200405275050 Received FERC OSEC 05/27/2004 10:02:00 PM Docket# AD04-4-000

APPLICATION FOR PANEL MEMBER LIST FOR HYDROPOWER LICENSING STUDY DISPUTE RESOLUTION

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Technical expertise:

I am applying to be a panel member based on my background and experience in fluvial geomorphology and river processes. I received a Ph.D. in fluvial geomorphology from the Department of Geography and Environmental Engineering at Johns Hopkins University in 1986. Since 1985, I have been conducting studies on river dynamics and processes as a Research Hydrologist with the USDA Forest Service Pacific Northwest Research Station in Corvallis, Oregon. Over that same time period, I have held courtesy appointments in the Departments of Geosciences, Forest Science, and Forest Engineering at Oregon State University. I went through the standard University promotion process and was promoted to Full Professor (Courtesy) in Geosciences in May, 2003.

The overarching goal of my research program is to advance process-based understanding of how stream networks, watersheds, and entire landscapes respond to changes in streamflow, sediment and wood transport, and disturbance regimes in mountain regions. The altered flow and transport regimes that I study can arise because of natural disturbances (i.e., fire), changes in land use (i.e., timber harvest and road construction), direct channel modifications (i.e., construction of dams and diversions), climate change, or the intrinsic evolution of geomorphic system.

To attack the broad set of scientific questions that attach to these drivers of system change, I have organized my research program to use emerging or current issues in key management and policy relevant arenas as opportunities to develop and test fundamental cause-and-effect relationships among geomorphic, hydrologic, and ecologic processes. Such research is necessarily complex and multi-faceted, requiring a coordinated effort of field, experimental, retrospective, and computer-

based modeling studies Moreover, the research is conducted against a backdrop of often intense public, policy, and media scrutiny that attaches itself to management issues surrounding water. Issues of floods, droughts, dams, land use, and related topics are of exceptional national and regional interest, and a critical part of my program is communicating the science implications of these phenomena to wide and diverse audiences, including national and regional media. Along with conducting scientific investigations, I have invested considerable time in interpreting results and implications for managers, policy makers, the academic community, and interested public.

Much of my research agenda is anticipatory in the sense that it focuses on scientific and management issues that are just emerging or have not been well-articulated; examples include geomorphic effects of dam removal, landscape-level responses to drought and flood; and watershed-scale dynamic modeling of effects of riparian zones on stream channels. Such emergent areas typically lack well-defined approaches or conceptual frameworks, previous studies, or syntheses of available knowledge. My research is directed at filling these gaps, and has had some success in influencing how these emerging issues are being addressed by the science community at large, as evidenced by invited commentaries and papers, invited keynote addresses to scientific societies, and invited participation in key working groups.

Selected research activities and foci include:

1) Mountain stream processes: An early and continuing focus of research is understanding how movements of water, sediment and woody debris structure mountain streams. When I began this work in the early 1980s, there were virtually no process-based descriptions of high-gradient mountain streams despite their ubiquity in steep forested landscapes and importance for aquatic ecosystems. These streams differ fundamentally from better-studied lowland channels, in terms of the dynamics of water, sediment, and wood transport that create channel form. I launched a broad-scale research program to understand mountain streams, weaving together field, laboratory, mathematical and computer modeling, and retrospective analyses and investigations. Specific investigations and resulting publications include: process-based field studies of channel and valley floor morphology (Grant and others, 1990; Grant and Swanson, 1995), flume studies of step-pool formation (Grant and Mizuyama, 1992), flume studies of woody debris transport and deposition based on first-principle mathematical models (Braudrick and Grant, 2000, 2001); theoretical and field studies of hydraulics in high-gradient streams (Grant, 1997); and field studies following a major regional flood in 1996 (Johnson and others, 1997).

2) Effects of forest practices on hydrology and sediment transport: The potential role of forest harvest in contributing to higher peak flows and sediment loads in rivers has been a subject of Forest Service paired- watershed studies for over 50 years, with often contradictory or ambiguous results. Using long-term data from the H.J.Andrews Experimental Forest, I initiated and co-authored the most rigorous retrospective analysis of 50+ years of streamflow records ever reported for small and large watersheds (Jones and Grant, 1996). The study revealed larger increases in peak flows following timber harvest in both small and large watersheds than had previously been recognized and suggested that road drainage may play a critical role in increasing peak flow. Further studies explored the specific effects of roads on peak flows (Wemple and others, 1996). Finally, new modeling efforts are extending empirical studies of long-term effects of harvest on sediment transport (Grant and Wolfe, 1991) towards better understanding how upland and riparian zone management practices interact with the channel network to affect long-term patterns of erosion and deposition of wood and sediment and resulting channel morphology (Lancaster and others, 2001, 2003).

3) Geomorphic effects of dams and alternative flow regimes on rivers: I have initiated, conducted, directed, and reported a range of studies designed to develop concepts, tools, and methods useful for evaluating effects of dams on rivers. The Deschutes River Geomorphology Project was a multi-year (1995-2003), multi-agency effort initiated and co-directed by myself to understand the effects of the Pelton-Round Butte hydroelectric dam complex on sediment transport and channel morphology in the Deschutes, a large, desert bedrock river in central Oregon, as part of the FERC relicensing application. The large size, uniform flow, and general inaccessibility of the river required new approaches and methods for measuring channel hydraulics and bed conditions. I designed a coordinated set of channel morphology studies carried out by 2 Master's students under my direction, and coupled them with geologic, stratigraphic and paleoflood analyses led by a co-PI that I recruited from the U.S. Geological Survey (Dr. Jim O'Connor).

These studies revealed that the Deschutes is a surprisingly stable river in modern times, showing virtually no geomorphic effects from the dam, but has experienced past cataclysmic floods from a variety of mechanisms. The unusual finding of stable flow regime, low sediment transport rates, and a channel and valley morphology adjusted to extreme events leading to limited response to dam regulation was integrated into the FERC relicensing application and communicated at national and international meetings. To synthesize the work, the co-PI and I co-edited a monograph on the Deschutes published by the American Geophysical Union (O'Connor and Grant, 2003), which included several papers specifically on the effects of the dam (Fassnacht and others, 2003) as well as a

new general framework for interpreting geomorphic effects of dams on rivers (Grant and others, 2003).

Additional work on the downstream geomorphic response of rivers to dams is being conducted by an Oregon State University Ph.D. student under my direction on the Clackamas River in western Oregon. Results are being directly incorporated into the FERC relicensing application. These studies are looking at historical channel changes below a suite of dams on the river and developing techniques for distinguishing dam-related effects as opposed to natural trends in river evolution.

Another dam related project is the North Santiam Turbidity Study, which is seeking to understand the sources and consequences of persistent turbidity in the North Santiam River watershed, a large (1000 km^2) basin that is the source of municipal water for the city of Salem, Oregon. I lead the geomorphic component of this study which includes defining cause-and-effect relationships among deep-seated earthflows as sources for smectite-rich clays that produce persistent turbidity, operation of large flood control reservoirs that store and release turbid water, and consequences to downstream water treatment facilities. These results have been published in report form (Hulse and others, 2002), presented at national scientific meetings, figured prominently in a General Accounting Office study of effects of forest practices on municipal water supply, and are now being prepared for publication as journal papers.

4) Geomorphic effects of dam removal: The geomorphic and ecologic response to dam removal is a major area of current interest in science, as evidenced by every major geological, engineering, and ecological society (i.e., GSA, AGU, ASCE, AAG, ESA) having hosted a symposium or workshop on the subject within the last few years. I am providing conceptual guidance and analytical tools to help frame this issue and resolve scientific uncertainties associated with dam removal. My standing on this issue is evidenced by having been invited to give 10 talks on this subject to national scientific societies within the past 2 years, numerous university seminars on the subject, invitation by the president of the American Society of Limnology and Oceanography to chair a symposium on the subject at the society's national conference in June, 2002, invitation to participate in a U.S. Bureau of Reclamation workshop to develop a scientific monitoring program for the Elwha Dam removals, request by the chair of the panel to provide an external review to a 1.5 year study on dam removal by the Heinz Center, and an invited commentary for the journal *Hydrological Processes* on dam removal (Grant, 2001). I currently supervise two Oregon State University Ph.D. students who are examining upstream and downstream geomorphic responses to removing dams through both field and laboratory studies, and am collaborating with scientists at

the U.S. Bureau of Reclamation and University of Nottingham to predict effects of removing the Elwha River dams.

5*) International collaborations:* My international research activities include extended research collaborations in Japan (all at the invitation of and with support from the Japanese government) in 1988 (2 months), 1993 (3 weeks), and 1997 (3 weeks), and in Italy in 1998 (5 months), plus shorter field visits to France, Germany, Switzerland, Austria, Belgium, China, and New Zealand. In Japan I have worked with Japanese scientists to conduct flume experiments on channel processes and woody debris transport in streams. This work pioneered coupling field observations with laboratory experiments to develop physical models predicting step-pool formation and movement of woody debris in streams. In Italy, I worked with Italian colleagues at the Universities of Florence and Padova to initiate studies on channel incision following channel and land use change in Tuscany, and step-pool formation in streams draining the Dolomites. Other international research activities have included a field visit to the Philippines in 1995 to conduct measurements on rivers draining Mt. Pinatubo, invited seminars at universities in Italy, France, Belgium, Japan, and Switzerland, and invited visits to laboratories and field areas in these countries plus Austria, Germany, and China to discuss channel processes, natural hazards, and erosion control in mountain regions. Current on-going collaborations include work with colleagues at universities in France and China; the latter is focused on predicting geomorphic effects of large dam projects on Chinese rivers.

6) Other research-related assignments:
I am an invited member and sole Forest Service representative of the Yuba River Technical Review Panel. The Upper Yuba River Studies Program is a stakeholder- driven, collaborative effort to determine if introduction of wild chinook salmon and steelhead trout to the Upper Yuba River watershed is biologically, environmentally, and socio-economically feasible over the long term. With $7 million funding from CALFED's Ecosystem Restoration Program, a workgroup has developed scopes of work for a set of six integrated studies. The scientist participates with other members of the Technical Review Panel to review the scopes of work and related work plans to ensure that the proposed work is technically sound and that the stated objectives can be achieved within the proposed time frame

2. Knowledge of the effects of construction and operation of hydroelectric projects.

My knowledge of hydropower projects and their operation is derived from past and current involvement with FERC relicensing projects as an external advisor and researcher. Along with my involvement with the Pelton-Round Butte

relicensing on the Deschutes River, I have served as an external geomorphology consultant and advisor to a multi-year inter-agency (USFS, NMFS, USFW among others) technical committee to provide oversight of studies conducted to evaluate the downstream effects of dams on the Clackamas River. This committee has been organized by Portland General Electric as part of their relicensing effort. In this capacity I interpret the geomorphic context of the river and dams for the group, direct an OSU Ph.D. graduate student who is studying effects of dams on the lower river, and helps guide the group's discussion on appropriate geomorphic studies.

I am generally recognized as the lead Forest Service scientist on the issue of geomorphic research related to dams, dam relicensing, and dam removal (*cf.* Larry Schmidt, former director, USFS Stream Systems Technology Center, 970-295-5984). As such, I provide on-going counsel to the Station Director, leaders of the USFS National Hydropower Assessment Team, regional hydropower assessment teams, the USFS Stream Systems Technology Center, and the National In-Stream Flow Coordinator, and Washington Office research staff on technical issues surrounding USFS involvement in dam-related issues. I was charged by the Deputy Chief for Research and Deputy Chief for the National Forest System with developing a national plan for research associated with dam relicensing, organized and led a regional workshop on geomorphic and biological issues underlying dam relicensing (2000), and developed a national workshop and web-based training module on dams and their effects on rivers (2003). I also review technical studies and projects for other dam relicensing projects, including Hells Canyon (Snake), Carmen-Smith (McKenzie), and North Umpqua. Upon request I provide science consistency and technical adequacy checks for proposed Forest Service policy decisions with respect to dams.

3. Working knowledge of laws relevant to expertise

Most of my knowledge of laws relevant to dam relicensing (i.e., FPA and subsequent revisions) comes from my participation in relicensing discussions as well as other management and policy forums. For example, I played a significant role in the changing environment of science and public policy in the Pacific Northwest and beyond over the past 10 years. As one of a handful of leading Forest Service hydrologists and aquatic ecologists, I was asked by the USFS leadership to help craft technically and legally defensible ecosystem management strategies. These included substantial contributions to scientific advisory efforts providing technical information to the President (Forest Ecosystem Management Assessment Team; Northwest Forest Plan - 1993), judiciary (Scientific Assessment Team 1993), and Chief of the Forest Service (PACFISH - 1994). In these efforts, I helped develop the (at that time new) idea of using watershed analysis as a basis for interpreting landscape capabilities before management

activities, and had primary responsibility for writing the watershed analysis sections of the final reports of these documents. Because of these initiatives, Federal policies now require watershed analysis on well over 24 million acres in the PNW, and similar guidelines apply to much of the western U.S., including Alaska and California. Developing these analysis procedures and guidelines required that they be consistent with current laws, including the Endangered Species Act, Clean Water Act, and Forest Management

4. Ability to promote constructive communication about a disputed study. Along with reviewing approximately 20 technical papers per year as a journal reviewer, I am a Deputy Editor for Water Resources Research, one of the primary journals in the field of water-related science. According to journal policy, Deputy Editors are "...individuals with established eminence in their fields of expertise. Their role is to provide knowledgeable advice to the editors concerning manuscripts whose reviews are contradictory or difficult for the editor to evaluate, and interact with authors at the request of the editors to provide knowledgeable feedback, particularly in areas outside the expertise of the editors." I am the Deputy Editor for erosion, geomorphology, and sediment, and in that capacity review or consult with the Editor or Associate Editors on technical soundness and appropriateness for journal publication of approximately 2-3 manuscripts per month, and help develop journal policies. This role requires me to communicate with authors and other reviewers around manuscripts that are problematic for one reason or another, and reach resolutions that are acceptable to all parties.

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200405275050 Received FERC OSEC 05/27/2004 10:02:00 PM Docket# AD04-4-000

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