BEFORE THE WASHINGTON STATE UTILITIES AND TRANSPORTATION COMMISISON

FOR THE STATE OF WASHINGTON

BNSF RAILWAY COMPANY, Petitioner, vs. CITY OF MOUNT VERNON, Respondent SKAGIT COUNTY, WASHINGTON STATE DEPARTMENT OF TRANSPORTATION, WEST VALLEY FARMS, LLC, Intervenors	**Docket No. TR-070696** **PREFILED TESTIMONY OF ALBERT LIOU**

Q. Please state your full name, job title and business address.

Albert Liou, Senior Hydrologic/Hydraulic Engineer

Pacific International Engineering, PLLC

Po Box 1599

123 2nd Avenue S

Edmonds, WA 98020

Q. What does your job as with Pacific International Engineering entail?

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Managing, supervising and directing riverine flood hydrologic and hydraulic analysis, floodplain delineation, and design of flood control facilities

Q. Please explain your background, qualifications, academic training, academic degrees or any special training that you have.

Over 35 years of experience in water resources engineering, design and analysis of hydraulic structures including dams, levees, hydropower, water supply, and flood control facilities. I am also a FERC approved Independent Consultant. ***Please see Resume Attached as Ex. No.__ (AL-1)***

Q. Are you familiar with the Skagit River System located in Skagit County and if so what is the extent of your knowledge and experience with this system?

I am very familiar with the Skagit River system. Working over the past five years (since early 2002) on the Skagit River flood hydrology and hydraulics. I've gained a lot of knowledge and experience with this system.

Q. Can you please explain what work you have conducted involving the Skagit River system in general?

I've led a team of engineers and conducted the Skagit River flood hydrologic and hydraulic analysis, and an evaluation of alternative flood reduction measures. Our team has developed a set of computer models that analyze the recent major floods including the two November 1990 events, the November 1995, and October 2003 floods. We've also developed a set of synthetic (hypothetic) flood events corresponding with various flood frequencies with return intervals between 2 to 500 years.

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Q. What work, documents, studies, research or other material or information did you examine before performing such work?

We reviewed all available flow, flood stage and reservoir operating data, and technical documents provided by USGS, PSE, the Corps, and Skagit County, and developed flood routing models including HEC-5 for the Baker reservoirs flood control storage operation, and HEC-RAS for the Skagit River system flood routing.

Q. What is a flood plain?

A low-laying topographic area adjacent to a stream channel, prone to be flooded when the stream exceeds its channel conveyance capacity and the stream flood stage rises above its channel bank(s).

Q. After a flood event occurs or during a flood event, how are floods evaluated?

Floods are evaluated by observed, measured, or estimated discharge, stage, flood volume, and frequency (or recurrence interval).

Q. What is a peak flow?

A peak flow is an observed, measured, or estimated instantaneous maximum discharge (in term of cubic feet per second) during a flood event.

Q. What, in your professional opinion, is the likelihood that the Skagit River system will experience another flood event? Why?

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Yes, definitely. The climatological and hydrological cycles, such as the raining and flood season in the winter months, keep repeating historically. There is no reason to believe these cycles would just stop suddenly.

Q. What degree of flooding is necessary in the Skagit River System before damages begin to accrue?

The Skagit River system starts flooding damage when the flow at Concrete exceeds approximately 60,000 cfs.

Q. What type of damages can be expected?

Farm lands in the Nookachamps area would be flooded first, and farm crops would be damaged. If flood begins getting larger, road systems would incur scouring. Further flood increase would cause damages to residential and commercial buildings, public facilities such as sewer and water supply systems, and even levee failures.

Q. What specific examples are you aware of in which damages from flooding were incurred that illustrate this relationship?

The 2003 flood incurred flooding damages in the entire Town of Hamilton, and the Nookachamps area. The 1995 flood incurred more damage than the 2003 experienced in Hamilton and Nookachamps. A pier scouring and failure occurred at the BNSF Bridge between Burlington and Mount Vernon during the 1995 flood. The two November 1990 floods caused twice failures of Fir Island levee resulting in a substantial damage to the entire Island in addition to similar damages in Hamilton and Nookachamps. Extensive flood fight efforts were taken on the existing levee during all of these flood events. Otherwise, the damage would have been a lot greater.

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Q. Have you modeled levy breaks or failures and their result in the general Mount Vernon area?

Yes.

Q. Does this include analysis of flooding and its effects in the South Mount Vernon area specifically the area surrounding Hickox Railroad Crossing? Can you describe the area in terms of flood risk?

Yes. The Hickox Railroad Crossing is at a high ground with ground level at El. 18 (NGVD-29), but the surrounding area is approximately 10 feet lower with ground level at El. 8. Our analysis results indicate that the 100-year flood water surface could potentially reach El. 17 if levee failure occurs.

Q. Can you describe how and where water would flow as a result of levy failure or flooding in the areas North of the Hickox Railroad Crossing such as Downtown Mount Vernon or North of Downtown Mount Vernon?

How and where water would flow depends on where a levee failure occurs. If a levee failure at the north side of the City, water would flow down south generally following the railroad tracks through the Cameron Way underpass of I-5, spreading into the downtown low-lying area, and continuing south on both sides o the railroad tracks to Hickox Road.

Q. According to FEMA's current flood insurance rate maps, what is the flood plain designation of the area surrounding the Hickox Railroad Crossing? What does that mean?

Current flood maps designate the area as Zone AO, Depth 2 (north of Hickox Road) and Depth 3 (south of Hickox Road). This means that during a 100-year event, the area would be inundated by an average water depth of 2 and 3 feet, north and south of Hickox road, respectively.

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Q. Are you aware of further studies that have been conducted regarding the Skagit River since FEMA produced its flood insurance rate maps? What studies? Why?

Yes. A revised flood insurance study for the Skagit River has been conducted by the U.S. Army Corps of Engineers, Seattle District. The revised study is intended to improve the accuracy of the current flood insurance rate maps.

Q. Do these studies suggest that the current FEMA maps understate or overstate the floodplain designation in the Mount Vernon Area surrounding Hickox Road?

The revised study suggests that the current FEMA maps understate the floodplain designation in the Hickox Road area.

Q. In your opinion, during a flood event of record, what is the depth of water for the Hickox Crossing Area during a:

A 100 year event? – **About 9 feet surrounding the Hickox Crossing area, although it would be dry right at the crossing**

A 50 year event? – **About 5 to 7 feet.**

A 25 year event? – **About 2 to 3 feet.**

All these estimated water depths are based on the assumption that a levee failure would occur during these flood events.

Q. What level of protection do the Dikes maintained by Diking District 3 that serve to protect that area provide?

The levee maintained by Diking District 3 would provide flood protection to that area up to about a 25 to 50 year event.

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Q. What would the likely result be to the area West of the Hickox Railroad Crossing and East of the Skagit River should levy failure occur?

All properties, crops, houses and Hickox Road would be flooded. Some road and ground surface scouring would occur. Severe economic losses and potential losses of life would be expected.

Q. How fast would the area be inundated in the event of Dike failure? How much time after one of the levies East of the area breaks would a person likely have to reach high ground?

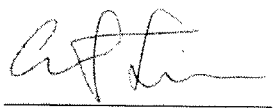
It depends on where the levee breaks. If a failure occurs within Diking District 3 levee, water would reach the Hickox Railroad Crossing within 10 to 20 minutes. This is the amount of time one could have to reach high ground.

Q. How important is it to maintain the integrity of the dike system in the area?

Very, very important to maintain the integrity or the dike system in the area in order to minimize flooding consequences.

I declare under the penalty of perjury pursuant to the laws of the State of Washington that the foregoing is true and correct.

DATED this 5th day of November, 2007 at Bothell, Washington.



Albert Liou

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EXHIBIT AL-1

Albert Liou, P.E.
Principal
Senior Civil/Hydraulic/Hydrologic Engineer

Education

Ph.D. Studies, Princeton University, 1971
Numerical Analysis and Computer Applications in Fluid Mechanics
M.S., Civil Engineering, University of Illinois (Urbana), 1970, Hydrodynamic Engineering
B.S., Civil Engineering, National Taiwan University, 1967

Continuing Education

HEC-RAS Version 3.0, 2001, University of Wisconsin-Madison
National Flood Insurance Program / CRS Workshop, 2002, FEMA/WDOE
DFIRM Workshop, 2002, FEMA/Michael Baker, Jr.

Professional Registrations

Registered Professional Engineer:
Illinois, 1974
Oregon, 1981
Washington, 1981

Professional Experience

Mr. Liou's 32-year professional experience has covered all aspects of water resources engineering. He has supervised and managed licensing/permitting, FEMA flood insurance studies, environmental studies, feasibility studies, flood control plans, dam safety inspections and failure analysis, engineering design and construction management of fish passage facilities, tunnels, pipelines, culverts, open channels, dams, dikes, levees, power plants, outlet works, and other hydraulic structures. Mr. Liou is a FERC-approved Independent Consultant.

As Project Manager, Mr. Liou managed and supervised engineering, environmental, and permitting activities for over two dozen hydropower, water supply, fishway, and flood control projects in the Pacific Northwest. These include Chehalis River Flood Reduction and Bank Erosion Stabilization, Wynoochee Dam and Storage Operation Modifications for Flood Control and Hydropower, SR 105 – Willapa Bay Bank Stabilization, Maplewood Creek Stormwater/Sediment Detention Pond and Fishway, Bonneville Dam Juvenile Fish Passage, Cowlitz Falls Dam and Fish Passage Facilities, Cowlitz Salmon Hatchery Barrier Dam and Fishways, Snoqualmie Falls Dam, SR2-Bypass Drainage Plan, Lakemont Stormwater and Sediment Detention Pond, Blakely Ridge Master Drainage Plan, Howard Hanson Dam Fishway, Wishkah Water Supply Pipeline, Cascade Lake Dam and Mountain Lake Dam Rehabilitation, Blue River Fish Screen, and Trailbridge Dam Spillway Expansion projects.

Mr. Liou has performed flood hydrologic and hydraulic analysis for over 100 projects, using various computer programs, including HEC-1, HEC-FFA, HEC-RAS, UNET, HEC-DSS, HEC-HMS, HEC-4, HEC-5, FESWMS, RMA2, FLO-2D, FLDWAV, RiverCAD, GeoRAS, GeoHMS, and several programs developed by him for dynamic floodwave routing, steady flow backwater, and storage routing. Project streams include Bear Creek, Woods Creek, Grays, Elochoman, Newaukum, Skookumchuck, Wynoochee, Chehalis, Skokomish, Cowlitz, Nisqually, White, Green, Cedar, Stillaquamish, Sultan, Pilchuck, Tolt, Snoqualmie, Snohomish, Skykomish, Nooksack, Skagit, Elwha, Dungeness, Hamma Hamma, Lewis and other rivers in Western Washington.

Mr. Liou has served as supervising and chief hydraulic engineer with other consulting firms, responsible for all hydrologic and hydraulic analysis and design. He performed analysis and design of the Sultan River Project, including a morning glory spillway, intake, and fishwater release pipeline; developed a computer model for analysis of historical floods on the entire Snohomish River Basin; and modeled the Spada Lake reservoir operation for flood control in addition to power, water supply, and fishery instreamflows. Mr. Liou developed a hydraulic

transient program by Method of Characteristics and supervised hydraulic transient analysis and design of the Green Lake and Swan Lake projects in Alaska; conducted dam-safety inspections; and performed flood studies on numerous streams in Washington and Oregon.

Earlier, as Project Engineer and acting head of a hydraulic and computer department, Mr. Liou performed hydraulic design and analysis for the main stream and the Calumet River systems of the Deep Tunnel and Reservoir Plan for the Metropolitan Sanitary District of the Greater Chicago Area, for which over 100 combined sewer overflow, outfall, and gate structures and more than 30 drop shafts and 20-mile-long tunnels were designed. He designed a stormwater detention pond for the City of Elmhurst and was responsible for the flood control plan of the East Branch Dupage River and for the stormwater management plan of the Blackberry Drainage District No. 1, all in Illinois. He designed cooling lake and circulating water system for several coal-fired and nuclear power plants located in the mid-west and east coast.

Project Experience

Hydraulic

CHEHALIS RIVER BASIN FLOOD REDUCTION PROJECT – LEWIS COUNTY, WASHINGTON

As Project Manager and Chief Hydraulic/Hydrologic Engineer, Mr. Liou has led a technical team working with communities, agencies, and the USACE in performing HEC-1, -5, and -FFA, UNET, HEC-RAS, RiverCAD, and GeoRAS modeling for five major historical floods and for the synthetic 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year floods for the entire 2,100-square-mile Chehalis River Basin. The unsteady flow UNET and HEC-RAS models calibrated and verified include over 800 channel cross sections and numerous bridges, culverts, levees, road/railroad embankments, lakes, storage areas, etc., along 190 miles of main and tributary streams. Work includes all engineering and environmental studies, and modeling of various flood reduction alternatives including several new and existing storage dams for flood control, levees, flood bypass channels, overbank excavations, wetland storages, and bridge and roadway modifications. Performed a new PMF study for Skookumchuck Dam based on Clark Unit Hydrograph method.

Supervised development of unsteady-flow flood models by converting all available HEC-2 and UNET models previously developed for FEMA, the Corps, and communities into new geo-referenced HEC-RAS and Geo-RAS models. The flood models were calibrated for the existing basin conditions based on observed high watermarks and gaged hydrographs for five major historical flood events with recurrence intervals spanning between 5- and 100- years. Directed modeling of the Skookumchuck Dam storage operation to include flood control function in addition to its existing operation for water supply and fishery instreamflows. Directed modeling of various levee alternatives in the basin. These alternatives include several new flood control storage dams, dikes, flood bypass channels, channel and overbank excavations, wetland storages, and bridge and roadway modifications. Two promising solutions to the flooding problem have been identified, and further evaluated and optimized by the modeling efforts. These solutions involve modifying the existing Skookumchuck Dam to provide for a 20,000 acre-foot flood control storage; enlarging the existing Mellen St. Bridge opening and excavating the adjacent overbanks to increase flood hydraulic conveyance; modifying SR-6 roadway and a farmland drainage ditch to provide flood flow bypass and storage; and modifying other floodway and floodplain to achieve desired flood stage reductions. Also, managed design and analysis for various hydraulic structures of the project; environmental investigations; agency and public meetings; and various project reports and documents.

SKAGIT RIVER FLOOD REDUCTION – SKAGIT COUNTY, WASHINGTON

As Project Manager and Chief Hydraulic/Hydrologic Engineer, Mr. Liou is leading a technical team in performing FESWMS, FLO2D, UNET, HEC-HMS, HEC-5

and HEC-RAS modeling. Work involves modeling of flood reduction alternatives including five upstream storage dams, bypass, overbank excavation, and bridge replacement and expansion; and simulating levee failure and setback design. Performed two new PMF studies for Baker Dams based on Clark Unit Hydrograph method.

FEMA REGION VIII ID/IQ FLOOD INSURANCE RESTUDIES – ND, SD, MT, CO, UT, WY

As Project Manager and Chief Hydraulic/Hydrologic Engineer, Mr. Liou has led a technical team since September 2001 in performing new FIS studies for Ashley, Spring, and Trumbull Creeks in Flathead County, MT; for the Sheyenne and Maple Rivers in Cass County, ND; and for American Fork, Hobble, and Peteetneet Creeks in Utah County, UT. Work performed includes community meetings, special problem reports, aerial LIDAR mapping, channel and ground surveys, HEC-FFA, regional flood frequency analysis, HEC-RAS steady and unsteady flow modeling for 10-, 50-, 100-, and 500-year floods and floodway analysis, use of GeoRAS and RiverCAD automated procedures and DTM geo-referenced database applications, GIS flood map preparation, draft FIS report, coordination with FEMA, MCC, and survey/mapping subconsultants, and Technical Support Data Notebook.

PACIFICORP DAM FAILURE FLOOD ANALYSIS AND DOWNSTREAM INUNDATION MAPS – SIX HYDROELECTRIC FACILITIES IN IDAHO, UTAH, AND WYOMING

Project Manager for dam-break flood study. Supervised and performed DAMBRK and FLDWAV floodwave dynamic routing and inflow design flood analysis, and prepared inundation maps for Ashton, Soda, Grace, and Oneida Dams in Idaho; Cutler Dam in Utah; and Viva Naughton Dam in Wyoming. The study included a new probable maximum flood analysis for Ashton Dam and a part 12 Exemption study for Grace Dam.

ANDERSON ROAD IMPROVEMENTS PROJECT FOR CHEHALIS INDIAN TRIBE - CHEHALIS RESERVATION, WASHINGTON

Project Manager and Chief Hydraulic / Hydrologic Engineer, leading a technical team in performing HEC-1, HEC-FFA, UNET, HEC-RAS, RMA2, RiverCAD, and GeoRAS modeling for 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year floods, and alternative 0.2-, 0.5-, and 1.0-ft rise floodway analyses for the Reservation floodplain along more than 30 stream miles of the Chehalis and Black Rivers and tributaries. Work includes delineation of 5-, 10-, 100-, and 500-year flood boundaries, and the alternative floodways on CADD and GIS-based 2-ft contour maps, following new FEMA guidelines and specifications. Project work includes all engineering design, plans, and specifications.

BLUE RIVER DAM PROJECT - OREGON

Managed agency consultation in the final stage of FERC licensing for this 15 MW hydropower development at an existing Corps of Engineers dam. Conducted a post-license feasibility study and design of an Eicher fish screen and bypass system, and a floating temperature control intake system. Provided technical assistance and participated in the ECPA Section 10(j) agency dispute resolution proceeding on issues relating to design of fish passage and water temperature control facilities.

TRAIL BRIDGE DAM PROJECT - OREGON

Project Manager for all engineering and environmental studies, prepared a preliminary design report and a resource protection plan document addressing all USFS concerns. Provided technical assistance and strategy recommendations in negotiations with FERC and USFS on the scope of engineering and environmental studies. Performed a new PMF study for this multi-development project involving three dams, and a DAMBRK dynamic wave modeling analysis for evaluation of downstream flooding consequences to human life and fish/wildlife resources, potentially resulting from operation of the proposed spillway expansion design.

PELTON REGULATING DAM - OREGON

Worked with tribes and PGE staff on final design, procurement and construction management of this 19-MW project. Responsible for fishery agency consultation and final design of fishway modifications, auxiliary attraction-water supply, and pumping facilities.

Performed computer modeling for the unit emergency shutdown operation and downstream 4-mile river stage fluctuation projection.

SNOQUALMIE FALLS DAM PROJECT - SNOQUALMIE, WASHINGTON

As Project Manager and Chief Hydraulic Engineer, Mr. Liou performed DAMBRK, HEC-FFA, and HEC-2 modeling of 2-, 5-, 10-, 50-, 100-, and 500-year floods for existing conditions and over two dozen alternatives for Dam and channel modifications; performed floodplain delineation; and assessed potential flood reduction benefits. Work was executed conforming to FEMA guidelines and the King County Surface Water Design Manual. Provided Calibrated HEC-2 model to the USACE for the Section 205 project baseline model.

Managed all engineering analysis and preliminary design for the proposed dam modifications involving replacement of flash boards with inflatable rubber dams and adding a new spillway capacity. Performed river ramping and flood stage profile computer modeling and presented technical analysis and results to agencies.

NORTH FORK SNOQUALMIE PROJECT - WASHINGTON

Served as hydropower engineering consultant advising the City of Bellevue on FERC licensing issues relating to design of project features including 220 foot high embankment dam, intake, penstock and a powerplant, reservoir operation, water quality, flood control, power benefits, cost allocation, and economic feasibility.

COWLITZ SALMON HATCHERY BARRIER DAM PROJECT - WASHINGTON

Managed all engineering, environmental studies, public meetings, agency consultation, and FERC licensing for this 9 MW retrofit facility at existing 25-foot high embankment and overflow spillway structure. Project involved extensive fishway and ladder modifications.

WEEKS FALLS PROJECT - WASHINGTON

Conducted feasibility study, preliminary design, FERC licensing and agency consultation for the 5-MW facility involving new construction of an 8-foot high inflatable rubber dam, intake and traveling belt fish screen structure, 750-foot long tunnel, a powerhouse containing a horizontal shaft tubular unit, and a buried 34-kv transmission line.

HENRY M. JACKSON PROJECT - WASHINGTON

Supervised hydraulic design of a 60,000-cfs morning glory spillway, power intake, and fish flow pipeline. Performed multipurpose reservoir operation analysis for optimization of water supply, hydropower, and flood control. Also conducted PMF, DAMBRK, HEC-1, -2, -5, and FFA analysis, as well as simulation of historical and synthetic flood events for the 1,800-square mile Snohomish River Basin, economic analysis, and cost allocation. Managed spillway hydraulic model study.

DAM, SPILLWAY, AND HYDRAULIC STRUCTURE DESIGN EXPERIENCE

Alaska: Green Lake (20 MW, 200-ft high arch dam), Swan Lake (22 MW, 195-ft high arch dam); Illinois: Newton (70-ft high earthfill dam), Deep Tunnel and Reservoir Plan (over 100 hydraulic control structures, 30 drop shafts and 20 miles of tunnels); Louisiana: Rodemacher (65-ft high earthfill dam); Kansas: Wolf Creek (60-ft high earthfill dam); Oregon: Owyhee Dam (5 MW), Mitchell Butte (2 MW), and Tunnel No. 1 (9 MW).

DAM SAFETY INSPECTION AND DAM-FAILURE FLOOD ANALYSIS EXPERIENCE

Glines Canyon (170-ft high concrete Arch), Elwha (100-ft high concrete), Malinowski (41-ft high concrete), Mossyrock (605-ft concrete arch/gravity), Mayfield (250-ft high concrete arch/gravity), Alder (330-ft concrete arch), Culmback (220-ft high rockfill), Packwood Lake (65-ft high earth/rockfill), Mountain Lake (17-ft high concrete arch), Cedar Falls (215-ft high concrete), Lake Anderson (28-ft high earthfill), Judy Reservoir Dams A & B (49 and 69-ft high earthfill), Lake Sylvia (23-ft high concrete), Lake Padden (12-ft high earthfill), Lake Whatcom (19-ft high concrete), William Symington (39-ft high earthfill), most in Washington.