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THE INTEGRATION OF BASIN, STREAMFLOW AND CHANNEL CHARACTERISTICS FOR CHANNEL CONDITION ANALYSES

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Prepared for:
EPA - Region 10
Office of Ecosystems and Communities
Seattle, WA

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Grant No. X990717

April 2001

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RESUME

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REGISTERED
PROFESSIONAL
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Civil, in the States of Minnesota, Washington,
Oregon, Alaska, Idaho, and Montana (1990)

PROFESSIONAL
SOCIETIES

Active Member: ASCE, AFS
Past Member: NSPE, APWA, TRB (NAS), ASEE, AGU

EDUCATION

University of Wisconsin - Ph.D.: Civil Engineering,
Hydrology, and Water Resources; Minor: Soils and
Geology, 1964

University of Minnesota - M.S.: Civil Engineering
(Hydromechanics); Minor: Water Supply, 1960

University of Colorado - B.S.: Civil Engineering
(Hydrology); Minor: Sanitary Engineering, 1957

Colorado College - B.A. (History), 1952

Elgin Academy - Elgin, Illinois, 1947

POSITIONS

Aug 1988-
Present

Professor and Hydraulic Research Engineer
Washington State University

Aug 1987-
Aug. 1988

Professional Leave: Survey of computer uses in
Fisheries; U.S. and Canadian Survey and Report;
partially supported by Atlantic Salmon Federation
Olin Fellowship.

Sept 1981-
1987

Professor and Hydraulic Research Engineer
Washington State University

Sept 1980-
August 1981

Professional Leave: Hydraulic Design Engineer with
Siuslaw National Forest, Corvallis, Oregon; and
Tongass National Forest, Ketchikan, Alaska; Courtesy
appointment as Professor in Department of Civil
Engineering at Oregon State University; conducting
research and writing on fisheries engineering and
hydrology.

July 1976-
August 1980
Chairman, Department of Civil and Environmental Engineering, Washington State University; Pullman, Washington.
Re-elected to second term in 1980. Declined in order to continue teaching and research.

July 1974-
June 1976
Professor and Hydraulic Research Engineer, Department of Civil and Environmental Engineering, Albrook Hydraulic Laboratory, Washington State University.

July 1969-
October 1974
Head, The R.L. Albrook Hydraulic Laboratory, Department of Civil and Environmental Engineering, Washington State University.

July 1968-
June 1969
Acting Head, The R.L. Albrook Hydraulic Laboratory, College of Engineering Research Division, Washington State University.

July 1968-
June 1974
Associate Professor of Civil Engineering, Washington State University, Teaching Fluid Mechanics, River Engineering, Water Resources Engineering, Senior Design, Orientation.

August 1964-
July 1968
Assistant Head, The R.L. Albrook Hydraulic Laboratory; Assistant Professor of Civil Engineering, College of Engineering Research Division, Washington State University.

July 1961-
June 1964
Project Assistant, University of Wisconsin, Sedimentation Basin Research at Hydraulics and Sanitary Engineering Laboratory.

February 1957
July 1961
Research Fellow, Design and Investigation of Hydraulic Models, St. Anthony Falls Hydraulics Laboratory, Minneapolis, Minnesota. Structural Design for Laboratory Expansion and Improvements. Instructor: Laboratory Courses Taught in Hydromechanics, Highway Pavements, Soil Mechanics, Applied Hydraulics and Hydrology, Lecture Course in Hydromechanics.

Summer 1956
U.S. Army Corps of Engineers, Hydrologic Design Branch, Design of Internal Flood Drainage for Levees, Missouri River System, Omaha, Nebraska.

1952-1955
Standard Practices and Flood Control (PL-566) for the U.S. Soil Conservation Service in Fairplay, Cripple Creek, and Colorado Springs, Colorado.

1949-1952
Surveying and Drafting for Consulting Engineering Firm in Colorado Springs, Colorado.

INSTRUCTION:

Courses taught between 1964 and the present in the Department of Civil and Environmental Engineering at Washington State University:

CEE 110 - Introduction to Civil and Environmental Engineering
CEE 299 - Civil Engineering Systems
CEE 315 - Mechanics of Fluids
CEE 351 - Hydrology
CEE 451 - Open Channel Flow
CEE 453 - Water Resources Engineering
CEE 460 - Intermediate Hydrology
CEE 465 - Systems and Design
CEE 480 - Senior Seminar in Professionalism
CEE 497 - Senior Design Problem Selection
CEE 498 - Engineering Systems Analysis and Design
CEE 499 - Senior Independent Study
CEE 553 - River Engineering
CEE 557 - Fisheries Engineering
CEE 563 - Hydropower Planning and Design
CEE 600 - Independent Study
CEE 700 - Master's Research and Thesis
CEE 702 - Masters Directed Study
CEE 800 - Doctoral Research and Dissertation

RESEARCH PROJECTS AND REPORTS:

CHARACTERISTICS OF TURBULENT FLOW THROUGH RECTANGULAR-BAR BAFFLES, M.S. Thesis (Hyromechanics), University of Minnesota, 1959-1960 under Dr. A.G. Anderson. An Analytical and experimental investigation of the geometric parameters which affect energy dissipation associated with flow through rectangular bar baffles as used in hydraulic structures. Projects investigated at St. Anthony Falls Hydraulics Laboratory, University of Minnesota, under the supervision of Dr. Lorenz G. Straub, 1957-1960: Mangla Dam Spillway, E. Pakistan; Priest Rapids Dam Powerhouse Fish Facilities; Wanapum Dam Powerhouse Fish Facilities; Wanapum Cofferdam Studies; Mission Creek Dam Spillway, British Columbia.

DRAINAGE BASIN INFLUENCES ON HYDROLOGIC PARAMETERS. Ph.D. Thesis (Hydrology), University of Wisconsin, 1964 under Dr. A.T. Lenz. A field and analytic comparative study of three geologically diverse drainage basins in North-Central Wisconsin to determine their physical influences on surface and ground-water streamflow components. Methods developed for the prediction of future ground-water levels and for determination of water balances and streamflow components on the basins. Projects investigated at Hydraulic and Sanitary Laboratory, University of Wisconsin, under the supervision of Dr. James R. Villemonte, 1961-1964: HYDRAULIC CHARACTERISTICS OF RECTANGULAR SEDIMENTATION BASINS, American Petroleum Institute and National Institutes of Health. HYDRAULIC CHARACTERISTICS OF CIRCULAR SEDIMENTATION BASINS, American Petroleum Institute and National Institutes of Health.

AS PRINCIPAL INVESTIGATOR AT ALBROOK HYDRAULICS LABORATORY, HYDRAULIC ENGINEERING SECTION, DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING, WASHINGTON STATE UNIVERSITY:

- HELLS CANYON SPILLWAY WALL AND SCOUR STUDIES, Idaho Power Co., Project Report, October 1964-February 1965.
- SUPPLEMENTARY HYDRAULIC MODEL TESTS OF THE SOUND SUPPRESSOR INLET, Author of Part 3, Supercritical Hydraulic Model, NASA, Research Report 65/9-92, 1965.
- HYDRAULIC MODEL STUDIES OF SULLIVAN CREEK DAM, Research Report 65/9-99, College of Engineering Research Division, Washington State University, August 6, 1965.
- RESEARCH NEEDS IN NAVIGATION, State of Washington Water Research Center, Planning and Evaluation Project, November 1965. Part of WRC Report No. 1, October, 1967.
- ANALYTICAL AND EXPERIMENTAL STUDIES OF SOUND SUPPRESSOR COMPONENTS--PART B, Theoretical and Dimensional Analysis, Supersonic Nitrogen Jet Apparatus, NASA Research Report published June, 1967.
PART C, Supercritical Hydraulic Jet, NASA Research Report published June, 1967.
- HYDRAULIC STUDIES OF CLAY SLURRY FLOW CHARACTERISTICS, J.R. Simplot Co., April-August 1967.
- HYDRAULIC MODEL STUDIES OF FLOATING BREAKWATERS, Wood Construction Research, Pacific Northwest Forest Experiment Station, U.S. Forest Service, Seattle, Research Report 68/9-1, June-December, 1967.
- CERRO PRIETO GEOTHERMAL WELL INVESTIGATIONS, Federal Electrical Commission of Mexico, Mexicali, B.C., 1968-1969, with J.W. Crosby III.
- FLUSHING OF SMALL SHALLOW LAKES, FWPCA Contract No. WP 01313, February-October, 1968; February-October, 1969. Report of same title, EPA, Water Pollution Control Research Series, 16010 DMG, December, 1971, with C.C. Lomax.
- ECONOMIC AND ENGINEERING CRITERIA FOR FLOOD ALLOCATION, Project Leader, Washington State Department of Water Resources, February, 1968-July, 1969. Report No. 4, State of Washington Water Research Center, June, 1970.
- SAMOWEN CAMPGROUND BEACH EROSION STUDY, U.S. Forest Service, Kaniksu National Forest, Sandpoint, Idaho. Research Report 68/9-126, November, 1968.
- HYDRAULIC MODEL STUDIES OF FISH GUIDANCE SCREEN, U.S. Bureau Commercial Fisheries, October, 1968-June, 1969. Research Report 69/9-75, July, 1969.

- EVALUATION OF TRASHRACK DESIGN CRITERIA, Chelan County PUD, February - March, 1969. Research Report 70/9-49, April, 1970.
- HYDRAULIC DESIGN OF ROCKY REACH POWERHOUSE TRASHRACKS, Chelan County PUD, August, 1969- June 1970. Research Report 70/9-49, April, 1970.
- A WATER PLANNING CONCEPT FOR THE STATE OF WASHINGTON, State of Washington Water Research Center, for the Washington State Department of Ecology, Contributor, September, 1970.
- BIBLIOGRAPHY OF SOLID-LIQUID TRANSPORT IN PIPELINES, INCLUDING THEORETICAL ANALYSIS AND RESEARCH NEEDS, Albrook Hydraulic Laboratory, State-of-the-Art Report, 909 References; with W.C. Mih and C.K. Chen, December, 1971.
- VANCOUVER LAKE HYDROLOGIC AND HYDROGRAPHIC STUDIES, Port of Vancouver, September, 1979-March, 1971. Summary Report: WATER QUANTITY AND QUALITY STUDIES OF VANCOUVER LAKE, WASHINGTON, with S.K. Bhagat, Federal Water Pollution Control Administration, September, 1971.
- SIMULATION OF WATER QUALITY ENHANCEMENT IN A POLLUTED LAKE, Bulletin 324, College of Engineering Research Division, with S.K. Bhagat and C.N. Lin, January, 1972.
- PILOT STUDY FOR FLOOD PLAIN MANAGEMENT, Washington Department of Water Resources, February, 1970-June, 1972. Reports: Movie FLOODS AND PEOPLE with Engineering Extension Service; Project Report to Department of Ecology.
- ESTABLISHMENT OF LOW-FLOW CRITERIA FOR CONSERVATION, RECREATION, AND AESTHETIC PURPOSES, Washington Department of Ecology, July, 1970-June, 1972, OWRR Matching Grant Project Completion Report, A SUMMARY OF QUANTITY, QUALITY AND ECONOMIC METHODOLOGY FOR ESTABLISHING MINIMUM FLOWS, WRC Report No. 13, Vol. 1, with B. Mar, J. Crosby III, J. Crutchfield, June, 1973; Vol. 2--Appendices, February, 1976.
- MONITORING AND EVALUATION AND THE SIX-COUNTY (FLOOD) DISASTER PLANNING PROGRAM, HUD Department of Ecology, and Planning and Community Affairs Agency, November, 1971-73.
- DEVELOPMENT OF RIVER BASIN GRAPHICAL MODELS AND STREAMFLOW METHODOLOGY, Washington State Department of Ecology, State Water Planning Program, Hydrographic Atlases and Technical Supplements Prepared for Following Study Areas: Lewis, Cowlitz, Chehalis, Okanogan-Methow, Spokane, and Big Bend, 1973-75.
- STUDENT TRAINING AND PUBLIC EDUCATION IN THE HUMAN WATER ENVIRONMENT-- EXPO '74, EPA Funded for May 1, 1974-December 31, 1974, for Student Host Training and Operation of the WSU Waterworld Pavilion, May-October, 1974. Documentary movie of Expo '74 was project report.
- REGIONAL WATER PROBLEM ANALYSIS IN THE PACIFIC NORTHWEST: PART A-- INSTREAM FLOW NEEDS, with H.R. Doerksen, B.L. Lamb, and F.D. Deane, OWRT Completion Report, Project B-056-WASH, State of Washington, Water Research Center, March, 1975.

- INSTREAM FLOW NEEDS IN THE PACIFIC NORTHWEST, Regional OWRT Project C-5344. Washington Water Research Center, April 15, 1974-April 14, 1975; Report No. 20, September, 1975.
- INVESTIGATIONS OF SILVER LAKE WATER QUALITY: CURRENT PROBLEMS AND POSSIBLE SOLUTION (Cooperative project with Environmental Research Section, Department of Civil and Environmental Engineering), Report on HYDROLOGY OF SILVER LAKE with M. Tsang, for the Washington Department of Ecology, April 1, 1974-March 30, 1975. WRC Report No. 19, July, 1975.
- CAPITOL LAKE HYDRAULIC AND WATER QUALITY STUDIES (Cooperative project with Environmental Research Section, Department of Civil and Environmental Engineering), Washington Department of General Administration, March 15, 1974-June 30, 1975; Co-investigators: W.C. Mih, C.C. Lomax. Reports on Sedimentation (3), Hydrology, and Hydraulic Model Studies prepared by Principal Investigator between August, 1974 and July, 1975, October, 1975.
- RELATIONSHIPS OF LOW, AVERAGE, AND FLOOD FLOWS IN THE PACIFIC NORTHWEST, OWRT Allotment project A-WASH, January 15-June 30, 1975, State of Washington, Water Research Center, Completion Report, August, 1975.
- PRELIMINARY INVESTIGATION OF THE WATER RESOURCES OF THE NORTHERN PART OF THE COEUR D'ALENE INDIAN RESERVATION, Appendix D, Technical Supplement-Surface Water Resources of the Coeur d'Alene, St. Joe, and St. Maries Rivers in Northern Idaho, December, 1975.
- INVESTIGATION INTO METHODS OF DEVELOPING A PHYSICAL ANALYSIS FOR EVALUATING INSTREAM FLOW NEEDS, OWRT Project A-084-WASH, State of Washington, Water Research Center, July 1, 1975-June 30, 1976.
- SUPPLEMENTAL HYDRAULIC MODEL STUDIES OF CAPITOL LAKE, WASHINGTON, Washington Department of General Administration, Two Reports; with W.C. Mih, December, 1975-May 1976.

Research from 1976-1980 limited to graduate student thesis projects (listed separately) while serving as Chairman of the Department of Civil and Environmental Engineering.

- DEVELOPMENT OF NEW CONCEPTS IN FISHLADDER DESIGN, Quarterly and Annual Progress Reports, BPA Fisheries Project 82-14, June, 1982-December, 1984.
- PLANNING FOR THE RESTORATION OF MEANDERS ON A TRIAL BASIS, Crooked River (Idaho) Habitat Improvement Project, Final Report, USDA Forest Service, Nez Perce National Forest, Elk City Ranger District, March, 1985.
- A PRELIMINARY EVALUATION OF THE RED RIVER (IDAHO) SEDIMENT TRAP, USDA Forest Service, Nez Perce National Forest, Red River Ranger District, September, 1985.

Four final projects reports for the Development of New Concepts in Fishladder Design (BPA Project 82-14), August, 1985:

1. Summary (Orsborn);
 2. New Concepts in Fishladder Design--Results of Laboratory and Field Research on New Concepts in Weir and Pool Fishways (Aaserude and Orsborn);
 3. Fishways--An Assessment of Their Development and Design (Orsborn and Powers);
 4. Analysis of Barriers to Upstream Fish Migration--An Investigation of the Physical and Biological Conditions Affecting Fish Passage Success at Culverts and Waterfalls (Powers and Orsborn).
- HYDROLOGY OF STREAMS ON THE OLYMPIC PENINSULA, with Karen S. Amerman, sponsored by the Federal Highway Administration, U.S. Forest Service, Bureau of Indian Affairs (Jamestown-Klallam Tribe), and Washington State University. Project Report, August, 1987.
 - MEADOW CREEK RESTORATION PROJECT, study conducted in Starkey Research Forest near Starkey, Oregon for USDA, Forest Service, Region 6., Portland, Oregon. May-September, 1987.
 - COMPUTER MODELS OF HYDROLOGY AND STREAM CHANNEL HYDRAULICS FOR HABITAT IMPROVEMENT PROJECTS, USDA Forest Service, National Ecological Services Unit, Ft. Collins, Colorado. June, 1987-December, 1990.
 - SABBATICAL LEAVE PROJECT--Computer Uses in Fisheries, partially supported by the Atlantic Salmon Federation, St. Andrews, N.B. Canada. August, 1987-August, 1988.
-
- COMPUTER MODELS OF HABITAT ESTIMATION, USDA Forest Service, Clearwater and Nez Perce National Forests, Idaho, 1988-1990.
 - ANALYSIS AND DESIGN OF BOULDERS AS FISHROCKS, MSCE Thesis Topic with Reg Cullen, RA, 1988-89.
-
- QUANTITATIVE MODELING OF THE AMBIENT MONITORING COMMITTEE CLASSIFICATION SYSTEM, State of Washington Timber, Fish and Wildlife Program, Department of Natural Resources, Olympia. May, 1989-July, 1990.
 - FLOWMOD: HYDROLOGIC MODELS FOR REGION 10, USDA Forest Service, Alaska. October, 1989-December, 1990.
-

PROFESSIONAL PUBLICATIONS:

RENAISSANCE OF STEEL DAMS, Modern Welded Structures, James F. Lincoln Arc Welding Foundation, 1963. Also published in Pacific Builder and Engineer, December, 1961.

THE PREDICTION OF PIEZOMETRIC GROUND-WATER LEVELS IN OBSERVATION WELLS BASED ON PRIOR OCCURRENCES, Water Resources Research, American Geophysical Union, Vol. 2, No. 1, First Quarter, 1966.

SOME CLAY-SLURRY FRICTION FACTORS, with W.C. Parrish and R.A. Sutherland, Civil Engineering, American Society of Civil Engineers, February, 1968.

Editor, Proceedings of the 7th Biennial Hydraulics Conference, IS FLOOD CONTROL A MYTH? November 13-14, 1969. Published June, 1970, College of Engineering Technical Extension Service.

DRAINAGE DENSITY IN DRIFT-COVERED BASINS, Journal Hydraulics Division, American Society of Civil Engineers, January, 1970.

Paper accepted for presentation in Stockholm, Sweden, August, 1970, on INCREASING POWER PRODUCTION THROUGH IMPROVED TRASHRACK DESIGN, International Association for Hydraulic Research. Published with discussion in Proceedings, October, 1970.

HYDROLOGY STUDIES, Proceedings, Instream Flow Methodology Workshop, Sponsored by Washington Department of Ecology, State Water Program, November 14-15, 1972.

PREDICTION OF LOW FLOWS AND FLOODS FROM UNGAGED DRAINAGE BASINS, Proceedings, ASCE 21st Specialty Hydraulics Conference, Montana State University, Bozeman, Montana, August 15-18, 1973.

DETERMINING STREAM FLOWS FROM GEOMORPHIC PARAMETERS, Journal Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 100, No. IR4, Proc. paper 10986, December, 1974, pp. 455-475.

PREDICTING UNGAGED LOW FLOWS IN DIVERSE HYDROLOGIC PROVINCES USING RIVER BASIN GEOMORPHIC CHARACTERISTICS, Proceedings, International Symposium, Intl. Assoc. of Hydrol. Sciences, Tokyo, Japan, December 1-8, 1975.

Editor, Proceedings, INSTREAM FLOW NEEDS CONFERENCE, and Program Chairman, Organizing Committee; American Fisheries Society and American Society of Civil Engineers, Boise, Idaho, May 3-5, 1976.

DRAINAGE BASIN CHARACTERISTICS APPLIED TO HYDRAULIC DESIGN AND WATER RESOURCES MANAGEMENT, Proceedings, Symposium on Geomorphology and Engineering, State University of New York at Binghamton, September 24-25, 1976.

WATER MANAGEMENT AND TECHNOLOGY: TECHNICAL ASPECTS OF STREAM FLOW ALLOCATION, Public Administration Review, No. 5, Sept.-Oct., 1977, pp. 462-466.

DETERMINING DESIGN FLOWS FOR CULVERTS AND BRIDGES ON UNGAGED STREAMS--A WATERSHED RATIONALE, Transportation Research Board (NASA), Publication Series, 1978.

CHARACTERISTICS OF LOW FLOW, Task Committee on Low-Flow Evaluation, Methods and Needs, Committee on Surface-Water Hydrology of the

Hydraulics Division, American Society of Civil Engineers, Journal Hydraulics Division, Vol. 106, No. HY5, Paper No. 15400, May, 1980. (Task Committee Members: James E. Caffey, John F. Orsborn, John C. Schaake, Jr., Krishan P. Singh, James R. Wallace, and Henry C. Riggs, Chairman.)

Two chapters in an invited printed symposium entitled Geomorphology-- Concepts, Theories, Models and Recent Trends, Edited by Dr. Hari Shanker Sharma, Department of Geography, University of Rajasthan, Jaipur-302004, India, 1980: Nadira Kabir and John F. Orsborn, RIVER CHANNEL AND BASIN CHARACTERISTICS; John F. Orsborn, Nadira Kabir and F. David Deane, RELATIONSHIPS AMONG LOW, AVERAGE, AND FLOOD FLOWS.

WELDED STEEL FISHLADDER DESIGN FOR RESOURCE ENHANCEMENT, Lincoln Arc Welding Foundation Design Contest, 1982.

ESTIMATING SPAWNING HABITAT USING WATERSHED AND CHANNEL CHARACTERISTICS, Published in Proceedings, AFS Western Division Symposium on Habitat Inventory, October 28-30, 1981 (Published 1982).

PRINCIPLES OF PERMAFROST, PIPELINES AND PILING, Treatise on Permafrost, Submitted to the Alaska Board of Registration, July, 1982, reviewed and approved by two members of the Board.

ESTIMATING HYDROLOGIC AND WATER QUALITY MANAGEMENT CHARACTERISTICS OF MINE-CUT LAKES and other portions of PLANNING AND MANAGEMENT OF MINE-CUT LAKES AT SURFACE COAL MINES, Office of Surface Mining, U.S. Department of Interior. Reviewed by 15 attendees at three-day draft review workshop--as Senior Consultant to R. Wayne Nelson and Associates, Boulder, CO, 1982.

COMMON STRATEGIES OF ANADROMOUS AND CATADROMOUS FISHES, NE Division of the American Fisheries Society. Invited Refereed Proceedings Paper on Fishways--Historical Assessment of Design Practice. March 9-13, 1986, Boston, Massachusetts.

STREAM IMPROVEMENTS AND FISH RESPONSE: A BIO-ENGINEERING ASSESSMENT, Invited Refereed Journal Paper of the American Water Resources Association. Principal author with John Anderson, BLM, Coos Bay, Oregon, June, 1986.

REVIEW AND ANALYSIS OF METHODS FOR QUANTIFYING INSTREAM FLOW REQUIREMENTS, Invited Refereed Journal paper, same AWRA Volume as noted above. Joint author with Christopher Estes, Alaska Department of Fish and Game, Anchorage, Alaska. June, 1986.

NEW MODELS OF HYDROLOGICAL AND STREAM CHANNEL RELATIONSHIPS, Invited paper in the Proceedings of the International Symposium on Erosion and Sedimentation, with J. M. Stypula, Oregon State University, Corvallis, Oregon. August 3-7, 1987.

BOULDERS AS FISHROCKS, American Fisheries Society, N. American Journal of Fisheries Management, submitted for possible publication, August, 1989.

GRADUATE STUDENT THESES AND SPECIAL PROBLEMS: (Civil Engineering unless noted otherwise)

Lin, Cheng-Nan, SIMULATION OF WATER QUALITY ENHANCEMENT IN A POLLUTED LAKE, Ph.D., 1972.

Beieler, Roger N., EFFECTS OF BLOCKAGE ON TRASHRACK LOADS AND LOSSES, M.S. Special Problem, 1972.

Trihey, Eugene, AN EVALUATION OF DESIGN PARAMETERS FOR CHANNEL RELOCATION PROJECTS IN ALLUVIAL DEPOSITS, M.S. Special Problem, 1972.

Chen, T. Shen, OPTIMIZATION OF JET ENTRAINMENT WITH A DIFFUSER, Ph.D., Dissertation, 1974.

Tsang, Michael, Y-L., RELATIONSHIPS AMONG STREAMFLOW, DRAINAGE BASIN AND CHANNEL CHARACTERISTICS, M.S. Thesis, 1980.

Kabir, Nadira, RIVER CHARACTERISTICS FROM BASIN CHARACTERISTICS, M.S. Thesis, 1980.

Aaserude, R.G., DEVELOPMENT OF NEW CONCEPTS IN FISHLADDER DESIGN, M.S., Thesis, 1984.

Powers, Patrick D., ANALYSIS OF BARRIERS TO UPSTREAM MIGRATION, M.S. Thesis, 1984.

Estes, C.E., EVALUATION OF METHODS FOR RECOMMENDING INSTREAM FLOWS TO SUPPORT SPAWNING BY SALMON, Environmental Science Program, 1984.

Kabir, Nadira, PHYSICAL MODEL STUDIES TO VERIFY A NUMERICAL MODEL OF FLOOD ROUTING, Ph.D. Dissertation, 1984.

McCrea, Mary, UPSTREAM, DOWNSTREAM--WHY THE STATE FOREST PRACTICES ACT IS NOT PROTECTING PUBLIC (FISHERIES) RESOURCES, M.S. Thesis, Institute for Resource Management, Environmental Sciences Program, 1984.

Burchfield, Stephanie, MOXEE BOG, YAKIMA WASHINGTON:; A CASE STUDY OF WETLAND PROTECTION, M.S. Thesis, Institute for Resource Management, Environmental Sciences Program, 1985.

Coulton, K.G., STREAM GAGING USING 35-MM CLOSE-RANGE PHOTOGRAMMETRY, M.S. Thesis, 1985.

Clark, Elizabeth, METHODS FOR ASSESSING THE IMPACT OF LAND USE CHANGES ON THE NATURAL LOW FLOW CHARACTERISTICS OF STREAMS, Geological Engineering, M.S. Thesis, 1985.

Stypula, Jeanne M., GEOMETRIC CHARACTERISTICS OF NATURAL STREAMS, M.S. Thesis, 1986.

Amerman, Karen S., A PRELIMINARY HYDROLOGIC ANALYSIS OF THE OLYMPIC PENINSULA, M.S. Thesis, 1987.

Meyer, Edward B., DEVELOPMENT OF A FLOOR-JET FISHWAY, M.S. THESIS, 1987.

Cullen, Reg T., ANALYSIS AND DESIGN OF BOULDERS FOR FISHERIES HABITAT, M.S. THESIS, 1989.

Gushman, Richard A., COMPUTERIZED HYDROLOGIC ANALYSIS FOR FISHERIES HABITAT IMPROVEMENT PROJECTS, M.S. THESIS, 1989.

Heiner, Bruce A., COMPUTERIZED ANALYSIS OF FISHERIES HABITAT IMPROVEMENT STRUCTURES, M.S. THESIS, 1989.

Wesche, Thomas A., ANALYSIS OF FLUSHING FLOWS REQUIRED FOR CHANNEL MAINTENANCE, Ph.D. Dissertation, 1990.

Garric, Craig M., AN ANALYSIS OF STREAM CHANNEL HYDRAULIC GEOMETRY, M.S. THESIS, 1990.

Storm, Mark C., HYDROLOGIC MODELS OF SOUTHEAST AND SOUTH-CENTRAL ALASKA, M.S. THESIS.

PAPERS PRESENTED AT PROFESSIONAL CONFERENCES:

THE PREDICTION OF PIEZOMETRIC GROUND-WATER LEVELS BASED ON PRIOR OCCURRENCES, Fourth Western National Meeting of American Geophysical Union, University of Washington, Seattle, December 30, 1964.

THE DISTRIBUTION OF PRECIPITATION, RUNOFF, AND FLOODS IN THE STATE OF WASHINGTON, Northwest Scientific Association, Portland, Oregon, April 10, 1965.

FLOOD PHILOSOPHY, Joint Meeting, American Society of Civil Engineers, Spokane Section and Washington State University and University of Idaho, Student Chapters, Invited Address, Pullman, Washington, March 19, 1966.

DRAINAGE DENSITY AND STREAMFLOW RELATIONSHIPS IN GLACIATED DRAINAGE BASINS, Pacific Northwest Region, American Geophysical Union, Corvallis, Oregon, August 15, 1966.

THE FUNCTIONAL FAILURE OF A FISH BARRIER IN A RESERVOIR, presented at National Meeting on Water Resources of American Society of Civil Engineers, New York, October 16-20, 1967.

A PILOT STUDY IN FLOOD PLAIN MANAGEMENT FOR THE STATE OF WASHINGTON, Spokane Regional Planning Conference, Planning Association of Washington, March 13, 1970.

THE FLUSHING OF SMALL SHALLOW LAKES, prepared for presentation with C. Lomax at the ASCE 18th Specialty Hydraulics Conference, Minneapolis, Minnesota, August 21, 1979.

HYDROLOGY STUDIES, Instream Flow Methodology Workshop, sponsored by Washington Department of Ecology, State Water Program, November 14-15, 1972.

PREDICTING LOW FLOWS AND FLOODS FROM UNGAGED DRAINAGE BASINS, presented at the ASCE 21st Specialty Hydraulics Conference, Montana State University, Bozeman, Montana, August 15-18, 1973.

DETERMINING STREAM FLOWS FROM GEOMORPHIC PARAMETERS, presented at the ASCE National Water Resources Conference, Los Angeles, California, January 21-15, 1974.

RESEARCH NEEDS IN THE CIVIL ENGINEERING ASPECTS OF POWER, Panel Presentation to update 1970 Report, American Society of Civil Engineers, Power Division Specialty Conference, University of Colorado, Boulder, August 12-13, 1974.

RELATIONSHIPS BETWEEN LOW, AVERAGE AND FLOOD FLOWS, Hydraulics Division Specialty Conference, American Society of Civil Engineers, University of Washington, Seattle, Washington, August 6-8, 1975. (Prepared by Orsborn, presented by F. David Deane).

A GEOMORPHIC METHOD FOR ESTIMATING LOW FLOWS, American Society of Civil Engineers, Annual Water Resources Convention, Denver, Colorado, November 30, 1975.

DRAINAGE BASIN CHARACTERISTICS APPLIED TO HYDRAULIC DESIGN AND WATER RESOURCES MANAGEMENT, Proceedings, Symposium on on Geomorphology and Engineering, State University of New York at Binghamton, September 24-25, 1976.

DETERMINING DESIGN FLOWS FOR CULVERTS AND BRIDGES ON UNGAGED STREAMS, Annual Meeting, Transportation Research Board (NAS), Washington, D.C., January 1978.

ESTIMATING SPAWNING HABITAT USING WATERSHED AND CHANNEL CHARACTERISTICS, Proceedings, AFS Western Division Symposium on Habitat Inventory, October 28-30, 1981.

ATTRACTION VELOCITY DESIGN FOR SALMONIDS, paper presented at AFS Pacific-International Chapter Meeting, Vancouver, B.C., Canada, February 22, 1982.

CONCEPTUAL DESIGN OF GRAVEL TRAPPING STRUCTURES, invited paper presented at a meeting of the American Fisheries Society, Oregon Chapter, Corvallis, Oregon, February 2-4, 1983.

HYDROLOGIC MODEL OF SOUTHEAST ALASKA, paper presented at Annual Meeting, Alaska Chapter, Alaska Chapter, American Fisheries Society; also Soldotna, Alaska, November 15-17, 1983.

THE USE OF GEOMORPHIC CHARACTERISTICS TO ESTIMATE STREAMFLOW CHARACTERISTICS, presented invited paper to EPA Workshop on Classification of Aquatic Eco-Systems, Corvallis, Oregon, December 6-8, 1983.

FISHWAYS--HISTORICAL ASSESSMENT OF DESIGN PRACTICE, presented paper at ASCE Hydraulics Conference, Coeur d'Alene, Idaho, August 14-17, 1984.

FISHERIES ENGINEERING AT WASHINGTON STATE UNIVERSITY, portable display (4' by 8') with photographs and text developed with T. Bumstead and K. Coulton. Displayed in poster session of ASCE Hydraulics Conference in Coeur d'Alene, Idaho, 1984.

SYSTEMATIC APPROACHES TO BIO-ENGINEERING PROBLEMS, prepared paper for presentation at North Pacific International Chapter Meeting of AFS in Burnaby, B.C., Canada, March 13-14, 1984. (Subsequently unable to attend due to illness.) At this NPIC/AFS Meeting, student papers by Aaserude and Powers were accepted for presentation (five out of an unknown number of applicants). Aaserude won the top paper prize (\$100) and Powers received a \$50 prize.

Article on our Fisheries Engineering Research Program, appeared in OVERVIEW, OGRD, WSU Journal of Research, Fall, 1985.

TWO NEW DEVELOPMENTS IN FISHWAY DESIGN, NPIC-AFS Meeting at Peninsula Community College, presentation with Pat Powers (WDOF: CEE Alumnus), March 25-27, 1985.

March 24-26, 1986: NPIC-AFS Meeting at Western Washington University, Bellingham, Washington: (1) Presentation on the Fisheries Engineering Program at WSU; (2) Session Chairman and Covener of Session on APPLIED BIOENGINEERING PROBLEMS: (1) Small-Scale Hydropower; (2) Culverts and Fish passage; (3) Fishways; and (4) Instream Flow Methods. Also, Lt. Edward Meyer, USACE, Graduate Student, won the student paper competition on the subject of "A Floor Jet Fishway."

March 7-9, 1988: NPIC-AFS meeting at Alderbrook, Washington. Bruce Heiner, Graduate Student, won the student paper competition on the subject of "Estimation of Instream Fish Habitat."

October 24-27, 1988: Bioengineering Section of AFS, Symposium at Portland, Oregon: "Computer Models of Habitat Improvement Projects--An Overview."

SEMINARS AND SHORT COURSES:

PULLMAN'S FLOOD PROBLEMS, Pullman Junior Chamber of Commerce, February 17, 1970.

THE PULLMAN-MOSCOW WATER SYSTEM, Pullman and Moscow Chapters of League of Women Voters, March 17, 1970.

SOME COMMENTS ON FLOOD PLAIN MANAGEMENT, AID Irrigation Short Course, Washington State University, July 7, 1970.

THE VANCOUVER LAKE STORY, Washington State Well Drillers Association, 24th Annual Convention, Seattle, Washington, August 15, 1970.

VANCOUVER LAKE STUDY PROGRESS SEMINAR, Design for Clark County, Fort Vancouver Library, October 22, 1970.

RIVER ENGINEERING SHORT COURSE, presented to members of the Washington State Department of Ecology and other State agencies, Olympia High School, February 4, 1971.

HOW LARGE IS YOUR ENVIRONMENT? Joint Student Chapter Meeting of ASCE from Gonzaga, Idaho, and Washington State Universities at Pullman, Washington, March 13, 1971.

THE WASHINGTON STATE DEPARTMENT OF ECOLOGY PILOT STUDY IN FLOOD PLAIN MANAGEMENT, Six-County Disaster Planning Workshop, Albrook Laboratory, Washington State University, September 16-17, 1971.

SOME RECENT DEVELOPMENTS IN STATE FLOOD PROGRAMS, meeting of County Civil Defense Directors, CUB, Washington State University, September 24, 1971.

THE PITFALL AND THE PENDULUM, a presentation on Resources Policy and Public Involvement, part of a program entitled Prosperity Without Pollution, College of Engineering Advisory Board Meeting, Washington State University, October 29-30, 1971.

A REVIEW OF THE RIVER BASIN SYSTEM, County-State Workshop on Cooperative River Management, sponsored by Washington State Flood Control Council and the Department of Ecology, Olympia, Washington, published in Proceedings, December 9-10, 1971.

THE VANCOUVER LAKE STUDY, presented to the Spokane Chapter of the Washington Society of Professional Engineers, February 7, 1972.

SHORELINES MANAGEMENT WORKSHOPS, presented for Washington PCAA and Department of Ecology in Spokane, Everett, and Chehalis on February 8, 15, and 17, 1972.

FLOODS--FLASHY, FLUVIAL FRESHETS FOLLOWED FREQUENTLY BY FUTILE, FEDERAL FUNDING OF FOOLISH, FRANTIC FLOURISHINGS--WHY?, American Society of Civil Engineers Student Chapter Meeting, February, 10, 1972.

MULTI-DISASTER DESIGN COURSE--FLOODS, WSU Spokane Graduate Center, February 13, 1972.

THE WATERSHED SYSTEM AND MAN, presented at the 1972 Annual Meeting of ALPS (Alpine Lakes Protective Society), Wenatchee, Washington, May 20, 1972.

ESTABLISHMENT OF LOW FLOW CRITERIA FOR CONSERVATION, RECREATION AND AESTHETIC PURPOSES, State of Washington Water Research Center Seminar Series, December 12, 1972.

PILOT STUDY IN FLOOD PLAIN MANAGEMENT, State of Washington Water Research Center Seminar Series, February 13, 1973.

FLOOD DAMAGE REDUCTION WORKSHOPS, for Elected Officials, County and City Planners and Engineers: Wenatchee, May 2; Yakima, May 3; Everett, May 16; and Aberdeen, May 17, 1973.

SHORT COURSE OF FLOOD PLAIN MANAGEMENT, Hill, Ingman, Chase and Co., Consulting Engineers and Analysts (now URS), Seattle, Washington, November 3, 1973.

SURFACE WATER RESOURCES IN THE STREAMS OF SOUTHWEST WASHINGTON, Southwest Washington River Basins Citizens' Committee, Kalama, Washington, February 21, 1974.

A REPORT ON THE WSU WATERWORLD PAVILION, presented to the College of Engineering Advisory Board Meeting, Pullman, Washington, May 24, 1974.

INSTREAM FLOW NEEDS PROBLEM ANALYSIS SESSIONS, Sun Valley, Idaho and Vancouver, Washington, Regional Water Research Project Problem Analysis Workshops, September 5-6, and October 7-9, 1974.

INSTREAM FLOW NEEDS METHODOLOGIES REPORT REVIEW WORKSHOP, Utah State University Cooperative Fisheries Unit, invited participant, September 15-17, 1975.

WE USED TO CALL IT MINIMUM FLOW, an overview of Instream Flow Problems, presented at University of Idaho Graduate Seminar in Water Resources on Instream Flow Needs, September 25, 1975, published May, 1976.

PREDICTING FLOODS IN UNGAGED MOUNTAIN WATERSHEDS, U.S. Forest Service Region 1 Annual Meeting, Bozeman, Montana, January 26-30, 1976.

HYDROLOGY AND HYDRAULICS FOR FISHERY BIOLOGISTS, through the U.S. Fish and Wildlife Service, Fisheries Academy, National Fisheries Center, Kerneysville, West Virginia. Course taught to 50 attendees (each) at:

1. Denver, Colorado: January 8-12, 1979.
2. Portland, Oregon: February 26-March 2, 1979.
3. Eugene, Oregon: (U.S. Forest Service Special Course) March 10-14, 1980.
4. Anchorage, Alaska: April 7-11, 1980.
5. Logan, Utah: November 26-30, 1984.

UNGAGED STREAM FLOW HYDROLOGY FOR FISHERY BIOLOGISTS, One-Day Workshops:

1. U.S. Forest Service, Region 1, Missoula, Montana, June 23, 1978.
2. Wyoming Department of Game and Fish, Casper, Wyoming, July 10, 1978.

TRASHRACK LOADS AND LOSSES, Hydraulic Engineering Seminar, Department of Civil and Environmental Engineering, Washington State University, December 4, 1979.

WATERSHED CHARACTERISTICS AND STREAMFLOW, Department of Forest Engineering Seminar, Oregon State University, Corvallis, October 27, 1980.

FISHERIES HABITAT IMPROVEMENT STRUCTURES, Hydraulic Engineering Seminar, Washington State University, Pullman, Washington, April 26, 1982.

HYDRAULICS, HYDROLOGY, AND FISH PASSAGE THROUGH CULVERTS, U.S. Forest Service, Sitka, Alaska, April 4-6, 1983.

FISH LADDER DESIGN, presentation to Senior Design Seminar, Department of Civil Engineering, Oregon State University, May 10, 1983.

FISHERIES ENGINEERING, Pullman Kiwanis Club, Pullman, Washington, May 19, 1983.

HYDRAULICS, HYDROLOGY AND FISH PASSAGE THROUGH CULVERTS, U.S. Forest Service, Gifford Pinchot National Forest, Vancouver, Washington, September 28-30, 1983.

HYDROLOGY AND HYDRAULICS FOR DESIGN OF FISHERIES HABITAT IMPROVEMENTS, U.S. Forest Service, Region 5, and California Department of Fish and Game Sacramento, California, April 10-13, 1984.

DESIGN, CONSTRUCTION AND EVALUATION OF HABITAT IMPROVEMENT STRUCTURES, U.S. Forest Service, Regions 1 and 4, Missoula, Montana, September 8-9, 1984.

RESTORATION OF CROOKED RIVER GOLD DREDGED AREA IN IDAHO, Hydraulic Engineering Seminar, Washington State University, Pullman, Washington, October 17, 1984.

FISHWAY DESIGN (portions of course), for the Fisheries Academy, U.S. Fish and Wildlife Service, Portland, Oregon, January 10-14, 1985.

FISHWAY DESIGN (portions of course), for the Fisheries Academy, U.S. Fish and Wildlife Service, Merrimack, New Hampshire, August 4-8, 1986.

HYDROLOGY AND HYDRAULICS FOR FISHERIES BIOLOGISTS, Cal-Neva Chapter of the American Fisheries Society, Eureka, California, October 27-31, 1986.

HYDROLOGY AND HYDRAULICS FOR FISHERIES BIOLOGISTS, USDA Forest Service and Bureau of Land Management, Coos Bay, Oregon, April 12-16, 1987.

HYDRAULICS OF HABITAT IMPROVEMENT STRUCTURES, USDA Forest Service, National Training Program for Fisheries Biologists, Colorado State University, Ft. Collins, Colorado, November 15, 1987.

FISHWAYS AND FISH PASSAGE FACILITIES, History and Classification, Fisheries Academy, USFWS, Olympia, Washington, March 17, 1988.

HYDROLOGY AND HYDRAULICS FOR FISHERIES BIOLOGISTS, Fisheries Academy, USFWS, Boise, Idaho, May 16-20, 1988.

HYDRAULICS OF HABITAT IMPROVEMENT PROJECTS, USDA Forest Service, Colorado State University, Ft. Collins, Colorado, October 6, 1988.

HYDROLOGY AND HYDRAULICS OF FISHERIES-RELATED PROJECTS, King County Surface Water Management Division, Seattle, Washington. September 27-29, 1989.

HYDRAULICS OF HABITAT IMPROVEMENT PROJECTS, USDA Forest Service, Colorado State University, Ft. Collins, Colorado, October 6, 1989.

CLASSIFICATION AND HISTORY OF FISHWAYS, U.S. Fish and Wildlife Service, Portland, Oregon, October 6, 1990.

HYDROLOGY AND HYDRAULICS OF FISHERIES HABITAT IMPROVEMENT PROJECTS:

- USDA Forest Service, Olympic National Forest, Alderbrook Lodge, Union, WA (TBA).
- Idaho Chapter, American Fisheries Society, Boise, Idaho, March 6-7, 1991.
- Washington Department of Fisheries, Olympia, WA (TBA).
- USDA Forest Service, Wallowa-whitman Zone Engineering, Enterprise, OR (TBA).

HYDROLOGY AND STATISTICS, Center for Streamside Studies, University of Washington, Pack Research Forest, June (-), 1991.

PROFESSIONAL CONSULTING:

Client	Project	Date
Pacific Power and Light Portland, OR	Speelyai Diversion Canal Energy Dissipator	1965
Yellowstone Pipeline Co. Spokane, WA	Analysis of Pipeline Break at River Crossing	1969-75
National Water Commission	Pricing of Water	1970-71
Private Citizen Spokane, WA	River Erosion Problem	1971-73
Port of Portland Portland, OR	Airport Expansion into Columbia River--EIS Review	1972

John A. Blume and Associates San Francisco, CA	Columbia River Flood Analyses Review	1973-74
Futrell-Redford-Saxton Spokane, WA	Water Balance Analysis Liberty Lake, Washington	1973
URS/Hill, Ingman, Chase and Company, Seattle, WA	Bothell Regional Center, Bothell Washington; Review EIS	1974
URS Seattle, WA	Snohomish/King County Area Wide Waste Management Planning Study	1975-76
Enviro Control, Inc. Rockville, MD	Assessment of Effects of Altered Stream Flow Characteristics on Fish and Wildlife	1975-76
Weyerhaeuser Corporation Centralia, WA	Small Watershed Hydrologic Research Program	1975-76
United Nations	Consultant to CWPRS Hydraulics Laboratory at Puna, India (October)	1977
U.S. Fish and Wildlife Service, Fort Collins, CO	Evaluation of Instream Flow Group Programs	1978
Enviro Control, Inc. Beltsville, MD	Fisheries Habitat Improvement for U.S. Fish and Wildlife Service	1978
URS Seattle, WA	Proposal to U.S. Forest Service on Hydrologic Analysis in Alaska	1978
Private Citizen	Beach Erosion Problem Pend Oreille River, Idaho	1978
Fisheries Academy, U.S. Fish and Wildlife Service Leestown, WV	Development and Presentation of One-Week Short Courses on "Hydrology and Hydraulics for Fisheries Biologists"	1978-84
URS/WWP Seattle, WA	Hydrologic Aspects of the Creston Coal-Fired Power Plant--EIS	1979
EPA Corvallis, OR	Hydrologic Characteristics of thirteen Oregon Coastal Salmon Spawning Streams	1979
EPA Corvallis, OR	Hydrologic Balances of Nine Spokane County Lakes in Washington	1979
Private Citizen Corvallis, OR	River Channel Change	1979-81

U.S. Forest Service Ketchikan, AK	Program Review on Fisheries Enhancement	1980
U.S. Forest Service Ketchikan, AK	Study of the Relationships Between Fish and Velocity	1980-81
Office of Surface Mining, R. Wayne Nelson & Associates Boulder, CO	Hydrologic and Hydraulic Design Criteria for Final-Cut Lakes in Surface Mining	1980-81
Eastern Energy and Land-Use Team, U.S. Fish and Wildlife Service, R. Wayne Nelson and Associates, Boulder, CO	Methods of Assessing Fish and Wildlife Impacts from Inland Dredge and Fill Activities	1980-81
R. Wayne Nelson and Associates, Boulder, CO	Methods of Assessing Fish and Wildlife Impacts from Inland Dredge and Fill Activities	1982
U.S. Forest Service Petersburg, AK	Low Cost Fish Passage Facility Design, Five Waterfalls, Preliminary Designs	1982
U.S. Forest Service Mt. Hood National Forest	Habitat Improvement for Lake Branch and Fish Creek	1982
R.W. Beck Consulting Engrs. Seattle, WA (for SSRAA Ketchikan, AK)	Neet's Creek Dam and Fishladder, Design Review	1982
Oregon Department of Fish and Wildlife	Habitat Restoration in a Sluiced- Out Stream	1982
Northern SE Regional Aquaculture Association Sitka, AK	The Hydrologic, Hydraulic and Spawning Habitat Characteristics of Medvejie Creek Near Sitka, Alaska	1982-83
U.S. Forest Service Alsea, OR	Five Rivers Bridge and Fish Ladder; Salmon Creek Culvert and Habitat Improvement Structures	1983
U.S. Forest Service Roseburg, OR	Corrections of Fish Passage Problems at the South Umpqua Falls Fishladder	1983
Washington Department of Game	Field Assessment and Design of Instream Habitat Improvement Projects on Asotin Creek and the Tucannon River	1983
U.S. Forest Service Grangeville, ID	An Evaluation of Red River, Crooked River and Newsome Creek Habitat Improvement Projects	1983

Seattle City Light	Engineering Aspects of the Boundary Reservoir Waterfowl Habitat Improvement Project at Site RM 32.8W on the Pend Oreille River in Northeast Washington	1983
Warm Springs Confederated Tribes, OR	Fish Passage Improvement at Strawberry Falls on Mill Creek	1983
Nez Perce National Forest, Grangeville, ID	Restoration of Crooked River in the Dredged Mining Areas, Idaho	1984
U.S. Forest Service Clearwater National Forest, ID	Correction of Waterfalls for Fish Passage	1984
Oregon Dept. of Fish and Wildlife, Corvallis, OR	Systems Planning for Research Management	1984
Ott Water Engineers, Bellevue, WA	Design Review of Dryden and Tumwater Fishways	1984
U.S. Forest Service Siskiyou National Forest Powers, OR	Evaluation of Culvert Barriers to Fish Migration; and Boat Ramp Scour Problem Analysis	1984
U.S. Forest Service Sawtooth National Recreation Area, Stanley, ID	Analysis of Fish and Boat Passage at Sunbeam Dam on the Salmon River	1984
Washington Department of Fisheries, Olympia, WA	Evaluation of Riprap Influences on Spawning Gravel Sources on the Newaukum River	1984
Pacific Gas and Electric and Southern California Edison	Advisory Committee on Riparian Vegetation	1985
U.S. Forest Service, Mt. Hood National Forest, OR	Rearing Channel Design	1985
U.S. Forest Service and Bureau of Reclamation, UT	Pilot Study of Habitat Improvement Structures for Currant Creek, Utah	1985
U.S. Forest Service Wenatchee National Forest, WA	Habitat Improvement, Little Naches River	1985
Northern SE Regional Aquaculture Association Sitka, AK	Analysis of Medvejie Creek Hatchery Flows	1985
Pacific Power and Light Portland, OR	Assessment of Habitat Improvement Plans for Cougar Creek	1985

U.S. Forest Service Nez Perce National Forest, ID	Analysis and Recommendations for Fish Passage Barriers on Peasley, Meadow, and Lower Slate Creeks	1985
U.S. Forest Service Siuslaw National Forest, OR	An Evaluation of Habitat Improvement Potential for Five Rivers, Lobster, and Savage Creeks	1985
U.S. Forest Service Boise National Forest, ID	Potential Improvements in Fisheries Habitat in Johnson Creek near Landmark, Idaho	1985
CH2M-Hill, Bellevue, WA and Chelan Co. PUD No. 1	Review of Proposed Fishway Designs for Dryden and Tumwater Dams	1986
Clearwater Ranger District Nez Perce National Forest, Grangeville, ID	Upstream Migration Barrier Design for Peasley and Meadow Creeks	1986
Slate Creek Ranger District Nez Perce National Forest, Whitebird, ID	1986 Slate Creek Habitat Improvements, and Future Planning	1986
Tongass National Forest USDA Forest Service, Sitka, AK	Redesign of Slippery Creek Fishway	1986
Fishlake National Forest Fillmore Ranger District, Fillmore, UT	Corn Creek Habitat Restoration Project	1986
Mt. Hood National Forest Hood River Ranger District, Mt. Hood Parkdale, OR	Lake Branch Stream Restoration	1986
Oregon Department of Fish and Wildlife, Enterprise, OR	Chesnimmus Creek Habitat Improvement	1986
Nez Perce National Forest Elk City Ranger District, Elk City, ID	Lower Crooked River Habitat Improvement Alternatives	1986
Northern SE Regional Aquaculture Association, Sitka, AK	Further Evaluation of Medvejie Creek Hatchery Flows	1986
Pacific Power and Light, Portland, OR	Alternative Methods for Correcting Fish Passage at Link River Dam, Klamath Falls, OR	1986
Nez Perce National Forest	Mill Creek Spawning Habitat	1986

Clearwater Ranger District, Grangeville, ID	Project	
Idaho Department of Fish and Game, Boise ID	Red River Sediment Analysis	1986
Siskiyou National Forest Powers Ranger District, Powers, OR	Milbury Creek Culvert Fish Passage Analysis	1986
Oak Ridge National Lab., Oak Ridge, TN	Program Review on Small Scale Hydro, and Seminar on Hydrology	1987
Warm Springs, Oregon, Indian Tribe	Shitike Creek Habitat Improvement Project	1987
Oregon Department of Fish and Wildlife, Roseburg, OR	Evaluation of Several Fish Habitat and Passage Problems	1987
USDA Forest Service, Roseburg, OR	Fish Passage Problems on the North Umpqua Ranger District, Umpqua National Forest	1987
Missouri Department of Conservation, Columbia, MO	Short Course on "Hydrology and Hydraulics for Fisheries Biologists"	1987
USDA Forest Service, Coos Bay, OR	Short Course on "Hydrology and Hydraulics for Fisheries Biologists"	1987
NSRAA and R. W. Beck, Seattle, WA	Hydrologic Analysis of Medvejie Creek, Sitka, Alaska	1987
Pacific Power, Portland, Oregon	Redesign of Prospect and Big Fork Dam Fishways	1987
USDA Forest Service, Washington, DC	Short Course on Hydraulics at CSU, Ft. Collins, CO	1987
Entrix Inc., Walnut Creek, CA	Review of Yellow Creek Habitat Improvement Project	1987
USDA Forest Service, LaGrande, OR	Upper Grand Ronde River Habitat Improvement Project	1987
Beak Consultants and Niagara-Mohawk Power Co., NY	Sherman Island Hydro-Project Habitat Enhancement Project	1987
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USDA Forest Service, UMPQUA NATIONAL FOREST, Glide, OR	Fish Passage at Two Waterfalls and Two Culverts on the North Umpqua District	1988 -89

Oregon Dept. of Fish and Wildlife, Roseburg, OR	Rock Creek Hatchery Fishladder Review and Little River Falls Fishway	1988 -89
USDA Forest Service CHUGACH Nat'l. Forest, Anchorage, AK	In-service, 1:1 training for new fish facilities engineer	1988
Fish Pro, Inc., Consulting Engineers Port Orchard, WA	Review of Tonto (Arizona) Fish Hatchery Piping System	1988
USDA Forest Service, OLYMPIC Nat'l. Forest, Olympia, WA	Pilot Study of the Physical Conditions Affecting Fisheries Habitat, S. Fk. Skokomish River	1988 -89
Attorney General, State of Washington, Olympia, WA	Deposition Regarding Hydraulic Model Studies of Capitol Lake, Olympia, WA	1988
Hosey and Associates, Consulting Engineers, Bellevue, WA	Analysis of Fish Passage Barrier on the Elwha River	1988
USDA Forest Service, BOISE National Forest, Boise, ID	Analysis of Habitat and Erosion Problems in Bear Valley, Idaho	1988
USDA Forest Service, NATIONAL FISHERIES PROGRAM Washington, DC	Hydraulics of Fisheries Projects --Shortcourse at CSU, Ft. Collins, CO	1988
USDA Forest Service, NEZ PERCE National Forest, Red River, ID	Red River Sediment Traps--Survey, Analysis, and Design	1988 -89
Summit Technology and WDOF, Seattle, WA	Hydrology and Flood Stages for Owl Creek on the Olympic Peninsula	1988
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Native American Rights Fund, Boulder, CO	Hydrologic and Channel Geometry Studies of the North Fork Skokomish River, Washington	1989 -90
USDA Forest Service, Suislaw National Forest, Alsea, OR	Review of Brush Creek Culvert Design for Fish Passage	1989
USDA Forest Service Mt. Baker-Snoqualmie NF Seattle, WA	Critique of Existing and Proposed Habitat Improvement Projects	1989

Lower Elwha Tribe, Port Angeles, WA	Hydrologic Analysis of Pre- and Post-Dam Conditions on the Elwha River	1990
USDA Forest Service, Olympic National Forest, Olympia, WA	Handbook on the Physical Aspects of the Fisheries Environment	1990
ENTRANCO ENGRS., Kirkland, WA	Review of Capitol Lake Habitat Modification Plan	1990
WASHINGTON DEPT. OF NATURAL RESOURCES, Olympia, WA	Hydrologic Analysis of Porter Creek Habitat Improvement Research Project	1990
USDA Forest Service, Mt. Baker-Snoqualmie Nat'l. Forest, Bend, WA	Gold Creek Borrow Pit and Outlet Channel Habitat Restoration Project	1990-91
USDA Forest Service, Mt. Baker-Snoqualmie Nat'l. Forest, Sedro Wooley, WA	Solution to Fish Passage Problems at Little Park Creek Culvert	1990-91

MEMBERSHIPS IN SOCIETIES:

American Society of Civil Engineers*
American Fisheries Society*
American Geophysical Union
American Society for Engineering Education
National Society of Professional Engineers
Transportation Research Board (National Academy of Sciences);
Committee A2A03, Hydrology, Hydraulics, and Water Quality
American Public Works Association
American Water Resources Association
Sigma Tau, Chi Epsilon, Sigma Xi (honoraries)

*Current Member

COMMITTEES AND OFFICES:

American Society of Civil Engineers

Spokane Section Legislative Committee, 1968.

Pipeline Division Committee on Planning, Subcommittee on Flow of Solids
and Slurries, 1968 (Handbook prepared by subcommittee).

Local Arrangements Chairman, ASCE Power Specialty Conference, Washington
State University, September 11-13, 1968.

Reporter and Invited Delegate, American Society of Civil Engineers Conference on Research Goals, Rose-Hulman Institute of Technology, Terre Haute, Indiana, September 1-4, 1971.

Chairman, Power Division Research Committee, October 1969-September 1972; Member, 1972-73.

Task Committee on Policy Research of the ASCE Research Committee, 1972-74 (Report prepared for the ASCE Committee on Research).

Elected, Executive Committee of Power Division, ASCE, 1974.

Program Chairman, Panel on Power Research, Specialty Conference, University of Colorado, August 12-13, 1974.

Vice-Chairman, Power Division Executive Committee, 1975-76.

Program Chairman, Specialty Conference jointly sponsored by the Power Division and the Western Division of the American Fisheries Society on INSTREAM FLOW NEEDS, Boise, Idaho, May 3-6, 1976, Editor of Proceedings, December 1976.

Surface Water Hydrology Committee, Task Force on Low Flow Evaluation; June 1977-September 1978, Chapter on "Interest Group Perspectives on Low Flow Problems," report published in Journal Hydraulic Division, ASCE, Vol. 106, No. HY5, May 1980.

Officers Management Training Workshop, San Francisco California, February 1978.

Spokane (Inland Empire) Section, ASCE; Director, 1976-77; Vice President, 1977-78; President-Elect (Program Chairman), 1978-79; President, 1979-80; Past President, 1980-81.

Received "Engineer of Merit Award" Inland Empire Section, 1982.

Reviewer of Professional Papers for Hydraulics Division, 1964-.

Inland Empire Chapter, Member of the Nomination Committee for Engineer of Merit Award, 1983.

Arrangements Committee, 1983-84; National Hydraulics Division Conference, Coeur d'Alene, Idaho, August 14-17, 1984.

American Society for Engineering, WSU Section

Secretary-Treasurer, 1965-66; Vice-President, 1966-67; President, 1967-68; UI-WSU Chapter.

American Geophysical Union

Member for Hydrology, Pacific Northwest Regional Committee (Elected), 1968.

Contact Member for American Geophysical Union to Pacific Northwest River Basins Commission, 1968.

Puget Sound Task Force Flood Control Technical Committee, Ad Hoc Member, 1966-68.

Reporter, University Council on Water Resources, Oregon State University, Corvallis, Oregon, August 2-3, 1971.

American Public Works Association (1979-1981)

Washington Chapter--Education Committee

Washington State University and Public Service

Member, Graduate Faculty, Washington State University, 1968-.

Member of Joint Scientific Committee, State of Washington Water Research Center, 1968-74; Chairman, 1973-74.

Chairman, Pullman Flood Protection Committee, 1969-70.

College of Engineering Ad Hoc Planning Committee, WSU, March, 1969-April, 1970.

General Chairman, 7th Biennial Hydraulics Conference, "Is Flood Control a Myth?" November 13-14, 1969, Pullman, Washington.

Department of Civil Engineering Committee on Communication Courses, 1970.

Executive Secretary, Washington State Flood Control Council, 1970.

Chairman, Task Force on Flood Plain Management, City of Pullman, September, 1970-November, 1971.

Assisted in preparations for Six-County Disaster Planning Workshop on Floods, September 16-17, 1971, with the Department of Ecology and Planning and Community Affairs Agency.

Chairman, Department of Civil Engineering Search Committee for New Department Chairman, 1972.

Elected to University Senate, Washington State University, Pullman, October, 1971-June, 1972. Member, Research and Arts Committee, 1971-1974; Chairman, Physical Sciences-Engineering Subcommittee, and Math Services Unit Evaluation Subcommittee, 1972-73.

Elected to Faculty of Environmental Science Program, 1972.

Developer and General Manager of the WSU "Waterworld" Pavilion, EXPO '74 World's Fair, Spokane, Washington, May-October, 1974; developed and handled coordination of all components including design, construction, funding, training of student hosts and A-V programs, between January and October, 1974.

Elected to Graduate Faculty of Rural and Regional Planning Program, 1975.

Chairman, Department of Civil and Environmental Engineering, 1976-1980. Re-elected to Second Term 1980-84 after Chair review by faculty in February, 1980. Declined.

On professional leave September, 1980-August, 1981: Corvallis, Oregon as Hydraulic Design Engineer, Siuslaw National Forests on Stream Improvement and Fisheries Enhancement Projects (half-time); and Courtesy Appointment in the Department of Civil Engineering at Oregon State University presenting seminars and lectures; professional leave activities included research on ungaged streamflow and Fisheries Engineering.

Arranged faculty voluntary noon discussions on "Teaching Improvement," Civil and Environmental Engineering, 1981-82.

Electrical and Computer Engineering Chair Search Committee, 1984-85.

Advisor to Pullman Futures Program on Flood problems, 1984-85, 1988.

Summer 1983 and Summer 1984, Civil Engineering Speaker at WSU Summer Institute for Minority and Women Students. Helped develop ASCE national support for this program.

Delivered invited lecture on the ENGINEERING CONTRIBUTIONS TO THE BUILT ENVIRONMENT, ARCH/ID/LA 202.

Chairman, Leon D. Luck Award Committee for Outstanding Faculty Member, Department of Civil and Environmental Engineering, 1984-85.

Alumni Coordinator/CEE, 1981-1982.

Developed graduate program in Fisheries Engineering, 1981-.

Review reports and proposals for Washington Water Research Center.

Advisory Committee on Promotion and Tenure to the Dean of the Sciences and Mathematics Division, College of Sciences and Arts, WSU, Pullman, 1983-1987.

CEE Department Ad Hoc Curriculum Committee, Chair, 1987.

CEE Department, Chair Search Committee, Chair, 1988-89.

CEE Department Curriculum Committee, Chair, 1989-90.

Submitted recommendations for improvements in research administration and management to WSU Vice President for Research

Nominated for WSU Faculty Award for Excellence in Public Service; 1989; 1990; 1991.

Received Outstanding Teacher Awards from Students in the Department of Civil and Environmental Engineering and the College of Engineering, 1990.

Received Leon D. Luck, Most Effective Faculty Award, 1990.

Chair, Department of Civil and Environmental Engineering Search Committee for Five Faculty, 1990-91.

American Fisheries Society (1980-

Member Western Division, "Water Development and Stream Preservation" Committee, 1980-83.

Reviewer of Papers for "Fisheries," the Bulletin of AFS.

Nominee for President (1981) and President-Elect (1982) of the Bio-Engineering Section, AFS.

Helped John Peters, (Chief, Environmental Affairs Office, USBR, Denver) prepare the position paper of the American Fisheries Society on the EFFECTS OF RIVER/STREAMFLOW ALTERATION, published in Fisheries, 1981.

Member, National Committee on Membership Concerns, 1984-86.

Member, Arrangements Committee, AFS Bio-Engineering Section Conference on Hydropower and Fisheries, Denver, Colorado, May 1-3, 1985.

Session Chairman on Bio-Engineering Problems, NPIC/AFS Meeting, WWU, Bellingham, Washington, March 24-26, 1986.

Provided coordination to AFS of review by colleagues of Forest Service series of reports for possible publication as a book on land-use influences on fisheries, through AFS Editor, Bob Kendall.

Invited address, AFS International Conference on Anadromous and Catadromous Species--State-of-the-Art on Fish Ladder Design, Boston, Massachusetts, March 10-14, 1986.

Member, Bio-Engineering Section.

North Pacific International Chapter Continuing Education Committee, 1989-90.

Textbook Chapter Reviewer, 1988-1991.

PROFESSIONAL SERVICE

Reviewed text On professional engineering for publisher, "Engineers and Their Profession," Saunders College Publishing, Philadelphia, 1989.

Reviewed Technical Reports for NOAA, National Marine Fisheries Service, 1989.

Received and filled numerous requests for publications on fishway design from places ranging from Argentina to East Germany to Finland and South Africa.

Member of Technical Advisory Group, Washington State Joint Select Committee on Water Resource Policy (Instream Flow and Hydrology Tasks), 1989-.

PERSONAL:

Place of Birth: Gary, Indiana
August 13, 1929

Married, four children, Ages 22-33

Spouse: Sally McPherran Orsborn, B.A., Drake University, 1953.
B.A. (Music), Summa Cum Laude, 1976; B. Mus., Summa Cum Laude,
1979; M.A. Music, 1979, at Washington State University,
Assistant Professor of Music, WSU; Music Specialist Grades 1-5,
Pullman Public School District.

HONORS:

Third Prize, James F. Lincoln Arc Welding Foundation Structural Design,
UNDERGRADUATE COMPETITION, 1957.

Second Prize, James F. Lincoln Arc Welding Foundation Structural Design,
PROFESSIONAL COMPETITION, 1961.

Scholarship, Colorado College, 1947-48; 1949-52.

Scholarship, University of Colorado, 1955-57.

Ford Foundation Doctoral Fellowship, University of Wisconsin, 1961-64.

Nominated for Outstanding Professor in Civil Engineering, 1984.

Engineer of Merit, Inland Empire Section, American Society of Civil
Engineers, 1982.

Elected to Fellow, ASCE, 1987.

MILITARY SERVICE:

Fire Direction, Hv Mort. Co., 9th Regiment, 2nd Infantry Division, 1948-
49, Fort Lewis, Washington. Reserves: Photo Interpreter Unit, Colorado
Springs, Colorado, Sgt., 1949-53.

PRINCIPAL AREAS OF PROFESSIONAL ACTIVITY:

Hydrology:

Ungaged streamflow analysis; development of new hydrogeomorphic theoretical analysis; flood plain management planning; relationships among low, average, and flood flows.

River and Fisheries Engineering:

Relationships among channel geometry and basin characteristics; instream flow methodology (incremental analysis) based on channel characteristics and habitat physical analog models; design of habitat restoration and enhancement structures; barrier analysis of the influence of waterfalls on fish passage success; culvert design for flow and fish passage; and spawning habitat estimation.

Hydraulic Model studies:

Spillways, fish habitat improvement structures, fish passage facilities, fish guidance screens, cofferdams, sedimentation tanks, scour, energy dissipators; NASA Saturn V sound suppressors; trashrack redesign; solid-liquid pipeline transport; floating breakwaters; lake circulation; powerhouse intake operations; beach erosion; flushing of pollutants from lakes.

Teaching:

Systems, fluid mechanics, hydrology, open channel flow, hydropower, water resources engineering, senior seminar in professionalism, senior design, river engineering (includes aspects of geomorphology, hydrology, fluid mechanics, sediment transport, and natural channel analysis) and fisheries engineering.

Short Courses and Workshops:

Hydrology and hydraulics for fisheries biologists, stream crossing design, river engineering, instream flow needs problem analysis, minimum flows, predicting ungaged flows, fish passage designs, habitat improvements.

SUMMARY OF RESEARCH PROJECT REPORTS

Bonneville Power Administration
BPA Fisheries Project 82-14

DEVELOPMENT OF NEW CONCEPTS IN FISH LADDER DESIGN

Conducted at the
Albrook Hydraulics Laboratory
Department of Civil and Environmental Engineering
Washington State University
Pullman, Washington 99164-3001

Project Period: June, 1982-October, 1984

1. Orsborn, John F. 1985. SUMMARY REPORT

A synopsis of the project components was prepared to provide an overview for persons who are not fisheries scientists or engineers. This short report can be used also by technical persons who are interested in the scope of the project, and as a summary of the three main reports. The contents includes an historical perspective on fishway design which provides the basis for this project. The major project accomplishments and significant additions to the body of knowledge about the analysis and design of fishways are discussed. In the next section the research project organization, objectives and components are presented to familiarize the reader with the scope of this project.

The summary report concludes with recommendations for assisting in the enhancement and restoration of fisheries resources from the perspective of fish passage problems and their solution. Promising research topics are included.

2. Aaserude, Robert G. and John F. Orsborn. 1985. NEW CONCEPTS IN FISHLADDER DESIGN.--Results of Laboratory and Field Research on New Concepts in Weir and Pool Fishways. (With contributions by Diane Hilliard and Valerie Monsey).

The driving force behind this project, and the nucleus from which other project components evolved, was the desire to utilize fish leaping capabilities more efficiently in fishway design. This report focuses on the elements which were central to testing the premise that significant improvements could be made in water use, costs and fish passage efficiencies by developing a new weir and pool fishway. These elements include: historical review of available information; optimization of weir geometry; fluid jet mechanics; air entrainment; energy dissipation in the pool chamber; and fish capabilities. The new weir and pool chambers were tested in the field with coho and chum salmon.

3. Orsborn, John F. and Patrick D. Powers. 1985. FISHWAYS--AN ASSESSMENT OF THEIR DEVELOPMENT AND DESIGN. (With contributions by Thomas W. Bumstead, Sharon A. Klinger, and Walter C. Mih.)

This volume covers the broad, though relatively short, historical basis for this project. The historical developments of certain design features, criteria and research activities are traced. Current design practices are summarized based on the results of an international survey and interviews with agency personnel and consultants. The fluid mechanics and hydraulics of fishway systems are discussed.

Fishways (or fishpasses) can be classified in two ways: (1) on the basis of the method of water control (chutes, steps [ladders], or slots); and (2) on the basis of the degree and type of water control. This degree of control ranges from a natural waterfall to a totally artificial environment at a hatchery. Systematic procedures for analyzing fishways based on their configuration, species, and hydraulics are presented. Discussions of fish capabilities, energy expenditure, attraction flow, stress and other factors are included.

4. Powers, Patrick D. and John F. Orsborn. 1985. ANALYSIS OF BARRIERS TO UPSTREAM MIGRATION.--An Investigation into the Physical and Biological Conditions Affecting Fish Passage Success at Culverts and Waterfalls.

Fish passage problems at natural barriers (waterfalls) and artificial barriers (culverts) are caused by excessive velocity and/or excessive height. By determining which geometric or hydraulic condition exceeds the capabilities of the fish, the most promising correction can be made to the barrier.

No waterfall classification system was found in the literature which could be applied to fish passage problems. Therefore a classification system was designed which describes: (1) downstream approach conditions at the base of the barrier; (2) central passage conditions as in a high velocity chute or the leap over a falls; and (3) upstream conditions where the fish exits the high velocity chute or lands after leaping past a barrier.

The primary objective was to lay the foundation for the analysis and correction of physical barriers to upstream migration, with fishways being one of the alternative solutions. Although many passage improvement projects are economically small compared with those at large dams, each year millions of dollars are spent on solving these smaller passage problems--and sometimes the money is wasted due to poor problem definition. This report will assist in both the definition of the problem and selection of the most beneficial solution.

FISHERIES ENGINEERING PROGRAM AT WASHINGTON STATE UNIVERSITY

Walter C. Mih and John F. Orsborn¹

ABSTRACT

Problems associated with the interrelationships of instream hydraulic structures, and migratory and resident fish, are in need of better analysis and design. This improvement can be realized only through the integration of knowledge from biological and engineering disciplines. An opportunity for such training is being developed within the Hydraulic Engineering program at Washington State University. The current status of the academic and research topics is presented.

INTRODUCTION

For the past thirty years the faculty, staff and students of the Albrook Hydraulic Laboratory at Washington State University have been conducting research on hydraulic, hydrologic, fluid mechanics and fisheries engineering problems. Some of the studies have included topics such as:

- air entrainment
- flood plain management
- lake restoration
- dispersion of heated effluents
- flushing of pollutants from lakes
- beach erosion and restoration
- effects of turbulence on blunt body drag
- sound suppression for Saturn V rocket engines
- floating breakwaters
- wind forces of buildings
- computerized mapping of land and water resources
- sediment in estuaries
- temperature stratification in reservoirs
- trashrack loads and losses
- flow through rough conduits
- non-Newtonian flows and slurries
- hydrology of ungaged watersheds

¹ Professors of Civil and Environmental Engineering in the R. L. Albrook Hydraulics Laboratory, Washington State University, Pullman, WA, 99164-3001

In the past six years an increasingly larger number of projects have been undertaken which deal directly with some aspect of fisheries engineering. These have included:

- instream flow needs
- spawning area measurements
- channel geometry and habitat characteristics
- fishway performance at existing and new dams
- hydraulic jets for cleaning spawning gravels
- design and optimization of habitat improvement structures
- spawning bed restoration
- development of new fishladder designs
- state-of-the-art in fishway design
- methods for bypassing smolts around dams
- analysis of culverts and waterfalls as barriers to upstream migration
- relationships between fish and velocity

This steady increase in research projects associated with bio-engineering aspects of fisheries projects has laid the foundation for an area of academic emphasis within the graduate program in Hydraulic Engineering at WSU. During professional leaves, and through contacts with fisheries agency personnel, faculty in the Albrook Laboratory have been able to identify areas of design and research to which the application of basic fluid mechanics and bio-mechanics would be beneficial. It is to these two areas that the remainder of this paper is addressed:

- 1) the emerging academic program; and
- 2) the current and projected research program.

These provide the opportunities for students to receive specialized and integrated training in fisheries engineering at WSU.

ACADEMIC PROGRAM

Persons with BS or MS degrees in Biological Sciences or Fisheries can, with about a year of remedial work, prepare to undertake graduate courses in hydrology, hydraulics, fluid mechanics and fisheries engineering. The remedial courses usually include: differential equations; statics; dynamics; fluid mechanics; hydrology; and hydraulic engineering. In addition, courses which have been found to be helpful include engineering economics (for benefit cost analysis) and elementary surveying (for field project control and design). An MS degree in Engineering can be earned in about two and one-half years.

Students with a BS degree in Civil Engineering undertake remedial work in fisheries which includes courses such as: aquatic ecology; fisheries biology; fishery ecology; and principles of fisheries management. (Courses at WSU & UI) ^{Science}

•corrections for culverts to improve fish passage

•hydrologic and hydraulic design of habitat improvement structures

•instream flow methodology based on channel geometry

•habitat estimation based on watershed and channel stream characteristics

Through literature reviews and discussions with practitioners and researchers it has been noted that many fisheries engineering projects receive little or no hydraulic or biological design considerations. Design is accomplished based on rules of thumb, experience and expensive trial and error approaches in the prototype environment. Better results will be achieved only through improved scientific and engineering analysis, and physical and computer modeling.

CONCLUSION

Specialized fields of training in fisheries biology and civil engineering in colleges and universities, and agency missions, have led to unilateral decisions in the design and installation of structures related to fisheries---bridges, culverts, fish passes, dams, waterfall modifications, habitat improvement structures---. It is a commonly accepted fact that poor communication, and biases developed during our technical training, are the biggest barriers to the successful solution of fisheries engineering problems.

The fisheries resources of the nation have suffered drastically from the waves of development impacts which have traveled across the country. It is time for professionals in various technical fields to combine their abilities and efforts to help restore and sustain our fisheries resources. By offering this opportunity for dual-discipline training at WSU, we hope to be able to assist in this worthwhile endeavor.

JOHN F. ORSBORN
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January, 2008
360-437-0670

EDUCATION:

1964 University of Wisconsin, PhD in Civil Engr, (Hydrology); Minors: Soils and Geology.
1960 University of Minnesota, MSCE (Hydromechanics); Minors: Water Supply and Structures.
1957 University of Colorado, BSCE, (Hydrology); Minor in Sanitary Engineering.
1952 Colorado College, BA (History); Minor in Civil Engineering.

POSITIONS: 1964 - 1991: Asst. to Full Professor, Hydraulic Research Engr. and Dept. Chair, Dept. of Civil and Environ. Engr., Wash. State Univ., Retired 1991, Professor Emeritus. 1952-1964: Positions with USSCS (NCRS), USFS, USACE, Consulting Firms, U. of Minn. and U. of Wis.

INSTRUCTION: Introduction to Civil Engineering; Systems Analysis and Design; Senior Design; Mechanics of Fluids; Hydrology; Advanced Hydrology; Open Channel Flow; Water Resources Engineering; Professionalism; River Engineering; Fisheries Engineering; and Hydropower Planning and Design. Short courses taught nationally on: Hydrology; Flood Plain Management; River Engineering; Disaster Planning; Shorelines Management; Low Flow Criteria; Instream Flow Problem Analysis; Flood Prediction in Ungaged Streams; Hydrology and Hydraulics for Fisheries Biologists; Ungaged Streamflow for Biologists; Fish Passage at Waterfalls and Culverts; Design of Fisheries Habitat Improvements; Fishway Design; Hydrology and Statistics; Physical Aspects of Watershed Analysis; Culvert Fish Passage.

CONSULTING: Numerous projects as consultant to: consulting firms; county, state and federal agencies; private citizens; National Water Commission; United Nations; power companies; EPA; NARF; USFWS; USFS; WDFW; WDNR; Office of Surface Mining; ODF&W; Tribes; Alaska Aquaculture Associations; Oak River National Laboratory.

RESEARCH: Reports and journal articles on: hydropower dams; floating breakwaters; beach erosion; Saturn V rocket engine; clay slurries in pipelines; geothermal wells in Mexico; flushing pollutants from lakes; fish guidance screens; trashrack design criteria; water planning for Washington; lake studies; floodplain management; establishing low flow criteria; river basin graphical models; public education in the human water environment (WSU-EXPO '74 PAVILION World's Fair in Spokane); instream flow needs in the PNW; water quality and water balances in lakes; Editor and Program Manager at the AFS Instream Flow Conference in Boise (1976); development of new concepts in fish ladder design; stream restoration at gold dredge sites in Idaho and Oregon; instream and offstream sediment traps; hydrology of streams on the Olympic Peninsula; hydrology of streams in Alaska; stream restoration; quantitative modeling of the relationships among basin, channel and habitat characteristics for classification and impact assessment; steel dam design; prediction of groundwater levels; streamflow estimation using regional basin characteristic models; welded steel fish ladders; mine-cut lakes in surface coal mines; stream improvements and fish response; quantification of instream flow requirements; models of hydrologic and stream channel relationships.

HONORS: Third Prize, James F. Lincoln Arc Welding Foundation, Undergraduate Competition, 1957. Second Prize, James F. Lincoln Arc Welding Foundation Design Contest, Professional, 1961. Scholarships: Colorado College, 1947-48; 1949-52; Univ. of Colo, 1955-57. Ford Foundation Doctoral Fellowship, Univ. of Wis., 1961-64. Engineer of Merit, Inland Empire Section, ASCE, 1982. Elected Fellow, ASCE, 1987. Student Awards as Outstanding Professor in Civil Engineering, and in the College of Engineering, at WSU, 1990. Most Effective Professor Peer Award in Civil Engineering at WSU, 1990.




Culvert Design Flows for Fish Passage and Structural Safety in East Cascade and Blue Mountain Streams

Description: The pervasive problem of restoring fish runs to their natal streams is characterized in many regions of Washington by improperly placed culverts. The replacement of these fish migration barriers requires knowledge of design flows: floods for structural safety and migration season high and low flows. High flows block fish passage with velocities that exceed their swimming capabilities. During low flows, the migration barrier is caused by a lack of enough water depth to support the bodies of the fish. The estimation of these fish passage and safety flows in ungaged streams is impeded in eastern Washington due to: the wide range of climatic conditions (5 to 110 in. per year of precipitation); diverse geology and soils; a lack of stream-gaging stations with long-term records; changes in land use; and the seasonal impacts of irrigation diversions and well pumpage on the remnant instream flows. Past efforts to estimate these flows have not been successful.

Therefore, the Washington State University (WSU) project was undertaken to model the high migration season flow in all of eastern Washington. In addition, WSU established 20 stream-gaging stations on salmon streams along the east side of the Cascade Mountains plus the Blue Mountains. This complementary project was developed to estimate other design flows in the Water Resource Inventory Areas (WRIA) 29, 30, 32, 35, 38, 40, 45, 48 and 49, in which the WSU gage sites are located. United States Geological Survey (USGS) gage records in those WRIsAs (and in WRIsAs 39, 46 and 47) were used to develop models that estimate the following statistical flows: 100-year, 25-year and 2-year daily and peak floods; the average annual flow and its variability; ranges of mean monthly flows (maximum, average and low); the 7-day average, 2-year, 10-year, 20-year low flow; and the 30- and 60-day average low flows. The model results are, for the most part, very good. The standard error of estimate ranges are: for floods, 2-37%; average annual flow, 10-37%; maximum annual flow, 6-14%; minimum annual flow, 13-23%; and low flows, 3-22%. Monthly average flows reflected the strong influences of seasonal variability and irrigation withdrawals: 3-242%, due to winter frozen low flows (3%) in the Entiat-Wenatchee Region, and August low flows (242%) in the Blue Mountains due to irrigation. All flow estimation equations were based on USGS stream-gaging data from continuous gages located in the WRIsAs

Date Published: October, 2002

 Full Report (pdf 5.15 MB)

Publication Number: WA-RD 545.2

Last Modified: May 1, 2007

Authors: John F. Orsborn, Mack T. Orsborn.

Originator: Washington State Transportation Center (TRAC)

of Pages: 146 p., 5,403 KB (PDF)

Subject: Culverts, Design, Fishes, Hydrology, Mathematical models, Migration, Stream gages, Streams.

Keywords: Culverts, fish passage, structural safety, design flows, hydrologic models.

Related Publications: Modeling hydrology for design of fish passage, (WA-RD 545.1).

This abstract was last modified April 29, 2008

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1 Is That Culvert a Barrier to Fish Passage ?

John F. Orsborn, PE
Roadbuilders' Clinic
Coeur d' Alene, ID
March 04-06, 2008



2 Introduction

- Because communication has been a major problem when working with culverts, we will start with a comparison of definitions from various sources.....

3 Definitions of a Culvert

- ASCE (1962) *Notice the Dates!!!*
 - (1) A closed conduit for the free passage of surface drainage water under a highway, railroad, canal, or other embankment.
 - (2) In highway usage, a **BRIDGE** waterway structure having a relatively short span.

4 Definitions of a Culvert

- Webster's (1980)
 - Culvert (origin unknown)
 1. a transverse drain
 2. a conduit for a culvert
 3. a bridge over a culvert
- Webster's (1996)
 - A drain or a channel crossing under a road, sidewalk etc.; sewer, conduit.

5 Definitions of a Culvert

- American FISHERIES Society (1998)
 - A passage, usually a pipe, constructed beneath a road, railroad, or canal to **TRANSPORT WATER** - - -

6 Definitions of a Barrier

- ASCE (1962)
 1. A low dam or sill in a small stream usually in a mountainous region, built to retard the downward cutting of a stream.
 2. A low ridge built by wave action near shore.

Definitions of a Barrier **7**

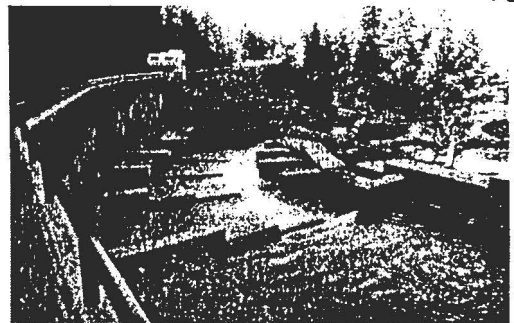
- Webster's (1996)
 - Any NATURAL obstacle; anything that restrains or obstructs access.
- American Fisheries Society (1998)
 - Any physical, physiographic, chemical or biological obstacle to migration or dispersal of AQUATIC ORGANISMS.

Classification of Culverts as Barriers **8**

- Culverts can be physical barriers classified either as:
 1. Temporary;
 2. Partial; or
 3. Complete

Classification of Culverts as Barriers **9**

- TEMPORARY
 - blocks ALL of the fish SOME of the *TIME*
- PARTIAL
 - blocks SOME of the fish ALL of the *TIME*
- COMPLETE
 - blocks ALL of the fish ALL of the *TIME*



Characteristics of Good & Bad Culverts **11**

- | | |
|------------------------|------------------------------------|
| • GOOD | • BAD |
| – Passes design flood | – Too shallow for fish at low flow |
| – Passes Debris | – Clogs with debris |
| – Easy fish passage | – Too steep |
| – Easy fish access | – Barrel too smooth |
| – Rough barrel (floor) | – Difficult fish access |
| | – NFI = NFO |

PHASES OF ANALYSIS **12**

- | | |
|--------------------|---|
| • HYDROLOGY | Flow TO Culvert |
| • HYDRAULICS | Flow IN Culvert |
| • CHANNEL GEOMETRY | Flow OUT of Culvert
Fish Access to Culvert |
| • FLUID MECHANICS | Flow past OBJECTS
Local Depth & Velocity |
| • BIOMECHANICS | FISH Capabilities to swim and leap |

FACTORS THAT LIMIT FISH CAPABILITIES AND SPAWNING SUCCESS 13

1. Distance from ocean to culvert and to spawning sites
2. Time left before spawning
3. Injuries
4. Delays
5. Swimming capabilities (water temperature)

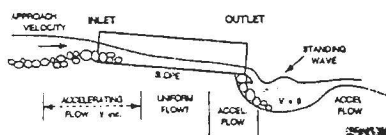


HYDRAULICS 14

- WHAT?
 - Route the flows
- WHICH?
 - Fish passage & flood design flows
- HOW?
 - By flow & energy calculations in the culvert
- WHY?
 - To determine depths & velocities to compare with fish capabilities.

HYDRAULIC CULVERT CONDITIONS 15

- Flow: $Q = \text{Area} \times \text{Velocity}$

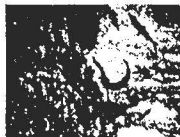
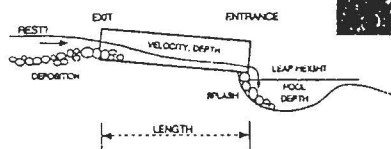


BIOMECHANICS 16

- WHAT?
 - Flow conditions vs. fish capabilities
- WHICH?
 - Flows during migration seasons
- HOW?
 - Compare fish capabilities to hydraulic conditions
- WHY?
 - To evaluate IF the fish will be able to negotiate the culvert

FISH & FLOW CULVERT CONDITIONS 17

- For FISH



DEPTHS AND VELOCITIES 18

- The "Maximum" allowable velocity in the culvert is really the "average" velocity ($V = Q/A$) (State Laws)
- The "Minimum" depth is to keep the fish's gills under water
- We cannot control when, or for how long, these conditions are going to occur (part of the uncertainty in design).

Samples of State Laws

19

"Design in Favor of the Fish"

WA (2003)

- 10% High Flow in migration season
- 7-Day Ave Low
- 1-ft. Min Depth for Salmon & SH
- 0.5 ft. Min Depth
- 1-ft. Max Drop at fish entrance

ID (2005)

- 5% High Flow
- Max velocity use Alaska curve
- 8 in. Min Depth for Salmon & SH
- 3 in. for others
- 1-ft. Max Drop
- Pool depth 1.25 x drop

A Short History of Culvert, Bridge and Fish Problems

20

- Post WWII: Chain saw
- 1960 – 80:
 - Engineers- bridges expensive for small streams.
 - Logging Roads- culverts plug; mass wasting; shotgun culverts
 - Debris Barriers & Concrete Aprons

A Short History of Culvert, Bridge and Fish Problems

21

- 1970 USFS Report on "Fish vs. Culverts" Howard Metsker, Logan UT
- 1973 Endangered Species Act
- 1980-90 Biologists & Engineers begin to communicate
USBPR buries culverts ½ depth with natural beds
- 1993 President Clinton's Forest Conference

A Short History of Culvert, Bridge and Fish Problems

22

- 1990-2000 Stream Simulation Design Developed (actually a bridge) State DOTs & DF&W Cooperative Programs to correct culverts
- 2005 US Forest Service National Inventory Identifying Barriers to Aquatic Organisms at Road-Stream Crossings

MOTHER GOOSE & GRIMM

