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WALKER BRANCH WATERSHED PROJECT: OBJECTIVES, FACILITIES, AND ECOLOGICAL CHARACTERISTICS

J. W. Curlin and D. J. Nelson

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Oak Ridge, Tennessee
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FOREWORD

The project described in this report is an intradivisional research effort which utilizes the talents of a broad spectrum of scientists and technicians from within the Health Physics Division, supplemented by off-site consultants and engineers from within ORNL. Those listed below have contributed significantly to the establishement of the Walker Branch Watershed Project.

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We anticipate an increasing number of research participants as the project develops from initial characterization to the experimental phase. It is intended that this project be coordinated with related work being done elsewhere so that rational conclusions with regional application will result.

J. W. Curlin - D. J. Nelson

WALKER BRANCH WATERSHED PROJECT:
OBJECTIVES, FACILITIES, AND ECOLOGICAL CHARACTERISTICS

J. W. CURLIN AND D. J. NELSON

ABSTRACT

ONE OF THE MOST SERIOUS ENVIRONMENTAL PROBLEMS FACING THE EASTERN U. S. IS THAT OF WATER QUALITY AND STREAM POLLUTION. SMALL EXPERIMENTAL WATERSHEDS WHICH DEFINE PRACTICAL ECOSYSTEMS PROVIDE A MEANS FOR STUDYING THE EFFECTS OF MAN-CAUSED DISTURBANCES ON WATER QUALITY.

WALKER BRANCH WATERSHED, A 241-ACRE FORESTED CATCHMENT BASIN, HAS BEEN ESTABLISHED TO PROVIDE DATA ON BASELINE VALUES FOR UNPOLLUTED NATURAL WATERS, CONTRIBUTE KNOWLEDGE OF CYCLING AND LOSS OF CHEMICAL ELEMENTS IN NATURAL SYSTEMS, AND ENABLE CONSTRUCTION OF EMPIRICAL MODELS WITH WHICH TO PREDICT THE ECOLOGICAL EFFECTS OF MAN'S ACTIVITIES.

THIS REPORT OUTLINES THE OBJECTIVES OF THE PROJECT, DESCRIBES THE FACILITY AND SUMMARIZES THE ECOLOGICAL CHARACTERISTICS OF THE WATERSHED.

THE WATERSHED AS AN ECOSYSTEM

ECOSYSTEM IS DEFINED IN WEBSTER'S DICTIONARY AS A COMPLEX OF ECOLOGICAL COMMUNITY AND ENVIRONMENT FORMING A FUNCTIONING WHOLE IN NATURE. THE CREATOR OF THIS TERM, A.G. TANSLEY (1), EMPHASIZED THE INSEPARABLE NATURE OF ORGANISMS AND THEIR ENVIRONMENT WHICH TOGETHER FORM A PHYSICAL SYSTEM. THE ECOSYSTEM CONCEPT ITSELF IS SOMEWHAT ARTIFICIAL IN THAT IT TENDS TO SEGREGATE OVERLAPPING AND INTERACTING SYSTEMS INTO ISOLATES FOR CONVENIENT STUDY. THE DEFINITION PLACES LITTLE RESTRICTION ON AREA OR SPATIAL VOLUME TO BE INCLUDED IN DELINEATING AN ECOSYSTEM, NEVERTHELESS, TO CARRY THIS DEFINITION TO EXTREMES IN EITHER DIRECTION RUNS THE RISK OF OVER-GENERALIZATION OR DISCONNECTED FINITENESS. THE PROBLEM THEN IS ONE OF CHOSING A REALISTIC EXPERIMENTAL UNIT WHOSE SYSTEMATIC RESPONSE HAS PRACTICAL IMPORTANCE TO THE SOLUTION OF ECOLOGICAL PROBLEMS.

A WATERSHED DEFINES A PRACTICAL ECOSYSTEM WHICH REACTS TO THE CLIMATE OF THE ATMOSPHERE ABOVE, DEPENDS UPON THE REGOLITH BELOW FOR NUTRITION, AND IS SUBJECT TO IRREVERSIBLE LOSS THROUGH SURFACE STREAM FLOW AND DEEP SEEPAGE, BUT WHICH RESISTS SUCH LOSS BY CONSTANT RECYCLING AND BIOSYNTHESIS.

THE BIOTIC PRODUCTIVITY AND WATER QUALITY OF TERTIARY STREAMS ARE DETERMINED BY THE LANDSCAPE FROM WHICH THE STREAM ORIGINATES AND THROUGH WHICH IT FLOWS. FROM THE TIME WATER ENTERS AN ECOSYSTEM AS PRECIPITATION UNTIL IT ULTIMATELY REACHES THE SEA, IT IS CONTINUALLY ACCRUING MINERALS AND ENERGY FROM THE BIOGEOCHEMICAL CYCLE. THE BIOTIC LIFE OF THE AQUATIC SYSTEM IS CLOSELY COUPLED WITH THE TERRESTRIAL SYSTEM IN JUXTAPOSITION. THE BIOGEOCHEMICAL CYCLE OF A WATERSHED ECOSYSTEM IS SHOWN IN FIG. 1.

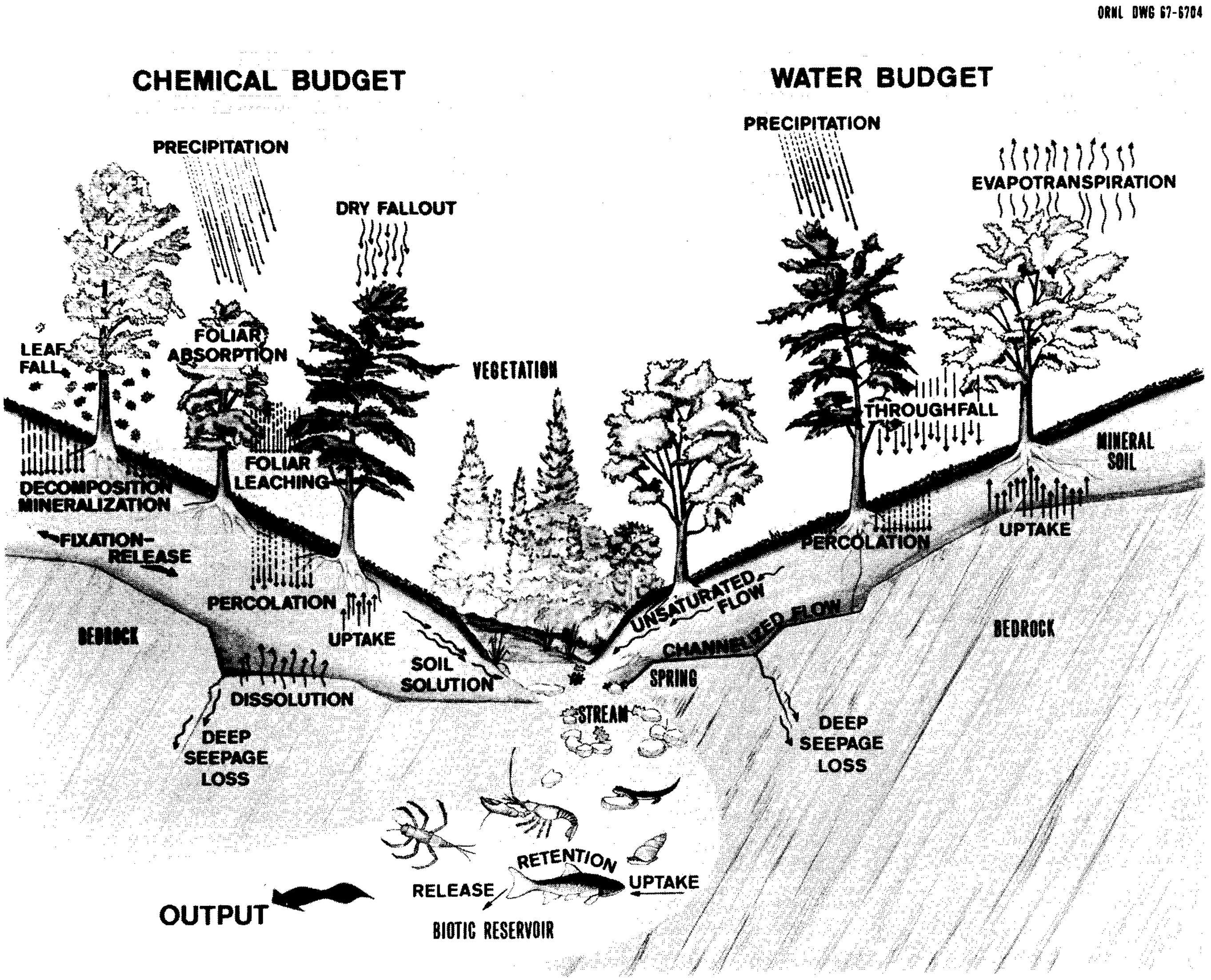

Fig. 1. The Biogeochemical Cycle in a Watershed Ecosystem.

CHEMICAL SOLUTES AND PARTICULATE MATTER IN THE SURFACE WATER OR IN DEEP SEEPAGE WATER REPRESENT AN IRREVERSIBLE LOSS TO THE TERRESTRIAL-AQUATIC ECOSYSTEM, WHILE DYNAMIC PROCESSES OF WEATHERING, BIOLOGICAL UPTAKE, FIXATION, AND DECOMPOSITION TEND TO REPLENISH THE SUPPLY AND TO CYCLE THE ELEMENTS WITHIN THE SYSTEM. WATER RECEIVED AS PRECIPITATION CONTAINS CHEMICAL ELEMENTS AND ALSO ACTS AS SOLVENT AND CARRIER FOR NUTRIENTS; THUS RATE AND VOLUME OF PRECIPITATION ARE MAJOR FACTORS IN DETERMINING THE CHEMICAL FLUX OF TERRESTRIAL-AQUATIC ECOSYSTEMS. THE CLIMATIC AND MICROCLIMATIC REGIME IS THEREFORE AN INTEGRAL PART OF THE TOTAL SYSTEM WHICH ESTABLISHES, TO A GREAT DEGREE, THE RATE OF BIOTIC PRODUCTION, DECOMPOSITION, ENERGY INPUT, AND NUTRIENT LOSS.

WITHIN THE STREAM ITSELF A SIMILAR INTRASYSTEM CYCLE OPERATES. DISSOLVED NUTRIENTS AND DECOMPOSITION PRODUCTS FROM PARTICULATE ORGANIC MATTER CARRIED INTO THE STREAM ARE TAKEN UP DIRECTLY BY BIOTA AND THUS ENTER THE FOOD CHAIN OF FISHES, AQUATIC INSECTS, AND BOTTOM-FEEDING ORGANISMS. MINERAL FIXATION BY PERIPHYTON, UPTAKE OF DISSOLVED NUTRIENTS BY PHYTOPLANKTON, AND PRECIPITATION AS INSOLUBLE COMPOUNDS ACT AS RESISTORS TO CHEMICAL LOSS BY THE FLOW OF SURFACE WATER.

BORMANN AND LIKENS (2) HAVE USED A SMALL WATERSHED ECOSYSTEM TO STUDY NUTRIENT CYCLING IN A NORTHERN HARDWOOD FOREST IN NEW HAMPSHIRE. TREATING THE WATERSHED AS AN INPUT-OUTPUT SYSTEM, THEY WERE ABLE TO ESTIMATE THE NET LOSS OF DISSOLVED NUTRIENT ELEMENTS BY MEASURING IONIC CONCENTRATION AND WATER VOLUMES RECEIVED BY, AND PASSING FROM, THE CATCHMENT BASIN. NOT ALL WATERSHEDS ARE SUITABLE FOR SUCH NUTRIENT-BUDGET STUDIES BECAUSE THIS APPROACH REQUIRES ASSUMPTION OF A COMPLETELY WATERTIGHT BASIN WITH NO DEEP SEEPAGE LOSS -- AN ASSUMPTION WHICH MOST WATERSHEDS DO NOT SATISFY.

BY STUDYING THE WATERSHED UNIT AS A SYSTEM, ONE IS ABLE TO RELATE THE PRODUCTIVITY OF A NATURAL, RELATIVELY UNDISTURBED, FORESTED LANDSCAPE TO THE PRODUCTIVITY AND NUTRIENT BALANCE OF THE STREAM. IF THE FOCAL POINT OF STUDY IS THE ECOLOGY OF THE STREAM AND QUALITY OF THE SURFACE WATER THEN EVEN A POROUS SYSTEM CAN BE STUDIED IF INFERENCES REGARDING TOTAL WATER BALANCE AND TOTAL NUTRIENT BUDGETS ARE AVOIDED OR TREATED WITH CAUTION. DETAILED STUDY OF THE COMPONENTS MAKING UP THE WATERSHED SYSTEM WILL YIELD DATA ON NUTRIENT FLUX, POPULATION DYNAMICS, AND TRANSFER RATES FROM WHICH EMPIRICAL MODELS OF THE WATERSHED ECOSYSTEM PROCESSES CAN BE DEVELOPED.

INFERENCES FROM SUCH A MODEL CAN HELP EXPLAIN THE MECHANISMS INVOLVED IN MAINTAINING TERRESTRIAL-AQUATIC PRODUCTIVITY IN DYNAMIC EQUILIBRIUM. BENCHMARK DATA OF THIS TYPE ARE VIRTUALLY NONEXISTENT -- YET, THEY ARE THE KEY TO THE NATURAL MAINTENANCE OF PRODUCTIVIY AND ARE A MEASURE OF THE NATURAL ENTROPY OF THE ECOSYSTEM. FURTHERMORE, COMPARISON OF THE STABILITY OF AN UNDISTURBED WATERSHED WITH THE DYNAMICS OF ONE ALTERED BY MAN'S CULTURAL PRACTICES AND ABUSE IS A GAUGE OF ENVIRONMENTAL DEGRADATION -- A PARAMOUNT PROBLEM IN THIS DAY OF RAPIDLY EXPANDING WORLD POPULATION.

WATERSHED RESEARCH IN THE EASTERN UNITED STATES

WATER YIELD AND SUPPLY

THREE-HUNDRED-TWENTY-SEVEN BILLION GALLONS OF WATER IN THE FORM OF PRECIPITATION FALL ON THE UNITED STATES ANNUALLY (3). ONLY 2% OF THIS VOLUME IS DIVERTED AND CONSUMED BY MAN AND 39% IS USED INDIRECTLY WHERE IT FALLS FOR SUPPORT OF NONIRRIGATED AGRICULTURE AND FORESTS. DISCOUNTING THE ARID REGIONS OF THE WESTERN UNITED STATES, THE NATION AS

A WHOLE IS BLESSED BY AN ABUNDANCE, AND IN SOME PLACES AN OVER ABUNDANCE, OF WATER. WITH THE PRESENT POPULATION STRUCTURE AND WATER-DEMAND ECONOMY, THE WATER SUPPLY EAST OF THE MISSISSIPPI RIVER MUST BE CONSIDERED AMPLE. THIS PROSPECT CAN CHANGE, HOWEVER, UNDER POPULATION PRESSURES PREDICTED BY THE END OF THE CENTURY. ALTHOUGH CERTAIN LARGE EASTERN METROPOLITAN AREAS TEMPORARILY SUFFER WATER SHORTAGES, THE PROBLEM IS PRESENTLY ONE OF DISTRIBUTION AND MANAGEMENT RATHER THAN REGIONAL SUPPLY.

PUBLIC AWARENESS OF THE PROBLEMS RELATED TO THE NATION'S WATER RESOURCES DEVELOPED ABOUT THE TURN OF THE CENTURY (4). INTRODUCTION OF THE HAPLESS NEWLANDS BILL IN 1908 PROVIDING FOR INTEGRATED WATER-RESOURCES PLANNING, AND LATER, PASSAGE OF THE WEEKS ACT (1911) AUTHORIZING PURCHASE OF CERTAIN EASTERN NATIONAL FORESTS FOR WATERSHED PROTECTION WERE THE INITIAL STEPS LEADING TO AN ESTABLISHED PUBLIC POLICY OF WATER RESOURCES RESEARCH. SINCE THAT TIME 18 GOVERNMENT AGENCIES HAVE ACTIVELY CONDUCTED OR SUPPORTED WATER RESEARCH.

INITIAL RESEARCH EFFORTS WERE AIMED AT STREAM FLOW REGULATION AND EVALUATION OF THE FOREST AS A MODERATING INFLUENCE. CONSERVATIONISTS OF THAT TIME FEATURED THE DEVASTATING FLOODS IN THE UPPER OHIO VALLEY AS BEING DIRECTLY CAUSED BY THE REMOVAL OF FORESTS AT THE HEADWATERS OF THE ALLEGHENY AND MONONGAHELA RIVERS. AS EVIDENCE ACCUMULATED SUPPORTING THE TENET THAT VEGETAL COVER ALONE COULD NOT REGULATE STREAM FLOW ON THE MAJOR TRIBUTARIES AND AS ENGINEERING PRINCIPLES WERE APPLIED TO SOLUTION OF THE FLOOD PROBLEM, ATTENTION WAS DIVERTED TO MEANS OF PRESERVING FLOW AND INCREASING WATER YIELD RATHER THAN REDUCING IT.

DURING THE 1930'S A NUMBER OF EXPERIMENTAL WATERSHEDS WERE ESTABLISHED TO EVALUATE THE EFFECTS OF LAND-USE AND VEGETATIONAL REGIMES ON WATER YIELD, STREAM FLOW, AND EROSION. THE NUMBER OF EXPERIMENTAL WATERSHEDS HAS PROLIFERATED SINCE THAT TIME UNTIL THERE IS NOW BETWEEN 585 AND 600 IN OPERATION -- 256 ARE OPERATED BY THE AGRICULTURAL RESEARCH SERVICE AND 212 BY THE U. S. FOREST SERVICE. THE REMAINING WATERSHED PROJECTS ARE ADMINISTERED BY PUBLIC AGENCIES SUCH AS THE BUREAU OF LAND MANAGEMENT, TENNESSEE VALLEY AUTHORITY, CORPS OF ENGINEERS, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, AND THE GEOLOGICAL SURVEY. THERE ARE 62 NON-FEDERAL PROJECTS, HOWEVER, MOST OF THESE ARE FINANCED WITH FEDERAL FUNDS. A MAJORITY OF THE NON-FEDERAL PROJECTS ARE ASSOCIATED WITH LAND GRANT UNIVERSITIES AND STATE AGRICULTURAL EXPERIMENT STATIONS.

IN THE EASTERN UNITED STATES SEVERAL INSTALLATIONS ARE PROMINENT FOR THEIR EARLY CONTRIBUTION TO THE BASIC KNOWLEDGE OF WILDLAND AND CROP- LAND HYDROLOGY. THESE ARE

1. COWEETA HYDROLOGIC LABORATORY, U. S. FOREST SERVICE, FRANKLIN, NORTH CAROLINA
2. FERNOW EXPERIMENTAL FOREST, U. S. FOREST SERVICE, PARSONS, WEST VIRGINIA
3. HYDRAULIC DATA BRANCH, TENNESSEE VALLEY AUTHORITY, KNOXVILLE, TENNESSEE
4. HUBBARD BROOK EXPERIMENTAL FOREST, U. S. FOREST SERVICE, WEST THORNTON, NEW HAMPSHIRE
5. NATIONAL HYDROGRAPH LABORATORY, U. S. AGRICULTURAL RESEARCH SERVICE, BELTSVILLE, MARYLAND
6. NORTH APPALACHIAN EXPERIMENTAL WATERSHED, U. S. AGRICULTURAL RESEARCH SERVICE, COSHOCTON, OHIO

AFTER 30 YEARS OF DATA COLLECTED FROM THESE AND OTHER LESS EXTENSIVE STUDIES, CERTAIN GENERALIZATIONS MAY BE DRAWN CONCERNING THE HYDROLOGIC RESPONSE OF WATERSHEDS TO CULTURAL DISTURBANCE BY MAN.

1. CONVERSION FROM CULTIVATED AGRICULTURE TO FORESTED CONDITIONS GREATLY REDUCES SURFACE RUNOFF AND SEDIMENTATION BUT REDUCES TOTAL WATER YIELD VERY LITTLE.
2. AMPLITUDE OF PEAK STREAM DISHARGE IN BOTH SUMMER AND WINTER FLOODS IS REDUCED BY FOREST COVER.
3. NORMAL STREAM FLOW IN THE HUMID, FORESTED,MOUNTAINOUS AREAS OF THE EASTERN U.S. IS FED PRIMARILY BY SLOW DRAINAGE FROM UNSATURATED SOIL RATHER THAN BY OVERLAND FLOW.
4. DISTURBANCE OF THE FOREST OVERSTORY BY CUTTING AND TIMBER REMOVAL TEMPORARILY INCREASES WATER YIELD BUT CAUSES LITTLE DISRUPTION OF THE HYDROGRAPHIC PATTERN, NOR DOES IT APPRECIABLY INCREASE SUSPENDED SEDIMENT LOAD IF THE HUMUS LAYER REMAINS INTACT AND SURFACE DISTURBANCE IS KEPT AT A MINIMUM.

A RECENT APPRAISAL OF THE STATUS OF FEDERAL WATER RESOURCES RESEARCH MADE BY THE FEDERAL COUNCIL FOR SCIENCE AND TECHNOLOGY, COMMITTEE ON WATER RESOURCES RESEARCH (5), CRITICIZED FEDERAL SUPPORT OF SUCH A LARGE NUMBER OF CONVENTIONAL EXPERIMENTAL WATERSHEDS AND SUGGESTED REAPPRAISAL OF GOVERNMENTAL PROGRAMS. THIS CRITICISM IS PARTIALLY JUSTIFIED IN THAT MANY PROJECTS HAVE COMPLETED THEIR USEFULNESS AND SHOULD BE SUSPENDED. CHARACTERISTICALLY, PAST WATERSHED RESEARCH HAS TREATED THE PROBLEM OF WATER QUALITY AS A SECONDARY OBJECTIVE. ASIDE FROM ROUTINE SAMPLING FOR SUSPENDED SEDIMENT WITH WHICH TO MEASURE SOIL LOSS, WATER QUALITY HAS BEEN CHARACTERIZED BY PH, TOTAL HARDNESS, ALKALINITY, AND CONDUCTIVITY. IN ADDITION TO THE GROSSNESS OF SUCH TESTS, THE SAMPLING PROCEDURES AND EQUIPMENT WERE

OFTEN INADEQUATE TO ACCURATELY DESCRIBE WATER QUALITY IN SUFFICIENT DETAIL TO SERVE ANYTHING BUT GENERAL CHARACTERIZATION. THERE IS ALSO A LACK OF COORDINATION AMONG THE VARIOUS INTERESTED AGENCIES.

THE COMMITTEE DID RECOGNIZE, HOWEVER, THE IMPORTANT ROLE THAT EXPERIMENTAL WATERSHEDS CAN PLAY IN TOTAL WATER RESOURCES RESEARCH. THERE IS NOW A NEED FOR DETAILED INFORMATION ON FACTORS OF WATER QUALITY RELATED TO MOVEMENT OF AGRICULTURAL CHEMICALS, EFFECTS OF NEWLY DEVELOPING LAND-USE PATTERNS, AND MATHEMATICAL MODELING OF THE HYDROLOGIC-WATER QUALITY CYCLE AND STREAM FLOW--ALL OF THESE PROBLEMS CAN BE ATTACKED THROUGH PROPERLY INSTRUMENTED, WELL-CONDUCTED, SMALL WATERSHED STUDIES.

WATER QUALITY AND POLLUTION

NATURALLY OCCURRING WATER IN NORMAL STREAMS AND IMPOUNDMENTS IS A DILUTE SOLUTION OF BOTH ORGANIC AND INORGANIC SUBSTANCES WHICH CONTAINS A COLLOIDAL SUSPENSION OF SEDIMENTS, ORGANIC DEBRIS, AND BIOLOGICAL ORGANISMS. CONCENTRATION OF THESE COMPONENTS DETERMINES THE QUALITY OF THE WATER. THE TERM WATER QUALITY , HOWEVER, IS AN ELUSIVE, AMBIGUOUS ONE, MEANING DIFFERENT THINGS TO DIFFERENT PEOPLE. IT IS USER ORIENTED, DEPENDING ON THE PARTICULAR CHARACTERISTICS REQUIRED FOR A SPECIFIC APPLICATION. VARYING DEGREES OF TOLERANCE ARE SPECIFIC FOR EACH USE WHETHER THE WATER BE FOR MUNICIPAL, AGRICULTURAL, INDUSTRIAL, OR RECREATIONAL PURPOSES.

POLLUTION IS AN INEVITABLE RESULT OF OUR TECHNOLOGICAL SOCIETY AND HIGH STANDARD OF LIVING, AND POLLUTION POTENTIAL WILL CONTINUALLY TEND TO INCREASE RATHER THAN DECREASE. THE MAGNITUDE OF THE CURRENT WATER

POLLUTION PROBLEM IS WELL DOCUMENTED IN THE LITERATURE AND HAS BEEN SUMMARIZED BY THE PRESIDENT'S SCIENCE ADVISORY COMMITTEE (6). POLLUTION ABATEMENT IS RECEIVING INCREASED NATIONAL ATTENTION AND THE PUBLIC IS BECOMING MORE AWARE OF THE SERIOUSNESS OF THE PROBLEM.

THE EFFECTS OF POLLUTION ARE SOMETIMES SPECTACULAR -- MORE OFTEN THEY ARE HIDDEN FROM CASUAL OBSERVATION. THE EFFECT OF POLLUTION ON STREAM ECOLOGY CAN BE VERY SUBTLE AND MAY DAMAGE ONLY A SINGLE ORGANISM OR GROUP OF ORGANISMS IN A FOOD CHAIN, BUT BY ELIMINATION OF THIS ONE LINK THE ENTIRE CHAIN MAY BREAKDOWN OR BE SEVERELY ALTERED. ON THE OTHER HAND, POLLUTION CAN CAUSE EXPANSION OF CERTAIN COMPONENTS OF THE ECOSYSTEM AT THE EXPENSE OF OTHERS. EUTROPHICATION CAUSED BY ENRICHMENT OF NATURAL WATERS BY AGRICULTURAL FERTILIZERS OR SEWAGE EFFLUENT IS AN EXAMPLE OF THIS KIND OF DAMAGE. SEVERE ALGAL BLOOMS RESULTING FROM SUCH EUTROPHICATION HAVE VIRTUALLY CHOKED SOME IMPOUNDMENTS CAUSING SERIOUS DISRUPTION OF THE ECOLOGICAL STRUCTURE AND IMPAIRING THE WATER QUALITY FOR HUMAN USE.

WE MUST KNOW MORE ABOUT THE DELICATE BALANCE OF THE ECOSYSTEM AND THE IMBALANCE CAUSED BY POLLUTION. IT MUST BE DECIDED JUST HOW MUCH POLLUTION WE CAN TOLERATE WITHIN AN ECOSYSTEM WITHOUT CAUSING SERIOUS CONSEQUENCES. THESE POLLUTION THRESHOLD VALUES ARE PARTICULARLY IMPORTANT SINCE IT IS APPARENT THAT WE WILL CONTINUE TO LIVE WITH SOME DEGREE OF POLLUTION. WE MUST ALSO ESTABLISH THE INTERACTION OF LAND AND WATER IN RESPONSE TO POLLUTANTS BECAUSE THEY ARE INSEPARABLE, AND THE LANDSCAPE OFTEN ACTS AS THE INTERMEDIARY BETWEEN MAN-CAUSED POLLUTION AND THE WATER.

WALKER BRANCH WATERSHED PROJECT

THIS PROJECT IS DESIGNED TO EVALUATE THE IMPACT OF MAN'S USE OR MISUSE OF THE LANDSCAPE UPON WATER QUALITY AND BIOTIC PRODUCTIVITY OF THE WATER WHICH FLOWS FROM THAT LANDSCAPE. IT WILL CONTRIBUTE TO THE UNDERSTANDING OF BIOGEOCHEMICAL RELATIONSHIPS BETWEEN AQUATIC HABITATS AND THEIR WATERSHEDS.

THE PROJECT IS ORGANIZED ON THE PAIRED-WATERSHED PRINCIPLE, WHICH ALLOWS MEASUREMENT OF TREATMENT EFFECTS ON THE TREATED WATERSHED TO BE COMPARED WITH CONTROL VALUES ON THE UNTREATED WATERSHED AFTER ADJUSTMENT FOR INHERENT RESPONSE DIFFERENCES ESTABLISHED DURING A 3-TO 5- YEAR CROSS-CALIBRATION PERIOD (7). DURING THE INTERIM, IMPORTANT INFORMATION ON PRECIPITATION, STREAM FLOW, MINERAL INCOME, MINERAL LOSS, WATER MOVEMENT, VEGETATIONAL CHARACTERISTICS, SOIL CHARACTERISTICS, AND STREAM ECOLOGY IS BEING ASSEMBLED WHICH WILL BE USED TO ESTABLISH INTERWATERSHED CORRELATIONS. SUCH DATA WILL ALSO PROVIDE AN INSIGHT TO THE STABILITY AND DYNAMIC EQUILIBRIUM CONDITIONS ON RELATIVELY UNDISTURBED FORESTED WATERSHEDS OF THIS REGION.

THE WALKER BRANCH WATERSHED STUDY IS ULTIMATELY AIMED AT SYNTHESIS OF AN EMPIRICAL MODEL WHICH WILL RELATE THE RESPONSE OF NUTRIENT FLUX TO WATER MOVEMENT AND PROVIDE A MEANS OF ESTIMATING OR PREDICTING THE SUBSEQUENT EFFECT OF A MAN-CAUSED PERTURBATION ON THE SYSTEM. THE RESULTING MODEL WILL.

1. RELATE THE PRODUCTIVITY AND WATER QUALITY OF THE STREAM TO THE PRODUCTIVITY AND NUTRIENT BALANCE OF THE ADJACENT TERRESTRIAL SUBSYSTEM.

2. EQUATE THE NET LOSS OF NUTRIENT ELEMENTS TO THE RATE OF NUTRIENT CYCLING.
3. ESTABLISH THE RELATIONSHIP BETWEEN THE HYDROLOGIC CYCLE AND NUTRIENT FLUX.
4. PROVIDE BENCHMARK INFORMATION OF NATURAL TERRESTRIAL-AQUATIC ECOSYSTEMS FOR COMPARISON WITH MAN-MODIFIED SITUATIONS.
5. ENABLE THE MEASUREMENT OF ENVIRONMENTAL DEGRADATION CAUSED BY MAN'S CULTURAL PRACTICES.

TABLE I IS AN OUTLINE OF THE ORGANIZATION OF RESEARCH ACTIVITIES BY SUBSYSTEMS AND RESEARCH CATEGORY. IN GENERAL, THE TIME SEQUENCE WILL PROGRESS FROM LEFT TO RIGHT, HOWEVER, THE STAGES OF QUANTIFICATION, ANALYSIS AND MODELING WILL BECOME SOMEWHAT SEQUENTIALLY INTERMIXED.

DESCRIPTION AND LOCATION

WALKER BRANCH WATERSHED IS LOCATED ON THE AEC OAK RIDGE RESERVATION IN ANDERSON COUNTY, TENNESSEE, LATITUDE 35 DEG 58 MIN NORTH, LONGITUDE 84 DEG 17 MIN WEST, 2.6 MILES EAST OF OAK RIDGE NATIONAL LABORATORY (X-10) AND 0.5 MILE NORTH OF BETHEL VALLEY ROAD (FIG. 2). WALKER BRANCH DRAINS INTO AN EMBAYMENT OF TVA'S MELTON HILL RESERVOIR WHICH IS FORMED BY THE IMPOUNDMENT OF THE CLINCH RIVER. THE OUTLET OF WALKER BRANCH IS 33 MILES ABOVE THE CONFLUENCE OF THE CLINCH AND TENNESSEE RIVERS.

THE WATERSHED OCCUPIES A TOTAL OF 241 ACRES (97.5 HA), CONSISTING OF TWO SUBWATERSHEDS--THE WEST FORK BEING 95 ACRES (38.4 HA) AND THE EAST FORK 146 ACRES (59.1 HA). THE CATCHMENT BASIN IS BOUNDED ON THE NORTH BY CHESTNUT RIDGE WHICH REACHES AN ELEVATION OF 1,150 FT AND SLOPES RAPIDLY SOUTHWARD TO AN ELEVATION OF 870 FT IN THE VALLEY AT THE

Table 1. Organization of Research Activities--Walker Branch Watershed Project

Subsystem	Establishment	Characterization	Quantification	Analysis	Modeling
Aquatic	1. Water Sampler Design and Construction 2. Stream Channel Survey	1. Species Lists: A. Flora B. Fauna 2. Preliminary Water Quality Analyses	1. Population Surveys 2. Stream Input: A. Organic Debris B. Inorganic Material 3. Stream Output: A. Organic Debris B. Suspended Inorganics C. Dissolved Organics D. Dissolved Inorganics 4. Productivity Estimates 5. Chemical Cycling	1. Establish: A. Relationships Among Compartments B. Transfer Functions 2. Relate Material Movement to Stream Flow	1. Develop: A. Subsystem Models B. Coupling Functions Between Subsystems C. Simulation Techniques
Terrestrial	1. Reference Grid System 2. Base Map Construction 3. Aerial Photos	1. Mapping: A. Topography B. Vegetation C. Soils 2. Description: A. Species Associations B. Soils	1. Sample Plot Inventory: A. Species-Size-Frequency B. Standing Crop Biomass C. Chemical Content of Flora 2. Forest Floor Litter: A. Annual Quantity B. Rate of Decomposition C. Chemical Contribution 3. Chemical Cycling 4. Soil: A. Exchange Properties B. Moisture Movement C. Chemical Concentration of Soil Solution	1. Establish: A. Differences Among Vegetational and Soil Strata B. Relationships Among Compartments C. Time Lags D. Transfer Functions E. Integrate to Watershed Basis	
Hydrologic	1. Weir Design and Construction 2. Precipitation Gage Net 3. Rainfall and Dry Fallout Collection Apparatus 4. Parshall Flumes on Springs	1. Data Reduction: A. Organization B. Bookkeeping C. Routine Reporting D. Graphic Output	1. Data Accumulation: A. Observe Trends B. Develop Analytical Techniques 2. Aerial Chemical Input: A. Rainout B. Dry Fallout	1. Establish: A. Precipitation-Stream Flow Relationships B. Correlations Between Watersheds C. Time Lag and Flow Periodicity	

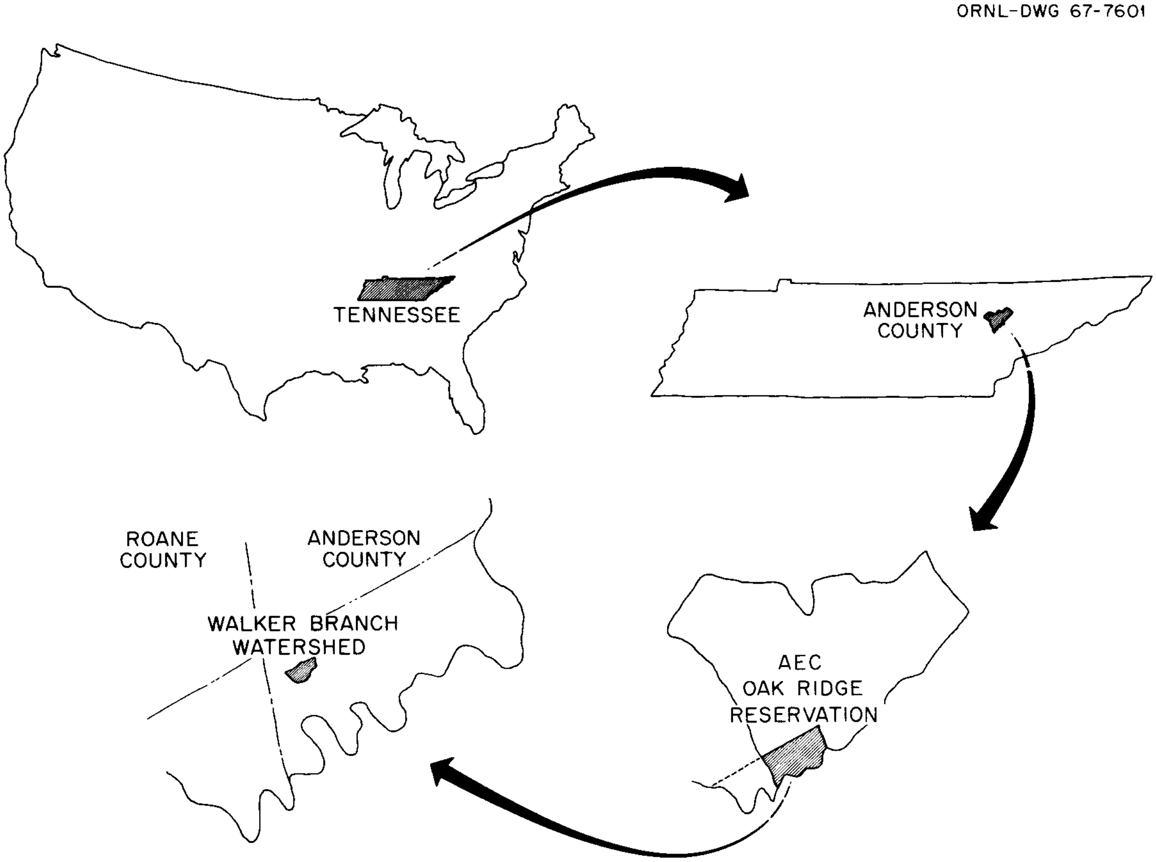

Fig. 2. Location of Walker Branch Watershed Project

CONFLUENCE OF THE TWO FORKS. THE WATERSHED IS ALMOST COMPLETELY ENCIRCLED BY A TERTIARY ROAD SYSTEM WHICH PROVIDES EASY ACCESS TO THE PERIMETER AND CENTER RIDGE DIVIDING THE SUBWATERSHEDS.

THE WATERSHED IS UNDERLAYEN BY KNOX DOLOMITE, A SILICEOUS, MEDIUM TO LIGHT GRAY, DENSE TO COARSELY CRYSTALLINE DOLOMITE ROCK OF THE LATE CAMBRIAN TO EARLY ORDOVICIAN AGE (8). WITHIN THE UPPER 400 FT (122 M) JASPER CHERT IS FOUND IN ABUNDANCE. THE BEDROCK DIPS TO THE SOUTHEAST AT A 35-DEGREE ANGLE AND OUTCROPS OCCASIONALLY ON THE STEEPER NORTHWEST SLOPES OF THE WATERSHED.

SOILS FORMED OVER THE DOLOMITIC SUBSTRATE ARE PREDOMINATELY TYPIC PALEUDULTS. THESE SOILS ARE WELL-DRAINED AND HAVE A HIGH INFILTRATION CAPACITY WHICH SERVES AS A RESERVOIR OF GROUND WATER WHICH FEEDS SPRINGS AT THE VALLEY FLOOR.

THE OVERSTORY VEGETATION IS PREDOMINATELY AN OAK-HICKORY ASSOCIATION WITH LESSER AMOUNTS OF PINE-OAK-HICKORY AND PURE PINE PRESENT. SMALL AREAS OF MIXED MESOPHYTIC VEGETATION ARE FOUND IN SHELTERED COVES AND STREAM VALLEYS. PRIOR TO 1942, 44% OF THE AREA WITHIN THE WEST SUBWATERSHED WAS CLEARED FOR AGRICULTURE (PRIMARILY PASTURE) WHILE ONLY 13% WAS CLEARED ON THE EAST SUBWATERSHED. SINCE ACQUISITION OF THE OAK RIDGE RESERVATION IN 1942, THE AREA HAS BEEN VIRTUALLY UNDISTRUBED AND NATURAL PLANT SUCCESSION HAS RESTORED THESE AREAS TO A WELL-STOCKED FORESTED CONDITION.

THE CLIMATE OF OAK RIDGE IS TYPICAL OF THE HUMID SOUTHERN APPALACHIAN REGION. MEAN ANNUAL RAINFALL IS APPROXIMATELY 54.7 IN. (139 CM) AND MEAN MEDIAN TEMPERATURE IS 58.2 °F (14.5 °C) (9). PRECIPITATION IS PREDOMINATELY IN THE FORM OF RAINFALL ALTHOUGH UNDER UNUSUAL

CONDITIONS SNOWFALL CAN REPRESENT A SIGNIFICANT PORTION OF THE TOTAL WINTER INCOME, SUCH AS IT DID IN THE WINTER OF 1959-1960 WHEN 41.4 IN. (105.2 CM) OF SNOW FELL (10). STORM TRACKS APPEAR TO TRAVEL NORTHWEST TO SOUTHEAST. THE PRECIPITATION PATTERN DURING THE YEAR IS CHARACTERIZED BY WET WINTERS, COMPARATIVELY DRY SPRINGS FOLLOWED BY A RELATIVELY WET SUMMER AND DRY AUTUMN. JULY RAINFALL (5.95 IN.) NORMALLY APPROACHES THAT OF THE WET WINTER MONTHS, WHILE JUNE (3.24 IN.) IS ALMOST AS DRY AS THE AUTUMN (FIG. 3). JULY IS GENERALLY THE HOTTEST MONTH (77.2 °F) WHILE JANUARY IS THE COLDEST (39.9 °F).

FIGURE 4 IS A GENERALIZED PICTURE OF THE WATER BALANCE OF THE AREA ACCORDING TO THORNTHWAITE S CLIMATIC CLASSIFICATION (11). THE STRIKING FEATURE OF THE OAK RIDGE CLIMATE, AS FAR AS PLANT GROWTH IS CONCERNED, IS THE DEVELOPMENT OF COMPARATIVELY EARLY MOISTURE DEFICITS IN THE SPRING. HOWEVER, JULY AND AUGUST RAINFALL NORMALLY PREVENTS THE DEVELOPMENT OF SEVERE SUMMER DEFICITS WHICH OFTEN OCCUR IN OTHER AREAS OF THE SOUTHERN UNITED STATES. ADDITIONAL CLIMATOLOGICAL DATA ARE INCLUDED IN APPENDIX A.

FACILITIES AND INSTRUMENTATION

THE FACILITIES AND EQUIPMENT ARE DESIGNED TO PROVIDE COMPREHENSIVE DATA ON THE FLOW PATTERN AND QUANTITY OF NUTRIENTS, ORGANIC MATERIAL, AND WATER WHICH ENTERS AND LEAVES THE ECOSYSTEM. THERE ARE THREE CATAGORIES OF INSTRUMENTATION.

1. HYDROLOGICAL MONITORING EQUIPMENT.
2. ENVIRONMENTAL MONITORING EQUIPMENT.
3. FIELD LABORATORY AND SAMPLE PROCESSING FACILITIES.

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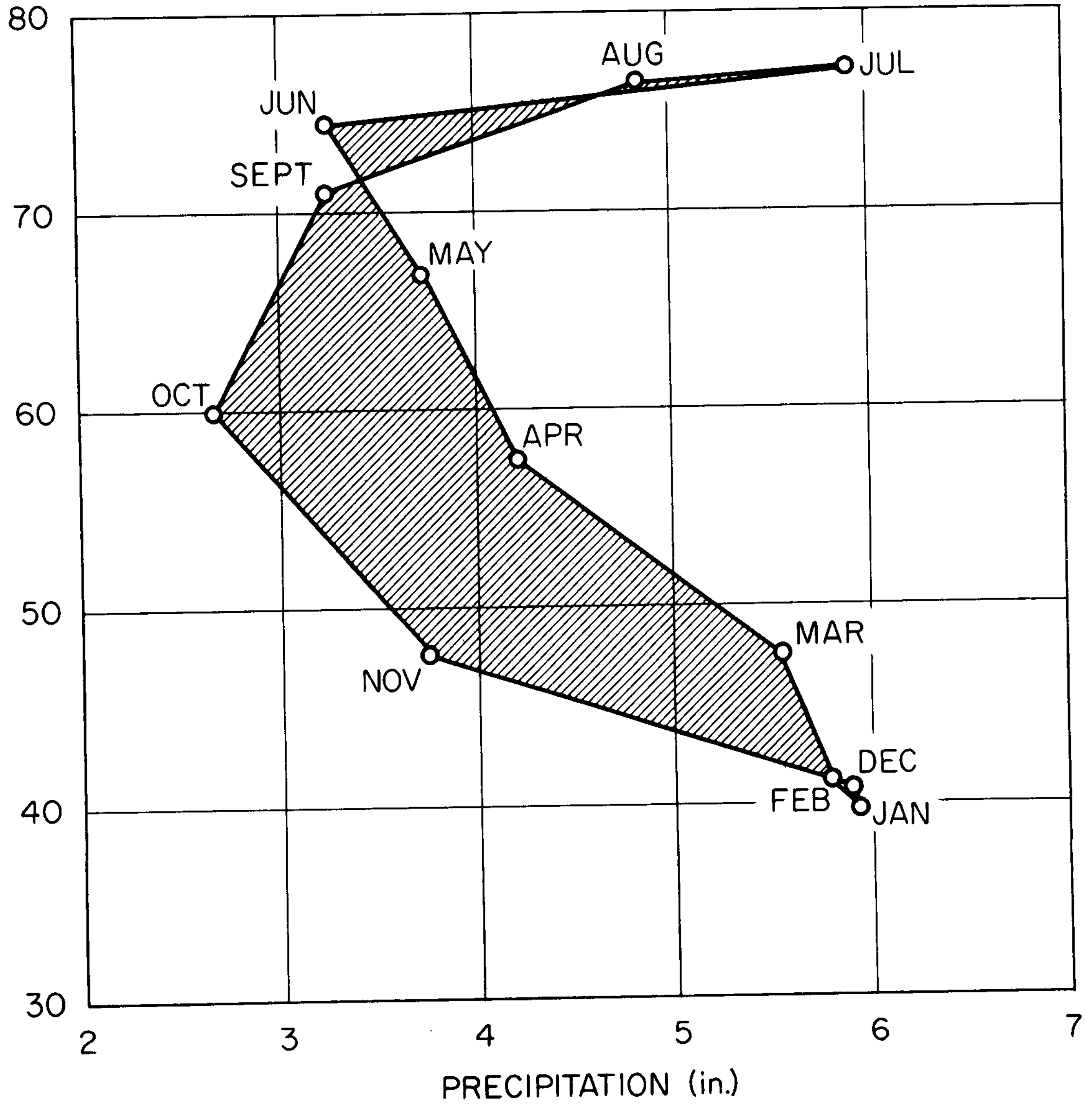

Fig. 3. Climograph of the Oak Ridge Area

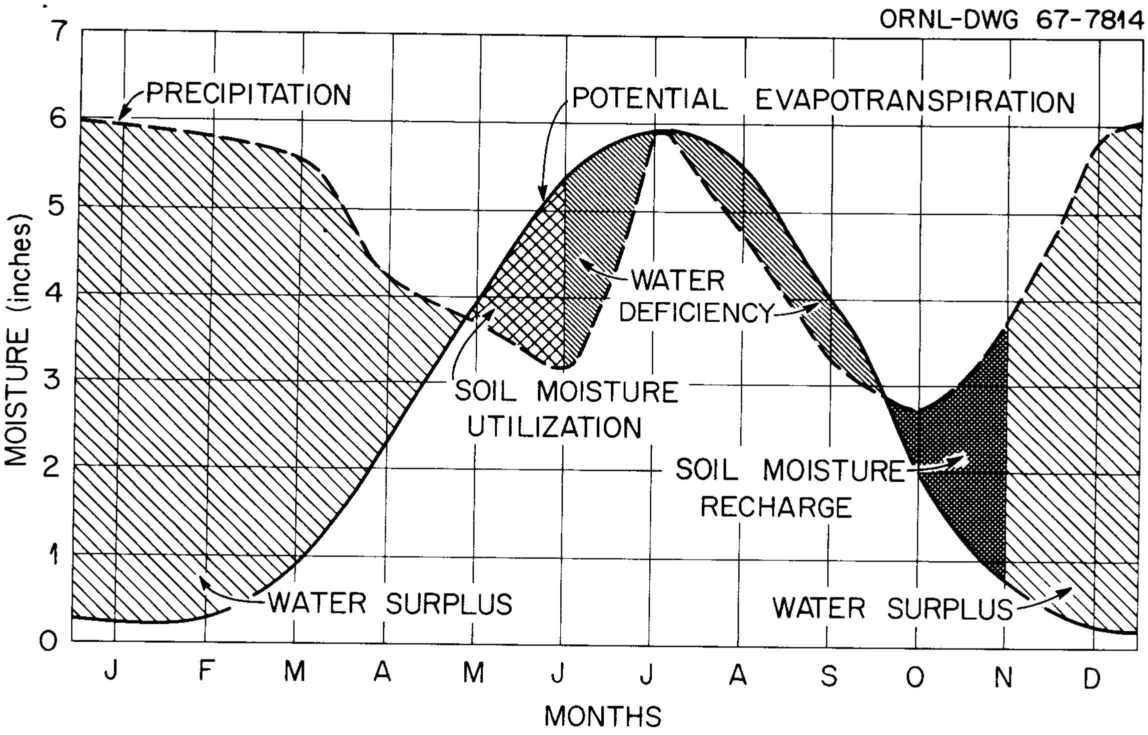

Fig. 4. Annual Water Balance of the Oak Ridge, Tennessee, Area, Assuming a Soil Moisture Storage Capacity of 12 In.

FIGURE 5 SHOWS THE LOCATION OF THE MONITORING EQUIPMENT SUPERIMPOSED ON A PHOTOMAP OF THE WATERSHED. BUILDING 0907, ONE-QUARTER MILE TO THE SOUTHWEST OF THE WATERSHED, SERVES AS AN EASILY ACCESSIBLE FIELD LABORATORY FOR SAMPLE PROCESSING AND OFFICE USE.

WEIRS

DESIGN AND CONSTRUCTION DETAILS -- THE STREAM GAGING STATIONS LOCATED ABOVE THE CONFLUENCE OF THE TWO FORKS OF WALKER BRANCH CONSIST OF 120-DEGREE V-NOTCH WEIRS CONSTRUCTED ACCORDING TO DESIGN CRITERIA OF HERTZLER (12).

DETAILED CONSTRUCTION DRAWINGS ARE SHOWN IN APPENDIX B. DUE TO BEDROCK CONDITIONS THE CUTOFF WALL ON THE WEST FORK WEIR WAS MOVED TO THE UPSTREAM END OF THE STILLING BASIN (DWG. 003, APPENDIX B) WHICH WAS THEN MADE INTO A WATERTIGHT BOX. GEOMETRY OF THE TWO STRUCTURES WAS UNCHANGED AND SHOULD THEREFORE GIVE COMPARABLE RESULTS.

THE 2.5 FT-DEEP V-NOTCH IS CAPABLE OF MEASURING MAXIMUM FLOWS OF 41.6 CFS (1.18 M/S). A SHARP-CRESTED RECTANGULAR SECTION ABOVE THE V-NOTCH EXTENDS THE UPPER FLOW LIMIT TO 65.7 CFS (1.86 M/S) WITH SLIGHTLY LESS ACCURACY. FLOW WILL SELDOM EXCEED 24 CFS (0.68 M/S) SO THE ACCURACY OF NORMAL STREAM FLOW MEASUREMENTS IS QUITE HIGH EVEN DOWN TO LOW FLOWS OF LESS THAN 0.001 CFS.

STAGED DRAINS SPACED 12 IN. APART ON THE WEIR FACE PERMIT INCREMENTAL DRAWDOWN, WHILE SAMPLING AND SEPARATION OF MACRO-SOLIDS CAN BE MADE WITH MESHED BAGS FASTENED TO EACH DRAIN OUTLET. BYPASS DRAINS

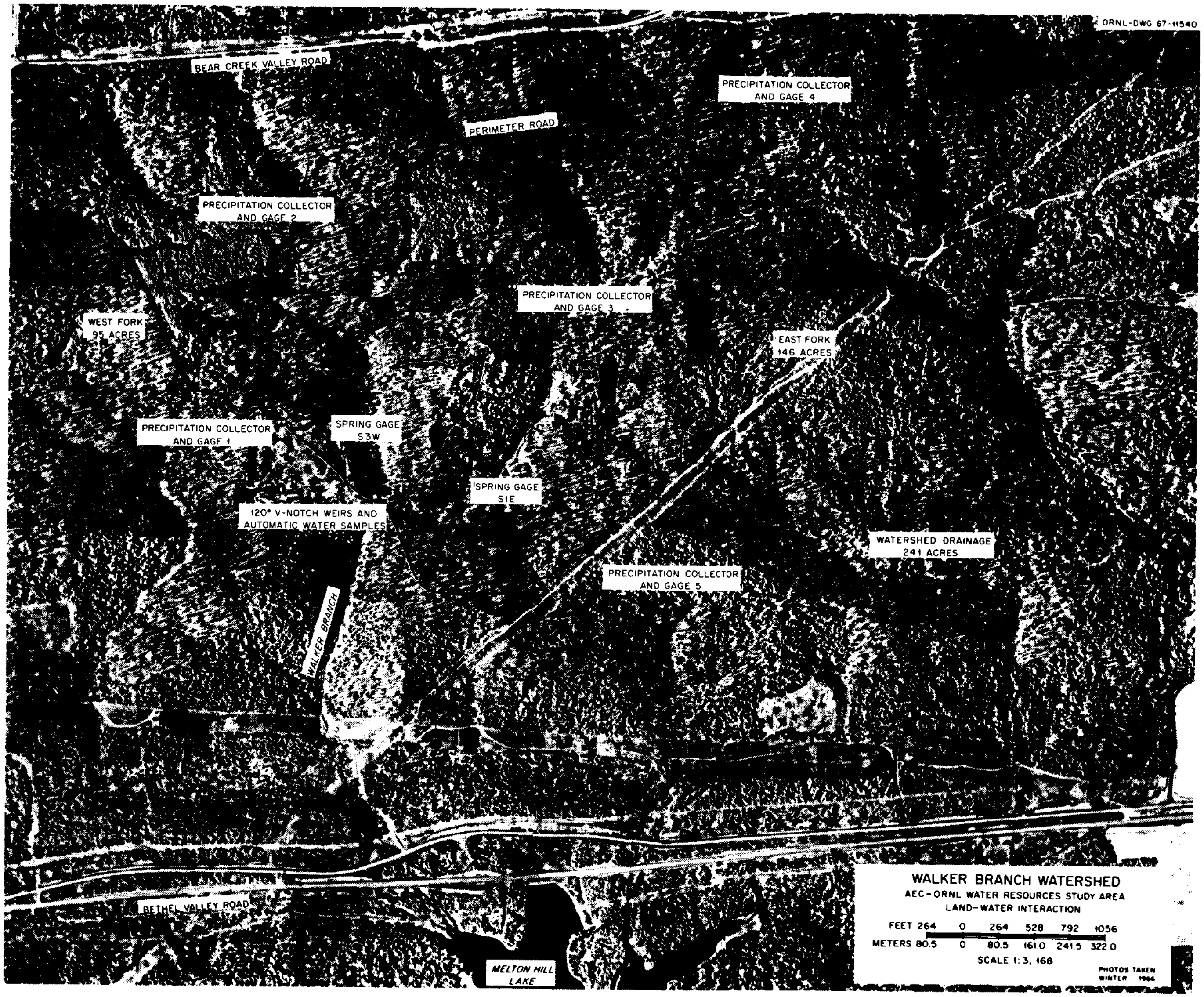

Fig. 5. Photomap of Walker Branch Watershed Showing Monitoring Equipment and Facilities.

AROUND THE STILLING BASIN PROVIDE FOR CLEANING AND REMOVAL OF BEDLOAD AND ORGANIC DETRITUS COLLECTED IN THE BASIN. TRASH SCREENS WILL PROTECT THE V-NOTCH FROM CLOGGING DURING PERIODS OF LOW FLOW IN THE AUTUMN WHEN THERE IS AN ABUNDANCE OF FLOATING DEBRIS AND WATER FLOW IS INSUFFICIENT TO KEEP THE WEIR BLADE FLUSHED FREE OF LEAVES. PROVISION WILL ALSO BE MADE TO KEEP THE V-NOTCH FREE OF ICE IN THE WINTER.

STAGE HEIGHT RECORDERS -- THE WEIRS ARE EQUIPPED WITH FISCHER AND PORTER MODEL 1542 PUNCHED TAPE WATER LEVEL RECORDERS (FIG. 6) WHICH WERE MODIFIED BY THE MANUFACTURER TO GIVE A RESOLUTION OF 0.001 FT RISE OR FALL IN STAGE HEIGHT. OUTPUT IS BINARY CODED AND DIGITALLY RECORDED ON 2.5-IN. FOIL-BACKED PAPER TAPE. DATA ARE PUNCHED AT 5-MIN INTERVALS DETERMINED BY A CRYSTAL OSCILLATOR WHOSE FREQUENCY IS REGULATED BY CASCADE FLIP-FLOPS.

THE DATA RECORDING SYSTEM IS OPERATED BY A 6-VDC WET CELL STORAGE BATTERY WHICH IS CONSTANTLY CHARGED BY A TRICKLE CHARGER CONNECTED TO 110-VAC LINE CURRENT. THIS POWER SYSTEM COMBINES THE MAINTENANCE-FREE OPERATION OF LINE CURRENT WITH THE DEPENDABILITY OF STORAGE BATTERIES. IN THE CASE OF POWER FAILURE THE BATTERY OVERIDE ASSURES RECORD CONTINUITY.

CORRESPONDENCE BETWEEN THE WATER LEVEL RECORDERS AND THE ACTUAL WATER LEVEL ABOVE THE APEX OF THE V-NOTCH, IS REFERENCED BY A PRECISE HOOK GAGE PERMANANENTLY MOUNTED IN THE STILLING BASIN (DWG. 008,

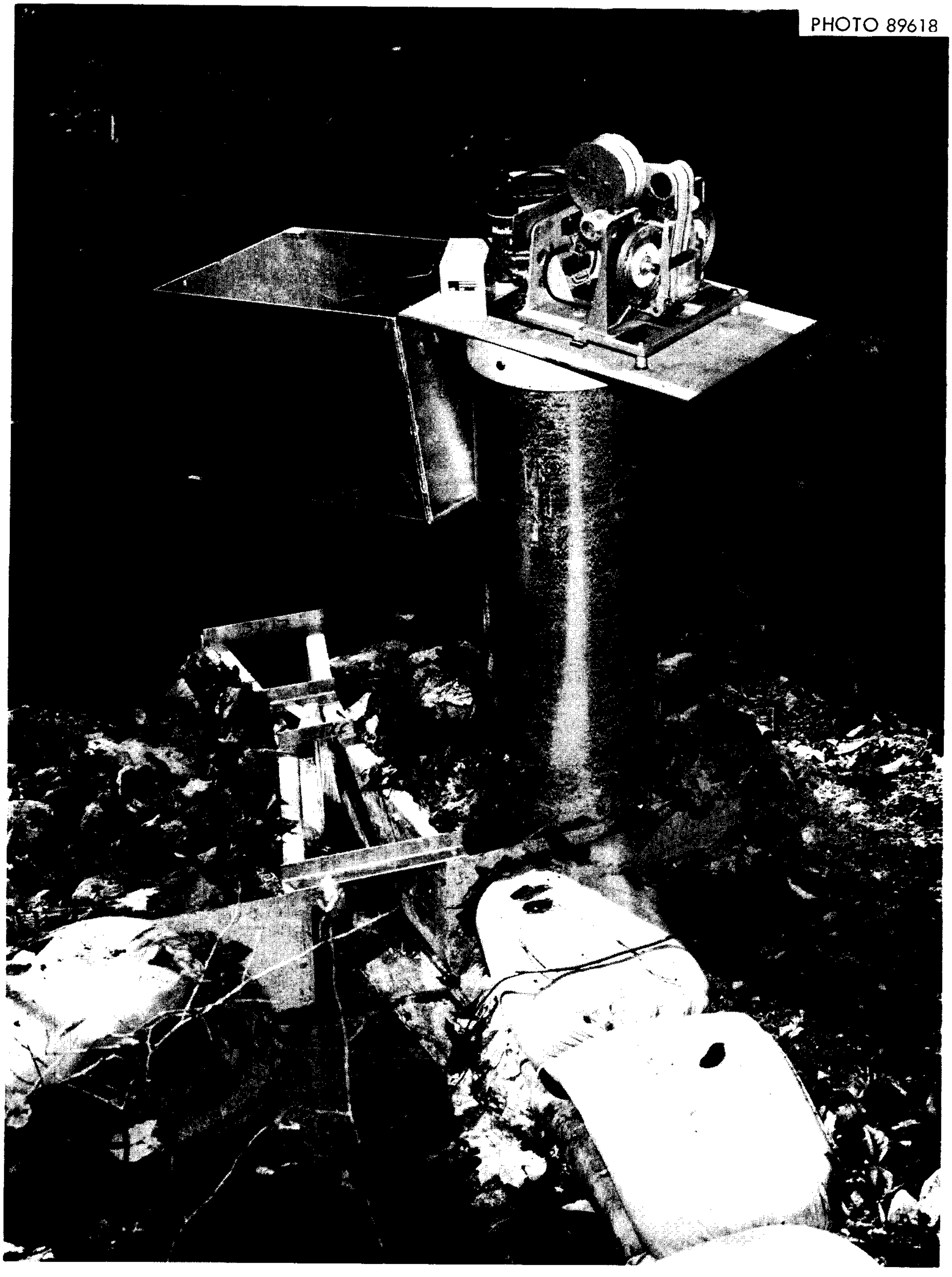

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Fig. 6. Water Level Recorders Installed at Spring Gage

APPENDIX B).

SPRING GAGING

THE PRIMARY SPRINGS WHICH FEED EACH FORK OF WALKER BRANCH ARE EQUIPED WITH PARSHALL FLUMES AND FISCHER AND PORTER MODEL 1542 PUNCHED TAPE WATER LEVEL RECORDERS SIMILAR TO THOSE AT THE WEIR SITES.

ON THE WEST FORK, SPRING S3W (APPENDIX D.) IS INSTRUMENTED WITH A 6-IN. FLUME CAPABLE OF MEASURING FLOWS UP TO APPROXIMATELY 1 CFS. SPRING S1E ON THE EAST FORK IS SIMILARLY EQUIPED WITH A 3-IN. FLUME OF APPROXIMATELY 0.5 CFS CAPACITY. THESE SPRINGS ARE THE SOURCE OF A HIGH PROPORTION OF BASE FLOW FROM EACH OF THE SUBWATERSHEDS. SMALLER SPRINGS ON EACH OF THE FORKS ALSO CONTRIBUTE A LESSER PROPORTION OF BASE FLOW BUT ARE TOO SMALL TO GAGE WITH EQUIPMENT AVAILABLE.

PORTABLE, CONTINUOUS-FLOW WATER SAMPLERS WILL BE INSTALLED AT THE PARSHALL FLUMES PERIODICALLY DURING PERIODS OF INTEREST IN ORDER TO CHARACTERIZE THE QUALITY OF GROUND WATER AS IT APPEARS AT THE SURFACE.

CONTINUOUS WATER SAMPLERS

AUTOMATIC WATER SAMPLERS AT EACH WEIR COLLECT A SAMPLE PROPORTIONAL TO STREAM FLOW (FIG. 7). A SIGNAL PROVIDED BY LOW-TORQUE POTENTIOMETERS LINKED TO THE FISCHER AND PORTER WATER LEVEL RECORDER REGULATES SAMPLING.

A UNIQUE FEATURE OF THE SAMPLING SYSTEM IS THE PROVISION FOR A FAST SAMPLING MODE WHICH FRACTIONATES THE SAMPLE OVER TIME (FIG. 8). UNDER NORMALLY STABLE FLOW CONDITIONS THE WATER SAMPLE IS COMPOSITED IN

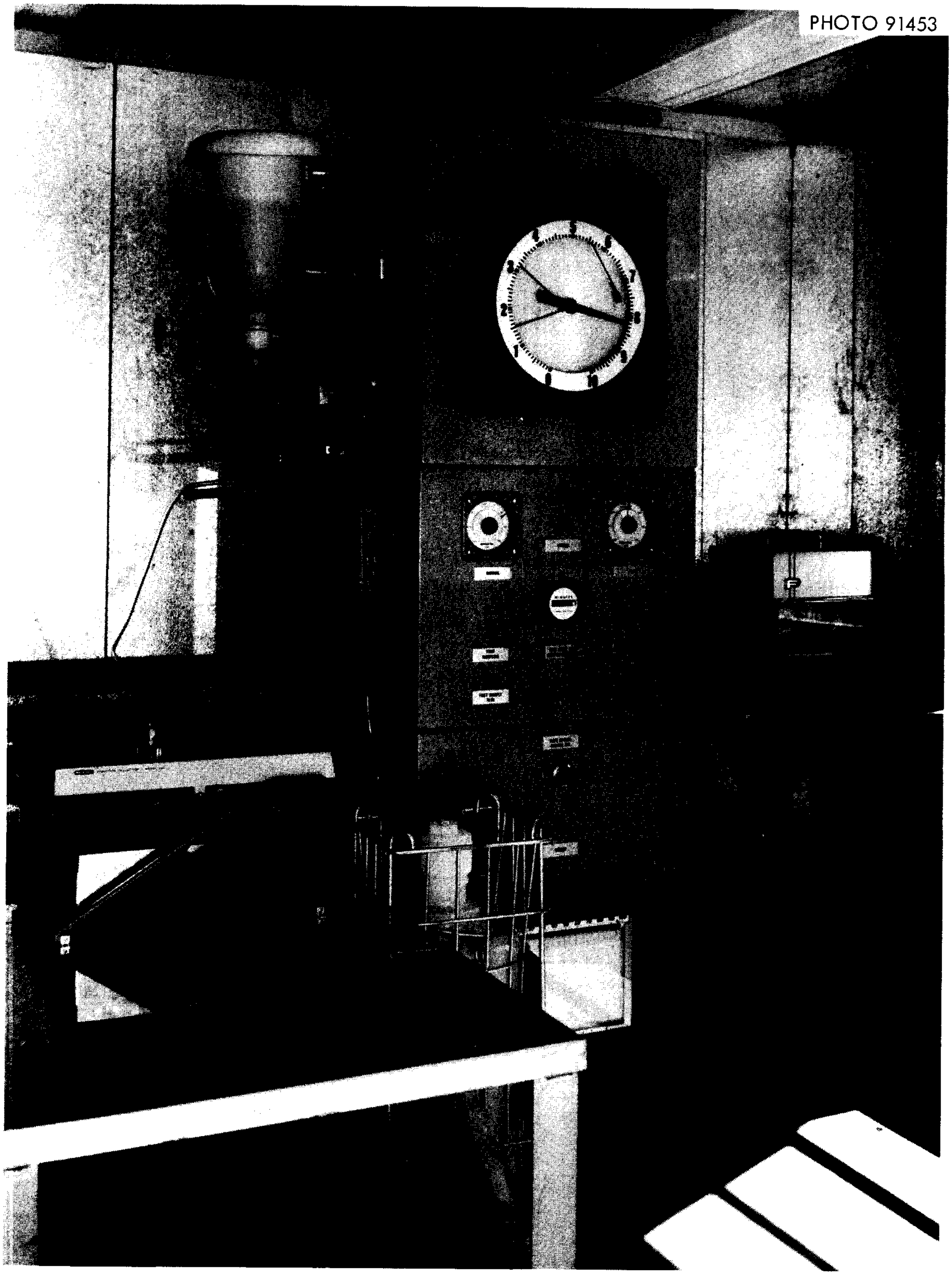

Fig. 7. Automatic Water Sampler and Fraction Collector

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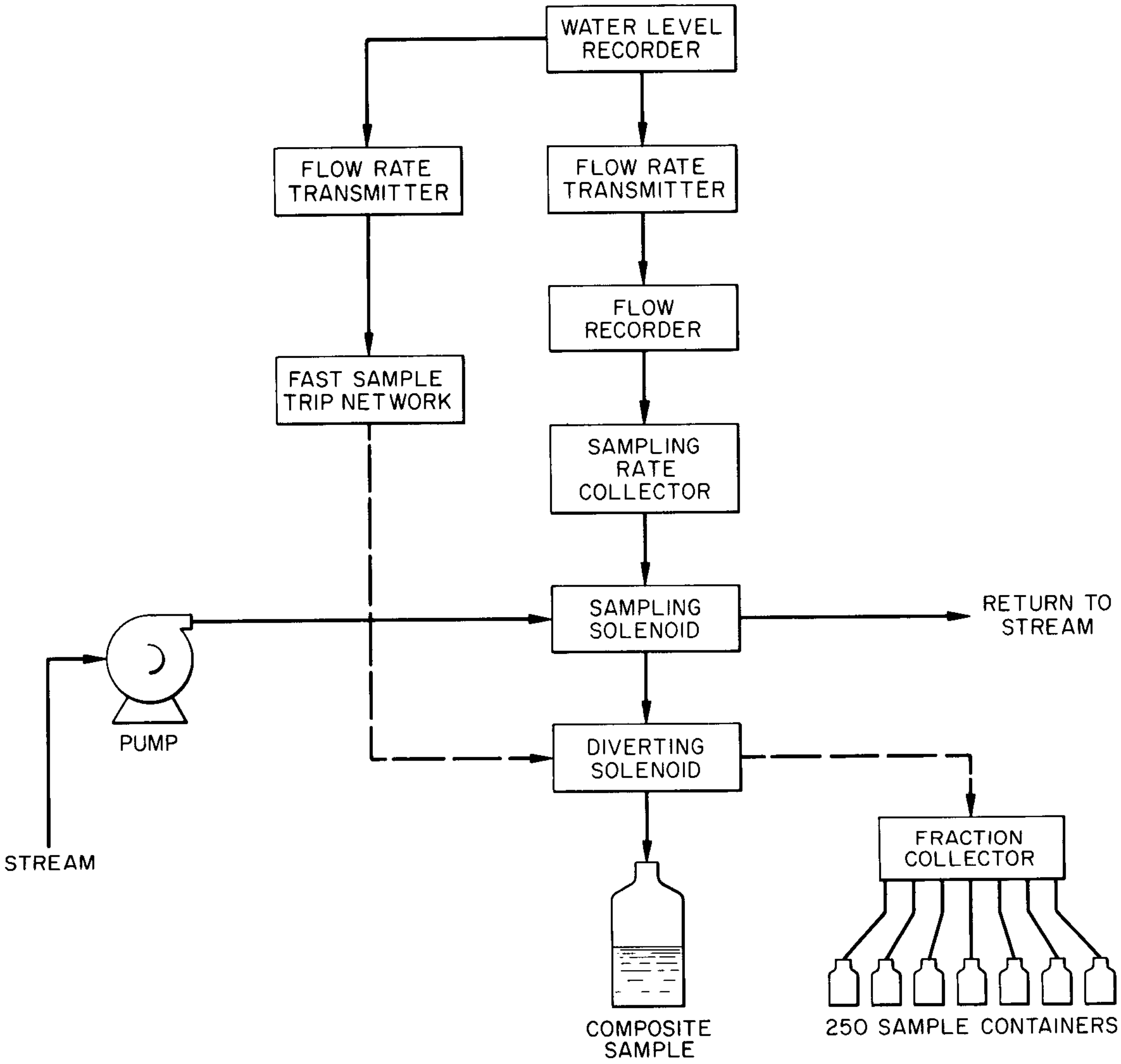

Fig. 8. Schematic Diagram of the Water Sampling System

27-LITER POLYETHLENE BOTTLES, UPON SENSING AN INCREASE IN STREAM FLOW WHICH EXCEEDS A PRESET DIFFERENTIAL THRESHOLD, A FAST-SAMPLE MODE IS ACTIVATED WHICH FRACTIONATES THE SAMPLE OVER THE DURATION OF THE STORM HYDROGRAPH. THE FAST-SAMPLE MODE IS ENERGIZED FROM A SIGNAL ORIGINATING IN AN OPERATIONAL AMPLIFIER CIRCUIT WHOSE SENSITIVITY IS REGULATED WITH A HELIPOT ADJUSTABLE BETWEEN 5% RISE/MIN AND 50% RISE/MIN. DURATION OF THE FAST SAMPLING PERIOD IS REGULATED BY AN INTERVALOMETER ADJUSTABLE FOR SAMPLE INTERVALS BETWEEN 15 SEC AND 100 MIN. THE QUANTITY OF WATER COLLECTED IN EACH FRACTIONATED SAMPLE AND THE TIMING OF COLLECTION BETWEEN SAMPLE INTERVALS IS ALSO ADJUSTABLE. A MAXIMUM OF 250 SAMPLES OF 250 ML EACH MAY BE COLLECTED, THUS, STORM FLOWS OF 1 HR TO 16 DAYS CAN BE SAMPLED CONTINUOUSLY. AFTER THE LAST FRACTIONATED SAMPLE IS COLLECTED THE SAMPLER AUTOMATICALLY RETURNS TO THE NORMAL COMPOSITE SAMPLING MODE.

WATER TEMPERATURE IS CONTINUALLY RECORDED WITH AN ANALOG MULTIPOINT STRIP-CHART RECORDER. RESISTANCE BULB SENSING PROBES ARE LOCATED NEAR THE WATER SAMPLE INTAKE IN EACH STILLING BASIN AND ARE SIMULTANEOUSLY RECORDED ALONG WITH AIR TEMPERATURE ON A SINGLE STRIP CHART. THE WATER TEMPERATURE PROBES ARE SENSITIVE TO 0.5 °F WITHIN A RANGE OF +20 °F TO +80 °F. AIR TEMPERATURE IS RECORDED WITH A SENSITIVITY OF 1.5 °F BETWEEN -20 °F AND 130 °F.

PRECIPITATION GAGE NETWORK

FIVE AUTOMATIC FISCHER AND PORTER SERIES 1548 WEIGHING PRECITATION RECORDERS (FIG. 9) PROVIDE A CONTINUOUS RAINFALL RECORD WITHIN A TRIANGULAR NETWORK SUPERIMPOSED OVER THE WATERSHED (FIG. 5). PRECIPITATION DATA ARE PUNCHED AT 5-MIN INTERVALS ON FOIL-BACKED PAPER

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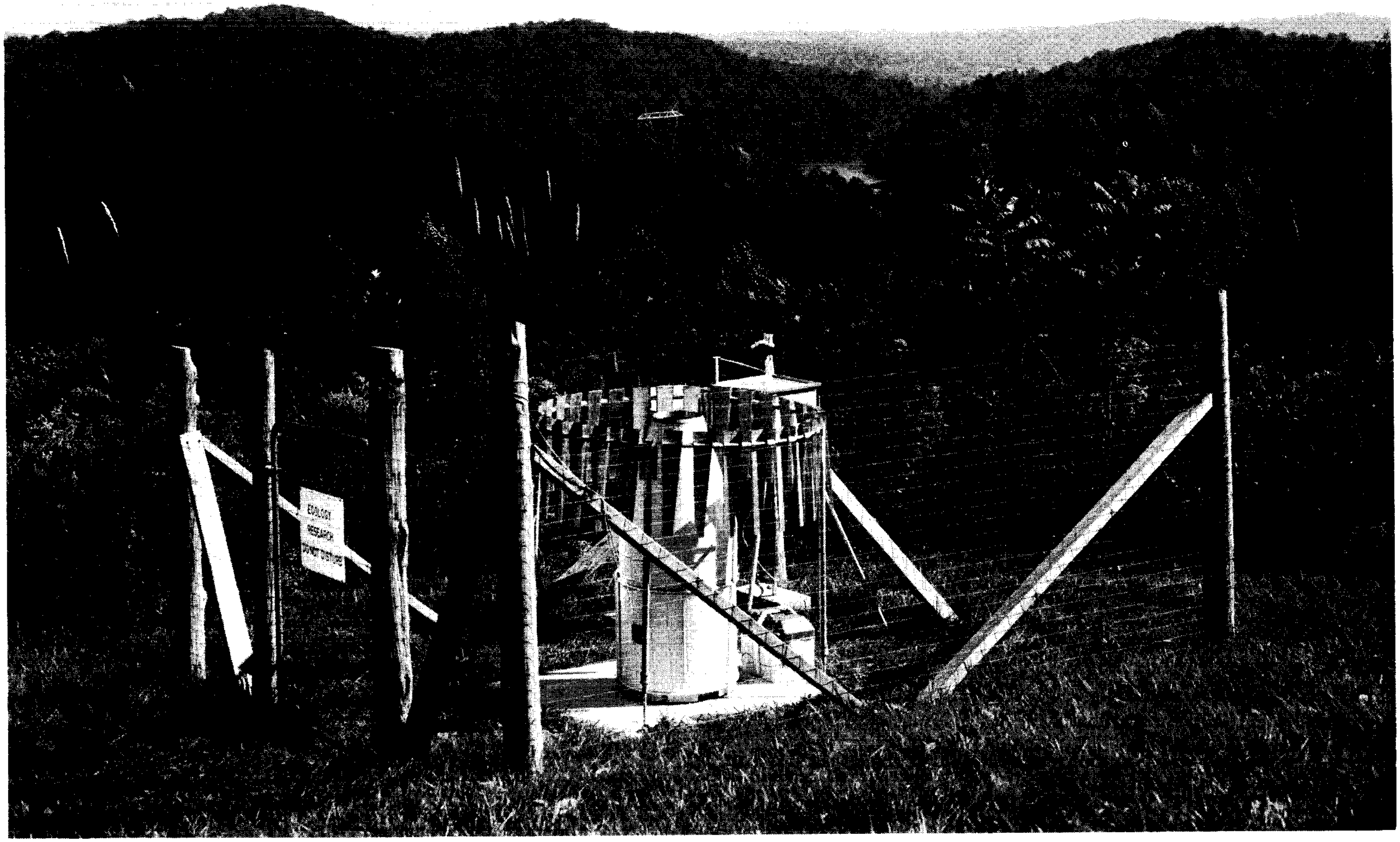

Fig. 9. Typical Precipitation Gage Installation

TAPE IDENTICAL TO THAT USED ON THE WATER LEVEL RECORDERS. CRYSTAL OSCILLATOR TIMERS ARE ALSO USED ON THE PRECIPITATION GAGES AND ARE SYNCHRONIZED WITH THE WATER LEVEL RECORDERS SO THAT THE CORRESPONDENCE BETWEEN TIMING OF PRECIPITATION AND STREAM FLOW CAN BE ESTABLISHED. THE RECORDERS HAVE BEEN CONVERTED FROM DRY CELL BATTERY OPERATION TO WET CELL BATTERY OPERATION FOR CONVENIENCE AND ECONOMY.

THE INSTRUMENTS ARE SENSITIVE TO CHANGES OF 0.025 IN. (0.635 MM) OF PRECIPITATION. MEASUREMENT ACCURACY IS PLUS OR MINUS 0.15 IN. (3.81 MM) BETWEEN 0 AND 15 IN., HOWEVER, THE ACCURACY OF THE RECORDER IS LIMITED TO THE NEAREST 0.1 IN. (2.54 MM) OF PRECIPITATION. THE 5-MIN PUNCH-OUT INTERVAL PROVIDES SUFFICIENT DATA FOR RESOLUTION OF SHORT-TERM RAINFALL INTENSITY INFORMATION AS WELL AS LONG-TERM CUMULATIVE PRECIPITATION. INTEGRATED, AREA-AVERAGED PRECIPITATION IS CALCULATED BY BOTH THIESSEN ESTIMATES FROM POLYGON AREAS SHOWN IN TABLE 2 AND A SECOND-ORDER POLYNOMIAL RESPONSE FUNCTION WHICH GENERATES AN ISOHYETAL MAP FROM THE PRECIPITATION INPUT DATA.

PRECIPITATION AND DRY FALLOUT COLLECTORS

ASSOCIATED WITH EACH PRECIPITATION GAGE IS A MODIFIED WONG RAINFALL COLLECTOR (FIG. 10) CAPABLE OF COLLECTING SAMPLES FOR ANALYSIS OF BOTH RAIN SCAVENGED CHEMICAL ELEMENTS AND DRY PARTICULATE FALLOUT. THE WONG SAMPLERS ARE SENSITIVE TO TRACE AMOUNTS OF PRECIPITATION. AS SOON AS SUFFICIENT MOISTURE HAS COLLECTED TO SHORT THE PRINTED CIRCUIT ON THE SENSING UNIT, A COVER SWINGS AWAY EXPOSING THE PRECIPITATION COLLECTING BOTTLE WHILE COVERING THE DRY FALLOUT COLLECTOR MOUNTED BEHIND. IN THIS MANNER, BOTH SOURCES OF ELEMENTAL INCOME ARE SAMPLED OUT OF PHASE WITH A SINGLE CONTROL UNIT. SAMPLERS OPERATED IN THIS FASHION PROTECT THE

Table 2. Areas Represented by the Precipitation Gages on Each Subwatershed (Thiessen Polygons)

Gage Number	West Fork (acres)	East Fork (acres)
1	34.6	4.6
2	33.2	--
3	27.2	75.8
4	--	30.6
5	--	35.0
Total	95.0	146.0

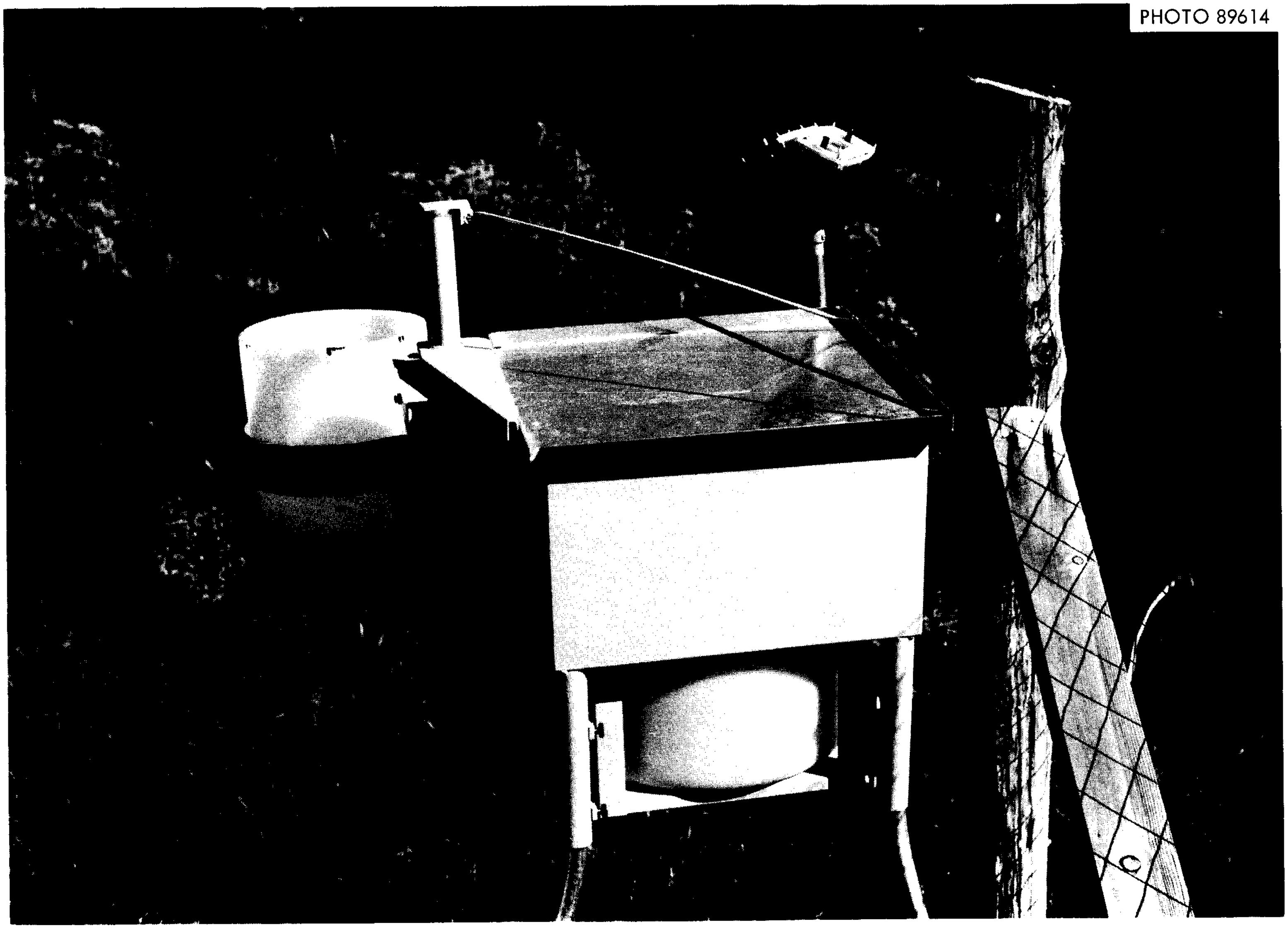

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Fig. 10. A Wong Precipitation Collector Modified to Also Collect Dry Fallout.

WATER SAMPLE FROM FOREIGN MATTER AND EVAPORATION. CHEMICAL ANALYSIS OF THE PRECIPITATION PROVIDES CONCENTRATION DATA WITH WHICH TO EXPAND THE AREA-VOLUME ESTIMATES BASED ON PRECIPITATION RECORDS. UNIT AREA ESTIMATES OF TOTAL CHEMICAL INCOME TO THE WATERSHED CAN THUS BE DEVELOPED FROM A COMBINATION OF DRY FALLOUT DATA EXPANDED FOR TOTAL AREA AND RAIN-SCAVENGED MATERIALS EXPANDED FOR AREA-VOLUME OF PRECIPITATION.

DATA HANDLING AND COMPUTER ANALYSIS

AN INTEGRATED SYSTEM OF HYDROLOGICAL ANALYSIS HAS BEEN DEVELOPED FOR PROCESSING MONTHLY PUNCHED TAPE RECORDS FROM THE FISCHER AND PORTER MONITORING EQUIPMENT. THE INITIAL TAPE-TO-CARD CONVERSION IS MADE AT THE COWEETA HYDROLOGIC LABORATORY UNDER SPECIAL AGREEMENT BETWEEN AEC AND THE U.S. FOREST SERVICE. RAW DATA CARDS ARE THEN EDITED FOR OMISSIONS AND INSTRUMENT MALFUNCTIONS AT ORNL PRIOR TO SUBSEQUENT SUMMARIZATION.

FIGURE 11 SHOWS THE FLOW OF DATA AND ANALYTICAL SUMMARIES PRODUCED BY THE COMPUTER ANALYSIS. THE INITIAL PHASE OF DATA REDUCTION PRODUCES A DECK OF HOLLERITH CARDS WITH TIME-DEPTH FIELDS FOR EACH PRECIPITATION GAGE AND PARALLEL DECKS OF TIME-HEAD READINGS FOR THE WATER LEVEL RECORDERS. THIS STEP REDUCES DATA VOLUME BY DELETING PERIODS OF ZERO PRECIPITATION OR PERIODS OF LITTLE CHANGE IN STREAM FLOW FROM THE RECORD.

SUMMARIES ARE THEN COMPILED FOR BOTH PRECIPITATION RECORDS AND STREAM FLOW DATA. THE SUMMARY TABLES INCLUDE DAILY AND WEEKLY VALUES, AREA-AVERAGED ESTIMATES OF PRECIPITATION, STORM PERIOD IDENTIFICATION, RAINFALL INTENSITY STATISTICS, AND A SAMPLE CORRELATION MATRIX FOR STORM PATTERN ANALYSIS. STREAM FLOW DATA ARE SIMILARLY SUMMARIZED TO GIVE

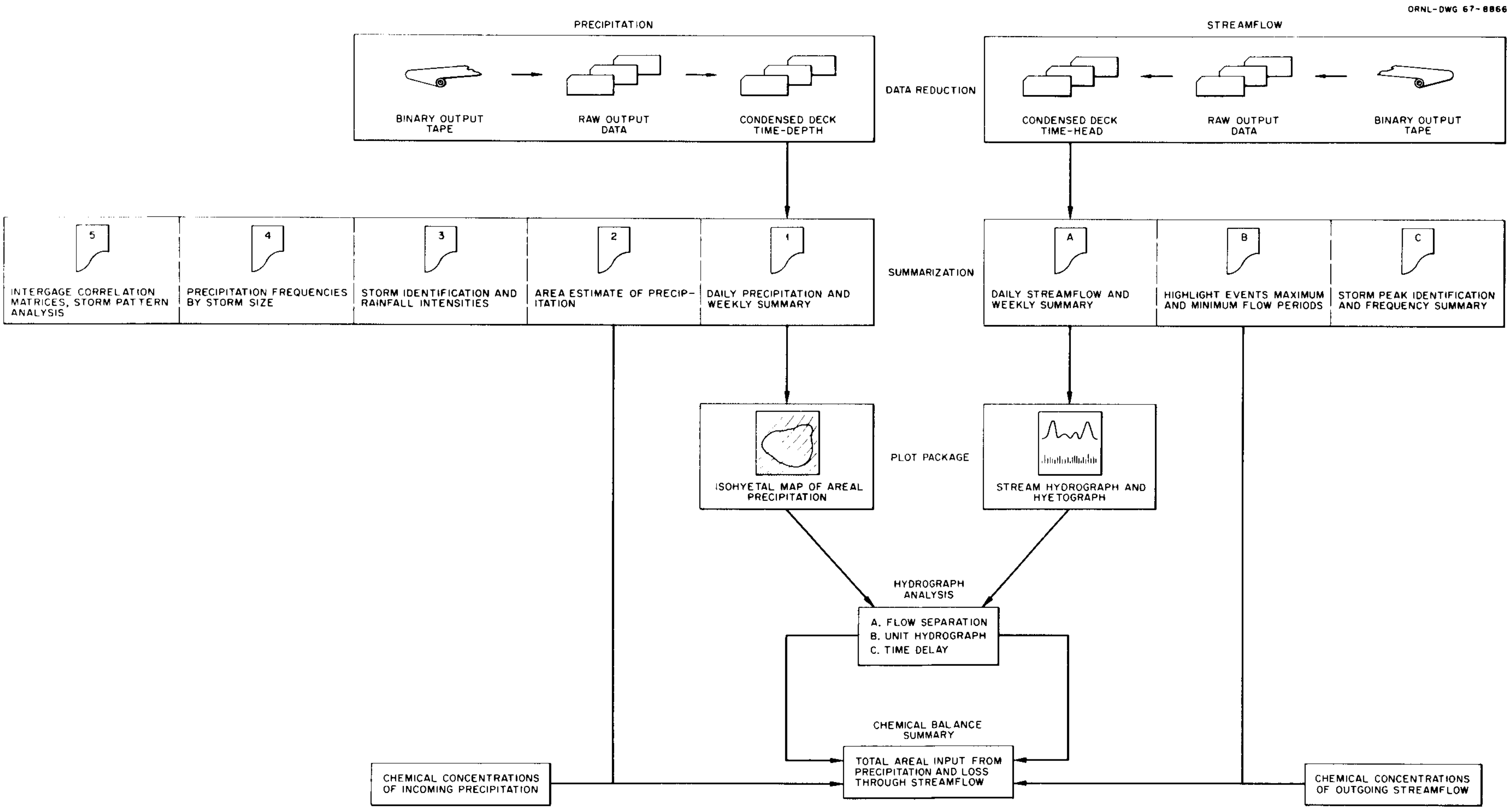

Fig. 11. Flow Chart of Data Handling and Computer Processing Sequence for Hydrological Analyses.

DAILY AND PERIODIC DISCHARGE, STORM PEAK IDENTIFICATION, FLOW-CLASS FREQUENCIES, AND MAXIMUM-MINIMUM FLOW PERIODS. PRECIPITATION AND STREAM FLOW DATA ARE EXPRESSED IN BOTH STANDARD U. S. UNITS AND METRIC EQUIVALENTS. A COMPUTER PLOTTING ROUTINE GIVES PARALLEL GRAPHIC OUTPUT OF THE CONTINUOUS STREAM HYDROGRAPH AND ASSOCIATED HYETOGRAPH AS WELL AS AN ISOHYETAL MAP OF THE PRECIPITATION PATTERN OVER THE WATERSHED. THE ENTIRE SUMMARY PACKAGE FOR BOTH PRECIPITATION AND STREAMFLOW WILL BE TRANSFERRED TO MICROFICHE AND REPRODUCIBLE MICROCARDS FOR STORAGE AND DISTRIBUTION TO PARTICIPATING INVESTIGATORS AT THE END OF THE YEAR OF RECORD.

HYDROGRAPH ANALYSES ARE PERFORMED SEPARATELY ON EACH STORM EVENT PREVIOUSLY IDENTIFIED FROM THE PRECIPITATION DATA. A MODIFIED UNIT HYDROGRAPH APPROACH IS USED TO EVALUATE THE RUNOFF RESULTING FROM ONE INCH OF EFFECTIVE RAINFALL IN CHARACTERIZING WATERSHED RESPONSE TO PRECIPITATION EVENTS. MORE DETAILED ANALYSES OF FLOW SEPARATION AND TIME DELAY PHENOMENA ARE PERFORMED ON THE STORM HYDROGRAPHS USING LEAST SQUARES SOLUTION, INTEGRATION, DIFFERENCING EQUATIONS, AND INFILTRATION MODELS.

THE FINAL STEP IN DATA PROCESSING MERGES THE CHEMICAL CONCENTRATION DATA FROM PRECIPITATION AND STREAM WATER SAMPLES WITH THE VOLUME EXPANSION DERIVED FROM TOTAL AREAL PRECIPITATION INCOME AND TOTAL STREAM FLOW VOLUME LOSS. COUPLED WITH THE ESTIMATES OF DRY PARTICULATE FALLOUT, THESE DATA REPRESENT THE GAIN AND LOSS OF CHEMICAL ELEMENTS TO THE NUTRIENT BUDGET OF THE WATERSHED ECOSYSTEM.

GRID SYSTEM AND GROUND CONTROL

PLANIMETRIC CONTROL ON THE WATERSHED IS TIED TO THE ADMINISTRATIVE GRID SYSTEM FOR THE RESERVATION. GRID NORTH HAS A DECLINATION 34 DEG 13 MIN WEST OF TRUE NORTH AND THE ORIGIN OF THE GRID SYSTEM IS AT LATITUDE 35 DEG 49 MIN 22 SEC NORTH, LONGITUDE 84 DEG 21 MIN 40 SEC WEST. ALL DISTANCES AND BEARINGS REFERENCED TO THIS GRID FALL IN THE NORTHEAST QUADRANT, THUS THEIR COORDINATES ARE POSITIVE AND THE DISTANCE AND DIRECTION OF ANY POINT IN RELATION TO ANOTHER CAN BE EASILY COMPUTED TRIGONOMETRICALLY.

CONTROL POINTS WERE SURVEYED ON OLD BETHEL VALLEY ROAD AND ON THE TELEPHONE RIGHT-OF-WAY NORTH OF BEAR CREEK VALLEY ROAD. THESE POINTS ARE MONUMENTED AND SERVE AS AERIAL PHOTO CONTROL POINTS. PRIOR TO THE INITIAL PHOTO FLIGHT IN SEPTEMBER 1966, WHITE Y-SHAPED TARGETS WERE PAINTED OVER EACH PHOTO CONTROL POINT TO SERVE AS GROUND CONTROL (FIG. 5). BOTH HORIZONTAL AND VERTICAL CONTROL WERE EXTENDED UP THE ACCESS ROAD TO THE WEIR SITES WHERE 3 PERMANENT BENCHMARKS WERE ESTABLISHED FOR TRIANGULATION (FIG. 12).

A HIGH DENSITY GRID SYSTEM WAS SUPERIMPOSED OVER THE AREA AT A GRID INTERVAL OF 264 FT (80.47 M). THE NORTH-SOUTH AND EAST-WEST LINES WERE CLEARED AND PAINTED WITH YELLOW PAINT. AT THE INTERSECTION OF THE LINES, ALUMINUM STAKES WERE DRIVEN INTO THE GROUND AND TAGGED WITH AN 8 DIGIT COORDINATE-- THE TOP 4 DIGITS DENOTING THE N COORDINATE AND THE BOTTOM 4 DIGITS THE E COORDINATE. THE GRID LINES ARE REFERENCED BY STEEL FENCE POSTS WHERE THEY CROSS ROADS AND WATERSHED BOUNDARIES. THIS GRID SYSTEM IS THE BASIS FOR ALL SUBSEQUENT MAPS AND SURVEYS ON THE WATERSHED.

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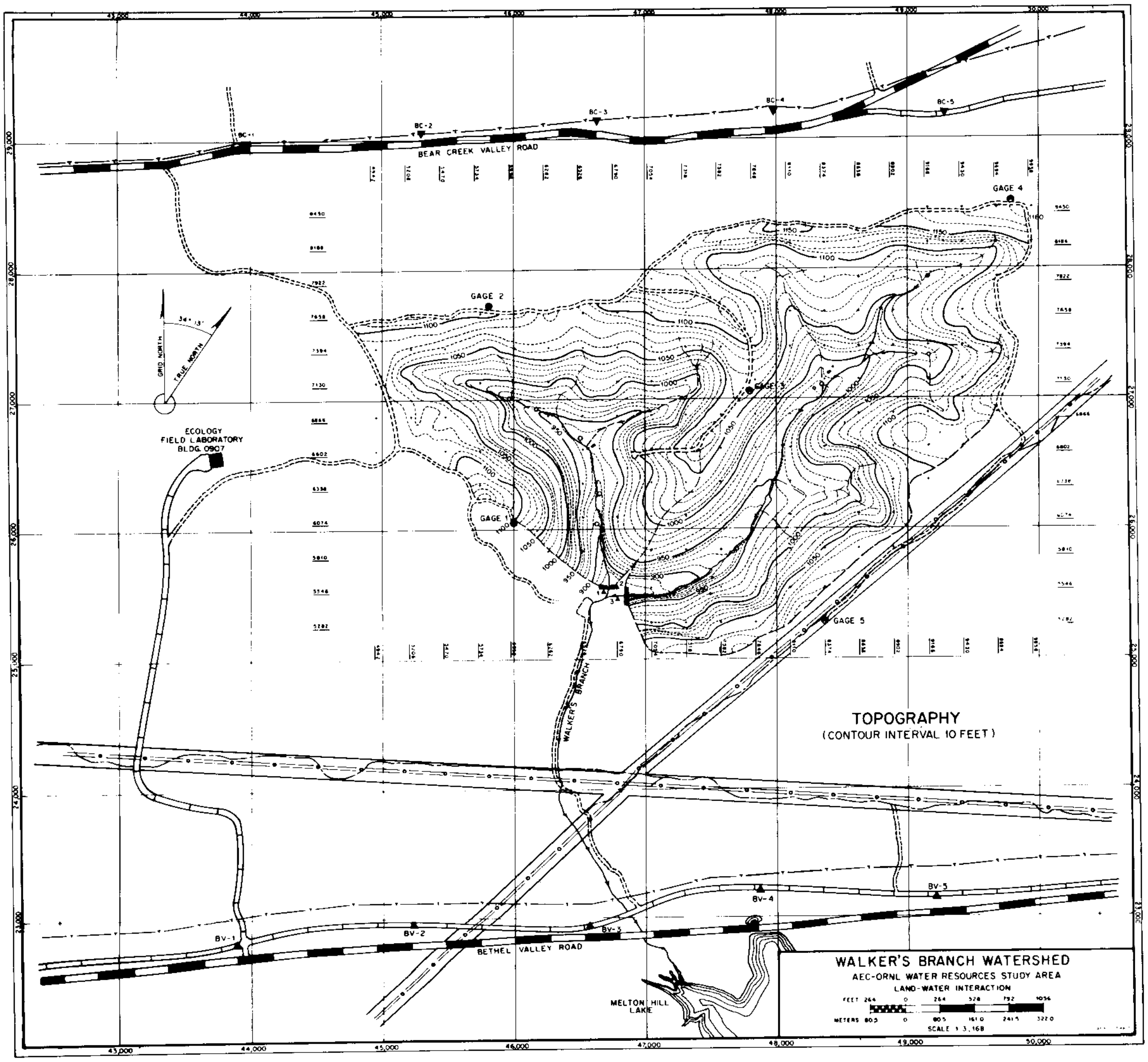

Fig. 12. Topographic Map of Walker Branch Watershed

A PLANIMETRIC BASE MAP WAS PREPARED FROM A RADIAL LINE PLOT OF THE SEPTEMBER, 1957, INFRARED AERIAL PHOTOGRAPHY COUPLED WITH THE GROUND SURVEY. ALL OTHER MAPS OF CULTURAL, TOPOGRAPHIC, AND VEGETATIONAL FEATURES WERE SUPERIMPOSED OVER THE BASE MAP AT A SCALE OF 1:3,168.

VEGETATION SURVEY

CLASSIFICATION OF OVERSTORY VEGETATION

THE INITIAL STEP IN CHARACTERIZING THE VEGETATION OF WALKER BRANCH WATERSHED WAS STRATIFICATION AND MAPPING OF THE FOREST OVERSTORY ON THE BASIS OF SPECIES COMPOSITION, STAND DENSITY, AND AVERAGE STAND HEIGHT (FIG. 13). MAPPING WAS DONE FROM THE GROUND USING THE GRID SYSTEM AS REFERENCE. SINCE EACH GRID CELL ENCLOSES 1.6 ACRES (0.648 HA), STANDS DOWN TO APPROXIMATELY 1/4 ACRE (0.1 HA) AREA WERE MAPPED.

A COMPUTER MAP WAS GENERATED FROM THE FOREST COVER DATA USING A MAP INFORMATION ASSEMBLY AND DISPLAY SYSTEM (MIADS) DEVELOPED BY THE U.S. FOREST SERVICE (13). THE COMPUTER PROGRAM CALCULATES AREAS AND PROPORTIONS REPRESENTED BY EACH STRATUM AND LISTS THEM IN TABULAR FORM. AN OPTIONAL SUBROUTINE MERGES TWO SEPARATE CLASSIFICATION SCHEMES (E.G. VEGETATION AND SOILS) INTO A NEW CODING SYSTEM WITH THE ASSOCIATED AREAS AND PROPORTIONS IN EACH NEW COMBINED STRATUM PLUS A COMPUTER BASE MAP OF THE MERGED CLASSIFICATION.

DISTRIBUTION OF OVERSTORY STRATA

TABLE 3 AND TABLE 4 SUMMARIZE THE AREA DISTRIBUTION OF OVERSTORY VEGETATION FOR THE WEST FORK SUBWATERSHED AND EAST FORK SUBWATERSHED,

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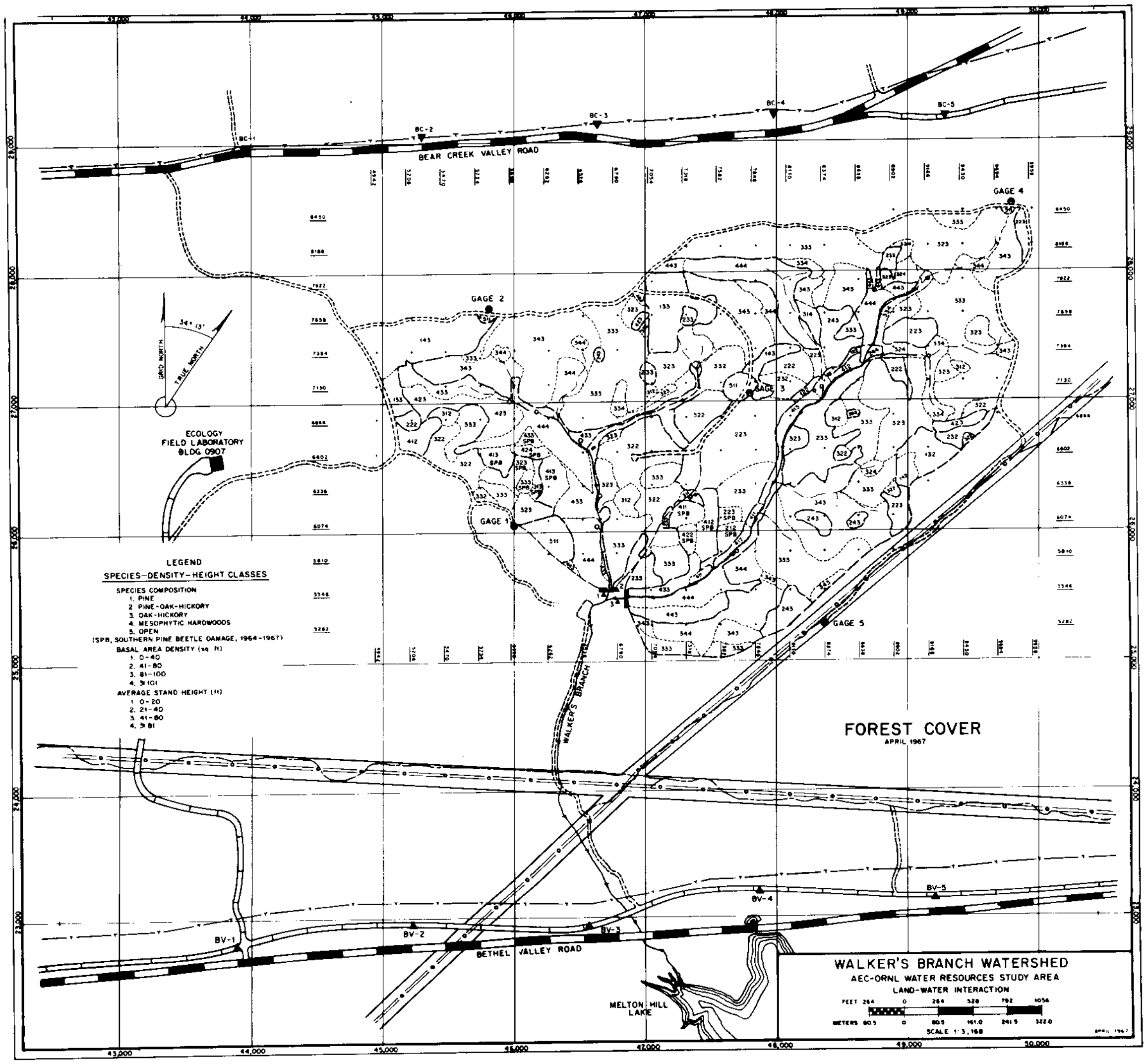

Fig. 13. Forest Cover Map.

Table 3. Acreage Summary of Overstory Strata – West Fork, Walker Branch Watershed

Acres						Percentage Area					
Density (Basal Area ft^2)	Average Stand Height (ft)				Total	Density (Basal Area ft^2)	Average Stand Height (ft)				Total
	0–20	21–40	41–80	≧81			0–20	21–40	41–80	≧81	
Pine											
0–40					0	0–40					0
41–80					0	41–80					0
81–100			4.0		4.0	81–100			4.2		4.2
≧101			6.8		6.8	≧101			7.2		7.2
Total	0	0	10.8	0	10.8	Total	0	0	11.4	0	11.4
Pine – Oak – Hickory											
0–40					0	0–40					0
41–80		0.5	1.1		1.6	41–80		0.5	1.2		1.7
81–100			1.0		1.0	81–100			1.1		1.1
≧101			0.2		0.2	≧101			0.2		0.2
Total	0	0.5	2.3	0	2.8	Total	0	0.5	2.5	0	3.0
Oak – Hickory											
0–40		1.7	0.6		2.3	0–40		1.8	0.6		2.4
41–80		11.5	7.5		19.0	41–80		12.1	7.9		20.0
81–100		2.1	16.4	0.7	19.2	81–100		2.2	17.3	0.7	20.2
≧101	0.2		13.1	2.1	15.4	≧101	0.2		13.7	2.2	16.1
Total	0.2	15.3	37.6	2.8	55.9	Total	0.2	16.1	39.5	2.9	58.7
Mesophytic Hardwoods											
0–40		1.1	2.7		3.8	0–40		1.2	2.8		4.0
41–80			3.6	0.6	4.2	41–80			3.8	0.6	4.4
81–100			7.5		7.5	81–100			7.9		7.9
≧101				7.1	7.1	≧101				7.5	7.5
Total	0	1.1	13.8	7.7	22.6	Total	0	1.2	14.5	8.1	23.8
				Open	2.9					Open	3.1
				Grand Total	95.0						

Table 4. Acreage Summary of Overstory Strata – East Fork, Walker Branch Watershed

Acres						Percentage Area					
Density (Basal Area ft^2)	Average Stand Height (ft)				Total	Density (Basal Area ft^2)	Average Stand Height (ft)				Total
	0–20	21–40	41–80	≧81			0–20	21–40	41–80	≧81	
Pine											
0–40					0	0–40					0
41–80		0.4			0.4	41–80		0.3			0.3
81–100		1.9	1.2		3.1	81–100		1.3	0.8		2.1
≧101		0.9	1.3		2.2	≧101		0.6	0.9		1.5
Total	0	3.2	2.5	0	5.7	Total	0	2.2	1.7	0	3.9
Pine – Oak – Hickory											
0–40		1.0			1.0	0–40		0.7			0.7
41–80		2.2	11.5		13.7	41–80		1.5	7.9		9.4
81–100		2.0	9.0		11.0	81–100		1.4	6.2		7.6
≧101			5.3	0.3	5.6	≧101			3.6	0.2	3.8
Total	0	5.2	25.8	0.3	31.3	Total	0	3.6	17.7	0.2	21.5
Oak – Hickory											
0–40	0.2	1.0		0.6	1.8	0–40	0.1	0.7		0.4	1.2
41–80		1.9	16.1	1.9	19.9	41–80		1.3	11.0	1.3	13.6
81–100			33.3	3.9	37.2	81–100			22.8	2.7	25.5
≧101			19.3	8.3	27.6	≧101			13.2	5.7	18.9
Total	0.2	2.9	68.7	14.7	86.5	Total	0.1	2.0	47.0	10.1	59.2
Mesophytic Hardwoods											
0–40	1.2	2.6	2.3		6.1	0–40	0.8	1.8	1.6		4.2
41–80		0.4	0.7		1.1	41–80		0.3	0.5		0.8
81–100			1.5		1.5	81–100			1.0		1.0
≧101			3.1	10.4	13.5	≧101			2.1	7.1	9.2
Total	1.2	3.0	7.6	10.4	22.2	Total	0.8	2.1	5.2	7.1	15.2
				Open	0.3					Open	0.2
				Grand Total	146.0						

RESPECTIVELY. PERCENTAGE DISTRIBUTION OF AREA IN OAK-HICKORY AND MESOPHYTIC HARDWOOD FOREST TYPES ARE SIMILAR ON BOTH SUBWATERSHEDS. THE EAST FORK SUBWATERSHED CONTAINS A MUCH LARGER PERCENTAGE OF PINE-OAK-HICKORY TYPE WHILE THE WEST SUBWATERSHED CONTAINS MORE PINE TYPE. THE WEST FORK SUBWATERSHED HAS A LARGER AREA CLASSIFIED AS OPEN BECAUSE OF A SOUTHERN PINE BEETLE (DENDROCTONUS FRONTALIS) CONTROL OPERATION IN 1965 WHICH REMOVED THE OVERSTORY VEGETATION, THIS AREA IS PRESENTLY IN AN INITIAL STAGE OF SUCCESSION. THE SOUTHERN PINE BEETLE EPIDEMIC WAS ALSO RESPONSIBLE FOR CONVERSION OF A MODERATE ACREAGE OF PINE AND PINE-HARDWOOD TYPE TO LOW DENSITY, SHORT STAND-HEIGHT MESOPHYTIC HARDWOODS AND OAK-HICKORY ON THE EAST FORK SUBWATERSHED (TABLE 4).

THERE IS A PREDOMINANCE OF FOREST COVER IN THE 41- TO 80- FT HEIGHT CLASS ON BOTH SUBWATERSHEDS. STAND DENSITY IS FAIRLY WELL DISTRIBUTED OVER ALL BASAL AREA CLASSES ALTHOUGH THERE IS A CENTRAL TENDENCY AROUND THE 41- TO 80- FT CLASS AND THE 81- TO 100- FT CLASS.

VEGETATIONAL INVENTORY SYSTEM

THE MAJOR OBJECTIVE OF THE VEGETATIONAL SURVEY IS TO QUANTIFY THE STANDING CROP OF VEGETATION IN RELATION TO SIZE DISTRIBUTION, SPECIES COMPOSITION, AERIAL BIOMASS, AND FINALLY, CHEMICAL BALANCE.

A STRATIFIED RANDOM DESIGN WITH SAMPLE PLOTS ASSIGNED TO EACH OVERSTORY STRATUM IN PROPORTION TO ITS AREA CONTRIBUTION (14) WAS USED AS BASIS FOR DEVELOPMENT OF STAND TABLES AND SPECIES-FREQUENCY DATA. ON THE BASIS OF VARIANCE ESTIMATES CALCULATED FROM FOREST MANAGEMENT DATA COLLECTED ON OAK RIDGE RESERVATION PLUS OTHER PRACTICAL CONSIDERATIONS, IT WAS DETERMINED THAT APPROXIMATELY 300 PLOTS WERE NEEDED TO ESTIMATE

THE REQUIRED STAND INFORMATION WITHIN PLUS/MINUS 15% ON THE WATERSHED. THE 95-ACRE WEST FORK SUBWATERSHED RECEIVED 123 PLOTS WHILE THE 146-ACRE EAST FORK RECEIVED 183 PLOTS.

PLOTS WERE ASSIGNED BY A COMPUTER RANDOMIZING ROUTINE IN CONJUNCTION WITH THE COMPUTER FOREST COVER MAP DEVELOPED BY MIADS (13). THE ROUTINE GENERATED RANDOM NUMBERS WHICH WERE REFERENCED TO A TWO DIMENSIONAL ARRAY IN WHICH THE CODED FOREST COVER MAP WAS STORED. IF A SAMPLE WAS NEEDED IN THE STRATUM COVERING THE GENERATED POSITION, A PLOT WAS ALLOCATED, AND THE COORDINATES OF THE SELECTED POINT WERE LISTED. THIS SEQUENCEWAS REPEATED ON EACH SUBWATERSHED SEPARATELY UNTIL THE NUMBER OF PLOTS NEEDED IN EACH STRATUM WAS FILLED. LOCATION OF THE PLOTS SUPERIMPOSED OVER THE COMPUTER MAP IS SHOWN IN FIG. 14. SAMPLE PLOT ALLOCATION PER STRATUM IS LISTED IN TABLE 5. PLOTS WERE NOT ASSIGNED TO STRATA OF LESS THAN 0.6 TOTAL ACRES.

CONCENTRIC CIRCULAR PLOTS WERE ESTABLISHED AT EACH SAMPLE POINT. CONFIGURATION, DIMENSIONS, AND SAMPLING CRITERIA ARE SHOWN IN FIGURE 15. PLOT RADII WERE CORRECTED FOR MAXIMUM SLOPE AT THE SAMPLE POINT. PLOT CENTERS ARE MARKED WITH ORANGE FLUORESCENT STAKES TAGGED WITH THE GRID COORDINATES OF THE SAMPLE POINT. THE NESTED CONCENTRIC PLOT DESIGN PERMITS SAMPLING OF THE VARIOUS TREE DIAMETER CLASSES WITH APPROXIMATELY THE SAME PRECISION. SINCE THE NUMBER OF STEMS PER UNIT AREA IS INVERSELY RELATED TO STEM DIAMETER, SAMPLE PLOT AREA IS DIRECTLY PROPORTIONAL TO STEM DIAMETER SO THAT TREES GREATER THAN OR EQUAL TO 9.6 IN. (24.38 CM) DBH ARE SAMPLED ON 0.2 ACRE (0.081 HA) WHILE STEMS LESS THAN OR EQUAL TO 0.5 IN. (12.7 MM) DBH ARE SAMPLED ON 0.001 ACRE (0.0004 HA). STEMS IN OTHER SIZE CLASSES ARE SAMPLED ON INTERMEDIATE SIZE PLOTS. EACH WOODY STEM GREATER THAN OR EQUAL TO 0.6 IN. DBH IS ASSIGNED

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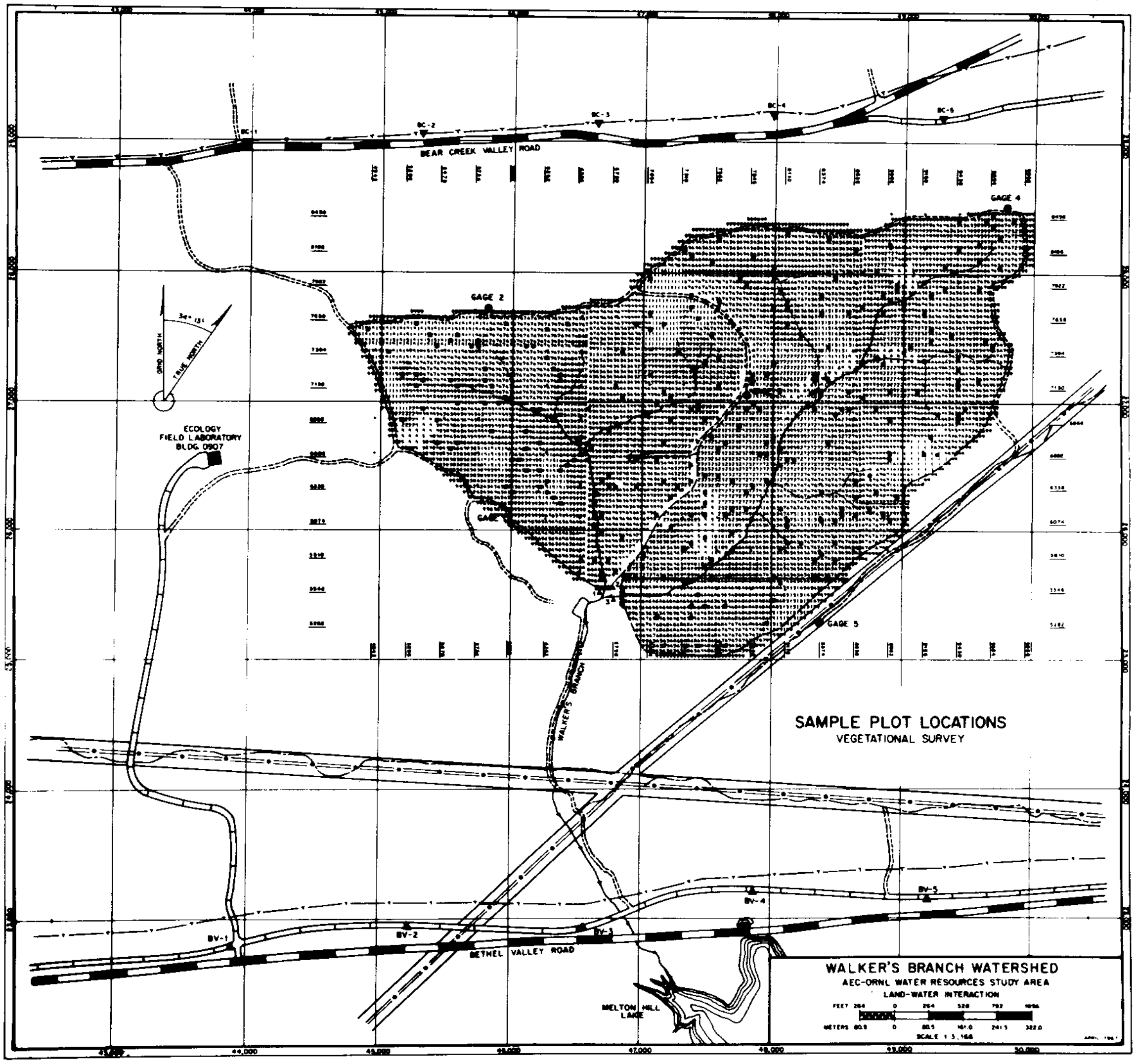

Fig. 14. Sample Plot Locations Superimposed on the Computer Map.

Table 5. Number of Sample Plots Allocated to Each Vegetational Stratum

West Fork Subwatershed						East Fork Subwatershed					
Density	Average Stand Height (ft)				Total	Density	Average Stand Height (ft)				Total
(Basal Area ft^2)	0–20	21–40	41–80	$\geqq$81		(Basal Area ft^2)	0–20	21–40	41–80	$\geqq$81	
Pine											
0–40					0	0–40					0
41–80					0	41–80					0
81–100			5		5	81–100		2	2		4
$\geqq$101			8		8	$\geqq$101		2	2		4
Total	0	0	13	0	13	Total	0	4	4	0	8
Pine – Oak – Hickory											
0–40					0	0–40					0
41–80			2		2	41–80		3	20		23
81–100			2		2	81–100		3	15		18
$\geqq$101					0	$\geqq$101			9		9
Total	0	0	4	0	4	Total	0	6	44	0	50
Oak – Hickory											
0–40		2	2		4	0–40		2			2
41–80		12	7		19	41–80		2	15	2	19
81–100		2	15	2	19	81–100			31	4	35
$\geqq$101			12	2	14	$\geqq$101			18	7	25
Total	0	16	36	4	56	Total	0	4	64	13	81
Mesophytic Hardwoods											
0–40		2	7		9	0–40	2	6	5		13
41–80			9	2	11	40–80		2			2
81–100			15		15	81–100			2		2
$\geqq$101				15	15	$\geqq$101			6	21	27
Total	0	2	31	17	50	Total	2	8	13	21	44
			Grand Total		123				Grand Total		183

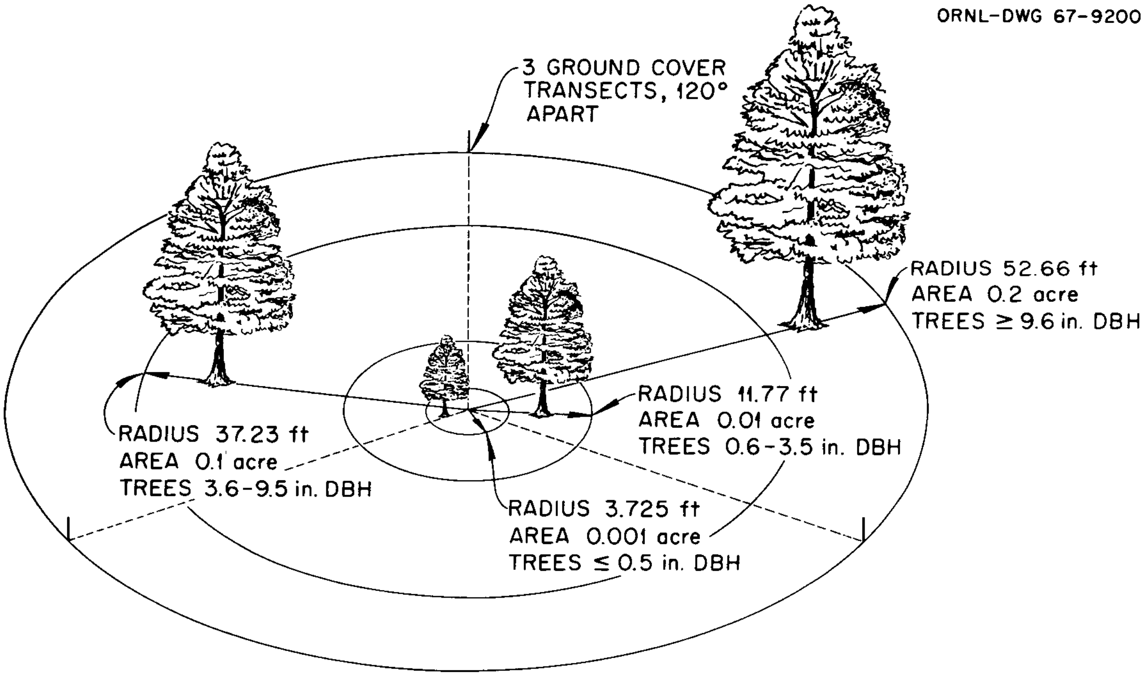

Fig. 15. Sample Plot Configuration

A NUMBER AND TAGGED AT 4.5 FT ABOVE THE GROUND (DBH). DIAMETER, TOTAL HEIGHT AND SPECIES ARE RECORDED ON FORMS FOR SUBSEQUENT COMPUTER PROCESSING AND TABULATION. STEMS LESS THAN OR EQUAL TO 0.5 IN. ARE RECORDED BY FREQUENCY WITHIN 2-FT HEIGHT CLASSES BY SPECIES.

UNDERSTORY VEGETATION IS INVENTORIED ON RADIAL LINE POINT TRANSECTS SPACED 120 DEG APART. EACH TRANSECT IS THE LENGTH OF THE 0.2 ACRE PLOT RADIUS AND IS LOCATABLE BY ALUMINUM STAKES ON THE PLOT PERIMETER. THE TRANSECTS WERE INVENTORIED BY STRETCHING A NYLON CORD MARKED AT 1-FT INTERVALS BETWEEN PLOT CENTER AND THE PERIMETER STAKE. AT EACH INTERVAL A POINT OBSERVATION WAS TAKEN AND SPECIES OCCURRENCE WAS RECORDED. PERCENTAGE OCCURRENCE BASED ON 159 POTENTIAL STRIKES PER PLOT WAS COMPUTED BY SPECIES FOR EACH STRATUM.

DETAILED RESULTS OF THE VEGETATIONAL SURVEY WILL BE COMPILED IN FUTURE DOCUMENTS.

SOIL SURVEY

AN INTENSIVE SOIL SURVEY WAS CONDUCTED BY EXPERIENCED PERSONNEL OF THE SOIL CONSERVATION SERVICE DURING THE SUMMER OF 1967. FIELD MAPPING WAS KEYED TO THE 4-CHAIN (264-FT) GRID SYSTEM DESCRIBED EARLIER, AND SOIL MAPPING UNITS OF 1/4 ACRE OR MORE WERE RECORDED. TABLE 6 LISTS THE SOIL SERIES MAPPED DURING THE COURSE OF THE SURVEY. DETAILED DESCRIPTIONS OF THE ESTABLISHED SERIES ARE GIVEN IN APPENDIX C.

AREAS OF EQUAL LAND SLOPE ARE SHOWN IN FIG. 16 AND ACREAGE SUMMARIES OF SLOPE CLASSES ARE GIVEN IN TABLE 7. APPROXIMATELY TWO-THIRDS OF THE TOTAL AREA IS ON SLOPES GREATER THAN 20%. SLOPES EXCEEDING 30% OCCUPY 42% OF THE AREA OF THE WEST SUBWATERSHED AND 48% OF

Table 6. Soil Series and Mapping Units Observed on Walker Branch Watershed

Soil Series	Texture	Slope Range (percent)	Degree Erosion	Comprehensive Classification (7th approximation)
Tarklin	sil to cherty sil	2-12	slight	Typic Fragiudults fine-loamy, siliceous, thermic
Fullerton	sil, cherty sil to cherty sicl	$5\text{-}30^{+}$	slight to severe	Typic Paleudults clayey, kaolinitic, thermic
Bodine	cherty sil	$5\text{-}30^{+}$	slight	Typic Paleudults loamy-skeletal, siliceous, thermic
Claiborne	cherty sil to cherty sicl	$12\text{-}30^{+}$	slight to severe	Not classified
Linside	sil	0-5	slight	Aquic Fluventic Eutrochrepts fine, silty, mixed, mesic
Stonyland (Fullerton soil material)	dolomite outcrop	20^{+}	--	Not classified
Rockland (dominantly chert)	chert fragments	20^{+}	--	Not classified

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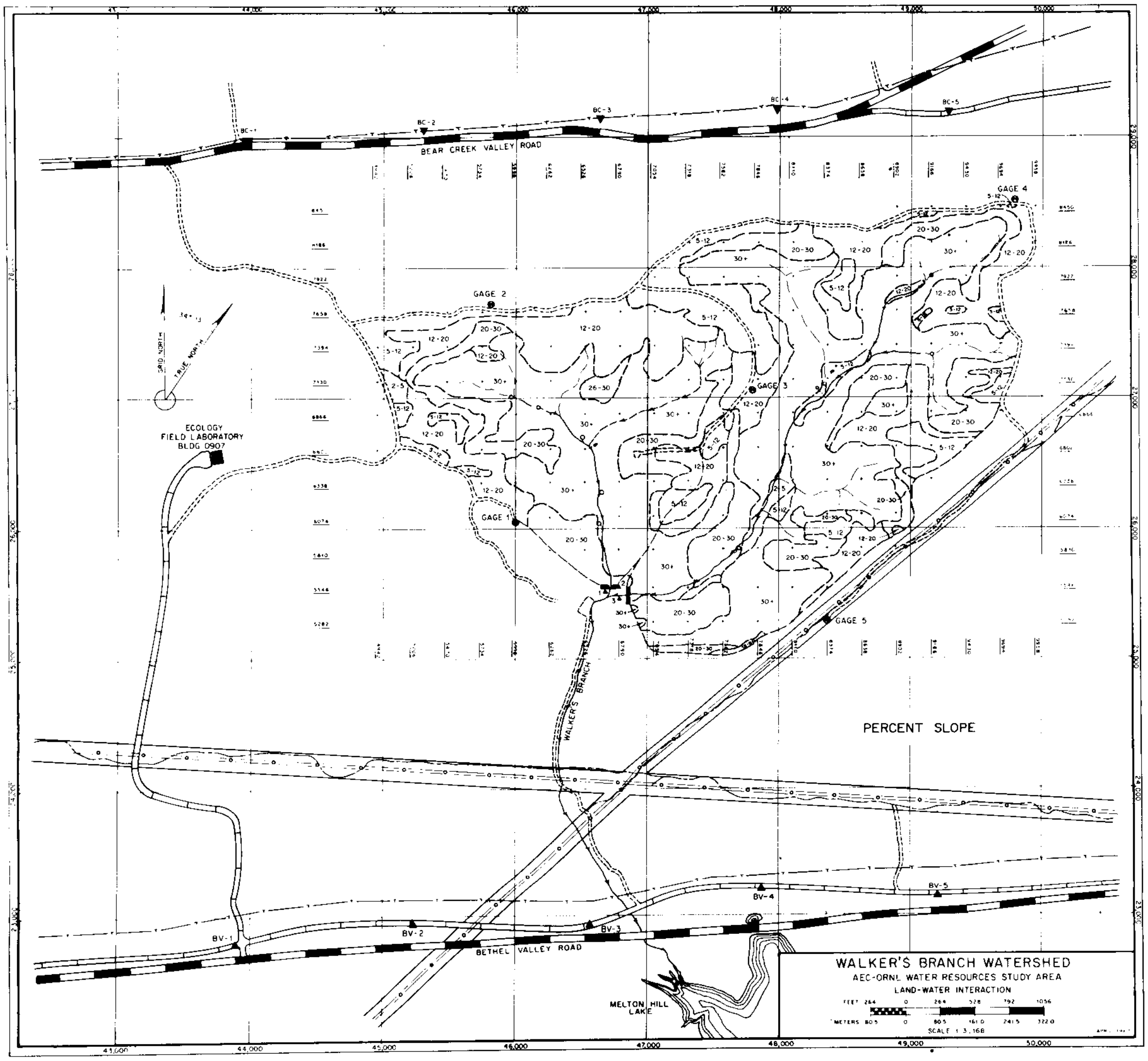

Fig. 16. Map of Land Slope, Walker Branch Watershed.

Table 7. Area Distribution of Land Slope on Walker Branch Watershed

Slope Class (%)	Acres		Percent Area	
	Subwatershed		Subwatershed	
	West	East	West	East
2-5	1	2	0.6	1.5
5-12	10	16	10.8	10.7
12-20	27	29	28.7	19.8
20-30	17	29	17.7	20.2
30+	40	70	42.2	47.8

THE EAST SUBWATERSHED. THE STEEPEST TOPOGRAPHY IS FOUND ON MID-SLOPES ADJACENT TO THE MAJOR STREAMS AND TRIBUTARIES (FIG. 12). SHEAR ROCK OUTCROPS OCCUR INTERMITTENTLY ON THESE AREAS, PARTICULARLY ON THE EAST SUBWATERSHED.

THE SOILS FORMED ON THE WATERSHED ARE PRIMARILY ULTISOLS (15), FORMERLY CALLED RED-YELLOW PODZOLICS. THESE SOILS DEVELOP IN HUMID CLIMATES OF THE TEMPERATE TO TROPICAL ZONES ON OLD OR HIGHLY WEATHERED PARENT MATERIAL UNDER FOREST OR SAVANNAH VEGETATION. SMALL AREAS OF INCEPTISOLS ARE FOUND IN ALLUVIAL AREAS ADJACENT TO THE STREAMS.

THE PREDOMINANT CLAY MINERAL IN THESE SOILS IS KAOLINITE WITH LESSER AMOUNTS OF VERMICULITE, HYDROUS MICAS, AND QUARTZ FORMING THE COMPLEMENT.

FULLERTON SOILS OCCUPY THE RIDGE TOPS AND UPPER SLOPE POSITIONS WHILE BODINE IS FOUND ON INTERMEDIATE AND LOWER SLOPES (FIG. 17). AREAS OF CLAIBORNE SOIL ARE LOCATED ON LOWER SLOPES AND BENCHES ON THE DOWNSTREAM PORTION OF EACH SUBWATERSHED JUST ABOVE THE WEIRS. TARKLIN AND LINSIDE SOILS OCCUPY MINOR AREAS IN THE MAJOR STREAM BOTTOM OF THE EAST FORK ON ALLUVIAL OR COLLUVIAL DEPOSITS WASHED FROM THE UPLANDS. STONYLAND AND ROCKLAND OCCUR ON LOWER SLOPES NEAR THE WEIRS WHERE THE DOLOMITE SUBSTRATE TENDS TO OUTCROP OR LIE NEAR THE SOIL SURFACE.

TABLE 8 SUMMARIZES THE RESULTS OF THE SOIL SURVEY. FULLERTON SOILS OCCUPY APPROXIMATELY ONE-HALF OF THE ACREAGE OF EACH SUBWATERSHED WHILE MEMBERS OF THE BODINE SOIL SERIES COVER APPROXIMATELY 47% OF THE EAST SUBWATERSHED AND 37% OF THE WEST SUBWATERSHED. TOGETHER, THE FULLERTON AND BODINE SOILS COMPRISE 90% TO 96% OF THE TOTAL AREA. THE REMAINDER OF THE WATERSHED IS OCCUPIED BY MINOR SOIL SERIES, ROCK OUTCROPS, AND DEEP CHERT BEDS.

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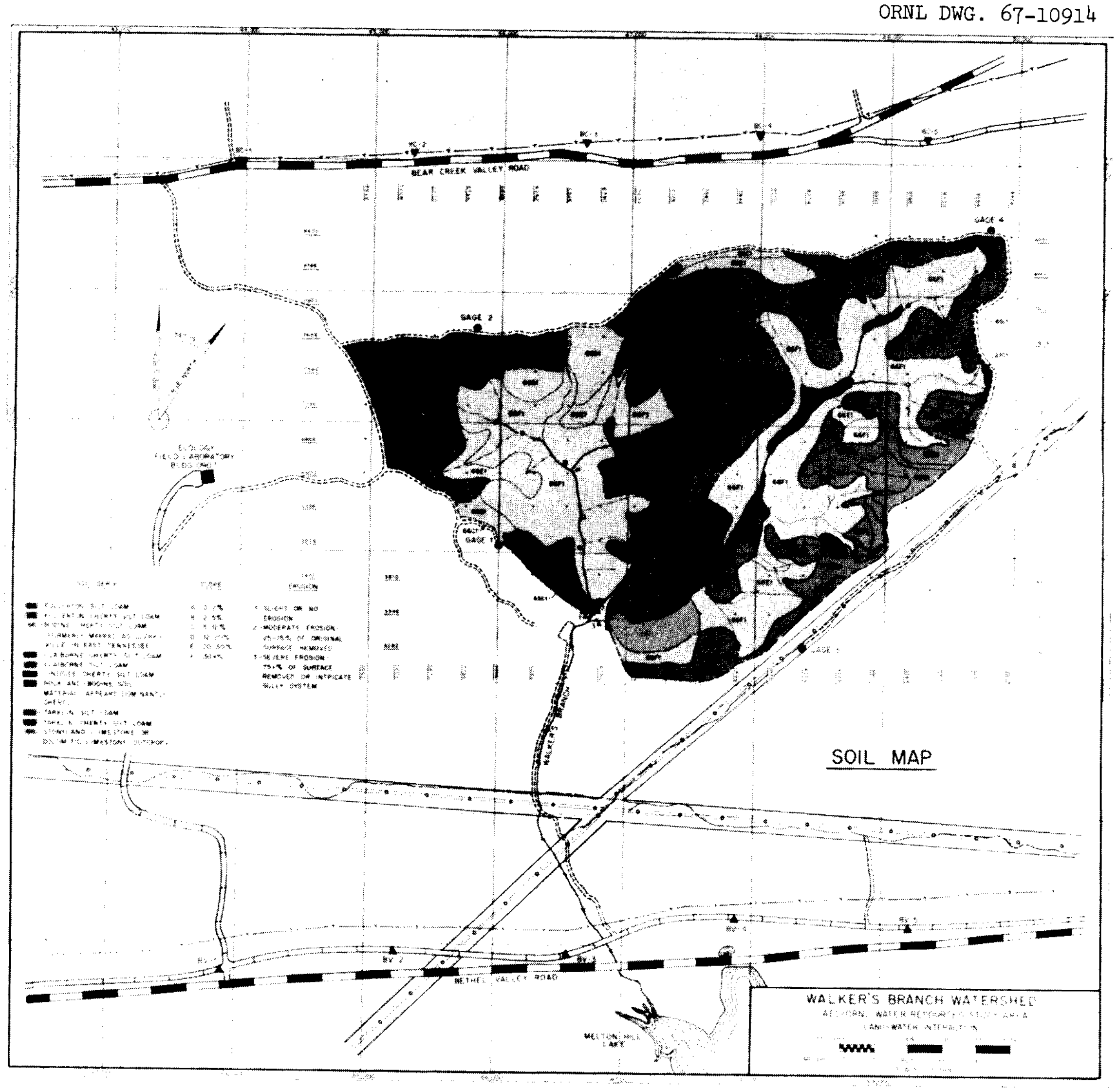


Fig. 17. Soils Map of Walker Branch Watershed

Table 8. Acreage Summary of Soil Survey on Walker Branch Watershed

Map Symbol	Texture	Slope Class %	Erosion Class	Acres		Percent Area	
				West	East	West	East
			Fullerton Series				
64C1	Sil	5–12	Slight	1.5		1.6	
64C2	Sil	5–12	Moderate	1.4	1	1.5	0.4
64D1	Sil	12–20	Slight	2.0		2.1	
64D2	Sil	12–20	Moderate	0.5		0.5	
65C1	Cherty Sil	5–12	Slight	7.3	10.8	7.7	7.4
65D1	Cherty Sil	12–20	Slight	17.0	28.5	17.9	19.5
65E1	Cherty Sil	20–30	Slight	7.7	14.6	8.1	10.0
65E3	Cherty Sil	20–30	Severe	0.2		0.2	
65F1	Cherty Sil	30^+	Slight	8.0	16.9	8.4	11.6
65F2	Cherty Sil	30^+	Moderate	0.6	5.1	0.6	3.5
			Bodine Series				
66D1	Cherty Sil	12–20	Slight	7.8		8.2	
66E1	Cherty Sil	20–30	Slight	5.3	6.1	5.6	4.2
66F1	Cherty Sil	30^+	Slight	31.7	47.8	33.3	32.7
66C1	Cherty Sil	5–12	Slight		0.7		0.5
			Claiborne Series				
160D1	Cherty Sil	12–20	Slight		0.4		0.3
160E1	Cherty Sil	20–30	Slight	1.2		1.3	
160E3	Cherty Sil	20–30	Severe	1.1		1.2	
160F3	Cherty Sil	30^+	Severe		4.7		3.2
			Tarklin Series				
21B1	Sil	2–5	Slight	0.6		0.6	
22C1	Cherty Sil	5–12	Slight		3.4		2.3
			Linside Series				
188B1	Cherty Sil	2–5	Slight		2.2		1.5
			Rockland				
123E1	Chert	20–30	Slight	1.1		1.2	
			Stonyland				
68E1	Limestone	30^+	Slight		4.2		2.9

STREAM SURVEY

STREAM TRAVERSE AND LONGITUDINAL PROFILE

A HORIZONTAL AND VERTICAL TRAVERSE WAS SURVEYED UP EACH PRIMARY AND SECONDARY FORK OF WALKER BRANCH. THE OPEN TRAVERSE AND VERTICAL PROFILES OF THE STREAM SYSTEM ARE SHOWN IN APPENDIX D. TOTAL CHANNEL LENGTH OF THE EAST FORK IS 38% GREATER THAN THAT OF THE WEST FORK (TABLE 9). RATE-OF-FALL OF THE PRIMARY CHANNEL OF THE WEST FORK EXCEEDS THAT OF THE EAST FORK BY 65 FT/MILE, WHILE THE SECONDARY CHANNEL FALL OF THE WEST FORK IS 515 FT/MILE GREATER THAN THAT OF THE EAST FORK.

BASE FLOW OF BOTH FORKS OF WALKER BRANCH IS SUSTAINED BY SPRINGS. TWO PRIMARY SPRINGS SUPPLY CONTINUAL FLOW FOR THE WEST FORK (APPENDIX C), THESE ARE SUPPLEMENTED BY 4 OTHER INTERMITTENT SPRINGS AND SEEPS WHICH ARE ACTIVE IN WET PERIODS. SIMILARLY, THE EAST FORK IS FED BY 2 PRIMARY SPRINGS AND 2 INTERMITTENT ONES. NUMEROUS MINOR SEEPS ALSO OCCUR ALONG THE STREAM CHANNELS DURING PERIODS OF HIGH RAINFALL.

REFERENCE STATIONS FOR STREAM SAMPLING HAVE BEEN ESTABLISHED AT 100-FT INTERVALS ON THE PRIMARY CHANNEL OF EACH FORK.

SURVEY OF AQUATIC ORGANISMS

THE AQUATIC ORGANISMS IN BOTH FORKS OF WALKER BRANCH WERE SAMPLED DURING JULY AND AUGUST 1967 TO DETERMINE THE BIOTIC RESOURCES AVAILABLE FOR STUDY. SEVERAL SAMPLING TECHNIQUES WERE TRIED, BUT THE QUANTITATIVE METHODS SUCH AS THE SURBER SAMPLER OR REMOVAL OF AN AREA OF THE SUBSTRATE WITH SUBSEQUENT ELUTRIATION OF ORGANISMS WERE UNSUCCESSFUL.

Table 9. Channel Characteristics, Walker Branch Watershed

Channel Classification	Length (ft)		Average Rate of Fall (ft/mile)	
	West Fork	East Fork	West Fork	East Fork
Primary	2398	3820	295	230
Secondary	1870	2070	900	385
Total	4268	5890		

SINCE THE MAJOR OBJECTIVE OF THE SURVEY WAS TO OBTAIN ORGANISMS FOR IDENTIFICATION, RANDOM PICKING OF ROCKS, LEAVES, OR BRANCHES WAS THE MOST EFFECTIVE METHOD.

APPROXIMATELY 60 TAXA OF AQUATIC INVERTEBRATES WERE COLLECTED (APPENDIX D). THE LIST IS PRELIMINARY AND IT SHOULD BE NOTED THAT THE IDENTIFICATIONS IN MANY CASES ARE TENTATIVE. MANY OF THE IMMATURE INSECTS WERE NOT DEVELOPED SUFFICIENTLY FOR POSITIVE IDENTIFICATION. CONTINUED COLLECTIONS AND IDENTIFICATIONS WILL IMPROVE OUR KNOWLEDGE OF THE SPECIES PRESENT.

THE SPECIES COLLECTED, PARTICULARLY TRICHOPTERA (CADDIS FLIES), EPHEMEROPTERA (MAYFLIES), AND PRECOPTERA (STONEFLIES), ARE TYPICAL OF SMALL, ROCKY CREEKS. DIPTERA (FLIES) LARVAE AND COLEOPTERA (BEETLES) LARVAE WERE NOT COLLECTED IN LARGE NUMBERS ALTHOUGH LIGHT TRAP COLLECTIONS SUGGESTED THE PRESENCE OF MANY SMALL CHIRONOMIDAE. GERRIDAE (WATER STRIDERS) WERE OBVIOUS IN THE POND AREAS BUT WERE NOT COLLECTED. CRAYFISH ARE REPRESENTED BY AT LEAST ONE SPECIES OF CAMBARUS, AND SALAMANDERS BY FOUR SPECIES (APPENDIX D). THE ONLY ABUNDANT FISH SPECIES IS THE BLACKNOSE DACE (RHINICHTHYS ATRATULUS), ALTHOUGH A FEW SPECIMANS OF THE CREEK CHUB (SEMOTILUS ATROMACULATUS) ARE PRESENT. SIMILAR NEARBY CREEKS ALSO HAVE POPULATIONS OF THE STONEROLLER (CAMPOSTOMA ANOMALUM) AND THE SCULPIN (COTTUS CAROLINAE).

SNAILS (GONIOBASIS CLAVAEFORMIS) ARE ONE OF THE MOST OBVIOUS COMPONENTS OF THE BIOTA OF BOTH FORKS. THE SNAILS OCCUR IN BOTH POOL AND RIFFLE HABITATS AND ARE PERHAPS THE MOST IMPORTANT PRIMARY CONSUMERS INHABITING WALKER BRANCH.

THE FAUNA OF THE TWO FORKS OF WALKER BRANCH ARE QUITE SIMILAR WITH 20 OF THE COMMONLY COLLECTED SPECIES OCCURRING IN BOTH STREAMS. THE WEST FORK CONTAINS 19 ADDITIONAL SPECIES WHILE THE EAST FORK CONTAINS 17 ADDITIONAL SPECIES. MANY OF THESE LATTER SPECIES WERE FOUND ONLY IN ONE COLLECTION AND FUTURE STUDIES WILL PROBABLY REVEAL AN EVEN GREATER SIMILARITY OF THE BIOTA IN THE TWO FORKS.

CURSORY EXAMINATION REVEALED A TYPICAL ENCRUSTING ALGAL FLORA ON THE GRAVEL AND RUBBLE OF THE STREAM BOTTOM. MOSSES OCCUR ON MANY OF THE LARGER ROCKS AND PERHAPS REPRESENT ONE OF THE MORE STABLE COMMUNITIES IN THE STREAM.

ALLOCHTHONOUS ORGANIC MATTER IN THE FORM OF LEAVES, STICKS, TWIGS, ETC., IS A PROMINENT COMPONENT OF THE STREAM BOTTOM MATERIAL. THESE MATERIALS FORM A SUBSTRATE FOR PERPHYTON GROWTH AS WELL AS ATTACHMENT AND SHELTER FOR OTHER AQUATIC ORGANISMS. EVENTUALLY THE ALLOCHTHONOUS ORGANIC MATTER BREAKS DOWN AND IS A SOURCE OF ENERGY FOR ORGANISMS, THE ORGANIC AND INORGANIC MATTER RELEASED BY DECOMPOSION ALTERS WATER QUALITY.

PRELIMINARY CHEMICAL ANALYSIS OF WATER

WATER SAMPLES WERE COLLECTED AT RANDOM INTERVALS BETWEEN JULY 1966, PRIOR TO ESTABLISHMENT OF THE STUDY, AND SEPTEMBER 1967. THE SAMPLES FROM THE STREAMS, SPRINGS, AND PRECIPITATION GAGES WERE ANALYZED TO DETERMINE THE IONIC COMPOSITION OF THE WATER ENTERING AND LEAVING THE SYSTEM. SINCE NO MEASURE OF STREAM DISCHARGE WAS AVAILABLE, THE RESULTS ARE ONLY RELATIVE. HOWEVER, AN EFFORT WAS MADE TO COLLECT SAMPLES DURING PERIODS OF DIFFERENT FLOWS.

TABLE 10 SUMMARIZES THE RESULTS OF STREAM WATER SAMPLES COLLECTED AT THE WEIR SITES. THESE DATA SUGGEST THAT THE IONIC CONCENTRATION OF BOTH FORKS OF WALKER BRANCH ARE QUITE SIMILAR. THERE ARE INDICATIONS THAT THE CONCENTRATION OF DISSOLVED IONS IS INVERSELY RELATED TO STREAM DISCHARGE. WIDE VARIATIONS IN NO_3 CONTENT WERE NOTED BETWEEN SAMPLES COLLECTED IN MAY AND SEPTEMBER. SUCH DIFFERENCES MAY BE DUE TO FLOW CHARACTERISTICS, PHYSIOLOGICAL CONDITION OF THE ECOSYSTEM OR TABULAR ERROR. NITRATE CONCENTRATIONS WITHIN THE LIMITS OF 0.1 MG/L AND 20 MG/L HAVE BEEN OBSERVED IN NATURAL WATERS FLOWING FROM SIMILAR LIMESTONE GEOLOGY (16), THUS IT IS IMPOSSIBLE TO IDENTIFY THE SOURCE OF THIS DISPARITY. SULFATE CONTENT WAS WELL WITHIN THE LIMITS OF DETECTION BUT CI AND NH_4 WERE MARGINAL WITH THE ANALYTICAL METHODS USED. PHOSPHATE CONCENTRATIONS BETWEEN SPRINGS WERE FAIRLY UNIFORM WITHIN THE LIMITS OF EXPERIMENTAL ERROR WITH THE EXCEPTION OF S4E (APPENDIX D) WHERE CONCENTRATIONS APPEAR TO BE AT THE NORMAL MINIMUM LEVELS FOR UNPOLLUTED SURFACE WATERS.

SOME VARIATION WAS NOTED BETWEEN IONIC CONCENTRATIONS IN SPRING WATER AS IT LEFT THE GROUND (TABLE 11). CALCIUM AND MAGNESIUM CONCENTRATIONS BETWEEN SPRINGS WERE FAIRLY UNIFORM WITHIN THE LIMITS OF EXPERIMENTAL ERROR WITH THE EXCEPTION OF S4E (APPENDIX D) WHICH WAS APPROXIMATELY ONE-THIRD OF THE NORMAL OBSERVED VALUES. THIS DIFFERENCE WAS ALSO REFLECTED IN WATER HARDNESS AND PH. NITRATE CONTENT OF THE SPRING WATER REVEALED WIDE VARIATION SIMILAR TO THAT OF STREAM WATER. DISSOVED CO_2 ALSO VARIED CONSIDERABLY BETWEEN SPRINGS.

RAINFALL COLLECTED DURING MAY 1967 HAD ELEMENTAL CONCENTRATIONS SIMILAR TO THOSE EXPECTED OF A SEMI-INDUSTRIALIZED AREA (TABLE 11). THE RAINFALL DATA ARE NOT WHOLLY QUANTITATIVE AND MUST BE CONSIDERED ONLY INDICATIVE.

Table 10. Preliminary Chemical Analyses of Water from Stream Channel of Walker Branch

	mg/L											
Date	Ca	Mg	Sr	Na	K	PO_4	NO_3	NH_4	SO_4	HCO_3	CO_2	pH
					WEST FORK							
7-26-66	27.9	15.9	0.016	0.42	0.80							
5-8-67[a]	9.3	5.2	0.008	0.46	0.61		10	1.4	3.2			
5-22-67[b]	21.2	12.6	0.015	0.44	0.69							
5-25-67[b]						0.013	17		1.9			
9-26-67	33.3	12.9					0.17			167	3.1	7.6
					EAST FORK							
7-26-66	30.0	14.8	0.033	0.49	0.79							
5-8-67[a]	8.3	3.9	0.009	0.52	0.62		8	1.4	3.0			
5-22-67[b]	12.0	5.6	0.011	0.47	0.61							
5-25-67[b]						0.012	10		1.2			
9-26-67	26.9	12.0					0.10			143	6.5	6.9

[a] After heavy rainfall.

[b] Normal discharge.

Table 11. Comparative Chemical Data of Spring Water from Walker Branch Watershed

Spring	Date	mg/L											
		Ca	Mg	Sr	Na	K	PO_4	NO_3	Cl	SO_4	HCO_3	CO_2	pH
						WEST FORK							
S1W	9-26-67	31.8	11.8					0.28			158	6.8	7.0
S3W	5-22-67	28.7	17.6	0.015	0.43	0.89							
S3W	5-25-67[a]						0.01	19		2.5			
S3W	9-26-67	34.4	14.3					0.35			177	7.3	7.2
S5W	9-26-67	23.8	10.0					0.10			128	4.8	7.0
S6W	9-26-67	26.6	8.4					0.14			122	15.8	6.5
						EAST FORK							
S1E	9-26-67	26.3	10.2					0.76			134	12.4	6.6
S2E	9-26-67	30.1	10.1					0.19			162	7.3	7.0
S3E	9-26-67	38.4	15.6					0.09			195	2.8	7.7
S4E	9-26-67	8.0	3.0					0.03			37	6.5	6.6
						RAINGAGE COLLECTIONS							
Gage 1	5-67	0.7			0.33	0.21		1.07	0.1	3.9			
Gage 4	5-67	0.8			0.38	0.35		0.98	0.4	1.1			

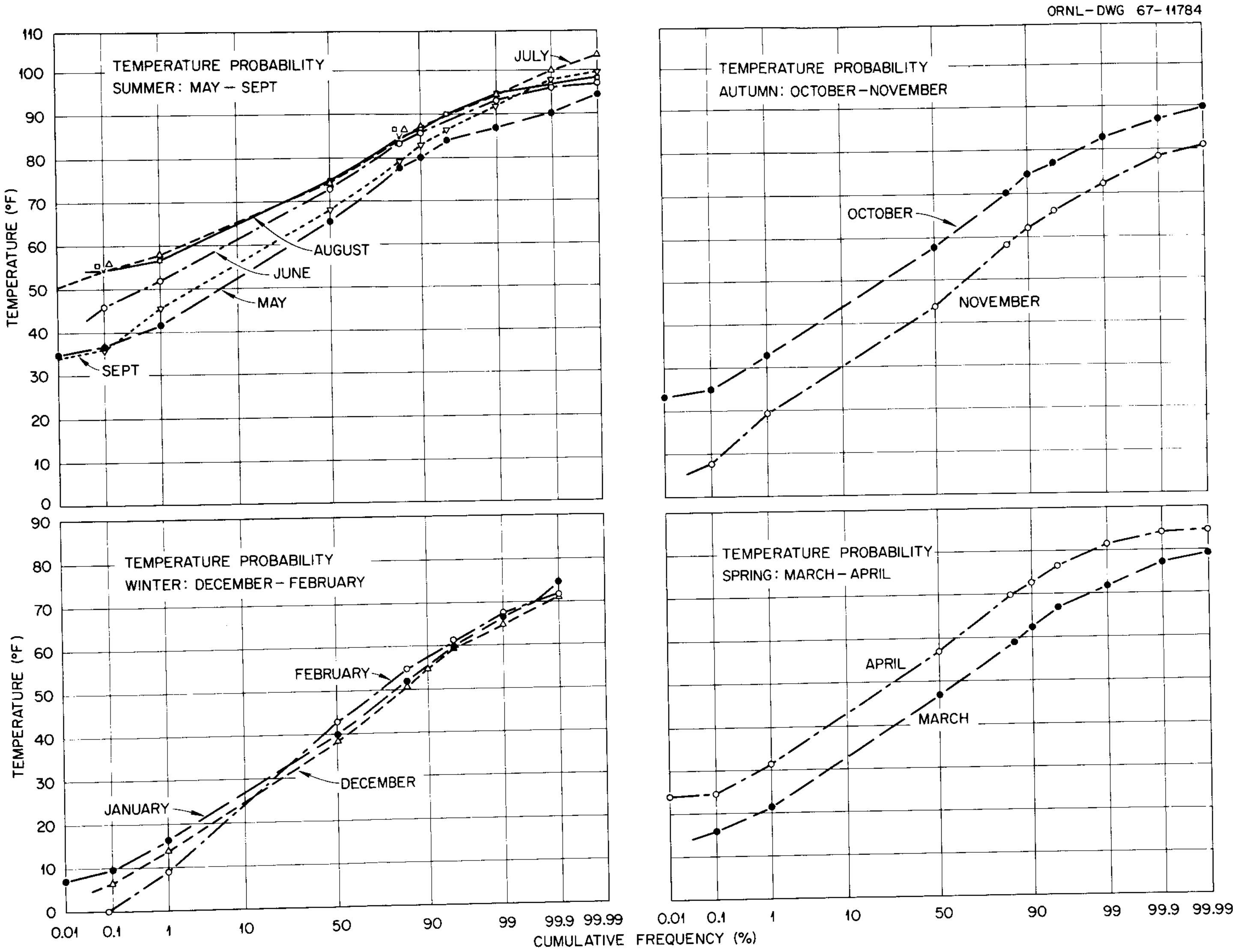
[a] After heavy rainfall.

THESE PRELIMINARY WATER ANALYSES SHOW THAT THE CHEMICAL CHARACTERISTICS OF PRECIPITATION FALLING ON WALKER BRANCH WATERSHED AND STREAM FLOW LEAVING THE WATERSHED IS WELL WITHIN LEVELS NORMALLY EXPECTED FROM NATURAL WATERS OF THIS AREA (17).

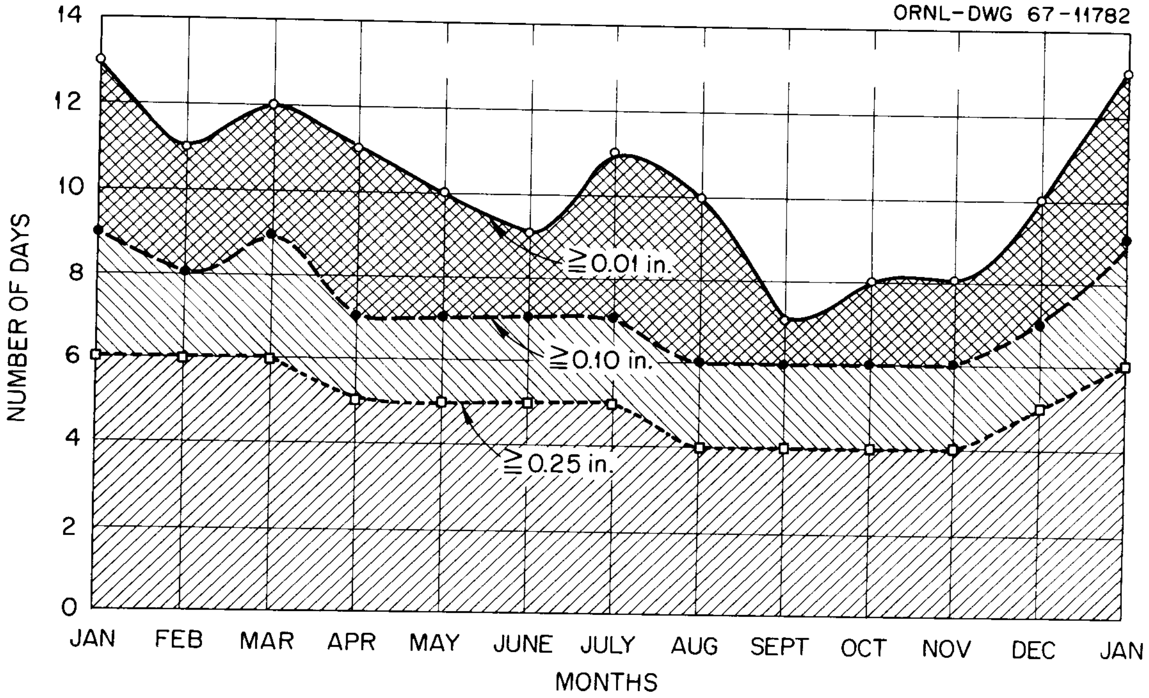
APPENDIX A.

CLIMATOLOGICAL DATA FOR THE OAK RIDGE AREA

1. TEMPERATURE PROBABILITY BY SEASONS
2. AVERAGE MONTHLY FREQUENCY OF PRECIPITATION
3. AVERAGE OCCURENCE OF CONSECUTIVE DAYS WITHOUT PRECIPITATION
4. WIND SPEED AND DIRECTION DURING LAPSE AND INVERSION CONDITIONS

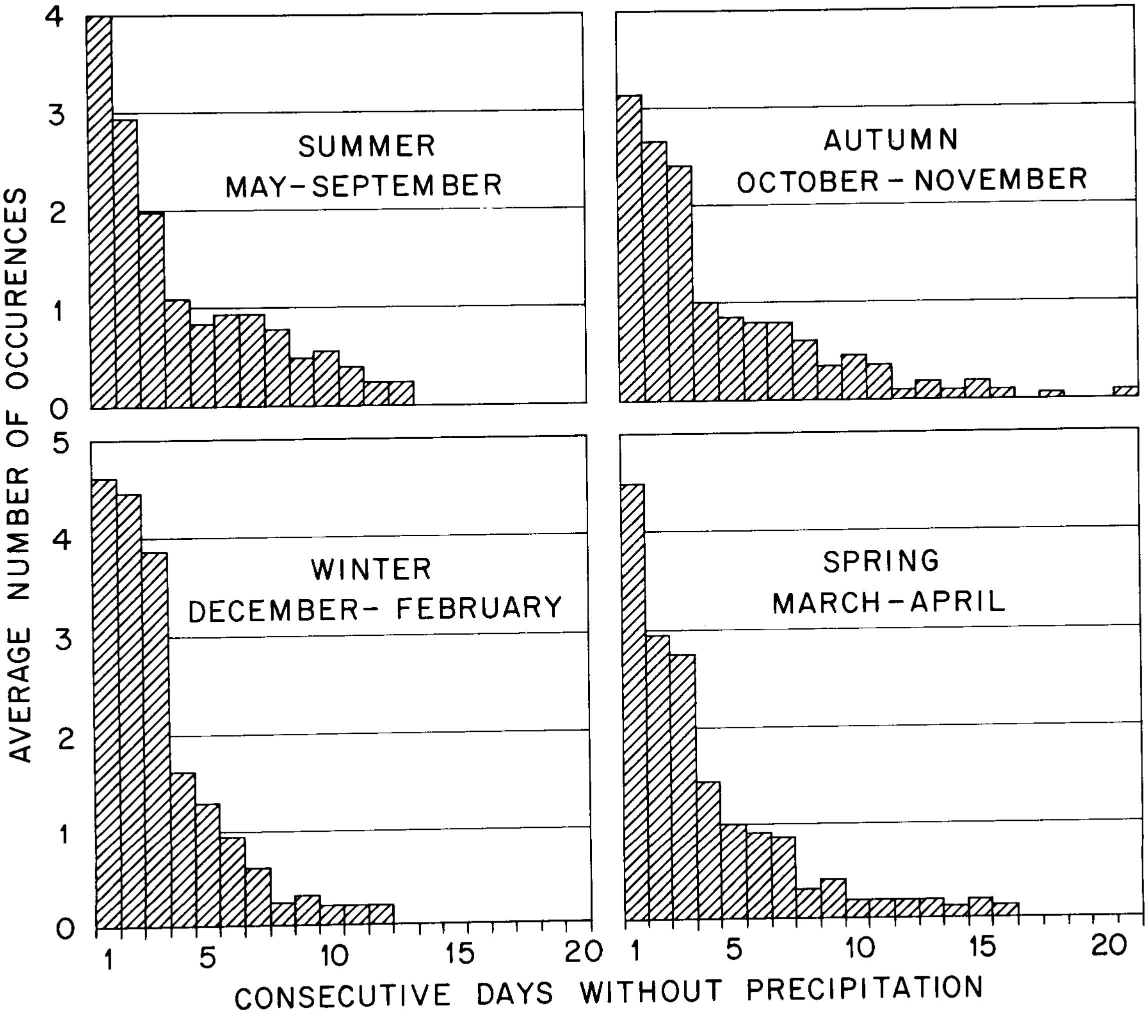


Temperature Probabilities by Season

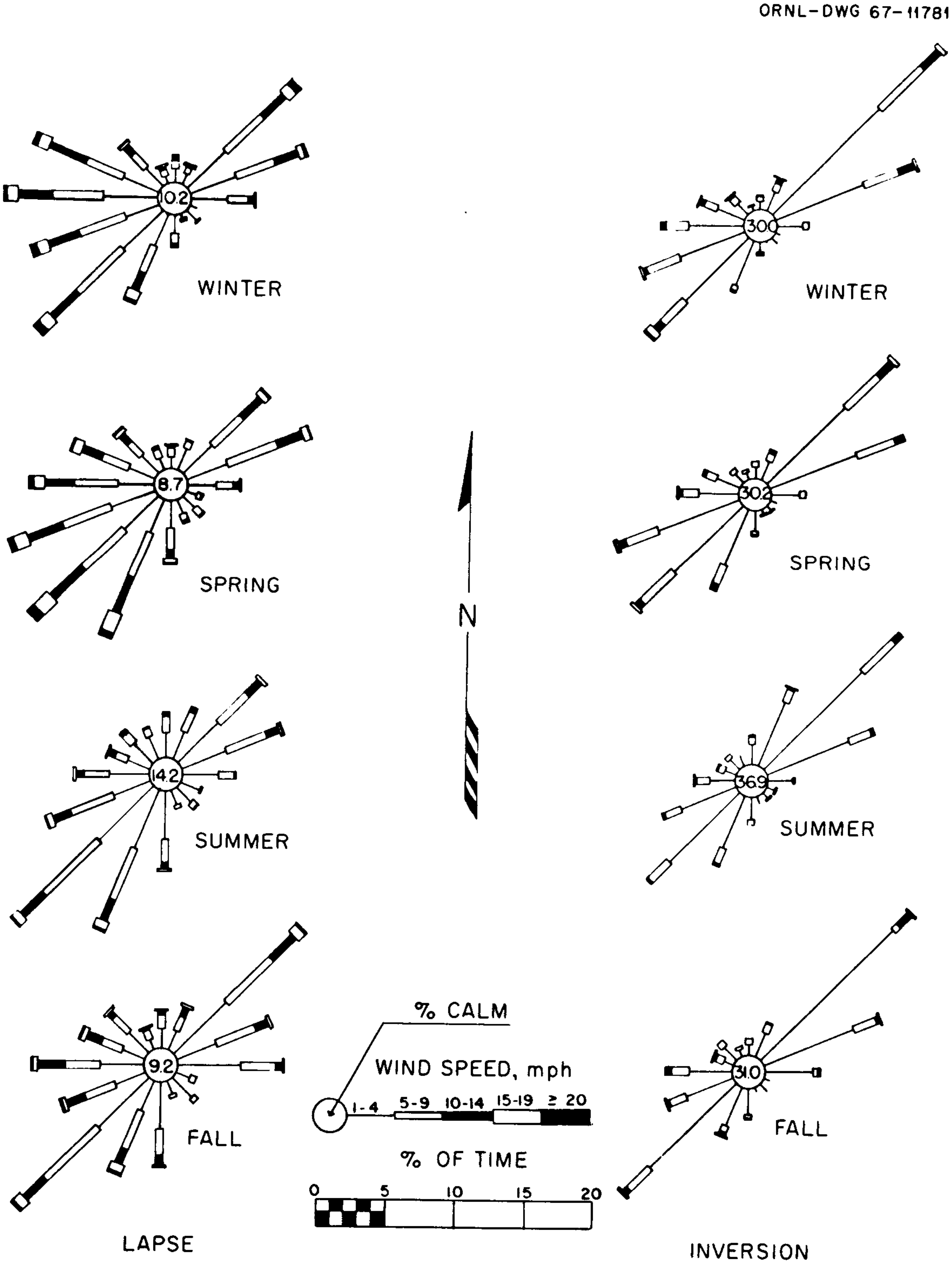


Average Monthly Frequency of Precipitation

ORNL-DWG 67-11783



Average Occurrence of Consecutive Days Without Precipitation

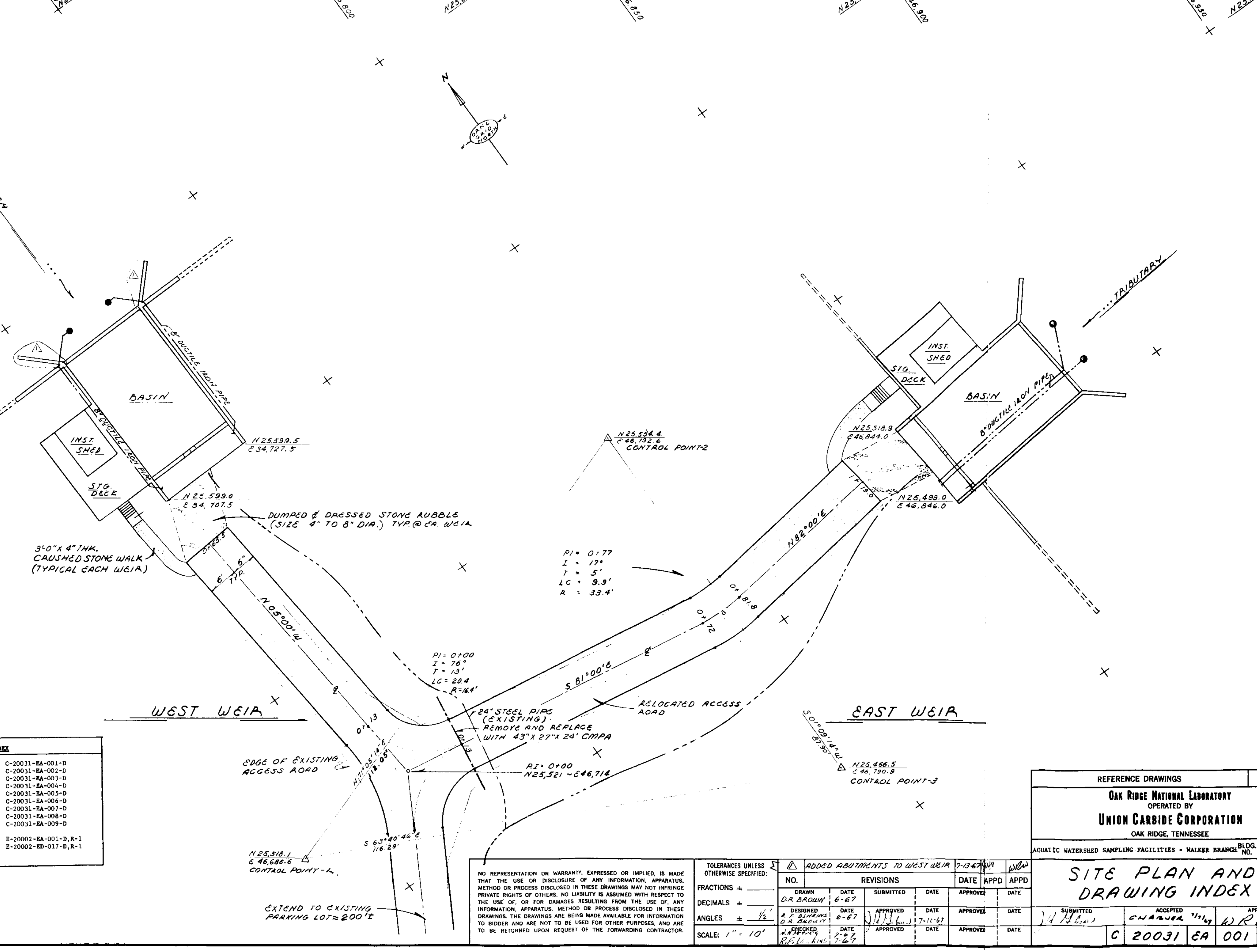


Wind Speed and Direction During Lapse and Inversion

APPENDIX B.

CONSTRUCTION DRAWINGS OF THE WEIRS

1. SITE PLAN AND DRAWING INDEX (001)
2. SITE TOPOGRAPHY AND GRADING PLANS (002)
3. PLAN AND DETAILS WEST WEIR (003)
4. PLAN AND DETAILS EAST WEIR (004)
5. SECTIONS WEST WEIR (005)
6. SECTIONS EAST WEIR (006)
7. SECTIONS AND DETAILS, SHEET 1 (007)
8. SECTIONS AND DETAILS, SHEET 2 (00)



DEX

C-20031-EA-001-D
C-20031-EA-002-D
C-20031-EA-003-D
C-20031-EA-004-D
C-20031-EA-005-D
C-20031-EA-006-D
C-20031-EA-007-D
C-20031-EA-008-D
C-20031-EA-009-D

E-20002-EA-001-D,R-1
E-20002-ED-017-D,R-1

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TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS ± ______
DECIMALS ± ______
ANGLES ± 1/2°
SCALE: 1" = 10'

NO.	REVISIONS	DATE	APPD	APPD
△	ADDED ABUTMENTS TO WEST WEIR	7-13-67	JHH	WRW

DRAWN	DATE	SUBMITTED	DATE	APPROVED	DATE
D.R. BROWN	6-67				
DESIGNED	**DATE**	**APPROVED**	**DATE**	**APPROVED**	**DATE**
R. F. DINKINS D.R. BROWN	6-67	JHH	7-10-67		
CHECKED	**DATE**	**APPROVED**	**DATE**	**APPROVED**	**DATE**
N.H. PETREE R.F. Dinkins	7-67 7-67				

REFERENCE DRAWINGS

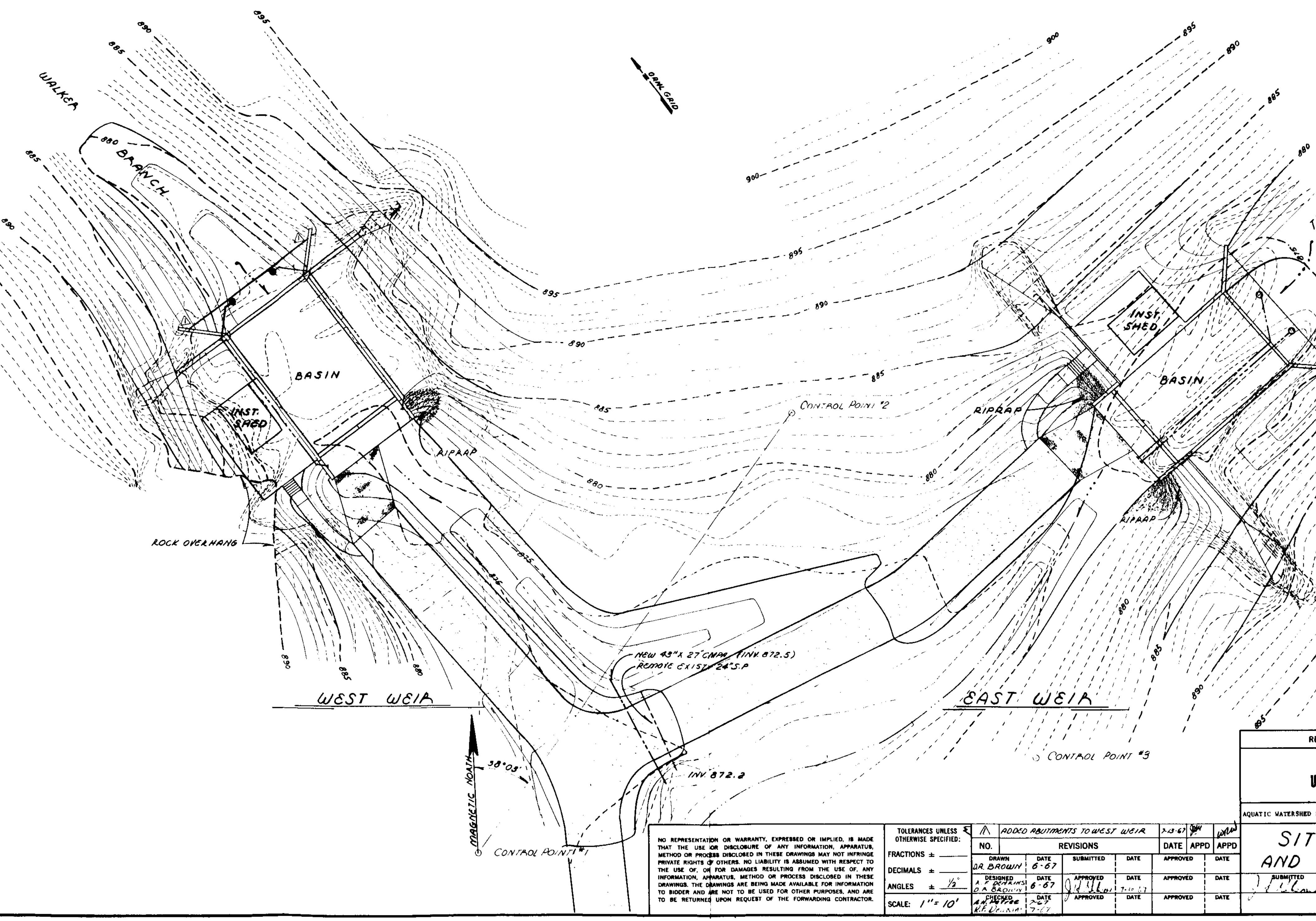
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

AQUATIC WATERSHED SAMPLING FACILITIES - WALKER BRANCH BLDG. NO.

SITE PLAN AND
DRAWING INDEX

SUBMITTED	ACCEPTED	APP
JHH	C H ABNER 7/7/67	W R

C 20031 EA 001



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TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS ± ______
DECIMALS ± ______
ANGLES ± ½°
SCALE: 1" = 10'

NO.	REVISIONS	DATE	APPD	APPD
1	ADDED ABUTMENTS TO WEST WEIR	7-13-67	JWH	WRW

DRAWN	DATE	SUBMITTED	DATE	APPROVED	DATE
D.R. BROWN	6-67				
DESIGNED	DATE	APPROVED	DATE	APPROVED	DATE
A. F. DENKINS D. R. BROWN	6-67		7-15-67		
CHECKED	DATE	APPROVED	DATE	APPROVED	DATE
A. N. Petree K. F. Dennis	7-67 7-67				

AQUATIC WATERSHED

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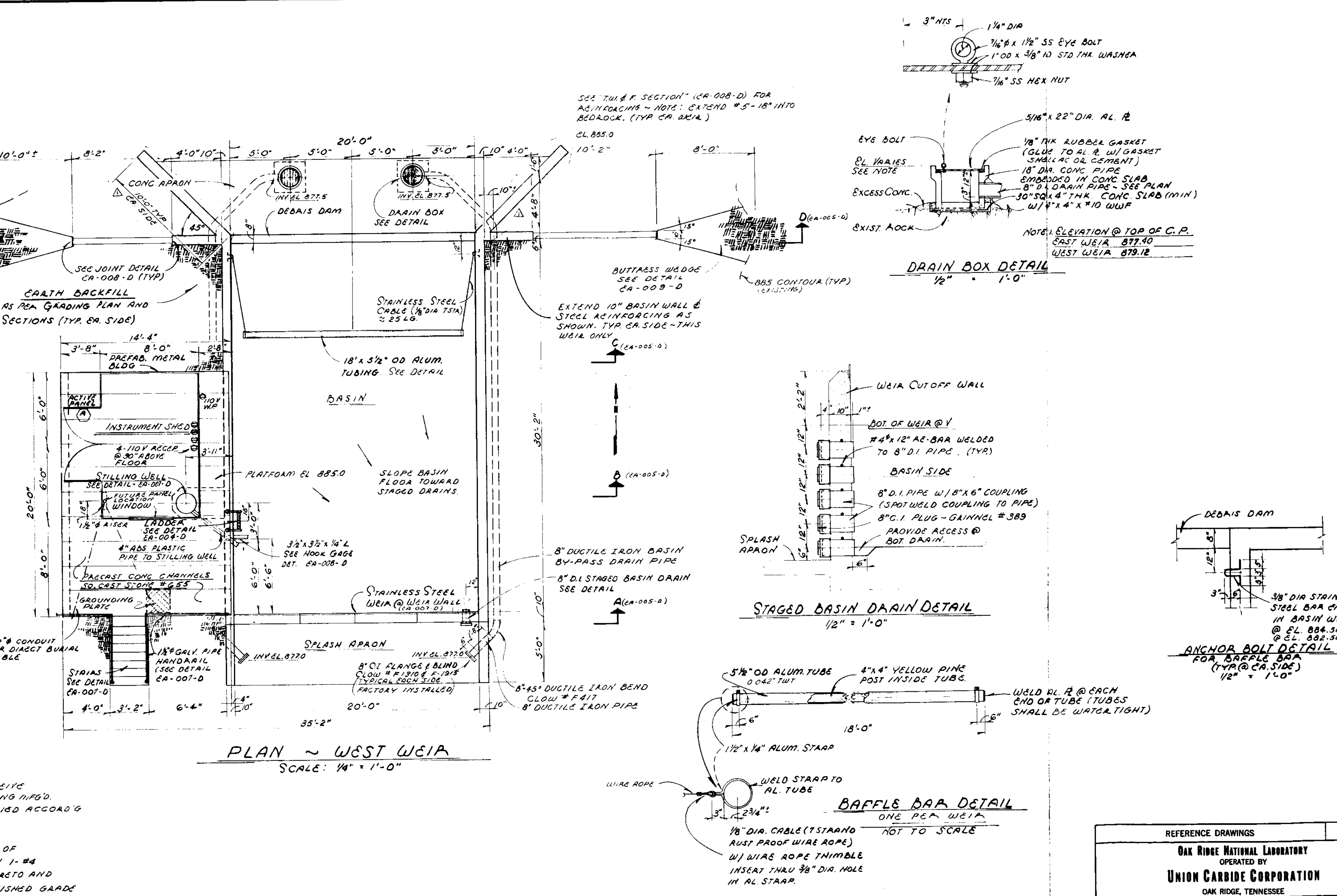
SUBMITTED

Site Topography and Grading Plans (002)



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Welding Notes:

1. Weld in accordance with AWS Welding Symbols.
2. Welds to be full penetration with complete fusion, free from slag inclusions, surface cracks, or undercutting.
3. Visually inspect before, during and after welding. Check with liquid penetrant for surface cracks or pin holes. Repair or remove weld defects.

TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS ± ______
DECIMALS ± ______
ANGLES ± 1/2°
SCALE: NOTED

NO.	REVISIONS	DATE	APPD	APPD
△1	ADDED ABUTMENTS TO WEIR	7-13-67		WLW

DRAWN	DATE	SUBMITTED	DATE	APPROVED	DATE
D.A. BROWN	6-67				
DESIGNED	**DATE**	**APPROVED**	**DATE**	**APPROVED**	**DATE**
R.F. DENKINS D.A. BROWN	6-67		7-10-67		
CHECKED	**DATE**	**APPROVED**	**DATE**	**APPROVED**	**DATE**
A.N. Petree R.F. Denkins	7-67 7-67				

REFERENCE DRAWINGS

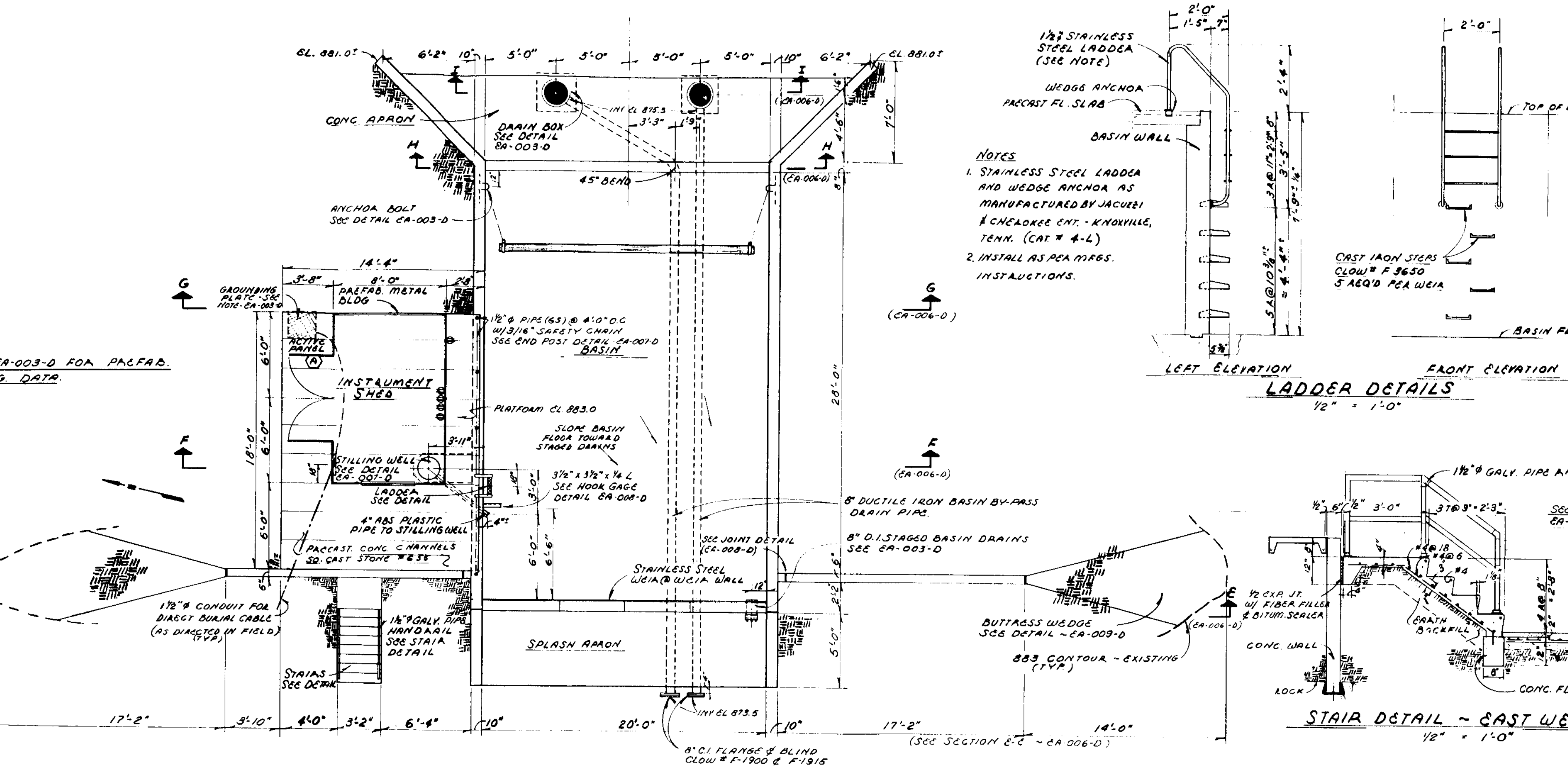
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

AQUATIC WATERSHED SAMPLING FACILITIES - WALKER BRANCH BLDG. NO.

PLAN AND DETAILS
WEST WEIR

SUBMITTED	ACCEPTED	APP
	C HAGNER 7/11/67	W R

C | 20031 | EA | 003



PLAN ~ EAST WEIR

SCALE: 1/4" = 1'-0"

LADDER DETAILS

1/2" = 1'-0"

STAIR DETAIL ~ EAST WE

1/2" = 1'-0"

Notes

1. STAINLESS STEEL LADDER AND WEDGE ANCHOR AS MANUFACTURED BY JACUZZI & CHEROKEE ENT. - KNOXVILLE, TENN. (CAT # 4-L)
2. INSTALL AS PER MFGS. INSTRUCTIONS.

NEVER A MANUFACTURER'S NAME OR CATALOG NUMBER IS
CATED ON THE DRAWINGS, AN APPROVED EQUAL MAY BE
TITUTED UNLESS OTHERWISE STATED.

Welding Notes:

1. Weld in accordance with AWS Welding Symbols.
2. Welds to be full penetration with complete fusion, free from slag inclusions, surface cracks, or undercutting.
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TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS ±
DECIMALS ±
ANGLES ± 1/2°
SCALE: NOTED

NO.	REVISIONS				DATE	APPD	APPD
DRAWN D.A. BROWN	DATE 6-67	SUBMITTED	DATE	APPROVED		DATE	
DESIGNED R. F. DENKINS D.A. BROWN	DATE 6-67	APPROVED	DATE	APPROVED		DATE	
CHECKED H. N. Petree R.F. Denkins	DATE 6-67	APPROVED	DATE	APPROVED		DATE	

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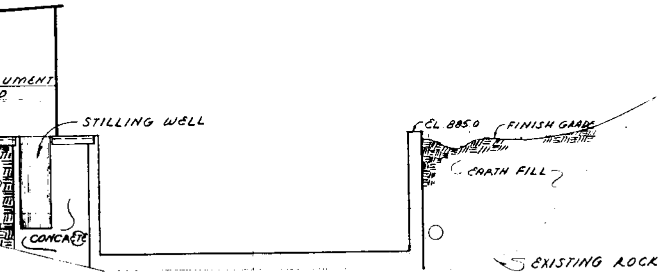
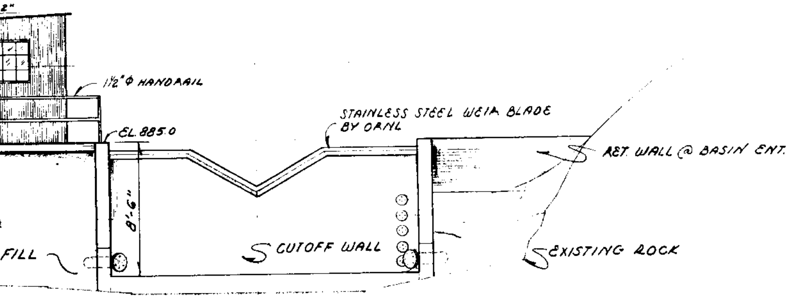
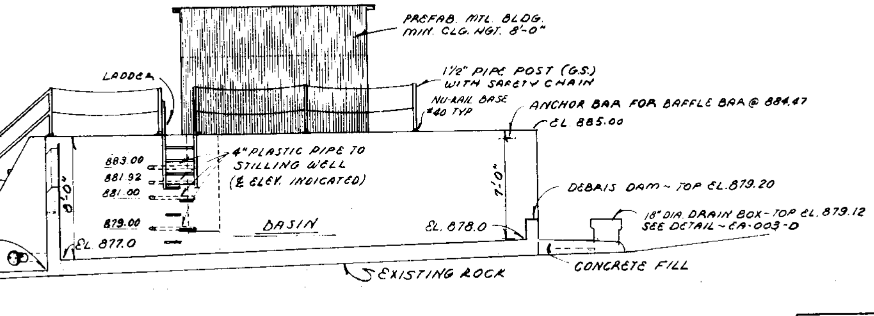
Plan and Details East Weir (004)



SECTION B-B



SECTION A-A



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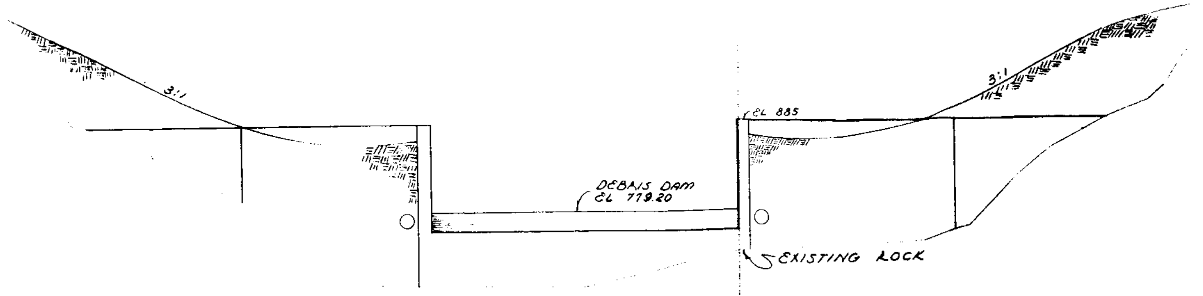
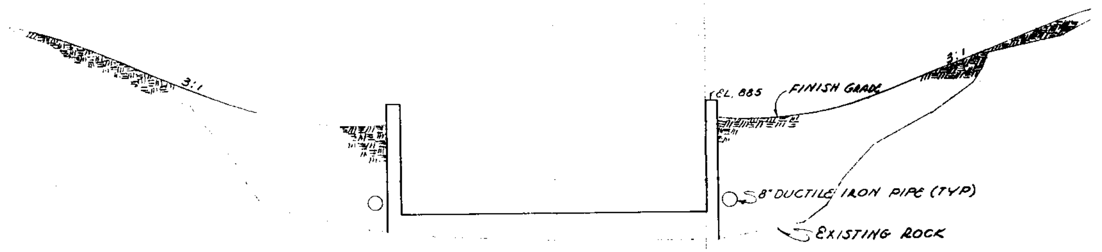


SECTION D-D



SECTION C-C

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TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS ± ____
DECIMALS ± ____
ANGLES ± ½°
SCALE: 1" = 5'

NO.	REVISIONS			DATE	APPD	APPD
DRAWN D.R. BROWN	DATE 6-67	SUBMITTED	DATE	APPROVED	DATE	
DESIGNED R.F. DENKINS D.R. BROWN	DATE 6-67	APPROVED J.H. Gibson	DATE 7-10-67	APPROVED	DATE	
CHECKED A.H. Petree R.F. Denkins	DATE 7-67 7-67	APPROVED	DATE	APPROVED	DATE	

REFERENCE DRAWINGS

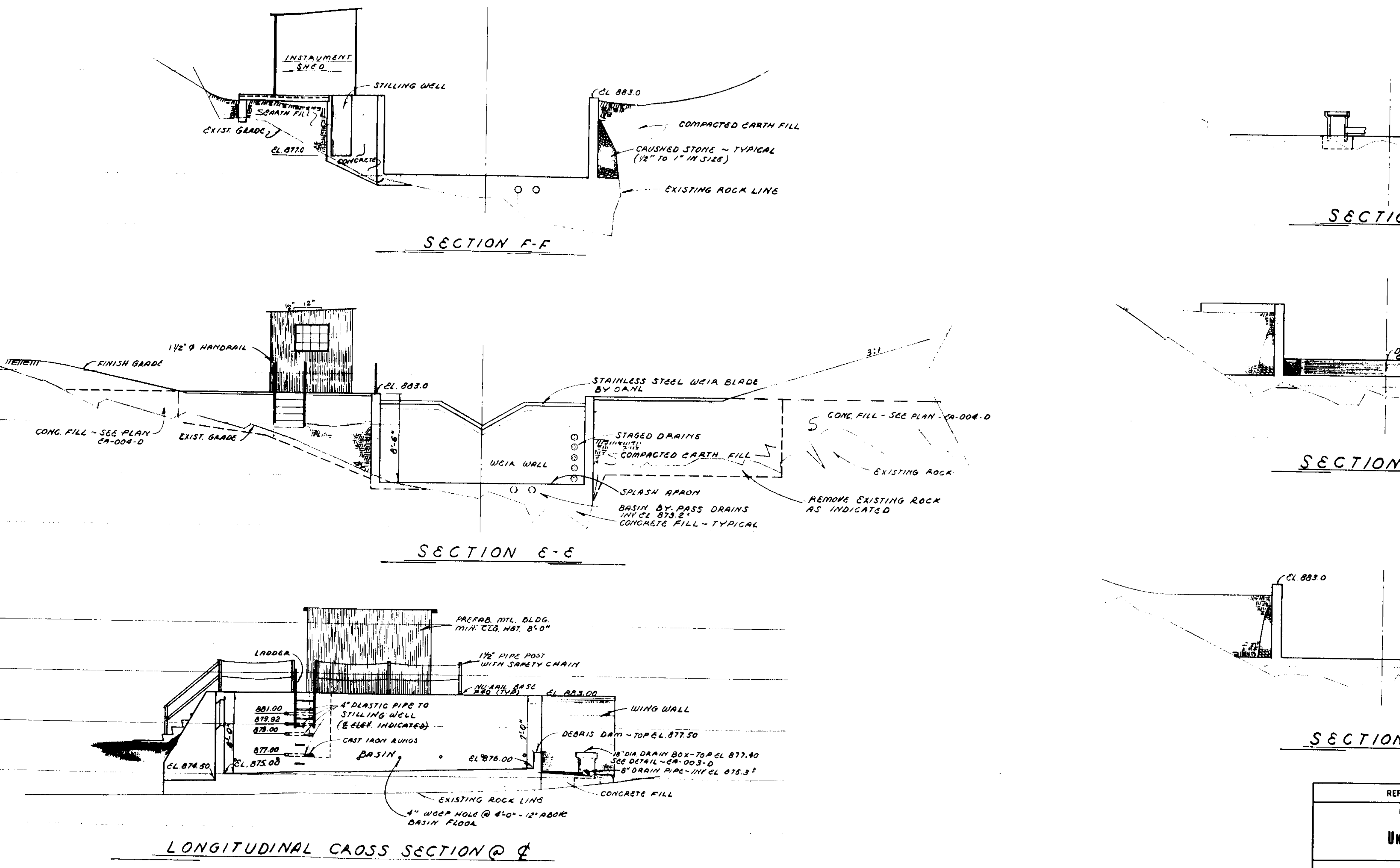
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

AQUATIC WATERSHED SAMPLING FACILITIES - WALKER BRANCH BLDG NO.

SECTIONS
WEST WEIR

SUBMITTED J.H. Gibson
ACCEPTED CH ABNER 7/7/67

C 20031 EA 005



MANUFACTURER'S NAME OR CATALOG NUMBER IS
ON THE DRAWINGS, AN APPROVED EQUAL MAY BE
UNLESS OTHERWISE STATED.

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TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS ±
DECIMALS ±
ANGLES ± 1/2°
SCALE: 1"= 5'

NO.	REVISIONS				DATE	APPD	APPD
DRAWN D.R. BROWN	DATE 6-67	SUBMITTED	DATE		APPROVED		DATE
DESIGNED R. F. DENNINS D.R. BROWN	DATE 6-67	APPROVED J H Gibson	DATE 7-10-67		APPROVED		DATE
CHECKED A.H. Petree R.F. Denkins	DATE 7-67	APPROVED	DATE		APPROVED		DATE

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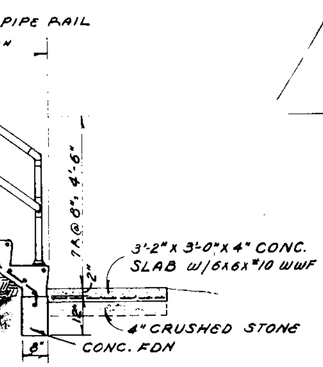
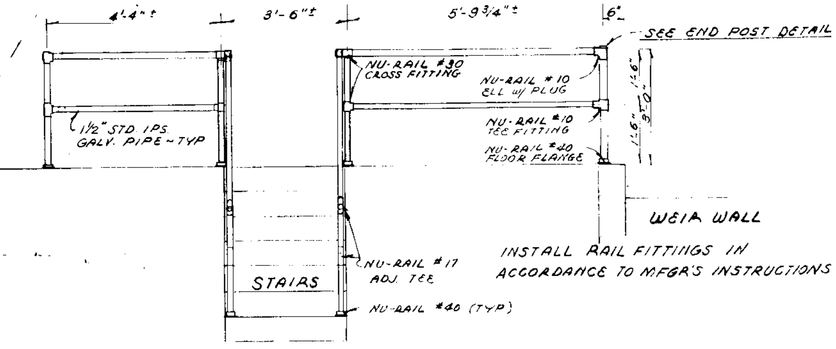
SUBMITTED
JH Gibson

Sections East Weir (006)

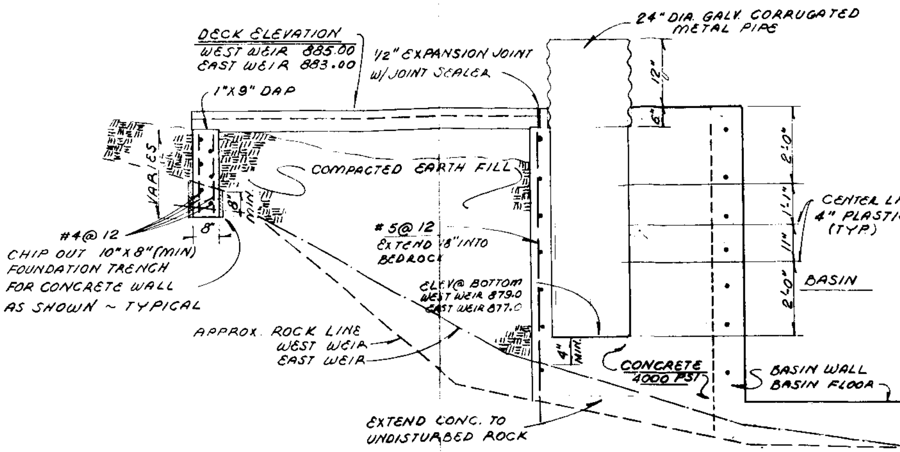


~ WEST WEIR
1'-0"

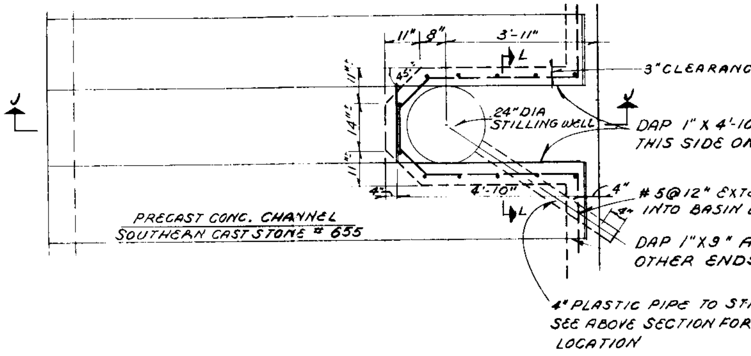


INSTALL RAIL FITTINGS IN ACCORDANCE TO MFGR'S INSTRUCTIONS

TYPICAL HANDRAIL DETAIL
1/2" = 1'-0"
(WEST WEIR)

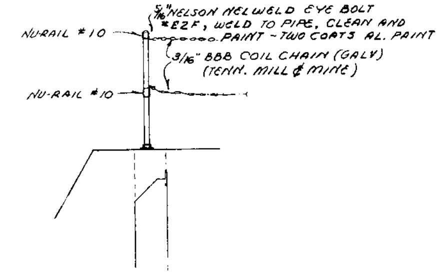


SECTION J-J
1/2" = 1'-0"

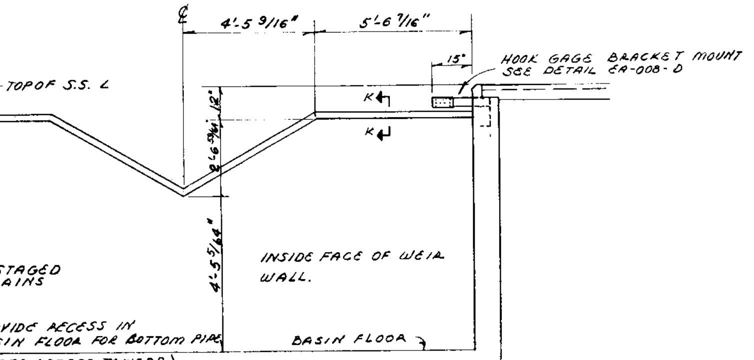


STILLING WELL DETAIL
1/2" = 1'-0"

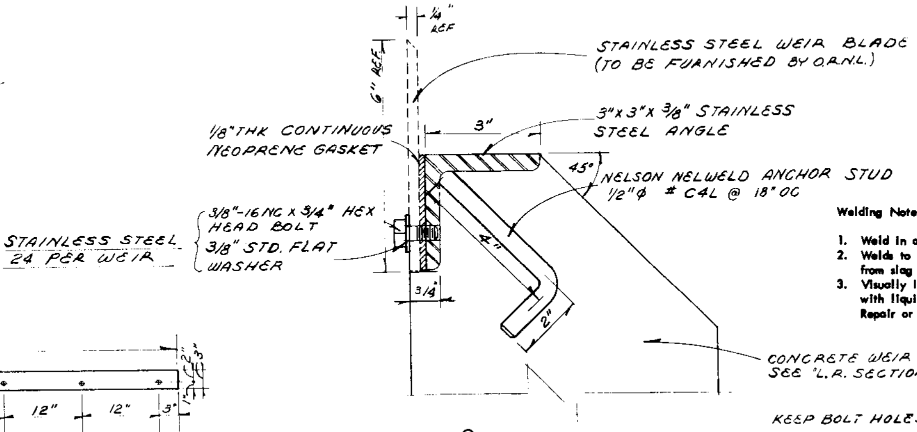
REFER TO "PLAN" FOR LOCATION
EA-003-D ¢ EA-004-D.



END POST DETAIL
1/2" = 1'-0"



WEIR WALL ELEVATION (INSIDE BASIN)
1/2" = 1'-0"



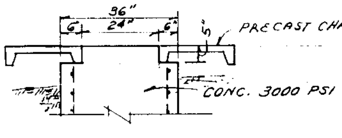
CONCRETE WEIR WALL
SEE "L.R. SECTION" EA-008-D

KEEP BOLT HOLES FREE OF CONC.

SECTION K-K
1/2" = 1"

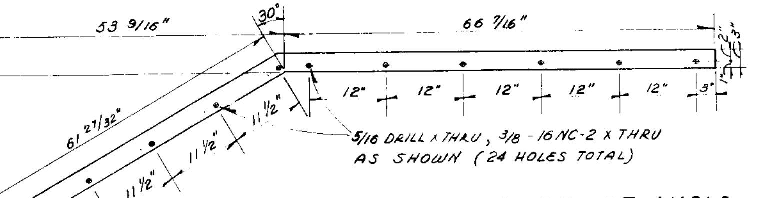
Welding Notes:

1. Weld in accordance with AWS Welding Symbols.
2. Welds to be full penetration with complete fusion, free from slag inclusions, surface cracks, or undercutting.
3. Visually inspect before, during and after welding. Check with liquid penetrant for surface cracks or pin holes. Repair or remove weld defects.



SECTION L-L
1/2" = 1'-0"

WHENEVER A MANUFACTURER'S NAME OR CATALOG NUM
INDICATED ON THE DRAWINGS, AN APPROVED EQUAL M
SUBSTITUTED UNLESS OTHERWISE STATED.



WEIR BLADE SUPPORT ANGLE
MATERIAL: 3"x3"x 3/8" L ~ STAINLESS STEEL
REQUIRED: 1 PER WEIR
1" = 1'-0"

TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS ± ____
DECIMALS ± ____
ANGLES ± 1/2°
SCALE: NOTED

NO.	REVISIONS	DATE	APPD	APPD
1	Relocated Dimension Line (DB)	7-21-67		WRb

DRAWN D.R. BROWN DATE 6-67
DESIGNED R.F. DENKINS D.R. BROWN DATE 6-67
CHECKED A.N. Pettee R.F. Denkins DATE 7-67 7-67
SUBMITTED DATE
APPROVED DATE 7-10-67
APPROVED DATE
APPROVED DATE
APPROVED DATE
APPROVED DATE

REFERENCE DRAWINGS

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORPORATION
OAK RIDGE, TENNESSEE

AQUATIC WATERSHED SAMPLING FACILITIES - WALKER BRANCH BLDG. NO.

SECTIONS AND DETA
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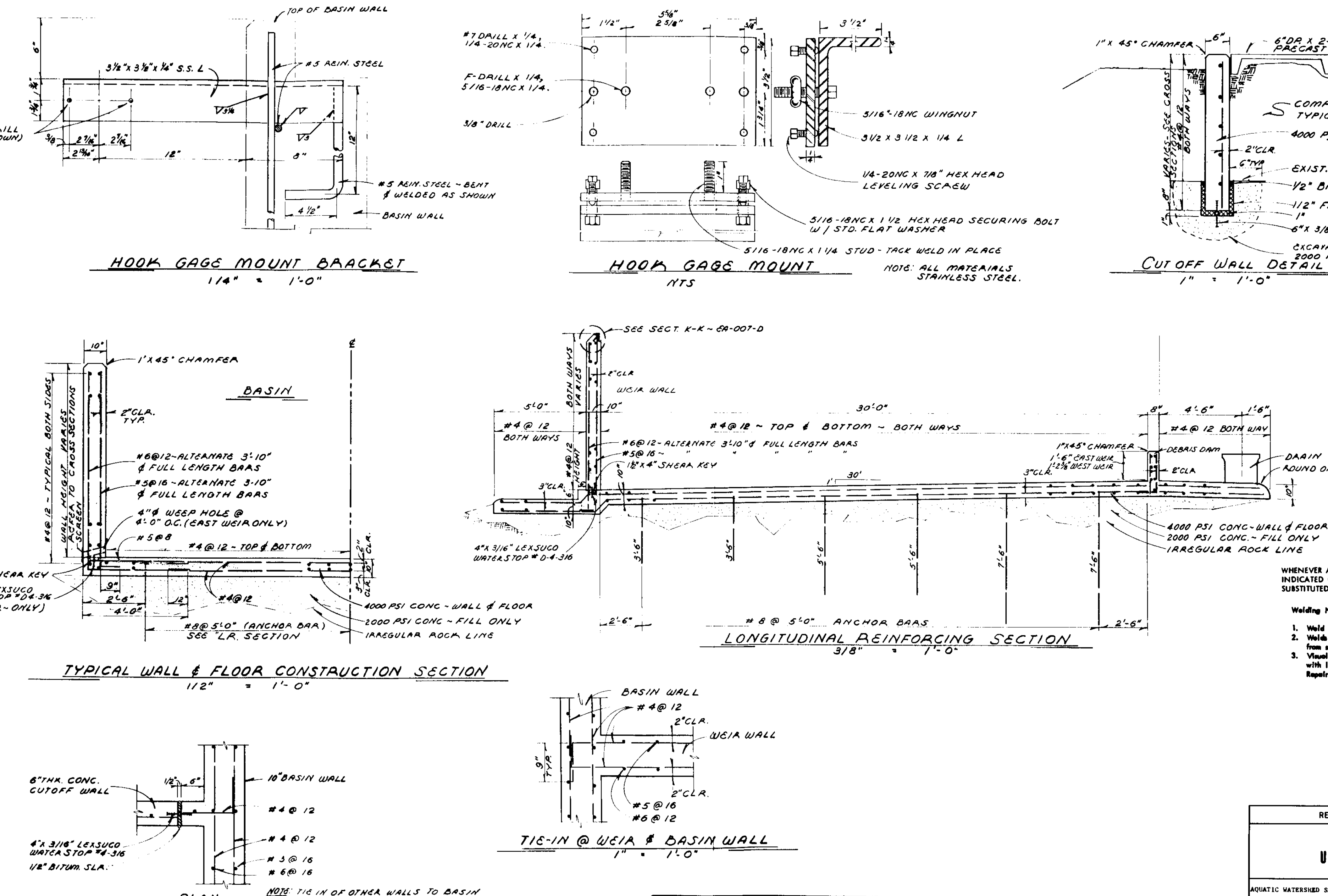
SUBMITTED
ACCEPTED C.H. Abner 7/7/67
AP WR

C 20031 EA 007



HOOK GAGE MOUNT BRACKET
1/4" = 1'-0"

HOOK GAGE MOUNT
NTS

CUT OFF WALL DETAIL
1" = 1'-0"

TYPICAL WALL & FLOOR CONSTRUCTION SECTION
1/2" = 1'- 0"

LONGITUDINAL REINFORCING SECTION
3/8" = 1'-0"

TIE-IN @ WEIR & BASIN WALL
1" = 1'-0"

JOINT DETAIL @ BASIN & CUTOFF WALL
1" = 1'-0"

WHENEVER A
INDICATED
SUBSTITUTED

Welding N

1. Weld
2. Welds from
3. Visual with Repair

TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS ± ____
DECIMALS ± ____
ANGLES ± ½°
SCALE: NOTED

NO.	REVISIONS					DATE	APPD	APPD
DRAWN DR BROWN	DATE 6-67	SUBMITTED	DATE	APPROVED	DATE			
DESIGNED D.R. BROWN	DATE 6-67	APPROVED JH Glen	DATE 7-11-67	APPROVED	DATE			
CHECKED A.K. Petres R.F. Deakins	DATE 7-67 7-67	APPROVED	DATE	APPROVED	DATE			

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SECT

SUBMITTED
JH Glen

APPENDIX C.

DESCRIPTION OF ESTABLISHED SOIL SERIES FOUND ON WALKER BRANCH WATERSHED

1. BODINE SOIL SERIES
2. CLAIBORNE SOIL SERIES
3. FULLERTON SOIL SERIES
4. LINSIDE SOIL SERIES
5. TARKLIN SOIL SERIES

BODINE SERIES

The Bodine series is a member of a loamy-skeletal, siliceous, thermic family of Typic Paleudults. These soils have been developed in residuum from very cherty (low-grade) limestone on dominantly strong to steep slopes. They occur in close geographic association with the Baxter, Mountview, Westmoreland, Sulphura, Frankstown, Nixa, and Fullerton series. The Bodine soils lack the distinct B horizons, are coarser textured, and are more yellow in color than the Baxter and Frankstown soils. Bodine soils are more cherty and lack the evident B horizon of the Mountview profile and lack the chert pans characteristic of the Nixa series. The cherty parent materials reflected in chertiness of the profile, distinguish the Bodine soils from the Westmoreland soils, formed from interbedded limestones, shales, and sandstones, and the Sulphura series, formed from blue-gray shales underlying the cherty materials at shallow depths. The Bodine series is widely distributed and extensive. Chertiness and relatively low fertility combined with strong slopes limit agricultural importance of the soils.

Soil Profile: Bodine cherty silt loam

A_{00} A_0	2-0"	Forest litter and partially decomposed organic matter. 1/2 to 3 inches thick.
A_1	0-2"	Dark grayish brown (10YR 4/2) silt loam with weak fine and medium granular structure; very friable; angular chert fragments, chiefly from 1/2 to 3 inches across are common; strongly acid; boundary abrupt, smooth. 1 to 3 inches thick.
A_2	2-8"	Brown (10YR 5/3) or grayish brown (10YR 5/2) cherty silt loam with weak fine and medium granular structure; very friable; common to many angular chert fragments; very strongly to strongly acid; boundary clear or gradual, wavy. 4 to 8 inches thick.
BC	8-20"	Brownish yellow (10YR 6/6) to yellowish brown (10YR 5/6-5/8) very cherty silt loam or silty clay loam faintly variegated with gray and yellowish red; massive; friable; angular chert fragments are 1/2 or more of horizon; some highly weathered and many coated with pale brown silt; very strongly to strongly acid; boundary gradual, wavy. 8 to 24 inches thick.
C	20-50"	Chert bed with interstices occupied by yellow (10YR 7/6) to brownish yellow (10YR 6/6) silty clay loam or silty clay usually variegated with strong brown, yellowish red, and gray; massive; firm; angular chert fragments are 3/4 of the soil mass; very strongly to strongly acid. 1 to 10 or more feet thick.

Range in Characteristics: Cherty silt loam is the dominant type in the series. Thickness of the regolith ranges from 2-1/2 to 50 feet, possibly more, whereas the thickness of profile above chert beds commonly ranges from 1 to 4 feet. Locally, the soil may contain some fine sand where the chert beds are underlain at shallow depths by unconforming fine-grained sandstone. The chert is flaggy in some profiles, but more commonly it is highly weathered, brownish yellow (10YR 6/6-6/8) and of low density. The high content of chert is a major feature of the soils and tends to obscure other morphology, though there is generally a gradual increase in clay with depth. Estimated chert content ranges from 20 to 75 percent in the upper part of the profile and from 50 to 90 percent in the lower part. The A_1 may range in color from dark grayish brown (10YR 4/2) to grayish brown (10YR 5/2), the A_2 from yellowish brown (10YR 5/4) to grayish brown (10YR 6/2), and the BC horizon from brownish yellow (10YR 6/6) through yellowish brown (10YR 6/4) to strong brown (7.5YR 5/8). Color patterns may also be so finely variegated that no one hue is dominant in the mass. Colors given are for moist conditions. When soil is dry, color values are one or two units higher.

Topography: Dominantly strongly sloping to steep; gradients usually range from about 15 to 20 percent, with a few gentler ridge tops ranging from about 3 or 4 to 15 percent.

Drainage and Permeability: Well drained to excessively drained. Runoff is medium to slow, depending on slope and cover, and permeability is rapid or very rapid.

Vegetation: Chiefly hardwoods such as oak species, hickory, maple, blackgum, and a few pines.

Use: Mostly in forest but with a considerable total acreage in pasture or idle. Some cleared areas are used for crops such as corn, tobacco, small grains, hay, and truck.

Distribution: The Highland Rim region of Tennessee and Alabama; the Pennyroyal region of Kentucky; the Ozark region of Arkansas, Missouri, and Oklahoma.

Type Location: Humphreys County, Tennessee, 3/4 mile north of Hurrican Mill.

Series Established: Humphreys County, Tennessee, 1938.

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CLAIBORNE SERIES

The Claiborne series consists of well drained Red-Yellow Podzolic soils with some characteristics of Reddish-Brown Lateritic soils. These soils are largely on north- or east-facing slopes or on ridge tops in the southern part of the Great Appalachian Valley, and they are developed in residuum of somewhat sandy cherty dolomitic limestones. They are associated chiefly with the Fullerton, Bodine, and Bolton series. The Claiborne soils differ from the Fullerton series in having thinner, much darker A horizons, and more friable, less plastic B horizons, which generally are redder in the lower part. They differ from the Bolton soils in having stronger horizonation and heavier textured, less permeable lower B horizons. Compared to the Bodine series, the Claiborne soils have much darker A horizons and much redder, heavier B horizons. The total acreage of these soils is small, hence their importance to agriculture is limited.

<u>Typifying</u> <u>Pedon</u>: Claiborne silt loam - cultivated

A_p	0-7"	Dark brown (10YR 3/3-4/3) silt loam with moderate fine granular structure; very friable; strongly acid; clear smooth boundary. 6 to 10 inches thick.
B_1	7-16"	Reddish brown (5YR 4/4) light silty clay loam with weak fine subangular blocky structure; friable; few small chert fragments and a little fine sand; very strongly acid; gradual smooth boundary. 4 to 10 inches thick.
B_{21}	16-24"	Yellowish red (5YR 4/6) silty clay loam or clay loam with moderate fine and medium subangular blocky structure; few to common clay films; friable; few chert fragments; very strongly acid; gradual smooth boundary. 7 to 15 inches thick.
B_{22}	24-32"	Red (2.5YR 4/6) to yellowish red (5YR 4/6) silty clay loam or clay with strong fine and medium angular blocky structure; common clay films; friable to firm; few chert fragments; very strongly acid; gradual smooth boundary. 6 to 12 inches thick.
B_{23}	32-48"	Red to dark red (2.5YR 4/6) to (10R 3/6) clay or sandy clay with strong fine and medium angular blocky structure; common clay films; firm, sticky, slightly plastic; few chert fragments; very strongly acid; gradual wavy boundary.
C	48-72"	Red (2.4YR 4/8) cherty clay or sandy clay with common medium mottlings of brownish yellow and strong brown; moderate medium angular blocky structure; few clay films on vertical faces; firm, slightly sticky, slightly plastic; very strongly acid.

Range in Characteristics: Depth to bedrock ranges from about 6 to 30 feet; thickness of solum from 2-1/2 to 6 feet. The boundary between the B and C horizons is difficult to detect. Types are silt loam and loam; there are cherty phases of each. The content of chert and sand varies from place to place. In places, the A_p is dark yellowish brown (10YR 4/4) or dark brown (7.5YR 3/2). Colors given are for moist conditions. When soil is dry, color values are one or two units higher.

Topography: Ridge tops and long, rather steep slopes, particularly the upper ones. Slopes face north or east in most cases. Gradients range from 4 to 30 percent. The surface may have an irregular (karst) configuration.

Drainage and Permeability: Well drained; runoff is medium and permeability is moderate.

Vegetation: Originally hardwoods, including oak species, hickory, beech, elm, yellow poplar, chestnut, ash, and gum. Invaders include Virginia and and shortleaf pine and lower-grade hardwoods.

Use: The steeper slopes are chiefly in pasture or forest. Where cleared and cultivated, crops include corn, tobacco, small grains, hay.

Distribution: Great Appalachian Valley in east Tennessee.

Type Location: Claiborne County, Tennessee; 1 mile east of Guin Post Office.

Series Established: Claiborne County, Tennessee, 1939.

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FULLERTON SERIES

The Fullerton series is a member of a clayey, kaolinitic, thermic family of Typic Paleudults. These soils have brown cherty silt loam A horizons and red cherty clayey B horizons.

Typifying Pedon: Fullerton cherty silt loam - forested

A1 -- 0-2"--Dark grayish-brown (10YR 4/2) cherty silt loam; moderate fine granular structure; very friable; abundant roots; strongly acid; abrupt smooth boundary. 1 to 3 inches thick.

A2 -- 2-11"--Brown (10YR 5/3)cherty silt loam; moderate medium granular structure; very friable; many roots; very strongly acid; clear smooth boundary. 6 to 10 inches thick.

A3 -- 11-15"--Strong brown (7.5YR 5/6) cherty silt loam; few fine streaks of yellowish-red; moderate medium granular and fine subangular blocky structure; friable; many roots; very strongly acid; clear smooth boundary. 3 to 5 inches thick.

B1t -- 15-19"--Yellowish-red (5YR 4/6) cherty silty clay loam; few streaks and pockets of strong brown extending down from A3 horizon; moderate fine subangular blocky structure; friable; few thin patchy clay films; common roots; very strongly acid; clear smooth boundary. 3 to 7 inches thick.

B21t -- 19-30"--Red (2.5YR 4/8) cherty clay; moderate medium and fine subangular blocky structure; firm; patchy clay films; common roots; very strongly acid; gradual smooth boundary. 8 to 15 inches thick.

B22t -- 30-50"--Red (2.5YR 4/8) cherty clay; strong medium subangular blocky structure; firm; continuous clay films; few roots, very strongly acid; gradual smooth boundary. 15 to 25 inches thick.

B23t -- 50-60"--Red (2.5YR 4/8) cherty clay; few medium distinct strong brown mottles; strong medium subangular blocky structure; firm; continuous clay films; very strongly acid; gradual smooth boundary. 8 to 12 inches thick.

B24t -- 60-90"--Red (2.5YR 4/8) cherty clay; common medium and coarse distinct strong brown (7.5YR 5/6) mottles; strong medium subangular blocky structure; firm; thin continuous clay films; very strongly acid. 20 inches to several feet thick.

Type Location: Meigs County, Tennessee: On River Road, 4 miles north of Eaves Ferry Road; on west-facing wooded slope, 150 feet east of a two-pronged chestnut oak tree which is 40 feet west of River Road.

Range of Characteristics: Depth to bedrock ranges from about 6 to 40 feet. Thickness of solum ranges from about 5 to 20 feet or more. Thickness of argillic horizon is more than 50 inches. Chert content by volume of each horizon ranges from 15 to 35 percent in most pedons, but some pedons are nearly free of chert fragments. Most of the chert fragments range from 1 to 4 inches across. The entire profile, except where limed, is strongly or very strongly acid. The A horizon has hues of 10YR or 7.5YR, the norm is 10YR, values of 4 through 6, and chromas of 2 through 4; in cultivated areas, especially in severely eroded areas, the A2 horizon may be absent and the Ap horizon may have hue as red as 2.5YR and chroma as high as 8. Surface soil textures are commonly silt loam, loam, and fine sandy loam, except that severely eroded phases may be silty clay loam or finer. The B horizon has hues of 5YR or redder in the major part. It has values of 4 through 6, rarely 3, and chromas of 6 through 8, chroma may be 4 in the B1 horizon. Clay content increases gradually with depth in the B horizon; it ranges from about 20 to 30 percent in the B1 horizon, and from about 35 to 60 percent in the B2 horizons. Sand content of the B horizon is generally less than 20 percent. Base saturation throughout the B horizon is very low--about 5 to 20 percent.

Competing Series and Their Differentiae: These are the Allen, Baxter, Bodine, Christian, Clarksville, Dewey, Dunmore, Frederick, Minvale, Talbott, and Waynesboro series. The Baxter, Clarksville, Dunmore, and Frederick have average annual soil temperature less than 59°F. The Bodine series has less than 35 percent clay content and more than 35 percent coarse fragments in the B horizon. The Christian series has an argillic horizon less than 50 inches thick. The Dewey series has an Ap horizon darker than value 4, lacks an A2 horizon, and has more clay in the upper part of the B horizon than the Fullerton. The Allen and Minvale series have less than 35 percent clay content in the upper 20 inches of the argillic horizon. The Talbott series has an argillic horizon less than 50 inches thick with more than 35 percent base saturation in the lower part. The Waynesboro series has more than 20 percent sand content in the B horizon. Also, the B horizon of the Waynesboro is commonly dark red in the lower part.

Setting: Gently sloping to very steep uplands. Slopes are about 3 to 40 percent. The regolith is residuum from limestone which is commonly cherty. These soils are in areas that have 45 to 55 inches average annual precipitation and average annual temperatures of about 60°F.

Principal Associated Soils: These are the Bodine, Dewey, and Minvale soils listed as competing series, and the Mountview and Dickson soils which are silty in the upper two feet with the Dickson having a fragipan.

Drainage and Permeability: Well drained. Permeability is moderate.

Use and Vegetation: About two-thirds of the acreage is cleared. Pasture is the main use. Small patches of corn, cotton, tobacco, small grains, and hay are grown. Native vegetation is forests of oaks, hickory, elm, yellow poplar, dogwood, and beech.

Distribution and Extent: The southern part of the Great Appalachian Valley in Alabama, northwest Georgia, and east Tennessee, and the Highland Rim in south-central Tennessee and Alabama. The series is of large extent.

Series Established: Cherokee County, Alabama, 1924.

Remarks: The Fullerton series was formerly classified in the Red-Yellow Podzolic great soil group.

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LINDSIDE SERIES

The Lindside series is a member of a fine silty, mixed, mesic family of aquic fluventic eutrochrepts. These soils are derived from young alluvium washed mainly from uplands underlain by limestone but which may have come in part from soils over other rocks (sandstones and shales, locally from igneous or metamorphic rocks, loess, or from glacial drift, as along the Ohio River and some of its tributaries). The Lindside series is the moderately well drained member of the Huntington-Lindside-Newark-Melvin-Dunning catena. Compared to the Huntington series, the Lindside soils are commonly lighter brown and are more mottled at shallower depths. Lindside soils are browner as well as less mottled and less gray, especially at shallow depth, than the Newark soils. The Lindside soils are browner and less acid than the closely related Philo and Lobelville soils. Lobelville soils are commonly more acid than Lindside soils and have developed in alluvium from drift composed largely or materials originating from sandstone and shale. Eel soils differ from Lindside soils in having developed in alluvium mainly from highly calcareous drift. The Lindside soils are widespread, of large total acreage, and important agriculturally.

<u>Soil Profile</u>: Lindside silt loam - cultivated

A_p	0-7"	Brown (10YR 4/3-5/3) silt loam; weak fine granular structure; very friable; neutral; clear smooth boundary. 6 to 10 inches.
C_1	7-15"	Dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; very friable; neutral; gradual smooth boundary. 5 to 12 inches thick.
C_2	15-26"	Dark grayish brown (10YR 4/2) silt loam; common medium faint mottles of light brownish gray and very dark grayish brown; weak fine granular structure; very friable; few small black and very dark brown concretions; neutral; clear smooth boundary. 6 to 20 inches thick.
C_3	26-48"	Light brownish gray (10YR 6/2) silt loam; common medium distinct mottles of very dark grayish brown and dark yellowish brown; massive; friable; common small very dark brown and black concretions; neutral. One to several feet thick.

<u>Range in Characteristics</u>: Some stratification of sediments may be evident in any profile, but the major portion (C_1 and C_2 horizons) is medium-textured. The surface layer may range from sandy loam to silty clay loam in texture, and a comparable range may also occur below depths near 3 feet. Gravel or chert are common in the surface layer in places so gravelly and cherty phases are recognized. Where Lindside soils are associated with uplands high in phosphate, phosphatic phases are also recognized. Where the series occurs in regions dominated by red or dark red soils, the A_p and C_1 horizons are commonly dark reddish brown to reddish brown, thus the A_p horizon ranges in color from brown (10YR 5/3) to dark brown

(10YR 3/3 or 7.5YR 3/2), very dark grayish brown (10YR 3/2), and dark reddish brown (5YR 3/2). The C_1 horizon may be brown, yellowish brown, dark yellowish brown, or reddish brown, and it ranges in structure to weak coarse prismatic or weak very coarse subangular blocky. Dominant color of the C_2 horizon may be yellowish brown or light olive brown and of the C_3 horizon light olive gray or gray. Reaction is commonly slightly acid to mildly alkaline but may be medium acid. Colors given are for moist conditions. When soil is dry, color values are commonly one or two units higher.

Topography: Nearly level floodplains and upland drainageways; gradients range mostly from 0 to 3 percent.

Drainage and Permeability: Moderately well drained. Runoff is very slow or slow; permeability is moderate to rapid. The water table lies within 3 feet or less of the surface for appreciable periods. Subject to overflow.

Vegetation: Hardwoods, including water-tolerant oaks, maples, elms, sycamore, poplar, willow, shagbark hickory, and ash; canebrakes in places.

Use: Nearly all areas are cleared and cultivated or pastured. Crops include corn, cowpeas, soybeans, hay, tobacco, and, in southern range of the series, cotton. Yields are good except in wetter years.

Distribution: Kentucky, Tennessee, Georgia, Alabama, Virginia, Maryland, Pennsylvania, Arkansas, Missouri, Ohio, Indiana, and West Virginia.

Type Location: Henderson County, Kentucky; in Green River bottoms, 4 miles east of Bluff City.

Series Established: Monroe County, West Virginia, 1925.

Remarks: The moderately well drained soils formerly mapped in the Hamblen series and in the Ooltewah series (with alluvium over 14 inches thick) are now included in the Linside series.

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TARKLIN SERIES

The Tarklin series is tentatively classed in the fine-loamy, siliceous, thermic family of Typic Fragiudults. These soils have dark grayish-brown cherty silt loam A horizons, yellowish-brown very strongly acid cherty silt loam B horizons, and mottled very firm cherty fragipans that extend to depths of more than 50 inches.

Typifying Pedon: Tarklin cherty silt loam - cultivated
(Colors are for moist soil)

A_p -- 0-8"--Dark grayish-brown (10YR 4/2) cherty silt loam, weak fine granular structure; very friable; many roots; strongly acid; clear smooth boundary. 7 to 12 inches thick.

B1 -- 8-11"--Yellowish-brown (10YR 5/4) cherty silt loam; weak fine subangular blocky structure; friable; many roots; some peds coated with very pale brown silt; very strongly acid; gradual smooth boundary. 3 to 6 inches thick.

B21t -- 11-19"--Yellowish-brown (10YR 5/6) cherty silt loam, finer textured than the horizon above; moderate medium blocky structure; friable; common roots; few clay films; very strongly acid; abrupt wavy boundary. 7 to 10 inches thick.

Bx -- 19-56"--Mottled yellowish-brown (10YR 5/4), strong brown (7.5YR 5/6) and light brownish-gray (2.5YR 6/2) cherty silt loam; weak prisms break into weak medium plates or angular blocks; very firm, compact, brittle; the prisms are separated by tongues and ped coats of gray (10YR 5/1) clay; common black concretions; common black stains; very strongly acid; gradual wavy boundary. 20 to 40 inches thick.

C -- 56-72"+--Mottled yellowish-red (5YR 4/6, 4/8, 5/6, 5/8) strong brown (7.5YR 5/6) yellowish-brown (10YR 5/4, 5/6, 5/8) and light gray (10YR 7/1, 7/2) very cherty silty clay loam; weak coarse blocky structure; firm; some peds covered with very pale brown silt coats; few black concretions; very strongly acid. 1-1/2 to 7 feet thick.

Type Location: Barren County, Kentucky; on terrace of Fallen Timber Creek at Cordell Hull Highway; 5.5 miles southeast of Glasgow, and 2.3 miles northwest of Temple Hill.

Range in Characteristics: Thickness of the cherty regolith is 4 to 12 feet. Thickness of solum, which coincides with the base of the fragipan is 40 to 65 inches. The soil contains 15 to 45 percent coarse fragments by volume; they are mainly of chert, but include some sandstone, quartzite, and geodes. Base saturation 30 inches below the top of the fragipan is less than 30 percent. Color of the A_p horizon is centered on dark grayish-brown (10YR 4/2) but includes brown (10YR 5/3 or 4/3) and pale brown (10YR 6/3). The A_2 horizon, where present, is pale brown (10YR 6/3) or rellowish-brown (10YR 5/4). Texture of the upper part, and yellowish brown (10YR 5/6) in the lower part. The lower part ranges from yellowish-brown (10YR 5/4) to light yellowish-brown (10YR 6/4) and in some places it has low chroma mottles in a 2 to 4 inch zone above the Bx horizon. Texture of the B2t horizon is slit loam or silty clay loam; clay content is 18 to 25 percent. In some pedons, the B2t horizon has a weak grade of structure. The Bx horizon has dominant color of light yellowish-brown (10YR 6/4) and mottles of yellowish-brown (10YR 5/4 or 5/6). Texture of the Bx horizon is light silty clay loam in some pedons. The C horizon has dominant colors of strong brown (7.5YR 5/6) or yellowish-brown (10YR 5/4) but it contains mottles of yellowish-red (5YR 4/6, 4/8, 5/6, 5/8) and light gray (10YR 7/1,7/2). Textures are very cherty silt loam, or silty clay loam. In some pedons the C horizon is extremely acid in reaction.

Competing Series and Their Differentiae: These are in the Airmont, Dickson, Landisburg, Leadvale, Locust and Nixa series. The Bt horizons of the Airmont and Locust soils are loam, sandy clay loam, and light clay loam and the fine earth fraction contains more than 15 percent coarser than very fine sand, in contrast to contents of less than 15 percent in the Tarklin soils. Dickson soils contain less than 15 percent coarse fragments, by volume, in the B horizon or control section. Landisburg soils have mean annual soil temperatures of less than 59°F. Leadvale soils lack coarse fragments of chert and quartzite. Nixa soils contain more than 50 percent, by volume, of chert and have average annual soil temperatures of less than 59°F.

Setting: Most of the soil is on foot slopes and stream terraces, but some is on upland ridgetops and upper slopes. Slopes range from 3 to 12 percent and generally are concave. These soils are in areas having 45 to 52 inches average annual precipitation, and average annual temperature is about 62°F.

Principal Associated Soils: These are the Baxter, Bodine, Clarksville, and Fullerton soils on adjoining uplands, Greendale soils on foot slopes, Humphreys soils on terraces and Ennis soils on bottomlands.

Drainage and Permeability: Moderately well drained; much of the soil is marginal to somewhat poorly drained. Runoff is medium, and permeability is slow.

Use and Vegetation: Mainly in cropland; corn, small grains, sorghum, tobacco, anc cotton are major crops; somewhat less than half is in pasture and forest. Forests are chiefly of oaks, hickories, beech, elm, dogwood, persimmon, and some shortleaf Virginia, and loblolly pines.

Distribution and Extent: The southern part of the Mississippian Plateau and Great Appalachian Valley in Kentucky and Tennessee, probably in northwestern Georgia, and northern Alabama. The soil is extensive; an estimated area is 120,000 acres. Kentucky and Tennessee each 35,000 acres, Georgia 30,000 acres, Alabama 20,000 acres.

<u>Series Established</u>: Barren County, Kentucky, 1966.

<u>Remarks</u>: The Tarklin series previously was classified in the Red-Yellow Podzolic great soil group. The comprehensive classification is tentative at the subgroup level. The evidence for the argillic horizon above the fragipan is inconclusive.

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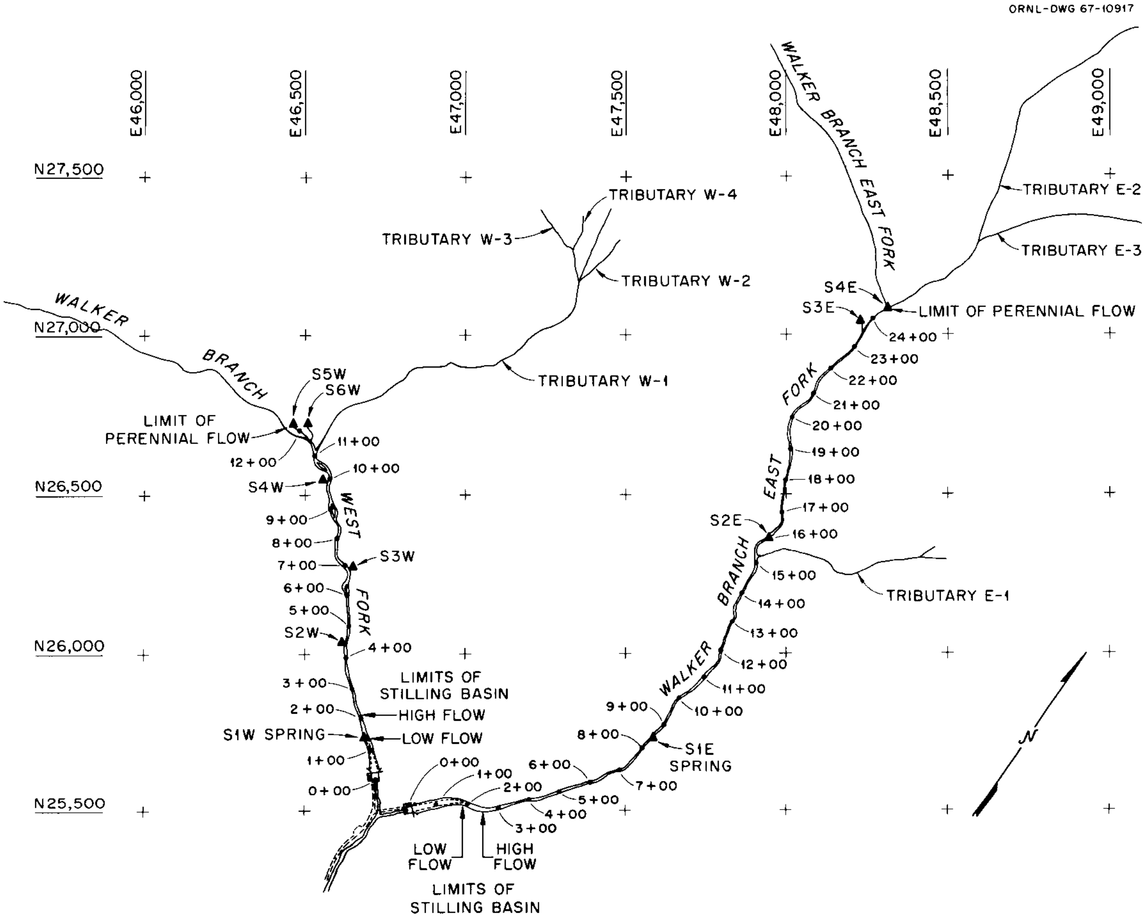
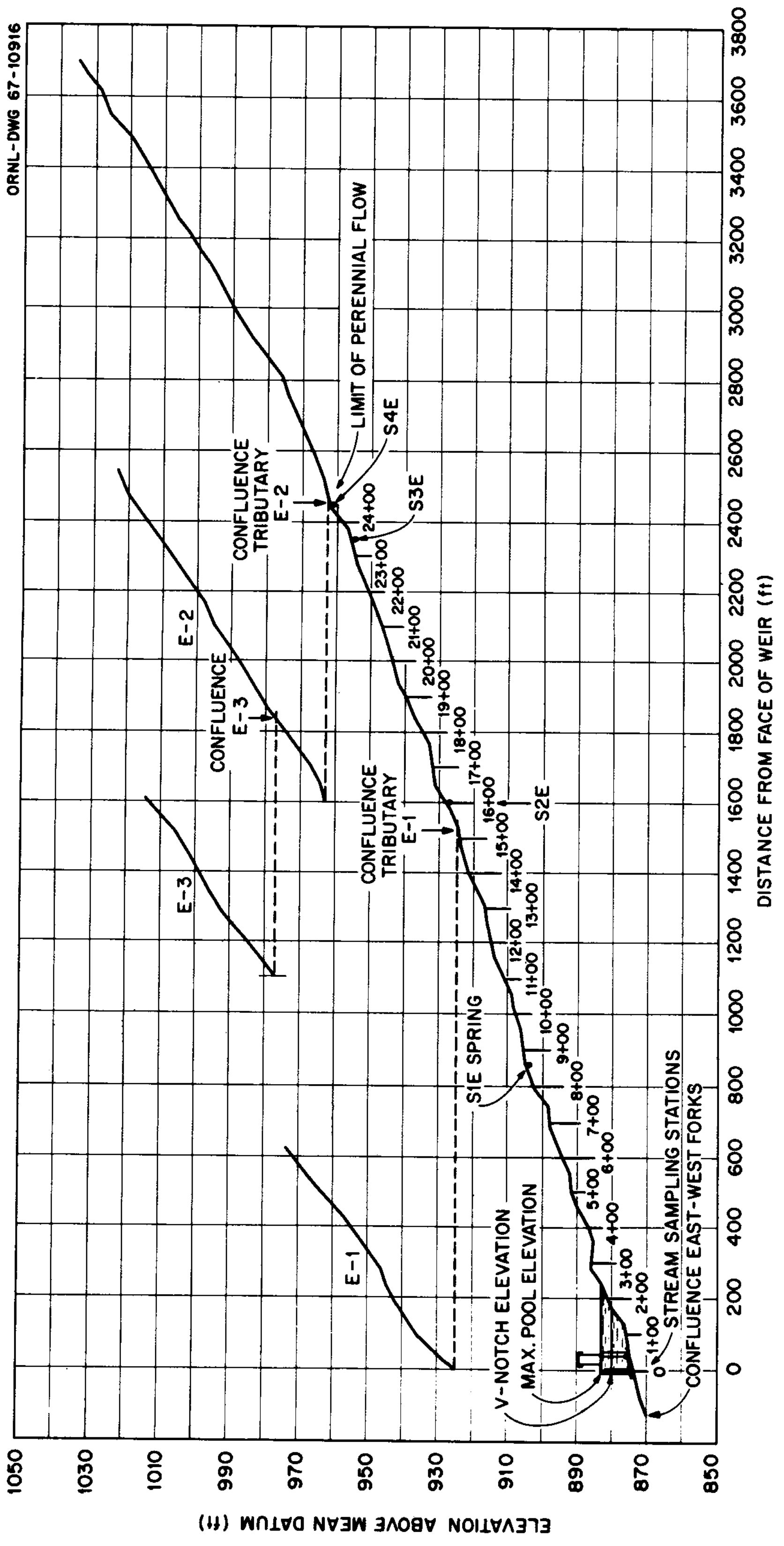
APPENDIX D.

BIOTIC AND PHYSICAL CHARACTERISTICS OF WALKER BRANCH

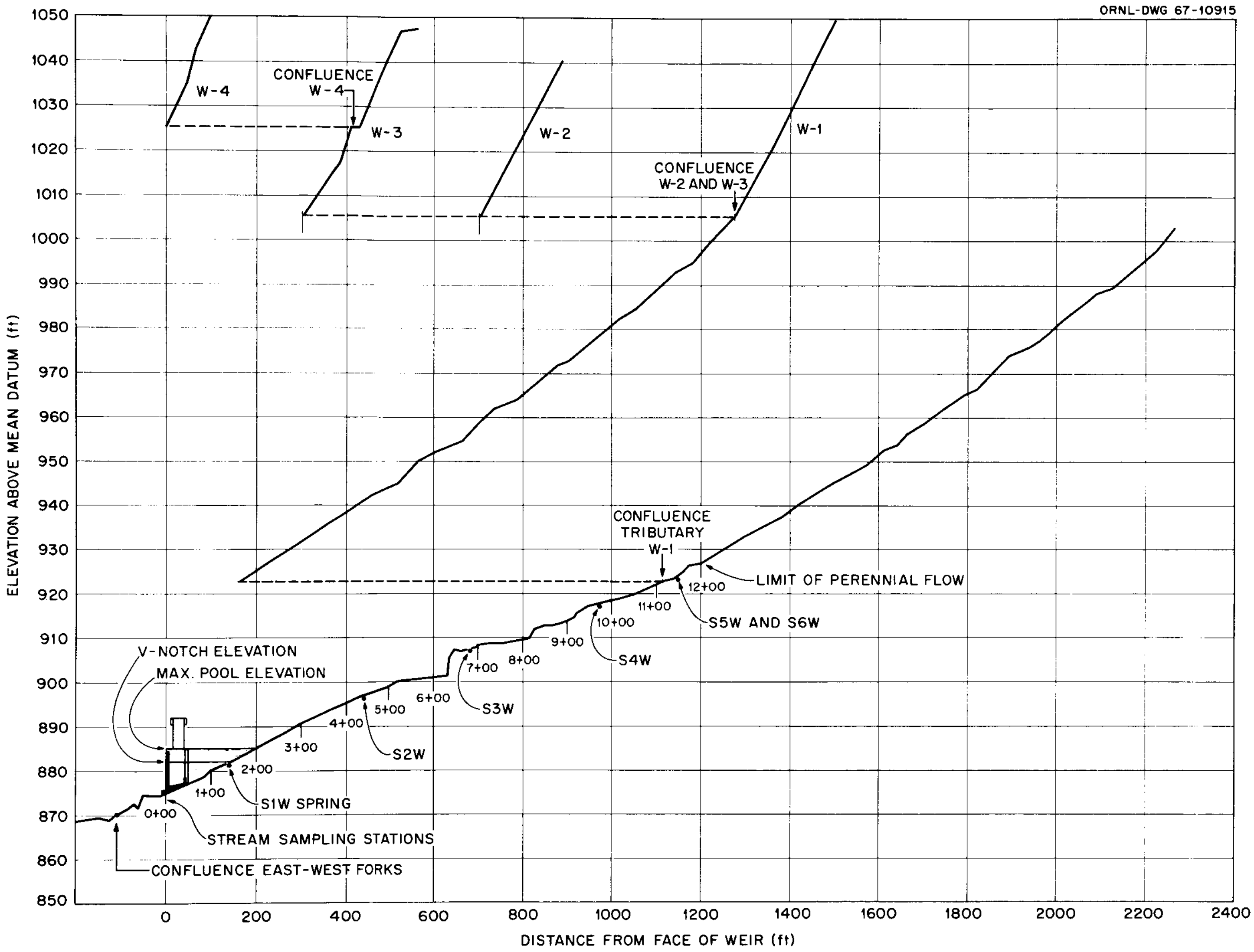
1. HORIZONTAL TRAVERSE OF WALKER BRANCH
2. PROFILE OF EAST FORK SUBWATERSHED AND TRIBUTARIES
3. PROFILE OF WEST FORK SUBWATERSHED AND TRIBUTARIES
4. PRELIMINARY LIST OF FAUNA FOUND IN WALKER BRANCH



Horizontal Traverse of Walker Branch



Profile of East Fork Subwatershed and Tributaries



Profile of West Fork Subwatershed and Tributaries

Preliminary List of Fauna Found in Walker Branch

Taxon	Occurrence West Fork	Occurrence East Fork
Arthropoda		
Amphipoda		
Gammarus sp.	X	X
Plecoptera		
Peltoperlidae	X	X
Leuctridae	X	X
Capniidae	X	X
Perlidae		
Perlinella drymo	X	
Acroneuria arida	X	
Neophasgonophora sp.	X	
Isoperlidae		
Isoperla bilineata	X	
I. marlynia	X	
Chloroperlidae	X	
Ephemeroptera		
Ephemeridae		
Ephemera guttulata		X
Leptophlebiidae		
Paraleptophlebia sp.		X
Habrophlebia sp.	X	
Habrophlebiodes sp.	X	
Baetidae	X	
Baetis sp.	X	X
B. vagans		X
B. rusticans	X	X
B. phoebus		X
Heptageniidae		
Stenonema sp.	X	X
S. gildersleevi	X	
S. tripunctatum	X	
S. bipunctatum	X	
S. ares	X	X
Megalaptera		
Sialidae		
Sialis sp.		X

Taxon	Occurrence		Taxon	Occurrence	
	West Fork	East Fork		West Fork	East Fork
Corydalidae			Odontoceridae		
Chauliodes sp.	X	X	*Psilotreta sp.*	X	X
Trichoptera			Goeridae		
Rhyacophilidae			*Geora sp.*		X
Rhyacophila fenestra		X	Lepidostomatidae		
Glossosoma sp.	X	X	*Lepidostoma sp.*	X	X
Philopotamidae			Coleoptera		
Trentonius sp.	X		Dytiscidae		
Psychomyiidae (undet)		X	*Laccophilus sp.*	X	
Neureclipsis sp.	X		*Copelatus sp.* (adult) light trap		
Polycentropus sp.	X	X	Noteridae		
P. cinereus	X	X	*Suphisellus sp.*	X	
Hydropsychidae			Psephenidae		
Parasyche sp.	X		*Psephenus sp.*	X	X
Diplectrona sp.	X	X	*Ectoparia sp.*	X	X
Smicridea sp.		X	Curculionidae		
Hydropsyche aerata			*Listronotus sp.*		X
H. betteni		X	Diptera		
Hydroptilidae (undet)		X	Tipulidae	X	
Pycnopsyche sp.	X	X	*Holorusia sp.*		
Neophylax autumnus	X	X			

Taxon	Occurrence	
	West Fork	East Fork
Antocha sp.		X
Dicranota sp.		X
Pedicia sp.	X	
Dixidae		
Dixa dixa		X
Simuliidae	X	X
Chironomidae		
Cryptochironomus sp.		X
Chironomus aberrans		X
Mollusca		
Goniobasis clavaeformis	X	X
Vertebrata		
Amphibia		
Plethodontidae		
Desmognathus fuscus (Rafinesque), Dusky Salamander		
Plethodon g. glutinosus (Green), Shiny Salamander		
Pseudotriton r. ruber (Sonnini), Northern Red Salamander		
Eurycea bislineata (Green), Two-Lined Salamander		
Osteichthyes		
Cypriniformes		
Cyprinidae		
Rhinichthys cataractae		
Semotilus atromaculatus		

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