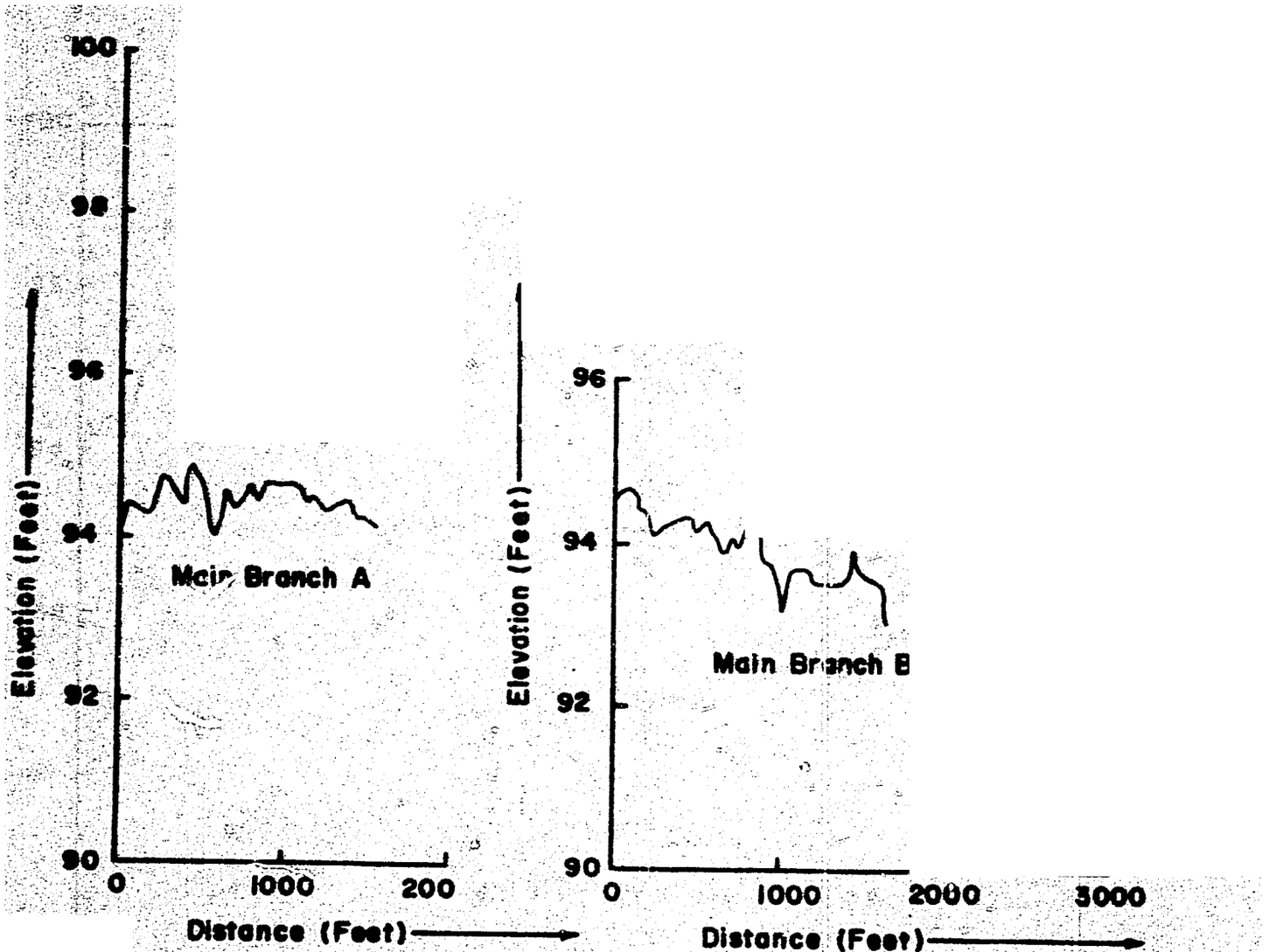


Figure 40. Watercourse Profile – Thatta W.C. No. 4 Village No. 116.

APPENDIX III

SOCIO-ECONOMIC SUMMARY DATA

TABLES A-L

TABLE A VILLAGE LEVEL CROPPING PERCENTAGES FROM CROP SURVEY MAP AND SEASON WHEN DATA GATHERED

Village	% Wheat	% Garden	% Rice	% Vege-table	% Cotton	% Sugar-cane	% Poly	% Fodder	% Other	% Fallow	% Season
101	.1	.8	.4	.4	.5	24.2	.1	12.2	.8	60.5	Rabi/Kharif
102		.2		1.4	8.2	1.7	4.2	13.3		71.0	Rabi/Kharif
103	73.4	.6				.9		11.6	3.9	9.6	Rabi
104	48.4	2.4		.4		.6	2.8	30.5	5.9	9.0	Rabi
105		1.0	22.3	.2	4.1	12.8	5.9	18.7	2.8	32.2	Kharif
106	41.5	1.6			5.0	7.8	8.3	8.6		27.2	Rabi
107			1.4	2.7	31.4	10.7	1.7	32.0	7.6	12.5	Kharif
108		.9	5.3	.2	10.3	12.3	3.2	19.1	.3	48.4	Kharif
109	27.7	7.1		4.2	.1	11.6	20.4	12.8	1.9	14.2	Rabi
110	.3		61.3	1.7	.5	3.5	1.3	5.4	1.3	25.0	Kharif
111	41.3	6.9		.6		1.6	28.9	8.4		12.3	Rabi
112	33.9	.7		1.4	2.1	7.3	2.5	8.1	2.8	41.2	Rabi
113	26.6	.1		3.8		20.2	9.7	16.7	1.0	21.9	Rabi
114	39.2	.6		1.9	10.3	1.0	3.3	13.6	1.8	28.3	Rabi
115	36.9	5.1		2.3	2.1	2.2	6.1	5.7	17.8	21.8	Rabi
116	17.1	.1		7.7			1.7	38.1	2.6	32.7	Rabi

TABLE B DATES WHEN SURVEYS WERE MADE FOR VILLAGE SITES

Village Sites	Dates of Survey	% Fallow	Cropping Season	Farm Operations Taking Place
101 (2wc)	May 15-31, 1975	60.5*	Rabi/Kharif	Wheat → Rice
102 (1wc)	June 1-7, 1975	71.0*	Rabi/Kharif	Wheat → Cotton
103 (1wc)	July 1-7, 1975	9.6	Rabi	Rice Planting Punjab-Nursery May-June Transplant June-Mid August
104 (3wc)	July 8-20, 1975	9.0	Rabi	Rice Planting
105 (1wc)**	July 21-30, 1975	32.2*	Kharif	Rice Planting
106 (1wc)	August 1-7, 1975	27.2*	Rabi	Rice Planting
107 (1wc)	June 8-30, 1975	12.5*	Kharif	Wheat → Cotton
108 (1wc)**	August 8-15, 1975	48.4*	Kharif	Rice Planting
109 (2wc)	August 15-22, 1975	14.2	Rabi	General Cultivation
110 (3wc)	Sept. 23-Oct. 7, 1975	10.0	Kharif	Harvest Preparations Rice → Wheat
111 (2wc)**	Jan. 19-29, 1976	12.3	Rabi	General Cultivation
112 (3wc)	Feb. 26-Mar. 3, 1976	41.2	Rabi	General Cultivation
113 (3wc)	Feb. 18-25, 1976	21.9	Rabi	General Cultivation
114 (4wc)**	Feb. 1-8, 1976	28.3	Rabi	General Cultivation
115 (6wc)**	Feb. 9-16, 1976	21.8	Rabi	General Cultivation
116 (4wc)	March 1-30, 1976	32.7	Rabi	General Cultivation

Due to time of crop survey the percentage of cultivated area fallow mapp is inflated.

* Denotes nonperennial watercourse.

TABLE C SUMMARY OF PERCENTAGE IN SELECTED CROPS MAPPED IN THE CROP SURVEY OF TOTAL WATERCOURSE COMMAND AREAS AT EACH VILLAGE SITE

Village Site and Watercourse Commands	Total Culti-vated Areas	Season of Crop Survey R=rabi K=kharif	Wheat	Garden	Rice	Vege-tables	Cotton	Sugar-cane	Fodder	Other
Perennial										
101-1,2	980.84	R/K		.8	.4	.4	.5	24.2	12.2	.8
102-1	521.66	R/K		.2		1.4	8.2	1.7	13.3	
103-1	149.01	R	73.4	.6				.9	11.6	3.9
104-1,2,3	410.62	R	46.4	2.4		.4		.6	30.5	5.9
106-1	539.70	R	41.5	1.6				7.8	8.6	
107-1,2,3	2053.78	K			1.4	2.7	31.4	10.7	32.0	7.6
109-1,2	730.10	R	27.7	7.1		4.2		11.6	12.8	1.9
110-1,2	912.40	K			61.3	1.7	.5	3.5	5.4	1.3
112-1,2,3	889.40	R	33.9	.7		1.4		7.3	8.1	2.8
113-1,2,3	742.68	R	26.6	.1		3.8		20.2	16.7	1.0
116-1,2,3,4	569.31	R	17.7	.1		7.7			38.1	2.6
Nonperennial										
105-1	457.83	K		1.0	22.3	.2	4.1	12.8	18.7	2.8
108-1	561.22	K		.9	5.3	.2	10.3	12.3	19.1	.3
111-1,2	600.89	R	41.3	6.9		.6		1.6	8.4	
114-1,2,3,4	899.07	R	39.2	.6		1.9		1.0	13.6	1.8
115-1,2,3,4,5,6	725.94	R	36.9	5.1		2.3		2.2	5.7	17.8
Noncommanded										
110-1	119.30	K			76.7			.6	2.4	2.7

Table D Differences in cropping intensities between head and tail farms on watercourse commands and note on supplemental supplies by watercourses.

Water-course number	No. of farms	Head farms	No. of farms	Tail farms	Difference between tail and head, %	Note related to canal water supplements
101-2	3	126	3	110	-16	No supplements Private TW, head=1, middle=1
102-1	3	131	4	119	-12	Private TW, head =1, middle =2, tail
103-1	1	135	1	114	-21	1 private TW at head
104-1	2	171	6	148	-23	No supplements
106-1	4	176	4	131	-45	Public TW at head
107-1	7	163	4	150	-13	Private TW, head=2, middle=3, tail=3
107-2	4	185	6	150	-35	Private TW, head=3, middle=2, tail=3
107-3	5	157	6	154	- 3	Private TW, head=2, middle=2, tail=
108-1	3	101	3	101	0	Public TW head and private TW, middle tail=1
110-2	3	158	3	151	- 7	Private TW, head=0, middle=4, tail=2
111-1	10	130	3	132	+ 2	Public TW at head, Persian wells head=1, middle=1, tail=0
111-2	2	185	4	154	-31	Public TW, Persian wells, head=6, middle=11, tail=7
112-1	1	175	2	153	-22	No supplements
112-3	3	120	4	114	- 6	No supplements
113-2	6	124	1	130	+ 6	No supplements
113-3	2	169	4	162	- 7	No supplements
114-2	4	130	4	130	0	Persian wells, head=3, middle=4, tail=
114-4	3	142	3	138	- 4	Persian wells, head=1, middle=5, tail=
115-2	2	157	2	153	- 4	Persian wells, head=0, middle=0, tail=
115-3	2	183	2	116	-67	Persian wells, head=1, middle=2, tail=
115-4	1	143	2	137	- 6	Persian wells, head=1, middle=2, tail=
116-1	4	169	3	155	-14	No supplements
116-2	1	200	3	164	-36	No supplements
116-4	1	106	1	58	-48	No supplements, tail farm waterlogged

Note: Adjusted measured watercourse position is used. The longest watercourse length was taken at each village site and all commands were adjusted to this in terms of head middle and tail farms.

Table D2 Watercourse showing higher differences between cropping intensities at tail as compared to farms located at head reach of watercourse.

Water-course number	No. of farms	Head location %	No. of farms	Tail location %	Possible explanation and note on supplements to canal supplies
101-1	2	154	2	177	*High water table at tail
104-2	6	146	3	155	No explanation
104-3	1	79	1	79	No data for tail cases
105-1	4	146	2	172	**Watercourse lined
109-1	4	190	2	188	**Earthen watercourse improved
109-2	2	149	1	156	Location of tubewell, tail, sample size small
110-1	3	144	2	174	Locations of private tubewells head=2, middle=8, tail=8
110-3	Noncommanded watercourse with 7 private tubewells, all farmers tabulated at head only due to short distance from tubewells.				
112-2	4	142	3	146	No explanation
113-1	0	NA	4	119	No data for head farmers
114-1	2	108	4	118	***Persian wells located head=0, tail=0, middle=1
114-3	4	100	6	103	***Persian wells located head=3, tail=3, middle=2
115-1	1	117	1	151	Insufficient cases, Persian wells, head=0, middle=0, tail=3
115-5	2	91	4	116	Persian wells located head=0, middle=2, tail=0
115-6	2	140	1	152	Insufficient cases, Persian wells, head=0, middle=0, tail=0
116-3	1	200	1	200	***Insufficient cases

*Observation of waterlogging, drainage system and farmers' reports.
**Denotes commands where watercourses had been improved as experiment by farmers in cooperation with CSU field team researchers.
***Also high water table at head.

TABLE E. SAMPLE FARMERS WHO OWN PRIVATE TUBEWELLS

INDIVIDUALLY OR JOINTLY BY VILLAGE SITES

By Watercourse	Total Tube-wells	Electric Powered Delivery Pipe Size Inches			Diesel Powered Delivery Pipe Size Inches		
		Less 5"	5"	6"	Less 5"	5"	6"
102-1	3	1	1	-	-	1	-
103-1	1	-	1	-	-	-	-
104-1	1	-	-	-	-	-	1
106-1	1	-	-	-	-	1	-
107-1	13	-	-	-	-	9	4
-2	5	-	-	-	-	3	2
-3	5	-	-	-	1	4	-
108-1	1	-	-	1	-	-	-
110-1	4	-	-	-	-	1	3
-2	1	-	-	-	-	1	-
-3	2	2	-	-	-	-	-
111-2	1	1	-	-	-	-	-
114-1	2	-	-	-	-	2	-
115-1	3	3	-	-	-	-	-
115-2	1	1	-	-	-	-	-
115-3	1	1	-	-	-	-	-
115-5	1	1	-	-	-	-	-
115-6	1	1	-	-	-	-	-
TOTAL	47	11	2	1	1	22	10

TABLE F. ENGINEERS' ESTIMATES OF TYPES OF MAJOR SOURCES OF LOSSES AT 28 SITES WHILE MAKING IRRIGATION EVALUATIONS*

Village Sites	# Cases	Leaks and Spills	Over-Top-ping	Seep-age	Dead Stor-age	Basin Over-flows	No Major Leaks Apparent
Perennial							
109-2wc	8	50.0	12.5	37.5	-	-	-
110-3wc	24	37.5	20.8	37.5	4.2	-	-
112-3wc	31	58.1	12.9	12.9	16.1	-	-
113-3wc	22	54.5	22.7	13.6	-	-	9.0
116-4wc	21	38.1	14.3	14.3	28.6	-	4.8
Nonperennial							
105-1wc	5	20.0	-	-	-	80.0	-
111-2wc	23	39.1	43.5	17.4	-	-	-
114-3wc	32	25.0	43.8	21.9	9.4	-	-
115-6wc	34	58.8	11.8	26.5	-	-	2.9
TOTAL (26wc)	200	45.4	22.4	21.5	6.1	2.3	2.3

* Note that for 12 wc commands these check lists were not maintained. They were introduced late in the field survey.

TABLE G

ENGINEERS' OBSERVATIONS OF METHODS FARMERS USED TO STOP IRRIGATIONS AT TWENTY-FOUR SITES

Village Sites	# Farms	When Basin Filled (Water Reaches Far Border)	When Few Marlas Left Before Water Reaches Far Border	Irrigation of Field Non Completed Due to Completion of Turn	When High Spots Covered	Farmer Went Away
Perennial						
109-2wc	8	87.5	-	12.5	-	-
110-3wc	23	56.5	13.0	26.1	4.3	-
112-3wc	30	83.3	10.0	6.7	-	-
113-3wc	22	59.1	13.6	22.7	4.5	-
Nonperennial						
10[illegible]-1wc	5	80.0	20.0	-	-	-
11[illegible]-2wc	22	54.5	13.6	22.7	-	9.1
114-4wc	33	66.7	9.1	21.2	3.0	-
115-6wc	37	91.9	2.7	5.4	-	-
TOTALS (24)	180	72.2	9.4	15.6	1.6	1.2

TABLE II. NUMBER OF FARMERS AND MARKET WHEAT, RICE, AND COTTON IN VILLAGE AND MARKET AND THOSE WHO DO NOT MARKET. (NO CULTIVATION AT SITE DENOTED BY X)

Village Sites	Total Sample Farmers	Marketing of Wheat (Place)				Marketing of Rice (Place)				Marketing of Cotton (Place)			
		# Cult.	NONE	Primarily Village	Primarily Market	# Cult.	NONE	Primarily Village	Primarily Market	# Cult.	NONE	Primarily Village	Primarily Market
101 (b)	15	14	-	7	7	4	1	1	2	11	3	1	7
102 (b)	9	9	-	3	6	0	-	-	-	9	-	4	5
103 (b)	16	16	4	6	6	7	5	1	1	12	-	6	6
104 (a)	36	35	14	17	4	34	14	15	5	12	9	3	-
105 (b)	8	8	0	7	1	8	1	6	1	6	1	4	1
106 (b)	12	11	0	5	6	11	-	4	7	11	-	7	4
107 (d)	55	54	1	50	3	0	-	-	-	54	-	51	3
108 (e)	9	8	1	5	2	8	2	3	3	8	1	5	2
109 (c)	14	14	1	11	2	12	4	5	3	13	1	10	2
110 (c)	27	24	2	2	20	27	-	1	26	2	2	-	-
111 (b)	24	23	7	10	6	20	4	13	3	20	3	14	3
112 (c)	34	29	2	1	26	5	4	1	-	29	1	2	26
113 (b)	26	23	3	15	7	5	2	-	3	12	-	7	5
114 (b)	39	34	8	16	10	17	14	1	2	33	2	19	12
115 (a)	32	32	3	6	23	10	4	-	6	15	3	1	11
116 (b)	26	16	6	1	9	23	-	4	19	0	-	-	-
TOTAL NO.	389	352	52	162	138	191	55	53	81	247	26	134	87
Percent Cultivating		90				49				63			
Percent No Sales			15				29				11		
Percent Primarily Village Sales				46				29				54	
Percent Primarily Market Sales					39				42				35

(a) Denotes market under 2 miles, (b) Denotes market 2 to under 5 miles, (c) Denotes market 5 to under 7.5 miles, (d) Denotes market 7.5 to under 10 miles, (e) Denotes market 10 to under 15 miles.

Table I

Comparison of Crop Dominant Watercourses

With Marketing of Fodder and Milk

Crop Dominant Watercourses	Marketing of Fodder				Marketing of Milk			
	No. of Farms	No Sales	Sales in Village	Sales in Market	No. of Farms	No Sales	Sales in Village	Sales in Market
		%	%	%		%	%	%
Fodder Dominant* (Rice w/ Wheat)	74	44.6	20.2	33.8	72	43.0	34.8	22.2
103	16	56.2	6.2	31.3	13	53.8	38.5	7.7
104	36	58.3	33.3	8.3	35	11.4	57.2	31.4
116	22	13.6	9.1	77.3	24	83.3	0.0	16.7
Cotton-Wheat*	118	89.8	6.8	3.4	125	93.6	4.0	2.4
102	9	100.0	0.0	0.0	9	100.0	0.0	0.0
107	54	96.3	3.7	0.0	54	100.0	0.0	0.0
112	20	90.0	0.0	10.0	27	96.3	0.0	3.7
114	35	77.1	17.2	5.7	35	80.0	14.3	5.7
Rice-Wheat*	63	84.1	3.2	12.7	60	88.3	0.0	11.7
110	27	92.6	3.7	3.7	27	100.0	0.0	0.0
115	36	77.8	2.8	19.4	33	78.8	0.0	21.2
Sugarcane-Wheat*	39	89.7	2.5	7.7	32	93.8	3.1	3.1
101	15	73.3	6.6	20.0	8	75.0	12.5	12.5
113	24	100.0	0.0	0.0	24	100.0	0.0	0.0
Mixed Crops* and Orchards	59	76.3	22.0	1.7	63	88.9	9.5	1.6
105	8	75.0	25.0	0.0	8	87.5	12.5	0.0
106	12	75.0	25.0	0.0	11	90.9	9.1	0.0
108	8	87.5	12.5	0.0	8	87.5	12.5	0.0
109	14	92.9	7.1	0.0	14	100.0	0.0	0.0
111	17	58.8	35.3	5.9	22	81.8	13.6	4.5
Totals*	353	77.0	11.0	11.6	352	81.5	10.3	7.9

*Weighted totals.

TABLE J. FARM SIZE AND TENURE CLASSES AND AVERAGE NUMBER OF FARM ANIMALS OWNED FOR EACH CLASS

Farm Characteristics	# of Farms	Bullocks	# of Farms	Milk	# of Farms	Calves	# of Farms	Goats and Sheep
		% of Farms		% of Farms		% of Farms		% of Farms
Farm Size Classes (Acres)								
12 Under 2.5	68	1.8	68	1.8	61	1.2	62	3.8
0 2.5-7.49	91	2.0	93	2.6	87	1.8	77	2.5
2 7.5-12.49	96	2.6	98	3.6	93	2.4	77	3.7
10 12.5-24.99	87	3.3	87	3.7	82	2.7	72	5.3
7 25.0-49.99	17	2.8	17	4.8	16	3.4	15	6.7
2 50.0 & Above	8	3.2	7	7.3	5	6.4	4	3.5
Tenure Classes								
9 Owners	244	2.5	249	3.5	229	2.3	204	3.9
2 Owner-Cum Tenants	55	2.9	54	2.8	51	1.9	45	5.0
1 Contractors	2	2.0	2	1.5	2	1.5	2	.5
0 Tenants	66	2.3	65	2.5	62	2.0	56	3.3
Overall Weighted Totals	367	2.5	370	3.2	244	2.2	3.7	3.9

TABLE [illegible] (Continuation) FARM SIZE AND TENURE CLASSES AND TOTAL NUMBER OF ANIMALS OWNED BY EACH CLASS

Farm Characteristics	# of Farms	Number of Camels Owned	# of Farms	Number of Donkeys Owned	# of Farms	Number of Horses Owned
Farm Size Classes (Acres)						
Under 2.5	25	0	8	3	12	0
2.5-7.49	46	3	14	6	23	2
7.5-12.49	44	9	13	5	14	1
12.49-24.99	34	6	18	11	12	7
25.0-49.99	4	1	2	2	2	2
50.0 and Above	1	0	1	1	0	0
Tenure Classes						
Owners	103	12	35	19	42	9
Owner-Cum-Tenants	26	7	6	1	9	2
Contractors	1	0	1	1	0	0
Tenants	24	0	14	7	12	1
Overall Weighted Totals	154	19	56	28	63	12

TABLE K. PERCENTAGE OF BULLOCKS, MILCH ANIMALS AND CALVES BY VILLAGE SITES

	Percentages of Farms with Following Numbers of Animals														
	Number of Bullocks					Number of Milch Animals					Number of Calves				
	# of Farms	0	1-2	3-4	5 or More	# of Farms	<3	4-5	6-7	8 or More	# of Farms	<3	4-5	6-7	8 or More
101-2wc	15	-	60	20	20	15	67	13	13	7	11	2	18	-	-
102-1wc	9	-	78	22	-	9	78	22	-	-	5	80	20	-	-
103-1wc	10	-	80	20	-	14	57	36	-	7	10	80	10	10	-
104-3wc	30	17	63	20	-	35	57	29	9	5	31	77	23	-	-
105-1wc	8	-	75	13	12	7	43	14	29	14	7	43	43	14	-
106-1wc	12	8	50	33	9	12	33	25	25	17	11	55	45	-	-
107-1wc	53	15	58	21	6	53	75	15	6	4	52	88	8	2	2
108-1wc	9	22	34	22	22	9	22	44	11	23	9	44	44	-	12
109-1wc	13	23	46	15	16	13	38	31	8	23	13	39	46	15	-
110-3wc	26	8	69	12	11	26	69	23	8	-	26	81	11	8	-
111-2wc	22	5	41	36	18	23	87	13	-	-	22	91	5	5	-
112-3wc	33	27	43	15	15	32	84	-	13	3	31	94	3	-	3
113-3wc	26	-	69	23	8	26	46	42	8	4	26	73	19	4	4
114-4wc	39	10	67	15	8	38	79	8	8	5	38	84	13	3	-
115-6wc	38	16	50	21	13	39	69	15	5	11	36	89	11	-	-
116-4wc	24	-	58	33	9	19	79	10	5	6	16	94	-	-	6
Weighted Totals	367	11	58	26	10	370	67	19	8	6	344	81	15	3	1

Note: Since there are only 19 camels, 28 donkeys and 12 horses on the sample farm, they are not included. Also, goats and sheep are not given because they forage primarily for fodder.

TABLE L. NUMBER OF FARMERS OWNING VARIOUS NUMBERS OF SHEEP-GOAT AND POULTRY UNITS

Village Sites	Number of Farmers With Number of											
	Sheep & Goats					Poultry Units						
	# of Farms	0	1-5	6-11	12 or More	# of Farms	0	1-5	6-11	12-17	18-23	24 or More
101	13	-	9	3	1	15	-	6	3	3	1	2
102	7	-	7	-	-	9	-	4	-	1	-	4
103	8	-	4	1	3	16	-	7	2	-	-	7
104	22	8	11	3	-	36	10	10	2	-	-	14
105	6	-	5	1	-	8	-	5	-	-	-	3
106	7	-	4	1	2	12	-	7	2	-	-	3
107	42	9	31	1	1	55	2	11	2	5	1	34
108	8	1	6	1	-	9	-	2	5	-	-	2
109	12	1	10	1	-	14	-	2	2	1	1	8
110	15	4	8	2	1	27	1	8	2	1	-	15
111	20	9	6	4	1	24	7	12	2	1	-	2
112	32	16	11	-	5	34	15	12	2	3	-	2
113	26	8	14	2	2	26	9	11	3	-	1	2
114	37	11	22	2	2	39	14	15	1	1	-	8
115	38	13	21	3	1	39	13	17	4	2	1	2
116	14	11	2	1	-	26	11	-	-	1	-	14
	N=307											

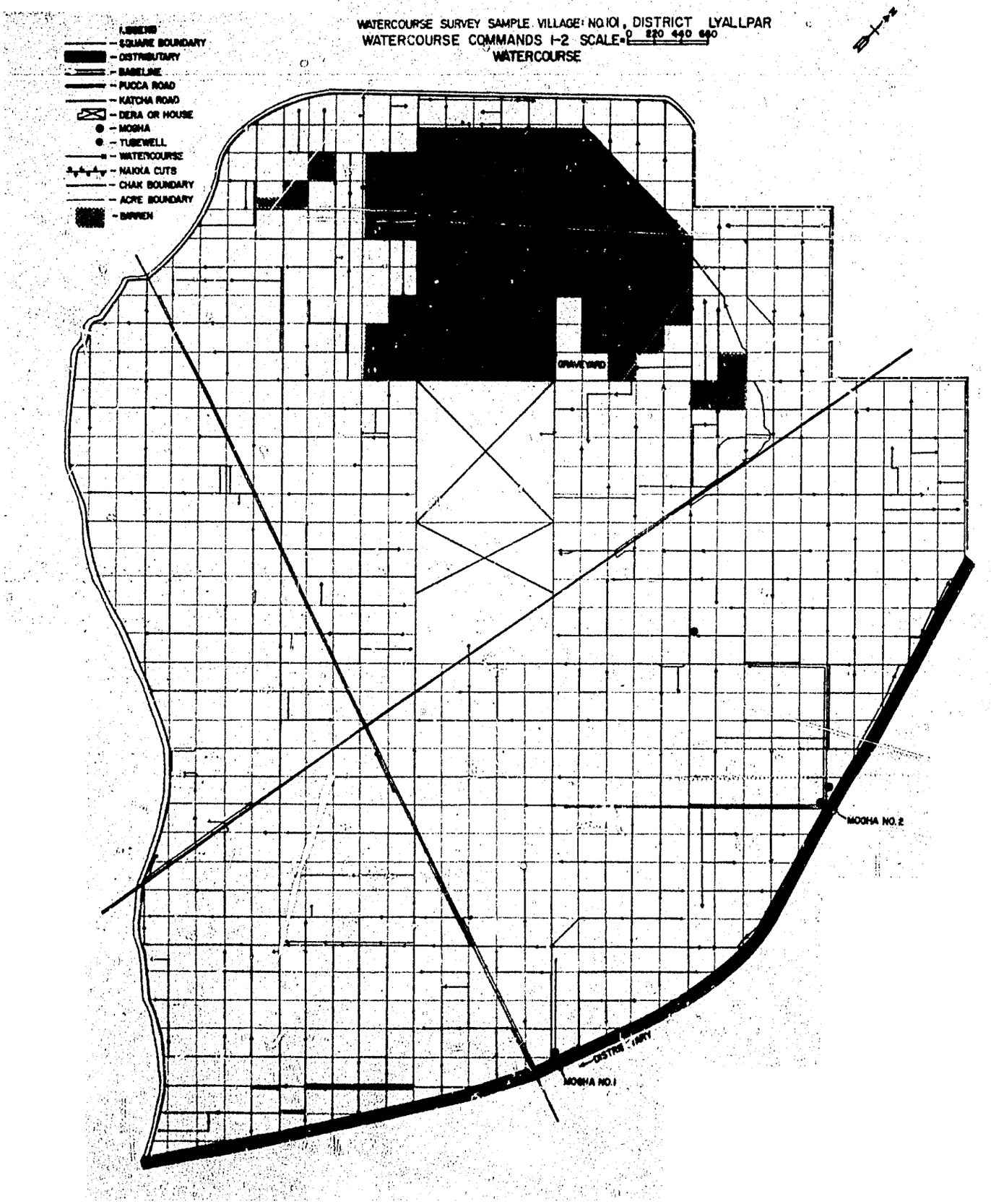
APPENDIX IV

Part A

WATERCOURSE MAPS

WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE: NO.101, DISTRICT LYALLPAR
WATERCOURSE COMMANDS 1-2 SCALE= 0 220 440 660
WATERCOURSE

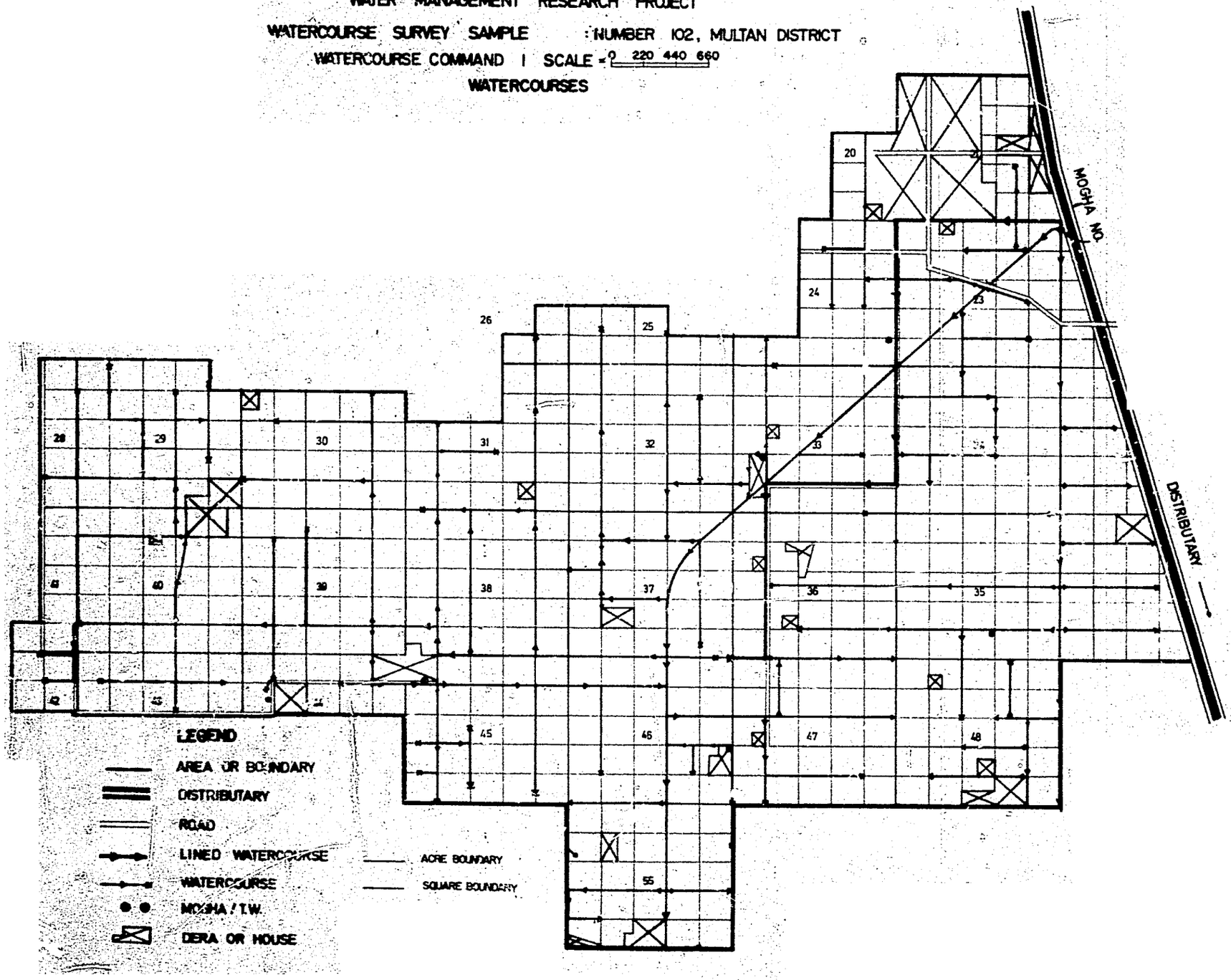


WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE : NUMBER 102, MULTAN DISTRICT

WATERCOURSE COMMAND I SCALE = 0 220 440 660

WATERCOURSES



WATER MANAGEMENT RESEARCH PROJECT

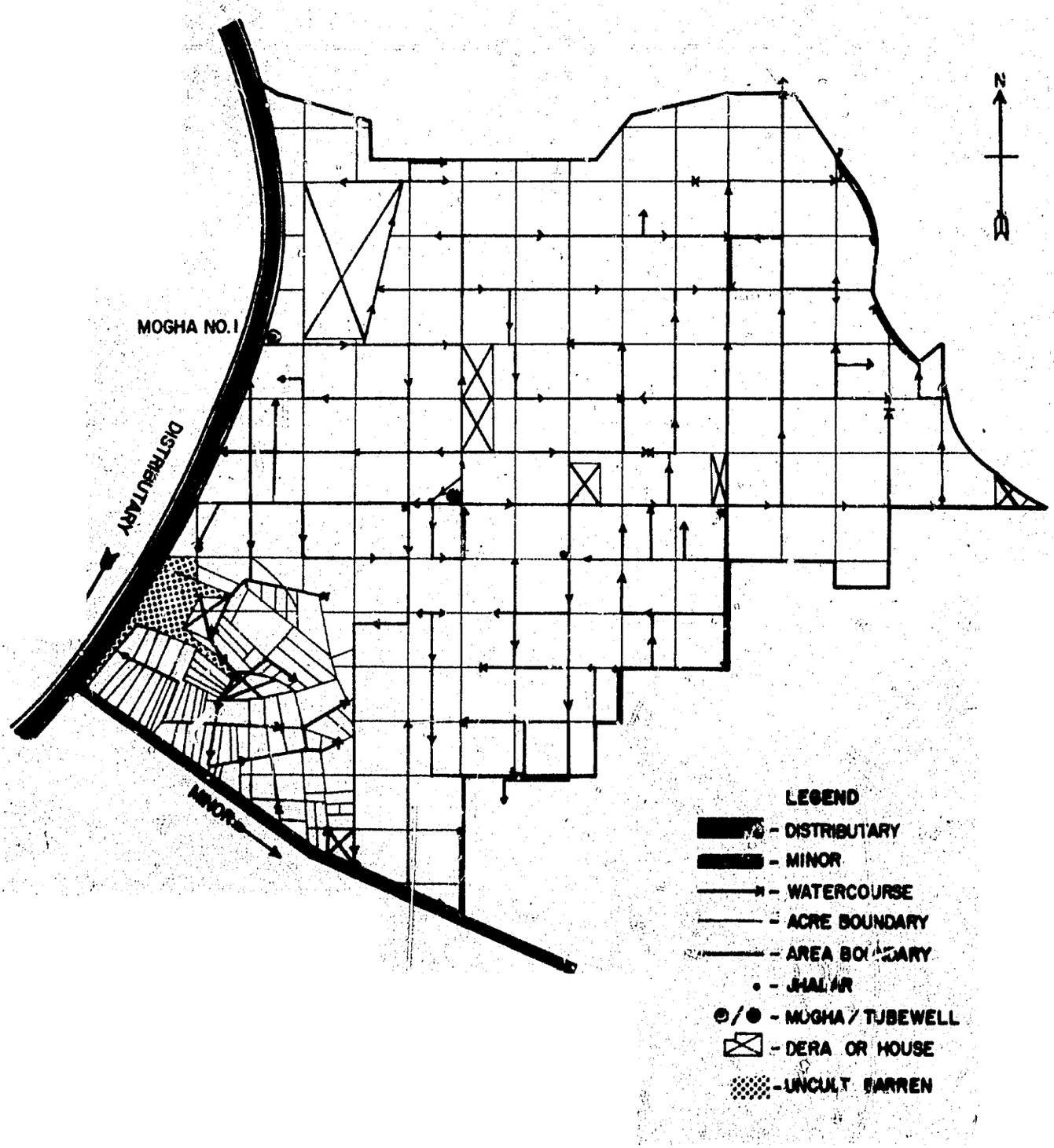
WATERCOURSE SURVEY SAMPLE VILLAGE NUMBER 103

DISTRICT LAHORE

WATERCOURSE COMMAND I

WATERCOURSE

Scale = 0 220 440 660



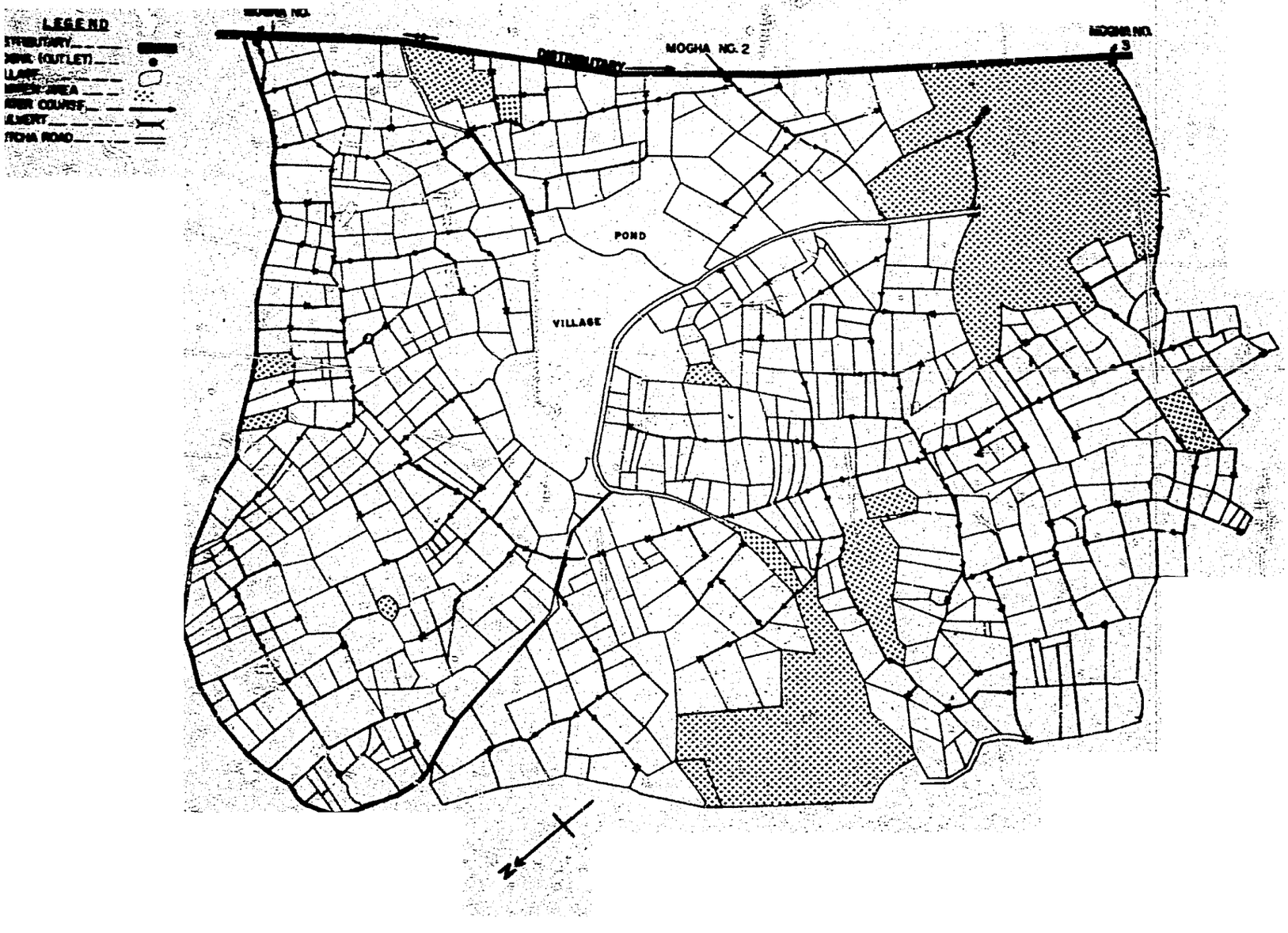
WATER MANAGEMENT RESEARCH PROJECT

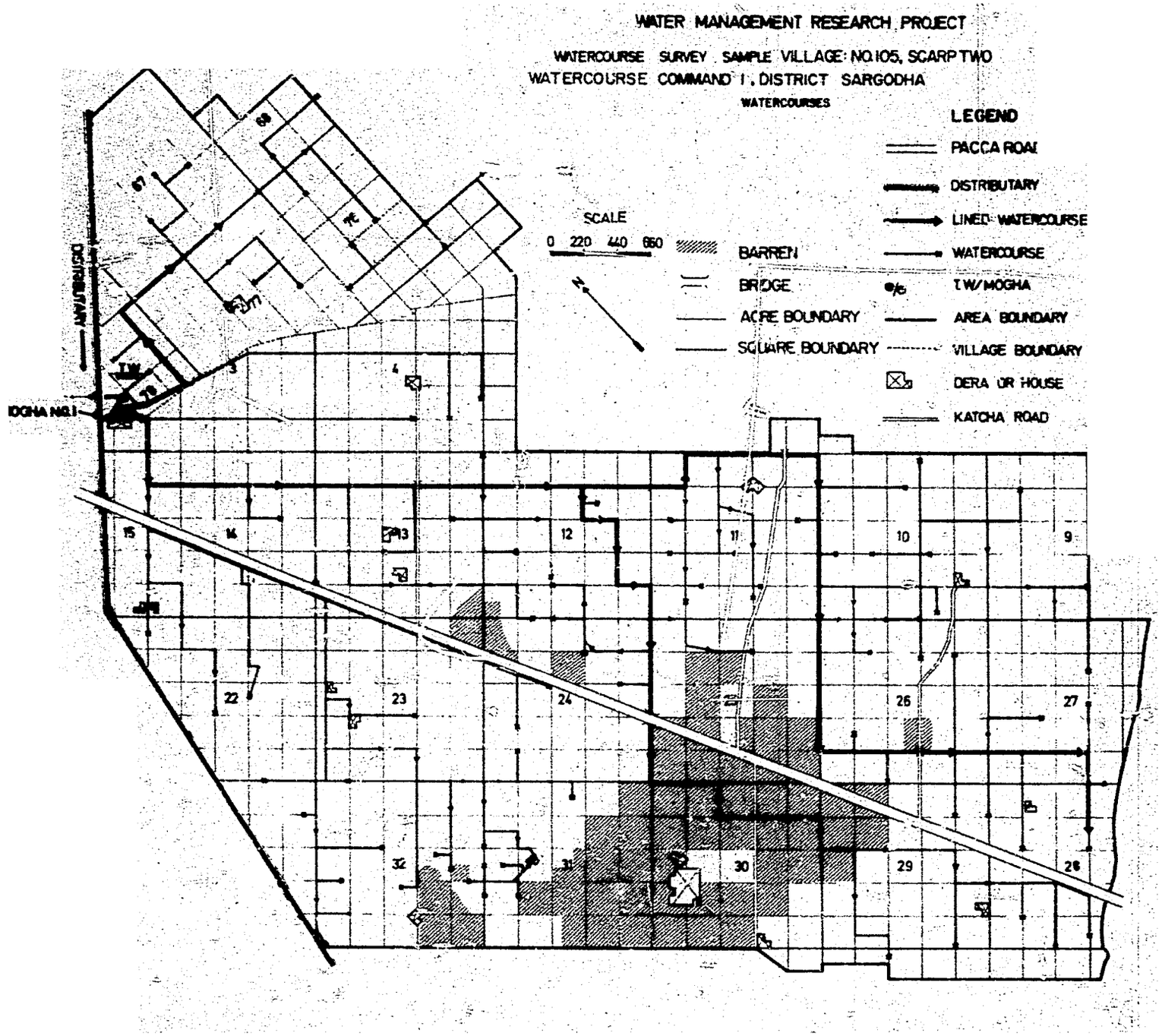
WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 104, DISTRICT LAHORE

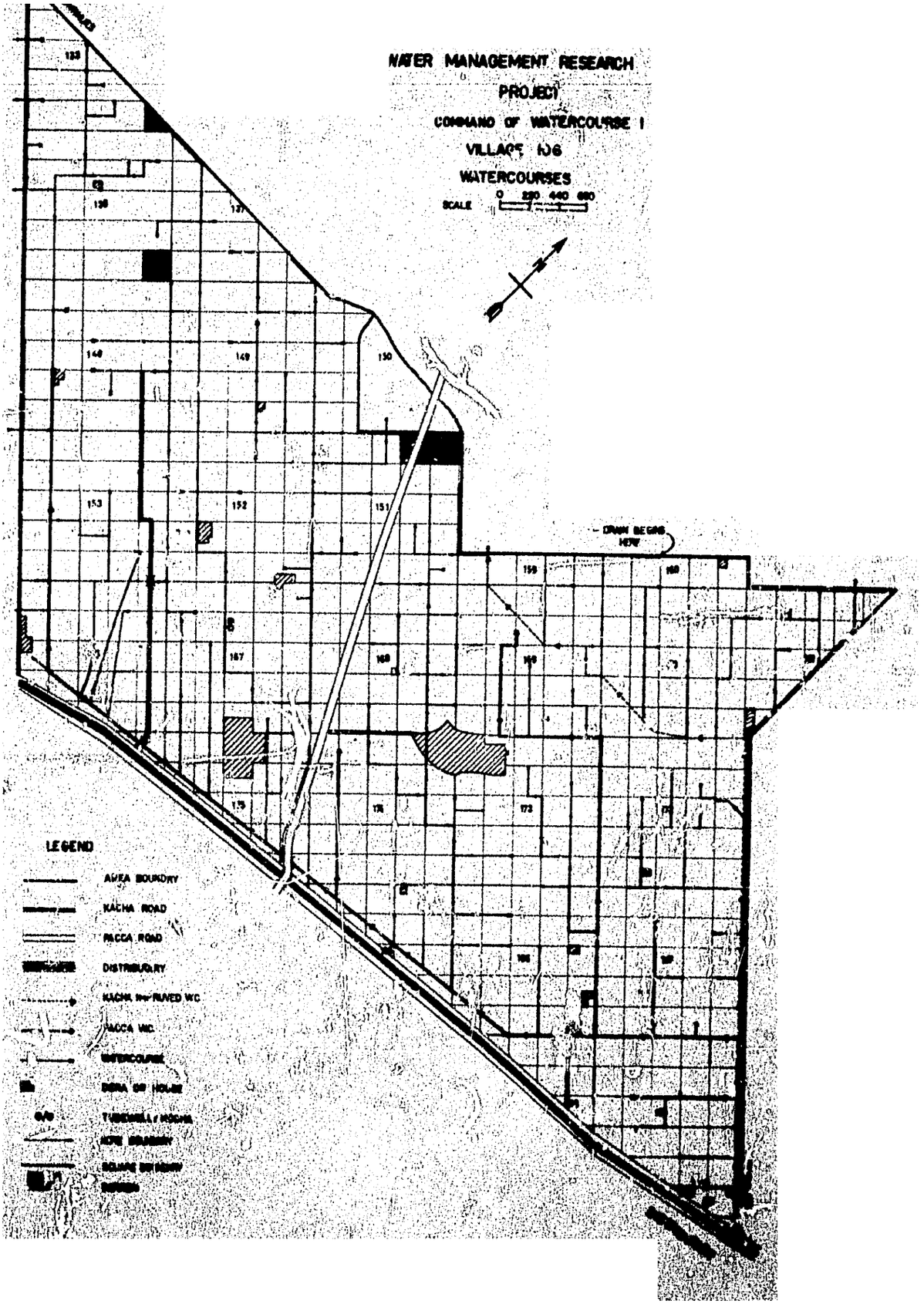
SCALE = 0 200 400 600

WATERCOURSE COMMANDS 1,2,& 3

WATERCOURSES




WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NO.105, SCARP TWO
WATERCOURSE COMMAND I, DISTRICT SARGODHA
WATERCOURSES
LEGEND
PACCA ROAD
DISTRIBUTARY
LINED WATERCOURSE
WATERCOURSE
T.W./MOGHA
AREA BOUNDARY
VILLAGE BOUNDARY
DERA OR HOUSE
KATCHA ROAD
SCALE
0 220 440 660
BARREN
BRIDGE
ACRE BOUNDARY
SQUARE BOUNDARY
DISTRIBUTARY
MOGHA NO.1
T.W.
67
68
69
70
3
4
9
10
11
12
13
14
15
22
23
24
26
27
28
29
30
31
32


WATER MANAGEMENT RESEARCH
PROJECT
COMMAND OF WATERCOURSE I
VILLAGE 106
WATERCOURSES
SCALE
0 220 440 660
DRAIN BEGINS HERE
LEGEND
AREA BOUNDRY
KACHA ROAD
PACCA ROAD
DISTRIBUTARY
KACHA IMPROVED W.C.
PACCA W.C.
WATERCOURSE
DERA OR HOUSE
TUBEWELL / KOCHA
AGRI BOUNDRY
SQUARE BOUNDRY
TOWERS

WATER MANAGEMENT RESEARCH PROJE(

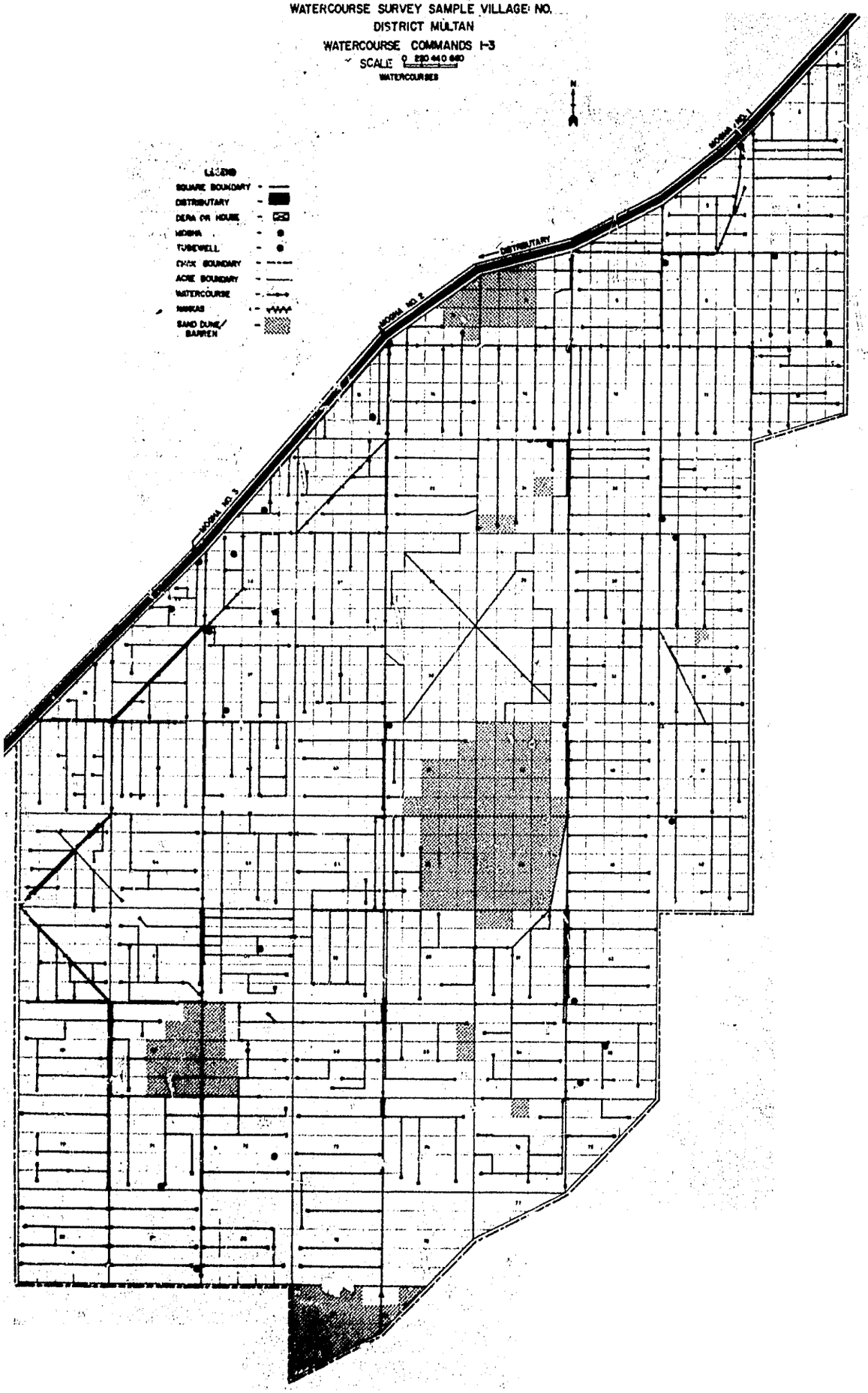
WATERCOURSE SURVEY SAMPLE VILLAGE NO.

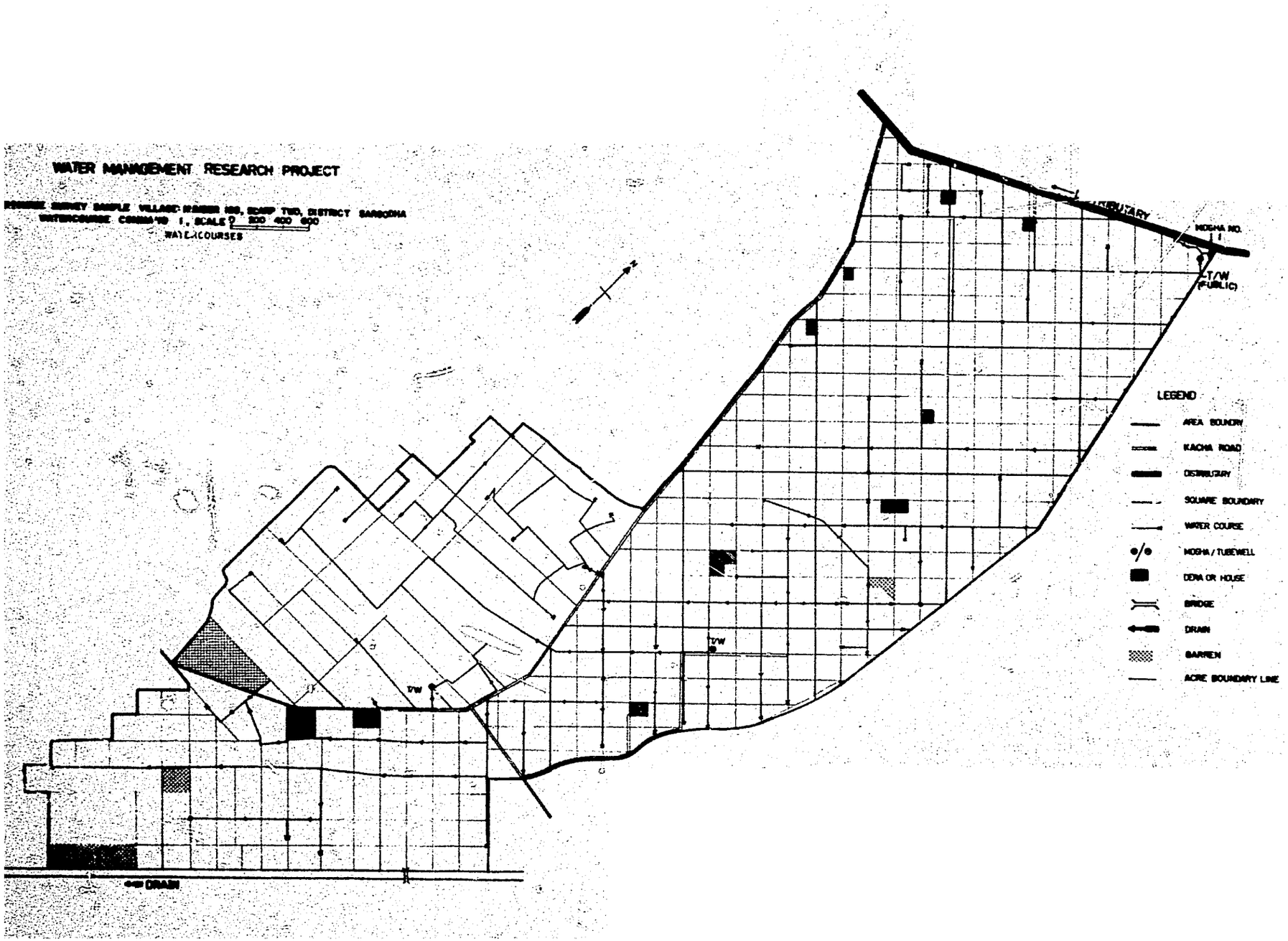
DISTRICT MULTAN

WATERCOURSE COMMANDS I-3

SCALE 0 220 440 660

WATERCOURSES



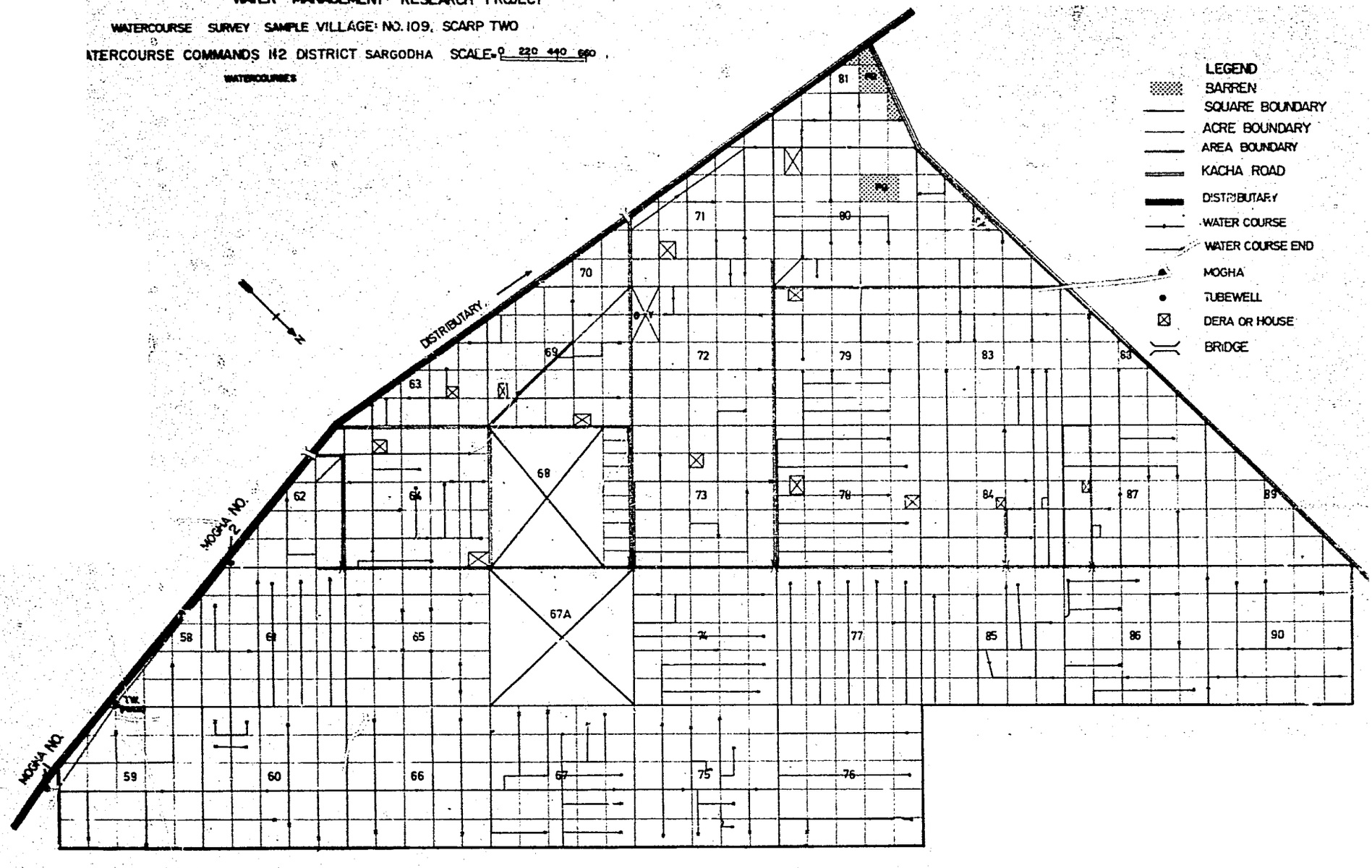

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSES
MOGHA NO. 1
T/W (PUBLIC)
T/W
T/W
DRAIN
LEGEND
AREA BOUNDRY
KACHA ROAD
DISTRIBUTARY
SQUARE BOUNDARY
WATER COURSE
MOGHA / TUBEWELL
DERA OR HOUSE
BRIDGE
DRAIN
BARREN
ACRE BOUNDARY LINE

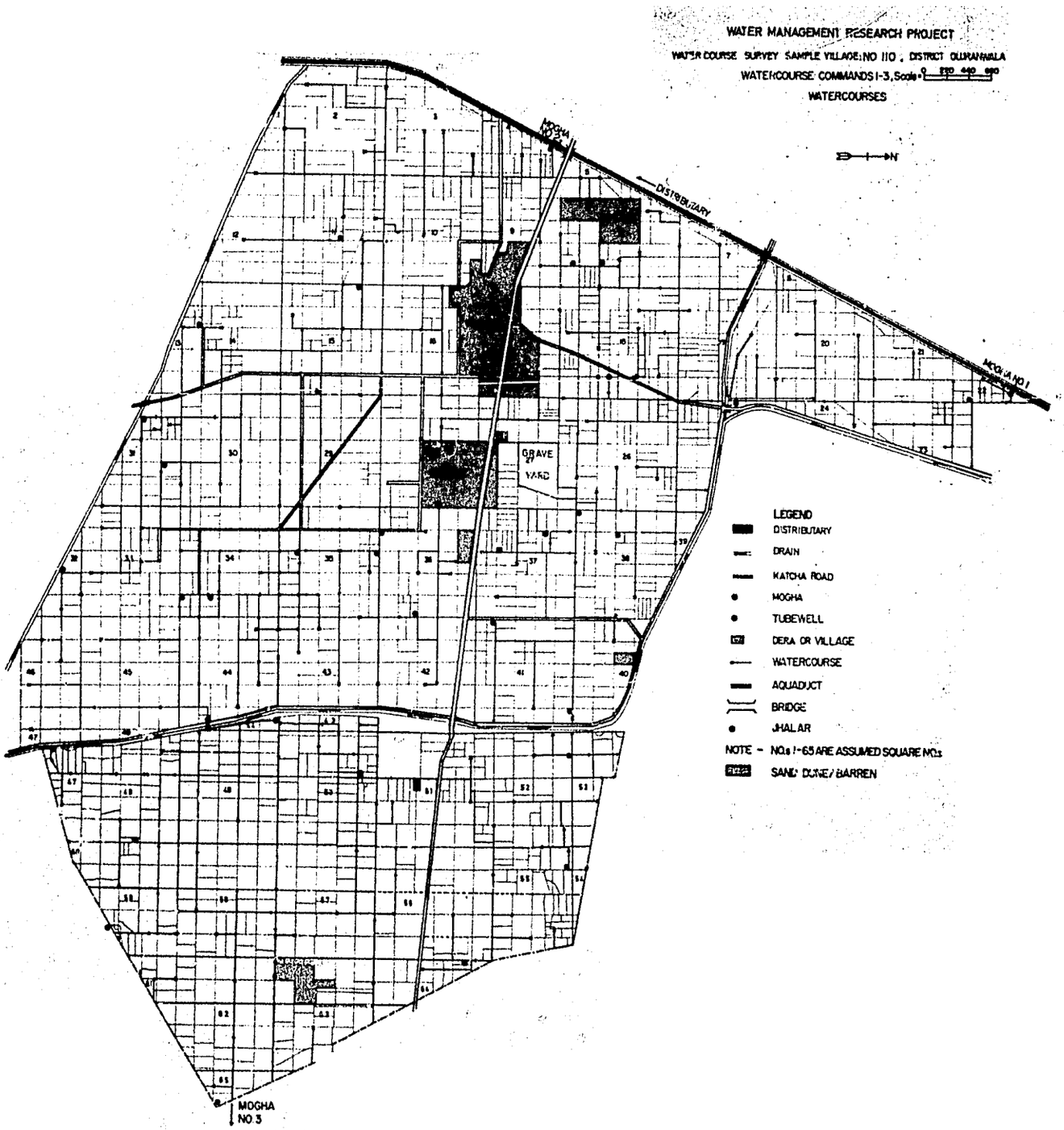
WATER MANAGEMENT RESEARCH PROJECT

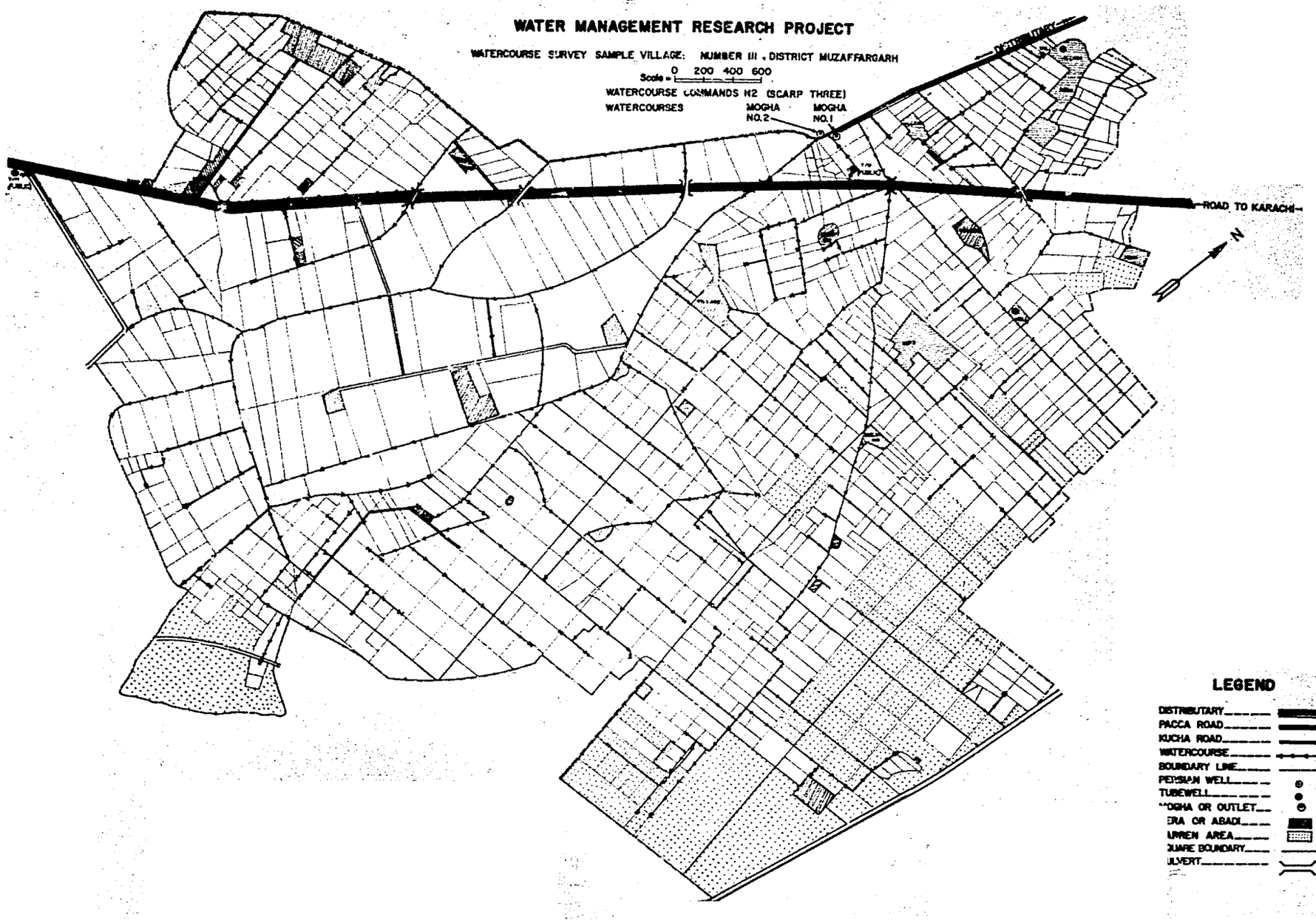
WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 109, SCARP TWO

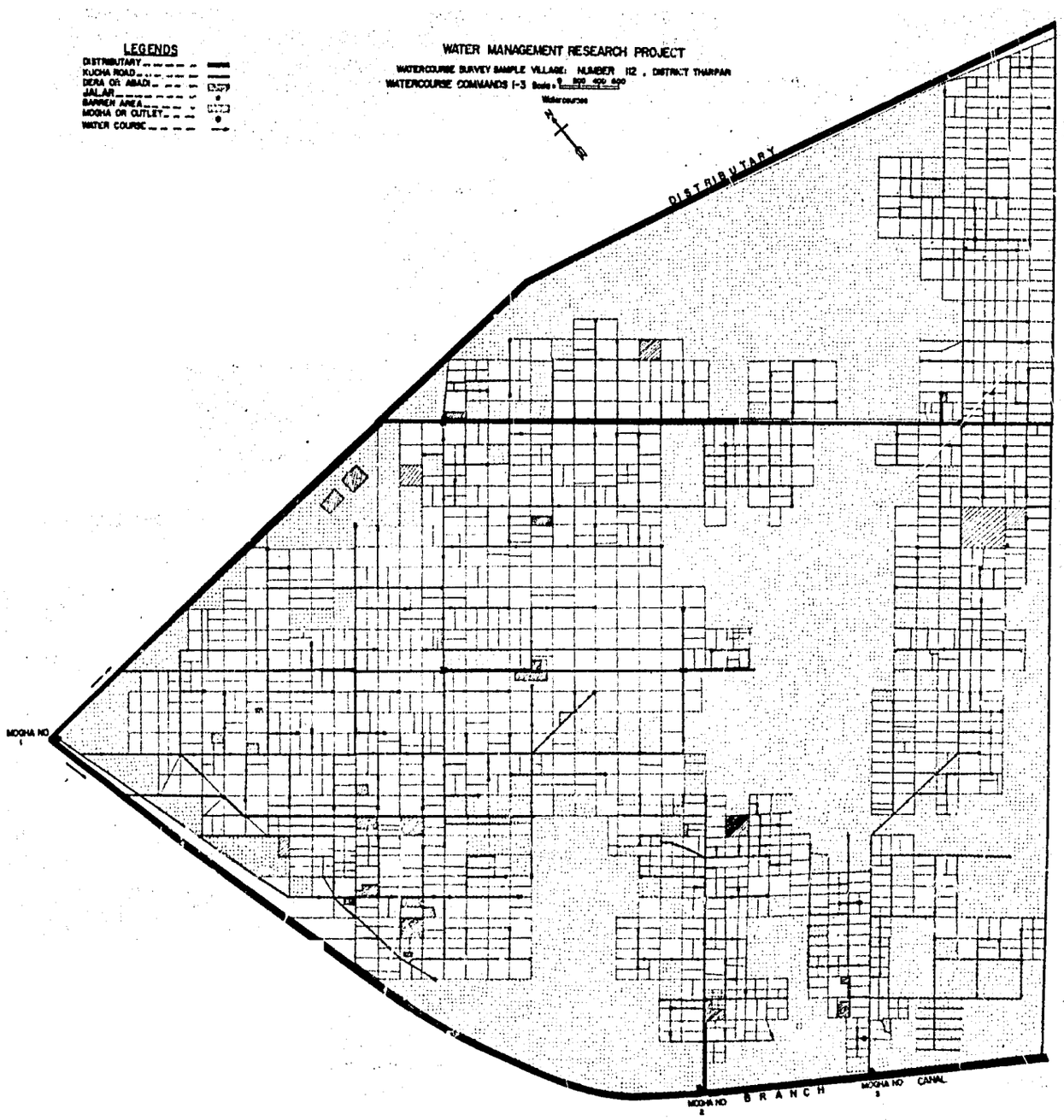
ATERCOURSE COMMANDS 112 DISTRICT SARGODHA SCALE: 0 220 440 660

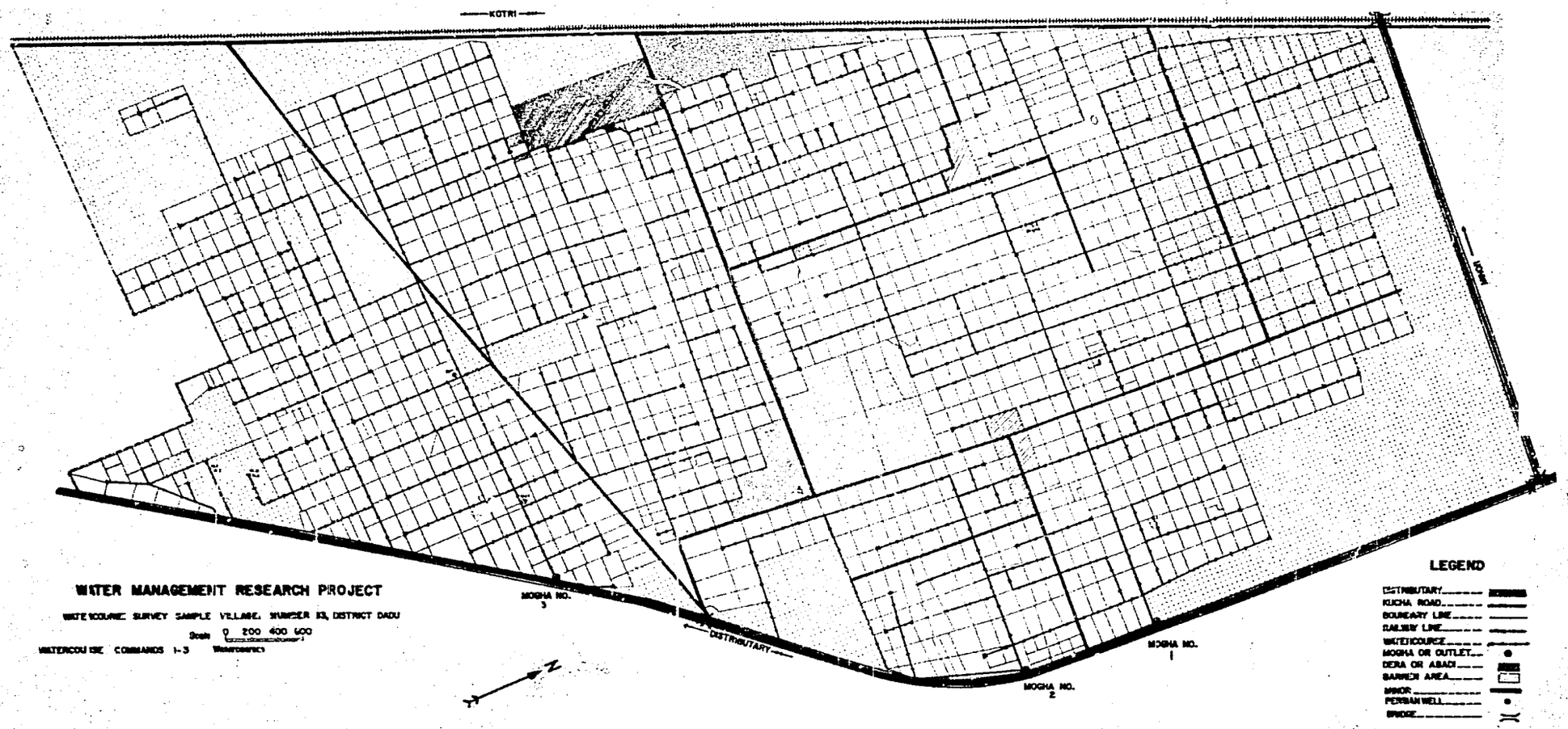
WATERCOURSES




WATER MANAGEMENT RESEARCH PROJECT
WATER COURSE SURVEY SAMPLE VILLAGE: NO 110 , DISTRICT GUJRANWALA
WATERCOURSE COMMANDS 1-3, Scale
WATERCOURSES
N
DISTRIBUTARY
MOGHA NO 1
MOGHA NO 2
MOGHA NO 3
GRAVE YARD
LEGEND
DISTRIBUTARY
DRAIN
KATCHA ROAD
MOGHA
TUBEWELL
DERA OR VILLAGE
WATERCOURSE
AQUADUCT
BRIDGE
JHALAR
NOTE - NOs 1-65 ARE ASSUMED SQUARE NOs
SAND DUNE/BARREN


WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER III . DISTRICT MUZAFFARGARH
Scale = 0 200 400 600
WATERCOURSE COMMANDS N2 (SCARP THREE)
WATERCOURSES
MOGHA NO.2
MOGHA NO.1
ROAD TO KARACHI
N
LEGEND
DISTRIBUTARY
PACCA ROAD
KUCHA ROAD
WATERCOURSE
BOUNDARY LINE
PERSIAN WELL
TUBEWELL
MOGHA OR OUTLET
ERA OR ABADI
URREN AREA
QUARE BOUNDARY
ULVERT


LEGENDS
DISTRIBUTARY
KUCHA ROAD
DERA OR ABADI
JALAR
BARREN AREA
MOGHA OR OUTLET
WATER COURSE
WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 112 , DISTRICT THARPAR
WATERCOURSE COMMANDS 1-3
Watercourse
N
DISTRIBUTARY
MOGHA NO 1
MOGHA NO 2
BRANCH
MOGHA NO 3
CANAL

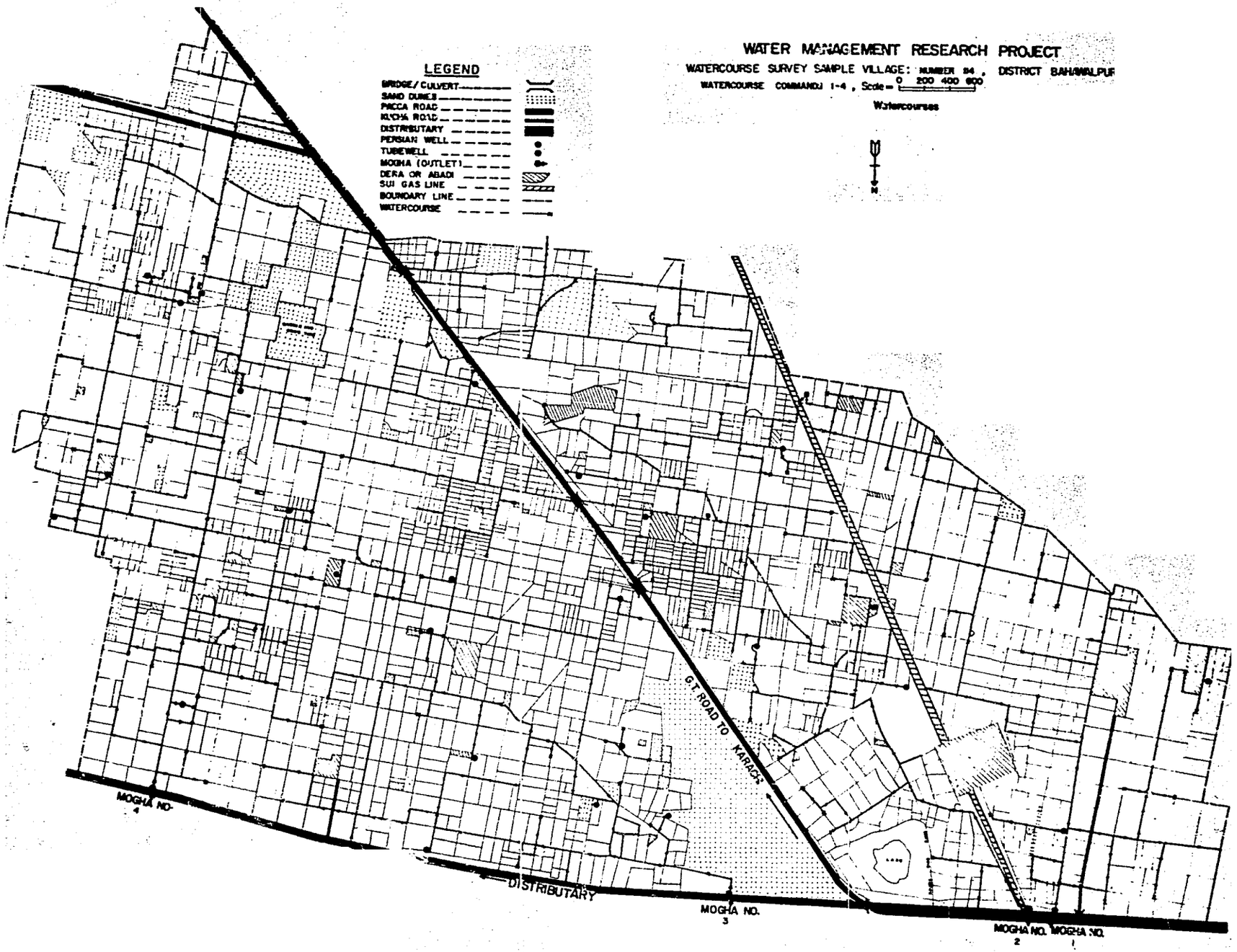


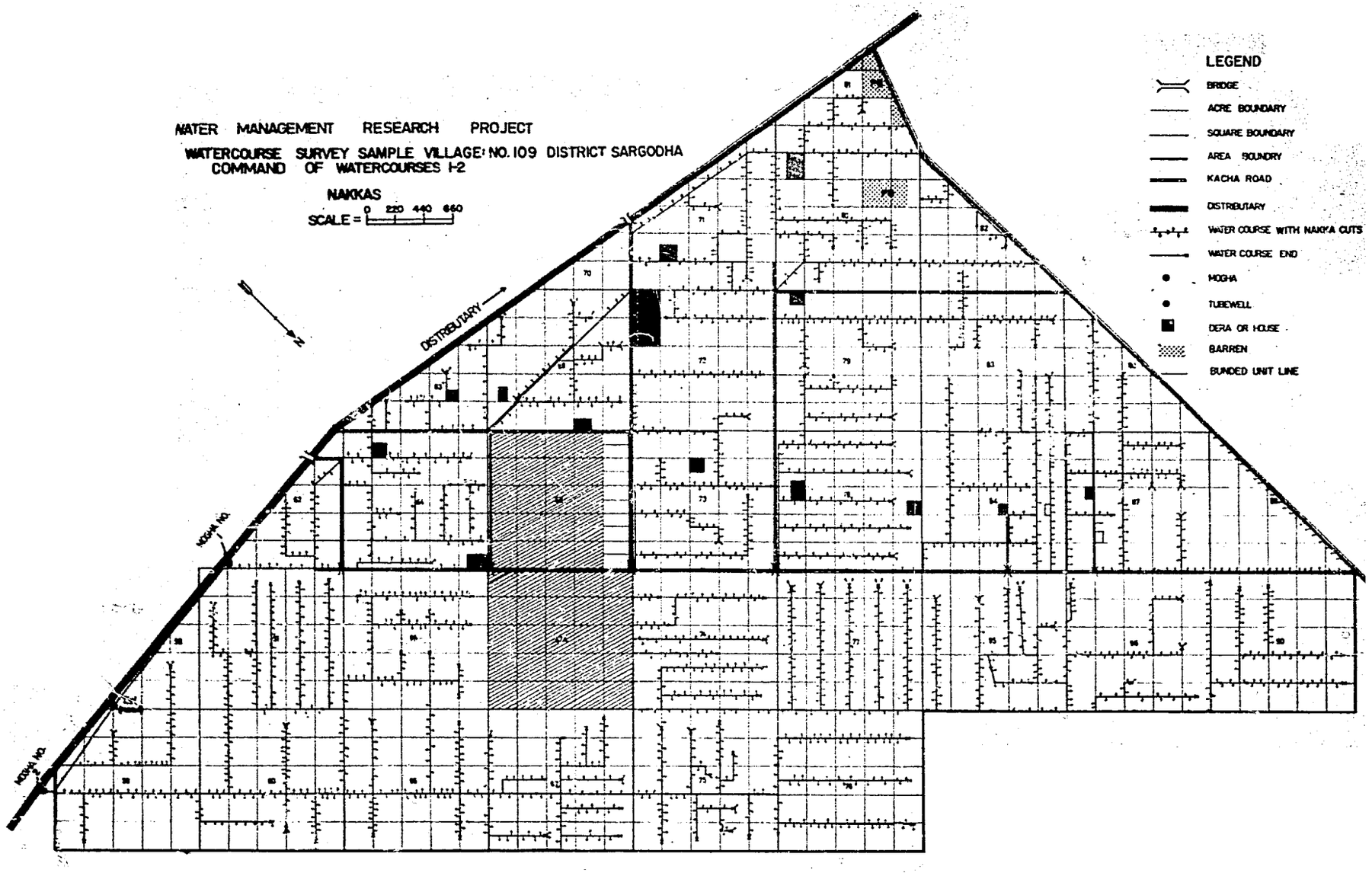
WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE, NUMBER 83, DISTRICT DADU

Scale 0 200 400 600

WATERCOURSE COMMANDS 1-3


WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 84 , DISTRICT BAHAWALPUR
WATERCOURSE COMMAND: 1-4 , Scale = 0 200 400 600
Watercourses
N
LEGEND
BRIDGE/ CULVERT
SAND DUNES
PACCA ROAD
KUCHA ROAD
DISTRIBUTARY
PERSIAN WELL
TUBEWELL
MOGHA (OUTLET)
DERA OR ABADI
SUI GAS LINE
BOUNDARY LINE
WATERCOURSE
G.T. ROAD TO KARACHI
DISTRIBUTARY
MOGHA NO. 4
MOGHA NO. 3
MOGHA NO. 2
MOGHA NO. 1

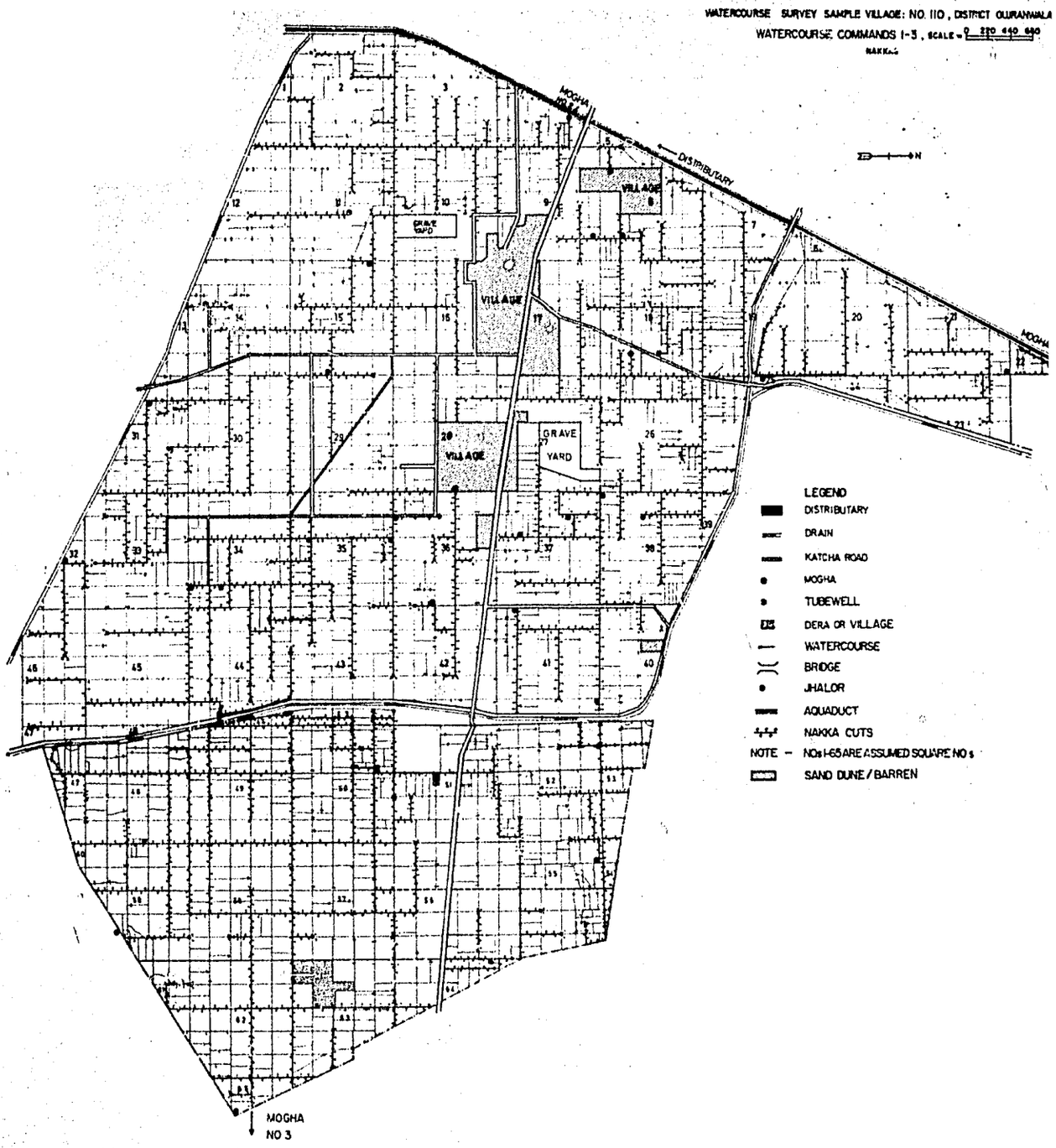

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 109 DISTRICT SARGODHA
COMMAND OF WATERCOURSES 1-2
NAKKAS
SCALE = 0 220 440 660
N
DISTRIBUTARY
MOGHA NO.
MOGHA NO.
LEGEND
BRIDGE
ACRE BOUNDARY
SQUARE BOUNDARY
AREA BOUNDRY
KACHA ROAD
DISTRIBUTARY
WATER COURSE WITH NAKKA CUTS
WATER COURSE END
MOGHA
TUBEWELL
DERA OR HOUSE
BARREN
BUNDED UNIT LINE

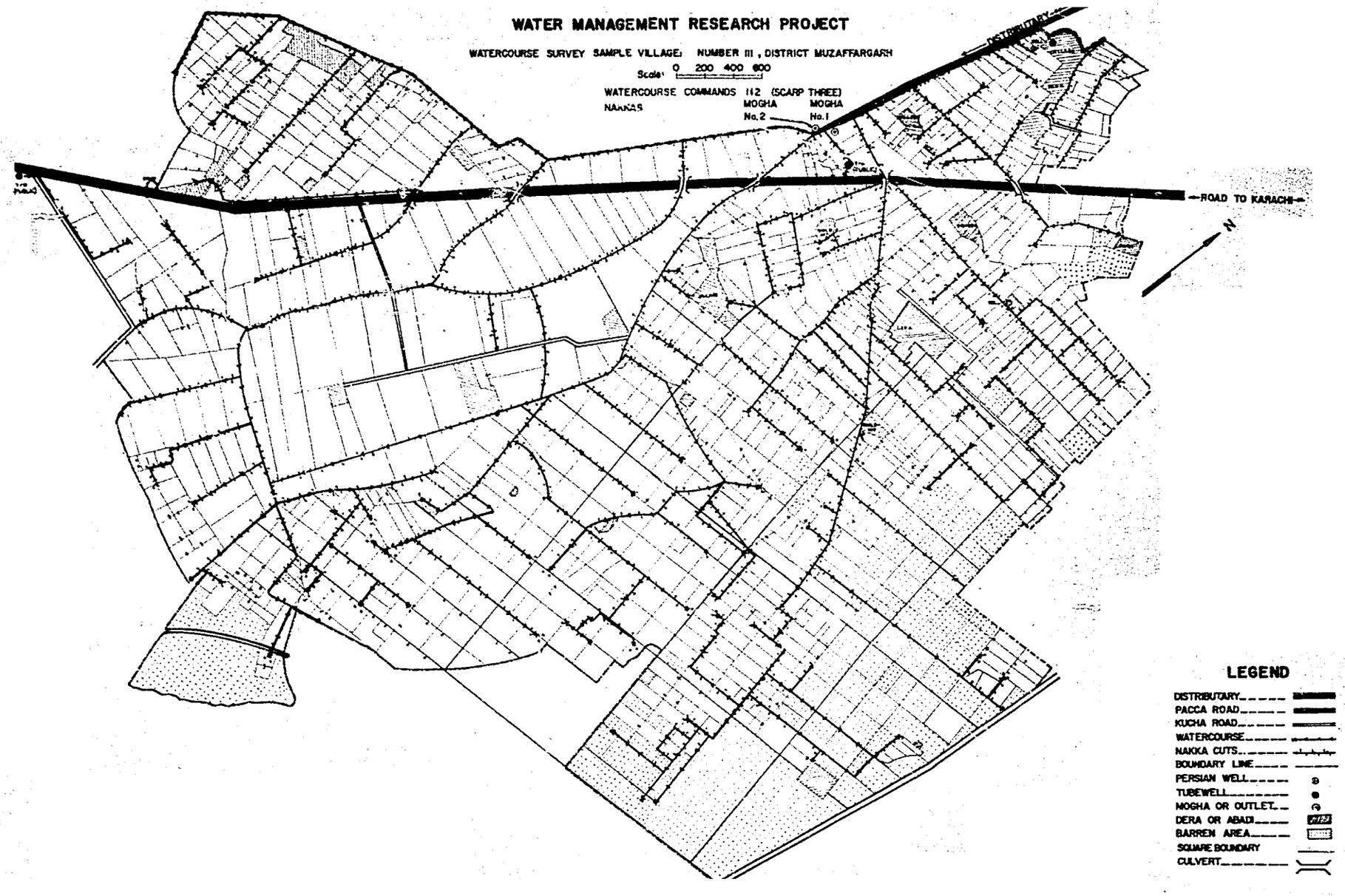
WATER MANAGEMENT RESEARCH PROJECT

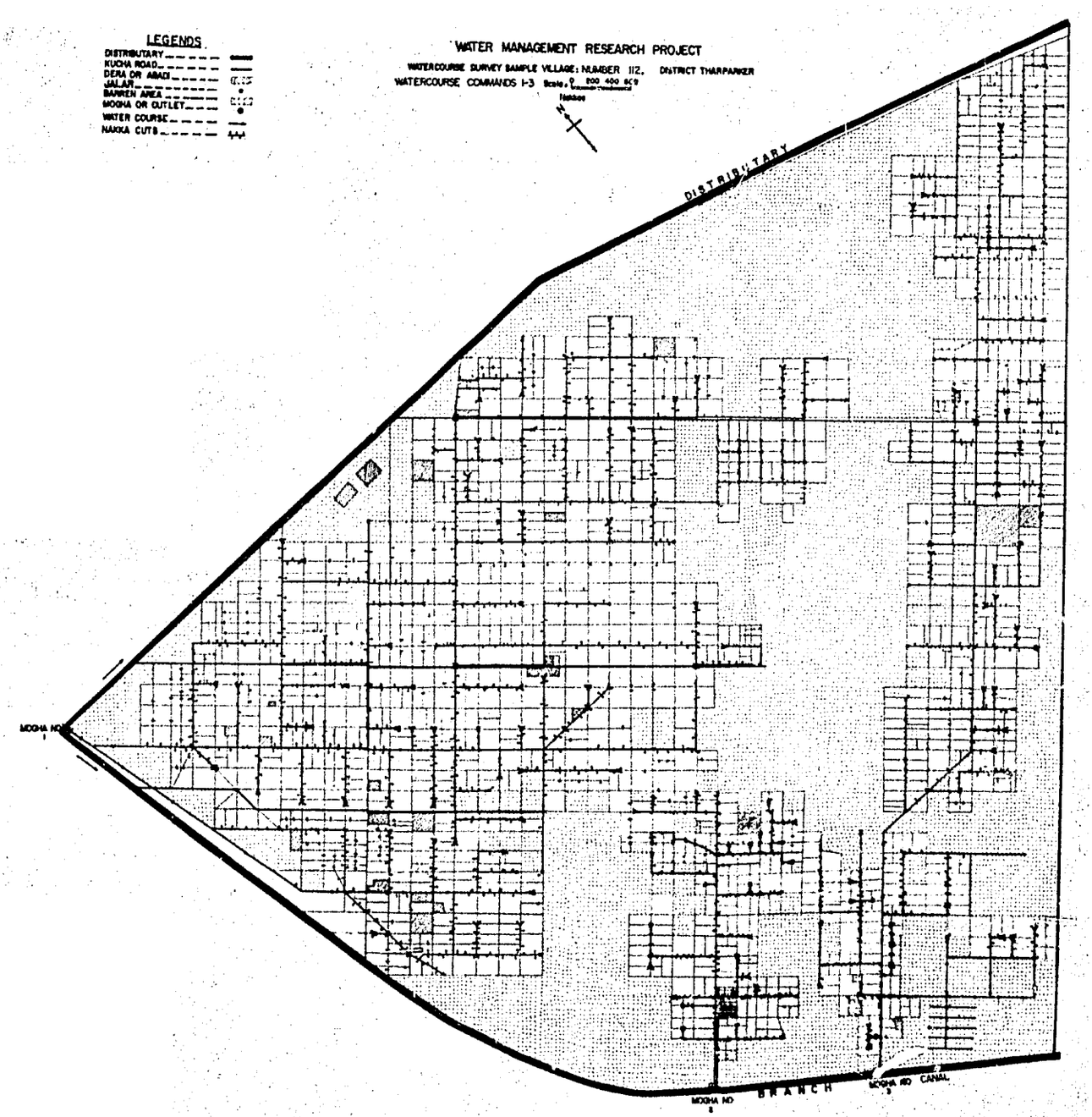
WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 110, DISTRICT GUJRANWALA

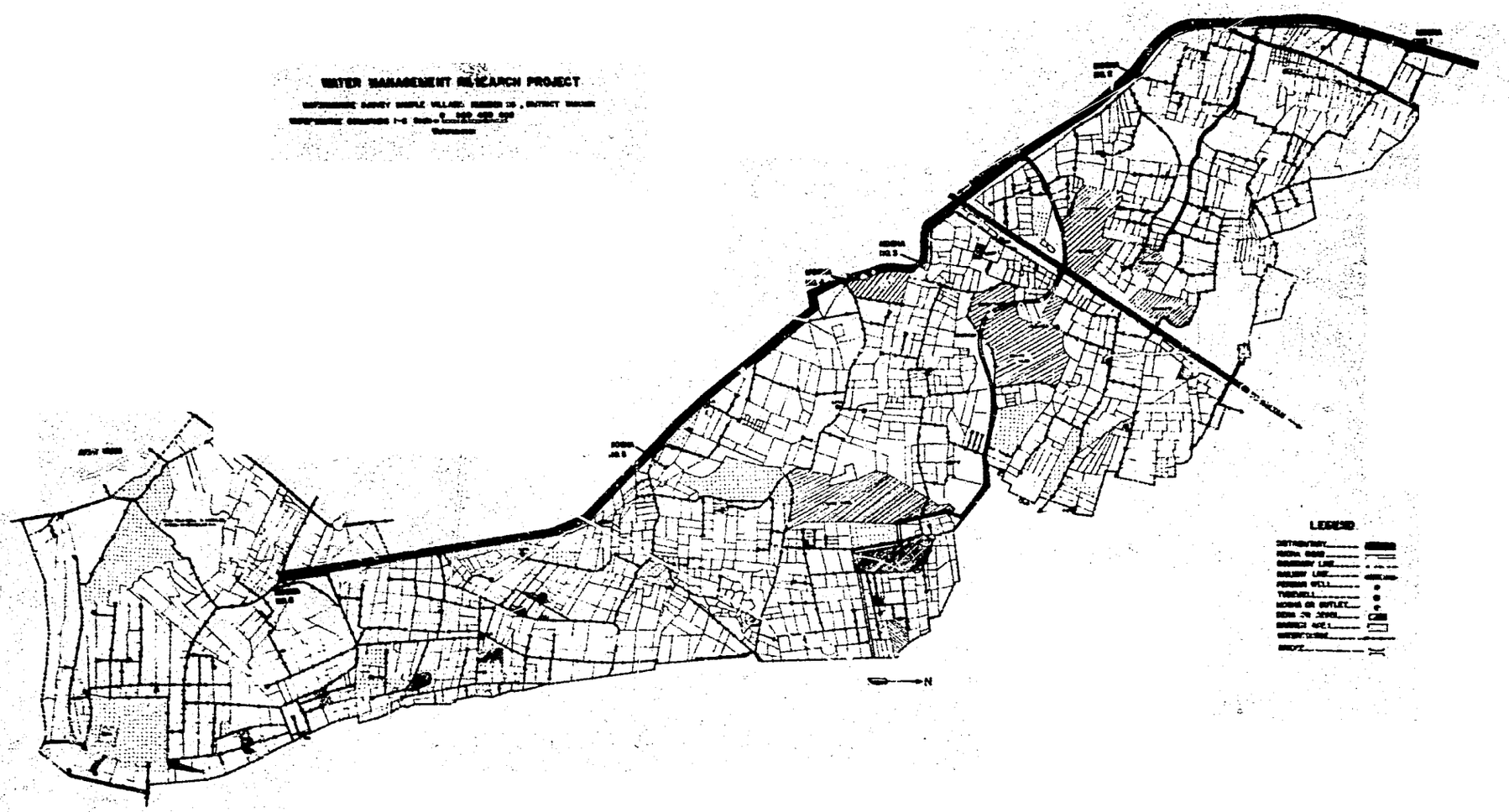
WATERCOURSE COMMANDS 1-3, SCALE = 0 220 440 660

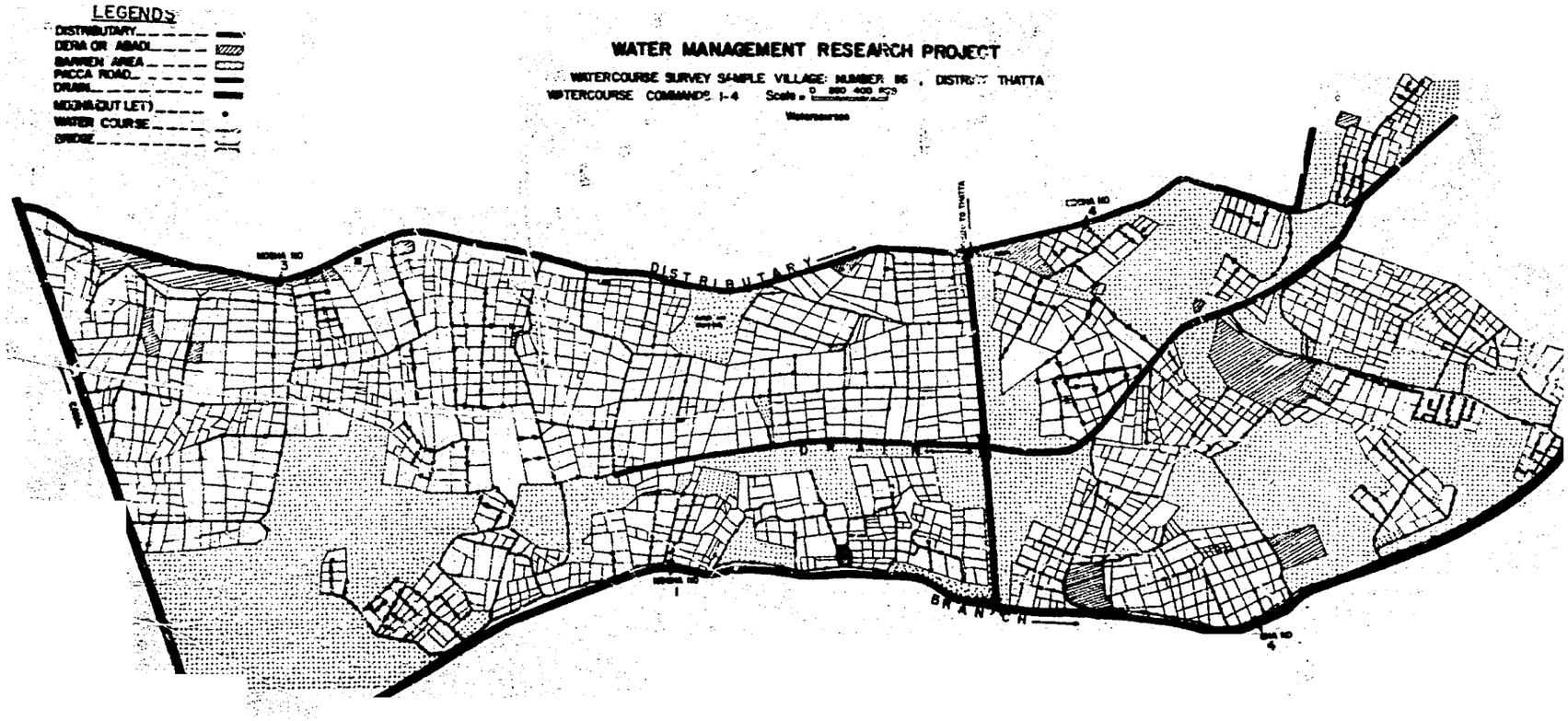
NAKKA




WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER III, DISTRICT MUZAFFARGARH
Scale: 0 200 400 600
WATERCOURSE COMMANDS 112 (SCARP THREE)
NAKKAS
MOGHA No. 2
MOGHA No. 1
ROAD TO KARACHI
N
LEGEND
DISTRIBUTARY
PACCA ROAD
KUCHA ROAD
WATERCOURSE
NAKKA CUTS
BOUNDARY LINE
PERSIAN WELL
TUBEWELL
MOGHA OR OUTLET
DERA OR ABADI
BARREN AREA
SQUARE BOUNDARY
CULVERT


LEGENDS
DISTRIBUTARY
KUCHA ROAD
DERA OR ABADI
JALAR
BARREN AREA
MOGHA OR OUTLET
WATER COURSE
NAKKA CUTS
WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 112, DISTRICT THARPARKER
WATERCOURSE COMMANDS 1-3
DISTRIBUTARY
MOGHA NO 1
MOGHA NO 2
BRANCH
MOGHA NO 3
CANAL

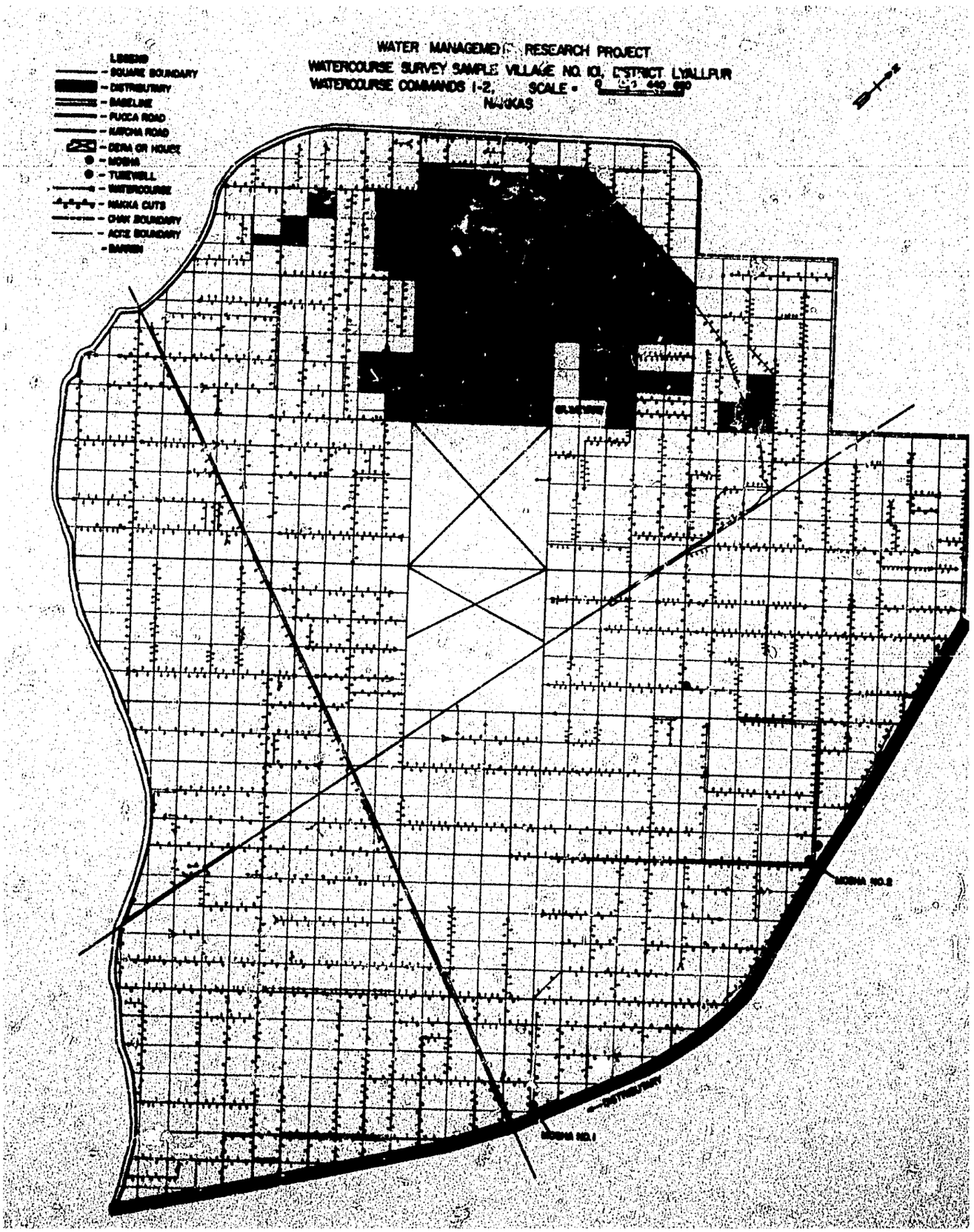

WATER MANAGEMENT RESEARCH PROJECT
LEGEND
N


LEGENDS
DISTRIBUTARY
DERA OR ABADI
BARREN AREA
PACCA ROAD
DRAIN
MOGHA (OUT LET)
WATER COURSE
BRIDGE
WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 86 , DISTRICT THATTA
WATERCOURSE COMMANDS 1-4
DISTRIBUTARY
DRAIN
BRANCH

APPENDIX IV

Part B

NAKKA CUT MAPS

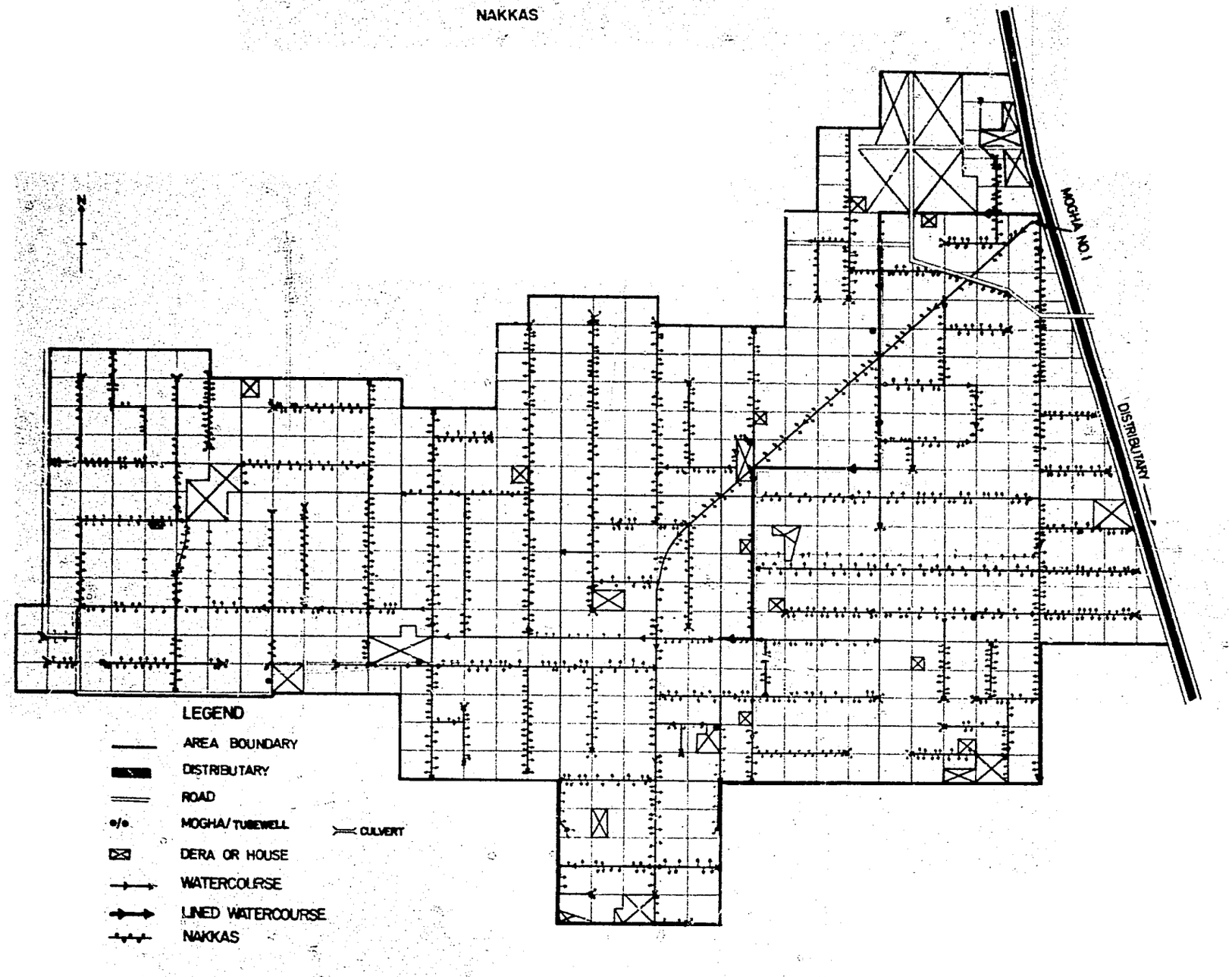

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE NO. 101, DISTRICT LYALLPUR
WATERCOURSE COMMANDS 1-2, SCALE =
NAJIKAS
LEGEND
- SQUARE BOUNDARY
- DISTRIBUTARY
- BASELINE
- PUCCA ROAD
- KACHA ROAD
- DERA OR HOUSE
- MOGHA
- TUBEWELL
- WATERCOURSE
- NAKKA CUTS
- CHAK BOUNDARY
- ACTZ BOUNDARY
- BARREN
MOGHA NO.2
MOGHA NO.1

WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE: NO.102, DISTRICT MULTAN

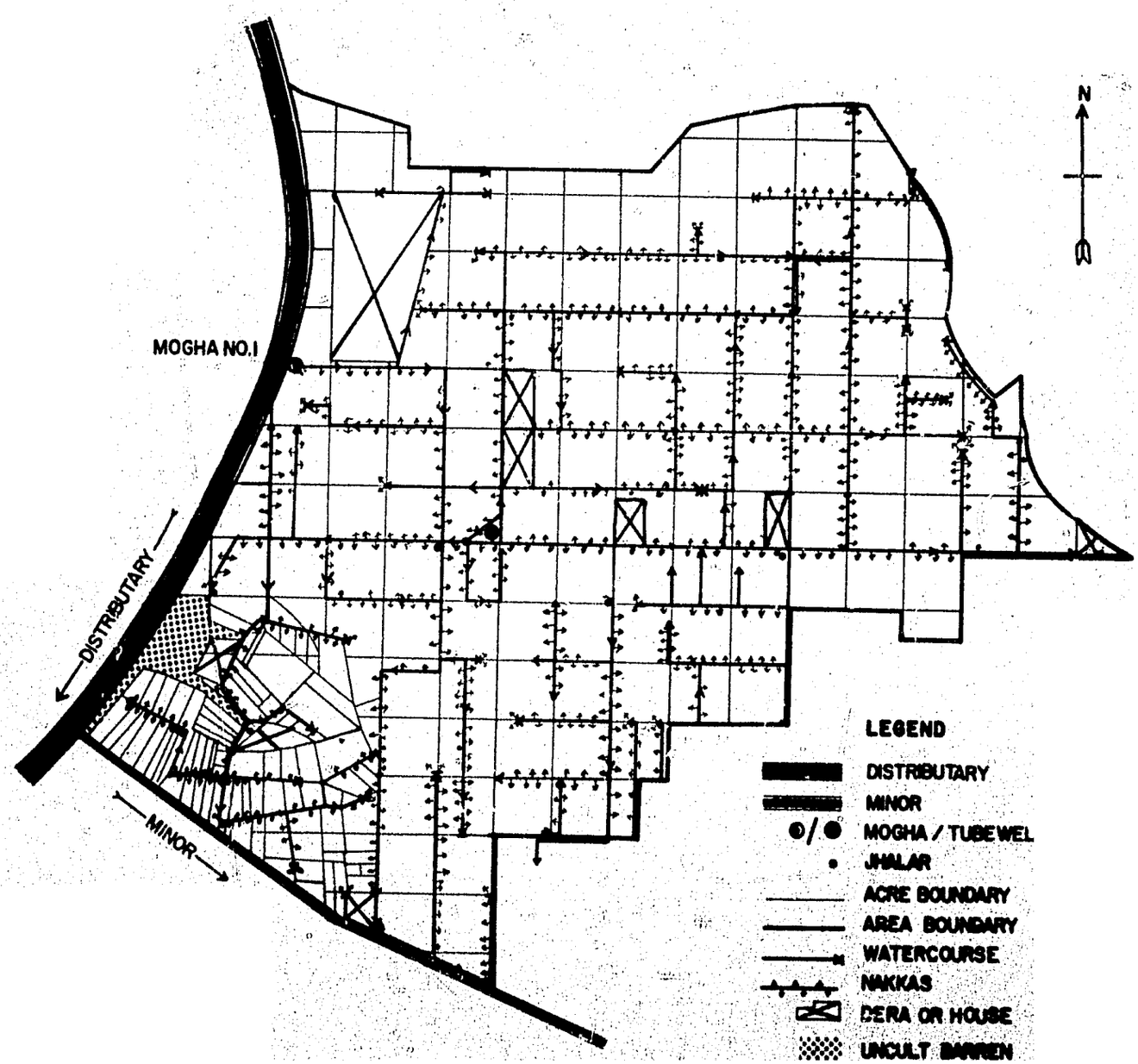
WATERCOURSE COMMAND 1, SCALE: 0 220 440 660

NAKKAS



WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 103
DISTRICT LAHORE, WATERCOURSE COMMAND 1,
NAKKAS

Scale = 0 220 440 660

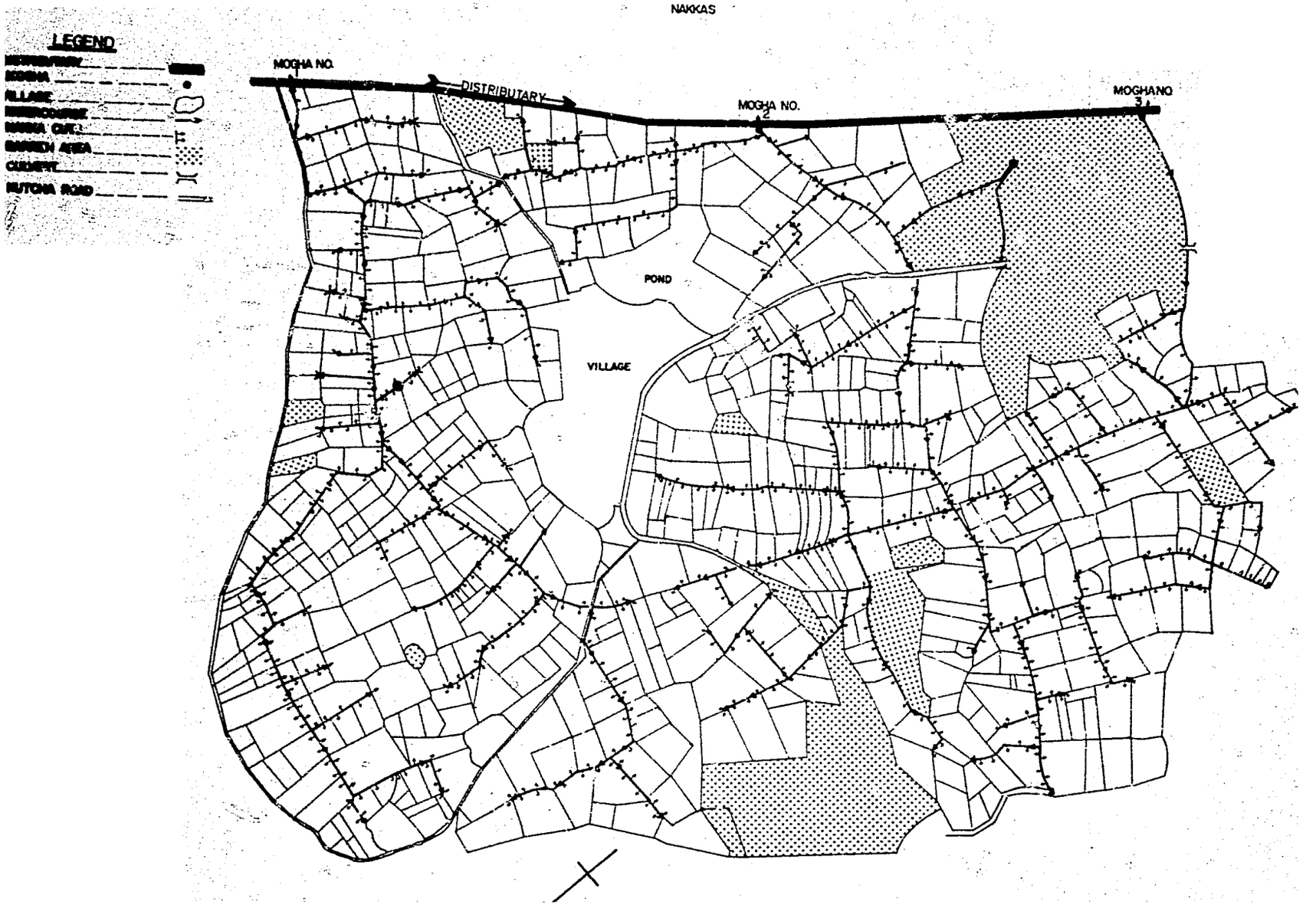


WATER MANAGEMENT RESEARCH PROJECT

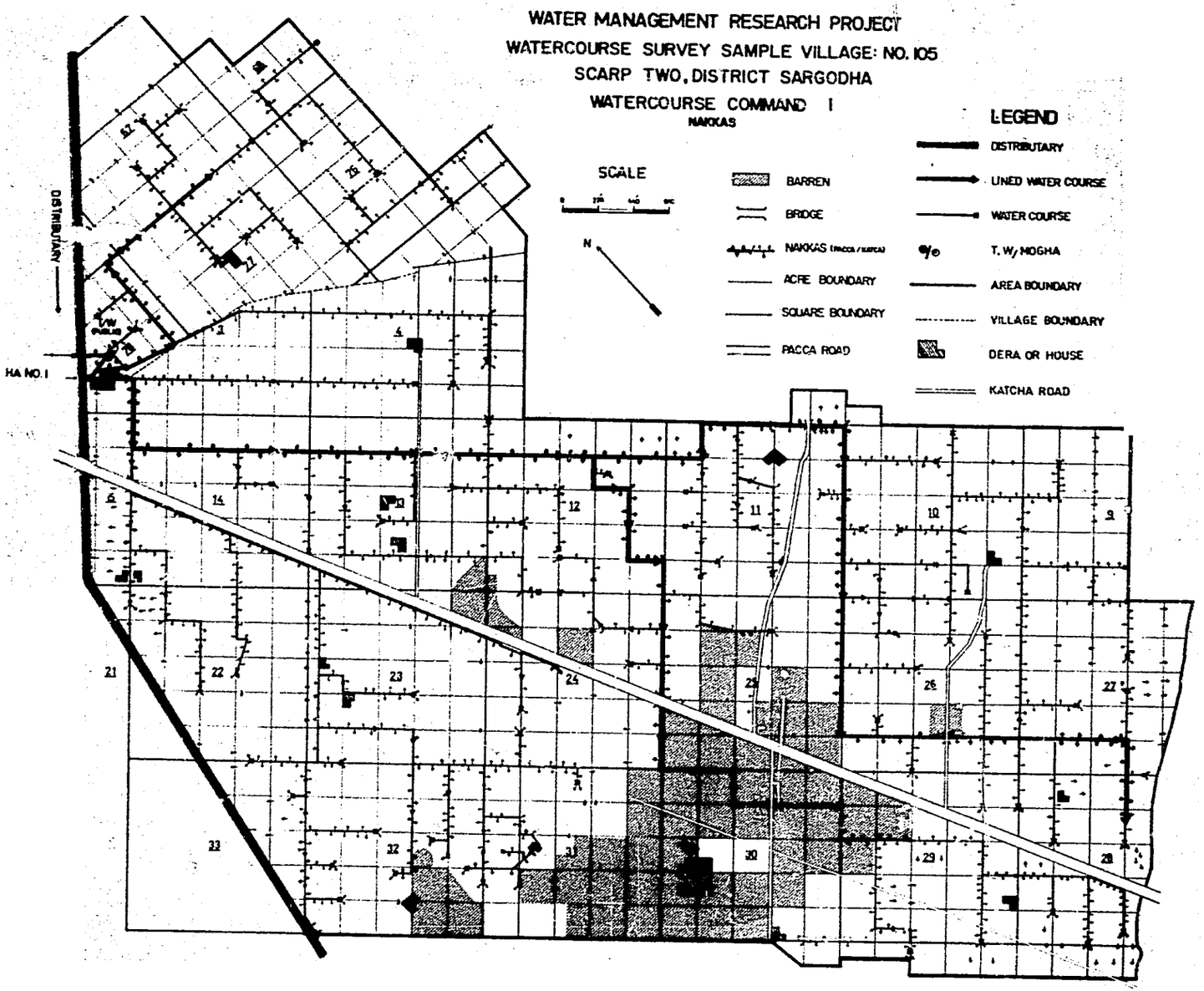
WATERCOURSE SURVEY SAMPLE VILLAGE: No. 104, DISTRICT LAHORE

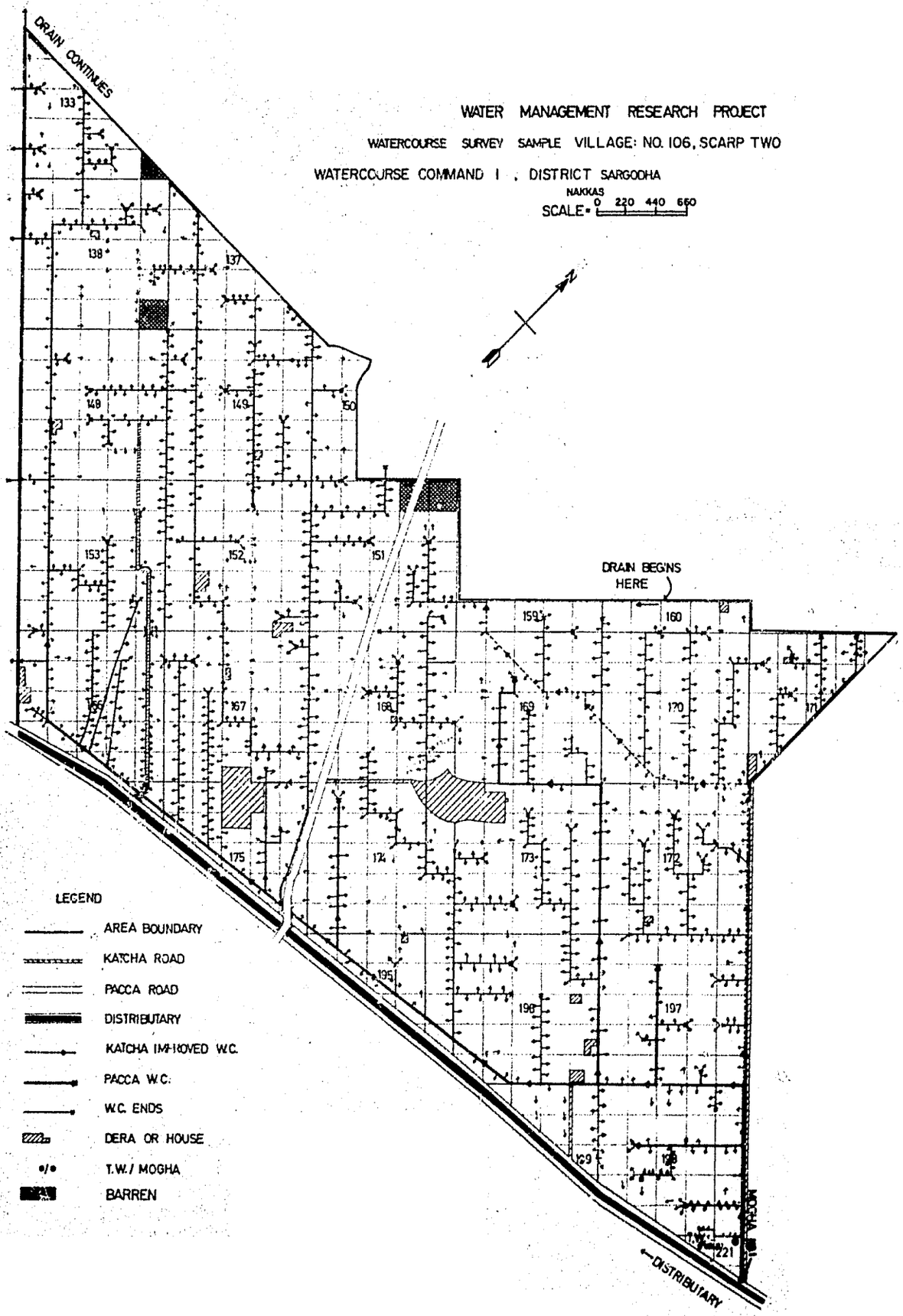
WATERCOURSE COMMAND I-3, SCALE 0 200 400 600

NAKKAS



WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 105
SCARP TWO, DISTRICT SARGODHA
WATERCOURSE COMMAND I
NAKKAS

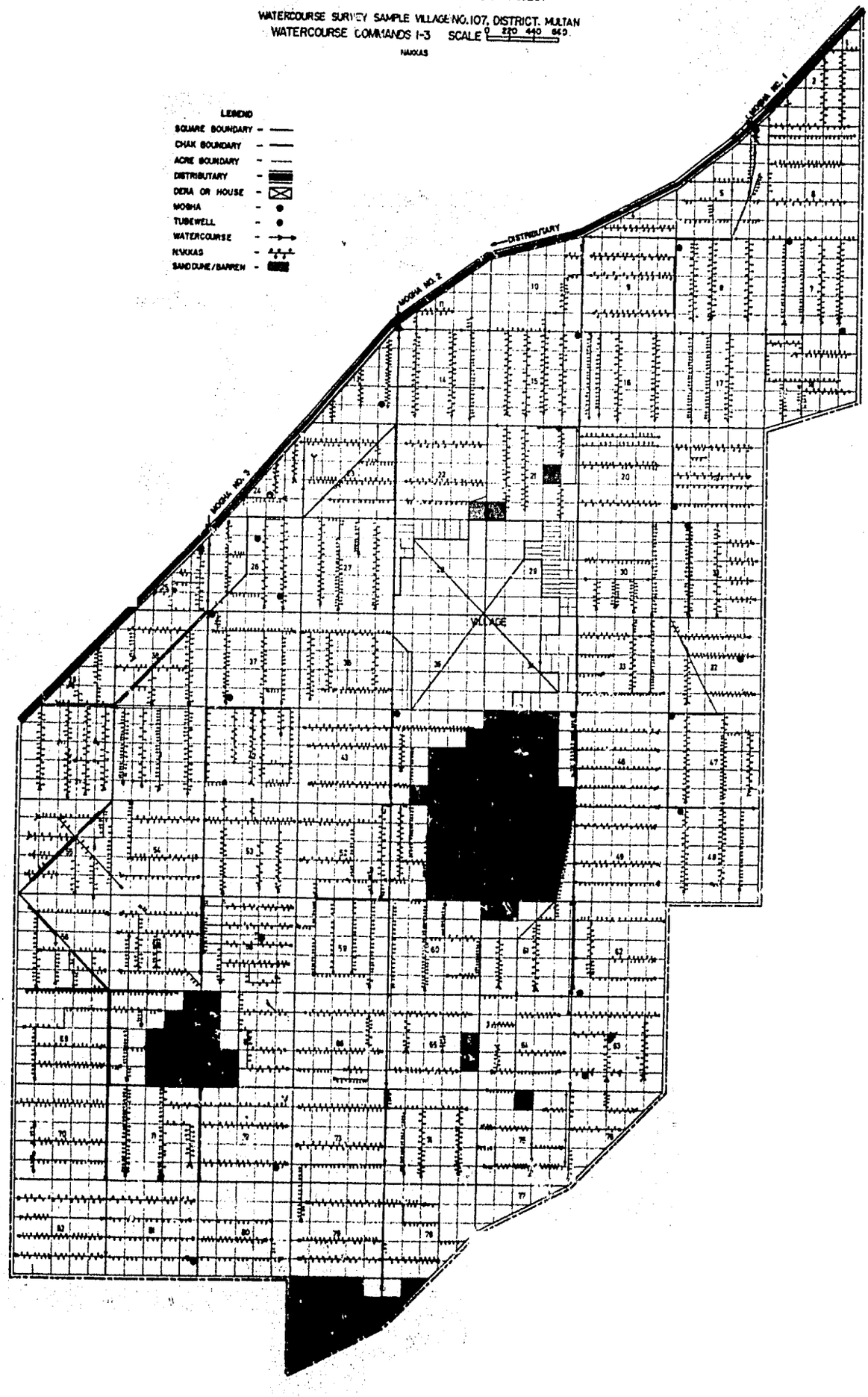



WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 106, SCARP TWO
WATERCOURSE COMMAND I , DISTRICT SARGODHA
NAKKAS
SCALE: 0 220 440 660
DRAIN CONTINUES
DRAIN BEGINS HERE
DISTRIBUTARY
LEGEND
AREA BOUNDARY
KATCHA ROAD
PACCA ROAD
DISTRIBUTARY
KATCHA IMPROVED W.C.
PACCA W.C.
W.C. ENDS
DERA OR HOUSE
T.W./ MOGHA
BARREN

WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE NO. 107, DISTRICT. MULTAN
WATERCOURSE COMMANDS 1-3 SCALE 0 220 440 660

NAKKAS

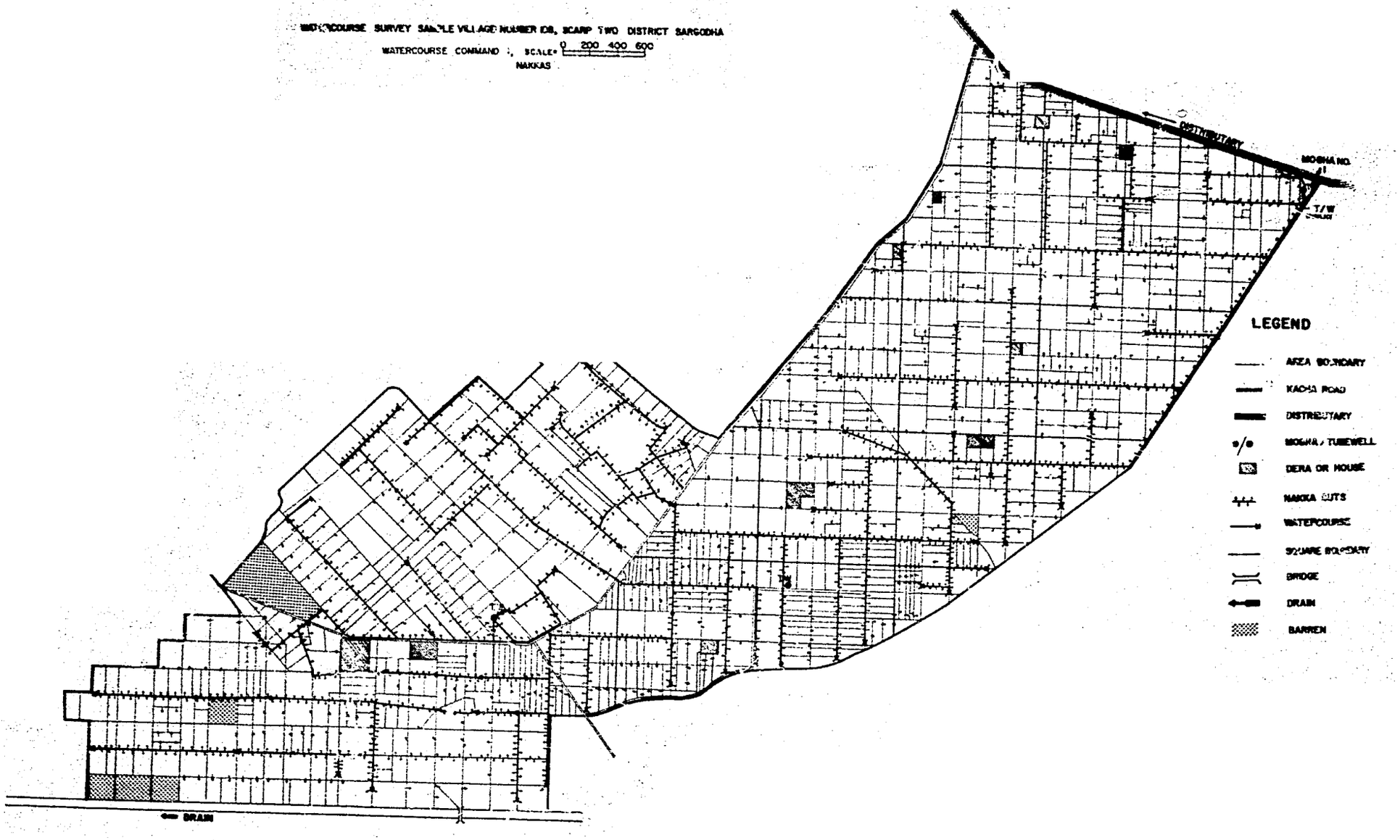


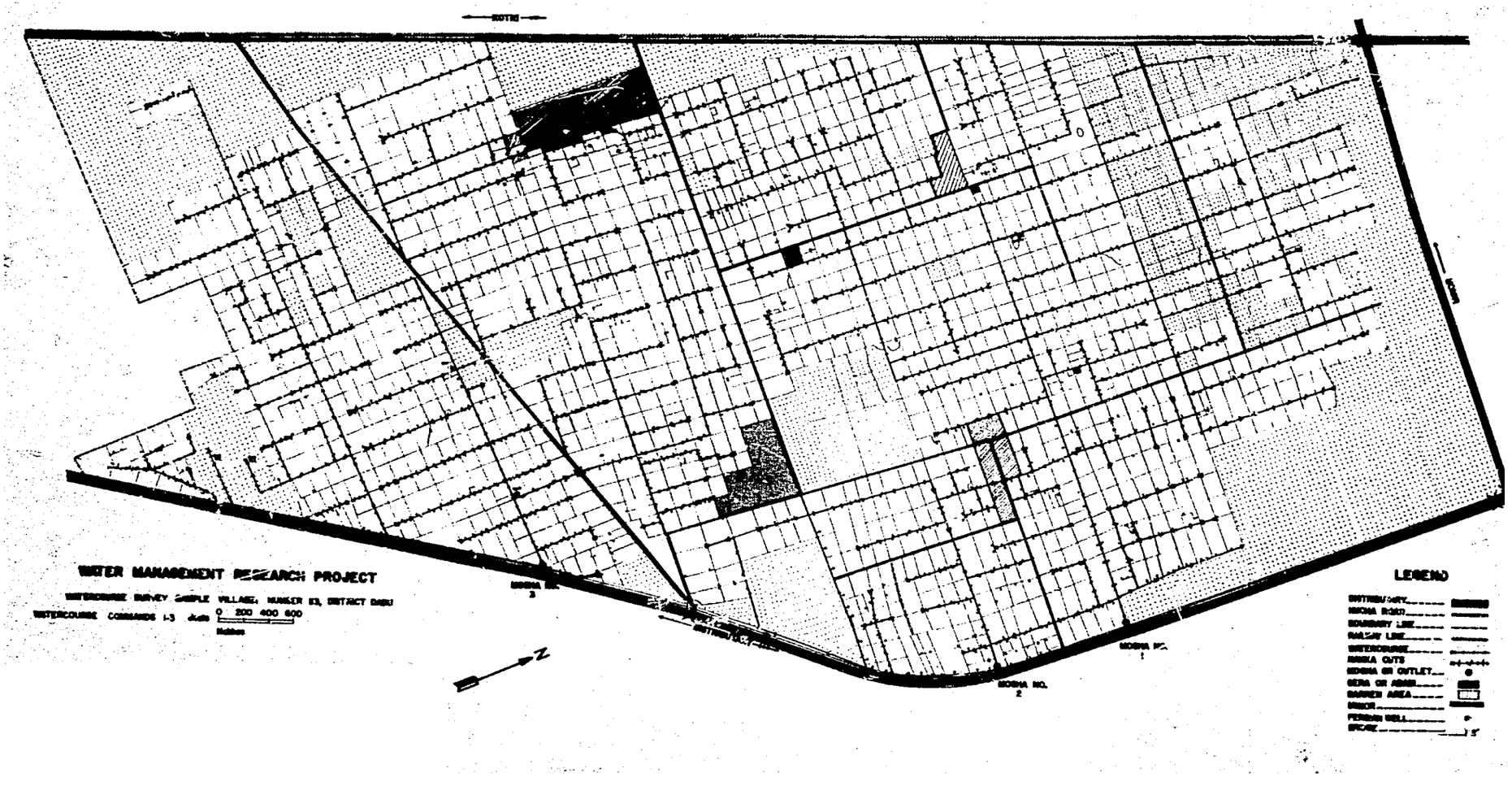
WATER MANAGEMENT RESEARCH PROJECT

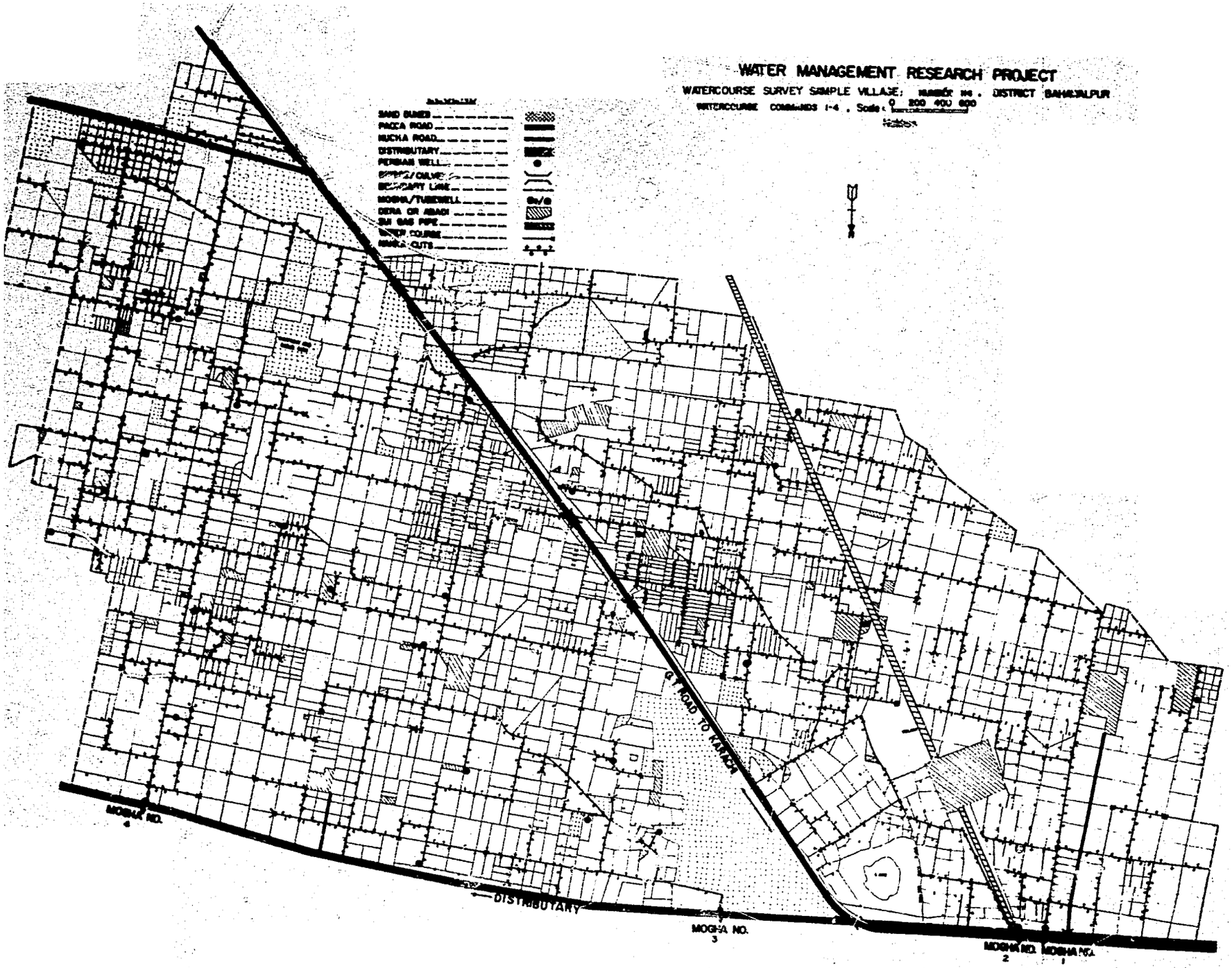
WATERCOURSE SURVEY SAMPLE VILLAGE NUMBER 108, SCARP TWO DISTRICT SARGODHA

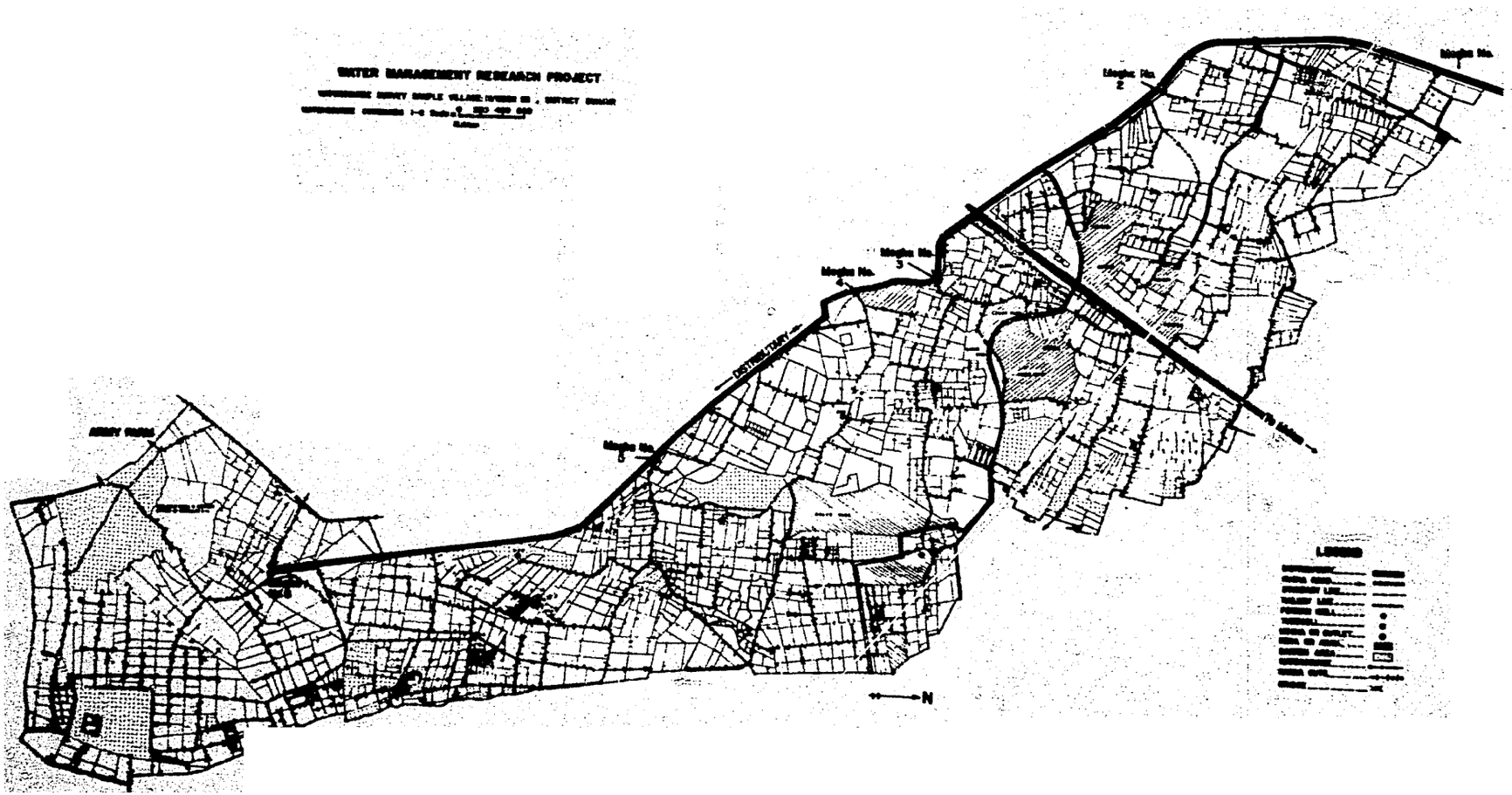
WATERCOURSE COMMAND : , SCALE: 0 200 400 600

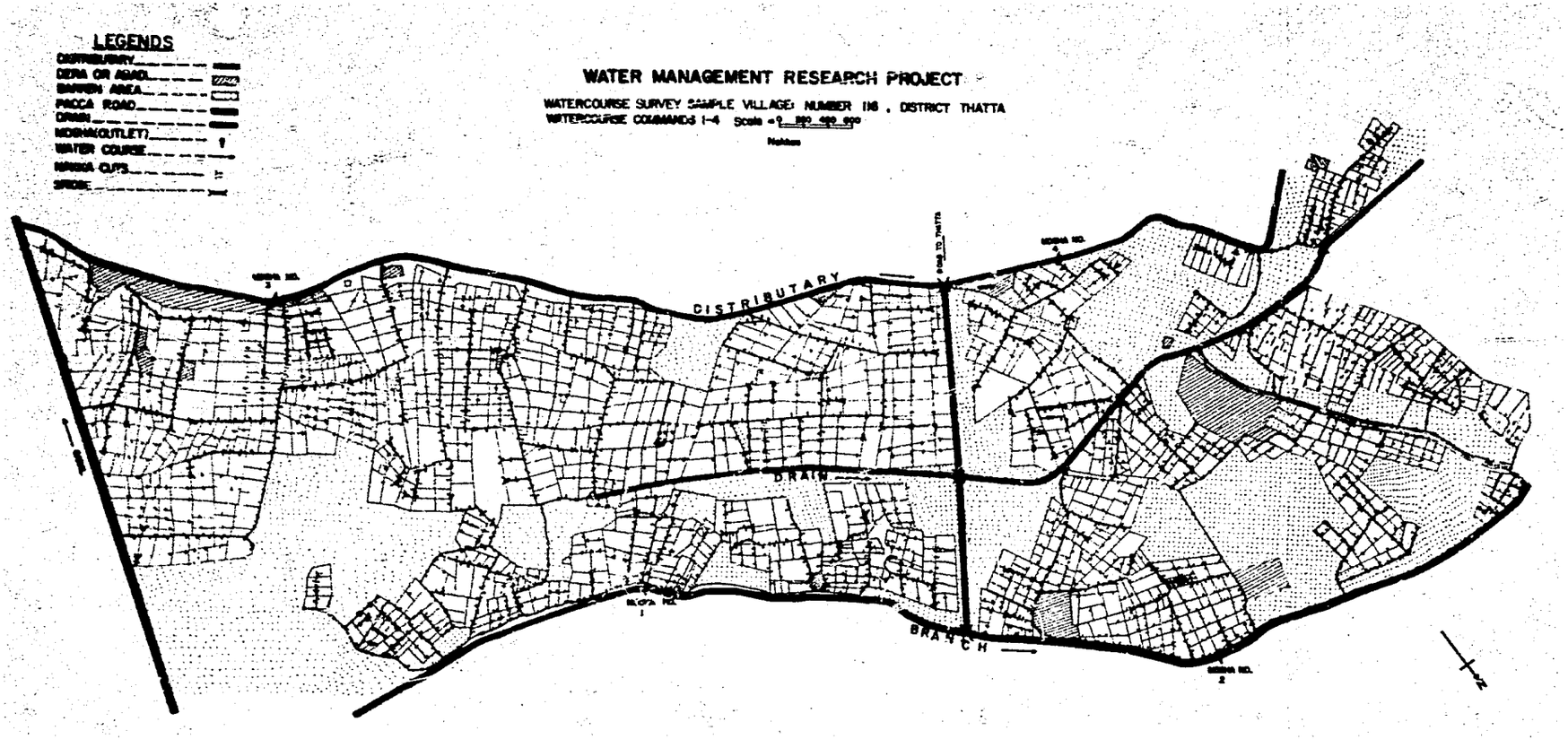
NAKKAS




WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE, NUMBER 13, DISTRICT DABU
WATERCOURSE COMMANDS 1-3 Scale 0 200 400 600
Meters
MOGHA NO. 3
MOGHA NO. 2
MOGHA NO. 1
N
LEGEND
DISTRIBUTARY
MOGHA ROAD
BOUNDARY LINE
RAILWAY LINE
WATERCOURSE
MOGHA GATE
MOGHA OR OUTLET
SERA OR ABADI
GARDEN AREA
DRAIN
PERMANENT WELL
BRIDGE


WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 96 . DISTRICT BAHAWALPUR
WATERCOURSE COMMANDS 1-4 . Scale: 0 200 400 800
SAND DUNES
PACCA ROAD
KUCHA ROAD
DISTRIBUTARY
PERMANENT WELL
SIPHON/CULVERT
SECONDARY LINE
MOGHA/TUBEWELL
DERA OR ABADI
GAS PIPE
WATER COURSE
MAIN CUTS
G.T. ROAD TO KARACHI
DISTRIBUTARY
MOGHA NO. 4
MOGHA NO. 3
MOGHA NO. 2
MOGHA NO. 1


WATER MANAGEMENT RESEARCH PROJECT
Mingha No. 1
Mingha No. 2
Mingha No. 3
Mingha No. 4
Mingha No. 5
N


LEGENDS
DISTRIBUTARY
DERA OR ABADI
BARREN AREA
PACCA ROAD
DRAIN
MOGHA(OUTLET)
WATER COURSE
NAKKA OUTS
BRIDGE
WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 116 , DISTRICT THATTA
WATERCOURSE COMMANDS 1-4 Scale =
Nakkas
DISTRIBUTARY
DRAIN
BRANCH

APPENDIX IV

Part C

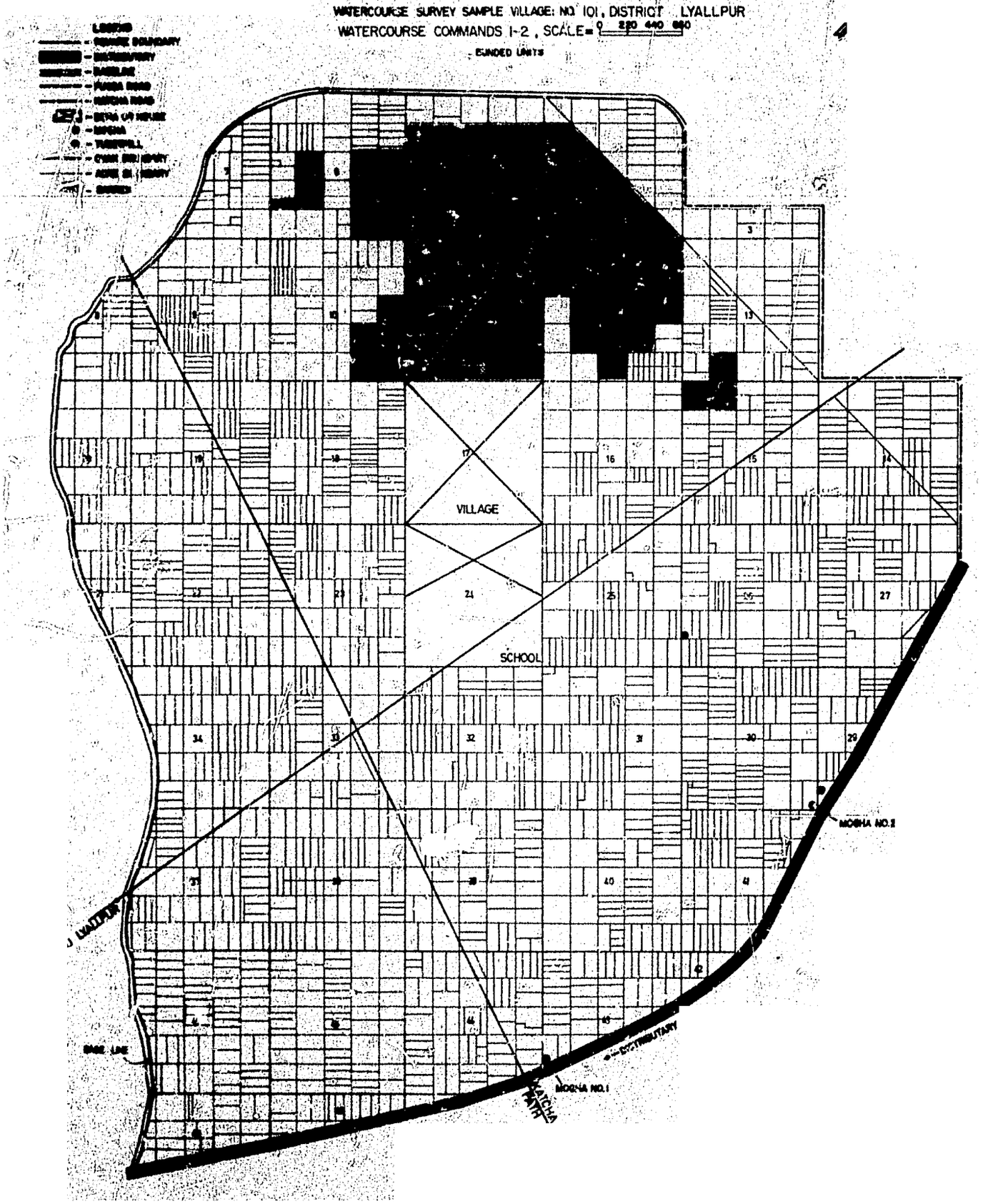
BUNDED UNIT MAP

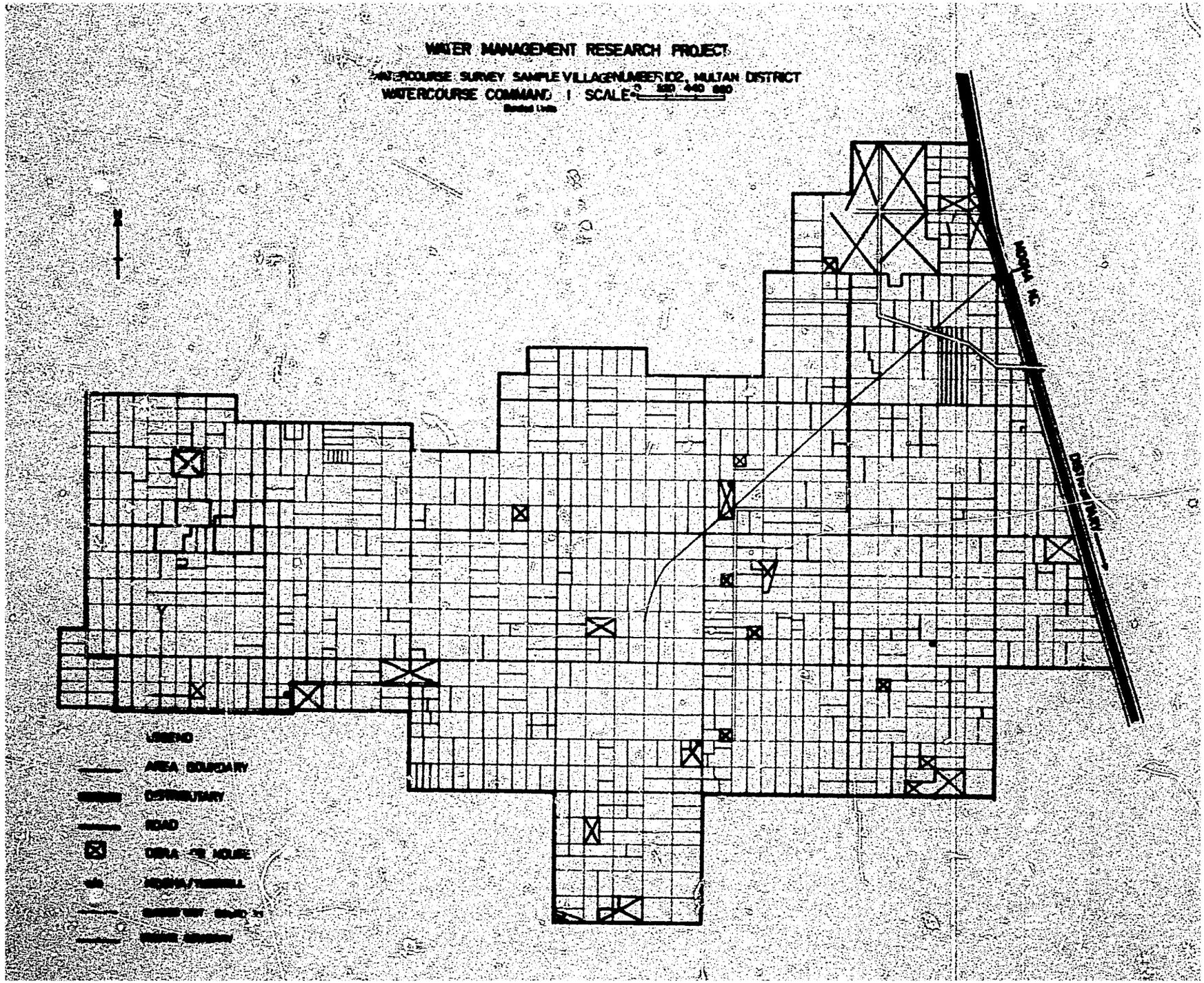
WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE: NO 101, DISTRICT LYALLPUR

WATERCOURSE COMMANDS 1-2, SCALE= 0 220 440 880

- BUNDED UNITS




WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE NUMBER 102, MULTAN DISTRICT
WATERCOURSE COMMAND 1 SCALE
Scaled Units
N
LEGEND
AREA BOUNDARY
DISTRIBUTARY
ROAD
DERA OR HOUSE
MOSQUE/TUBEWELL
SURVEY WAY GRID
MOSQUE WALL
DISTRICT ROAD

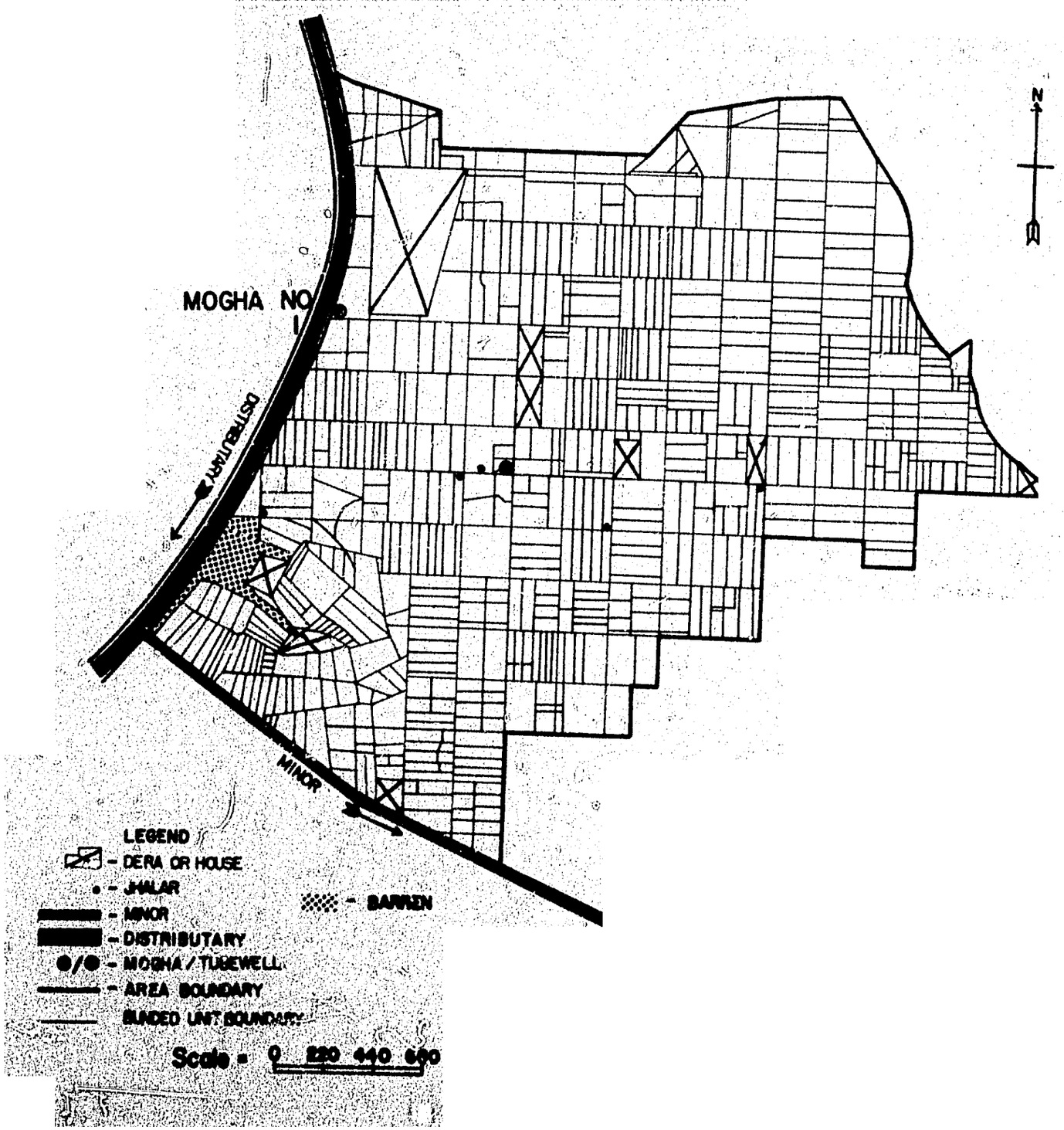
WATER MANAGEMENT RESEARCH PROJECT

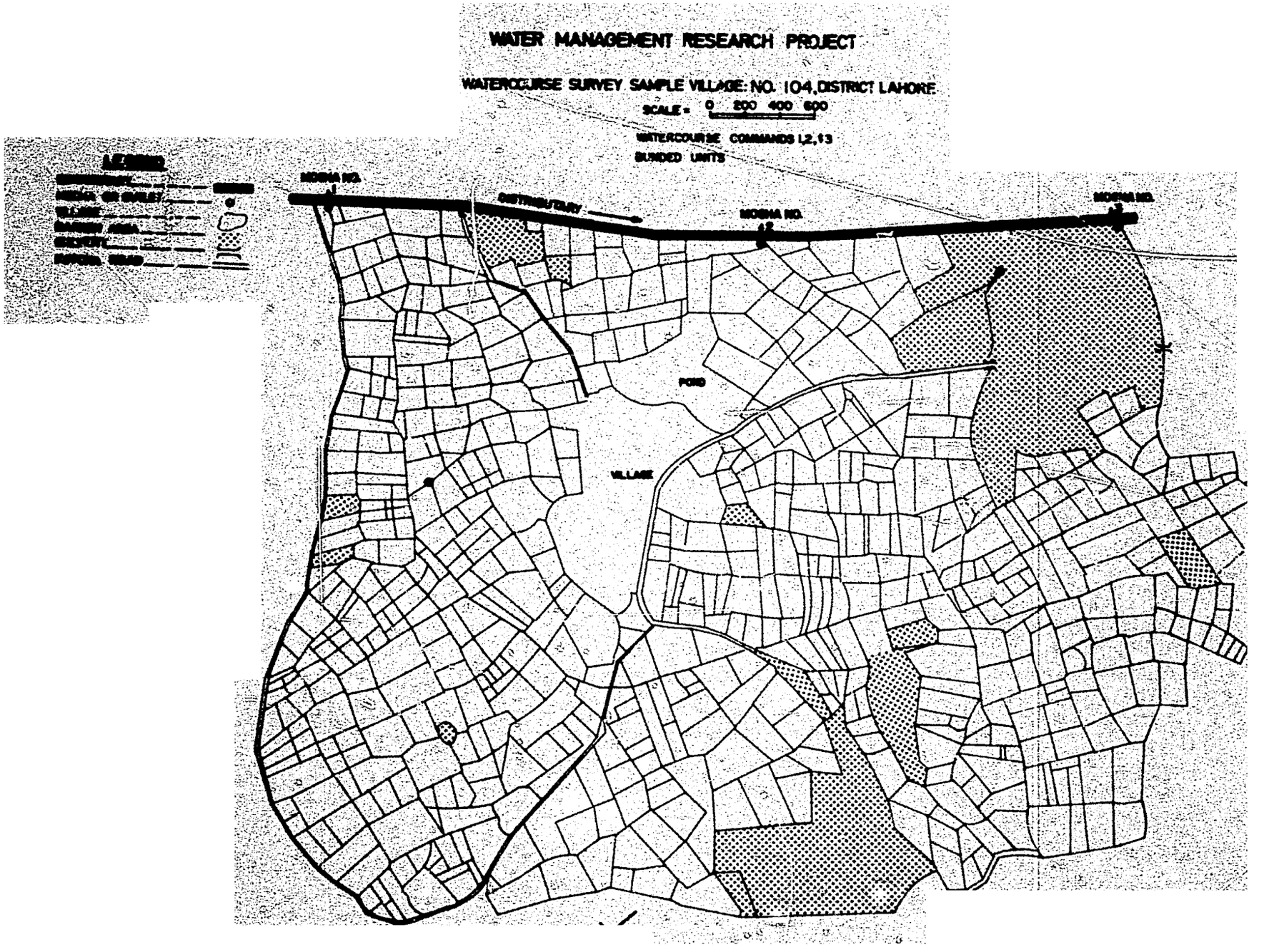
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 103

DISTRICT LAHORE

WATERCOURSE COMMAND I

BUNDED UNT



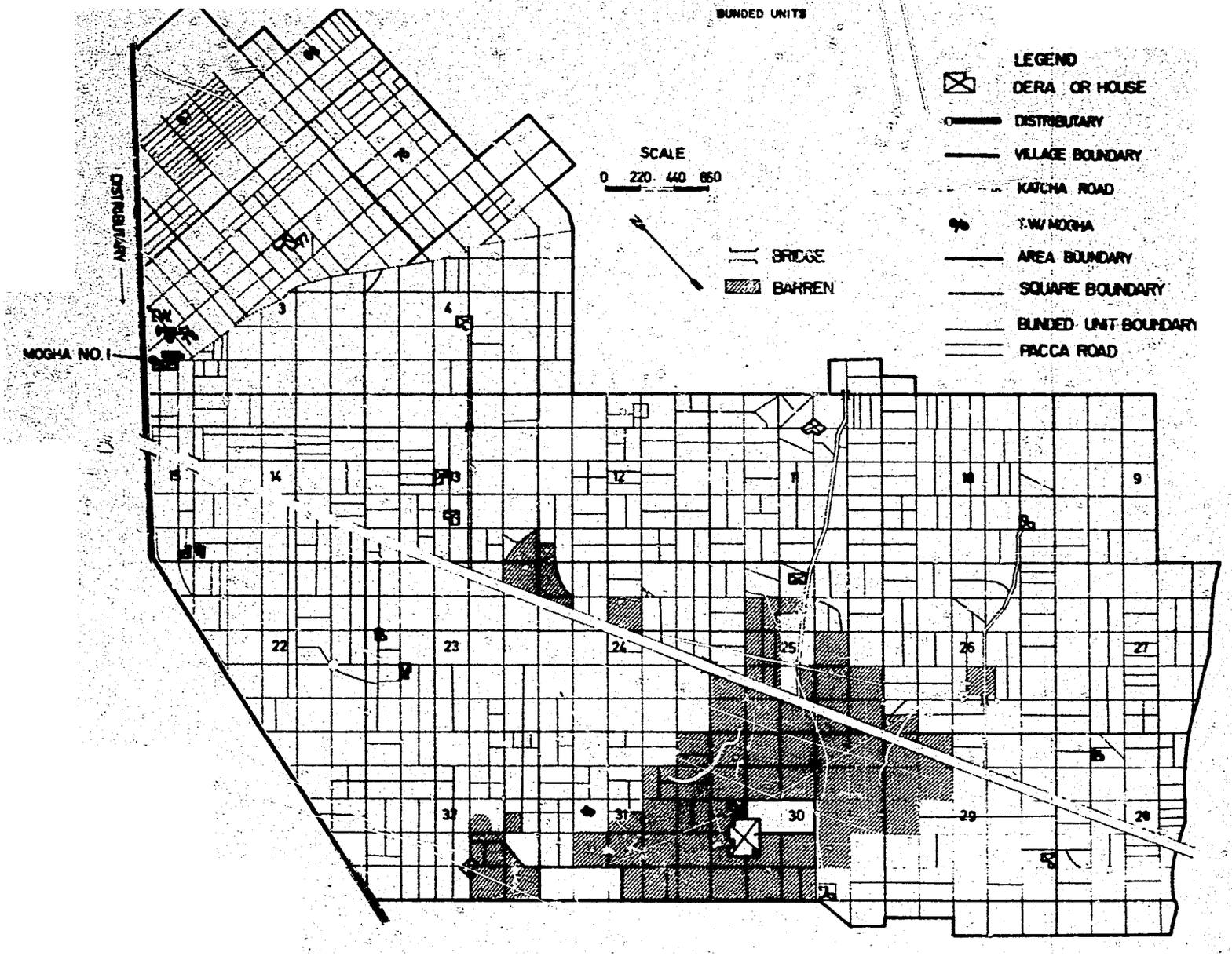

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 104, DISTRICT LAHORE
SCALE = 0 200 400 600
WATERCOURSE COMMANDS 1,2,13
BUNDED UNITS
LEGEND
MOGHA NO.
DISTRIBUTARY
MOGHA NO.
MOGHA NO.
POND
VILLAGE

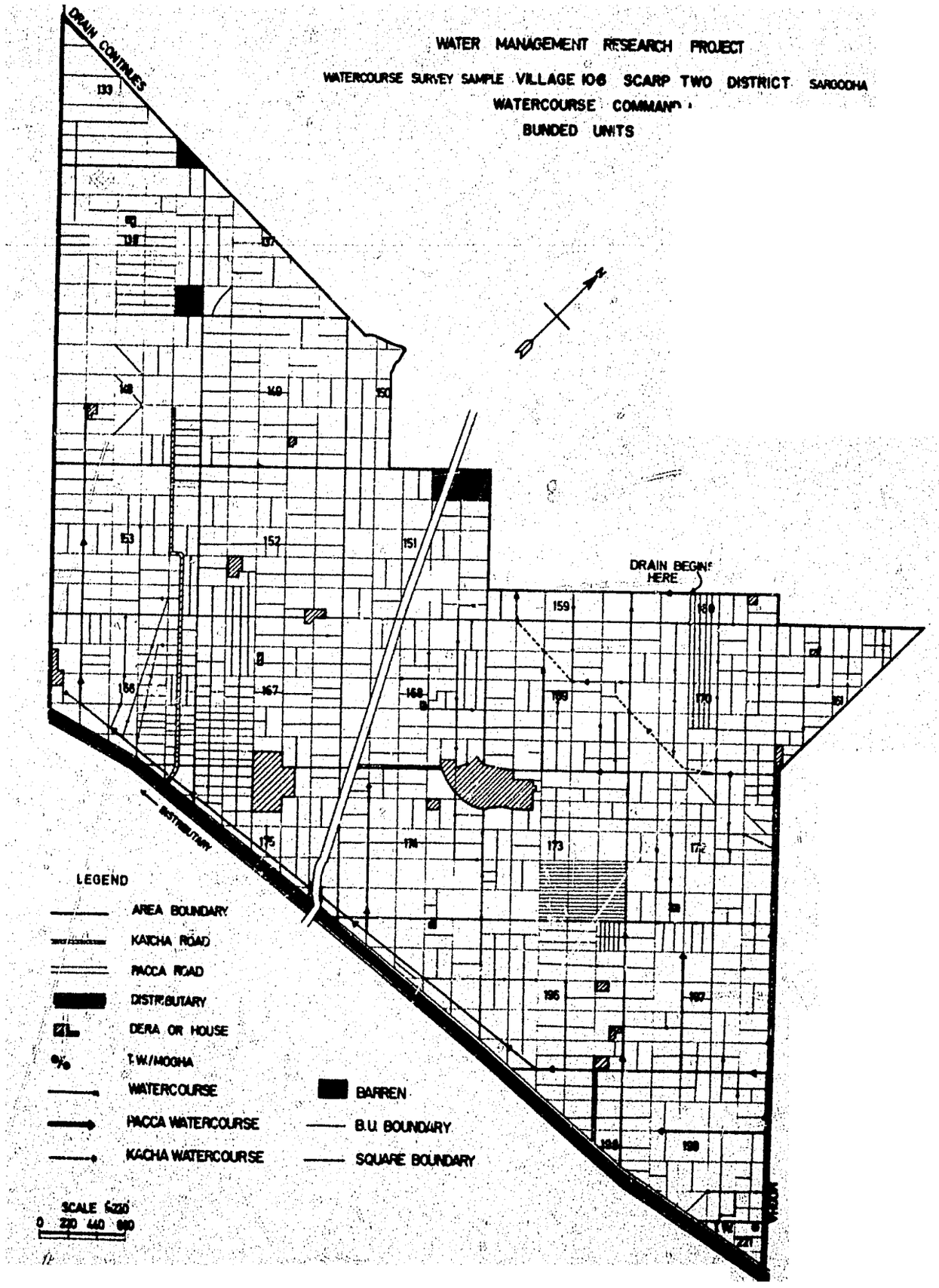
WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 105, SCARP TWO

WATERCOURSE COMMAND I, DISTRICT SARGODHA

BUNDED UNITS



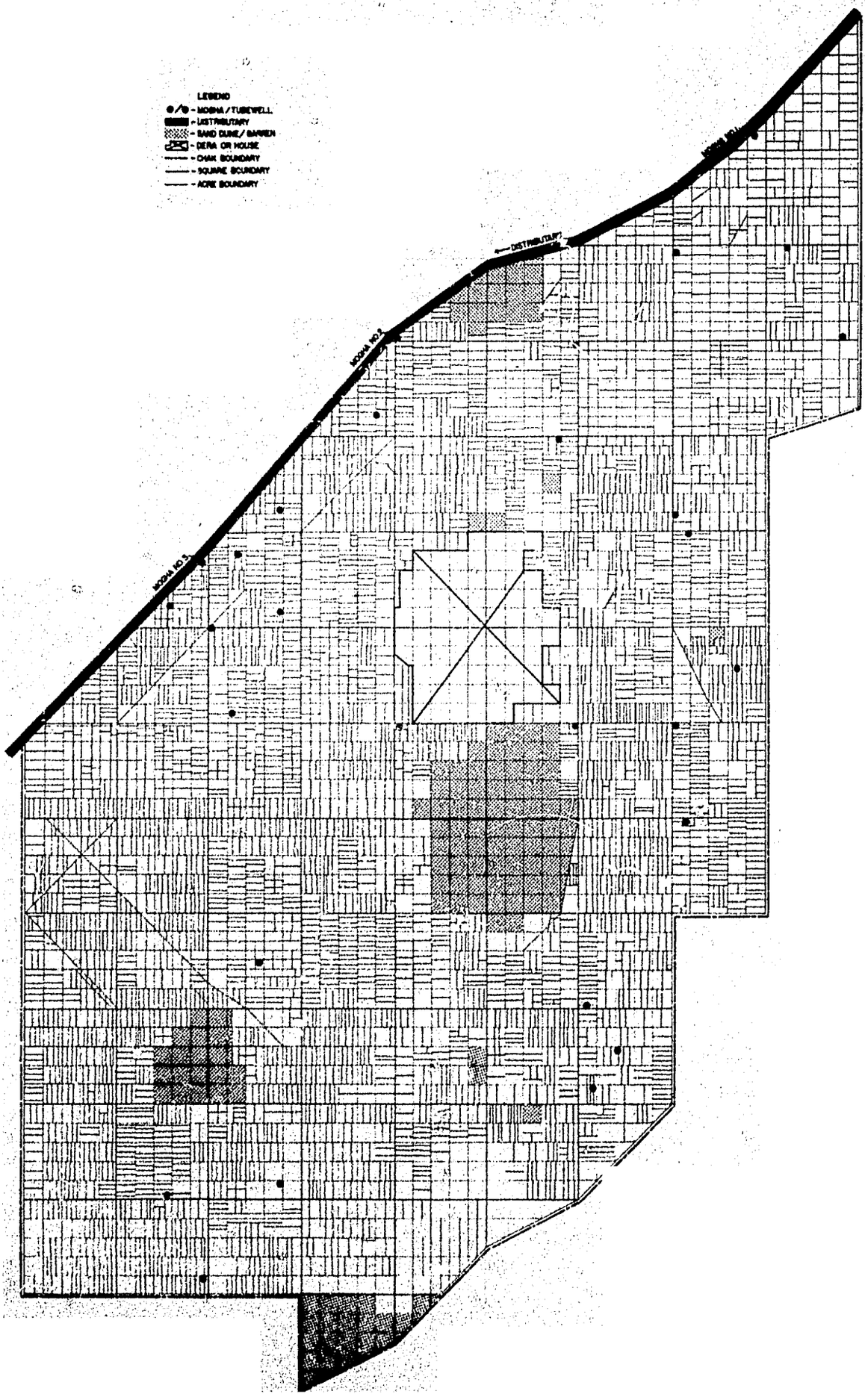

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE 106 SCARP TWO DISTRICT SARGODHA
WATERCOURSE COMMAND
BUNDED UNITS
DRAIN CONTINUES
DRAIN BEGINS HERE
DISTRIBUTARY
LEGEND
AREA BOUNDARY
KATCHA ROAD
PACCA ROAD
DISTRIBUTARY
DERA OR HOUSE
T.W./MOGHA
WATERCOURSE
PACCA WATERCOURSE
KACHA WATERCOURSE
BARREN
B.U. BOUNDARY
SQUARE BOUNDARY
SCALE 1:220
0 220 440 880

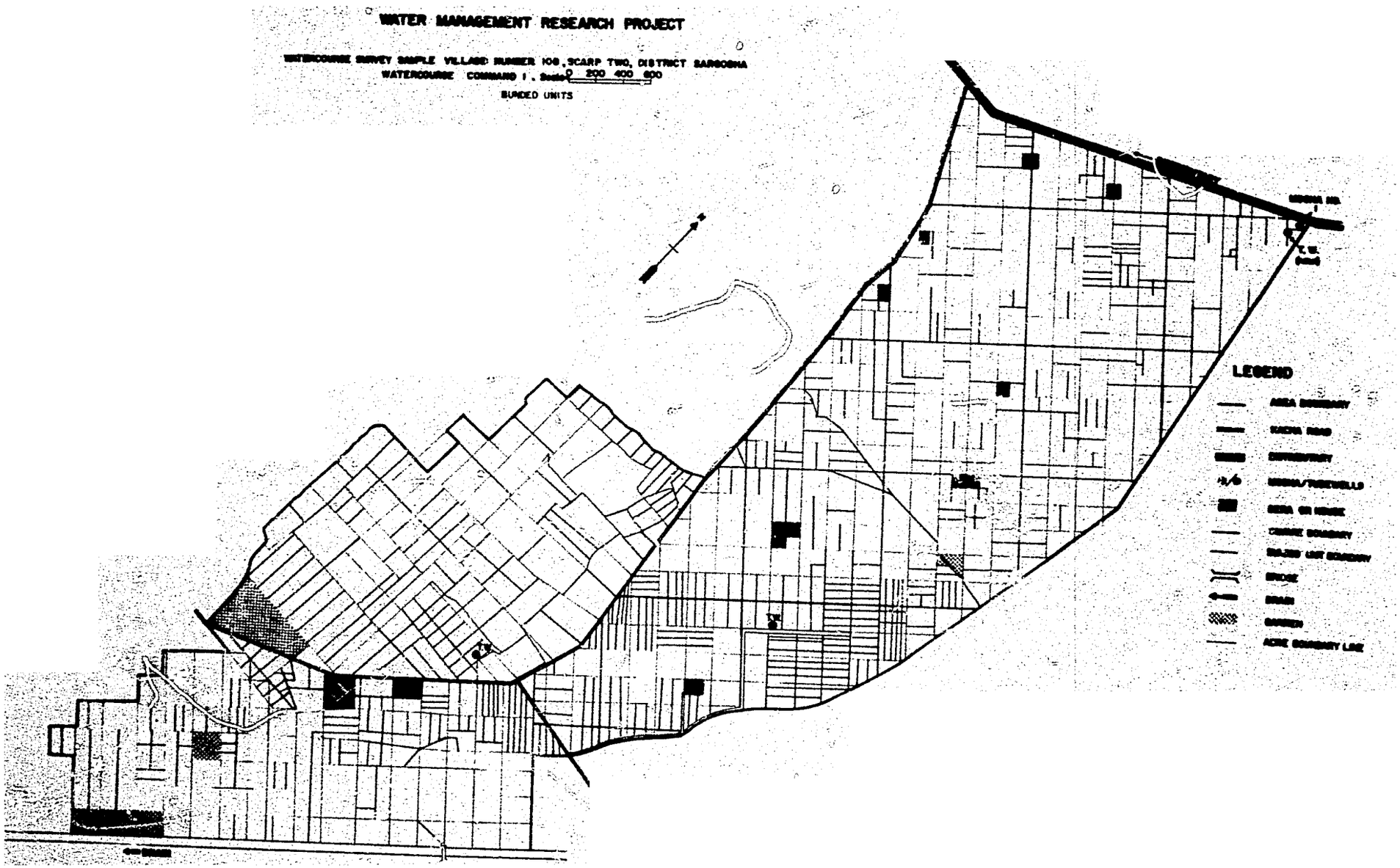
WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE NO.107, DISTRICT MULTAN

WATERCOURSE COMMAND I-3, SCALE 0 220440 660

BUNDED UNITS



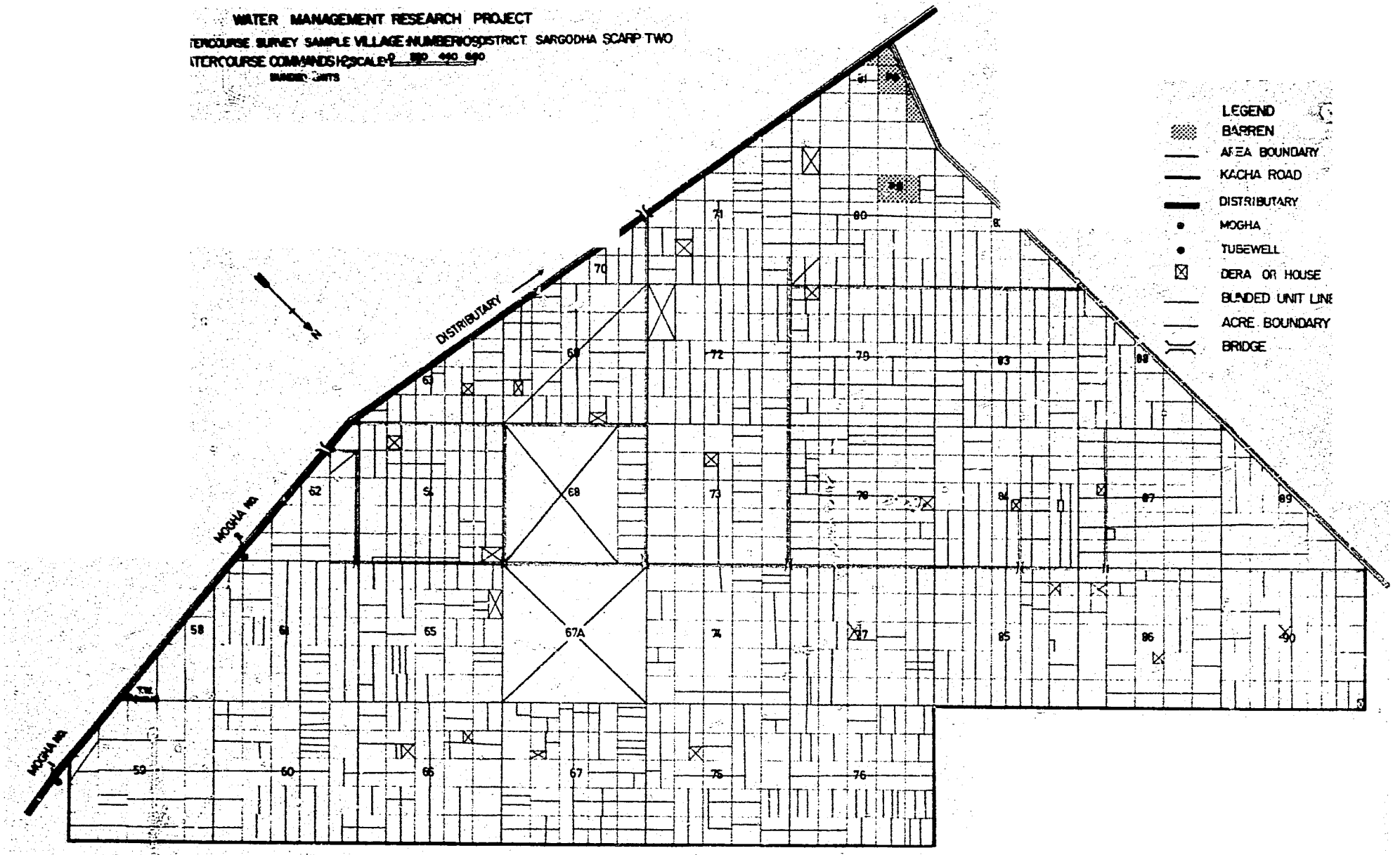

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE NUMBER 108, SCARP TWO, DISTRICT SARGODHA
WATERCOURSE COMMAND 1 . Scale 0 200 400 600
BUNDED UNITS
LEGEND

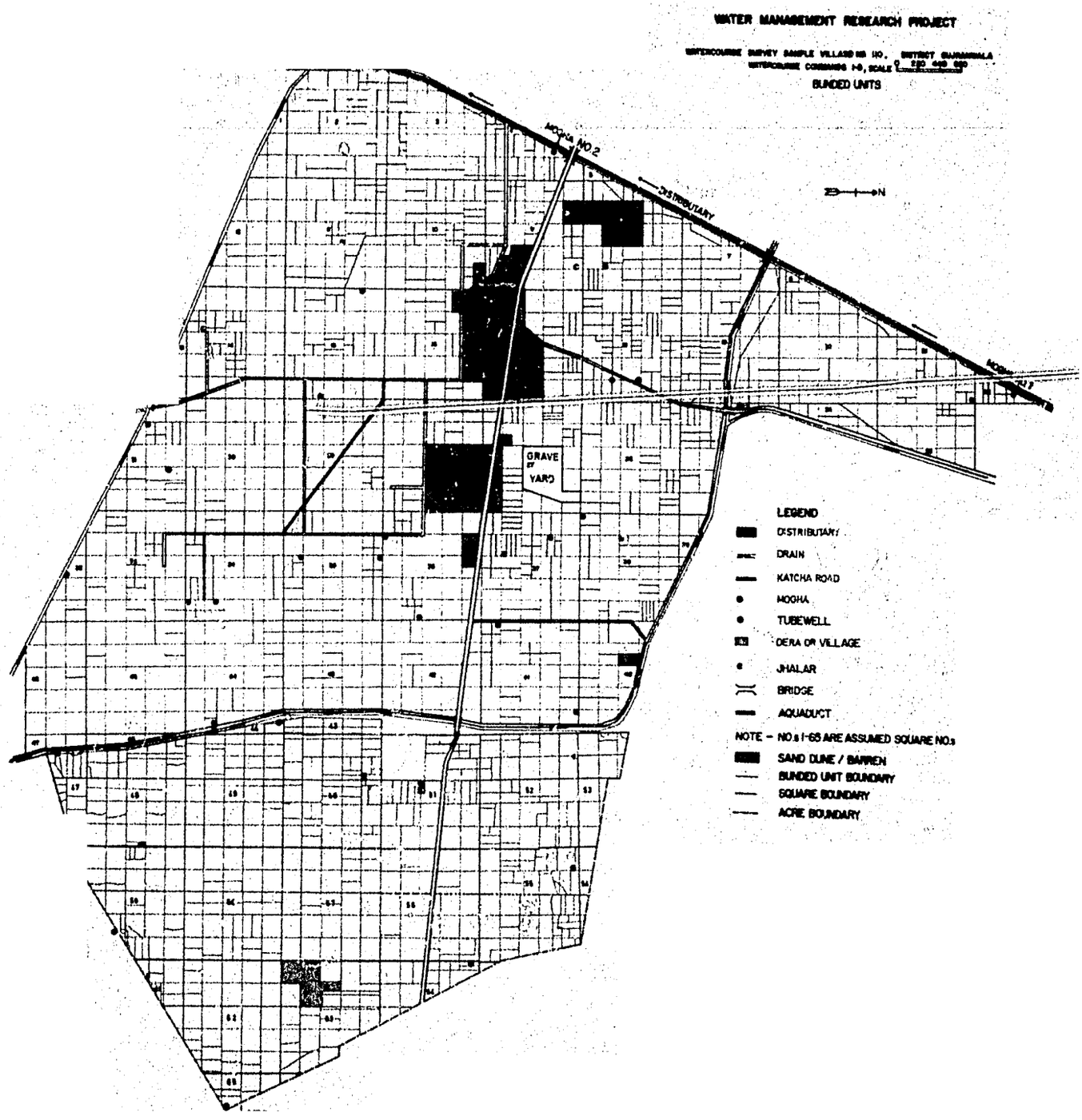
WATER MANAGEMENT RESEARCH PROJECT

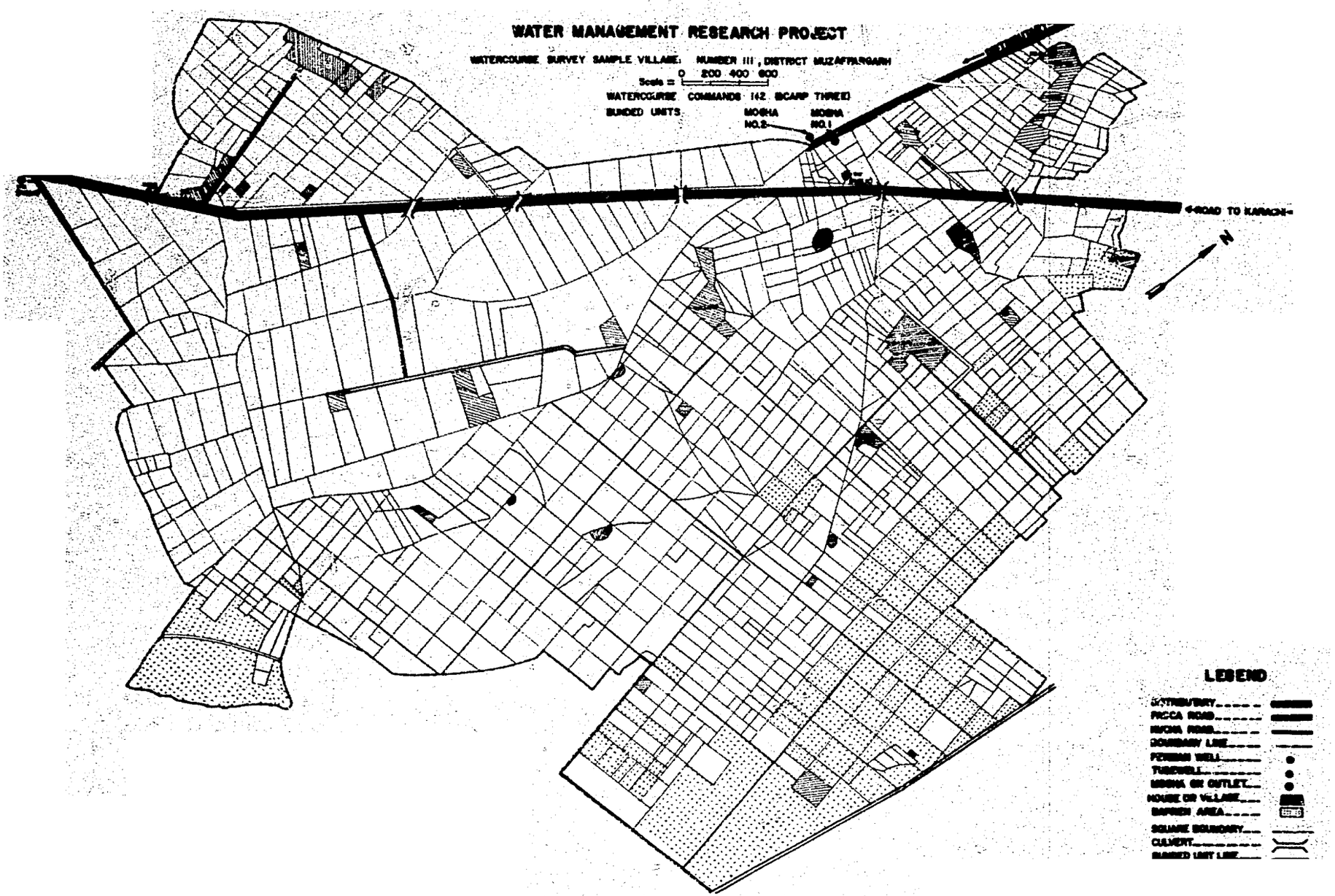
TERCOURSE SURVEY SAMPLE VILLAGE NUMBER 109 DISTRICT SARGODHA SCARP TWO

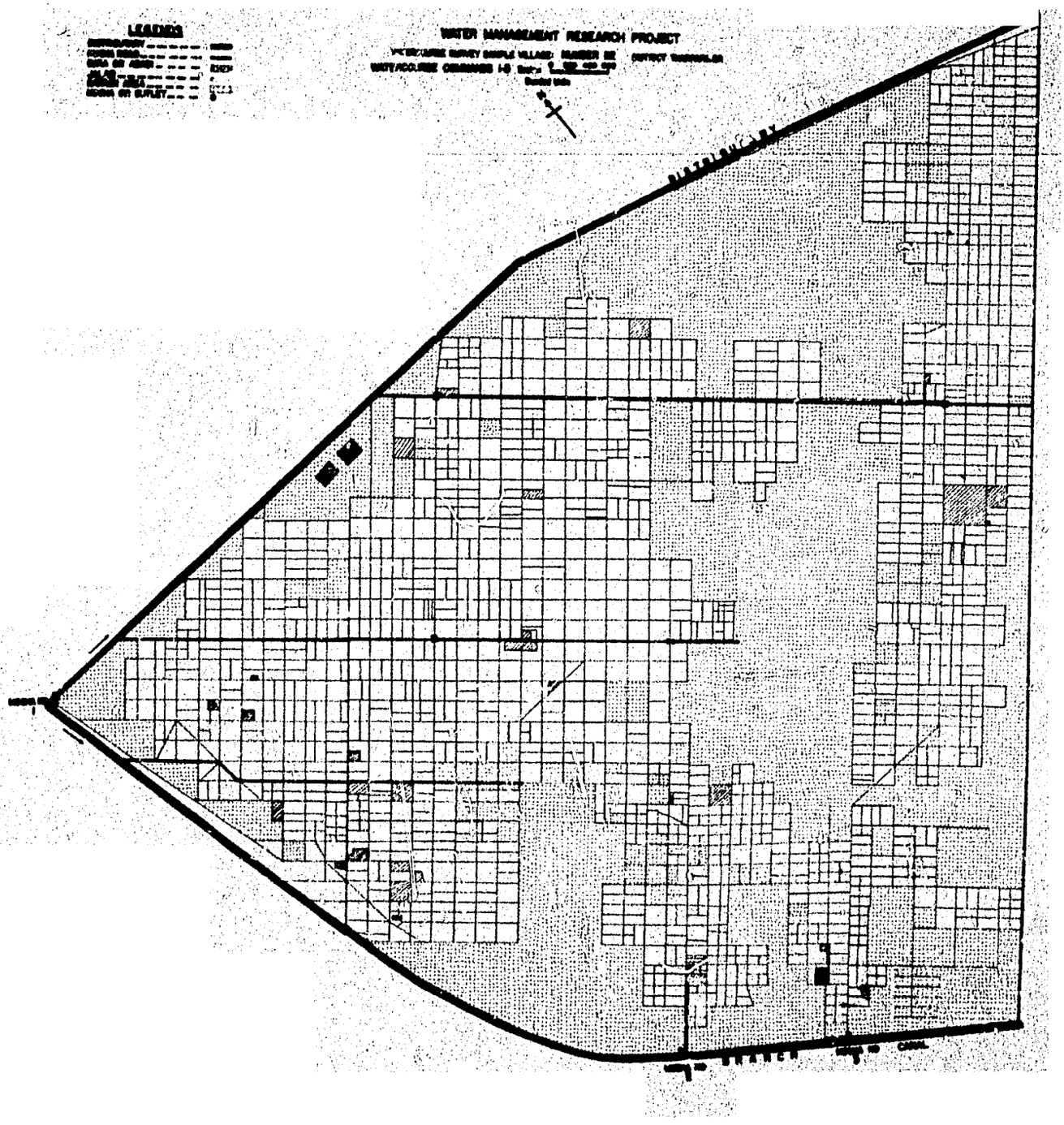
ATERCOURSE COMMANDS H2 SCALE: 0 220 440 660

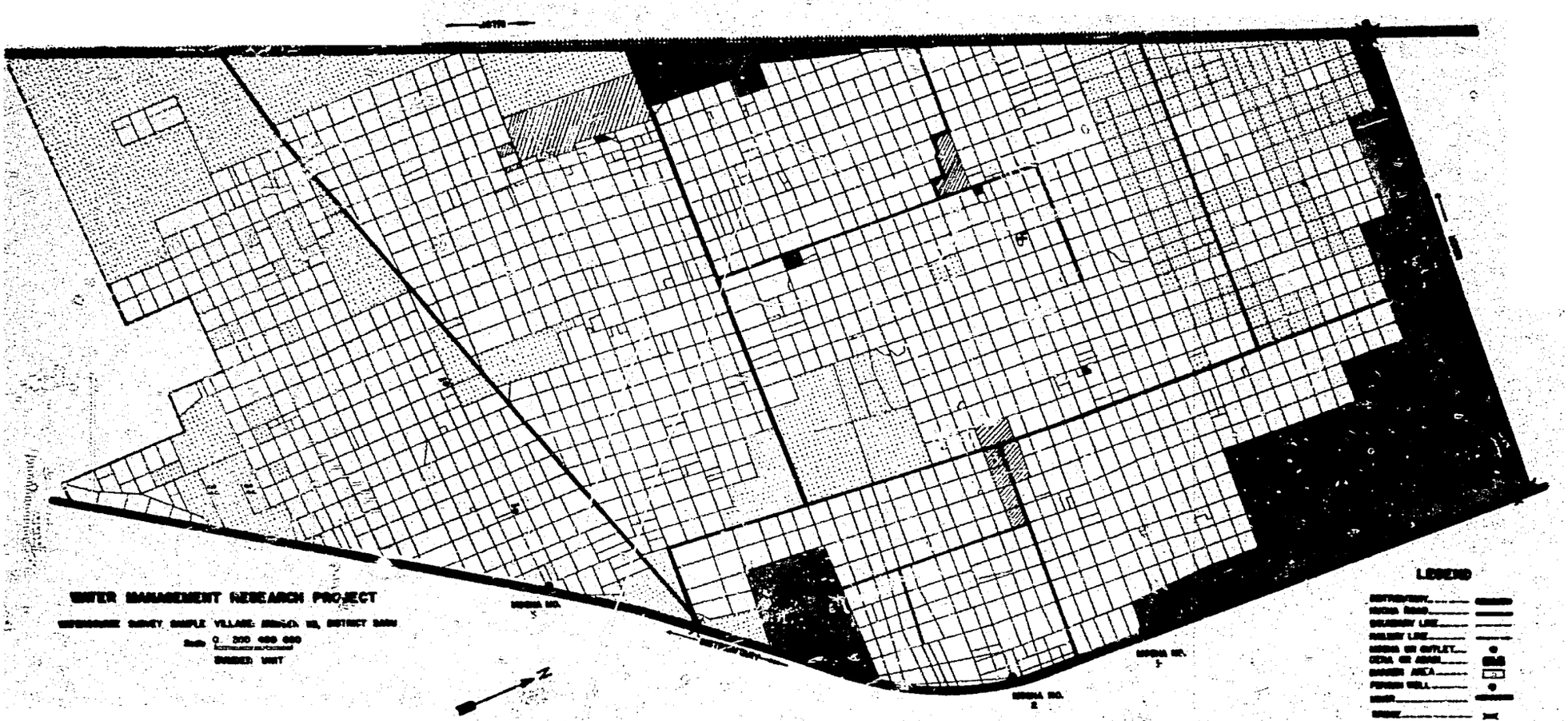
MARGIN: UNITS

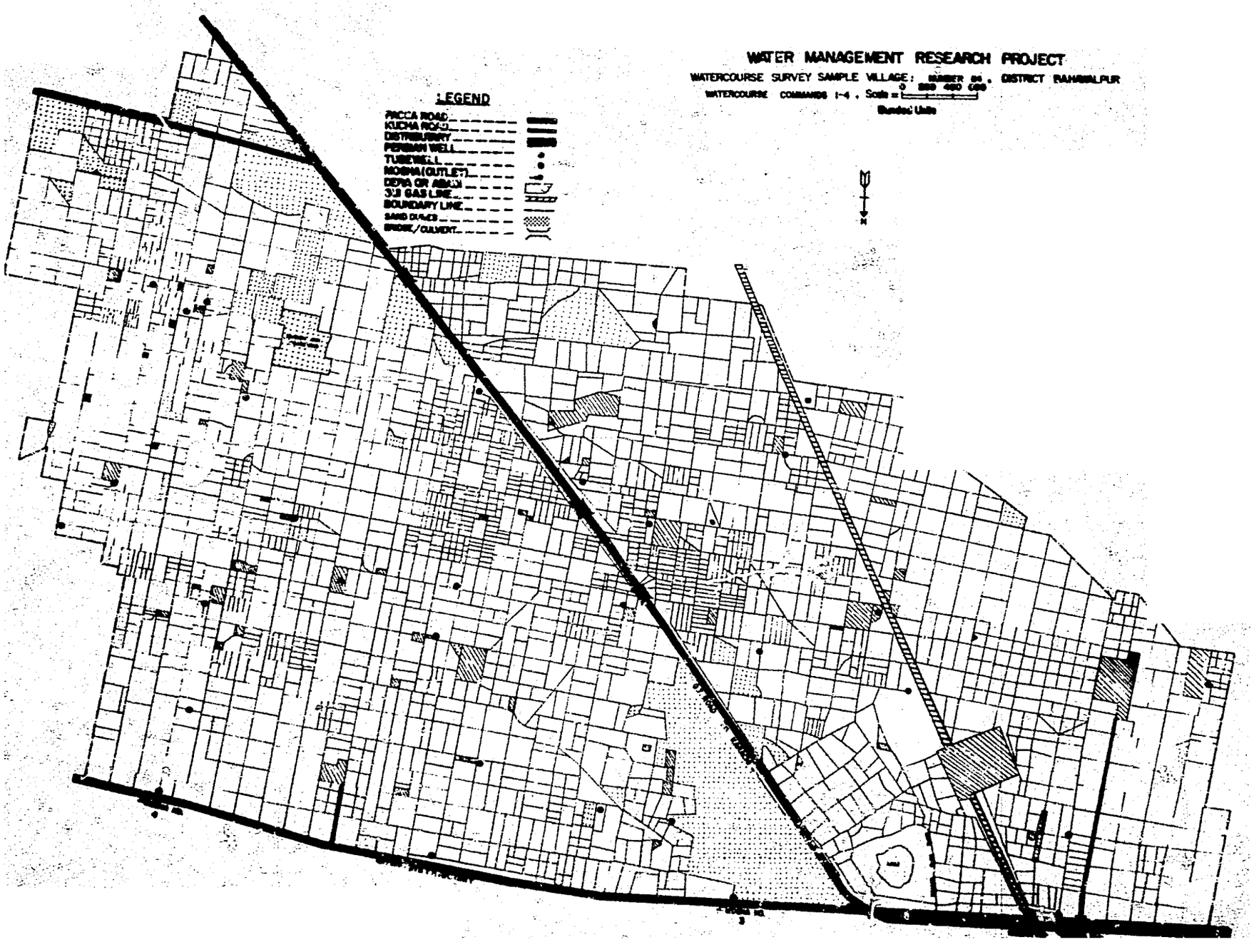


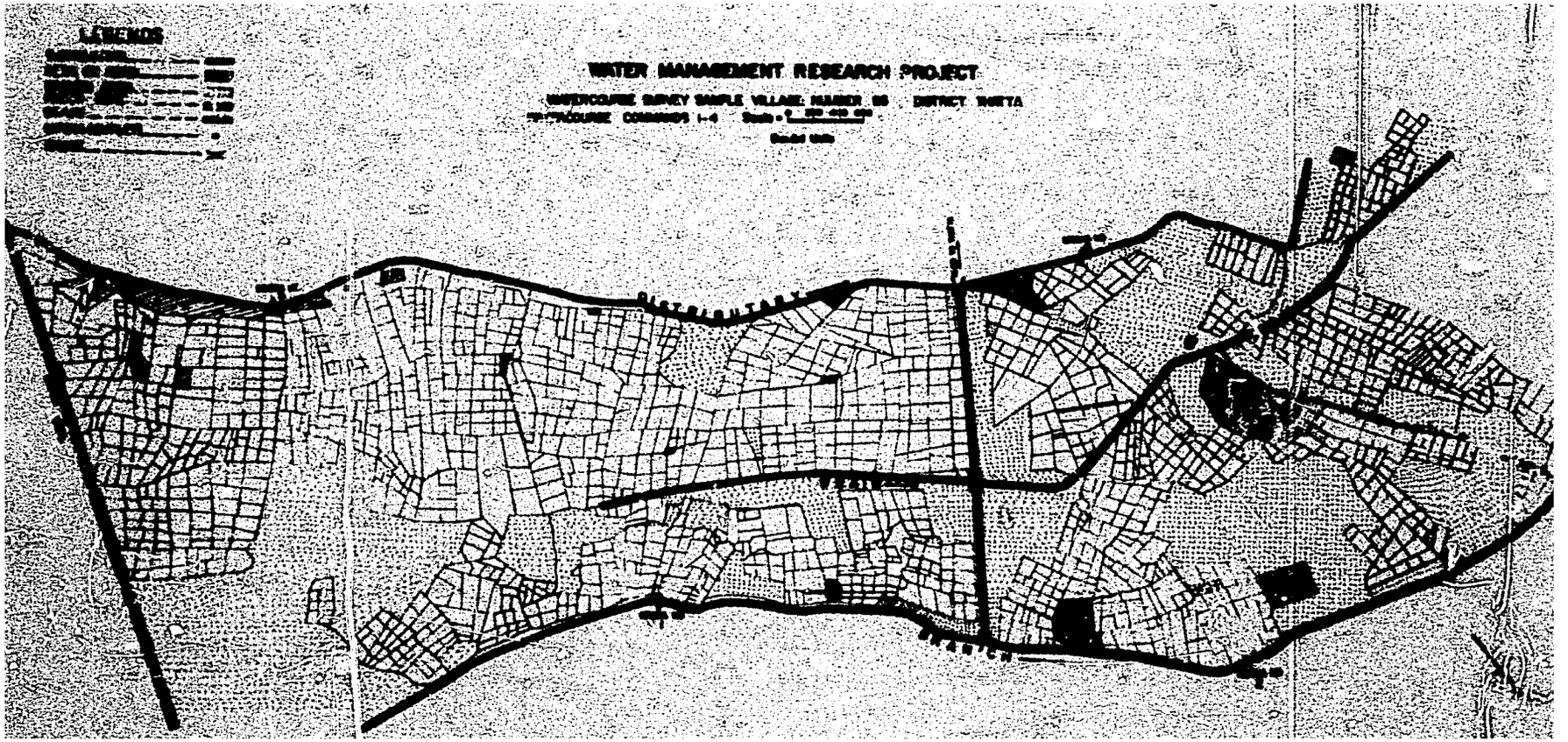

WATER MANAGEMENT RESEARCH PROJECT
BUNDED UNITS
MOGHA NO.2
DISTRIBUTARY
N
GRAVE YARD
LEGEND
DISTRIBUTARY
DRAIN
KATCHA ROAD
MOGHA
TUBEWELL
DERA OR VILLAGE
JHALAR
BRIDGE
AQUADUCT
NOTE - NO.s 1-65 ARE ASSUMED SQUARE NO.s
SAND DUNE / BARREN
BUNDED UNIT BOUNDARY
SQUARE BOUNDARY
ACRE BOUNDARY


WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER III, DISTRICT MUZAFFARGARH
Scale = 0 200 400 600
WATERCOURSE COMMANDS 142 (SCARP THREE)
BUNDED UNITS
MOGHA NO.2
MOGHA NO.1
ROAD TO KARACHI
N
LEGEND
EXTREMITY
PACCA ROAD
MOGHA ROAD
BOUNDARY LINE
PERMAN WELL
TUBEWELL
MOGHA OR OUTLET
HOUSE OR VILLAGE
BARREN AREA
SQUARE BOUNDARY
CULVERT
BUNDED UNIT LINE


LEGEND
WATER MANAGEMENT RESEARCH PROJECT
CANAL


WATER MANAGEMENT RESEARCH PROJECT
SURVEY SAMPLE VILLAGE
DISTRICT DAMI
Scale 0 200 400 600
GRIDDED UNIT
N
LEGEND

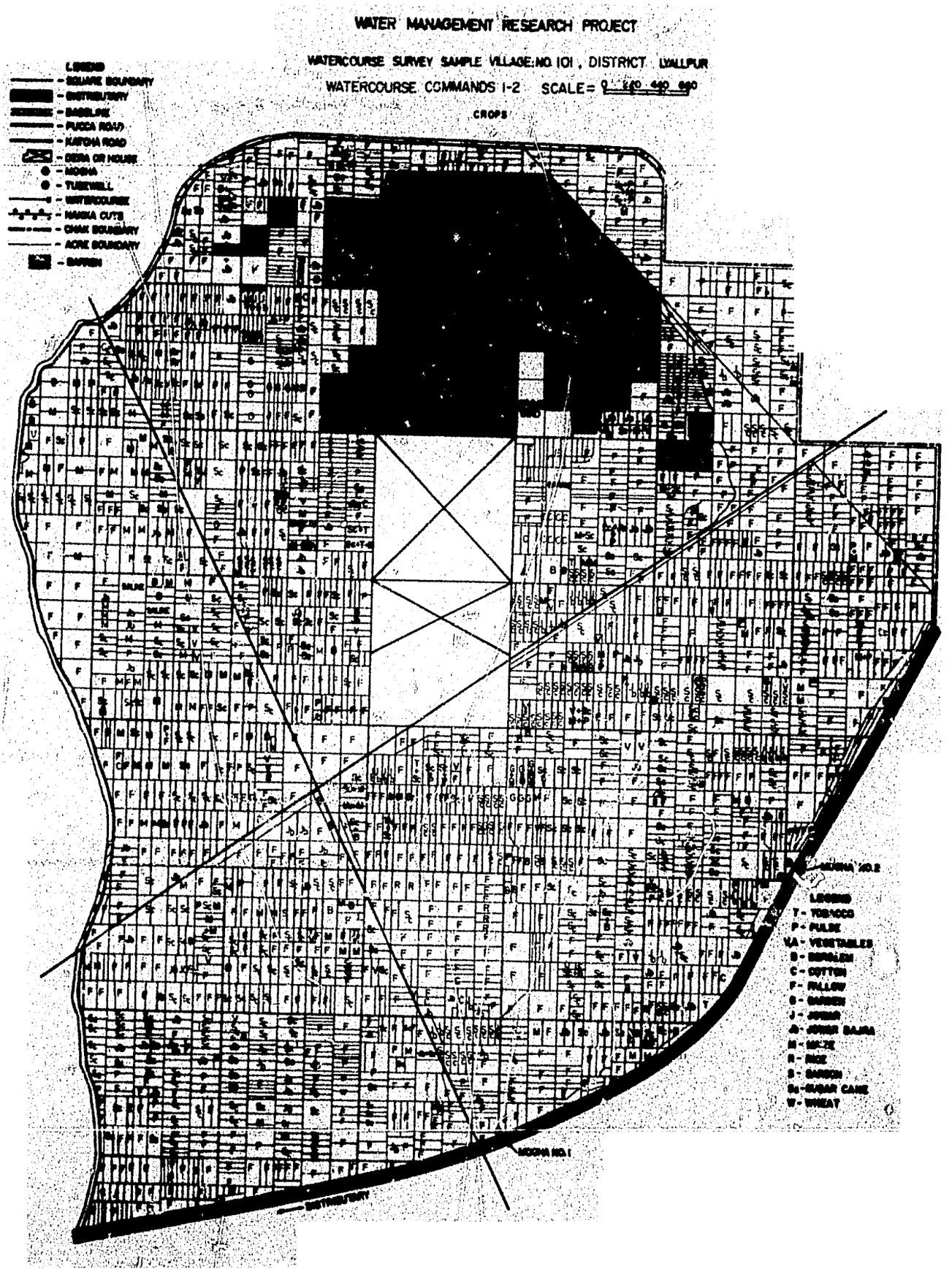

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 84 , DISTRICT BAHAWALPUR
WATERCOURSE COMMANDS 1-4 , Scale = 0 200 400 600
Bunded Units
LEGEND
PACCA ROAD
KUCHA ROAD
DISTRIBUTARY
PERMAN WELL
TUBEWELL
MOGHA(OUTLET)
DEPA OR ABAJI
SUI GAS LINE
BOUNDARY LINE
SAND DUNES
BRIDGE/CULVERT


WATER MANAGEMENT RESEARCH PROJECT

APPENDIX IV

Part D

CROPPING MAPS


WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 101, DISTRICT LYALLPUR
WATERCOURSE COMMANDS 1-2
SCALE =
CROPS
LEGEND
- SQUARE BOUNDARY
- DISTRIBUTARY
- BASELINE
- PUCCA ROAD
- KATCHA ROAD
- DERA OR HOUSE
- MOGHA
- TUBEWELL
- WATERCOURSE
- NAKKA CUTS
- CHAK BOUNDARY
- ACRE BOUNDARY
- BARREN
MOGHA NO. 2
MOGHA NO. 1
DISTRIBUTARY
LEGEND
T - TOBACCO
P - PULSE
VA - VEGETABLES
B - BERSEEM
C - COTTON
F - FALLOW
G - GARDEN
J - JOWAR
Jb - JOWAR BAJRA
M - MAIZE
R - RICE
S - SARSON
Sc - SUGAR CANE
W - WHEAT

WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 102, DISTRICT MULTAN

WATERCOURSE COMMAND I , SCALE: 0 220 440 880

CROPS

LEGEND
F - FALLOW
B - BERSEEM
C - COTTON
J - JOWAR
Jb - JOWAR BAJRA
Fd - FODDER
M - MAIZE
Sc - SUGAR CANE
V,A - VEGETABLES
G - GARDEN
L - LUCERNE

N

MOGHA NO. 1

DISTRIBUTARY

LEGEND

AREA BOUNDARY

DISTRIBUTARY

ROAD

MOGHA / TUBEWELL

DERA OR HOUSE

BUNDED UNIT BOUNDARY

SQUARE BOUNDARY

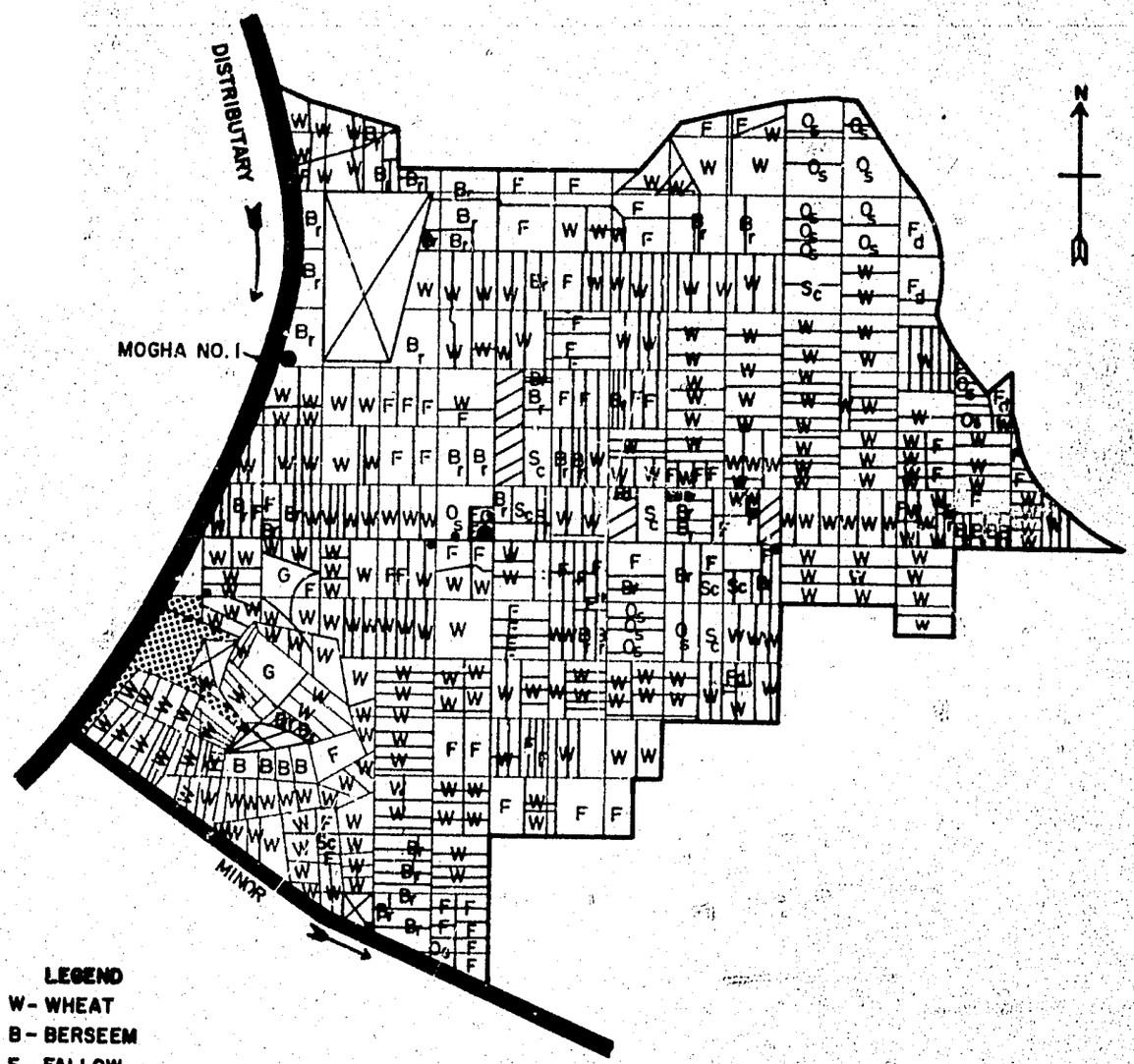
WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 103

DISTRICT LAHORE

WATERCOURSE COMMAND I

CROPS



LEGEND

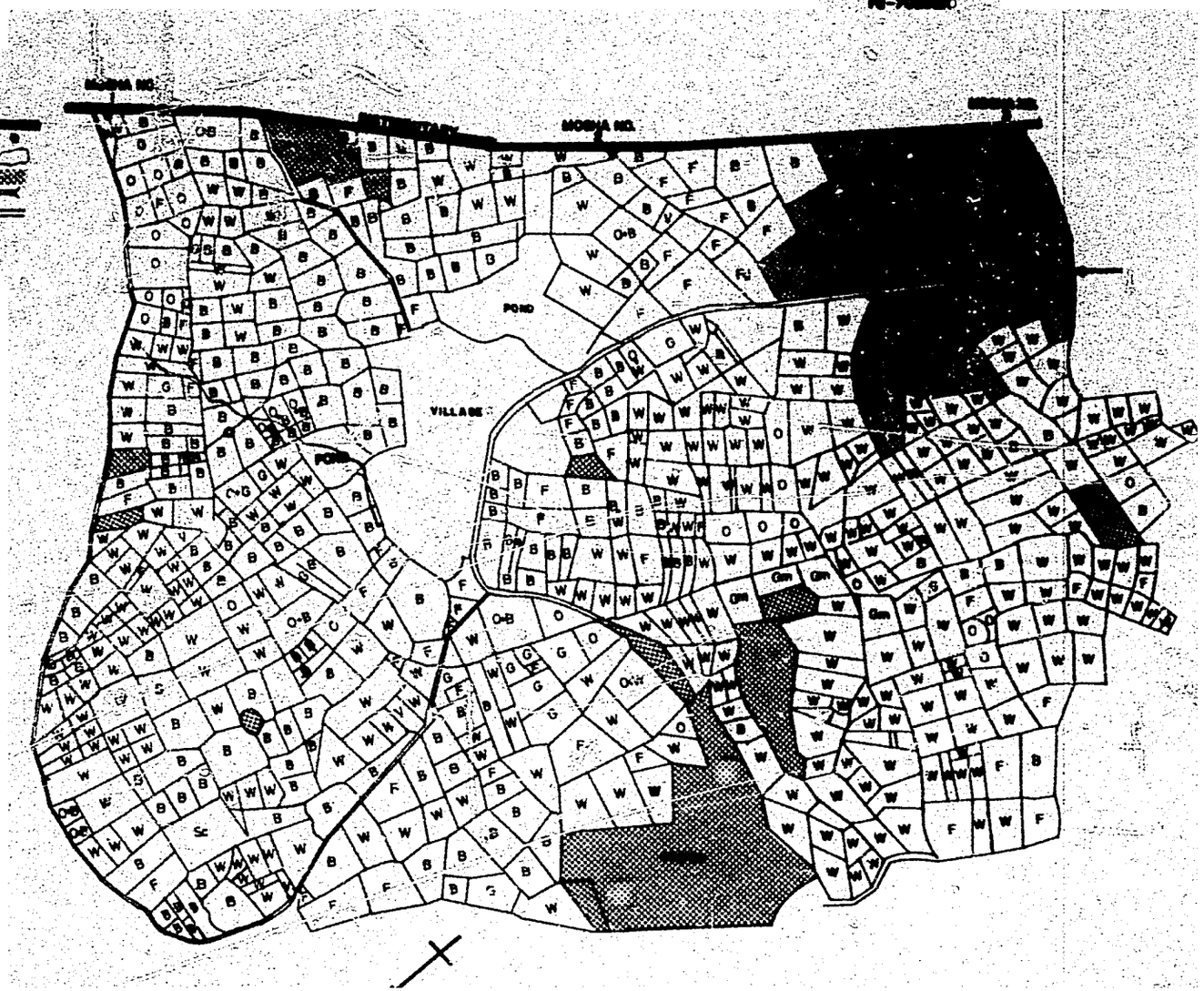
W - WHEAT
B - BERSEEM
F - FALLOW
Sc - SUGAR CANE
Os - OIL SEED
Br - BARREN
Fd - FODDER
G - GARDEN
- DISTRIBUTARY
- MOGHA / TUBEWELL
- HOUSE
- MINOR
- JHALAR
- BUNDED UNIT BOUNDARY
- AREA BOUNDARY
- UNCULT BARREN

Scale: 0 220 440 660

WATER MANAGEMENT RESEARCH PROJECT

WATERBORNE SURVEY SAMPLE VILLAGE NO. 104, DISTRICT LAKHIM
WATERCOURSE COMMAND 1-3, SCALE 0 200 400 600
CROPS

LEGEND
W - WHEAT
V - VEGETABLES
B - BERSEEM
O - OATS
F - FALLOW
Gm - GRAM
G - GARDEN
Sc - SUGAR CANE
Fd - FODDER



LEGEND

WATER MANAGEMENT RESEARCH PROJECT

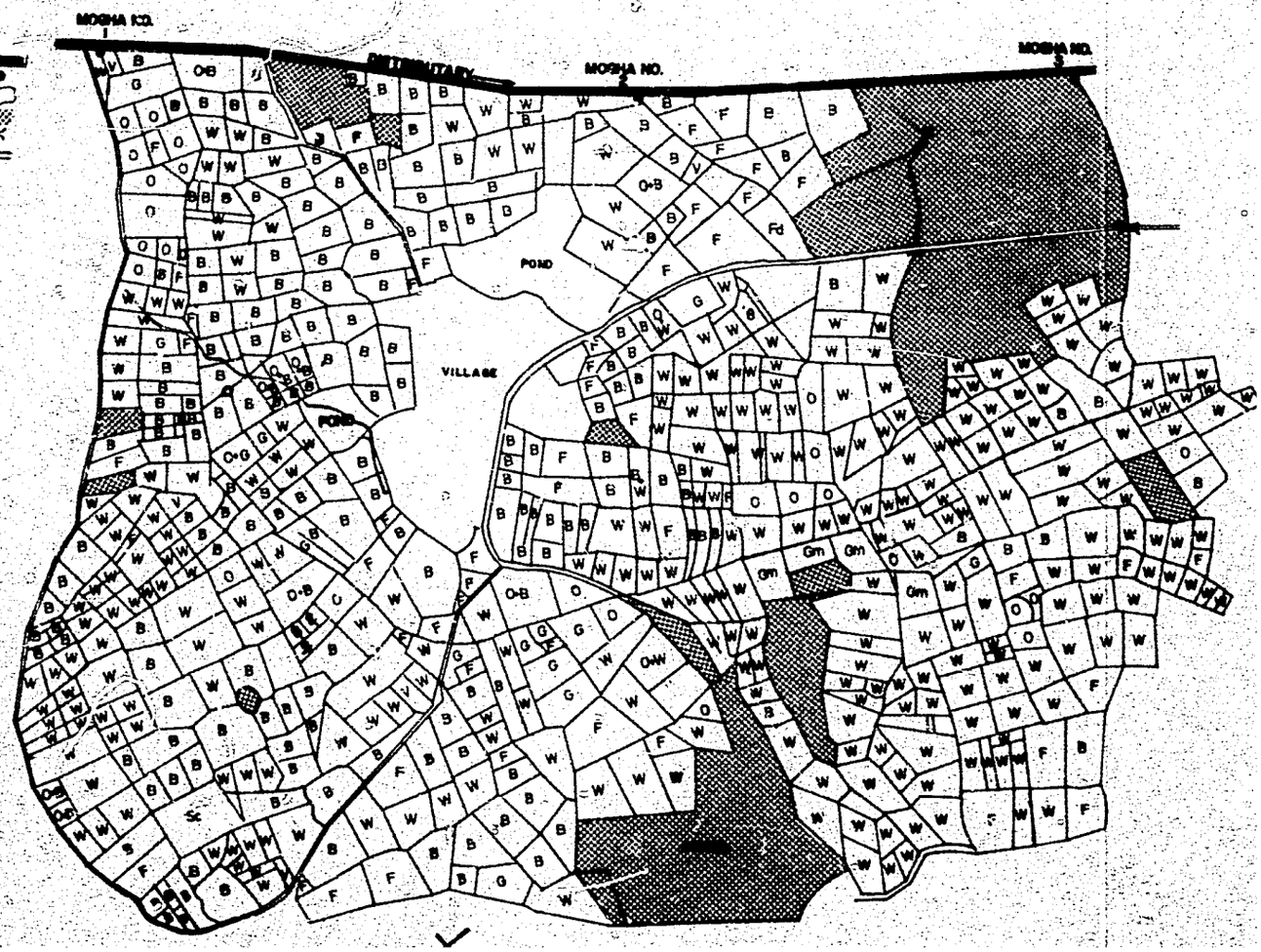
WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 104, DISTRICT LAHORE
WATERCOURSE COMMANDS 1-3, SCALE: 0 200 400 600
CROPS

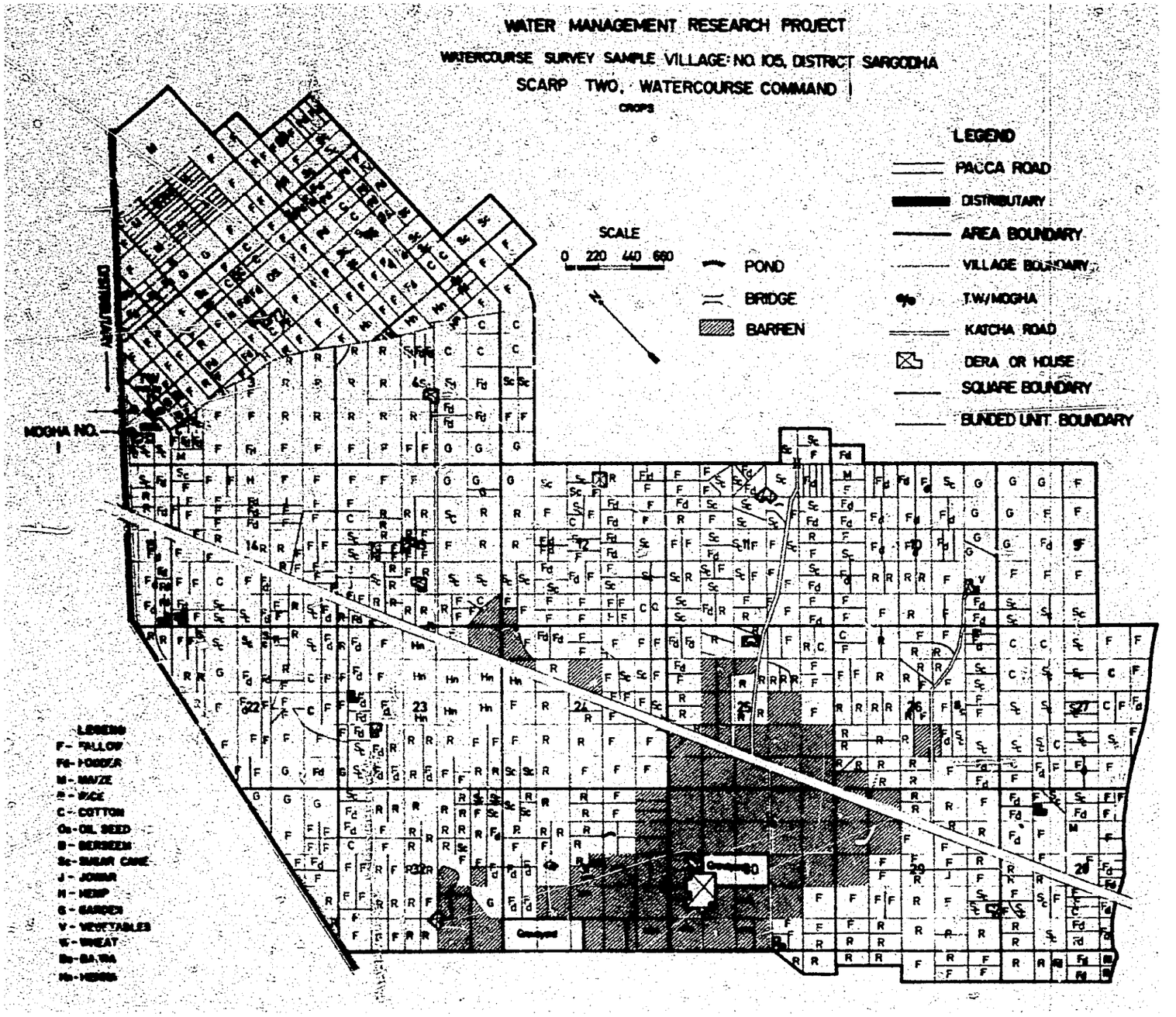
LEGEND

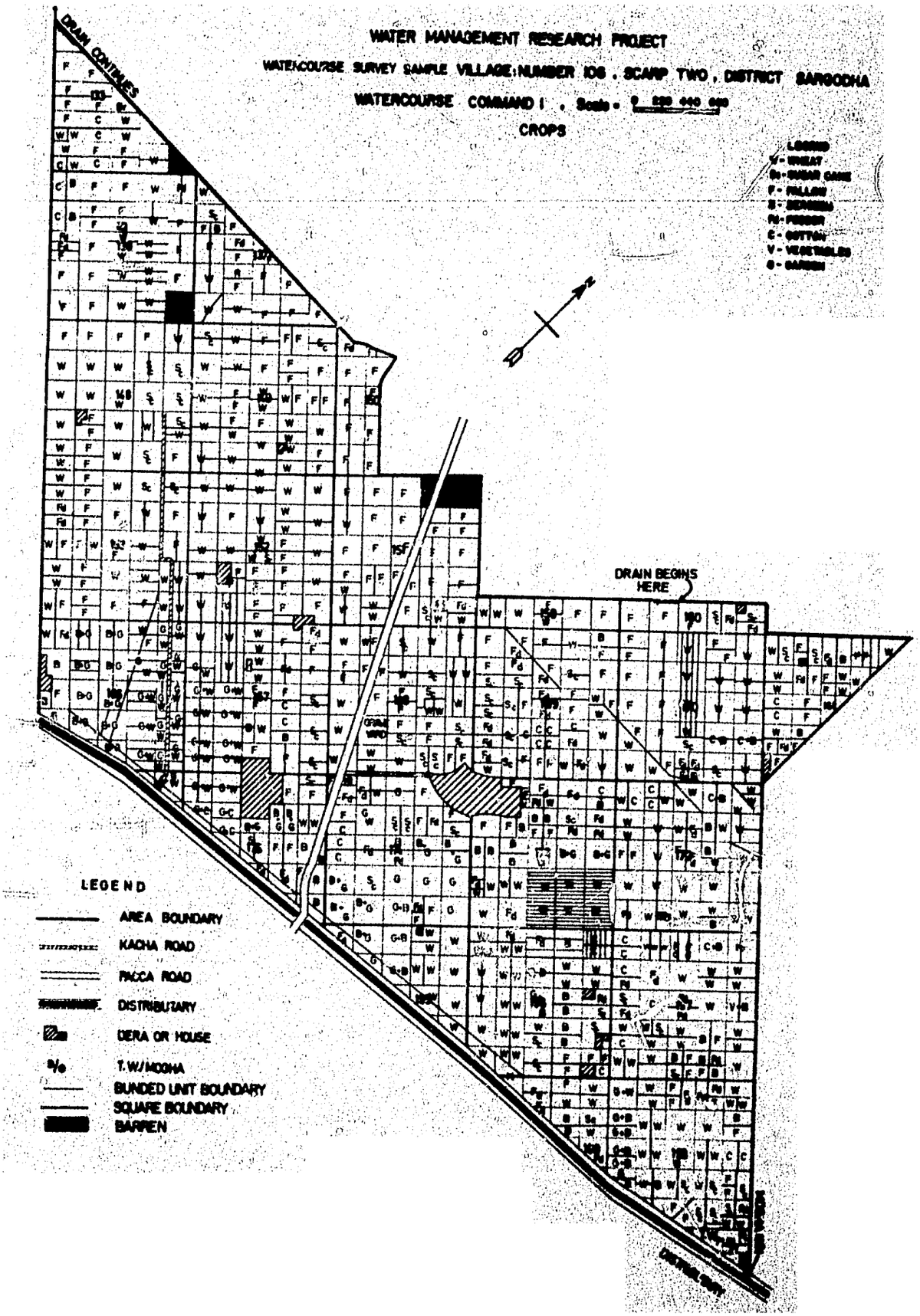
- W - WHEAT
- V - VEGETABLES
- B - BERSEEM
- O - OATS
- F - FALLOW
- Gm - GRAM
- G - GARDEN
- Sc - SUGAR CANE
- Fd - FODDER

LEGEND

- DISTRIBUTARY
- MOGHA (INLET)
- VILLAGE
- BARAN AREA
- CREEK
- KUTCHA ROAD




WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 105, DISTRICT SARGODHA
SCARP TWO, WATERCOURSE COMMAND I
CROPS
LEGEND
PACCA ROAD
DISTRIBUTARY
AREA BOUNDARY
VILLAGE BOUNDARY
T.W./MOGHA
KATCHA ROAD
DERA OR HOUSE
SQUARE BOUNDARY
BUNDED UNIT BOUNDARY
SCALE
0 220 440 660
POND
BRIDGE
BARREN
MOGHA NO. 1
LEGEND
F - FALLOW
Fd - FODDER
M - MAIZE
R - RICE
C - COTTON
Os - OIL SEED
B - BERSEEM
Sc - SUGAR CANE
J - JOWAR
H - HEMP
G - GARDEN
V - VEGETABLES
W - WHEAT

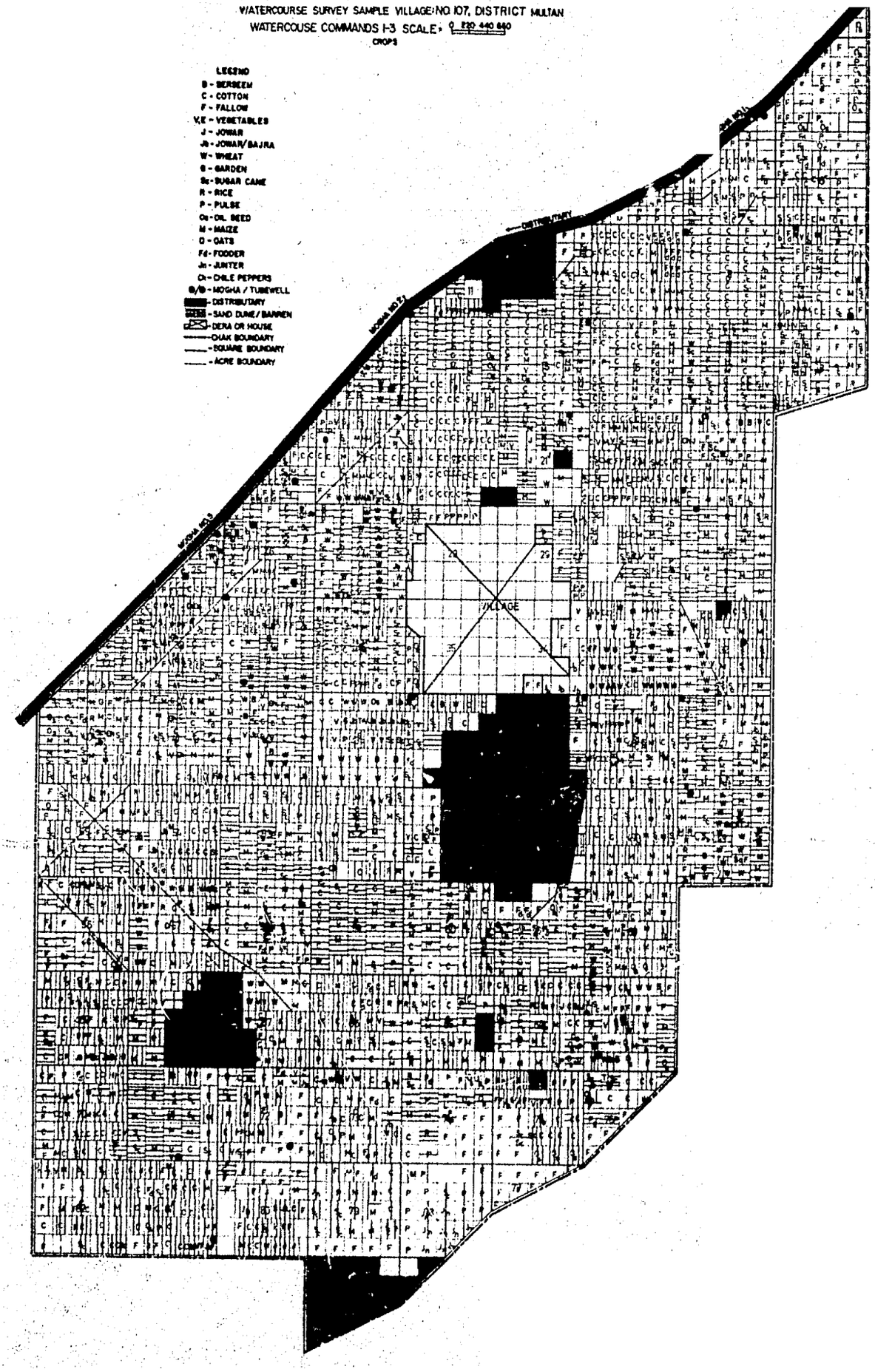

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 106 , SCARP TWO , DISTRICT SARGODHA
WATERCOURSE COMMAND I , Scale =
CROPS
LEGEND
W - WHEAT
Sc - SUGAR CANE
F - FALLOW
S - SORGHUM
Fd - FODDER
C - COTTON
V - VEGETABLES
G - GARDEN
DRAIN CONTINUES
DRAIN BEGINS HERE
DRAIN
LEGEND
AREA BOUNDARY
KACHA ROAD
PACCA ROAD
DISTRIBUTARY
DERA OR HOUSE
T.W./MODHA
BUNDED UNIT BOUNDARY
SQUARE BOUNDARY
BARREN

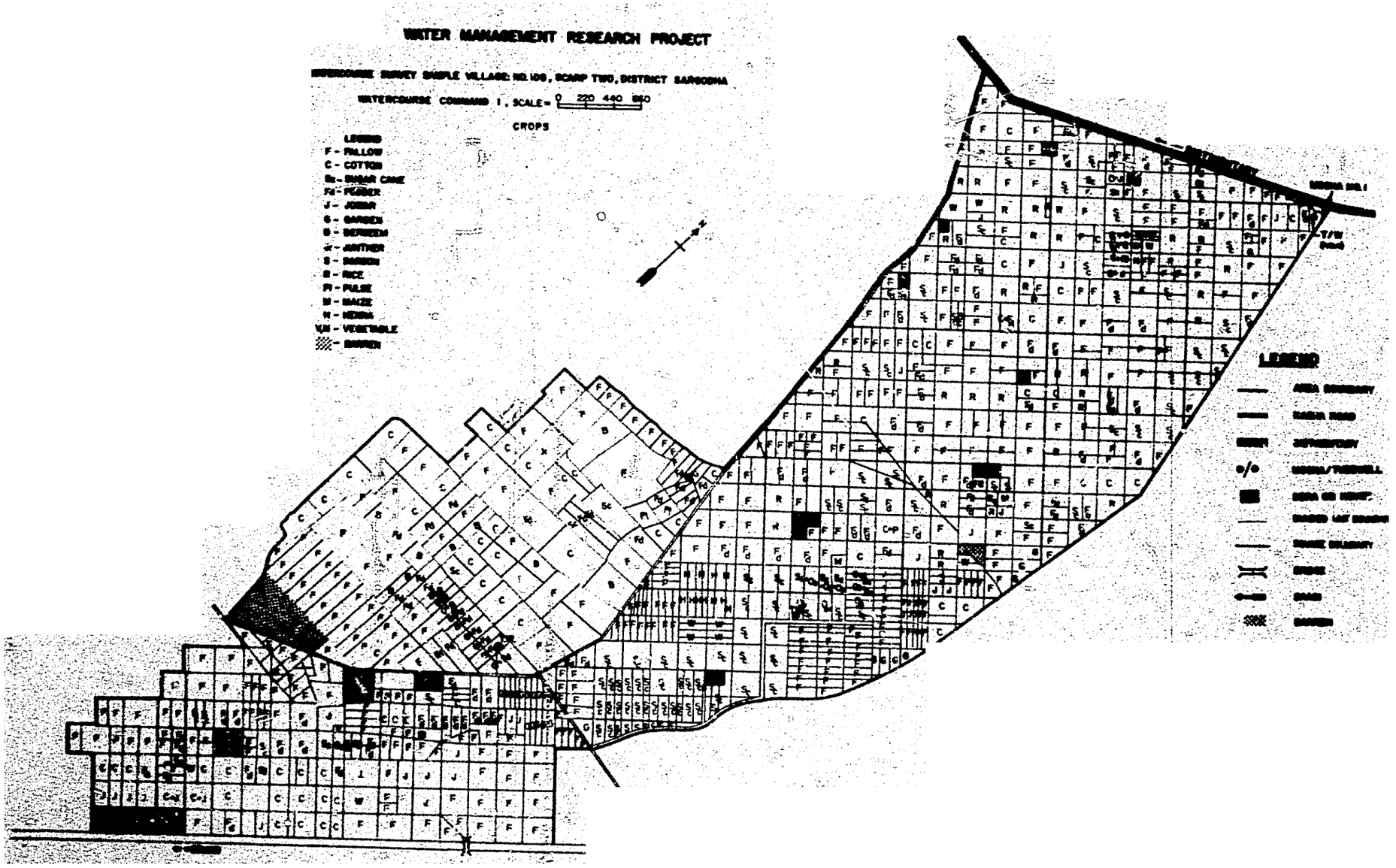
WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE NO 107, DISTRICT MULTAN

WATERCOUSE COMMANDS I-3 SCALE: 0 220 440 880

CROPS



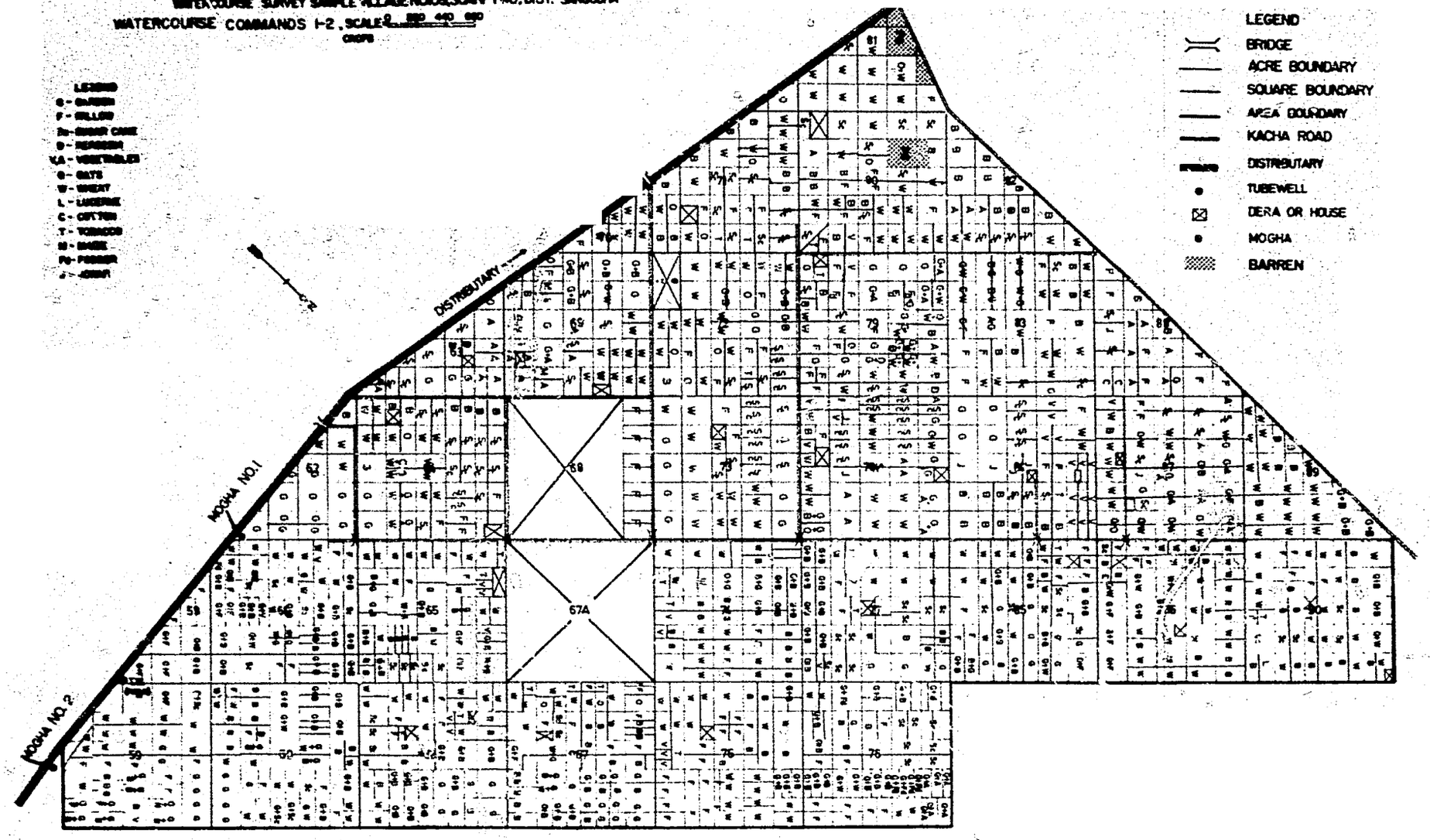

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE COMMAND 1, SCALE = 0 220 440 880
CROPS
LEGEND
F - FALLOW
C - COTTON
Sc - SUGAR CANE
Fd - FODDER
J - JOWAR
G - GARDEN
B - BERSEEM
W - WHEAT
S - SARSON
R - RICE
Pl - PULSE
M - MAIZE
H - HENNA
V/M - VEGETABLE
- BARREN
LEGEND

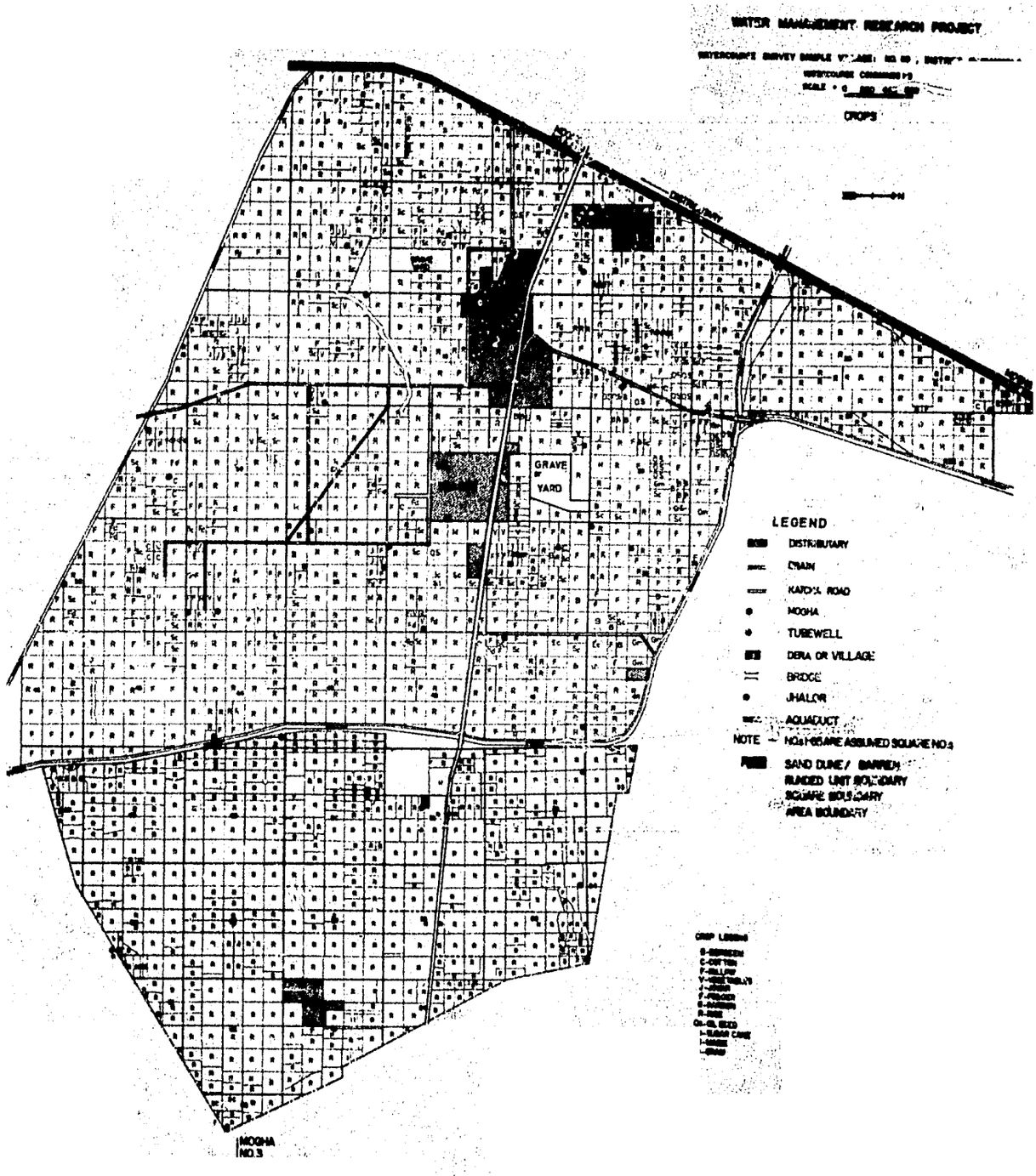
WATER MANAGEMENT RESEARCH PROJECT

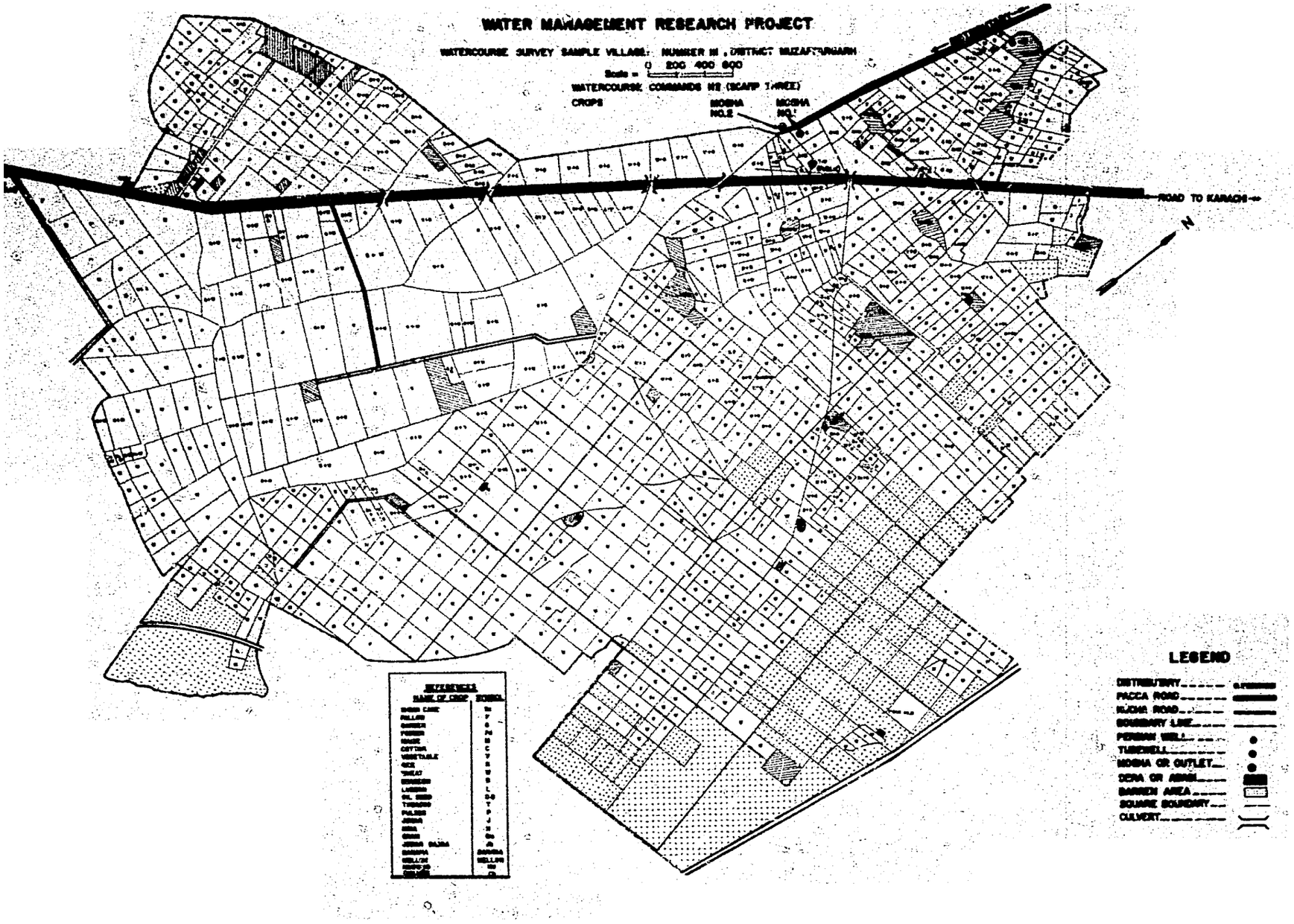
WATERCOURSE SURVEY SAMPLE VILLAGE NO.108, SCARP TWO, DIST. SARGODHA

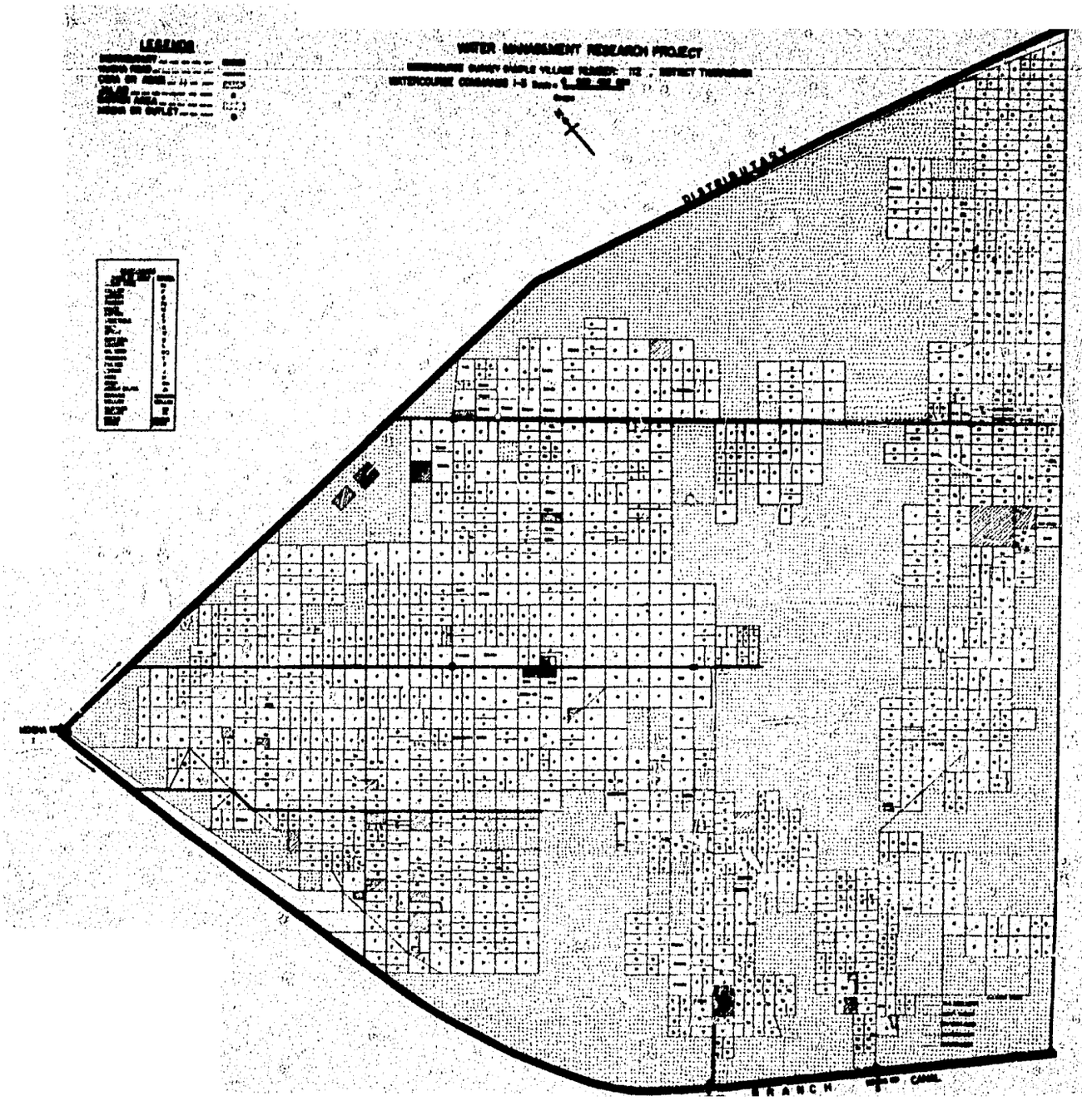
WATERCOURSE COMMANDS 1-2, SCALE 0 220 440 660

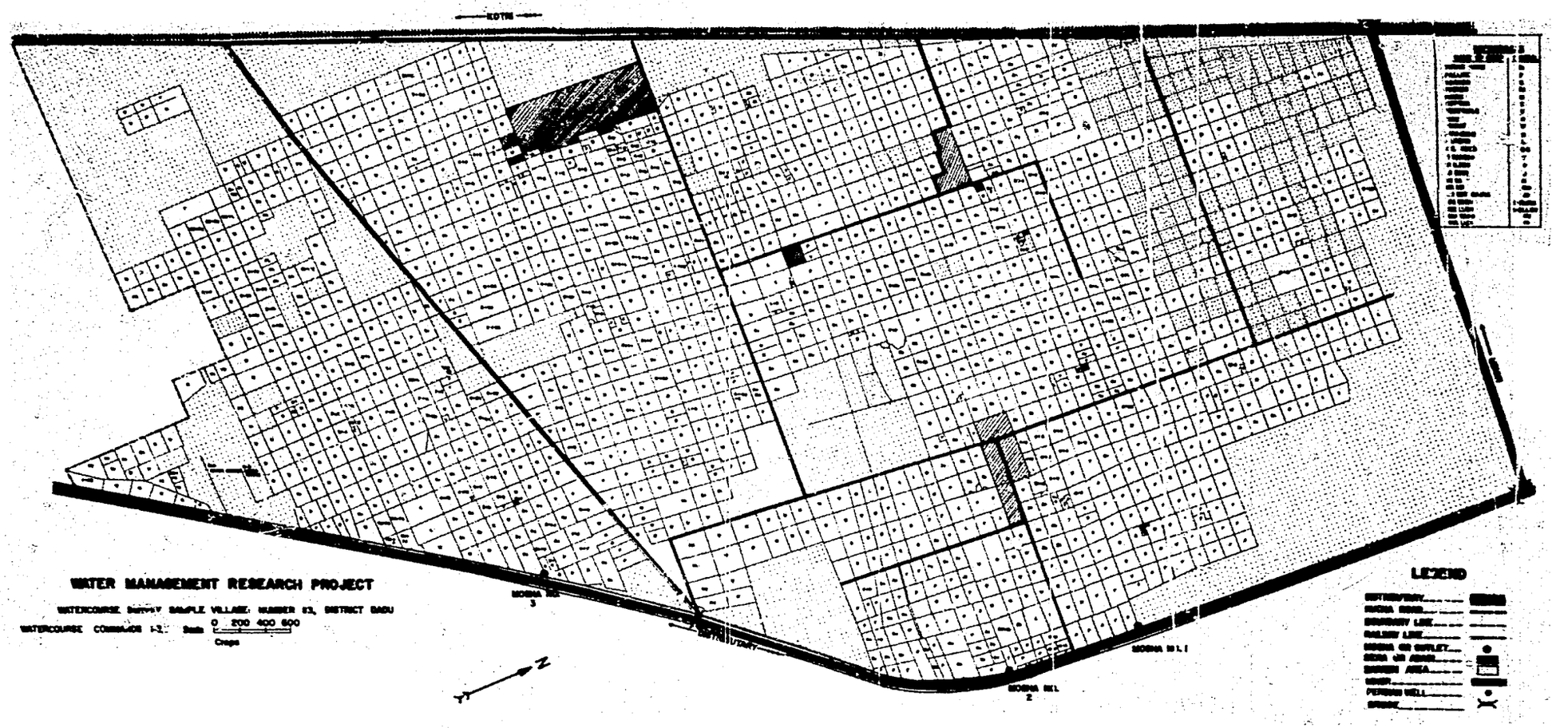
CROPS

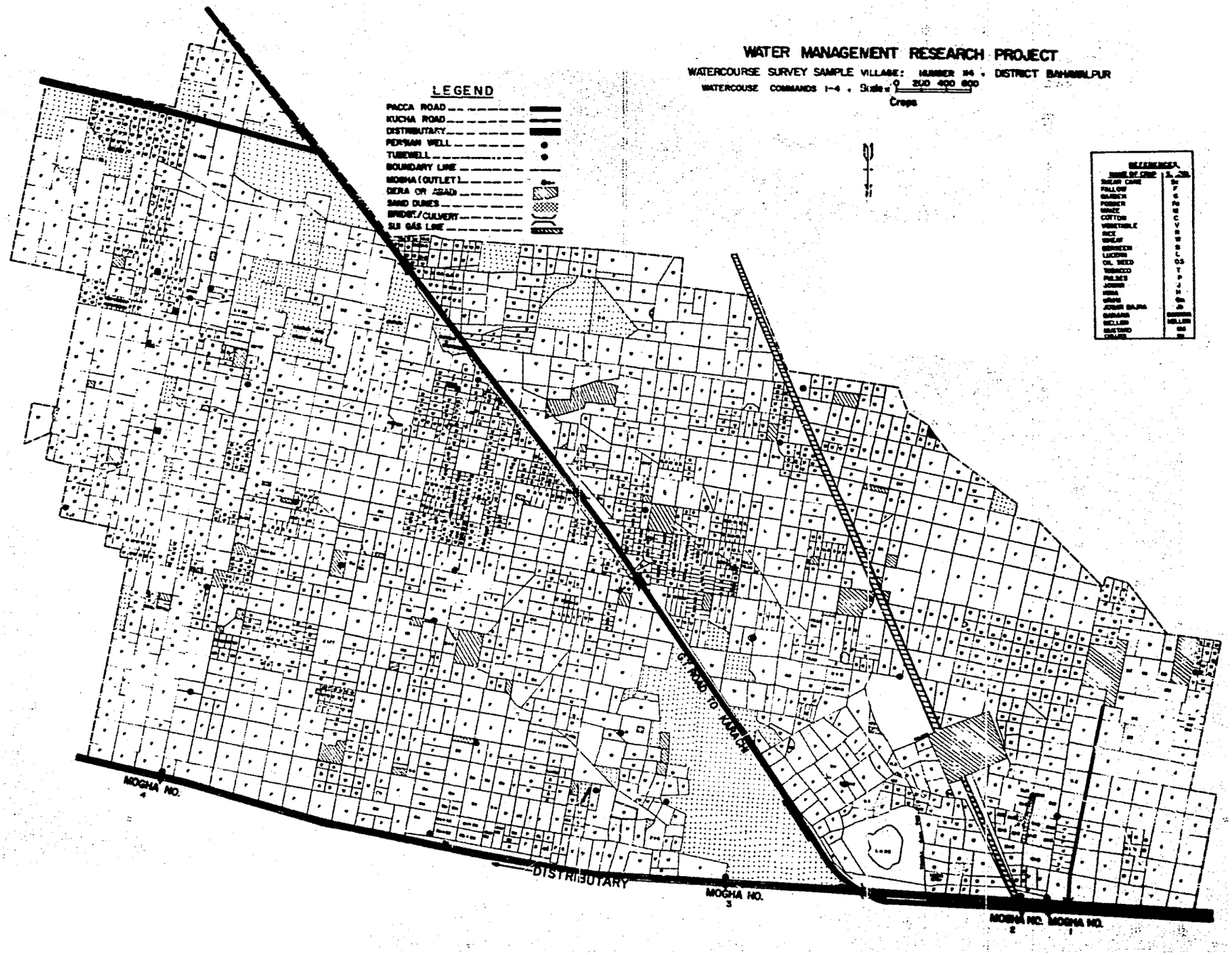


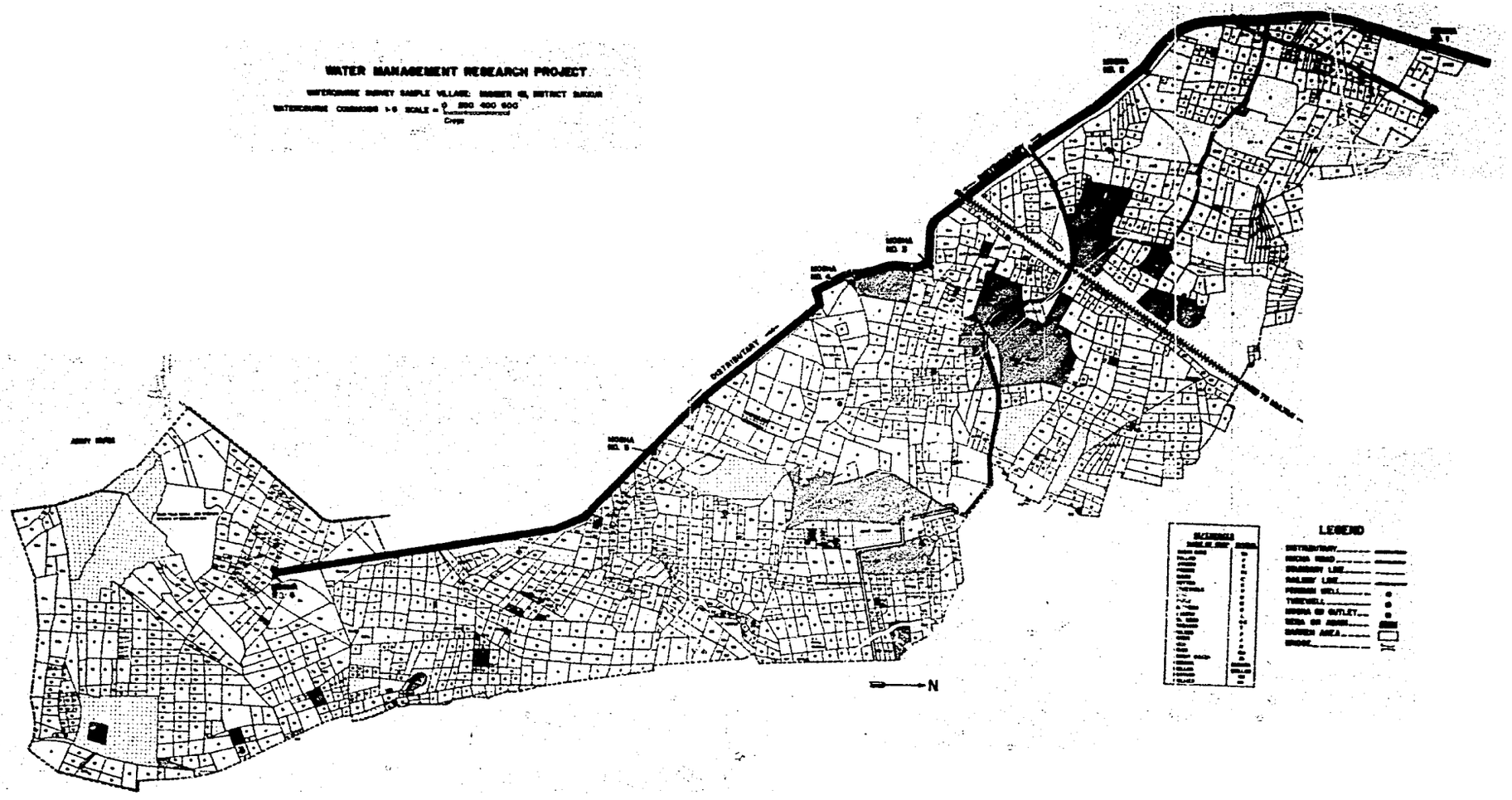

WATER MANAGEMENT RESEARCH PROJECT
CROPS
GRAVE YARD
LEGEND
DISTRIBUTARY
DRAIN
KACCHA ROAD
MOGHA
TUBEWELL
DERA OR VILLAGE
BRIDGE
JHALOR
AQUADUCT
NOTE – NOs 1-65 ARE ASSUMED SQUARE NOs
SAND DUNE / BARREN
RUNDED UNIT BOUNDARY
SQUARE BOUNDARY
AREA BOUNDARY
MOGHA NO.3

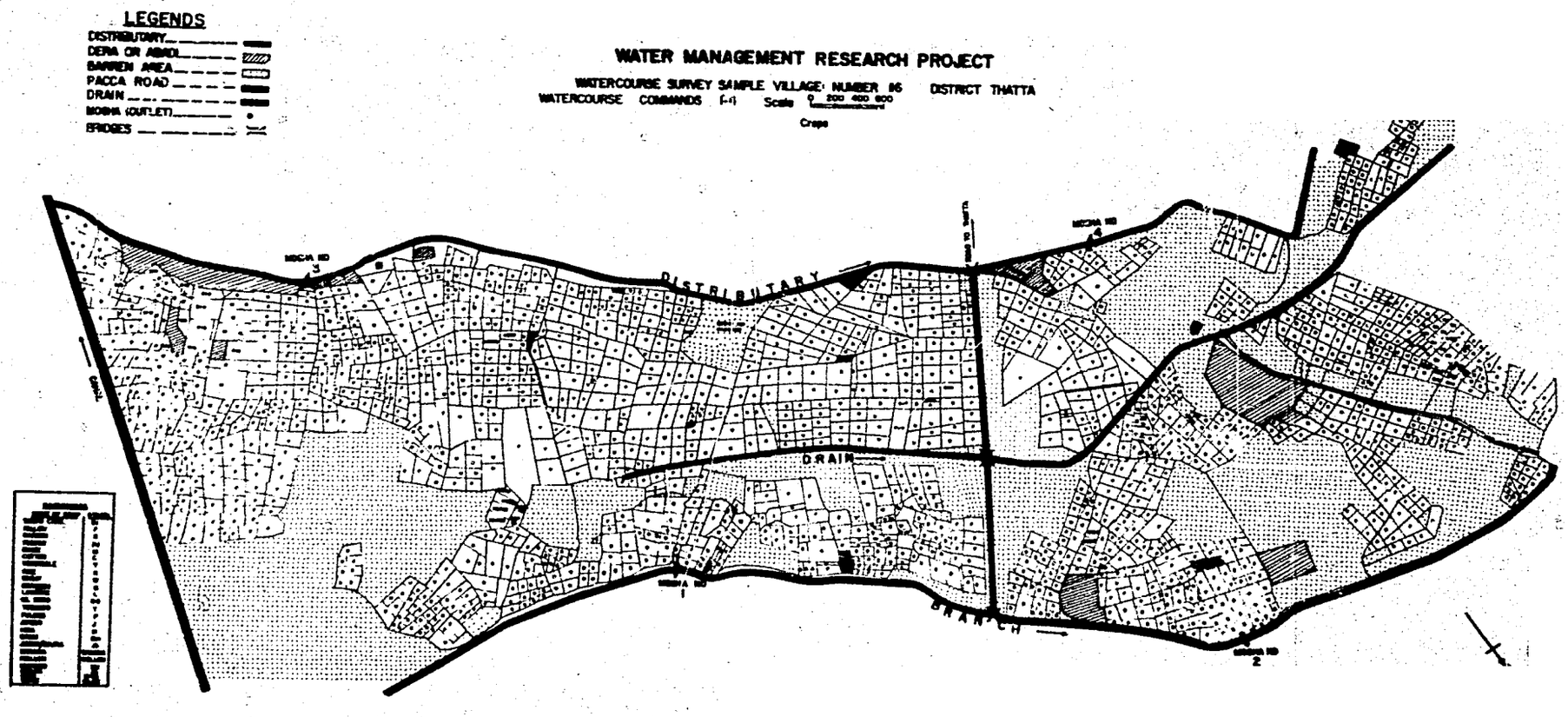

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER III , DISTRICT MUZAFFARGARH
0 200 400 800
Scale =
WATERCOURSE COMMANDS 112 (SCARP TUBEWEL)
CROPS
MOGHA NO.2
MOGHA NO.1
ROAD TO KARACHI
N
LEGEND
DISTRIBUTARY
PACCA ROAD
KUCHA ROAD
BOUNDARY LINE
PERSIAN WELL
TUBEWELL
MOGHA OR OUTLET
DERA OR ABADI
BARREN AREA
SQUARE BOUNDARY
CULVERT


WATER MANAGEMENT RESEARCH PROJECT
LEGEND
DISTRIBUTARY
BRANCH
CANAL


KOTRI
WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 23, DISTRICT SAGU
WATERCOURSE COMMAND 1-2. Scale 0 200 400 600
Crops
MOGHA NO. 3
MOGHA NO. 2
MOGHA NO. 1
N
LEGEND
INTERVIEW
MOGHA ROAD
BOUNDARY LINE
RAILWAY LINE
MOGHA OUTLET
MOGHA JUNCTION
BORROW AREA
RIVER
PERENNIAL WELL
BRIDGE


WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 24 , DISTRICT BAHAWALPUR
WATERCOURSE COMMANDS 1-4 , Scale: 0 200 400 600
Crops
LEGEND
PACCA ROAD
KUCHA ROAD
DISTRIBUTARY
PERSIAN WELL
TUBEWELL
BOUNDARY LINE
MOGHA (OUTLET)
DERA OR ABADI
SAND DUNES
BRIDGE/CULVERT
SUI GAS LINE
REFERENCES
NAME OF CROP
SUGAR CANE
FALLOW
BARSEEM
FODDER
MAIZE
COTTON
VEGETABLE
RICE
WHEAT
SUNNEES
LUCERN
OIL SEED
TOBACCO
PULSES
JOWAR
BAJRA
GRAM
JOWAR BAJRA
BARLEY
MELLON
MUSTARD
ONION
C.V. ROAD TO KARACHI
DISTRIBUTARY
MOGHA NO. 4
MOGHA NO. 3
MOGHA NO. 2
MOGHA NO. 1


WATER MANAGEMENT RESEARCH PROJECT
LEGEND
N


LEGENDS
DISTRIBUTARY
DERA OR ABADI
BARREN AREA
PACCA ROAD
DRAIN
MOGHA (OUTLET)
BRIDGES
WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 86 DISTRICT THATTA
WATERCOURSE COMMANDS (-1) Scale 0 200 400 600
Crops
DISTRIBUTARY
DRAIN
BRANCH
MOGHA NO 3
MOGHA NO 4
MOGHA NO 1
MOGHA NO 2
CANAL

APPENDIX I

Part E

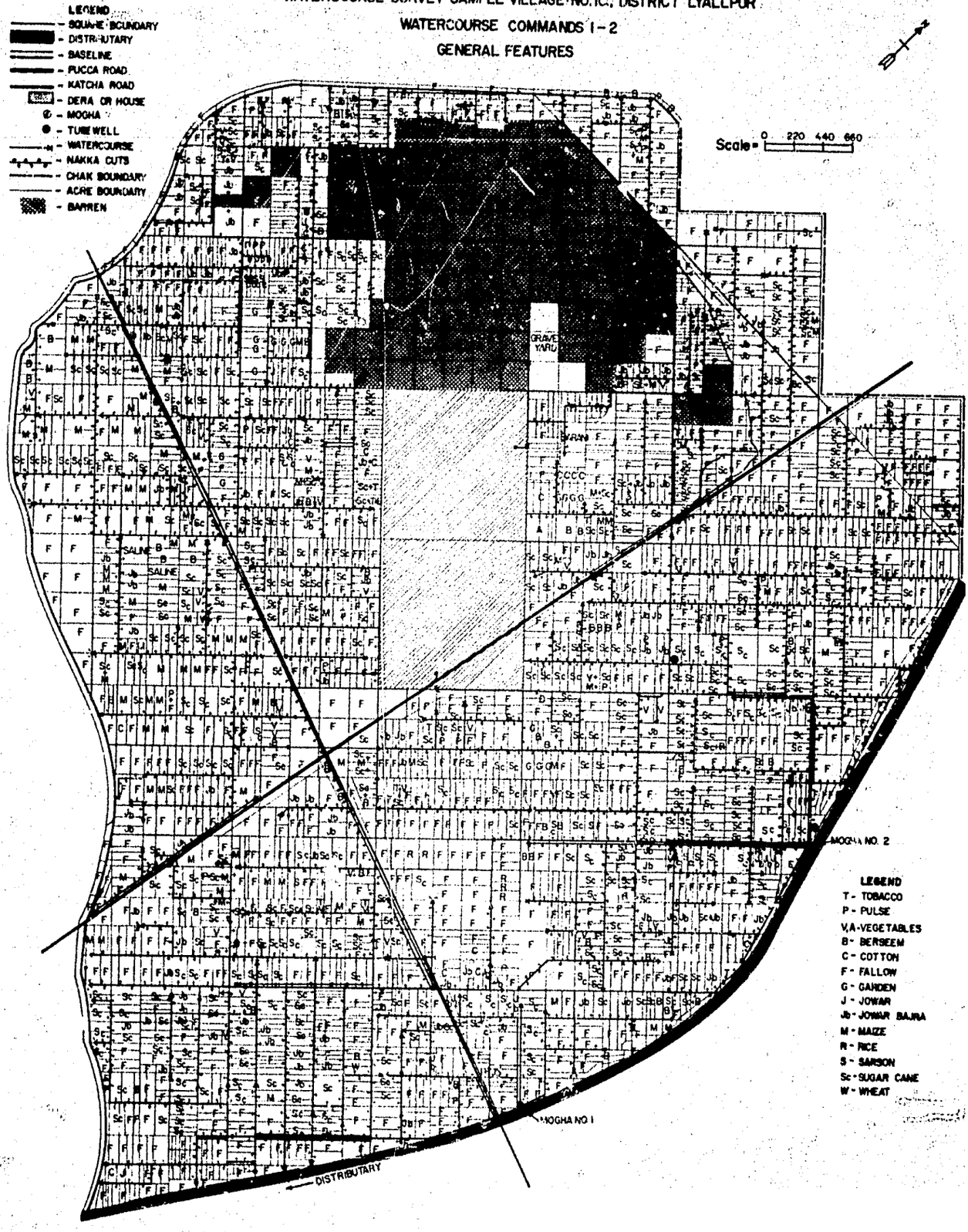
GENERAL FEATURES MAPS

WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE NO. IC, DISTRICT LYALLPUR

WATERCOURSE COMMANDS 1 – 2

GENERAL FEATURES

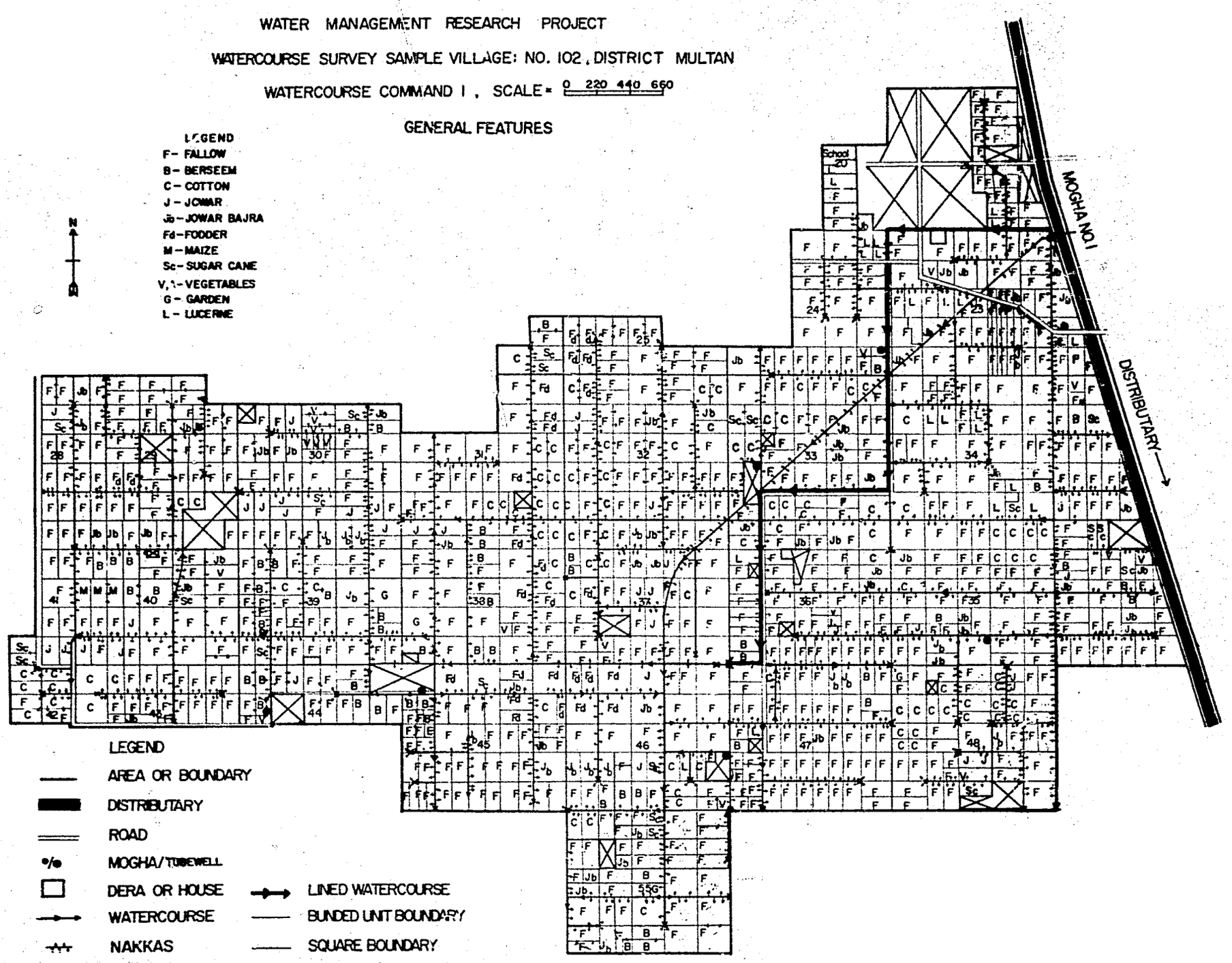


WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 102, DISTRICT MULTAN

WATERCOURSE COMMAND I, SCALE = 0 220 440 660

GENERAL FEATURES



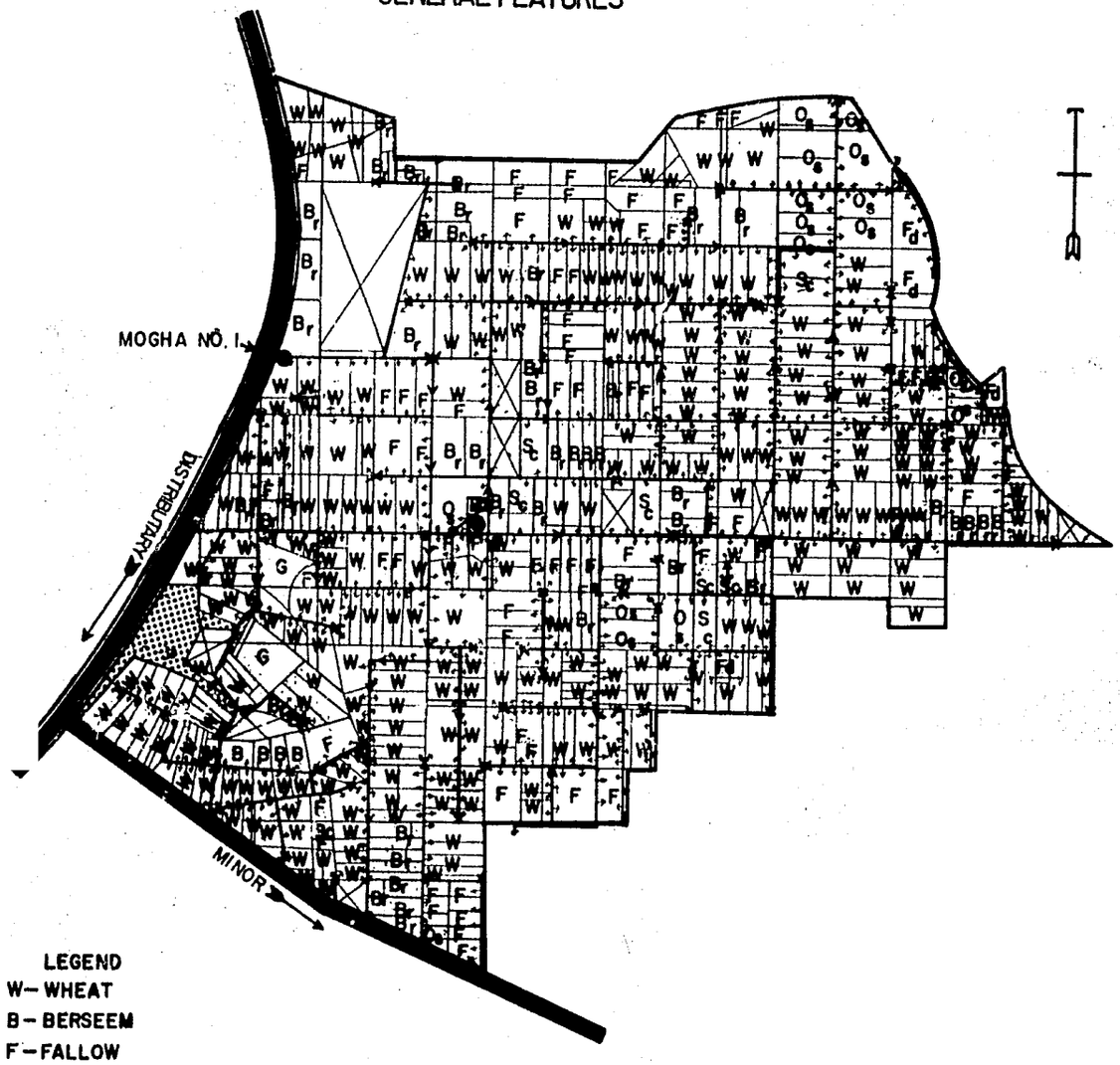
WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE NO. 103

DISTRICT LAHORE

WATERCOURSE COMMAND I

GENERAL FEATURES



LEGEND

W – WHEAT
B – BERSEEM
F – FALLOW
Sc – SUGAR CANE
Os – OIL SEED
Br – BARREN
Fd – FODDER
G – GARDEN
– DISTRIBUTARY
– MINOR
– HOUSE ORDERA
– WATERCOURSE
– NAKKAS
JHALAR
TUBEWELL/MOGHA

Scale = 0 220 440 660

UNCULT BARREN
ACRE BOUNDARY
AREA BOUNDARY

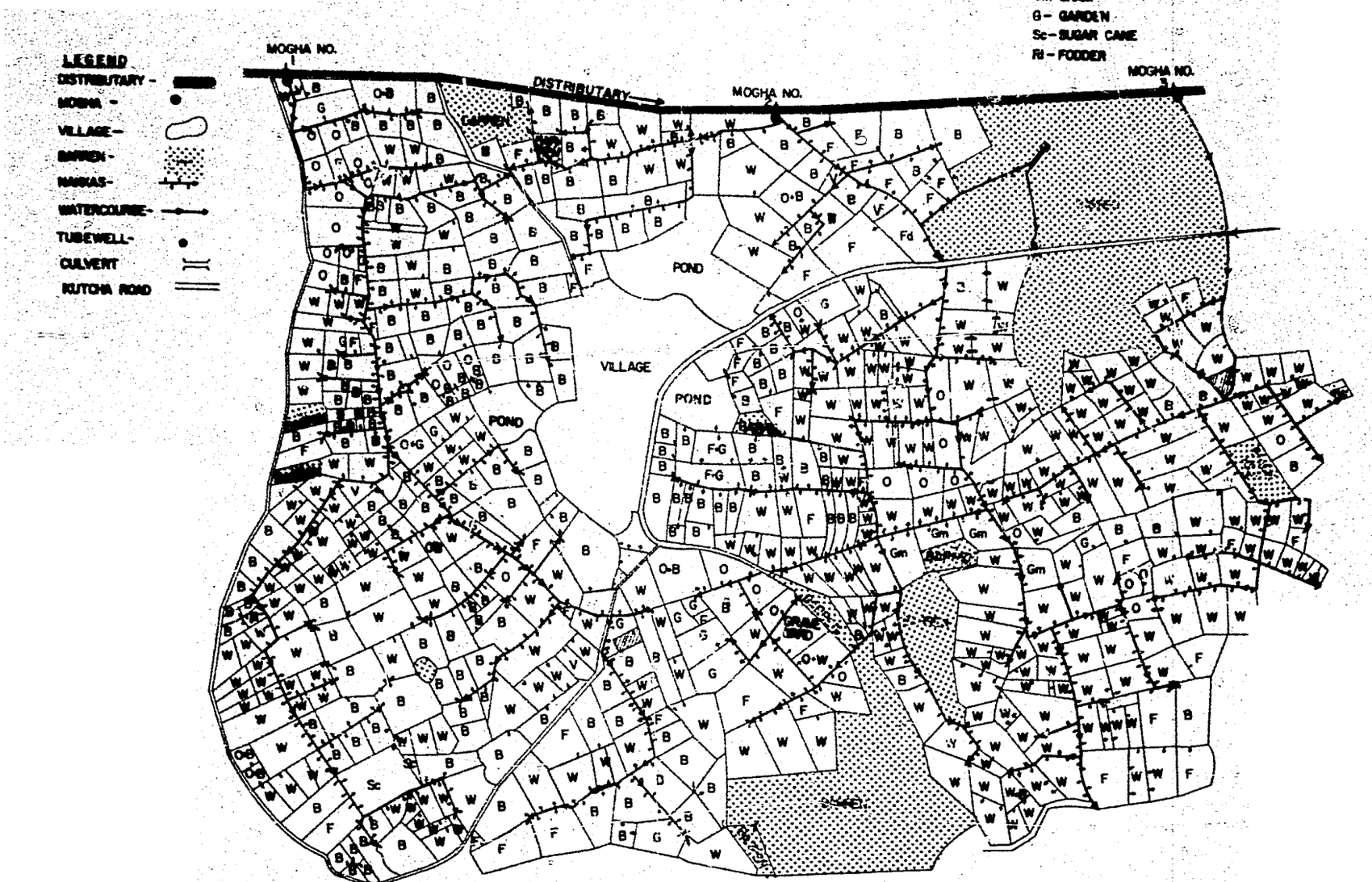
WATER MANAGEMENT RESEARCH PROJECT

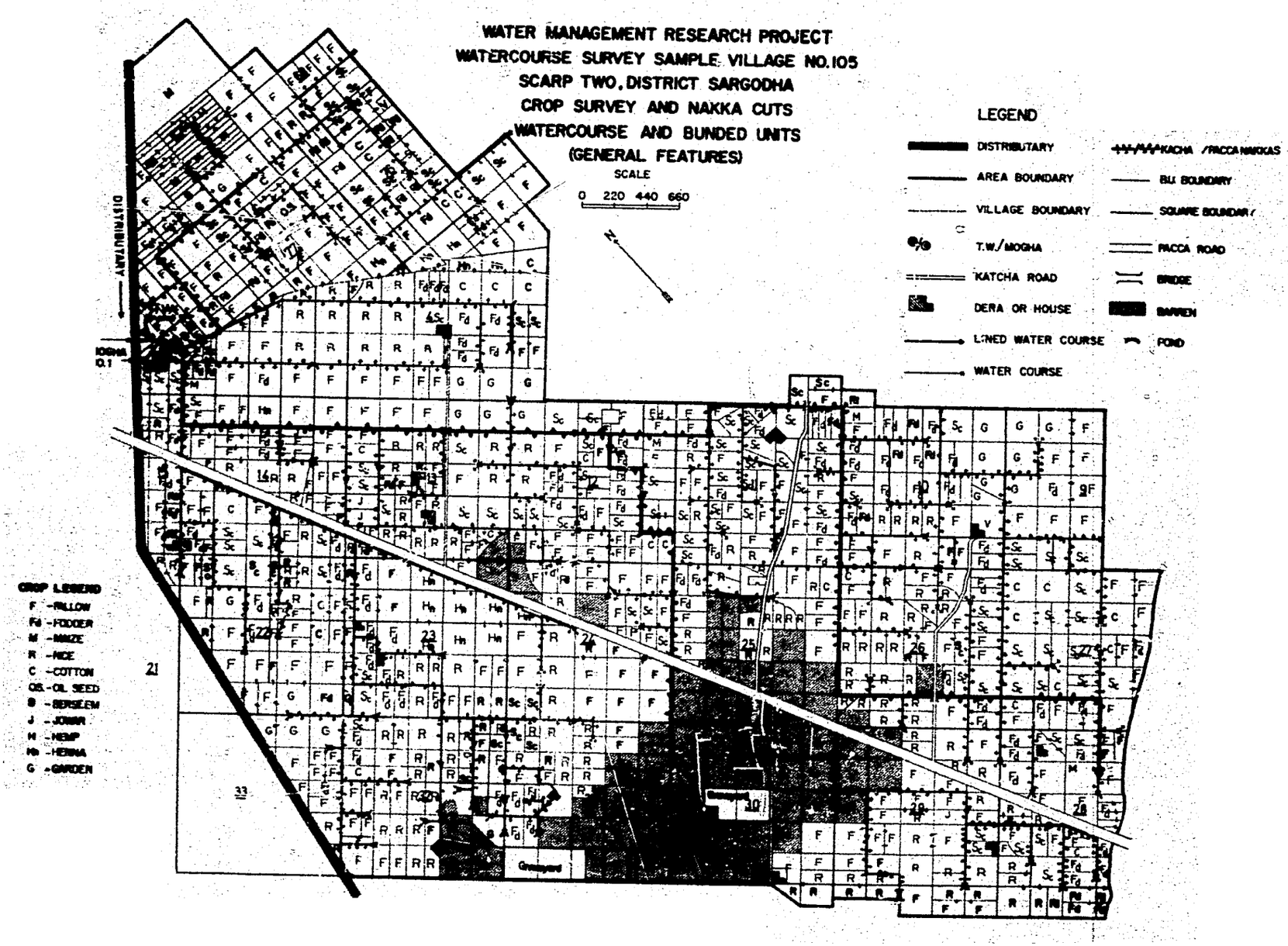
WATERCOURSE SURVEY SAMPLE VILLAGE NO. 104, DISTRICT LAHORE

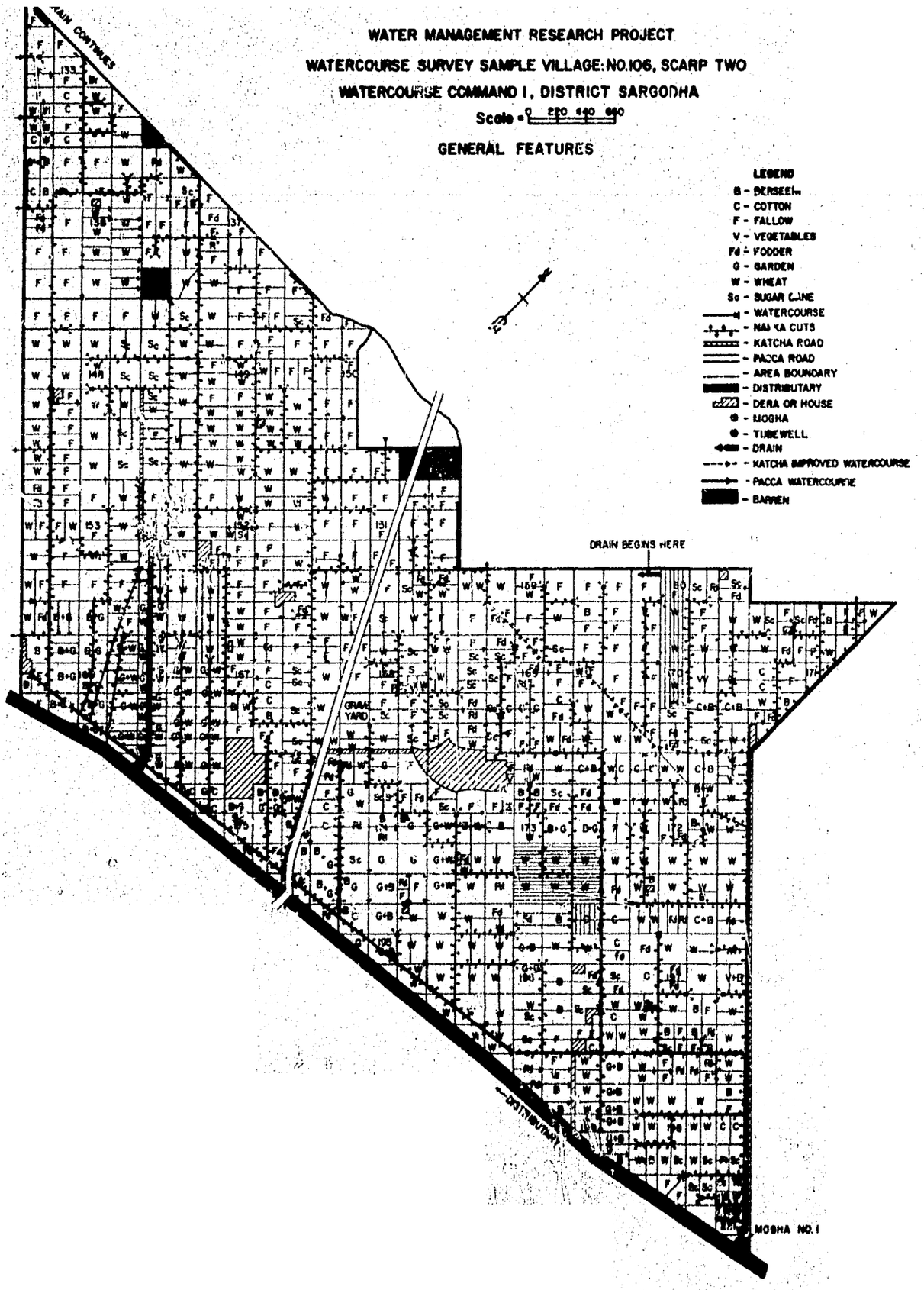
WATERCOURSE COMMANDS 1-3 SCALE 0 200 400 600

GENERAL FEATURES

LEGEND
W- WHEAT
V -VEGETABLES
B- BERSEEM
O- OATS
F -FALLOW
Gm-GRAM
G- GARDEN
Sc-SUGAR CANE
Fd-FODDER




WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE NO.105
SCARP TWO, DISTRICT SARGODHA
CROP SURVEY AND NAKKA CUTS
WATERCOURSE AND BUNDED UNITS
(GENERAL FEATURES)
SCALE
0 220 440 660
LEGEND
DISTRIBUTARY
AREA BOUNDARY
VILLAGE BOUNDARY
T.W./MOGHA
KATCHA ROAD
DERA OR HOUSE
LINED WATER COURSE
WATER COURSE
KACHA /PACCA NAKKAS
BLI BOUNDARY
SQUARE BOUNDARY
PACCA ROAD
BRIDGE
BARREN
POND
CROP LEGEND
F -FALLOW
Fd -FODDER
M -MAIZE
R -RICE
C -COTTON
OS -OIL SEED
B -BERSEEM
J -JOWAR
H -HEMP
Hn -HENNA
G -GARDEN
DISTRIBUTARY
MOGHA
10.1
21
33
Graveyard

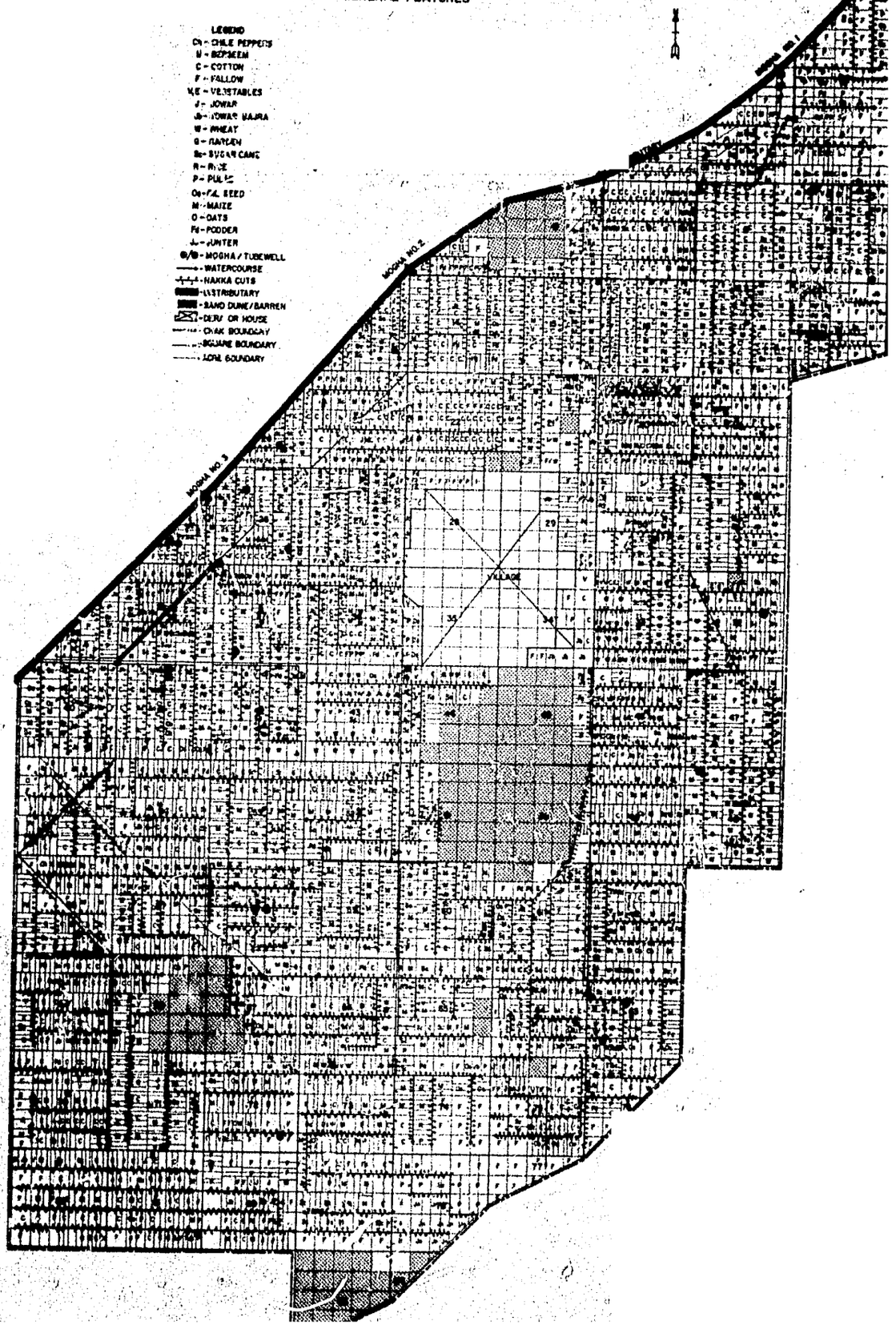

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NO.106, SCARP TWO
WATERCOURSE COMMAND I, DISTRICT SARGODHA
Scale = 0 220 440 880
GENERAL FEATURES
LEGEND
B - BERSEEM
C - COTTON
F - FALLOW
V - VEGETABLES
Fd - FODDER
G - GARDEN
W - WHEAT
Sc - SUGAR CANE
- WATERCOURSE
- NAIKA CUTS
- KATCHA ROAD
- PACCA ROAD
- AREA BOUNDARY
- DISTRIBUTARY
- DERA OR HOUSE
- MOGHA
- TUBEWELL
- DRAIN
- KATCHA IMPROVED WATERCOURSE
- PACCA WATERCOURSE
- BARREN
DRAIN BEGINS HERE
DRAIN CONTINUES
DISTRIBUTARY
MOGHA NO. I
GRAVE YARD

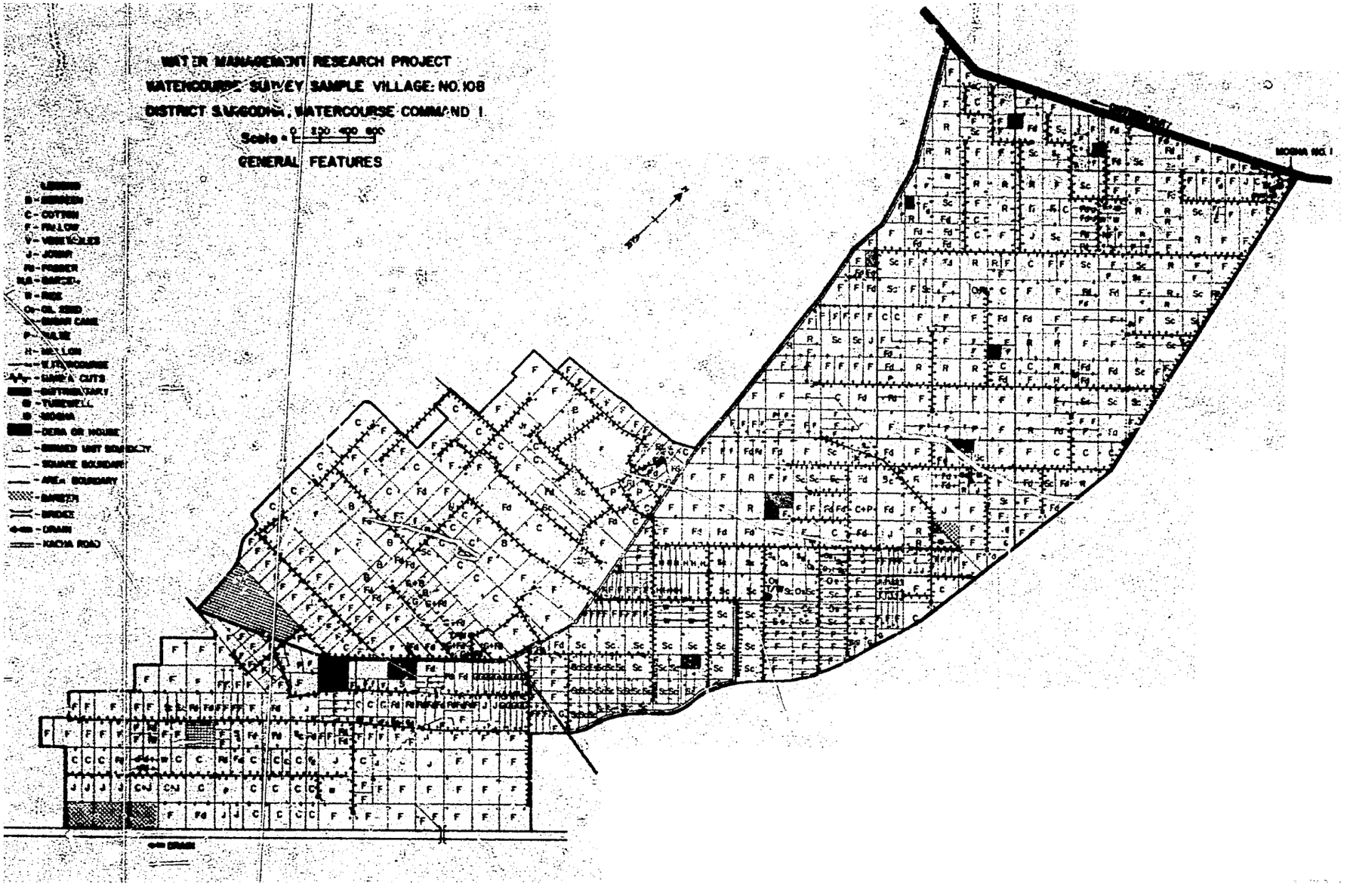
WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE NO. 107, DISTRICT MULTAN

WATERCOURSE COMMANDS 1-3 Scale = 0 220 440 660

GENERAL FEATURES




WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NO.108
DISTRICT SARGODHA, WATERCOURSE COMMAND I
Scale = 0 100 400 800
GENERAL FEATURES
C - COTTON
F - FALLOW
V - VEGETABLES
J - JOWAR
FD - FODDER
B - BAJRA
OS - OIL SEED
P - PULSE
H - MELLON
- WATERCOURSE
- DRAIN
- DISTRIBUTARY
- TUBEWELL
- MOGHA
- DERA OR HOUSE
- SQUARE BOUNDARY
- AREA BOUNDARY
- BRIDGE
- DRAIN
- KACHA ROAD
MOGHA NO. 1

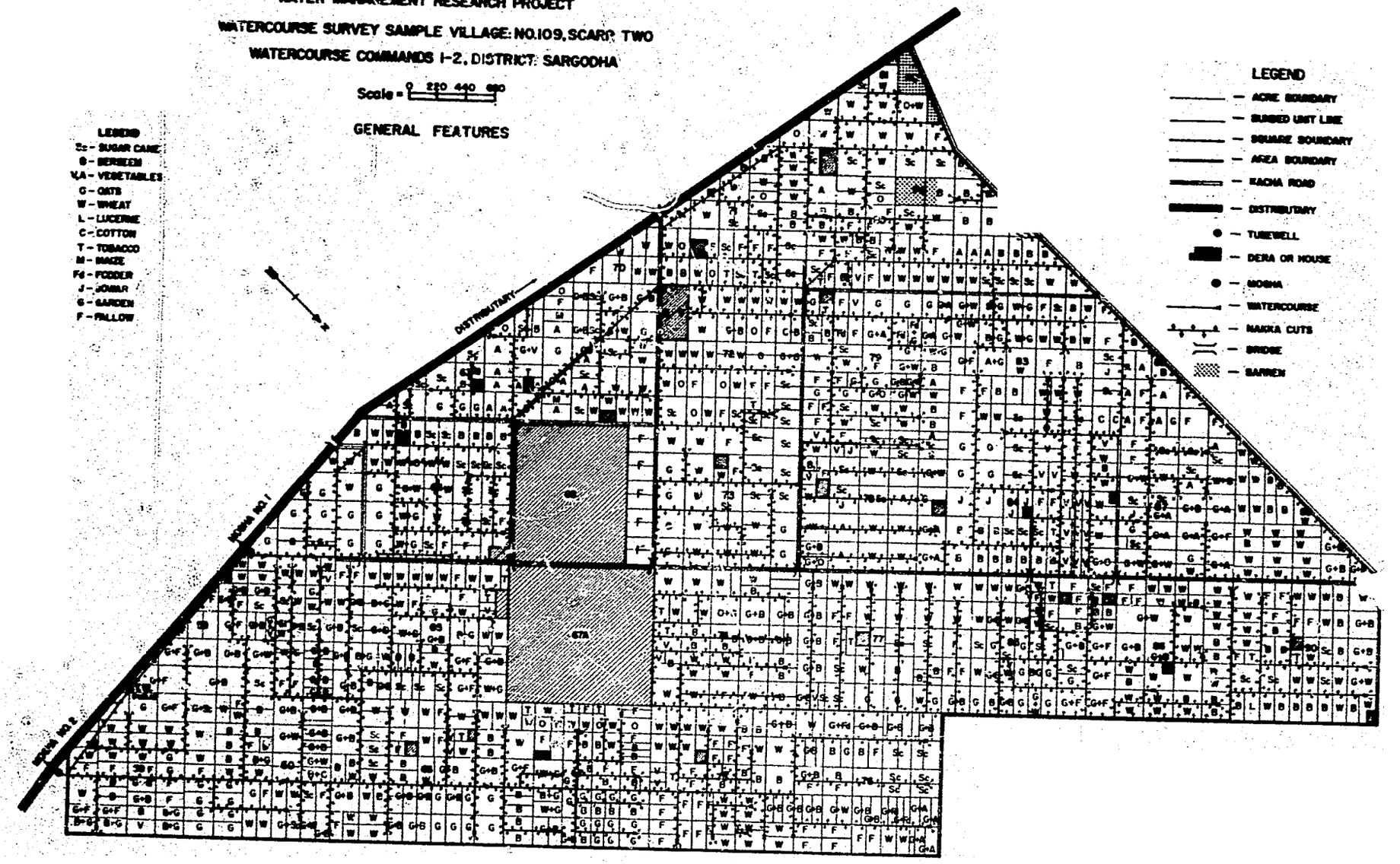
WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE: NO.109, SCARP TWO

WATERCOURSE COMMANDS 1-2, DISTRICT: SARGODHA

Scale = 0 220 440 880

GENERAL FEATURES



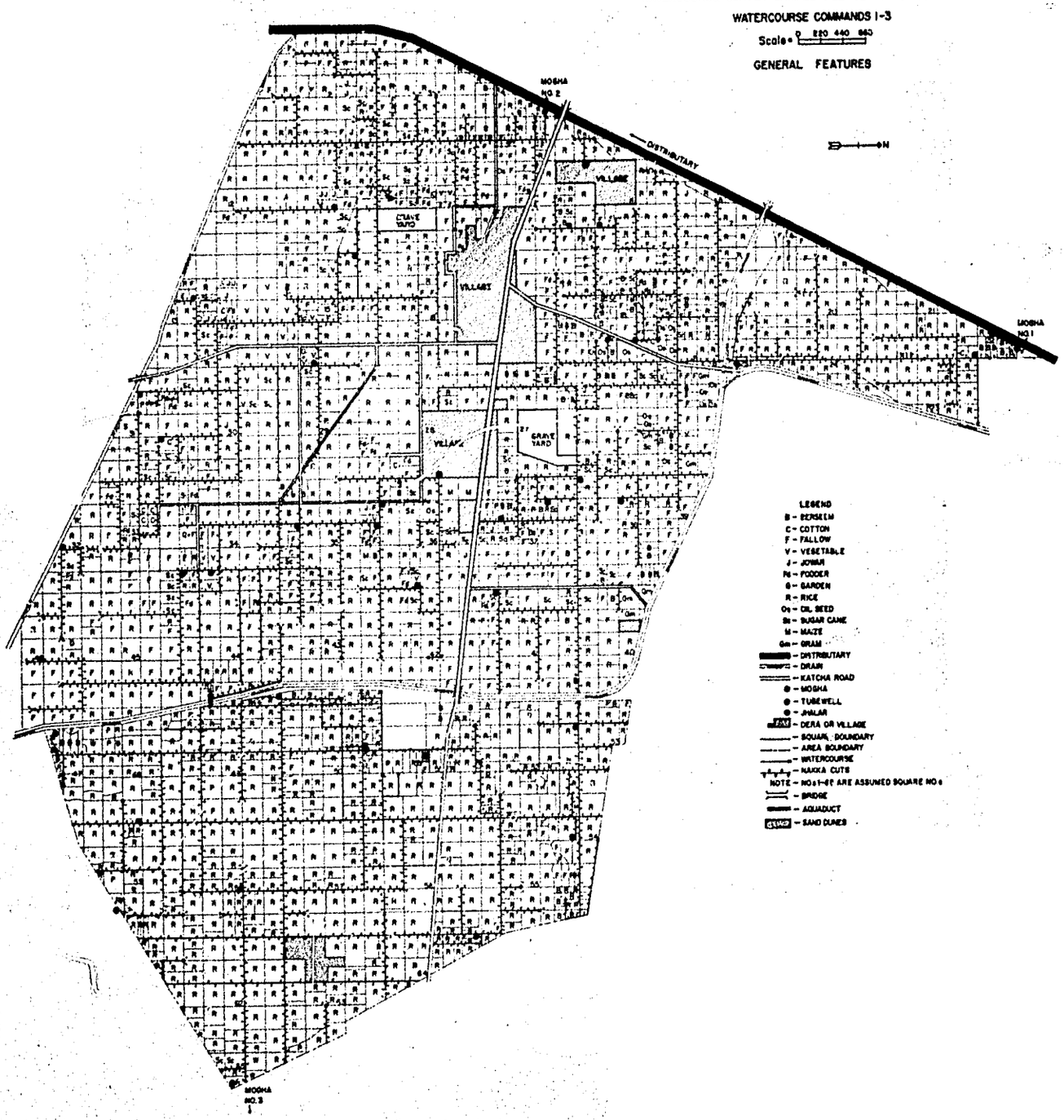
WATER MANAGEMENT RESEARCH PROJECT

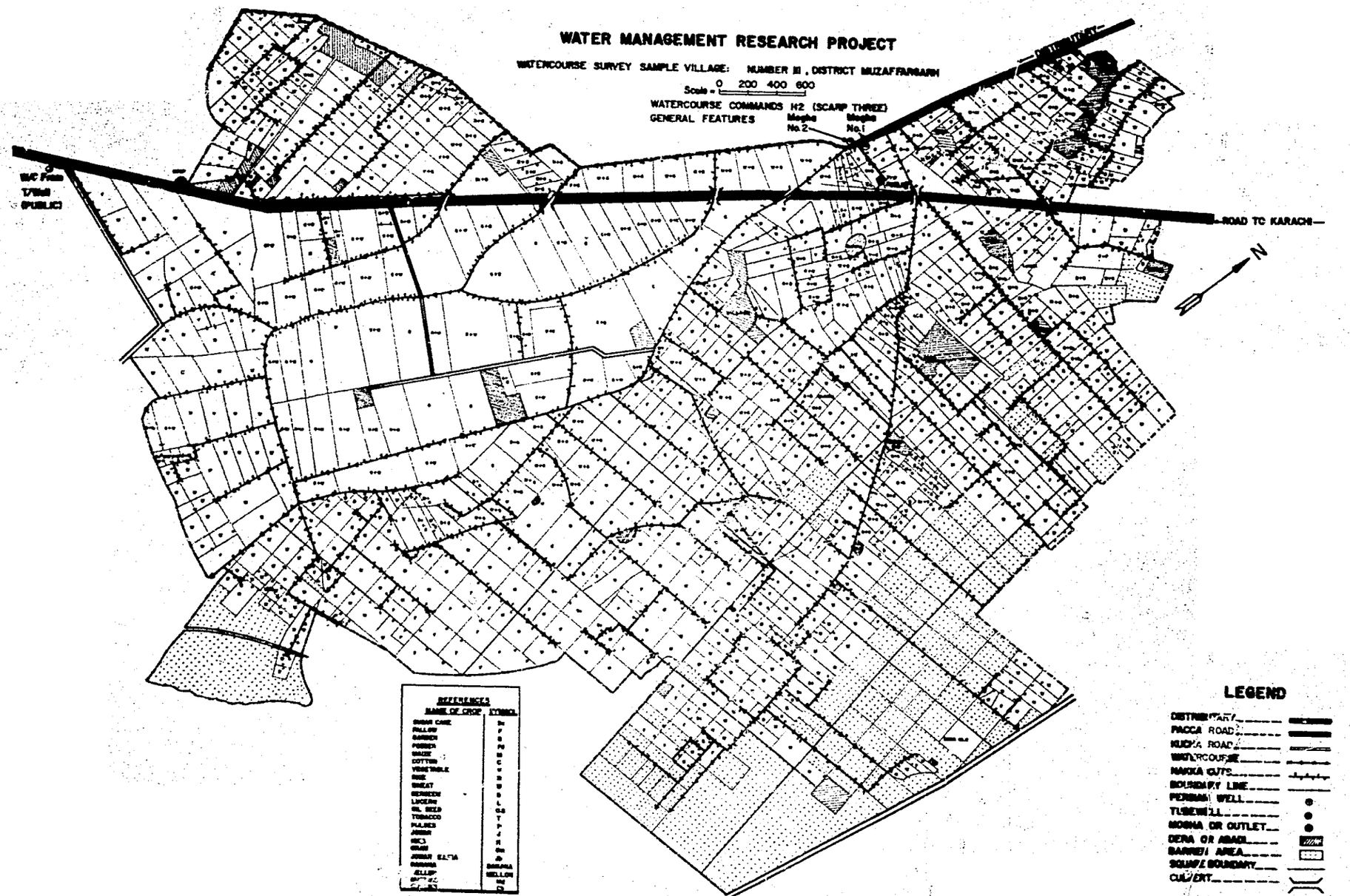
WATERCOURSE SURVEY SAMPLE VILLAGE: NO.10, DISTRICT GUJRANWALA

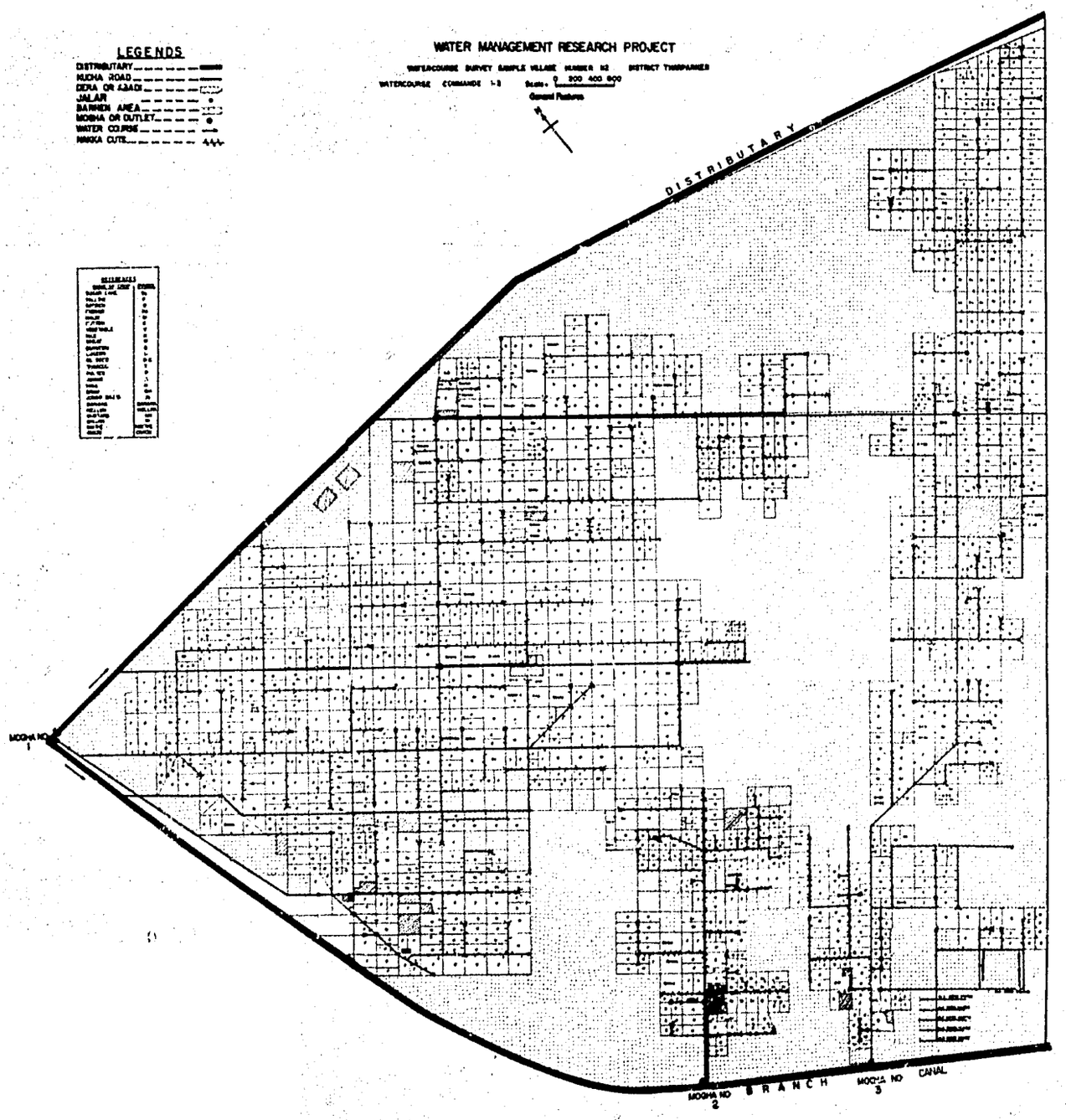
WATERCOURSE COMMANDS 1-3

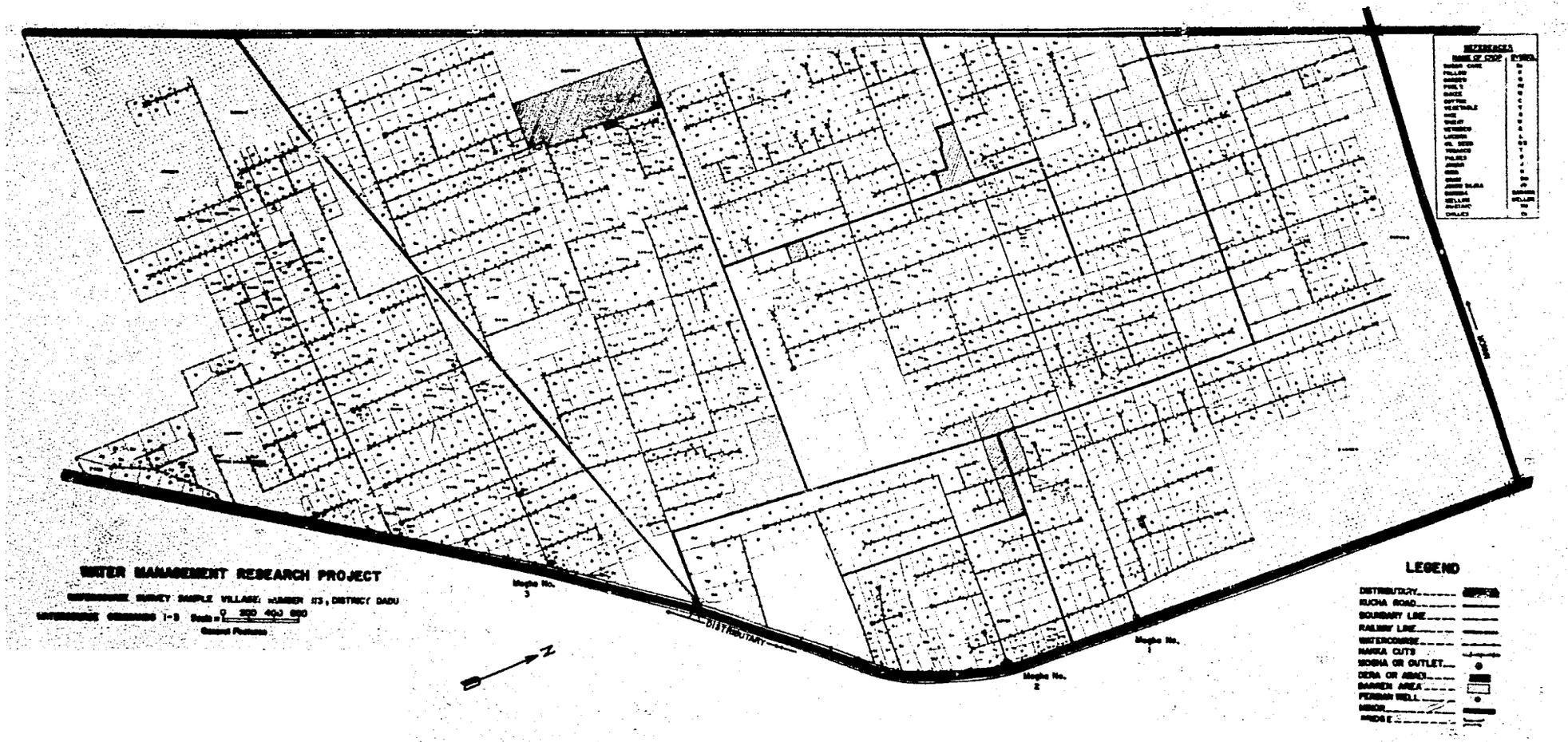
Scale: 0 220 440 660

GENERAL FEATURES




WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER III, DISTRICT MUZAFFARGARH
Scale = 0 200 400 600
WATERCOURSE COMMANDS H2 (SCARP THREE)
GENERAL FEATURES
Moghe No.2
Moghe No.1
W/C From T/Well (PUBLIC)
ROAD TO KARACHI
N
REFERENCES
NAME OF CROP
SYMBOL
LEGEND
DISTRIBUTARY
PACCA ROAD
KUCHA ROAD
WATERCOURSE
NAKKA CUTS
BOUNDARY LINE
PERMANENT WELL
TUBEWELL
MOGHA OR OUTLET
DERA OR ABADI
BARREN AREA
SQUARE BOUNDARY
CULVERT


LEGENDS
DISTRIBUTARY
KUCHA ROAD
DERA OR ABADI
JALAR
BARREN AREA
MOGHA OR OUTLET
WATER COURSE
NIKKA CUTE
WATER MANAGEMENT RESEARCH PROJECT
DISTRIBUTARY
MOGHA NO 1
MOGHA NO 2
BRANCH
MOGHA NO 3
CANAL

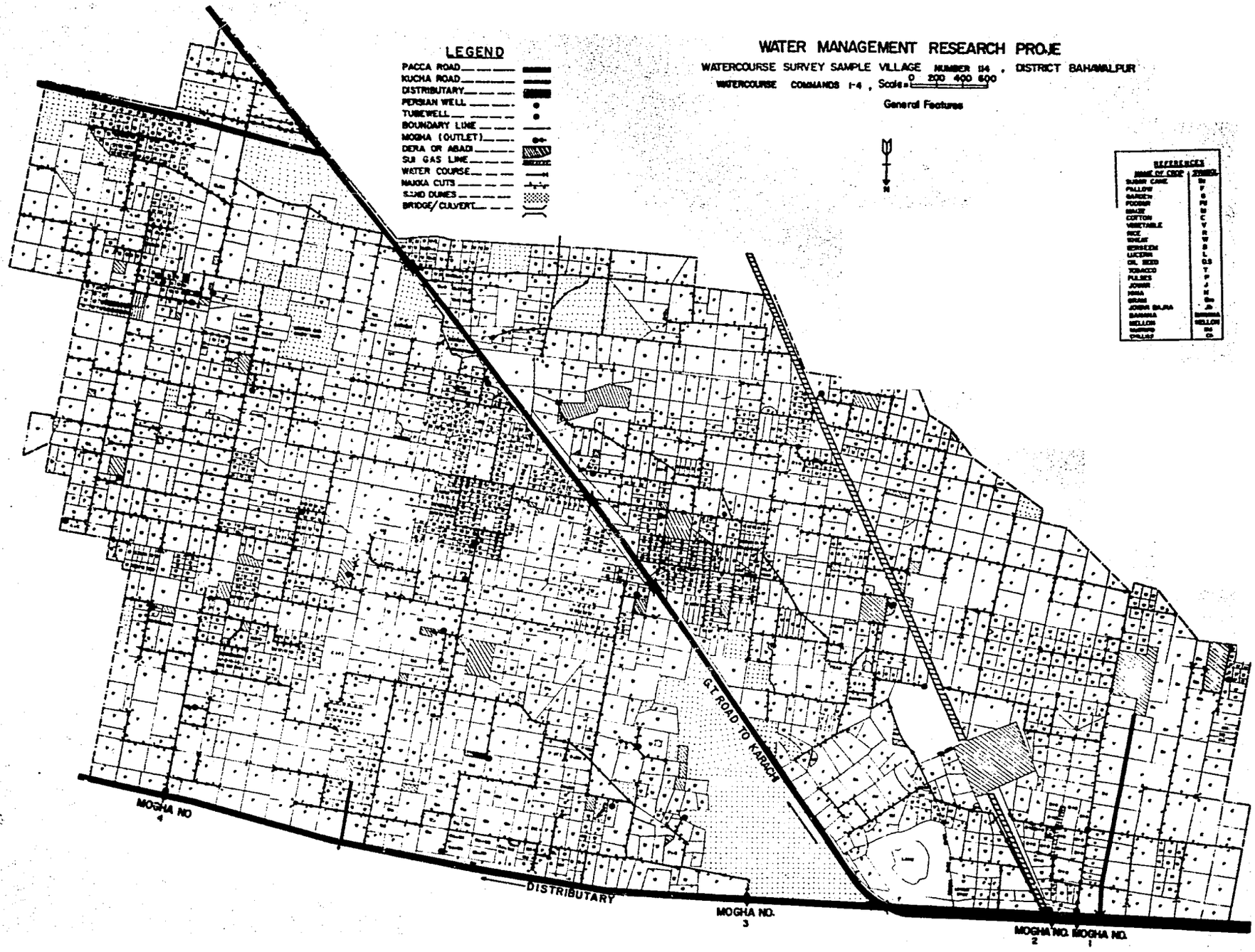

WATER MANAGEMENT RESEARCH PROJECT
Moghe No. 3
Moghe No. 2
Moghe No. 1
LEGEND
DISTRIBUTARY
KUCHA ROAD
BOUNDARY LINE
RAILWAY LINE
WATERCOURSE
MARKA CUTS
MOGHA OR OUTLET
DERA OR ABADI
BARREN AREA
PERSIAN WELL
MINOR
BRIDGE

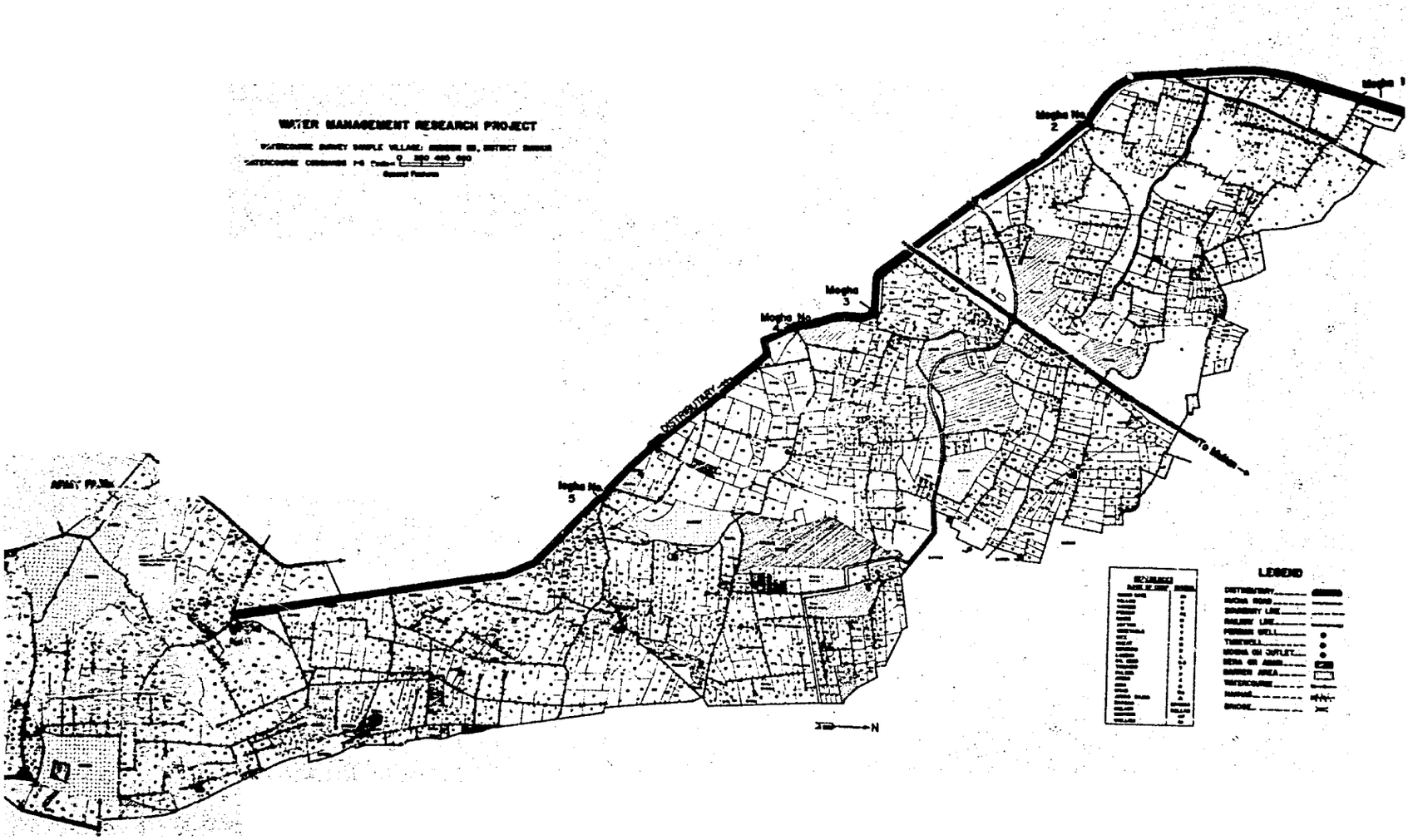
WATER MANAGEMENT RESEARCH PROJE

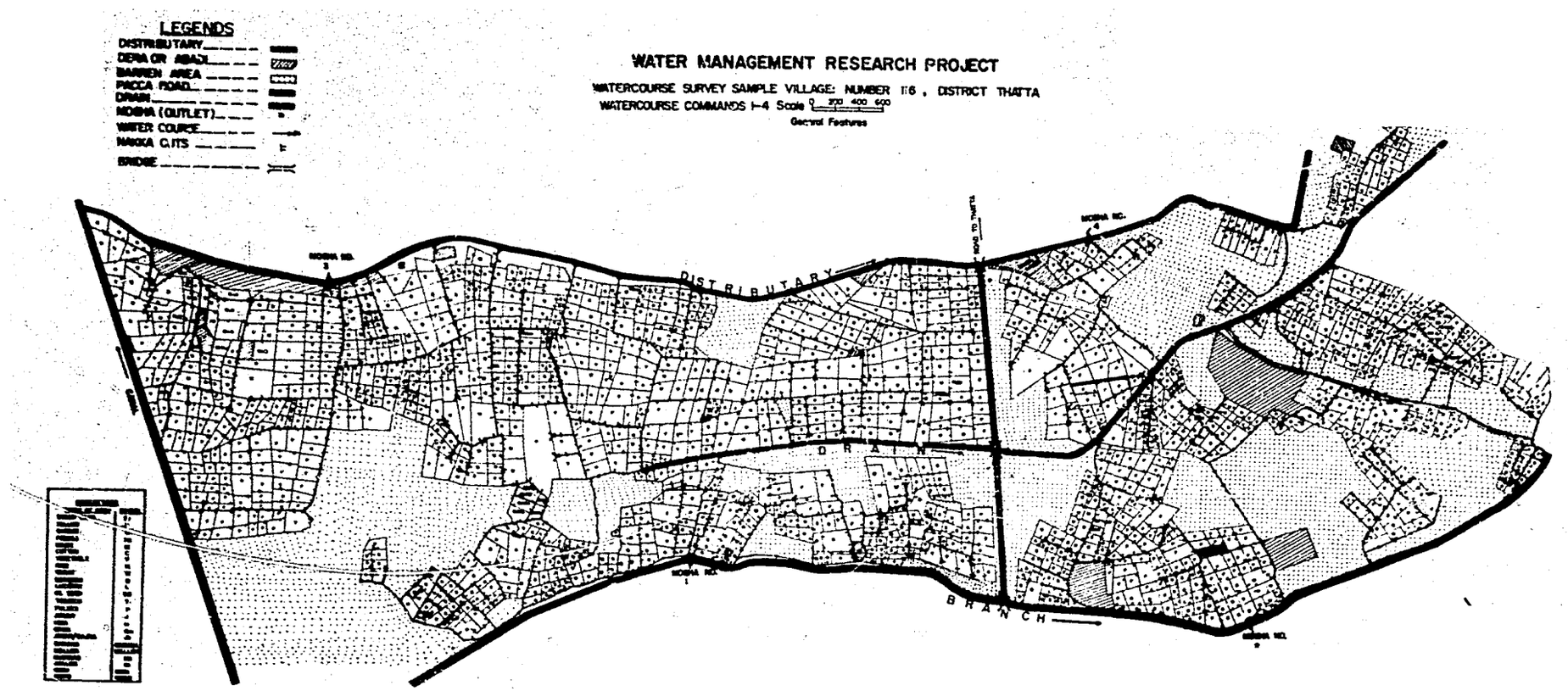
WATERCOURSE SURVEY SAMPLE VILLAGE NUMBER 114 , DISTRICT BAHAWALPUR

WATERCOURSE COMMANDS 1-4 , Scale = 0 200 400 600

General Features




WATER MANAGEMENT RESEARCH PROJECT
Moghe No. 1
Moghe No. 2
Moghe No. 3
Moghe No. 4
Moghe No. 5
To Mulan
N
LEGEND


LEGENDS
DISTRIBUTARY
DERA OR ABADI
BARREN AREA
PACCA ROAD
DRAIN
MOGHA (OUTLET)
WATER COURSE
NAKKA CUTS
BRIDGE
WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 116 , DISTRICT THATTA
WATERCOURSE COMMANDS 1-4 Scale 0 200 400 600
General Features
DISTRIBUTARY
DRAIN
BRANCH
MOGHA NO. 1
MOGHA NO. 2
MOGHA NO. 3
MOGHA NO. 4

APPENDIX IV

Part F

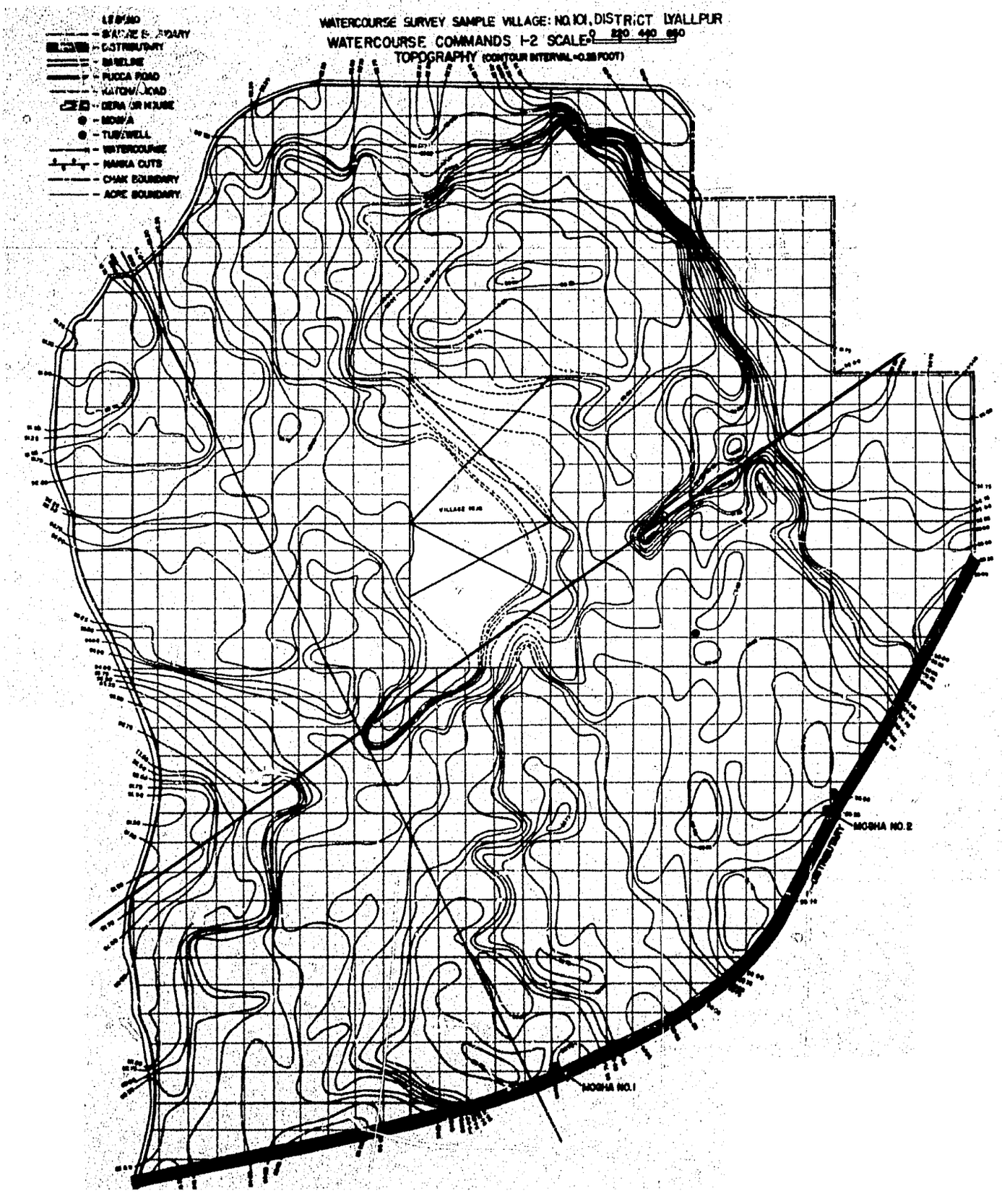
TOPOGRAPHIC MAPS

WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE: NO.101, DISTRICT LYALLPUR

WATERCOURSE COMMANDS 1-2 SCALE 0 220 440 880

TOPOGRAPHY (CONTOUR INTERVAL = 0.25 FOOT)



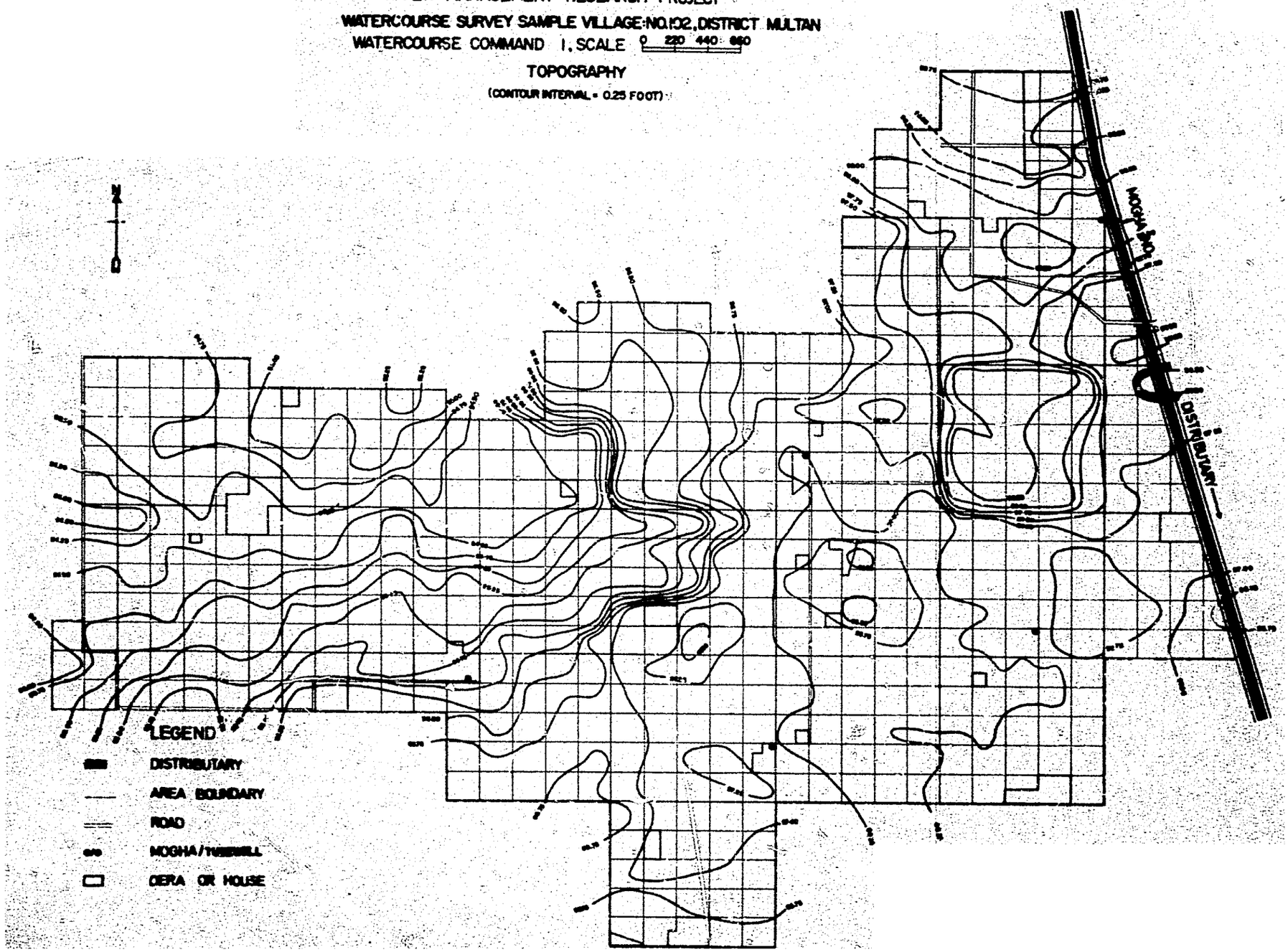
WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE:NO.102, DISTRICT MULTAN

WATERCOURSE COMMAND I, SCALE 0 220 440 880

TOPOGRAPHY

(CONTOUR INTERVAL = 0.25 FOOT)



WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE 103

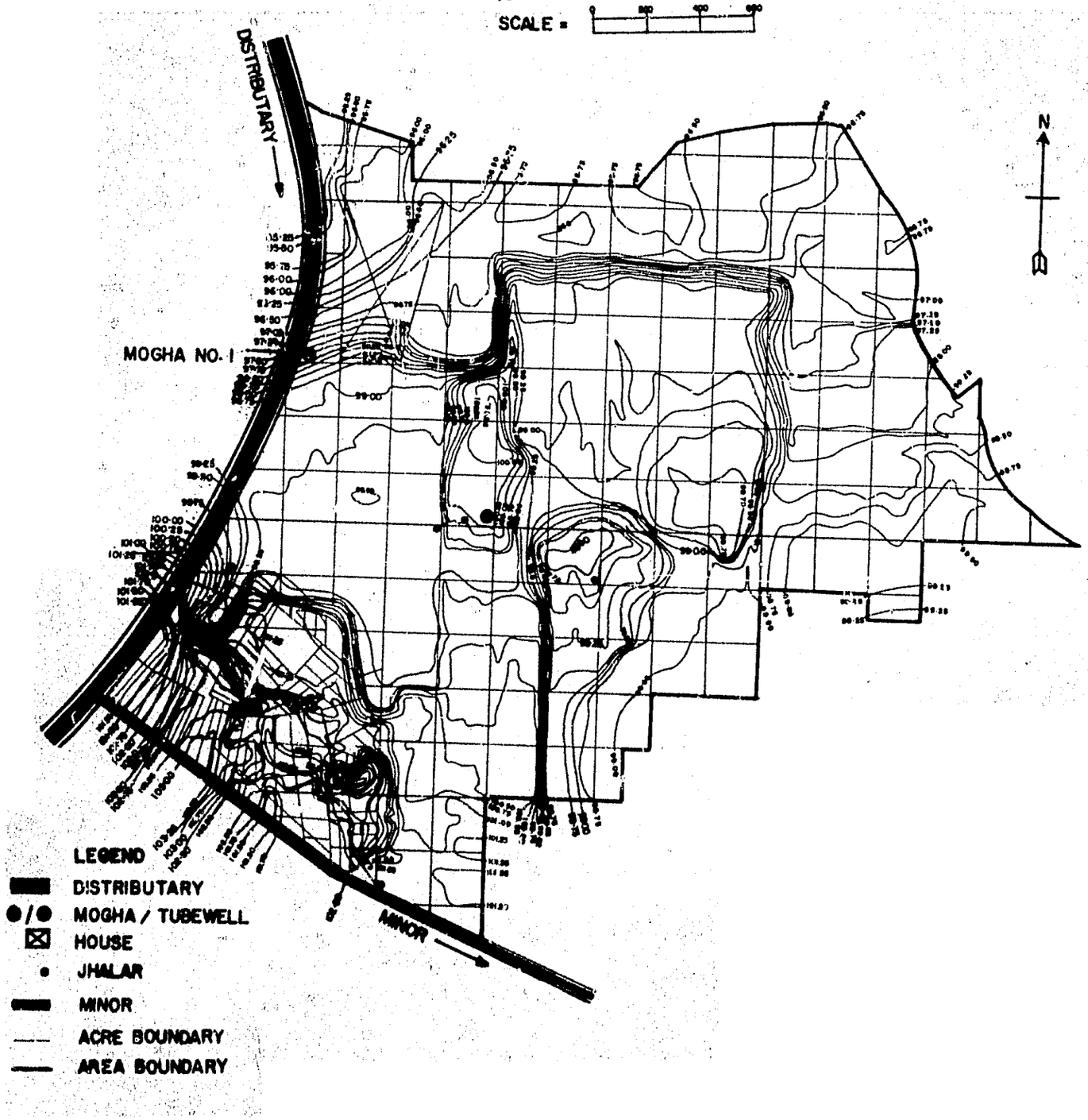
DISTRICT LAHORE

WATERCOURSE COMMAND I

TOPOGRAPHY

(CONTOUR INTERVAL = 0.25 FOOT)

SCALE =



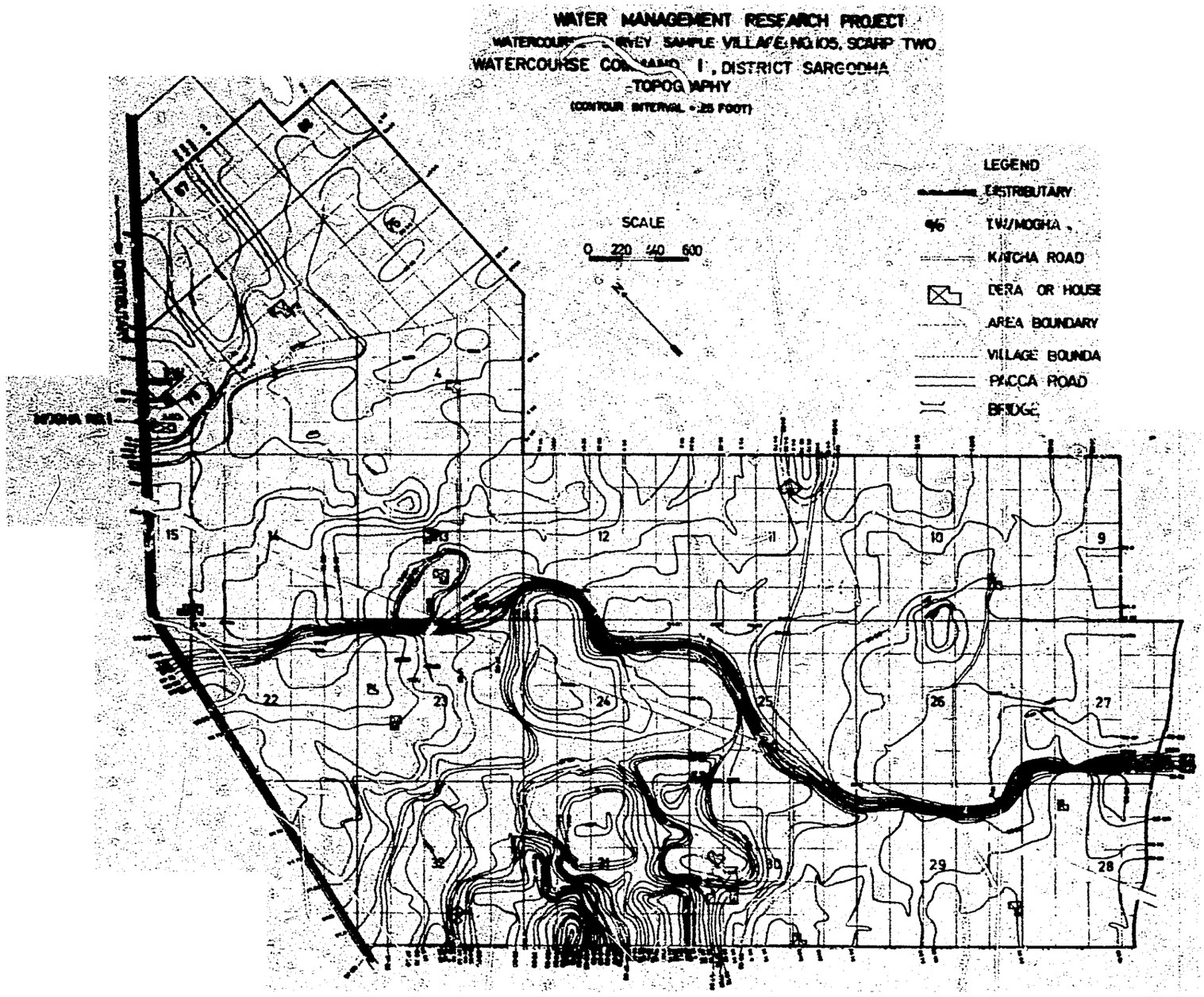
WATER MANAGEMENT RESEARCH PROJECT

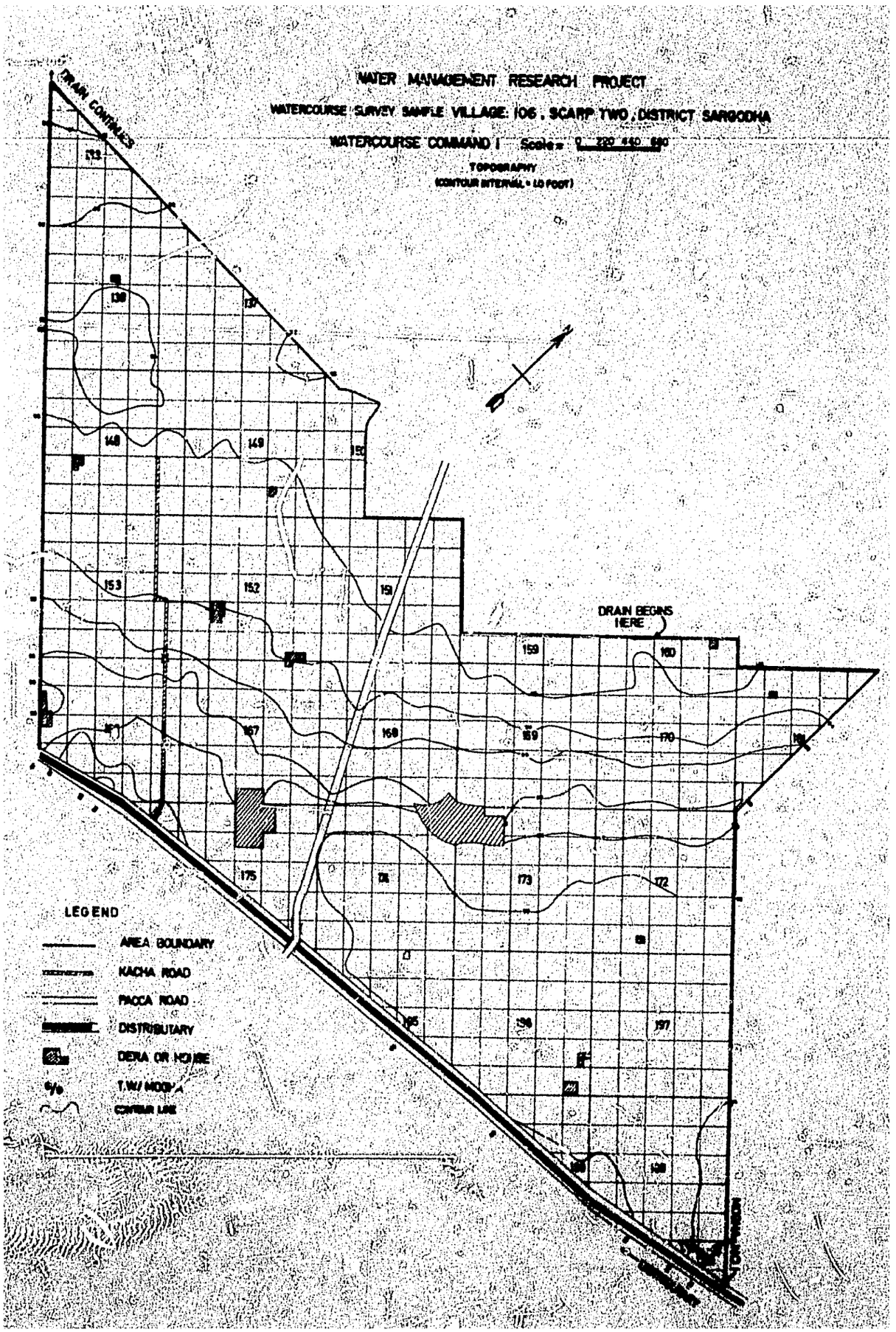
WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 104, DISTRICT LAHORE

SCALE = 0 200 400 600

WATERCOURSE COMMANDS 1,2,&3

TOPOGRAPHY


WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE NO.105, SCARP TWO
WATERCOURSE COMMAND I, DISTRICT SARGODHA
TOPOGRAPHY
(CONTOUR INTERVAL = .25 FOOT)
LEGEND
DISTRIBUTARY
TW/MOGHA
KATCHA ROAD
DERA OR HOUSE
AREA BOUNDARY
VILLAGE BOUNDA
PACCA ROAD
BRIDGE
SCALE
0 220 440 660
MOGHA NO.1
15
13
12
11
10
9
22
23
24
25
26
27
32
31
30
29
28

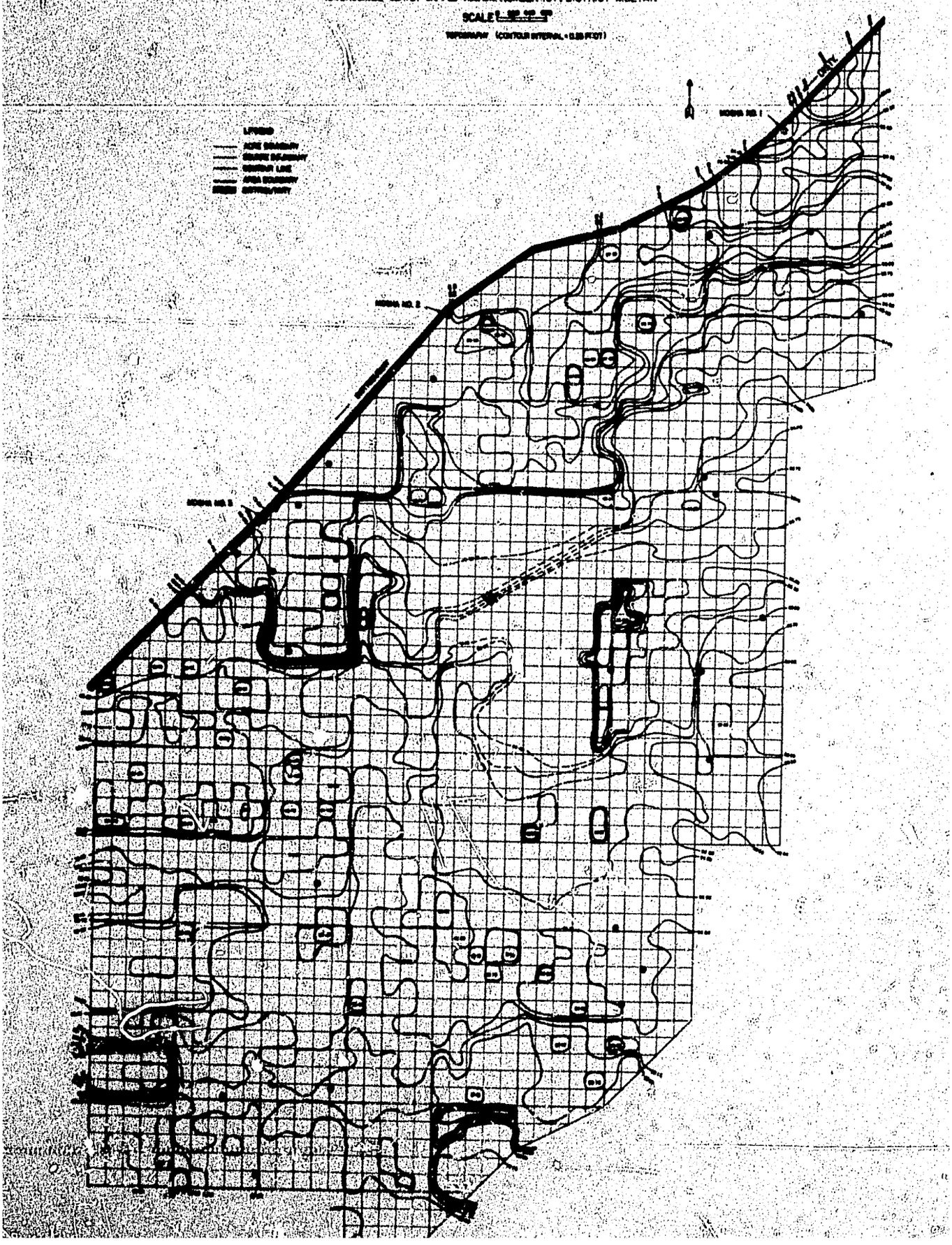

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: 106, SCARP TWO, DISTRICT SARGODHA
WATERCOURSE COMMAND I Scale = 0 220 440 880
TOPOGRAPHY
(CONTOUR INTERVAL = 1.0 FOOT)
DRAIN CONTINUES
DRAIN BEGINS HERE
LEGEND
AREA BOUNDARY
KACHA ROAD
PACCA ROAD
DISTRIBUTARY
DERA OR HOUSE
T.W./ MOGHA
CONTOUR LINE

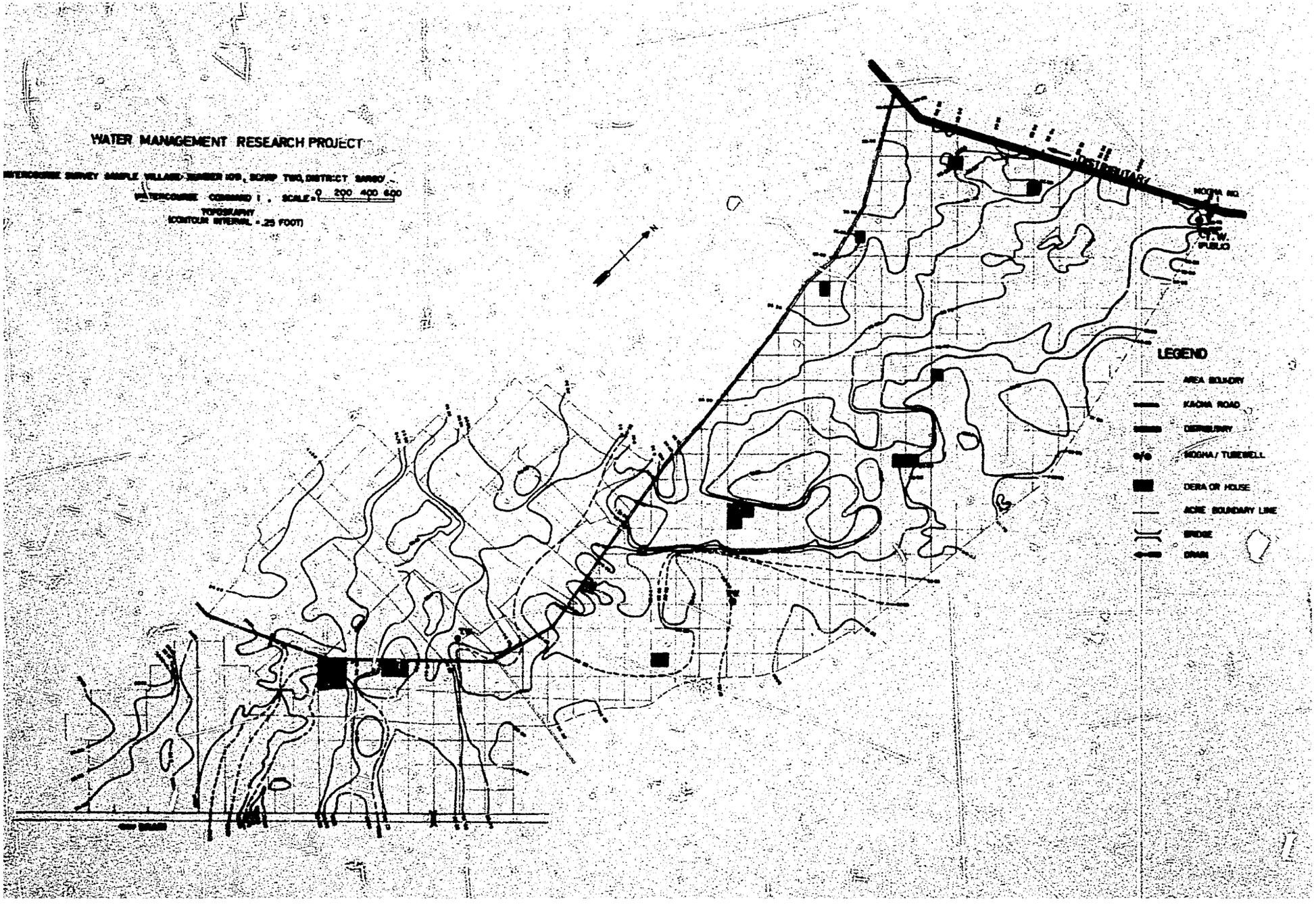
WATER MANAGEMENT RESEARCH PROJECT

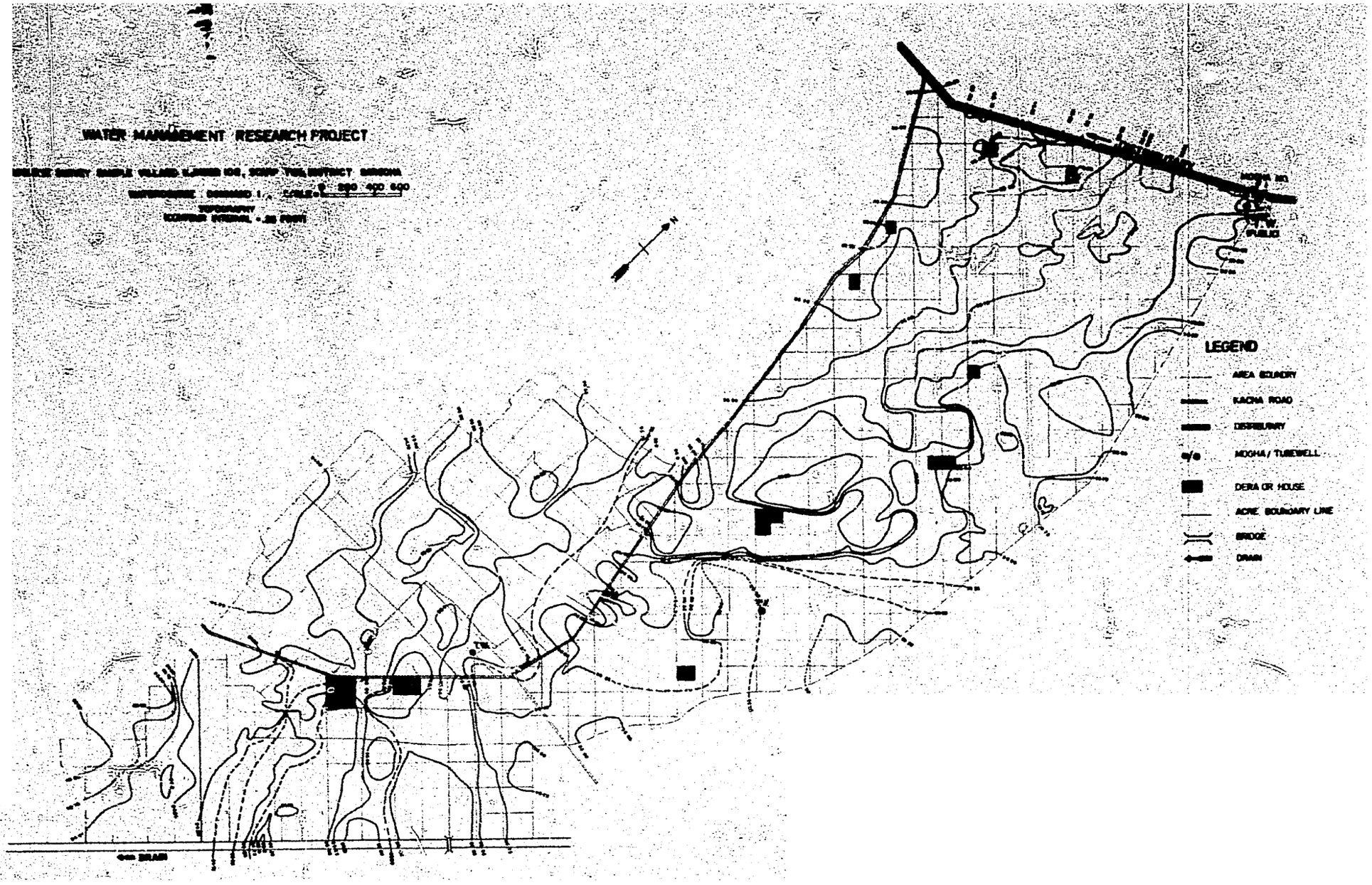
WATERCOURSE SURVEY SAMPLE VILLAGE NUMBER 107, DISTRICT MULTAN

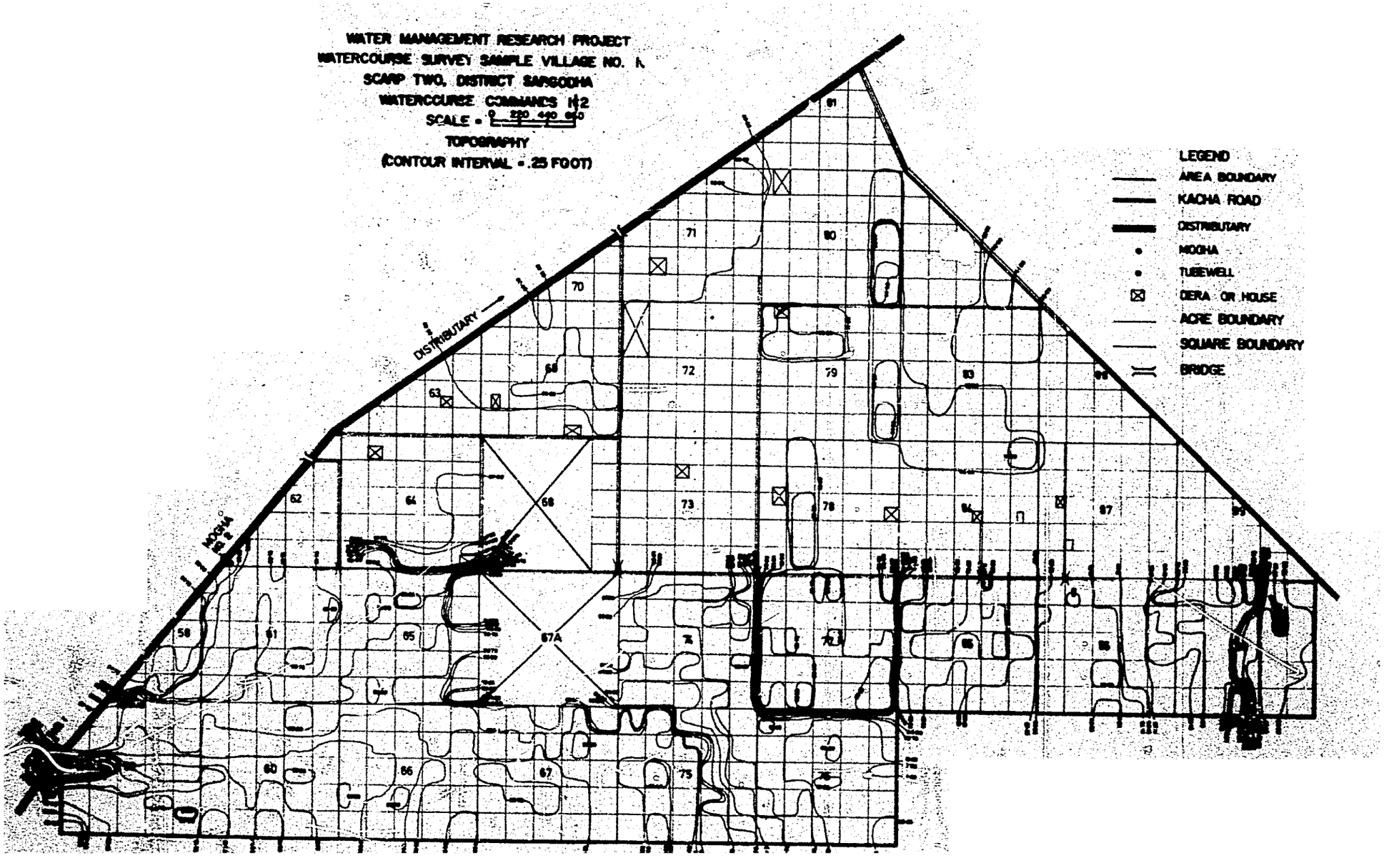
SCALE

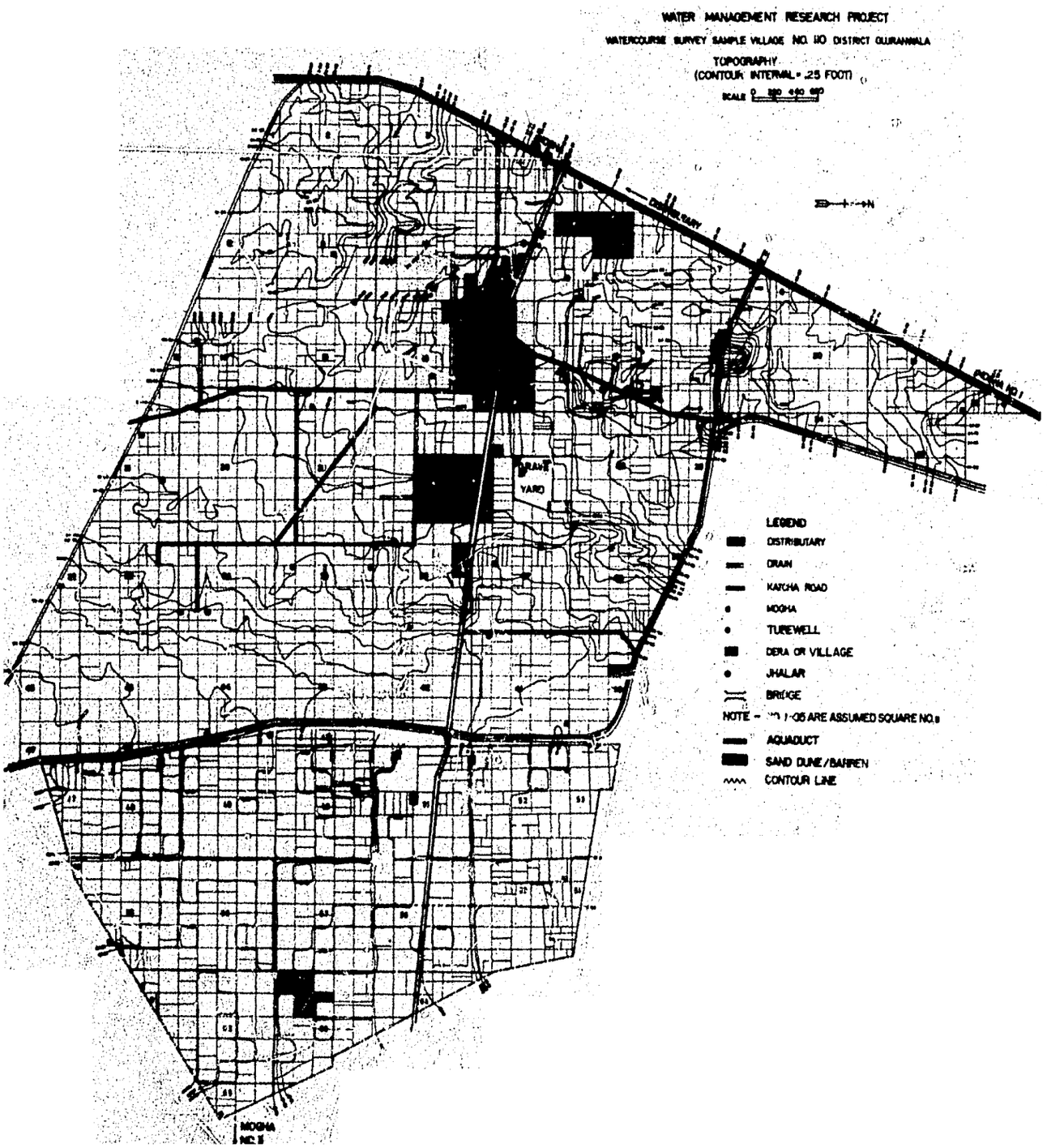
TOPOGRAPHY (CONTOUR INTERVAL = 0.25 FOOT)

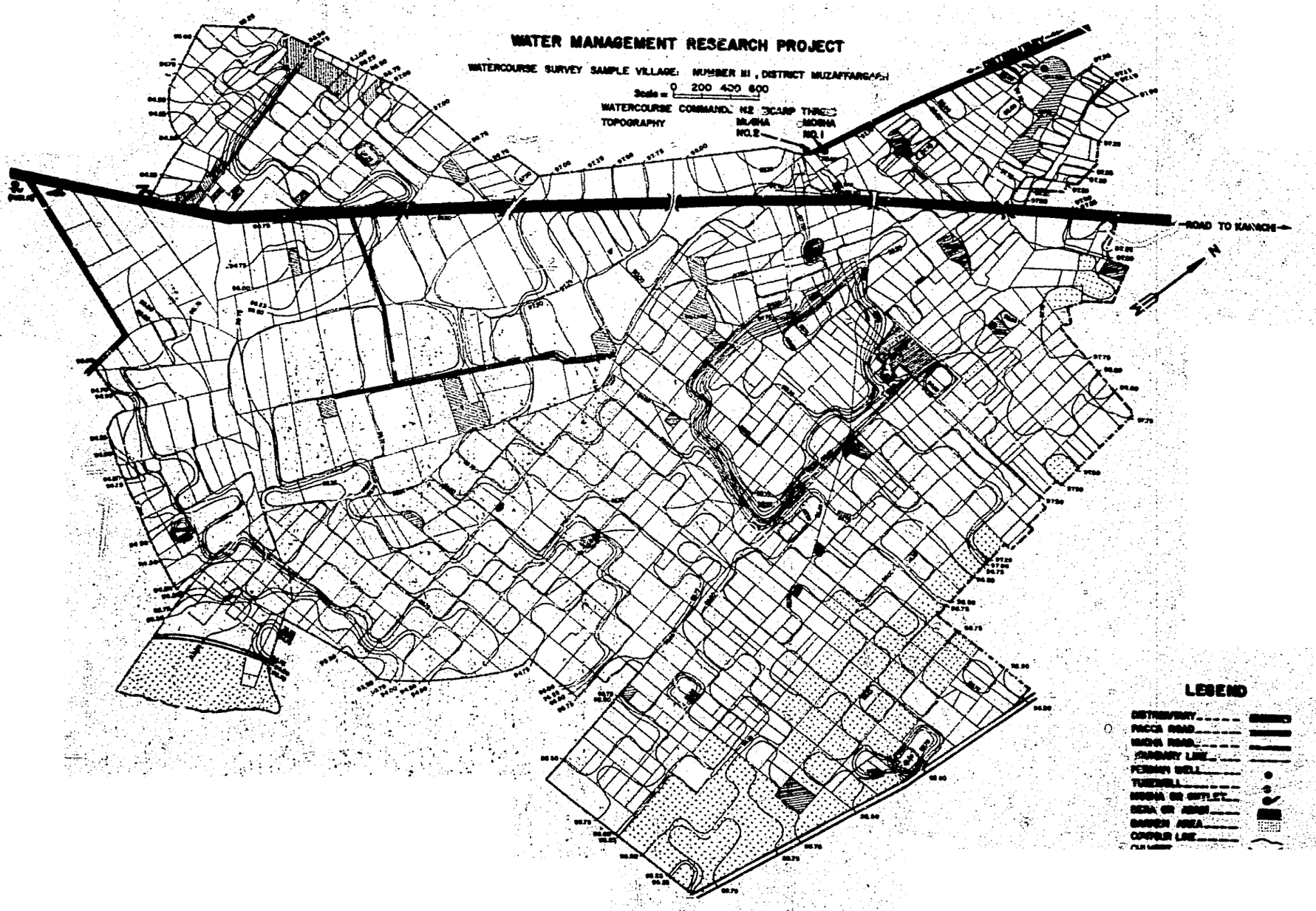


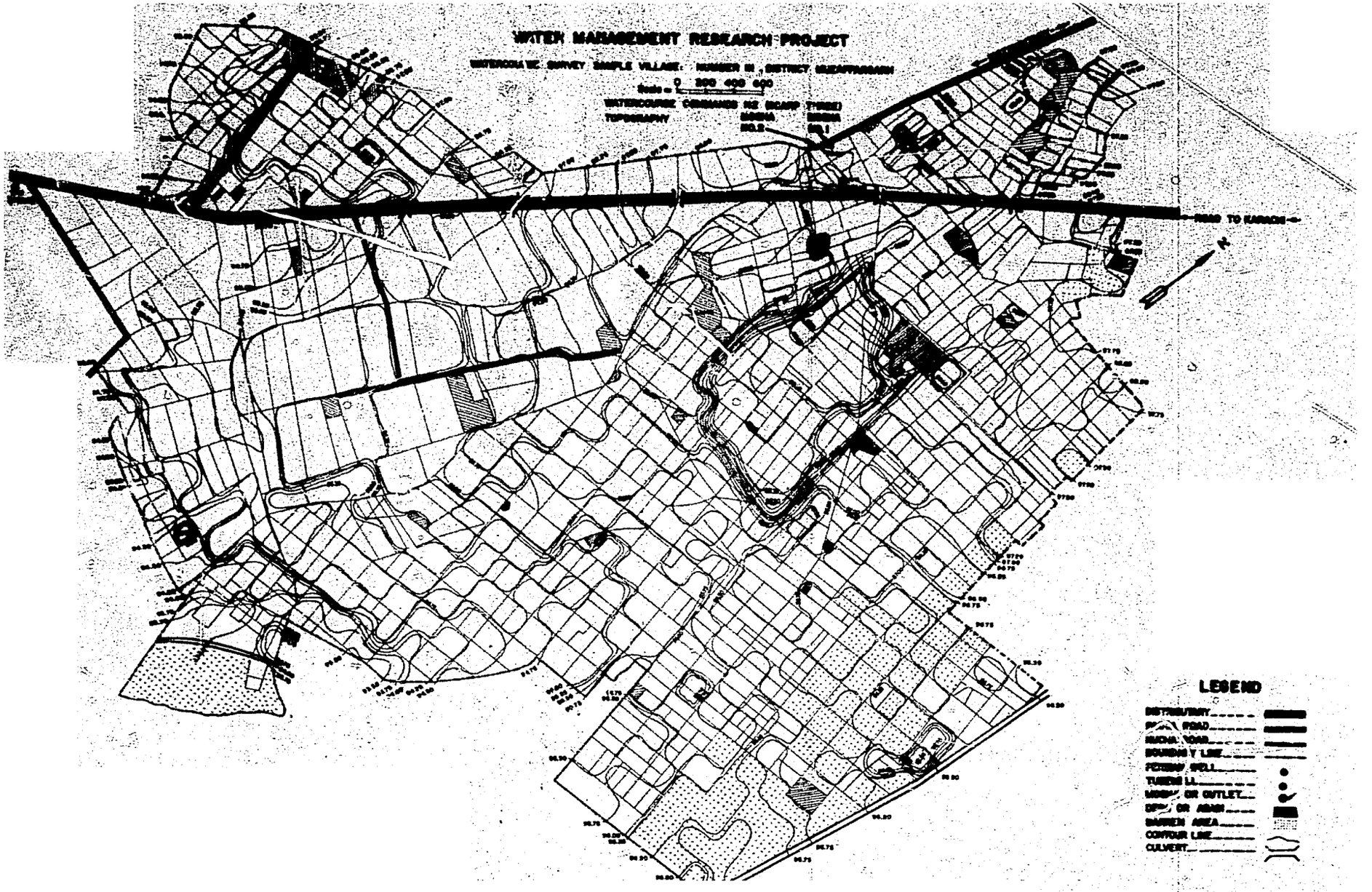

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE NUMBER 109, SCHEME TWO, DISTRICT SARGODHA
WATERCOURSE COMMAND 1 , SCALE = 0 200 400 600
TOPOGRAPHY
(CONTOUR INTERVAL = .25 FOOT)
N
DISTRIBUTARY
MOGHA NO.
T.W.
PUBLIC
LEGEND
AREA BOUNDRY
KACHA ROAD
DISTRIBUTARY
MOGHA / TUBEWELL
DERA OR HOUSE
ACRE BOUNDARY LINE
BRIDGE
DRAIN

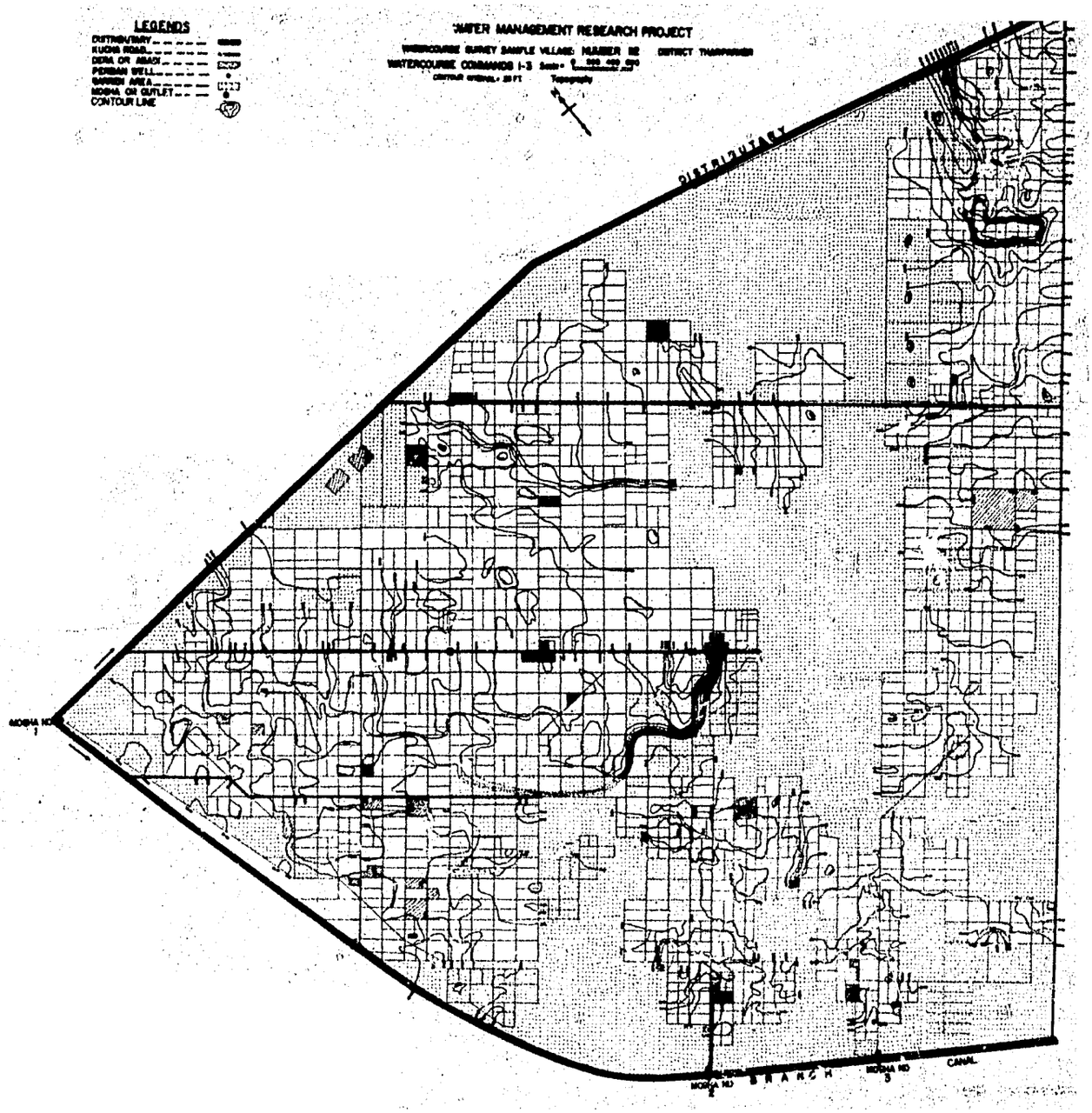

WATER MANAGEMENT RESEARCH PROJECT
LEGEND
AREA BOUNDRY
KACHA ROAD
DISTRIBUTARY
MOGHA / TUBEWELL
DERA OR HOUSE
ACRE BOUNDARY LINE
BRIDGE
DRAIN
N

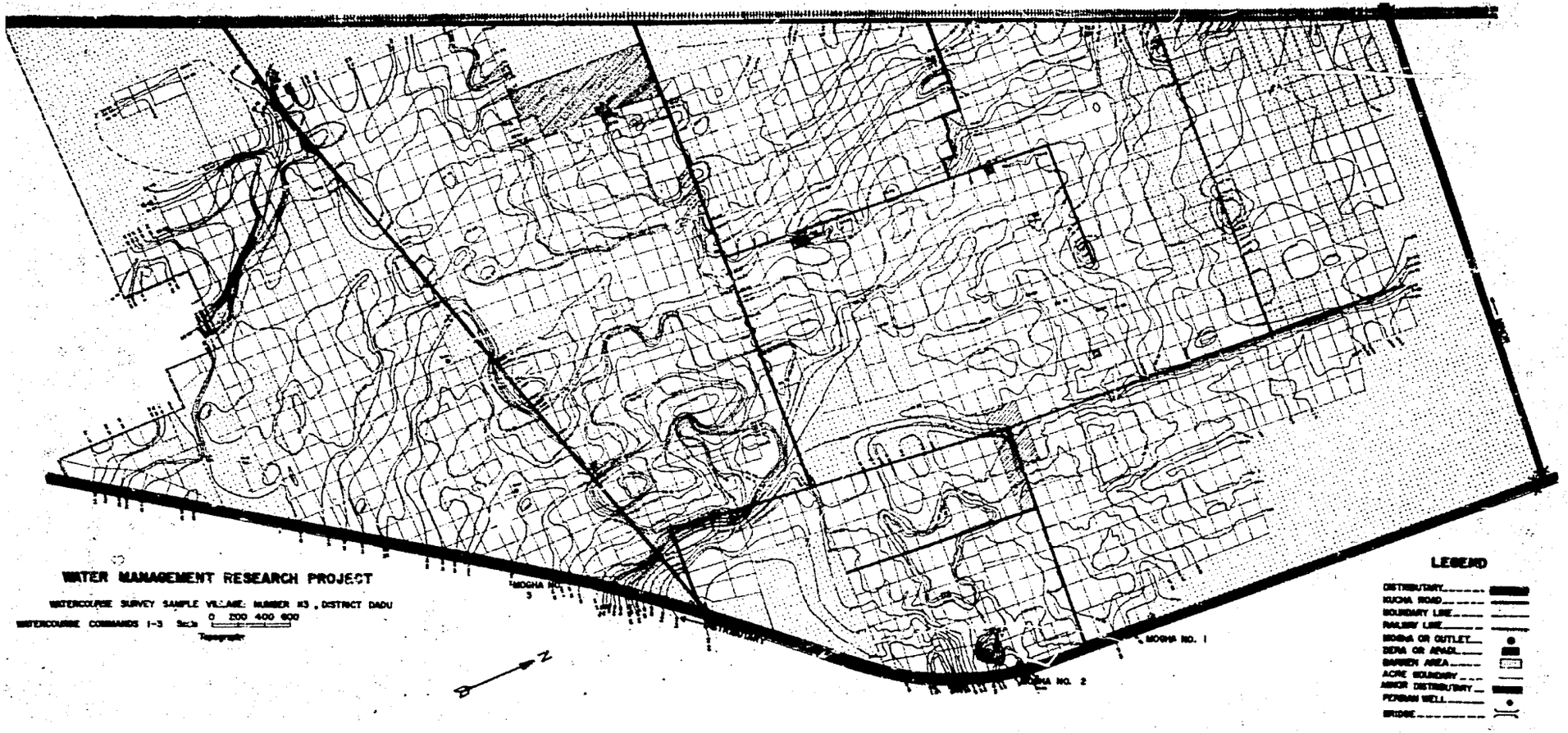

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE NO. 1
SCARP TWO, DISTRICT SARGODHA
WATERCOURSE COMMANDS 112
SCALE = 0 220 440 880
TOPOGRAPHY
(CONTOUR INTERVAL = .25 FOOT)
LEGEND
AREA BOUNDARY
KACHA ROAD
DISTRIBUTARY
MOGHA
TUBEWELL
DERA OR HOUSE
ACRE BOUNDARY
SQUARE BOUNDARY
BRIDGE
DISTRIBUTARY
MOGHA
58
61
62
63
64
65
66
67
67A
68
70
71
72
73
75
79
80
81

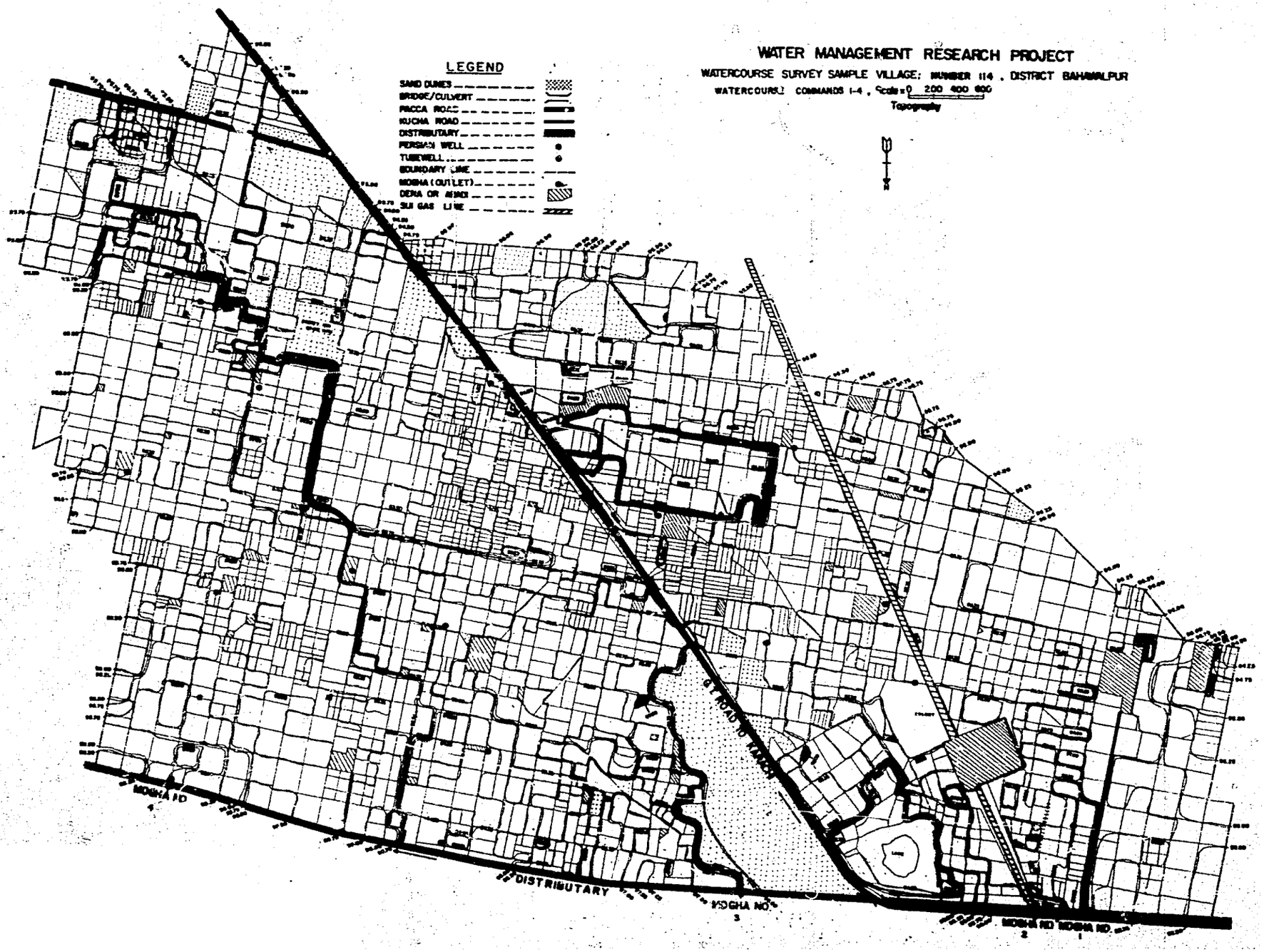

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE NO. 110 DISTRICT GUJRANWALA
TOPOGRAPHY
(CONTOUR INTERVAL = .25 FOOT)
SCALE 0 200 400 600
N
DISTRIBUTARY
DRAIN
YARD
MOGHA NO. 11
LEGEND
DISTRIBUTARY
DRAIN
KATCHA ROAD
MOGHA
TUBEWELL
DERA OR VILLAGE
JHALAR
BRIDGE
NOTE - 1-05 ARE ASSUMED SQUARE NOS
AQUADUCT
SAND DUNE/BARREN
CONTOUR LINE

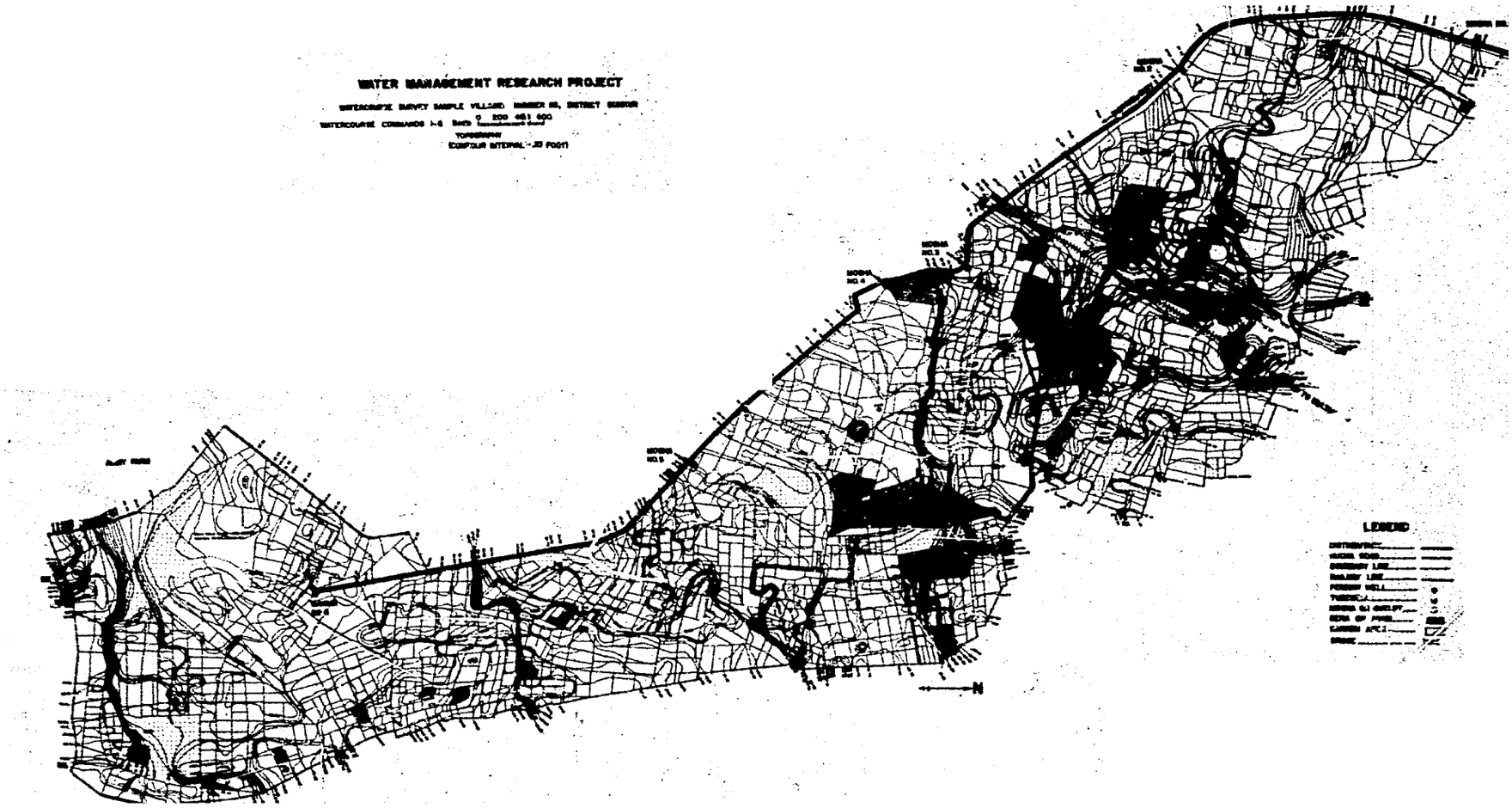

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER III, DISTRICT MUZAFFARGARH
Scale = 0 200 400 600
WATERCOURSE COMMAND: M2 SCARP THREE
TOPOGRAPHY
MOGHA NO.2
MOGHA NO.1
ROAD TO KAMICHI
N
LEGEND
DISTRIBUTARY
PACCA ROAD
MOGHA ROAD
BOUNDARY LINE
PERMANENT WELL
TUBEWELL
MOGHA OR OUTLET
MOGHA OR ARMS
BARREN AREA
CONTOUR LINE

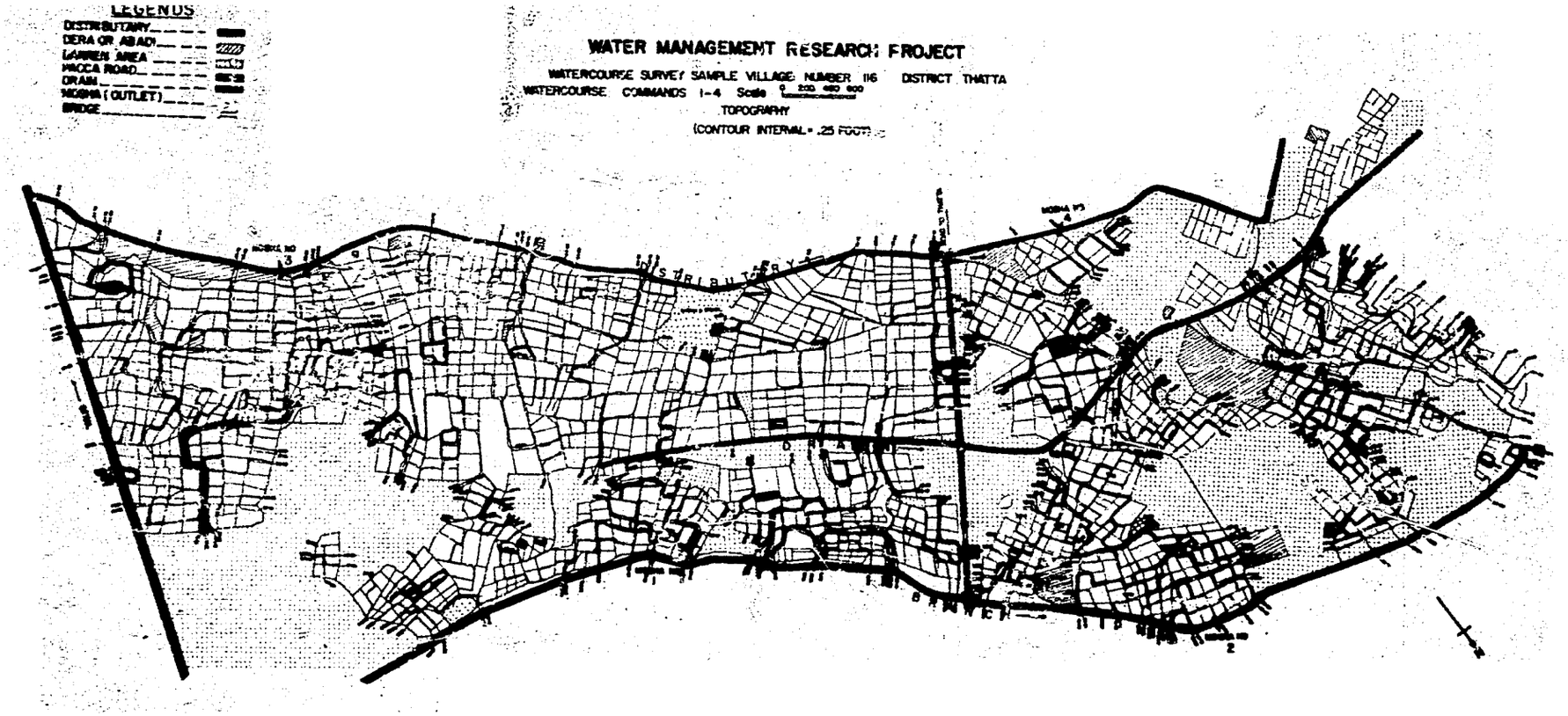

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER III, DISTRICT MUZAFFARGARH
Scale = 0 200 400 600
WATERCOURSE COMMANDED NIZ BRANCH (TIBBI)
TOPOGRAPHY
ROAD TO KARACHI
N
LEGEND
DISTRIBUTARY
ROAD
BOUNDARY LINE
TUBEWELL
DRAIN OR ABAD
BARREN AREA
CONTOUR LINE
CULVERT


LEGENDS
DISTRIBUTARY
KUCHA ROAD
DERA OR ABADI
PERMAN WELL
WARBAN AREA
MOGHA OR OUTLET
CONTOUR LINE
WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE NUMBER 82 DISTRICT THARPARKER
WATERCOURSE COMMANDS 1-3
Topography
DISTRIBUTARY
MOGHA NO 1
MOGHA NO 2
BRANCH
MOGHA NO 3
CANAL


WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER #3 , DISTRICT DADU
WATERCOURSE COMMANDS 1-3 Scale 0 200 400 600
Topographic
MOGHA NO. 3
MOGHA NO. 1
MOGHA NO. 2
N
LEGEND
DISTRIBUTARY
KUCHA ROAD
BOUNDARY LINE
RAILWAY LINE
MOGHA OR OUTLET
DERA OR APADI
BARREN AREA
ACRE BOUNDARY
MINOR DISTRIBUTARY
PERMAN WELL
BRIDGE


WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 114 , DISTRICT BAHAWALPUR
WATERCOURSE COMMANDS 1-4 , Scale = 0 200 400 600
Topography
LEGEND
SAND DUNES
BRIDGE/CULVERT
PACCA ROAD
KUCHA ROAD
DISTRIBUTARY
PERSIAN WELL
TUBEWELL
BOUNDARY LINE
MOGHA (OUTLET)
DERA OR ABADI
SUI GAS LINE
MOGHA RD 4
DISTRIBUTARY
MOGHA RD 3
MOGHA RD 2
MOGHA RD 1


WATER MANAGEMENT RESEARCH PROJECT
LEGEND
N


LEGENDS
DISTRIBUTARY
DERA OR ABADI
LARREN AREA
PACCA ROAD
DRAIN
MOGHA (OUTLET)
BRIDGE
WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE NUMBER 116 DISTRICT THATTA
WATERCOURSE COMMANDS 1-4 Scale 0 200 400 600
TOPOGRAPHY
(CONTOUR INTERVAL = .25 FOOT)
DISTRIBUTARY
DRAIN
BANWEL

APPENDIX IV

Part G

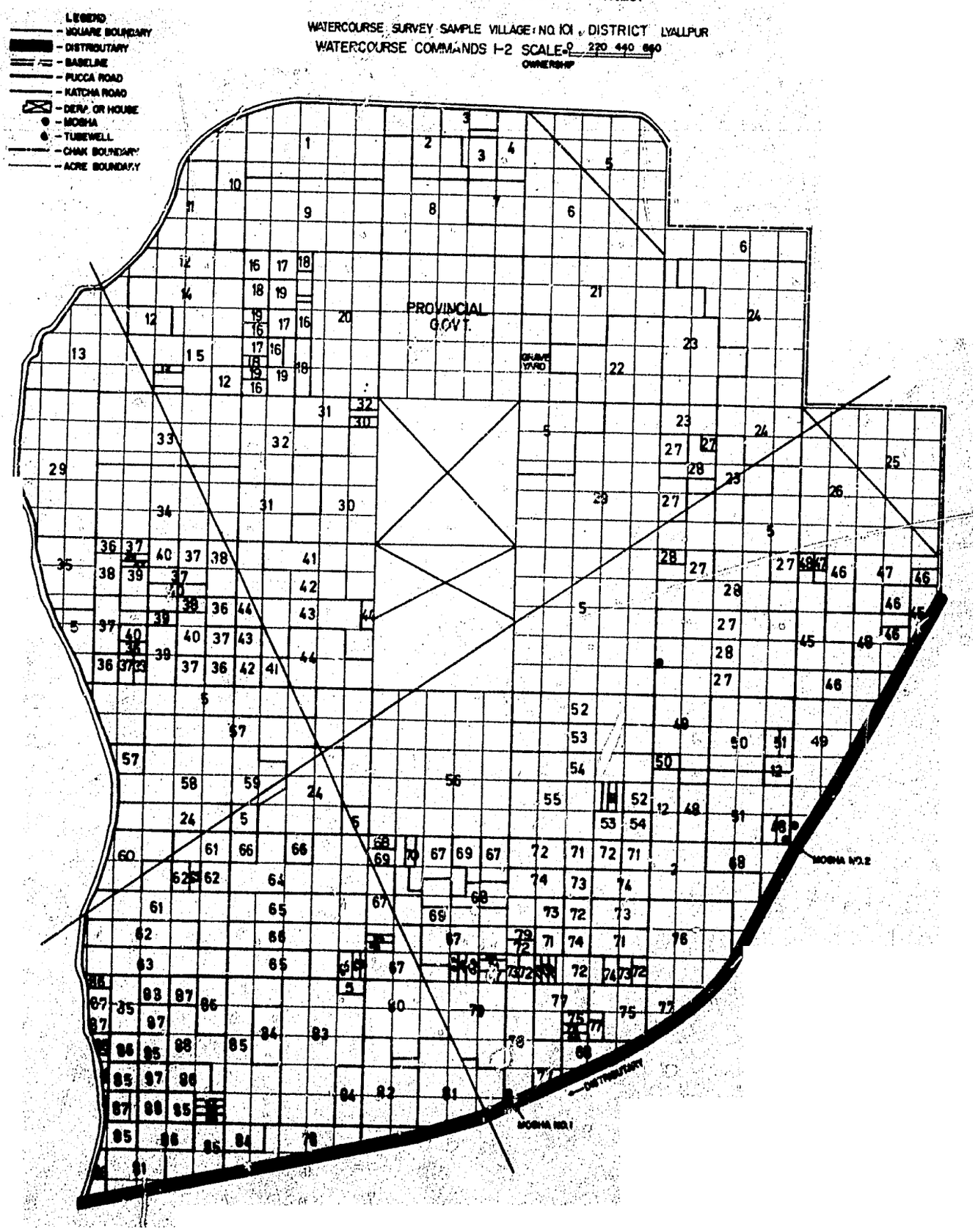
OWNERSHIP MAPS

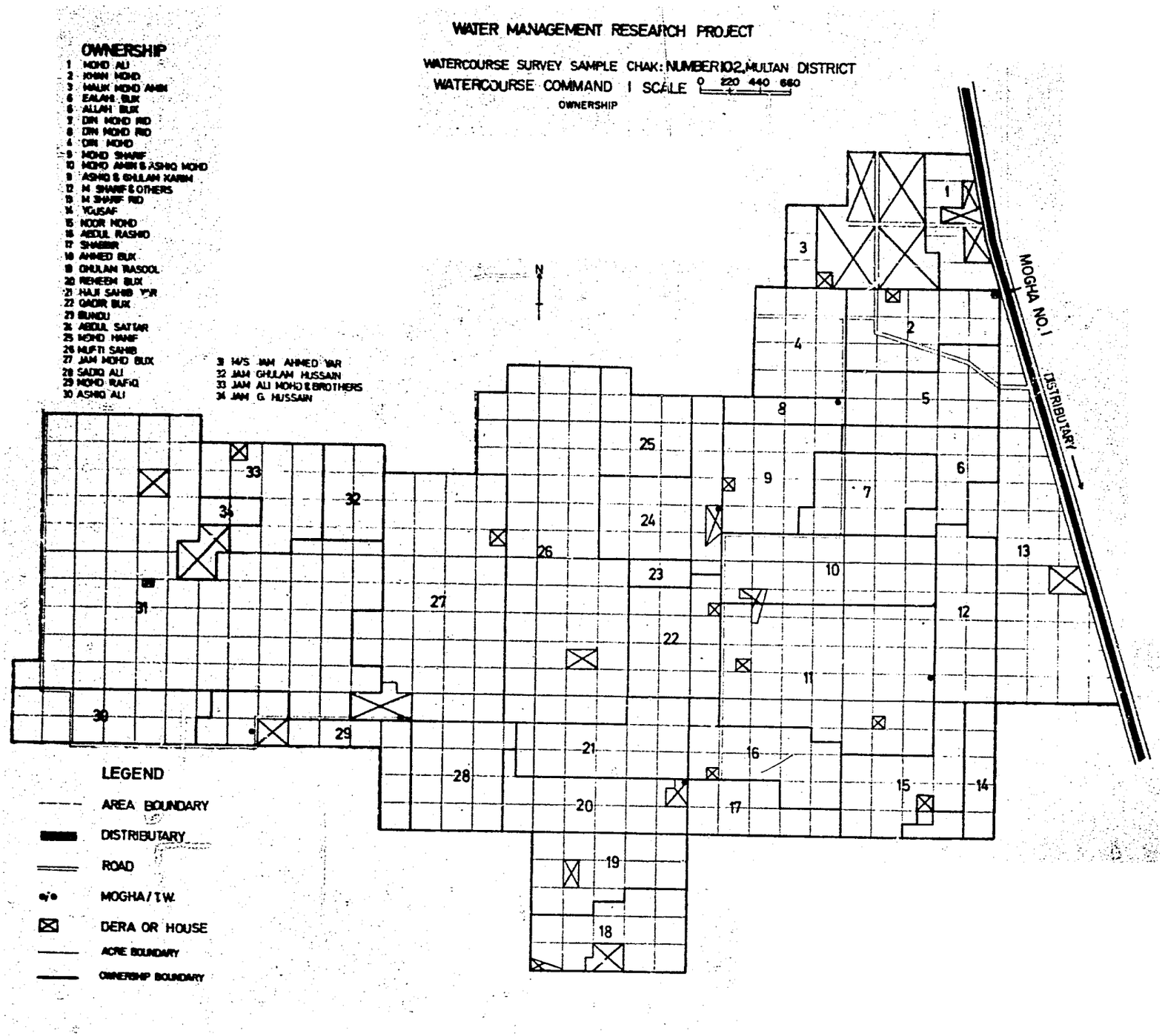
WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 101 , DISTRICT LYALLPUR

WATERCOURSE COMMANDS I-2 SCALE: 0 220 440 660

OWNERSHIP




WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE CHAK: NUMBER 102, MULTAN DISTRICT
WATERCOURSE COMMAND I SCALE 0 220 440 660
OWNERSHIP
OWNERSHIP
1 MOHD ALI
2 KHAN MOHD
3 MALIK MOHD AMIN
6 EALAHI BUX
6 ALLAH BUX
7 DIN MOHD RID
8 DIN MOHD RID
4 DIN MOHD
5 MOHD SHARIF
10 MOHD AMIN & ASHIQ MOHD
11 ASHIQ & GHULAM KARIM
12 M SHARIF & OTHERS
13 M SHARIF RID
14 YOUSAF
15 NOOR MOHD
16 ABDUL RASHID
17 SHABBIR
18 AHMED BUX
19 GHULAM RASOOL
20 RENEEM BUX
21 HAJI SAHIB YAR
22 QADIR BUX
23 BUNDU
24 ABDUL SATTAR
25 MOHD HANIF
26 MUFTI SAHIB
27 JAM MOHD BUX
28 SADIQ ALI
29 MOHD RAFIQ
30 ASHIQ ALI
31 M/S JAM AHMED YAR
32 JAM GHULAM HUSSAIN
33 JAM ALI MOHD & BROTHERS
34 JAM G. HUSSAIN
N
MOGHA NO.1
DISTRIBUTARY
LEGEND
AREA BOUNDARY
DISTRIBUTARY
ROAD
MOGHA / T.W.
DERA OR HOUSE
ACRE BOUNDARY
OWNERSHIP BOUNDARY

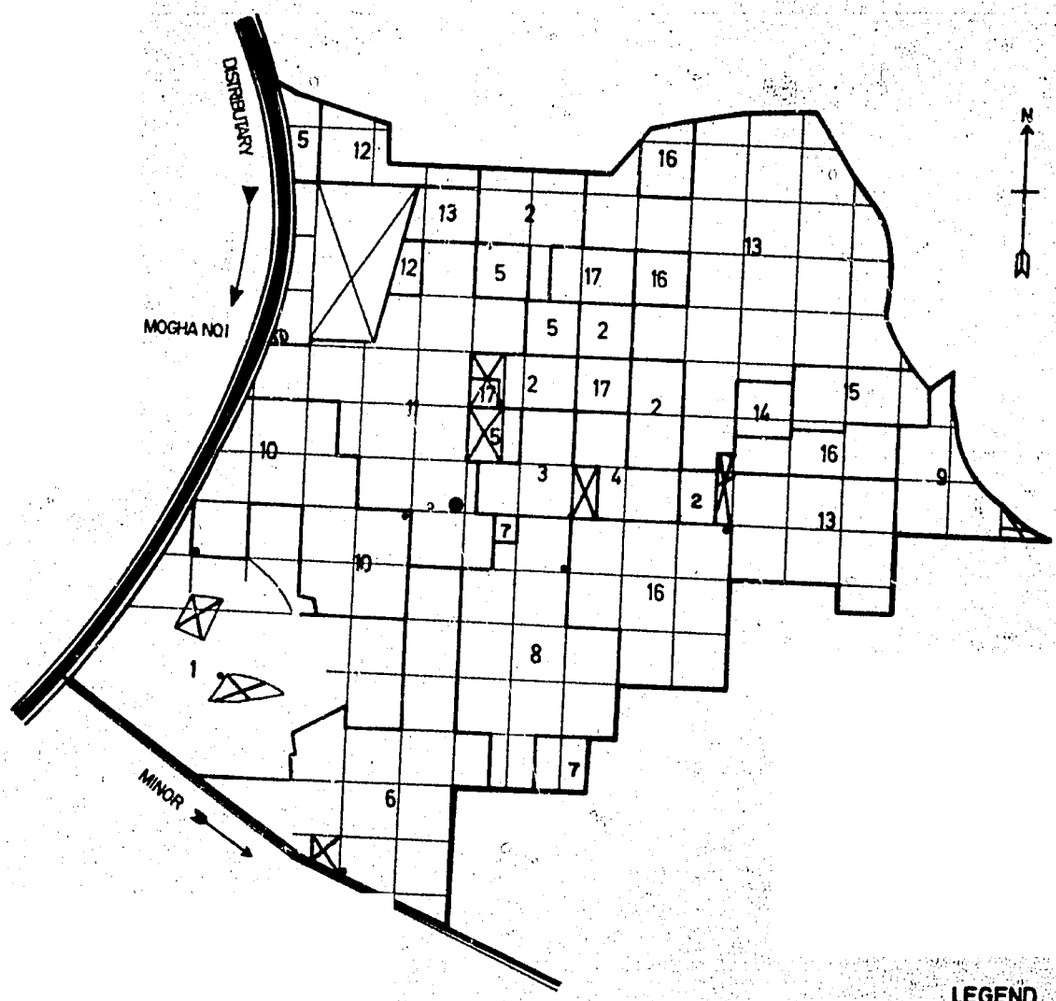
WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 103

DISTRICT LAHORE

WATERCOURSE COMMAND I

OWNERSHIP



LEGEND

1 HAJI ALIF DIN S/O I
2 AGAR DIN S/O ROI
3 GHULAM MOHD S/O TANO
4 DIL MOHD S/O TANO
5 MOHD BUX S/O UMER DIN
6 FAZAL DIN S/O RANJ ALI
7 NASIB DIN S/O NAIK MOHD
8 FAZAL MOHD S/O MADAR BUX
9 ALLAH RAHAN S/O ALLAH DITTA
10 FAQIR MOHD S/O NEHMAT ALI
11 MOHD YOUSUF S/O NOOR AHMED
12 MUNIR AHMED S/O MOHD ALI
13 MALIK MOHD BOOTA S/O BEHRAN DIN
14 AKBAR S/O JAMAL DIN
15 AHMED DIN S/O AZIM DIN
16 WARIS S/O FATEH DIN
17 NOOR DIN S/O ROSA

Scale = 0 220 440 660

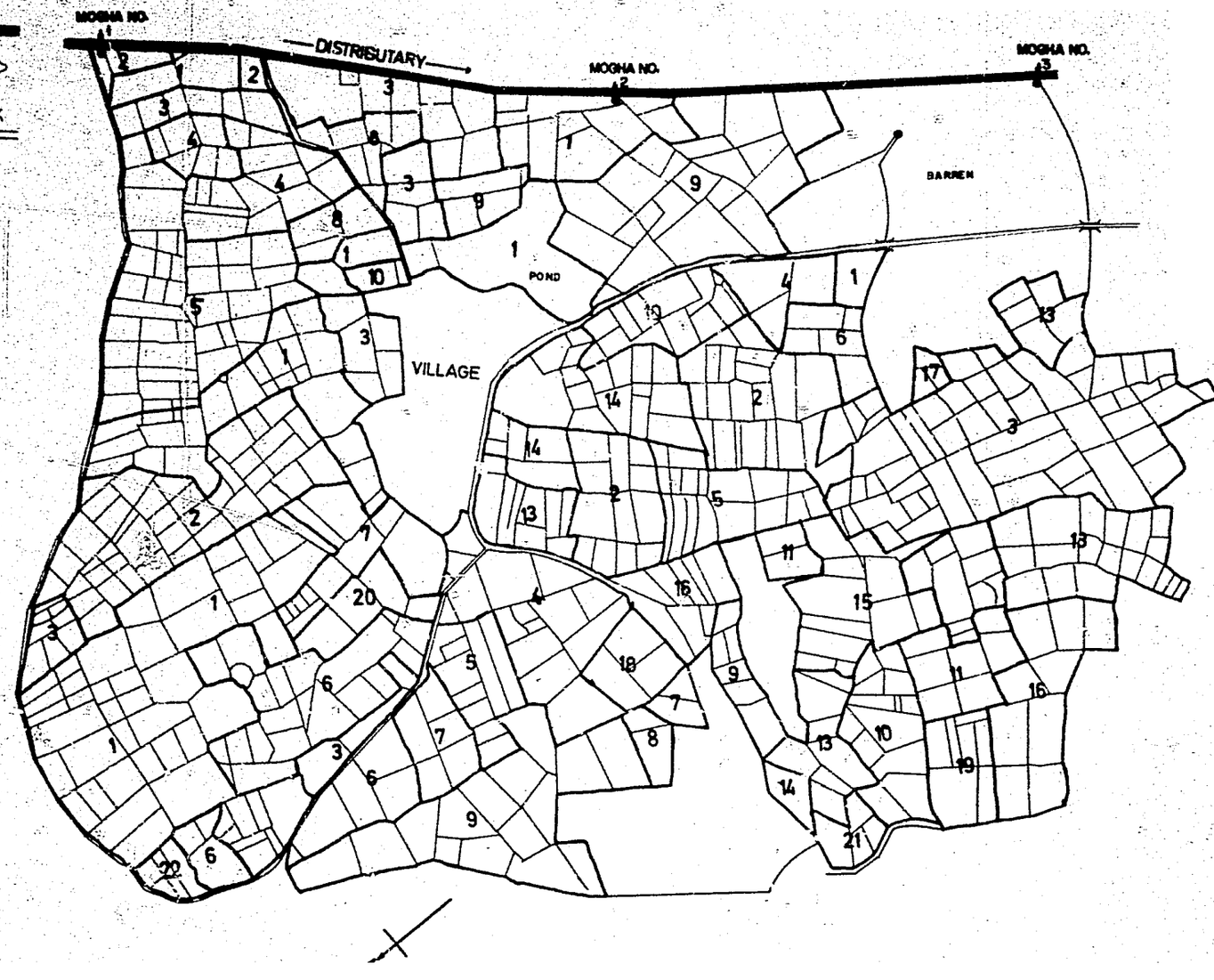
- DISTRIBUTARY
- MINOR
- TUBEWELL/MOGHA
- JHALAR
- DERA OR HOUSE
- ACRE BOUNDARY
- OWNERSHIP BOUNDARY
- AREA BOUNDARY

WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 104, DISTRICT LAHORE

WATERCOURSE COMMANDS 1-3 SCALE = 0 200 400 600

OWNERSHIP



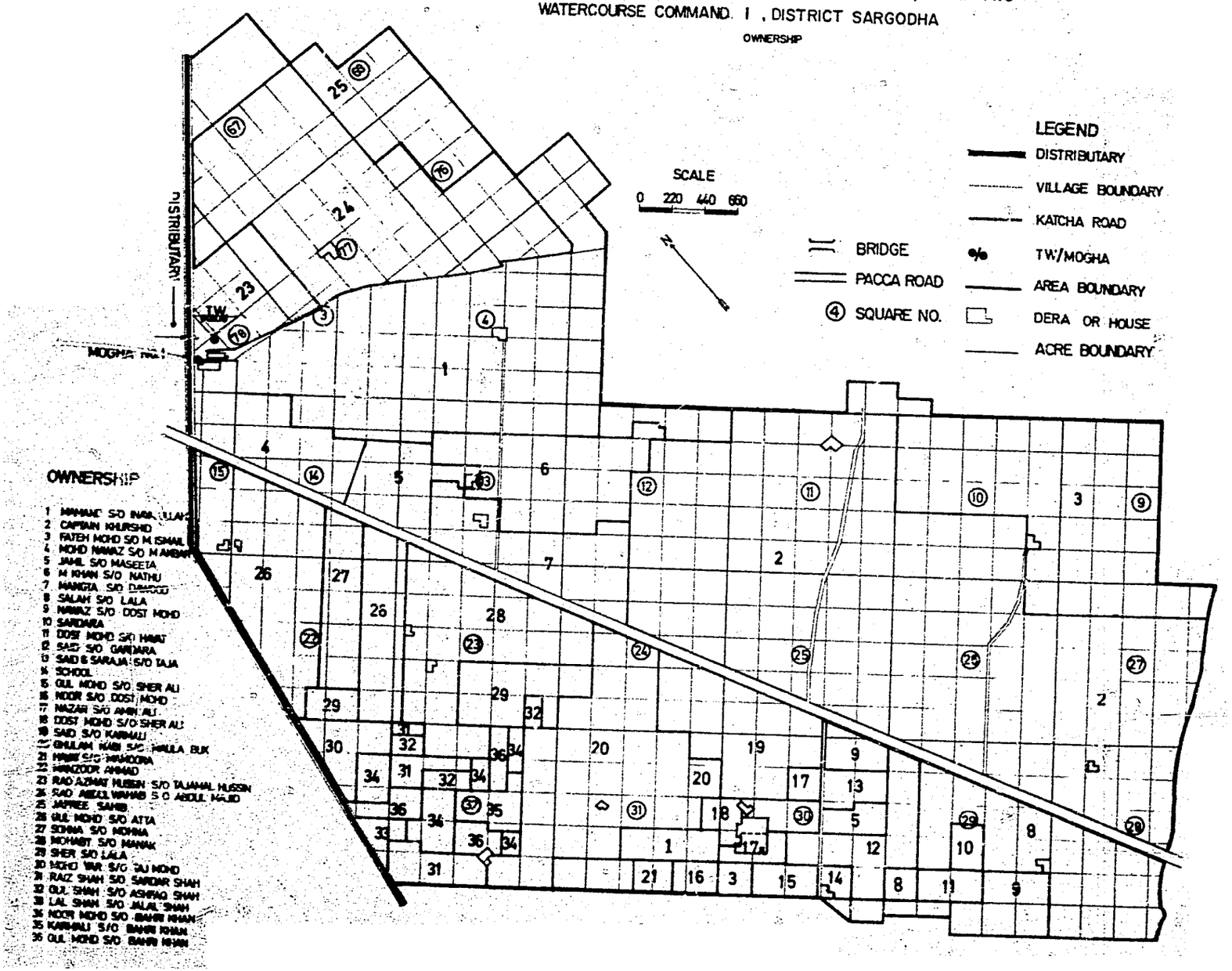
1 AHMAD DIN S/O GAMIN-ER
2 MOHD IQBAL
3 ALI MOHD S/O NAWAB
4 MASSAMAT FATMA
5 HAMAT MOHD S/O ALLAH DIN
6 HASSAN DIN S/O KHAIR DIN
7 MANDA S/O FAZAL DIN
8 CHARAG DIN S/O FATEH DIN
9 AKBAR ALI S/O MERAJ DIN
10 SARDAR S/O NISAM DIN
11 NAZIR AHMAD S/O ABDUL MAJEED
12 MOHD SALEEM S/O ALLAH DIN
13 MASSAMAT KARAM BIBI
14 UMER DIN S/O DULLO
15 AHMAD DIN S/O RAHIM BUX
16 AMAM DIN S/O KHAIR DIN
17 HASSAN DIN S/O AMAM DIN
18 ALLAH DIN S/O BHADA
19 MASSAMAT RAZIA
20 MOHD DIN S/O ALLAH DIN
21 MOHD SHAFFI S/O CANNN DIN
22 MAND S/O GHULLAM MOHD

WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE:NO.105, SCARP TWO

WATERCOURSE COMMAND. I , DISTRICT SARGODHA

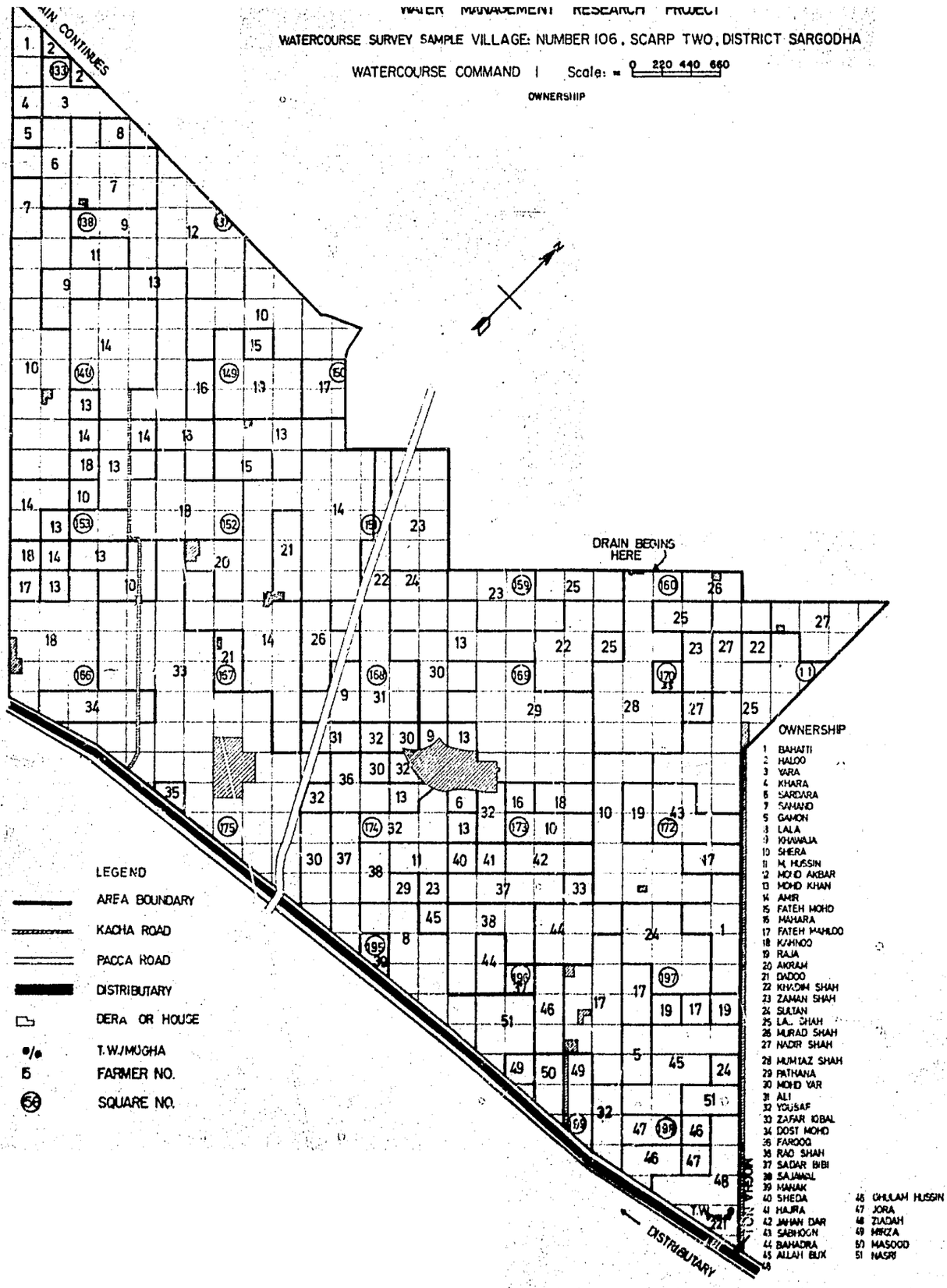
OWNERSHIP



WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 106, SCARP TWO, DISTRICT SARGODHA

WATERCOURSE COMMAND I Scale: = 0 220 440 660



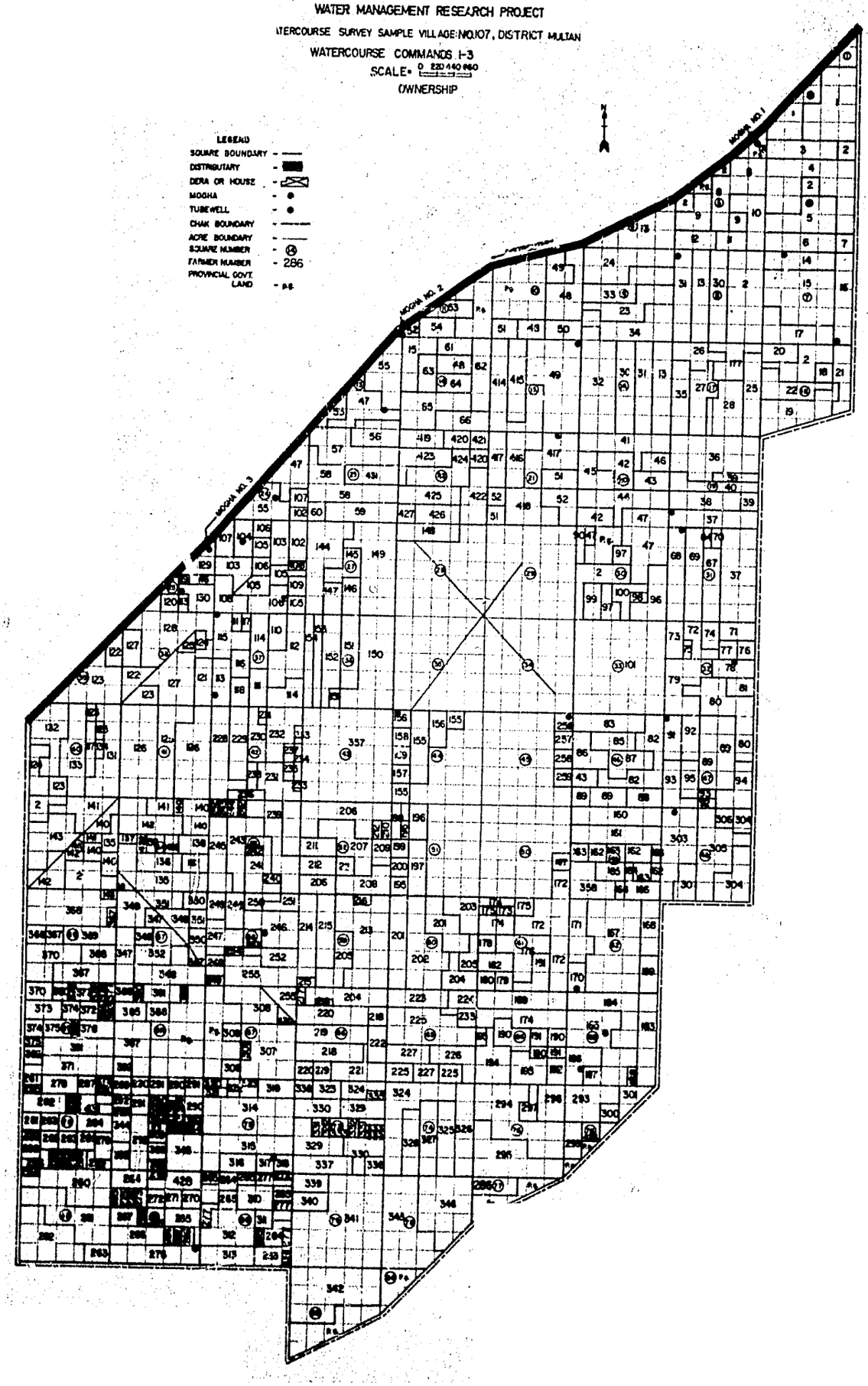
WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE NO.107, DISTRICT MULTAN

WATERCOURSE COMMANDS 1-3

SCALE: 0 220 440 660

OWNERSHIP

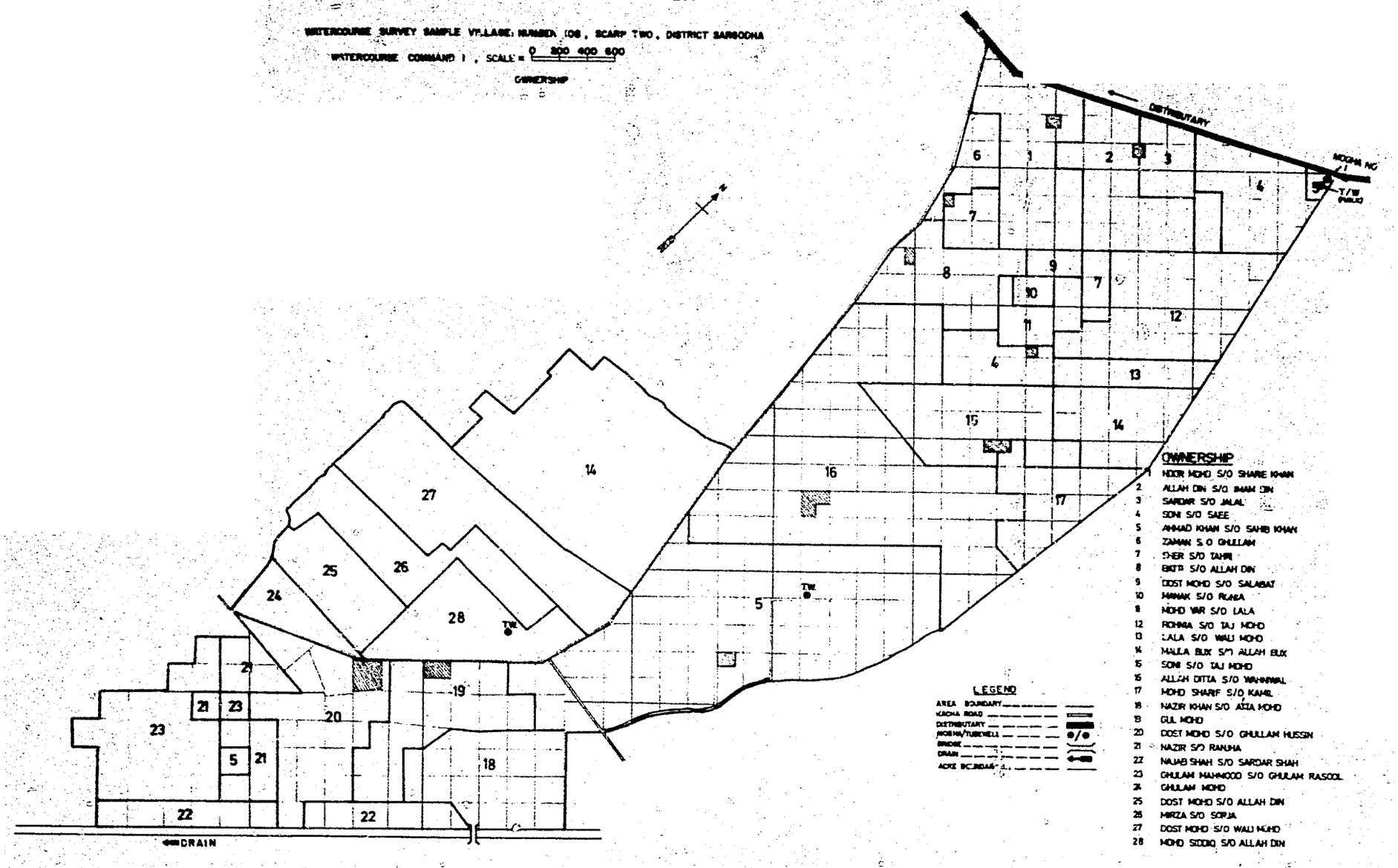


WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER 108, SCARP TWO, DISTRICT SARGODHA

WATERCOURSE COMMAND I, SCALE = 0 200 400 600

OWNERSHIP

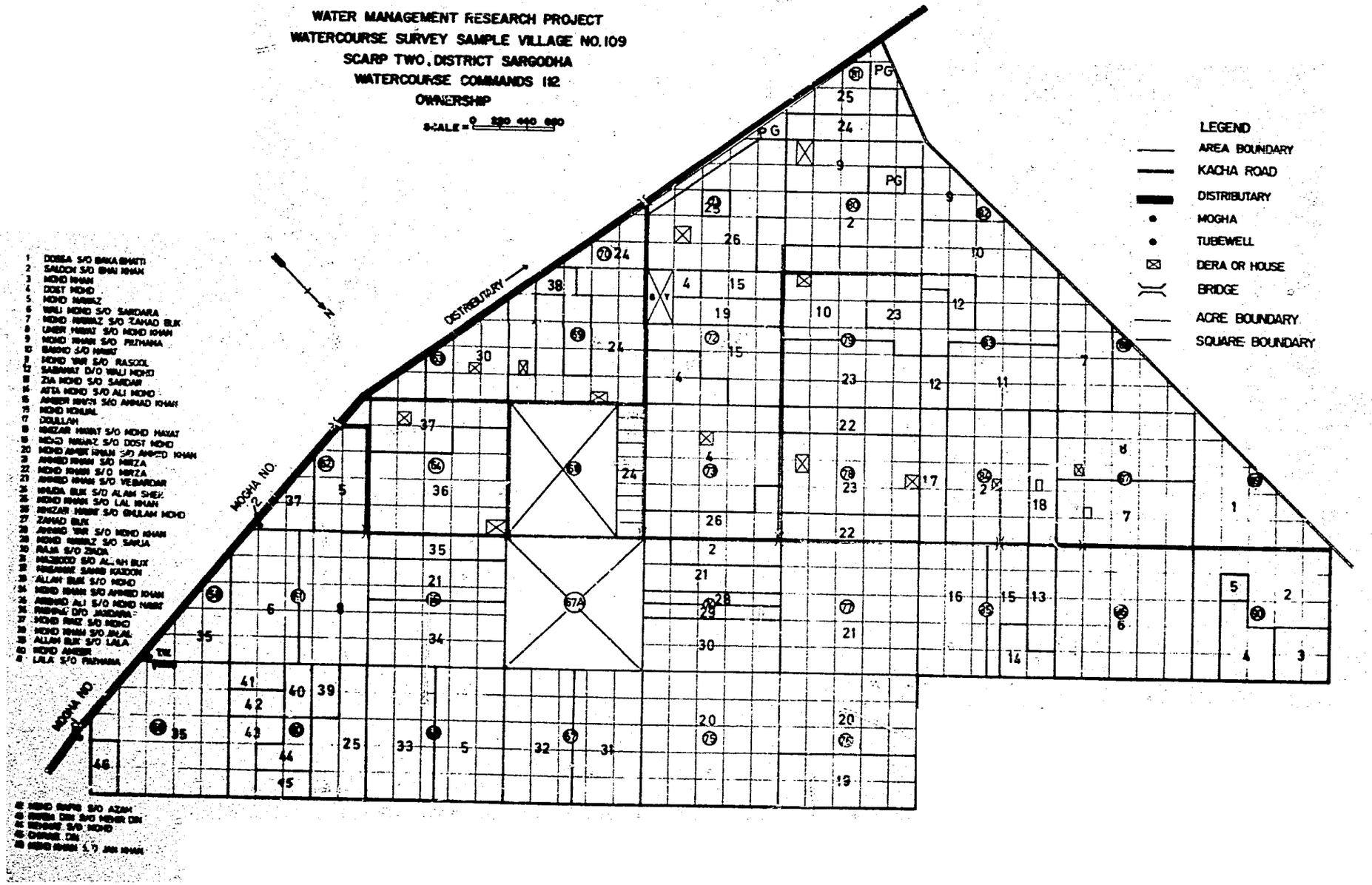


OWNERSHIP

1 NOOR MOHD S/O SHARE KHAN
2 ALLAH DIN S/O IMAM DIN
3 SARDAR S/O JALAL
4 SONI S/O SAEE
5 AHMAD KHAN S/O SAHIB KHAN
6 ZAMAN S/O GHULAM
7 SHER S/O TAHIR
8 BIKTA S/O ALLAH DIN
9 DOST MOHD S/O SALABAT
10 MANAK S/O RANBA
11 MOHD WAR S/O LALA
12 ROHMA S/O TAJ MOHD
13 LALA S/O WALI MOHD
14 MAULA BUX S/O ALLAH BUX
15 SONI S/O TAJ MOHD
16 ALLAH DITTA S/O WAHNWAL
17 MOHD SHARIF S/O KAMIL
18 NAZIR KHAN S/O ATTA MOHD
19 GUL MOHD
20 DOST MOHD S/O GHULAM HUSSIN
21 NAZIR S/O RANJHA
22 NAWAB SHAH S/O SARDAR SHAH
23 GHULAM MAHMOOD S/O GHULAM RASOOL
24 GHULAM MOHD
25 DOST MOHD S/O ALLAH DIN
26 MIRZA S/O SORJA
27 DOST MOHD S/O WALI MOHD
28 MOHD SIDDIQ S/O ALLAH DIN

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE NO.109
SCARP TWO, DISTRICT SARGODHA
WATERCOURSE COMMANDS 112
OWNERSHIP

SCALE = 0 220 440 880



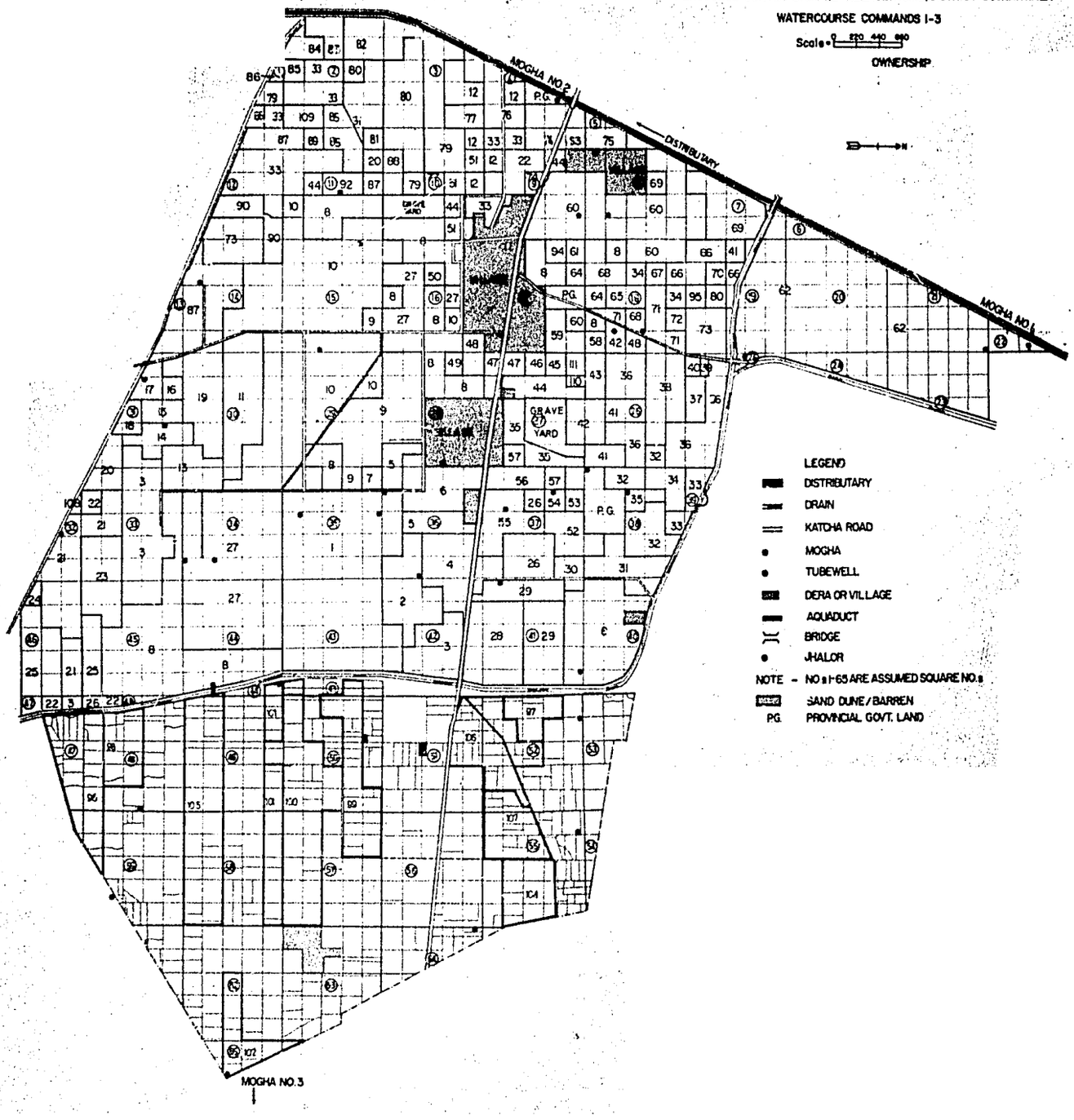
WATER MANAGEMENT RESEARCH PROJECT

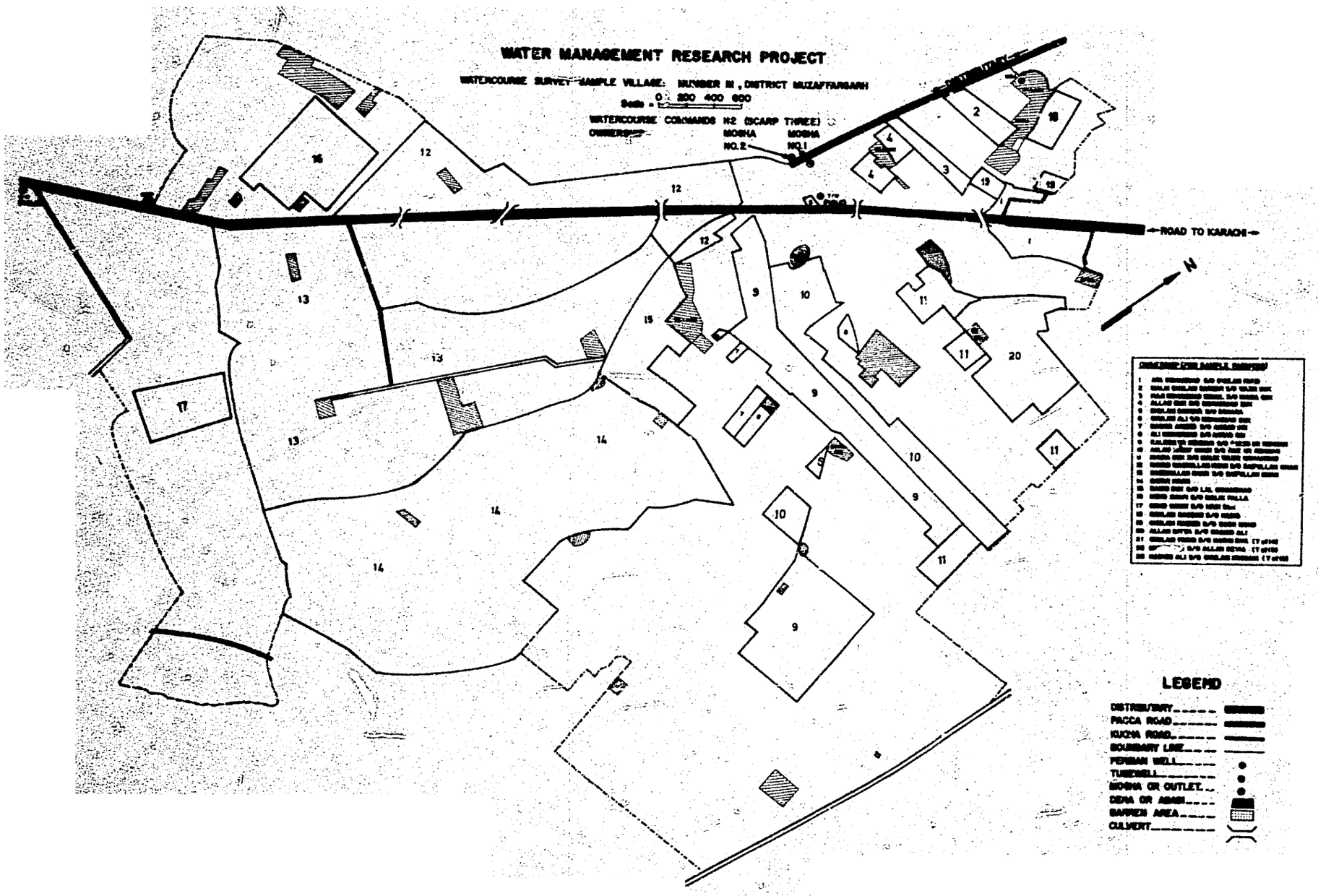
WATERCOURSE SURVEY SAMPLE VILLAGE: NO.110, DISTRICT GUJRANWALA

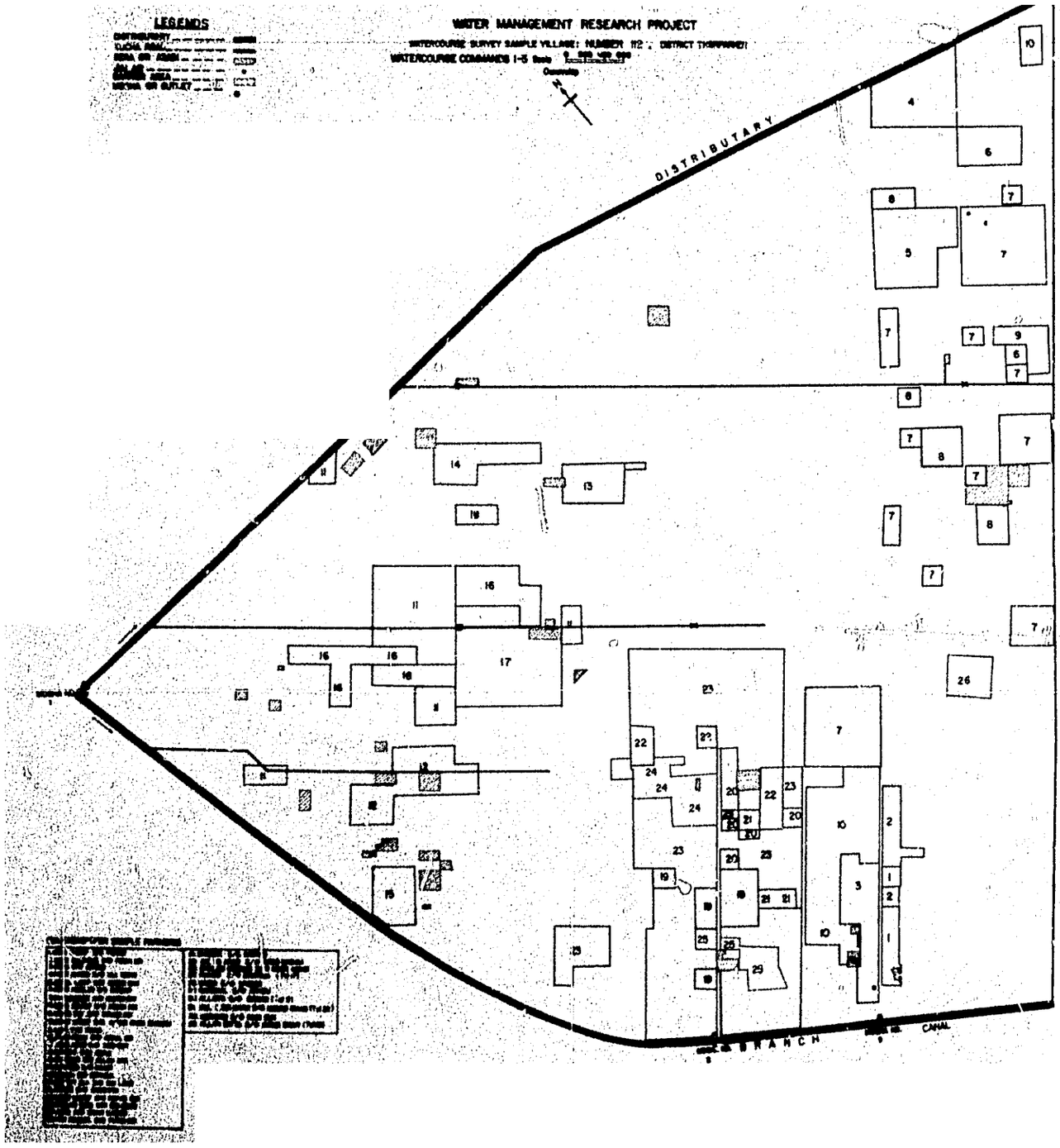
WATERCOURSE COMMANDS 1-3

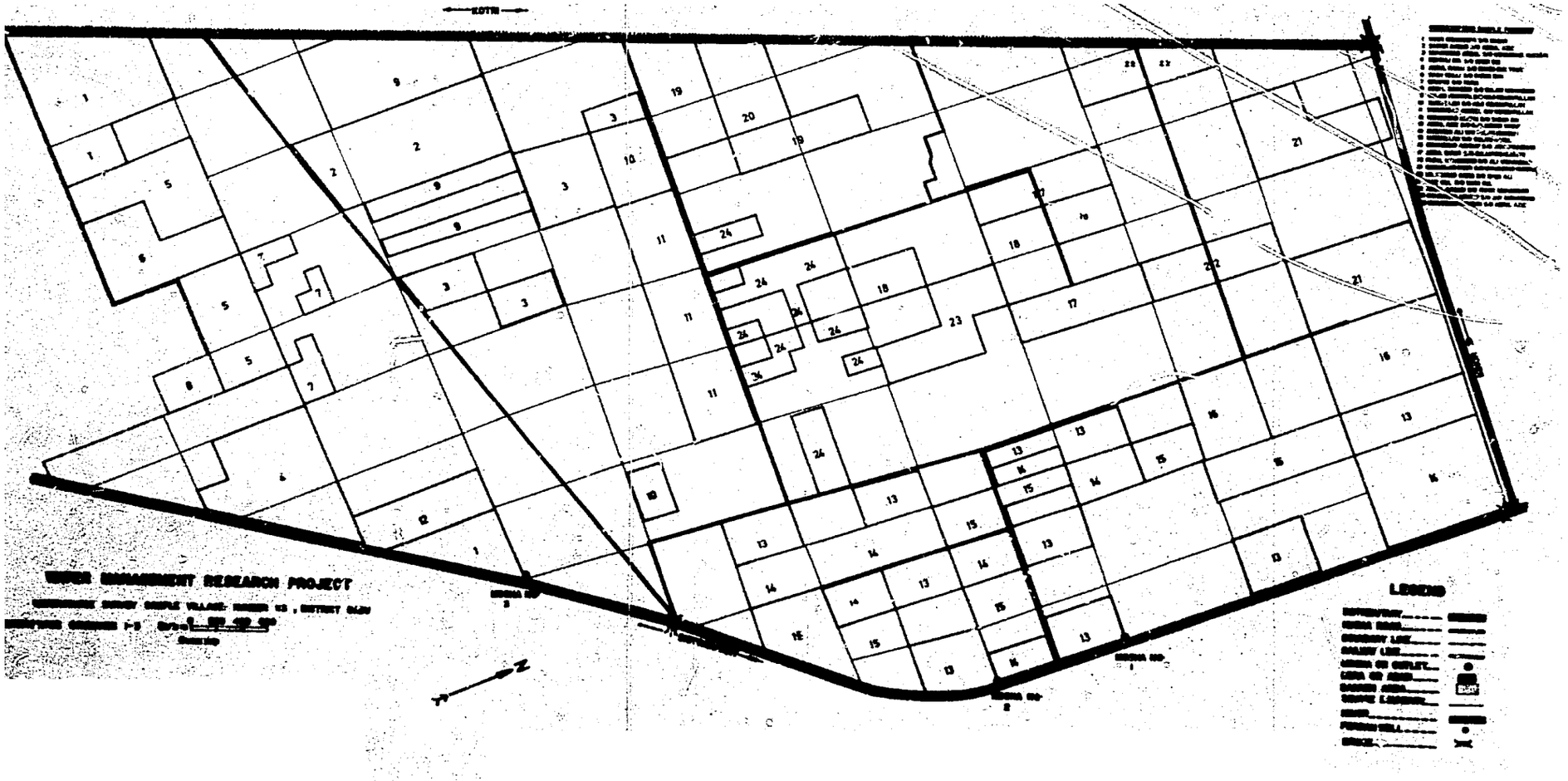
Scale = 0 220 440 880

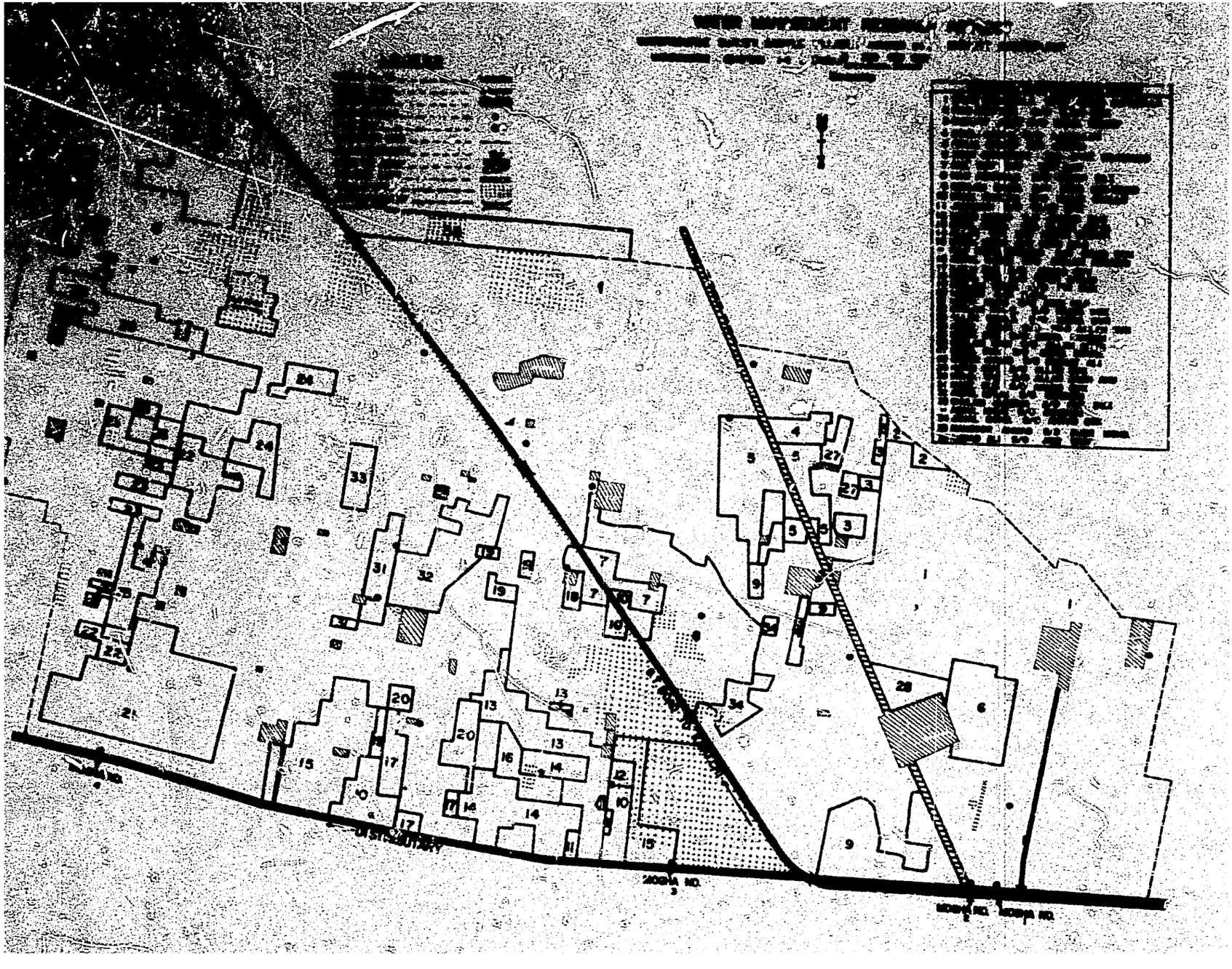
OWNERSHIP

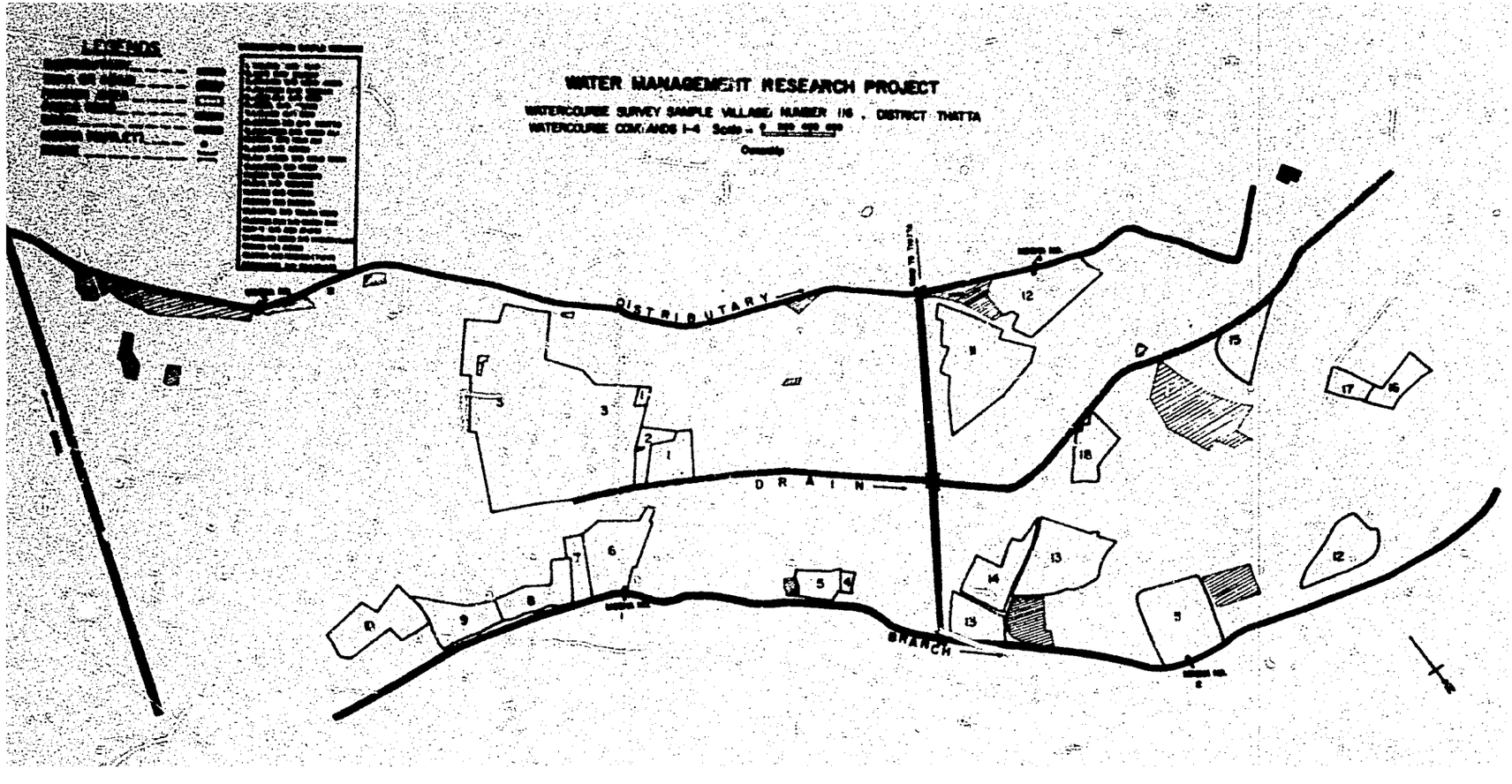



WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NUMBER III, DISTRICT MUZAFFARGARH
Scale = 0 200 400 600
WATERCOURSE COMMANDS N2 (SCARP THREE)
OWNERS
MOGHA NO.2
MOGHA NO.1
ROAD TO KARACHI
N
LEGEND
DISTRIBUTARY
PACCA ROAD
KUCHA ROAD
BOUNDARY LINE
PERMAN WELL
TUBEWELL
MOGHA OR OUTLET
DERA OR ABADI
BARREN AREA
CULVERT


LEGENDS
WATER MANAGEMENT RESEARCH PROJECT
DISTRIBUTARY
BRANCH
CANAL


WATER MANAGEMENT RESEARCH PROJECT
LEGEND



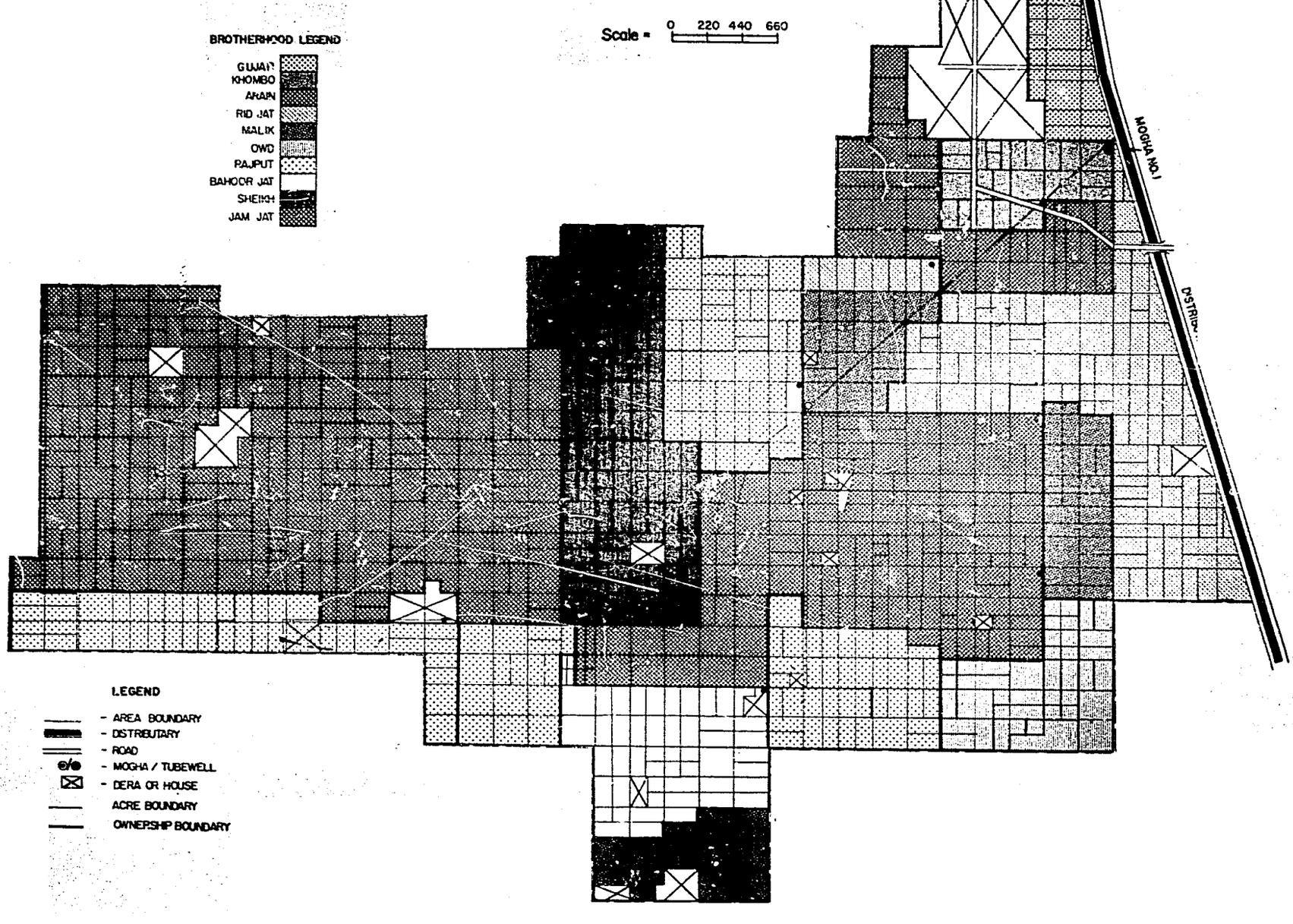

LEGENDS
WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE NUMBER 116 , DISTRICT THATTA
WATERCOURSE COMMANDS 1-4
DISTRIBUTARY
DRAIN
BRANCH

APPENDIX IV

Part H

BIRADARI MAPS

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE NO. 102
DISTRICT MULTAN
WATERCOURSE COMMAND I
BROTHERHOOD / OWNERSHIP



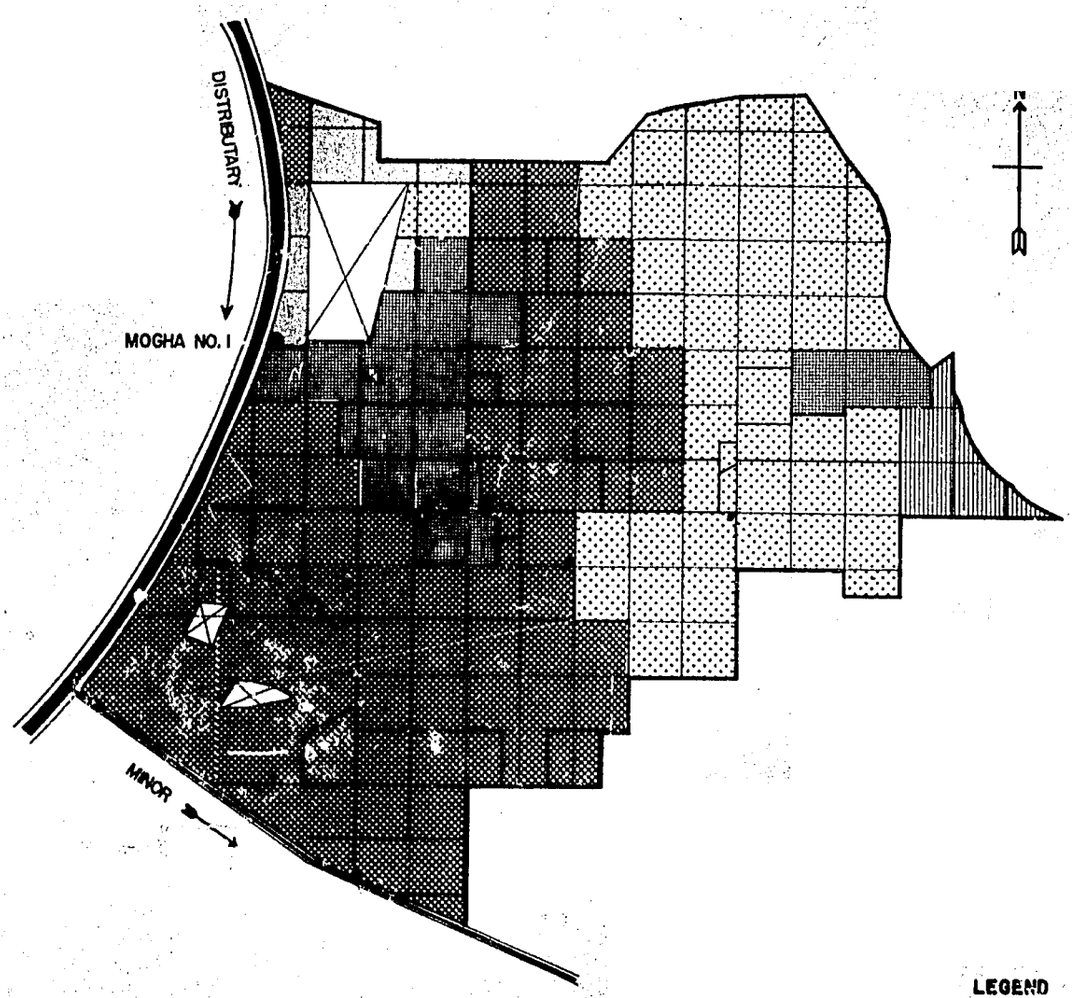
WATER MANAGEMENT RESEARCH PROJECT

WATERCOURSE SURVEY SAMPLE VILLAGE NO. 103

DISTRICT LAHORE, WATERCOURSE COMMAND

BROTHERHOOD / OWNERSHIP

Scale = 0 220 440 660



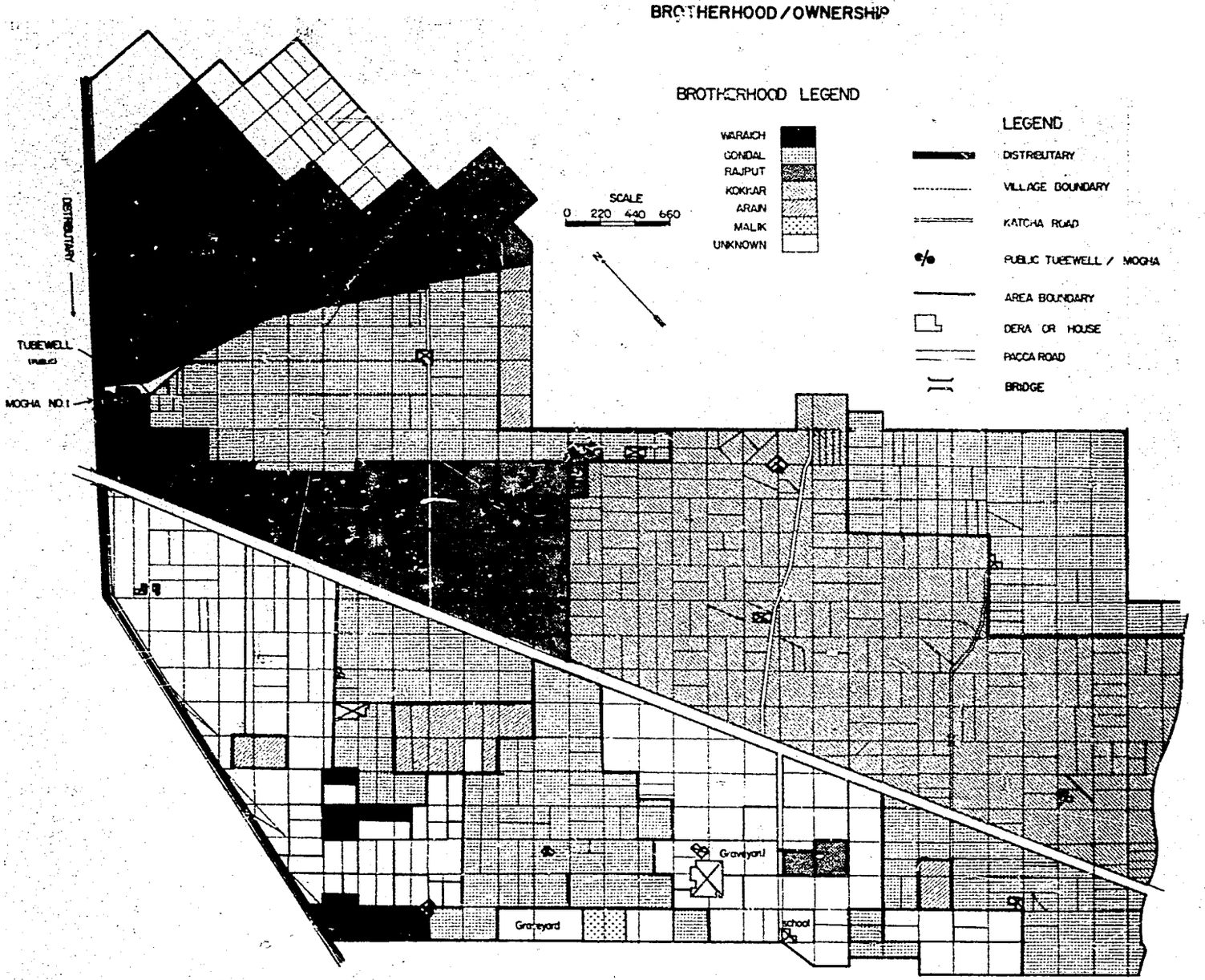
BROTHERHOOD LEGEND

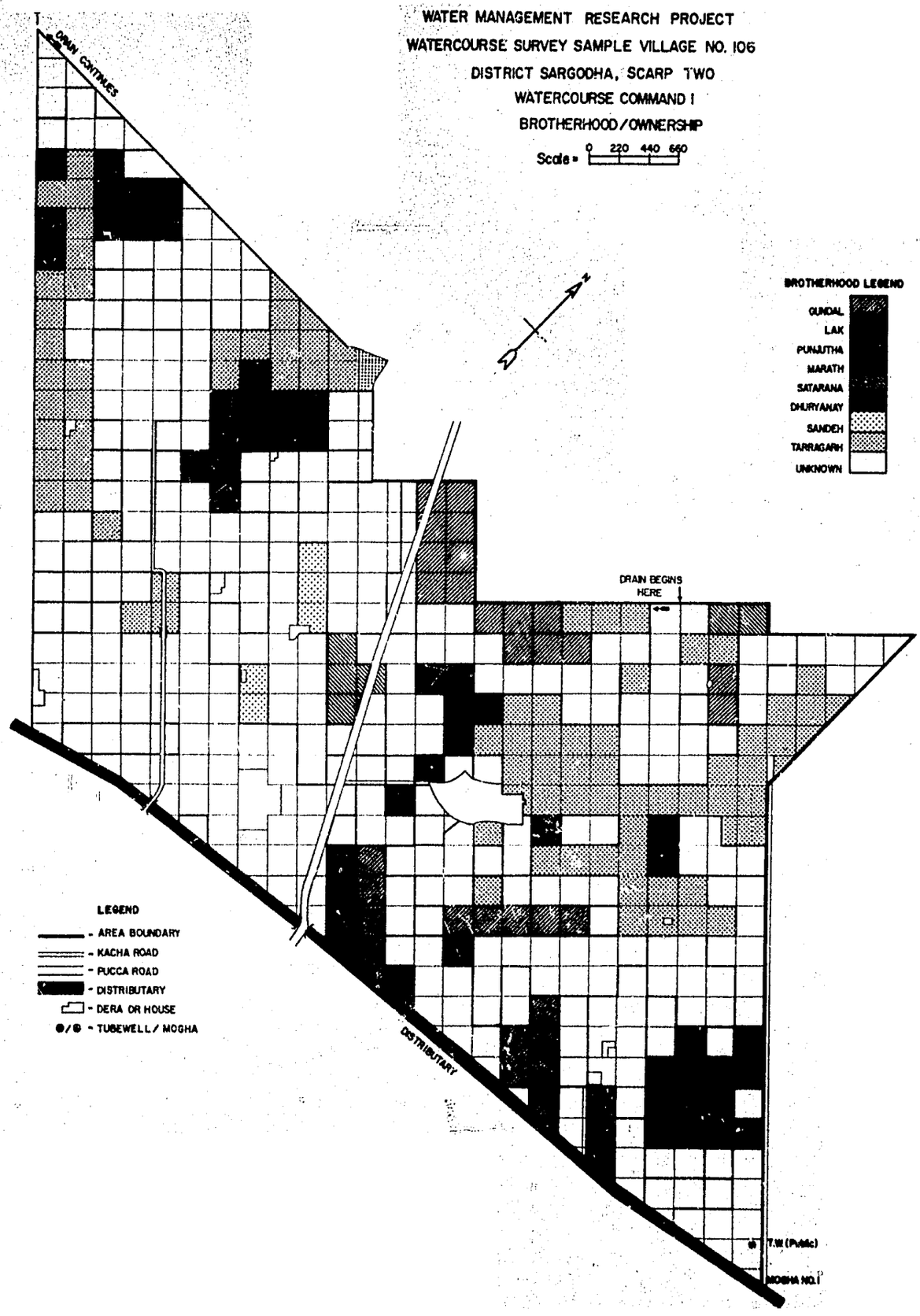
- GUJUR
- KUMBAR
- RAJPUT
- SHEIKH
- ARAIN

LEGEND

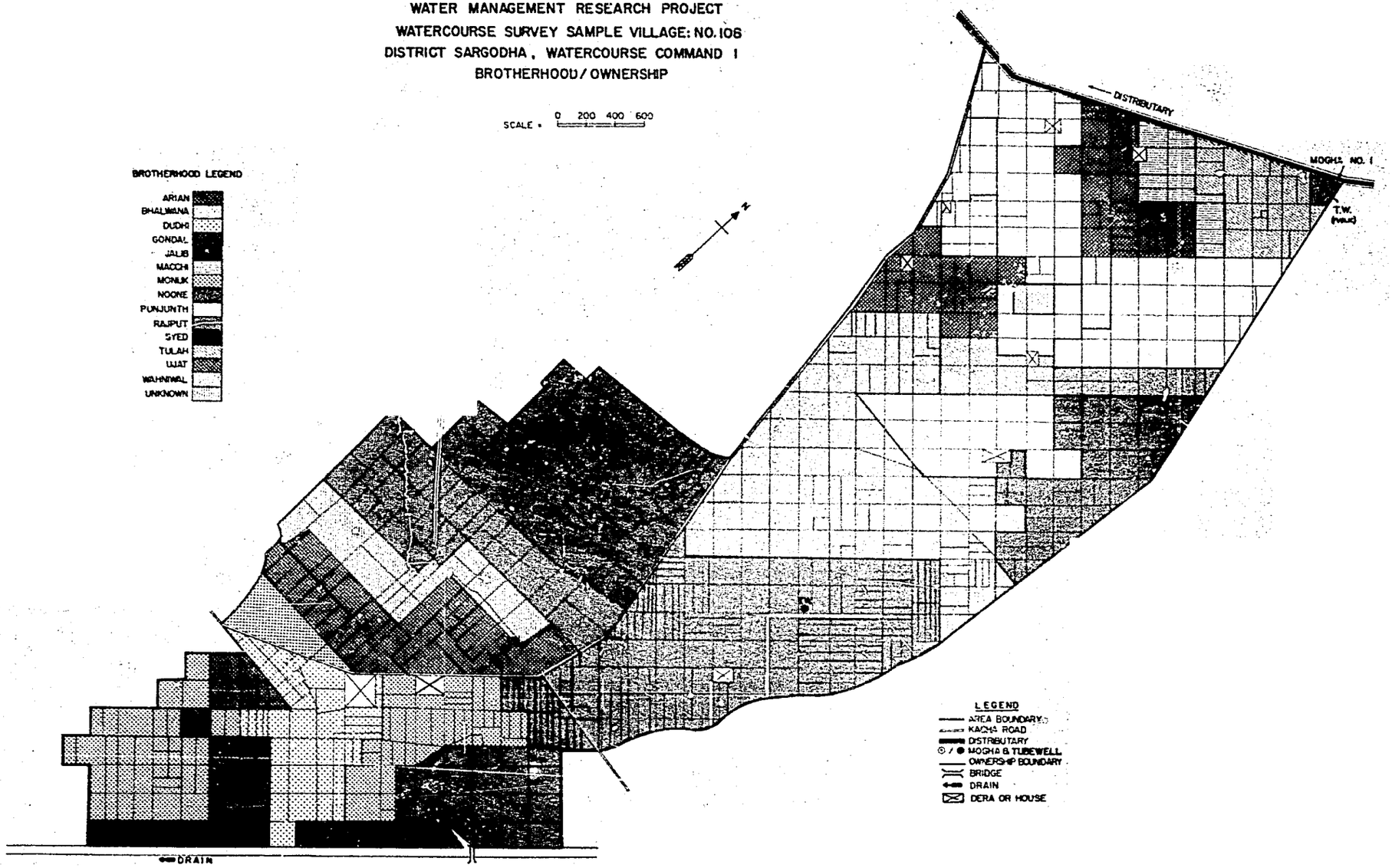
- DISTRIBUTARY
- MINOR
- ⊙/● - MOGHA / TUBEWELL
- JALAR
- DERA OR HOUSE
- ACRE BOUNDARY
- OWNERSHIP BOUNDARY
- AREA BOUNDARY

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 105
DISTRICT SARGODHA, WATERCOURSE COMMAND I
BROTHERHOOD / OWNERSHIP

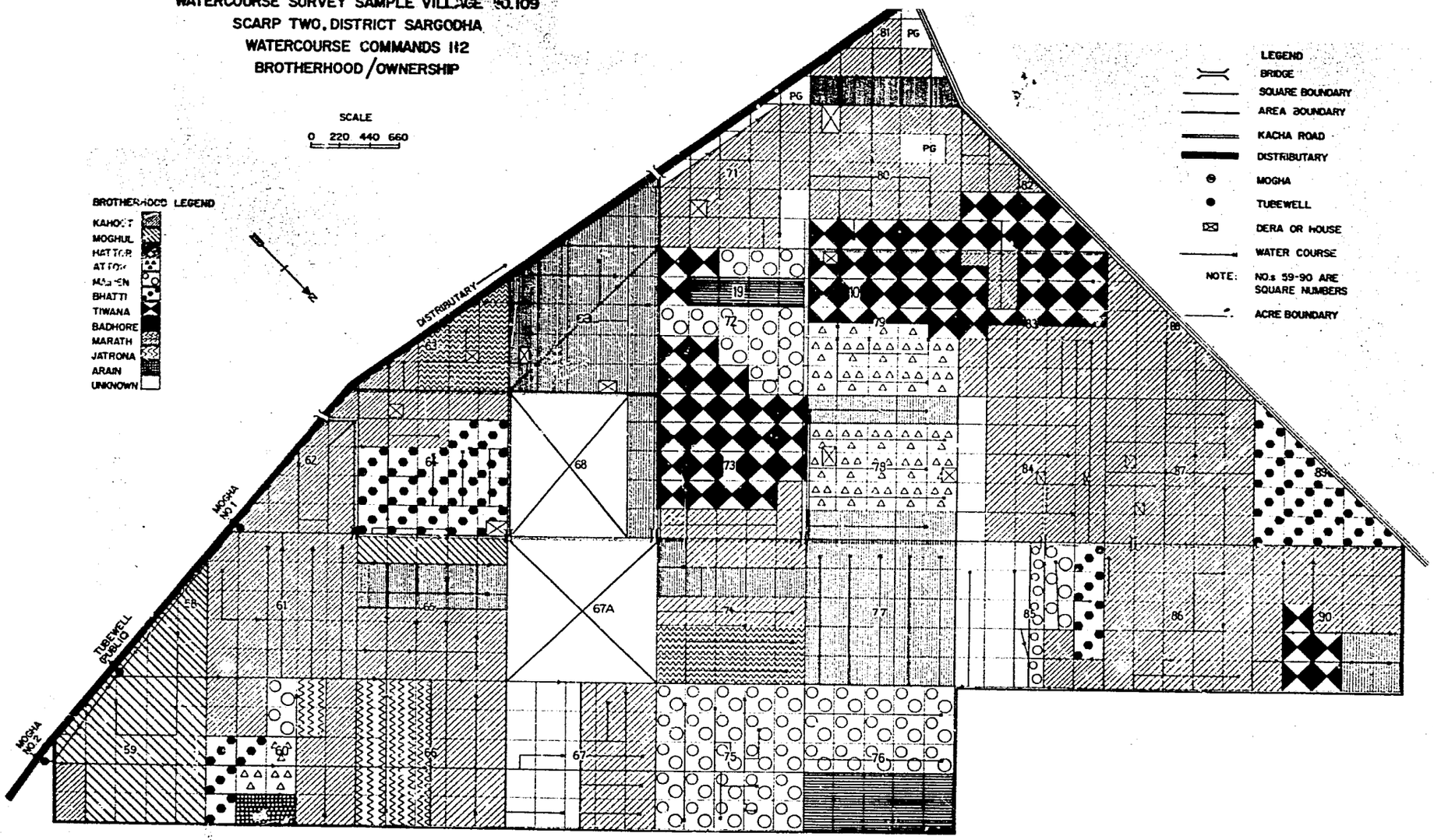



WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE NO. 106
DISTRICT SARGODHA, SCARP TWO
WATERCOURSE COMMAND I
BROTHERHOOD/OWNERSHIP
Scale = 0 220 440 660
N
BROTHERHOOD LEGEND
GUNDAL
LAK
PUNJUTHA
MARATH
SATARANA
DHURYANAY
SANDEH
TARRAGARH
UNKNOWN
DRAIN CONTINUES
DRAIN BEGINS HERE
DISTRIBUTARY
T.W (Public)
MOGHA NO.1
LEGEND
- AREA BOUNDARY
- KACHA ROAD
- PUCCA ROAD
- DISTRIBUTARY
- DERA OR HOUSE
- TUBEWELL / MOGHA

WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE: NO. 108
DISTRICT SARGODHA, WATERCOURSE COMMAND 1
BROTHERHOOD / OWNERSHIP



WATER MANAGEMENT RESEARCH PROJECT
WATERCOURSE SURVEY SAMPLE VILLAGE 50.109
SCARP TWO, DISTRICT SARGODHA
WATERCOURSE COMMANDS 112
BROTHERHOOD/OWNERSHIP



APPENDIX V

Part A

SAMPLE OF FARMERS REPORTING KNOWLEDGE OF NAME, LOCATION AND CONTACTS WITH CANAL PATWARI, CANAL ZILLADOR, AND CANAL SUB-DIVISIONAL OFFICER (SDO)

TABLE 1. PERCENTAGE OF SAMPLE FARMERS REPORTING KNOWLEDGE OF NAME, LOCATION AND CONTACTS WITH CANAL PATWARI, CANAL ZILLADAR AND CANAL SDO

Farm Characteristics	# of Farms	Canal Patwari: Knows Name	Canal Patwari: Knows Location	Canal Patwari: Any Contact Last 3 Mo.	Canal Zilladar: Knows Name	Canal Zilladar: Knows Location	Canal Zilladar: Any Contact Last 3 Mo.	Canal SDO: Knows Name	Canal SDO: Knows Location	Canal SDO: Any Contact Last 3 Mo.
Farm Class (Acres)										
Under 2.5	75	38.7	56.0	20.0	8.0	37.3	5.3	5.3	37.3	5.3
2.5-7.49	98	60.2	78.6	27.3(n=97)	5.1	35.7	6.2(n=96)	4.1	36.7	6.2(n=96)
7.5-12.49	99	59.6	80.8	31.6(n=98)	10.1	56.1(n=98)	7.1(n=98)	11.1	46.9(n=98)	7.1(n=98)
12.5-24.9	86	67.4	83.7	37.2	11.6	58.1	15.1	12.8	53.5	18.2
25.0-49.9	17	94.1	100.0	35.3	29.4	76.5	23.5	11.8	70.6	23.5
50 or More	8	100.0	100.0	100.0	62.5	100.0	25.0	25.0	75.0	25.0
χ^2		29.7** (5df)	29.5** (5df)	39.9** (15df)	31.3** (5df)	29.3** (5df)	30.8* (15df)		14.5* (5df)	32.8* (15df)
Tenure										
Owners	255	63.9	82.4	31.6(n=253)	13.7	54.3(n=254)	10.3(n=252)	11.8	49.6(n=254)	10.3(n=252)
Owner-Tenants	56	60.7	76.8	35.7	10.7	48.2	10.7	5.4	42.9	10.7
Owner & Contractors	72	44.4	59.7	27.1	2.9	33.3	5.7	1.4	33.3	5.7
χ^2		11.5* (3df)	18.3** (3df)			10.2* (3df)				
Distance to a Main Road										
No Distance	70	68.6	74.3	46.4(n=69)	27.1	56.5(n=69)	21.7(n=69)	18.6	51.4	21.7(n=69)
Under 2 Miles	177	48.6	73.4	36.7(n=176)	4.5	40.1	6.9	7.9	44.9(n=176)	6.9(n=175)
2-4.9 Miles	81	54.3	72.8	32.1	12.3	53.1	9.9	6.2	43.2	9.9
5-7.49	55	92.7	100.0	12.7	10.9	65.5	1.8	3.6	43.2	1.8
χ^2			18.9** (3df)	38.0** (9df)	25.9** (3df)	13.6* (3df)	20.0* (9df)	10.9* (3df)		20.0* (9df)
Overall	383	59.8	77.3	31.2(n=381)	11.2	49.5(n=382)	9.5(n=380)	8.9	45.5(n=382)	9.5(n=380)

* Denotes significance between .05 and .001
** Denotes significance at the .001 level or higher

APPENDIX V

Part B

SUMMARY OF SAMPLE FARMER AND HOUSEHOLD EDUCATIONAL LEVELS

EDUCATIONAL LEVEL OF FARMER RESPONDENTS AND FAMILY MEMBERS

This appendix provides a general summary of the data collected on the educational level of farmer respondents and their family members. This brief discussion will provide an estimate of the relationships between educational level and farm size classes, tenure status and size of family units.

I. LEVEL OF EDUCATION OF FARMER RESPONDENTS

Table 1 shows the general educational level of farmer respondents who are the primary decision makers related to agricultural matters. An explanation about this table is that in each case, if a farmer has had some education at a higher level such as high school he is counted as having had both primary and middle education as well. The data show that 82 percent of the respondents had no formal education, 18 percent had reached some level of primary schooling, about 10 percent completed some level of middle schooling, and just over 6 percent completed some level of high school or a higher level. This shows that about one-third of those in primary completed some level of high school. The data show, as expected, that farm size is related to educational level of farmer respondents. Note that 50 percent of large farmers (50 acres or more) had some level of high school or more education. Little difference is found between educational levels of tenure classes which is surprising.

II. HOUSEHOLD SIZES

Data in Table 2 shows the range of household members by farm size and tenure classes. For total sample note that about 7 percent of the families had up to four members, 51 percent had a range of 5 to 9 members, 25 percent had a range of 10 to 14 family members, and 15 percent had 15 or more family members. This indicates that the joint family is still intact given the average size of nuclear families of 6.5 members. Larger families of 15

TABLE 1. FORMAL EDUCATIONAL LEVEL OF FARM DECISION MAKER

Farm Characteristics	# of Farms	None %	Some Primary %	Some Middle %	High or More %
Farm Size Classes (Acres)					
Under 2.5	74	90.5	9.1	1.4	-
2.5-7.49	94	87.3	12.7	6.4	5.3
7.5-12.49	97	85.6	14.4	10.3	3.1
12.5-24.99	82	76.8	23.2	14.1	13.4
25.0-49.99	17	52.9	47.1	17.7	5.9
50.0 and Above	8	12.5	87.5	87.5	50.0
Tenure Classes					
Owners	254	79.5	20.5	13.0	7.1
Owner-Cum-Tenant	52	84.6	15.4	9.6	5.8
Contractors	2	100.0	-	-	-
Tenants	64	89.1	10.9	4.7	4.7
Overall	372	82.0	18.0	10.7	6.5

TABLE 2. SIZE OF HOUSEHOLDS BY FARM SIZE AND LAND TENURE CLASSES

Farm Characteristics	# of Farms	Number of Members in Household* Up to 4	5 - 9	10 - 14	15 and Over
Size Holding					
Under 2.49	68	10.3	52.9	26.5	10.3
2.5-7.49	79	8.9	62.0	19.0	10.1
7.5-12.49	85	4.7	52.9	27.1	15.3
12.5-24.99	72	5.6	37.5	27.8	29.2
25.0-49.99	13	-	38.5	23.1	38.5
50.0 and Over	5	-	60.0	-	40.0
Tenure Classes					
Owners	220	5.5	50.5	23.6	20.4
Owners-Cum Tenants	44	4.5	50.0	31.8	13.7
Contractors	2	-	-	100.0	-
Tenants	56	14.3	57.1	19.6	9.0
Overall Weighted Totals	322	6.9	51.2	24.5	17.4

*of 312 reporting households with children under six: 72 have no children under six, 68 with 1; 84 with 2; 44 with 3; 18 with 4; 7 with 5; 10 with 6; 1 with 7; and 8 with 8 for a total of 696 children under six years of age for 322 houdeholds.

or more members are related to size of land holdings owned. Also, note that owner operators and owner-cum-tenants have larger families than pure tenants. This is to be expected due to the lower income of tenant families and the need to split-up to gain employment. Also, it is interesting that for the 322 reporting families, there are 606 children under the age of six years or about two such children per family group.

III. FARM SIZE AND TENURE CLASSES AND NUMBER OF SCHOOL AGE CHILDREN WITH SOME FORMAL EDUCATION

Table 3 shows that of all classes of farm families, only about 38 percent had no family member with no education. About 43 percent had from 1 to 3 family members with some education and over 15 percent of the families had from 4 to 6 family members with some education. This is significant in that in the majority of the families, there are literate members who can make use of written information. Sometimes this important fact is overlooked in designing extension materials in countries where the majority of the population is illiterate. Farmers reported that "They read through their educated children". Therefore it is very important to provide agricultural materials for illiterate farmers. Usually these are read by children for their parents. Developers should not have such a bias toward literacy that they overlook the fact that "illiterate people have means of reading".

Again, the data show a significant relationship between farm size and number of family members with some education. Also, we note that owners and owner-cum-tenants have more family members in the range of 4 to 6 members and over with some level of education.

IV. HOUSEHOLD SIZE OF SCHOOL AGE MEMBERS AND EDUCATIONAL LEVELS

Table 4 shows that the greater the number of family members of school age, the greater the number with some education in the various school

TABLE 3. PERCENTAGE OF HOUSEHOLDS WITH SCHOOL AGE MEMBERS SHOWING NUMBER WITH SOME LEVEL OF FORMAL EDUCATION

Farm Characteristics	# of Farms	Percentage of Households With Following Numbers with Formal Education				
		None	1-3	4-6	7-9	10 or More
Farm Size Classes (Acres)						
Under 2.5	74	58.1	35.1	5.4	1.4	-
2.5-7.49	95	45.7	41.5	11.7	-	1.1
7.5-12.49	97	33.7	47.4	14.7	3.2	1.1
12.5-24.99	85	25.9	44.7	23.5	3.5	2.4
25.0-49.99	17	5.9	35.3	47.1	5.9	5.9
50.0 and Above	8	-	75.0	-	12.5	12.5
Tenure Classes						
Owner	255	28.5	49.8	17.1	2.8	2.0
Owner-Cum-Tenant	52	47.2	32.1	15.1	3.8	1.9
Contractors	2	100.0	-	-	-	-
Tenants	67	64.2	26.9	9.0	-	-
Overall Weighted Totals	376	37.7	43.0	15.3	2.4	1.6

TABLE 4. NUMBER IN HOUSEHOLD OF SCHOOL AGE WHO ARE OR HAVE EVER BEEN IN PRIMARY, MIDDLE AND HIGH SCHOOL (PERCENTAGES)

Number in Household of School Age	No. Reporting	Percentages of Households with Following Number											
		Number in Primary Classes				Number in Middle Classes				Number in High School Classes			
		0	1-2	3-4	5 or More	0	1-2	3-4	5 or More	0	1-2	3-4	5 or More
Under 5	22	68.0	31.8	-	-	77.2	22.7	-	-	86.4	13.6	-	-
5 to 9	164	45.1	47.5	6.7	.1	72.6	26.7	.6	.6	80.1	15.3	-	4.5
10 to 14	79	34.2	51.9	8.9	5.1	65.8	29.1	3.8	1.3	71.8	19.2	4.5	4.5
15 or More	56	17.9	46.4	21.4	12.5	44.6	41.1	10.7	3.6	53.6	32.1	10.7	1.8
Weighted Totals	321	39.2	47.3	9.3	3.5	66.4	29.5	3.1	1.3	73.9	19.1	3.0	3.7

levels--primary, middle and high school or above. This is expected because as we observed in Tables 2 and 3, the greater the farm size in acres, the larger the family members and the greater the educational levels. Larger farmers have the resources to maintain large joint families and also to provide more education to the family members.

V. SCHOOL AGE HOUSEHOLD MEMBERS AND LEVELS OF FORMAL EDUCATION BY FARM SIZE AND TENURE CLASSES

The data in Table 5 show the percentages of school age family members with various levels of formal education. Note first that only 25 percent of the largest farm size have none in high school or above levels, while 93 percent of the smallest farm size class have no members even in high school or beyond. As expected this is significantly related to both farm size and land tenure status. In the primary level, almost 60 percent of the smallest farm class has no one even at some level, while the largest farm size class, there is no one without some level of primary education. At the middle school level, farm size is related to educational levels. Again, we observe that in the majority of families of all classes, there is someone who has some level of education. Even in about 40 percent of the tenant familes there is some member who has been in primary school; however, in only about 15 percent of these families are there members in middle school. Only about 6 percent of tenant families have some family members who were ever in high school or beyond in their education.

VI. SUMMARY STATEMENT

Since a more intensive study of educational levels of farmer respondents and their family members is not central to this particular survey, further analysis is not made of the data. In the main body of

TABLE 5 FARM SIZE AND LAND TENURE CLASSES SHOWING PERCENTAGE OF HOUSEHOLDS WITH NUMBER OF MEMBERS WHO ARE OR HAVE BEEN ENROLLED IN PRIMARY, MIDDLE, AND HIGH SCHOOL CLASSES

Farm Characteristics	Households Reporting	Percentage of Households With Number of Individuals of School Age Who Have Completed or in											
		0	1-2	3-4	5 or More	0	1-2	3-4	5 or More	0	1-2	3-4	5 or More
Total Land Owned													
Under 2.5	74	59.5	36.5	4.1	-	86.5	13.5	-	-	93.1	6.9	-	-
2.5-7.49	95	46.3	43.2	8.4	2.2	67.4	30.5	2.1	-	78.9	21.0	-	-
7.5-12.49	97	34.0	54.6	8.3	3.0	61.9	36.1	2.1	-	82.5	16.5	1.0	-
12.5-24.99	85	32.9	51.8	15.3	-	54.1	35.3	7.0	2.4	60.0	29.4	5.2	2.4
25.0-49.99	17	11.8	29.4	52.	5.9	41.2	35.3	23.5	-	47.1	35.3	17.6	-
50.0 or More	8	-	75.0	-	25.0	12.5	62.5	12.5	12.5	25.0	37.5	25.0	12.5
Tenure Class													
Owners	255	30.6	51.4	13.7	4.6	57.3	35.7	5.5	1.3	68.9	25.2	5.7	1.2
Owners-Cum Tenants	52	46.2	42.3	5.7	5.7	71.2	27.0	1.9	-	84.6	13.5	1.9	-
Contractors	2	100.0	-	-	-	100.0	-	-	-	100.0	-	-	-
Tenants	67	61.2	34.4	4.6	-	85.1	14.9	-	-	93.9	6.1	-	-
Overal Weighted Totals	376	39.4	46.8	10.9	3.0	64.4	30.6	4.0	.8	75.7	20.0	3.4	.8

the report where educational level is used as a variable, it is noted. Other important analysis is an examination of drop out rates which are considered to be very high, especially for low income groups. Also, household education should be examined in relationship to number of various type schools located in the villages and distances to school. Pakistan has done a creditable job in the last 10 years in attempting to establish village schools. This is a complex task as demands for education increases along with rapidly increasing population rates.

We have stressed the importance of providing agricultural extension materials to all farmers, literate or not, because someone in each family of all classes of farmers have some level of formal education. This trend also is expected to increase rapidly.

TABLE 6. SUMMARY OF DISTANCES OF VARIOUS TYPES OF SCHOOLS FROM SIXTEEN SAMPLE VILLAGES IN MILES

Type Schools	Located in Village	Under 2 Miles	2.0 to 4.99 Miles	5.0 to 7.49 Miles	7.5 to 9.99 Miles	10.0 to 14.99 Miles	15 and Over Miles
Primary (Boys)	10	4	2	0	0	0	0
Primary (Girls)	6	5	4	1	0	0	0
Middle (Boys)	3	5	6	1	0	1	0
Middle (Girls	1	4	6	3	0	2	0
High (Boys)	1	2	7	3	0	2	1
High (Girls)	1	1	8	3	0	2	1
TOTAL of all Types	22	21	33	11	0	7	2

APPENDIX V

Part C

NOTE ON JOINT TUBEWELLS IN VILLAGE 107

I. NOTE ON JOINT TUBEWELLS IN VILLAGE 107

This brief appendix is meant to show that on some watercourses small farmers without Government assistance pool their resources for the inntallation of small discharge private tubewells.

Table 1 provides summary information about tubewells located on three watercourses in one village in Multan Region which has more than 2,000 acres of cultivated land. In this particular refugee village of small farmers there are 26 diesel powered tubewells of which 16 are jointly owned and operated by small farmers. There is a private tubewell for about each 75 acres of land in the village.

There are an average of 4 members for each joint tubewell. Only four tubewells include farmers of more than one brotherhood group; this confirms our finding that there is much brotherhood boundedness in most cooperative efforts. Of those four tubewells with more than one brotherhood included 3 have 75 percent of members from one brotherhood group.

Members of these joint tubewells establish their own informal rules for operation. Expenses for maintenance and repairs are in relationship to the fraction of the tubewell a member owns. Accounts, which were examined by interviewers, are kept by a literate treasurer elected by members and where none is literate a literate son maintains the accounts for fuel, hours operated, sales of water and expenses for repairs and maintenance. Farmers report that when there are major conflicts of interest, the tubewell is closed to operations until the conflict is resolved. Farmers report a few cases where, due to conflicts, members sold their shares and established other joint tubewells. The land on which these wells are located is owned by one or more members who agree to provide a place for tubewell installation.

The major problem reported by these joint tubewell owners was the present high cost of diesel fuel and mobile oil.

The investigators have found this phenomenon of joint owned small discharge tubewells on other watercourses in Pakistan.[13] It may be much more widespread than some tubewell surveys in the past have indicated. This suggests that given incentives such as liberal long-term credit arrangements for small farmers, there is a potential for increasing wate supplies on many watercourses by the installation of tubewells. It appears more feasible to allow farmers to organize themselves for the installation and operation of these wells than to follow the SCARP model of installing Government owned and operated wells.

13/ Lowdermilk, Max K., Wayne Clyma and Alan C. Early. 1975. Physical and Socio-Economic Dynamics of a Watercourse in Pakistan's Punjab - System Constraints and Farmers' Responses. Colorado State University Water Management Technical Report No. 42.

TABLE 1. PATTERNS OF COOPERATIVE TUBEWELL ORGANIZATION, VILLAGE 107

Watercourse & Tubewell	No. Coop. Members	Percent Members in same biradari	Amount Land Cultivated by Coop. Members (Acres) Mean	Median	Max	Year Coop Estab.	Size Delivery Pipe (in
W-e1							
T-W1	4	100	17.0	15.0	25	1960	6 x 6
T-W2	6	100	5.9	5.5	10.5	1961	5 x 6
T-W3	4	100	4.8	4.5	5.3	1962	5 x 6
T-W4	2	100	10.8	10.8	14.0	1971	6 x 6
T-W5	Private	--*	--	--	42	1960	6 x 6
T-W6	Private	--	--	--	12	1973	5 x 6
T-W7	Private	--	--	--	13.5	1971	5 x 6
T-W8	8	75	4.7	5.4	8.0	1965	6 x 6
T-W9	Private	--	--	--	15.0	1969	5 x 5
T-10	4	100	3.6	3.6	5.0	1973	5 x 5
T-W11	4	100	6.9	7.0	8.8	1965	5 x 5
T-W12	4	75	6.0	5.3	8.8	1967	6 x 6
T-W13	6	75	7.3	6.4	14.0	1960	6 x 6
W-e2							
T-W1	3	100	10.4	9.5	12.0	1972	5 x 6
T-W2	Private	--	--	--	10.8	1958	7 x 7
T-W3	3	100	25.0	15.0	45.0	1958	6 x 6
T-W4	Private	--	--	--	11.3	1972	5 x 5
T-W5	Private	--	--	--	2.5	1968	6 x 6
T-W6	4	100	4.3	4.1	5.5	1971	6 x 6
T-W7	Private	--	--	--	8.0	1971	6 x 6
T-W8	6	100	3.0	2	5.0	1971	6 x 6
W-e3							
T-W1	2	100	5.5	5.5	6.0	1965	6 x 6
T-W2	2	100	6.0	6.0	7.0	1974	5 x 5
T-W3	4	50	4.6	5	8.0	1960	5 x 5
T-W4	Private	--	--	--	8.0	1971	6 x 6
T-W5	Private	--	--	--	8.0	1967	5 x 5

Note: This village is composed of four biardaris--Arjan, Kambo, Dogur, and Bingut. All tubewells were privately financed and are diesel powered. These tubewells, although called "cooperatives" for purposes of this study, have no connection with the Pakistan Department of Cooperatives.

*Private means -- Individually owned and operated for use from an joint family farm.

APPENDIX V

Part D

SAMPLE FARMER REPORTS OF PLACE OF INORGANIC FERTILIZER AND SEED ACQUISITION

TABLE 1. FARMERS' REPORTS OF PLACE OF AQUISITION OF INORGANIC FERTILIZER AND SEED (WHEAT, RICE, COTTON, FODDER SEED)

Village Site	Fertilizer Requirements			Major Seed Requirements			
	Number of Farmers Reporting %	Village Shop %	Fertilizer Agency %	Number of Farmers Reporting %	Self or Other %	Shop in Market %	Other %
101	15	-	100	15	80	20	-
102	9	11	89	9	56	44	-
103	16	-	100	16	75	25	-
104	30	-	100	35	37	63	-
105	8	-	100	8	50	38	12
106	12	42	58	12	83	17	-
107	54	24	76	54	92	4	4
108	9	-	100	9	33	67	-
109	14	7	93	14	79	21	-
110	27	4	96	27	78	22	-
111	24	67	33	24	71	29	-
112	29	10	90	30	37	62	-
113	26	8	92	26	23	77	-
114	34	-	100	38	42	58	-
115	35	-	100	36	14	86	-
116	22	-	100	24	25	75	-
Total	364	12	8	377	54	46	1

APPENDIX V

Part E

SUMMARY OF SAMPLE FARMER FASALANA PAYMENTS

TABLE 1. SUMMARY OF FASALANA PAYMENTS FOR FARMERS REPORTING TYPE OF PAYMENTS BY VILLAGE LOCATION.*

Village size	Payments in wheat seers				Payments in rice seers				Payments in cash or other
	N	Mean	Med.	Range	N	Mean	Med.	Range	
101	1	40	40	-					2 report payment of Rs. 5/season
102	7	52.8	50	20-80					
103	7	34	40	20-40					
104	4	20	15	10-40					
105	4	45	40	20-80	1	40	40	-	
106	9	82	60	10-320					
107	17	54	60	20-100	4	55	60	40-80 (1-40 seers cotton)	
108	4	70	80	40-80					
109	6	50.8	50	5-80	(3 report payments of cotton range 40-80-seers)				
110	2	19	19	18-20	3	59	20	18-140 (1-20 seers cotton)	
111	12	50	40	10-200	1	40	40	-	1 reports Rs.130/
112	4	65	40	20-160					1 reports Rs.40/y 1 reports Rs.55/y
113	(3)	(1.7)	(2)	(1-2)	(seers/acre)				4 - Rs.1.00/ irrigated acre 1 - Rs.50/yr.
114	20	27	25	10-60	1	40	40	-	
115	1	40	40	-					
116	4	47	45	10-60					3 reports Rs.10/ 100Rs. of abania; Rs.100/yr; Rs. 20/ acre
Weighted Total	105	45.9	40	10-320	10	52	40	18-140	

These are only reported payments of the farmers who reported fasalana payments. Only those who reported amounts and kinds of payments have been recorded in the Summary Table 1. There is much variation in kinds and amounts of payments as shown in the table. Usually the amount is related to the size of holdings of the farmer and the services rendered. For example: one farmer at site 108 paid 320 seers of wheat, one farmer at site 116 paid 240 seers of rice; one farmer at site 114 [illegible] according to the needs of the natural.

APPENDIX V

Part F

NUMBER OF IRRIGATIONS APPLIED BY SAMPLE FARMERS BY SELECTED CROPS BY VILLAGE SITES

TABLE I. NUMBER OF IRRIGATIONS APPLIED BY SAMPLE FARMERS FOR SELECTED CROPS BY VILLAGE SITES.

Types of command and sites		Modal number of irrigations applied excluding preirrigations (Note optimum is shown by + and number of irrigations in addition to usual.)									
		HYV Wheat		Oats-Barley		Maize Grain		Maize Fodder		Cotton	
		usual	optimum	usual	optimum	usual	optimum	usual	optimum	usual	optimum
Perennial											
110	L**	6-7	+0	NA	NA	4-5	+0	4-5	+0	3-4	+1
103	L	4-5	+2	6-7	+0	4-5	+2	4-5	+2	3-4	+1
104	L	3-4	+1	4-5	+0	3-4	+1	3-4	+1	3-4	+0
101	ML	4-5	+2	3-4	+1	3-4	+1	3-4	+1	3-4	+0
106	ML*	4-5	+2	3-4	+1	4-5	+0	4-5	+0	4-5	+0
109	ML*	4-5	+2	3-4	+2	4-5	+2	4-5	+2	3-4	+1
102	MH**	6-7	+2	6-7	+0	4-5	+0	3-4	+1	6-7	+0
107	MH**	8-9	+4	8-9	+0	6-7	+2	6-7	+2	8-9	+0
112	H	4-5	+2	NA	NA	2-3	+1	2-3	+1	4-5	+0
113	H	4-5	+2	2-3	+2	4-5	+0	4-5	+0	4-5	+0
116	H	3-4	+0	NA	NA	2-3	+2	NA	NA	NA	NA
Nonperennial											
105	ML*	4-5	+0	2-3	+0	3-4	+0	2-3	+0	3-4	+0
108	ML*	4-5	+2	2-3	+0	4-5	+0	4-5	+0	3-4	+0
111	MH*	3-4	+2	4-5	+2	4-5	+2	4-5	+2	4-5	+0
114	MH	3-4	+1	2-3	+2	3-4	+1	2-3	+2	4-5	+2
115	H	4-5	+0	2-3	+2	3-4	+1	2-3	+2	4-5	+0

Note: Letters refer to following estimated annual atmospheric evaporative deficit in inches: L = Low 40"; ML = Medium Low 50"; MH = Medium High 60"; and H = High 80"

*Refers to public tubewell supplemented watercourse commands.
**Refers to high density of private tubewells (7 or more). Site 102 included with 6 tubewells.

ENGLISH GLOSSARY

Agro-Climatic Zone - A region where climate makes a well defined demand for water and a general cropping pattern prevails on a majority of the farms.

Alidade and Plane Table - Engineering telescope and table tripod tools used for preparation of maps to scale in the fields.

Alkaline Soil - A high pH soil that contains sufficient sodium to cause deleterious effects on most crops.

Application Efficiency - The quotient of soil moisture deficiency and nakka discharge in inches equivalent multiplied by one hundred to construct a percentage value.

$$Ea = \frac{\text{soil moisture deficiency}}{\text{nakka discharge (in depth of water equivalent)}} (100)$$

Authorized Supply - The design discharge of water from a mogha.

Barrage - Headworks with movable gates that allow flood waters to pass over their crests. Not to be confused with storage dams.

Barren Land - Land which is not cropped due to salinity, waterlogging, lack of water, presence of sand dunes, etc.

Brotherhood (Biradari) - A lineage group of families related as brothers, sons, uncles, etc. typically with common interests on various issues. A subdivision of a caste group.

Bunded Unit - The smallest field unit irrigated as a separate unit, surrounded by a small earthen ridge or bund.

Canal Colony - Large areas of land brought into production by Irrigation Department and settled by cultivators.

Caste - Ancestral, occupational grouping of people implying prestige gradations.

Centrality of Power - The amount of power/influence attributed to watercourse farmers by 25% sample of farmer/judges. A watercourse centrality value expresses the percentage of all farmers who score at a specified level or above.

Command Area - The area served by a watercourse or set of watercourses in a village.

Concentration of Power - The extent to which power/influence is distributed equally on a watercourse.

Conflict Cleavage - Line of division between opponents over an issue.

Conveyance (Delivery) Efficiency - The percentage of water passing the mogha which reaches the field nakka outlet. The nakka discharge is divided by the mogha discharge and the quotient is multiplied by 100 to create a percentage value.

Cropped Area - The sum of the acreage under rabi or kharif crops in a watercourse command area.

Cropping Intensity - The number of crops grown on a given field in a given year times 100 to express a percentage value. Applied to a farm, it is the acreage of all crops grown in a year divided by the area on which they were grown times 100.

Cropping Pattern - The combination and sequence of crops grown on a given farm over a year's time.

Cross Cutting Cleavage - Opponents on one conflict issue are allies on other conflict issues. Makes for cooperation and negotiability of issues.

Cultural Command Area - The cultivated area of a watercourse command area which can be served by gravity irrigation.

Cutthroat Flume - A water measuring flume device especially suited for low gradient watercourse channels.

Delivery Efficiency -- See Conveyance Efficiency.

Delta - Amount of water applied for an irrigation.

Depth of Application - The average depth of water applied to a field obtained as the product of nakka discharge (in cusecs) times the time of application in hours divided by the area irrigated in acres.

Discharge - the volumetric rate of water flow or delivery, expressed as cubic feet per second (cusec)

Discharge Factor - The mogha outlet design capacity from distributary to watercourse expressed as discharge per 1000 acres of command area.

Distributary - The smallest water channel maintained by the government. The size hierarchy of channels would be, in descending order, major canal, minor canal, distributary. Moghas may be placed on any of these channels.

Duty - The area irrigated per unit of water per season of the year.

Evaporative Moisture Deficit - Estimated annual atmospheric evaporation.

Evapotranspiration - The total water lost to the atmosphere via evaporation and plant transpiration.

Farm Irrigation Efficiency - The proportion of water, passing the mogha, which is stored in the root zone of a crop, calculated as the product of the conveyance efficiency and application efficiency times 100 to create a percentage value.

Gross Command Area - The portion of the entire village area that is commanded by gravity canal irrigation; includes roads, schools, graveyards, canals, etc.

Groundwater Recharge - Deep percolation which replenishes the water table.

Headworks - A division with controllable gates on a major canal dividing water into two or more minors.

Landlord - Owner of land who does not cultivate the land.

Link Canal - Largest of the canals -- each carries water from the western to eastern rivers as part of the Indus Basin Replacement Project mandated by the Indus River Treaty with India (1960).

Local (person) - Person living, or whose family has lived, at present location since before partition of British India into India and Pakistan.

Minor - A water supply canal smaller in discharge than a major canal but greater in capacity than a distributary.

Non-perennial - A single season, kharif, water supply situation for a watercourse command area.

Overlapping Cleavage - Opponents on one conflict issue are opponents on all conflict issues. High polarization. Issues become difficult to negotiate. Hurts cooperation.

Percolation - The downward movement of water through soils.

Perennial - A year-round water supply situation for a watercourse command area.

Persian Well - A water lifting device used on a deep open well comprised of a chain of buckets or earthen pots powered by a pair of bullocks or a camel moving in a horizontal circle.

Potential Evapotranspiration - The maximum evaporative demand which a given climate can place on a given crop when there is no constraint on water availability and crop maturity.

Private Tubewell - A small discharge irrigation well individually or jointly owned by farmers.

Province - Administrative unit such as Sind, Baluchistan, Punjab and North West Frontier areas.

Public Tubewell - Large discharge tubewells installed and operated by WAPDA and Irrigation Department.

Refugee - Person displaced from India at partition.

Saline Soil - Soil which contains a sufficient percentage of soluble (non-sodium) salts to impair crop growth.

SCARP - Acronym for the Salinity Control and Reclamation Project areas where public tubewells are used for lowering watertables and augmenting water supplies.

Seepage- The lateral movement of water through soils.

Soil Moisture Deficiency - Estimated inches of soil moisture depleted due to evapotranspiration.

Tenant - A non-landowner who cultivates a block of land on a share-cropping basis with a landlord.

Time of Application - The duration of an irrigation application of turn.

Tubewell - An irrigation well.

Union Council - A governmental subdivision of a tehsil comprised of approximately 8 to 10 villages.

WAPDA - Acronym for the Water and Power Development Authority - a government corporation.

Watercourse - A water supply channel placed on a 16 foot wide government right of way, constructed and maintained by farmers to deliver water from a mogha outlet to a farmers field ditch.

Watercourse Command Area - The area served by the water passing through an authorized mogha.

Waterlogging - Soil condition where water table is at or above the ground surface.

GLOSSARY OF URDU/PUNJAB AND LOCAL ENGLISH TERMS

Abadi - Land set aside for a village site.

Abiana - Water rate.

Agricultural Assistant - Supervisor of field assistant level extension workers in the Agricultural Extension system. Usually has a Bachelor of Science degree in agriculture.

Bagh - Orchard.

Bajra - Spiked millet.

Bakhsheesh - Gratuity.

Barani - Rainfed cropping.

Berseem - Egyptian clover.

Bhusa - Wheat straw used as animal feed.

Biradari - A brotherhood lineage group of families related through brothers, sons and uncles within the same caste. Typically members take common interests on issues.

Bund - Small earth ridge.

Caste - Ancestral, occupational grouping of people implying prestige gradations.

Chaj Doab - Land between Jhelum and Chenab Rivers.

Chak - Block of land set aside as smallest administration unit.

Chula - Earthen hearth.

Crore - Ten million, 100 Lakh.

Dab - Preplanting, irrigation and cultivation to control weeds.

Deh - Administrative division below Tehsil.

Deputy Commissioner - Administrative officer at the district level.

Desi - Indigenous, unimproved.

District Revenue Collector - Revenue officer for the District Revenue Department.

Divisional Canal Officers - Administrative head of a divisional branch of a canal command system.

Doab - Land between two rivers in Punjab.

Executive Engineer - Mid-level Irrigation Department or WAPDA Official.

Field Assistant - Local lowest level extension worker, education usually 10th class plus one or two years of general training in agriculture.

Fasalana - Payment for reduced water rates.

Guara - Cluster bean.

Gur - Indigenously prepared country sugar.

Gunta - 1/40 of an acre.

Halqa - Circle of villages of which a canal patwari is in charge to make water dues assessments.

Hakim - Local doctor.

Hari - Share cropper or tenant.

Henna - English translation "Myrtle" and known by botanical name Lawsonia alba. Used as a local orange dye.

Hukka - Waterpipe.

Hul - Local plow.

Jhallar - Persian well adapted to low water lifts.

Jhenab - Land unit used in Sind for one-half acre.

Jowar - Sorghum.

Kacha - Unripe, unimproved, earthen, random, poor quality.

Kanai - 1/8 of an acre.

Kassi - Hoe-like shovel used by irrigators.

Khal - Watercourse, conducts water from mogha to fields.

Khati - Process of removing silt from the watercourse.

Kharaba - Crop failure; declaration for reduced water rates.

Kharif - Warm season cropping, approximately April-October.

Khasrah - Register on revenue due on units of land.

Kiari - System recommended by Agriculture Department for compartment of a field into very small basins for irrigation.

Killa - Area of land equal to 1.11 acre.

Kistiwar - Random layout of land in bunded units

Karah - Indigenous two team bullock pulled scraper for moving earth.

Karahi - Same as karah but powered by one bullock team.

Lakh - One hundred thousand.

Lucerne - Alfalfa.

Mal - Property.

Mandi - Chartered market center.

Maraba - A square of land made of 25 parcels, usually acres or squares.

Marla - 1/160 of an acre; 1/20 of a kanal.

Muhavir - Person or family migrated from India.

Maund - Unit of measure, 82.3 pounds equivalent to 40 seers.

Mauza - Village, smallest division of government.

Moeen - Non-agricultural castes who perform services for a share of agricultural produce (also kami).

Mogha - An ungated outlet of fixed size passing water from irrigation canal to a watercourse.

Mukamis - Local resident.

Nakka - Outlet from branch watercourse; inlet to a field.

Numbardar - Village headman -- function of government who collects land revenues.

Nikal Water - Water left in watercourse at the end of a complete rotation of warabundi.

Overseer - Irrigation Department functionary over patwari, responsible for maintenance and repair of moghas.

Pansal Nawees - Irrigation Department gate keeper.

Pahar - Turn of water of five hours.

Patwari - Title of revenue officer for Irrigation Department and Land Revenue Department.

Patti - Division of a village under the responsibility of a numbardar or village leader.

Pora - Seed tube attached behind plow for seeding crops.

Pucca - Ripe, improved, concrete, specified to order, high quality.

Parchas - Chits of paper used for notifying farmer of revenue assessments.

Rabi Hul - Bullock pulled mouldboard plow.

Rabi - Cool season cropping; approximately November-March.

Rauni - Presowing irrigation.

Rechna Doab - Land between Ravi and Chenab rivers.

Rej - Irrigation prior to land preparation.

Rosewari - Irrigation schedule to a particular block of land on a particular day.

Saip System - Traditional system by which village artisans exchange their goods and services with landed agriculturalists for a portion of the crop.

Sarkari Khal - Watercourse constructed by farmers on a 16 foot right-of-way provided by the government for the purpose of conducting water from the mogha outlet to the individual farmers field ditches.

Seer - Unit of measure, smaller than kilogram, 2.08 lb. Forty seer equal one maund.

Sem - Waterlogged soil condition.

Shamlat - Village common land usually used for grazing.

Sohaga - Wooden plank or beam drawn by bullocks used in land preparation.

Square - 25 acre, 27.5 acre of 16 acre block of land depending on location.

Subdivisional Officer - Irrigation Department Official under the Executive Engineer.

Superintending Canal Engineer - Irrigation engineer who heads up a canal command hydrologic unit.

Tehsil - A sub-unit of a district.

Tehsildar - Official at Tehsil level.

Thal Doab - Land between Indus and Jhelum rivers.

Thur - Salinized soil condition.

Tonga - Horse drawn two-wheeled carriage.

Union Council - Political subdivision of a tehsil.

Vattar - Farmers' concept of optimum soil moisture condition for plowing.

Wahn - Watering of a field for first ploughing for seedbed preparation.

Warabundi - Schedule of irrigation turn rotations agreed to by farmers either informally (katcha warabundi) or under formal agreement through the Irrigation Department (pucca warabundi).

Warashikni - Taking irrigation water out of turn.

Zilladar - Junior member of Superior Revenue establishment of Irrigation Department.

Zamin - Land

Zamindar - Landholder - farmer