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IN THE SUPERIOR COURT OF THE STATE OF ARIZONA

IN AND FOR THE COUNTY OF PIMA

ENERGY & ENVIRONMENT LEGAL INSTITUTE Petitioner/Plaintiff, vs. ARIZONA BOARD OF REGENTS and TERI MOORE, in her official capacity as Custodian of Public Records for the University of Arizona, Respondents/Defendants.	Case No. C2013-4963 **DECLARATION OF DR. MALCOLM HUGHES** [Hon. James Marner]

1. My name is Malcolm K. Hughes. I am Regents' Professor of Dendrochronology in the Laboratory of Tree-Ring Research, a unit of the College of Science at the University of Arizona ("UA"). I am also a Professor in the School of Natural Resources and Environment, a unit of the College of Agriculture and Life Sciences also at the UA. The Tree-Ring Lab was founded at UA in 1937 by Andrew Ellicott Douglass, widely regarded as the father of the modern science of dendrochronology. The Lab was the first in the country dedicated to dendrochronology and is today one of the world's leading centers of research focused on the use of tree rings and dendrochronology to solve important scientific questions. The Lab's faculty, staff, and students work on a wide range of problems that translate into important new knowledge, such as fire history and fire ecology, geomorphology, and paleoclimatology—the study of the earth's past climate.

2. For thirteen years, until 1999, I was the Director of the Tree-Ring Lab. At least 60% of the funding for the research of the Tree-Ring Lab comes from federal research grants, primarily

from the National Science Foundation (NSF) and the National Oceanic and Atmospheric Administration (NOAA) and agencies of the US Departments of the Interior, Agriculture and Energy.

3. I am a Fellow of the American Geophysical Union and a Fellow of the American Association for the Advancement of Science and have been an author of more than 150 scientific publications. A true and correct copy of my *curriculum vitae* is attached as Exhibit A.

4. One of my lines of research has concerned climate variability and change. This seems to be the aspect of my work of interest to E & E Legal and, indeed, was the subject of a prior request made by the same organization to the University of Virginia concerning the email records of my colleague and co-author, Dr. Michael Mann, with whom I have had a professional relationship since 1997. Mann is a Distinguished Professor of Meteorology and Director of the Earth System Science Center at Pennsylvania State University.

5. Some of my most widely cited work has been conducted in collaboration with Dr. Mann and Dr. Raymond S. Bradley, Distinguished Professor in the Department of Geosciences and Director of the Climate System Research Center at the University of Massachusetts, Amherst. Our work together began with two scientific articles, "Global-Scale Temperature Patterns and Climate Forcing Over the Past Six Centuries," *Nature*, Vol. 392, p. 779-787 (1998), and "Northern Hemisphere Temperatures During the Past Millennium: Inferences, Uncertainties, and Limitations," *Geophysical Research Letters*, Vol. 26, No. 6, p.759-762 (1999). These works are commonly referred to by the year of publications as "Mann, Bradley, Hughes 1998" ("MBH98") and "Mann, Bradley, Hughes 1999" ("MBH99"). MBH98 and MBH99 represented one of the first scientific efforts to compile and analyze proxy indicators to estimate Northern Hemisphere temperatures over past centuries. Proxy indicators are derived from natural archives that contain a record of past climatic conditions. These archives include ancient tree rings and coral growth bands, sediments from ocean and lake bottoms, and ancient ice from glaciers. Physical and chemical properties ('climate proxies') of these natural archives were combined, using then novel techniques, with late 19th and 20th century temperature measurements to provide a record of past temperature and pioneering estimates of the uncertainties associated with that record.

6. The MBH98 and MBH99 works produced the so-called "hockey stick graph" – a graphical representation of data showing gently declining temperature over the past 1000 years with a pronounced upward curve in the 20th Century, reflecting recent warming. The hockey stick graph produced strong reactions because it showed that global temperature increased in correlation with the rise in the burning of fossil fuels.

7. In 2005, the House of Representatives Science Committee requested that the National Research Council (NRC) of the National Academy of Sciences (NAS)—America's highest scientific body—evaluate the quality of our work in reconstructing global surface temperature records over the past millennia and the implications of these efforts for our understanding of global climate change. In 2006, the NRC Panel published its report, "Surface Temperature Reconstructions for the Last 2,000 Years," which found that "the basic conclusion of Mann et al. (1998, 1999) . . . that the late 20th century warmth in the Northern Hemisphere was unprecedented during at least the last 1,000 years . . . has subsequently been supported by an array

of evidence that includes the additional large-scale surface temperature reconstructions and documentation of the spatial coherence of recent warming . . . and also the pronounced changes in a variety of local proxy indicators..." "(*see* the penultimate paragraph of page 3 in Summary of the report http://www.nap.edu/catalog/11676.html).

8. The NRC report went on to conclude that "[b]ased on the analyses presented in the original papers by Mann et al. and this newer supporting evidence, the committee finds it plausible that the Northern Hemisphere was warmer during the last few decades of the 20th century than during any comparable period over the preceding millennium." The Chairman of the NRC Committee that wrote the report, Dr. Gerald North of Texas A&M University, later explained to the House of Representatives Committee on Energy & Commerce (which had convened a hearing to examine our work) that the NRC's use of the word "plausible" in the report meant that no evidence exists to refute the claim that the Northern Hemisphere was warmer during the last few decades of the 20th century than during any comparable period over the preceding millennium.

9. Numerous further governmental and institutional investigations followed the National Academies' evaluation of MBH98 and MBH99. Most of these investigations were prompted by unfounded and untruthful allegations arising from a series of emails stolen from the University of East Anglia in 2009. The emails were anonymously posted online a few weeks before the United Nation's global climate change conference in Copenhagen, Denmark. The Norfolk Constabulary, which investigated the crime stated that "as a result of our enquiries, we can say that the data breach was the result of a sophisticated and carefully orchestrated attack on the CRU's data files, carried out remotely via the internet. The offenders used methods common in unlawful internet activity to obstruct enquiries." Once the emails were posted on the internet, the emails were distorted and taken out-of-context by various anti-global warming groups to fabricate a myth that the hockey stick graph was the product of data manipulation.

10. Since the publication of the so-called "climategate" emails, the National Science Foundation, the U.S. Environmental Protection Agency, and the National Oceanic and Atmospheric Administration, among other institutions undertook separate inquiries into the allegations that the hockey stick graph was the product of data manipulation and that I and my co-authors, Mann and Bradley, had engaged in unethical conduct. Each of these investigations found that we and the other scientists did not engage in any unethical or improper conduct. To the contrary, each of us has received high professional accolades in the years since those papers were published, as the scientific validity of our work was replicated and extended by more than a dozen subsequent studies.

11. For example, our MBH99 paper on which Petitioners center their attack (Petitioner's Opening Brief at 4) was recently selected by current and former editors of the journal Geophysical Research Letters (GRL) as one of only 40 '*cutting-edge scientific papers*' included in a special 40th anniversary open access issue of the journal (http://publications.agu.org/grl-40/) that '*showcases the ground-breaking research consistently published in GRL*'. This occurred 15 years after the publication of the paper, providing more than ample time for it to be tested in the fire of scientific scrutiny. The journal published more than 31,000 peer-reviewed papers in its first 40 years and ours was one of only 40 accorded this accolade. This, it seems, is the paper containing the '*particularly controversial claim*' E&E refers to on page 4 of their Opening Brief.

12. As Gerald North, chair of the NAS panel, wrote in the preface to its report that: *"The reconstruction produced by Dr. Mann and his colleagues was just one step in a long process of research, and it is not (as sometimes presented) a clinching argument for anthropogenic global warming, but rather one of many independent lines of research on global climate change"*. Since 2006, even more studies have been published building on, extending and validating our basic finding, using greatly enhanced data sets and different methods.

13. Contrary to the impression that might be gained from the Petitioners' Opening Brief, most of the data used in the MBH98 and MBH99 papers were in the public domain and freely available before we used them. For instance, the great majority of the primary tree-ring data were taken from the publicly-accessible International Tree-Ring Data Bank (ITRDB) maintained by the U.S. National Oceanic and Atmospheric Administration (NOAA) and the World Data Center for Paleoclimatology. *See* http://www.ncdc.noaa.gov/data-access/paleoclimatology-data/datasets. The data sources were listed in the supplementary material to MBH98 in the leading scientific journal *Nature*. In 2004, we published small corrections, with no effect on our conclusions. *See Nature*, 430, 105, (2004).

14. In July 2005, in response to an inquiry by the U.S. House of Representatives Committee on Energy & Commerce concerning a similar claim that we did not make our data available, I wrote to Congressman Joe Barton on July 15, 2005: *"We have actively made the data and methods we used freely available. The proxy data (tree rings, coral bands, ice cores, etc) we used in the Mann, Bradley, Hughes 1998 and 1999 papers have been at a **publicly**-accessible ftp site since **2000**, and these data, plus the instrumental data we used, and an amplification of certain details of our methods have been available at the website of the journal Nature since July 2004. In fact, the original papers and supplementary material published in 1998 and 1999 were sufficient for working scientists to replicate both our methods and results, **as they have done**."* (emphasis added).

15. I added that "*Expanding on the question of data availability and repeatability, my peer-reviewed published papers have given sufficiently detailed information to satisfy the scientific editors of the journals concerned and their peer-review processes. The U.S. National Science Foundation has stated that I have "complied with the policy guidelines set out by the US government, and the NSF in particular, regarding access to data from publicly funded research*".

16. In making these statements to Congressman Barton, I was attempting to clarify that the data we used were primarily from publicly available sources and also that all of our data were made available for download for free to interested parties. In fact, many peer-reviewed scientific papers have been published in which other researchers have been able to successfully repeat our work or build on it and other earlier work, as we have done. As such, I am confident that I have met my professional obligations as an author of scientific papers, as defined in Guideline B "Ethical Obligations of Authors/Contributors in the ethics statement of the American Geophysical Union (http://ethics.agu.org/files/2013/03/Scientific-Integrity-and-Professional-Ethics.pdf), page 9.

17. Responding to the E&E public records request was and continues to be a very burdensome and dispiriting task that diverted my energies and attention from productive work to a notable degree. The task of reviewing my emails for information responsive to Petitioner's broad

demands took at least ten weeks of my time. The task was of such a scale and complexity that I could not have performed it during the semester because it would have unduly disrupted my primary obligations of research, teaching and service, including outreach. For an active science professor, summer is much more a time for intensive scientific activity than for vacation. In my case, summer is when I can focus on writing papers, other documents such as proposals for funding, conducting fieldwork, and preparing for classes. This E&E matter deprived me of one of a small handful of summers remaining in my career. Given my general level of activity, this is a significant loss, not only to me professionally, but also to my department and the UA.

18. Specifically, I had planned two main activities for summer 2012, neither of which was I able to accomplish, as a direct result of the diversion of my time to responding to the E&E public records request. One activity was the analysis of results from a NASA project during a period when grant funds were available and the work was supported by a scientific staff member specifically assigned. As a result of the delay, I am still working, unfunded and far less efficiently, on that project and it remains incomplete. The other activity was the development of a proposal for research funds for a substantial new project on the relationship between climate and sustained drought being experienced in California. I was unable to prepare that grant request and it now seems very unlikely that I will be able to make that scientific contribution before I retire. I should also add that not only professional opportunities were lost that summer, but also planned time with family members was lost to time devoted to E&E's public records request.

19. Why was so much time needed? The record request directed principally at me sought emails from January 1, 1999 through December 31, 2005 ("Request Period"). There is not a central repository at the UA maintaining an archive of email from 1999 from which a search could be conducted. Instead, any emails that still existed here would have exclusively been those I retained in some electronic format through several generations of computers. During the Request Period I used several different computers for university work, and two different computer operating systems. Since the time of the Request Period and for the last several years, I have used an entirely different computer. Moreover, I moved from one email program to another during the Request Period and through to the time of the request. As a result of this history, I first had to reconstruct the universe of saved email from the Request Period and I spent a considerable amount of time and energy searching multiple devices and storage media, each of which was written and transferred at various times, on different operating systems, and by different email programs for potentially responsive material. Because E&E's request sought all emails with particular key words, I then had to find ways to make old files readable and searchable by current email software. It was only after compiling all of the email during the entire span of the Request Period and making such files searchable that I was then able to set about the task of searching through the tens of thousands of emails to assemble those possibly responsive to the subject matter of E&E's request.

20. Having assembled the possibly responsive emails, I estimated that I had about 3,500 items (approximately 17,500 pages) to examine for duplication and relevance. I reduced this to approximately 2,500 messages (about 10,250 pages) by removing duplicates and obviously non-responsive materials. This is the body of material I then reviewed again in order to classify the emails for release or withholding based upon E&E's public records request. In the case of

materials to be released, I then had to search for information I was required to redact. The result of this effort was a body of approximately 7340 pages. Of these pages, over 300 were released. I then prepared the detailed withheld log with regard to each of the 1381 withheld emails.

21. The entirety of the task of responding to E&E's request was a major disruption over a significant period of time and took me away from my primary obligations of research, teaching and service, including outreach.

22. In their Opening Brief, E&E claims on page 4, section II, that I have *"..used (my) university role... from which to participate in policy advocacy"*. There is no factual citation given nor example of my supposed use of my university role in order to participate in policy advocacy. Regardless, I can unequivocally state that I have not engaged in policy advocacy, which is not to say that such activity somehow is improper, as E&E implies. In any case, the claim is false.

23. As a faculty member of a public university, my main duties include teaching, scholarship (including research), and service (including outreach and to professional organizations). In my outreach work, I have sought to bring the latest and best science to those who can use it, but have scrupulously avoided policy advocacy insofar as my research is concerned. I do not believe that informing the public of scientifically based concerns about our environment is any more policy advocacy than a physician promoting exercise and a healthy lifestyle. If my professional input were sought on a policy matter by some arm of government or community body, my response would be framed by the policies of the UA and the ethical guidelines of the appropriate professional body.

24. E&E describe me as a member of a *"small coterie of climate alarmists"* (Petitioners Opening Brief, page 5) and imply that I or other members of such "coterie" have actively worked to suppress good science that disagrees with the underlying conclusions of some of my work. E&E cite the Wegman Report (their Exhibit 9) as evidence for such a 'coterie'. The pressure to work collaboratively to better use public resources in science has strengthened in recent decades and, as may be seen in my curriculum vitae and Dr. Overpeck's, we have done our best to respond positively to this encouragement. This scarcely merits the negative associations of the words 'coterie', or, as in the Wegman Report 'cliques'. It should be noted that a paper describing the 'social network analysis' technique behind the 'coterie' claim was retracted in 2008. (http://www.sciencedirect.com/science/article/pii/S0167947307002861.). The Wegman Report was found to be thoroughly unpersuasive by the Chairman of the NRC Committee, Dr. Gerald North, who testified to the House Committee that commissioned the Wegman Report:

> Personally, I was not impressed by the social network analysis in the Wegman report, nor did I agree with most of the report's conclusions on this subject. As I stated in my testimony, one might erroneously conclude, based on a social network analysis analogous to the one performed on Dr. Mann, that a very active and charismatic scientist is somehow guilty of conspiring or being inside a closed community or 'mutual admiration society'. I would expect that a social network analysis of Enrico Fermi or any of the other scientists involved with the development of modern physics would yield a similar pattern of connections, yet there is no reason to believe that theoretical physics has suffered from being a tight-

knit community. Moreover, as far as I can tell the only data that went into Dr. Wegman's analysis was a list of individuals that Dr. Mann has co-authored papers with. It is difficult to see how this data has any bearing on the peer-review process, the need to include statisticians on every team that engages in climate research (which in my view is a particularly unrealistic and unnecessary recommendation), or any of the other findings and recommendations in Dr. Wegman's report. I was also somewhat taken aback by the tone of the Wegman Report, which seems overly accusatory towards Dr. Mann and his colleagues, rather than being a neutral, impartial assessment of the techniques used in his research. In my opinion, while the techniques used in the original Mann et al papers may have been slightly flawed, the work was the first of its kind and deserves considerable credit for moving the field of paleoclimate research forward. It is also important to note that the main conclusions of the Mann et al studies have been supported by subsequent research. *Questions Surrounding the 'Hockey Stick' Temperature Studies: Implications for Climate Change Assessments*, Hearings Before the Subcommittee on Oversight and Investigations of the Committee on Energy and Commerce, House of Representatives, 109th Congress, 2nd Session, July 27, 2006, p. 592.

25. The many scientists with whom I have collaborated each have their own views on technical matters, and those views develop over time as science progresses, sometimes agreeing with one another, sometimes not. However, it is certainly the case that the evidence for an important human role in changing global climate has been found convincing by the great majority of climate scientists, by the major relevant scientific societies in this country, and the world's major science academies. *See e.g.* http://climate.nasa.gov/scientific-consensus. Hardly a 'small coterie' of 'alarmists', but rather a massive preponderance of qualified scholars and the world's leading scientific organizations. In summary, there was and is no "coterie."

26. I cannot speak for nameless others supposedly in my 'coterie', but I can unequivocally state that I have never conspired to suppress the scientific work of others based upon their conclusions nor would I ever do so. I would most certainly, and have, disputed or opposed publications or draft publications that fail to utilize valid scientific methodologies or whose conclusions are not supported by their results and analyses. This is the very nature of carrying out science.

27. I understand that E&E is arguing in their Opening Brief that following publication, any matter broadly encompassed within the "subject matter" should be publicly available along with any "abandoned" research, which presumably would include all email communications. From a practical standpoint, this view is wholly at odds with how science is carried out. Since publication of MBH98, my fellow collaborators and I have written several additional papers on this same "subject matter" of long term paleoclimate reconstructions based upon proxy data. Indeed, many of the underlying concepts and ideas for these later papers were raised in our collaborative efforts, but were not able to be incorporated. This is often the case as ideas for related research must be shelved for want of time, funding, space constraints in publications, or simply because at some point research must be published. However, none of these other ideas, concepts, proposals, or lines of thought were remotely "abandoned" when not included in the

published result nor even if they were not picked up again for several years. As a specific example from MBH99, we took a very cautious approach to the interpretation of one kind of record - tree rings of bristlecone pine from highest elevations of the mountains of the West - and to the possibility that they might be influenced more by the amount of carbon dioxide in the atmosphere than by temperature. My primary research direction in the succeeding fifteen years has been focused on this issue, and we have only recently, in 2013, published what we hope will be the definitive resolution of this issue that began as a discussion well over a decade ago.

28. Researchers commonly develop these concepts for future research and share them in confidence as part of the collaborative process. If these communications were not protected from public records requests even after publication of the initial "subject matter" of the research, it would significantly harm ongoing and future research by exposing these initial ideas and concepts to others before they might be published. This would almost certainly lead to parties being reluctant to share their ideas with one another and impede the free flow of ideas, but also prevent such ideas from being made public before they might be properly researched, supported, and ultimately published. It is difficult to know, even years later, which ideas or concepts might be picked up or explored again as a field of further or additional research. Indeed, science itself is a constant process of building upon prior work and any notion that publication should expose the entirety of public researchers' communications in the broad "subject matter" of the publication is contrary to the very method by which science progresses.

29. Under E&E's view, since some of the bristlecone pine information referenced above was available but not included in MBH99, I would have only two options in responding to a public records request for this "unpublished research data" involving such subject matter: (a) I could turn this research over to anyone who asked for it after publication of MBH99, or (b) I could become embroiled, as I am now, in a protracted fight over whether the bristlecone pine data were "planned research" – and therefore, not subject to release according to E&E - or "abandoned research" - which E&E says must be turned over. I never imagined this sort of entanglement would flow from the use of a communication tool as efficient and valuable as email, and I am convinced that the sort of problem posed by this case must be prevented. Once publication occurs, which *should* include a) research findings and conclusions, b) the data on which they are based, and c) sufficient methodological information to enable others to attempt replication, no further release of information or documention should be compelled. After conforming to the data sharing requirements of the funding agency, we researchers should then be left in peace to move onto next projects or to further investigate the thoughts and theories brought up in the course of creating a publication.

30. I have reviewed the Affidavit of Michael E. Mann dated July 23, 2012 submitted to E&E in the Circuit Court of Prince William County Docket No. 11-3236. I agree with and concur with Dr. Mann's statements regarding the chilling effect of allowing public records requests as a vehicle to require the production of communications involving public university scientists. I have direct experience of the ongoing disruption of my professional and personal life caused by the release of stolen emails in November 2009 and the consequent accusations, attacks, innuendo, and inquiries. I have been directly informed by several colleagues that they have limited their email communications with me because I have been targeted in public records requests. As email is the

essential medium of scientific cooperation in the modern world, there is no doubt that this chilling effect has been an obstacle to collaboration. My coauthor, Professor Raymond Bradley of the University of Massachusetts, Amherst, told me that he has avoided email communication with me because of such concerns. Although Drs. Mann, Bradley and I had published at least 17 items together prior to 2009, there has been only one co-authored paper since our emails were stolen from the University of East Anglia and released anonymously, followed by a subsequent campaign of public records requests. The added burden of working together without the vital free-ranging use of email was just too much. As a result, I believe this chilling effect is not merely theoretical, but rather an actual and present harm that is contrary to the best interests of this state.

31. I wrote about this chilling effect in a letter to President Teresa Sullivan of the University of Virginia ("UVA") in 2011, referring specifically to ATI's (now E & E Legal) pursuit of emails and other records to and from Dr. Mann, which would likely have included a number of my records or communications that included Dr. Mann. There were early indications that UVA would provide unfettered access to such records (as it turned out, UVA did oppose and successfully resist E&E's demands), but it was in this context that I wrote to President Sullivan regarding my views on the vital importance of academic freedom.

32. I wrote to President Sullivan: "*In addition to my personal and individual professional interest in this matter, I fear the effect such a release of emails will have on intellectual and academic freedom in this country. I have taught, researched and administered in academia for more than 40 years and have not seen a time in which freedom of inquiry has been more needed, or more imperiled than it is now. Several lines of scientific inquiry and those who conduct them are under coordinated political and ideological attack. ... This offensive against science makes tactical use of the collaborative nature of modern science*".

33. Referring to this last sentence I asked rhetorically: "*Why do I say this? Many of the most pressing issues in modern science demand study by collaborative groups of scholars drawn from several fields and often multiple locations. In order to make best use of their differing skills, experience and abilities, the members of such groups must be free to float ideas, express opinions, and, importantly, change opinions in the course of the collaborative work. In practice, this means they must exchange large numbers of email messages, often written rapidly in an informal style, so as not to delay the group's work. The subsequently published papers and the archived data that accompany them, **not** ongoing discussions in coffee rooms or telephone calls or email messages, form the proper basis of an open discussion of the work by the scholarly community.*" (emphasis added)

34. My letter to President Sullivan continued: "*Nothing is more likely to squash the creativity of America's scientists than the ever-present ear of a hostile listener intent on finding, at all costs, the appearance of malfeasance. Nothing is more calculated to discourage research into topics that may challenge powerful interests than the telephone tap, or its modern cousin the carefully cherry-picked phrase in one out of thousands of emails. ... It is indeed the modern 'hostile ear'.*"

35. Later in the same letter I wrote: "*Why would any smart and imaginative young scholar in the sciences or any other area start a career in any field where such interference can be*

expected? Will this not affect their willingness to join the faculty of a public university in a state where such informal exchanges between scholars are not protected from the hostile ear?"

36. In my letter to President Sullivan, I wrote from personal experience when I discussed the effects on scholars' and universities' ability to hire the very best candidates and of an atmosphere of hostile scrutiny. I am near the end of my professional life, but were I a young scientist now, with a family to support, I would certainly consider a different line of work or another institution, in light of the ongoing harrying of climate scientists exemplified by the present action.

37. What do I mean by 'harrying of climate scientists'? Since the much-publicized, unauthorized 2009 release of stolen emails from the Climatic Research Unit of the University of East Anglia in England in 2009, there has been a repeated pattern of using a single phrase taken out of context in attempts to discredit climate scientists. These unfounded attacks on my integrity and that of my colleagues came from influential media sources and some senior politicians. We were subject to accusatory and offensive messages from multiple other individuals in the months after the email theft. I saw the multiple attacks aimed particularly at the integrity of Dr. Mann and my colleagues in the UK. This went far beyond 'embarrassment' for the individual scientists, their institutions, and their families. This is the chilling context for campaigns seeking public records requests.

38. I continue to believe that, as I stated in my letter to UVA President Sullivan, there is a real and actual likelihood that allowing access to communications of scientists at public universities will put such institutions at a competitive disadvantage. Indeed, even being required to trawl through thousands of pages of emails and prepare a log of withheld emails, as I was, was such a significant disruption that such process alone would result in a competitive disadvantage. Why would anyone volunteer for this? Today's young scientists are a mobile, international, group, with plenty of good choices outside Arizona's public universities and, unless they can be free to collaborate on an equal playing field, they will likely avail themselves of such other choices to the detriment of Arizona and its universities.

39. I declare the foregoing is true and correct to the best of my knowledge.

Dated July 28, 2014

Malcolm K. Hughes

EXHIBIT A

CURRICULUM VITAE

Malcolm K. Hughes

CHRONOLOGY OF EDUCATION

1965	B.Sc. (Honours) in Botany and Zoology, University of Durham, U.K..
1970	Ph.D., title of thesis: 'Investigations of the ecosystem energetics of an English woodland'. Supervisor; Dr. J. Phillipson, University of Durham.

CHRONOLOGY OF EXPERIENCE

1968-69	Amanuensis, Research Fellow, Soil Biology Institute, University of Aarhus, Denmark
1969-71	University Research Fellow, Botany Department, University of Durham.
1971-73	Lecturer II in Ecology, Biology Department, Liverpool Polytechnic (now Liverpool John Moores University).
1973-80	Senior Lecturer in Ecology, Liverpool Polytechnic.
1980-82	Principal Lecturer in Ecology, Liverpool Polytechnic.
1982-86	Reader in Paleoecology, Liverpool Polytechnic.
1986-1999	Director of the Laboratory of Tree-Ring Research, University of Arizona
1986-	Professor of Dendrochronology, University of Arizona
1992-	Professor of Watershed Management, School of Renewable Natural Resources, University of Arizona
2007-	Regents' Professor of Dendrochronology, University of Arizona.

HONORS AND AWARDS

1969-71	University Research Fellow, University of Durham
1992-3	Visiting Fellow, Cooperative Institute for Research in Environmental Sciences, University of Colorado-Boulder_
1998	Fellow, American Geophysical Union
1999-2000	Bullard Fellow, Harvard University
2006	Galileo Circle Fellow, University of Arizona
2007	Regents' Professor, University of Arizona
2007-8	Visiting Fellow, Cooperative Institute for Research in Environmental Sciences, University of Colorado-Boulder
2008	Visiting Faculty Fellow, National Center for Atmospheric Research.
2009	Elected Chair, Section E (Geology and Geography) American Association for the Advancement of Science (AAAS)
2013	Elected President, Global Environmental Change Focus Group, American Geophysical Union.
2014	Fellow, American Association for the Advancement of Science (AAAS)
2014	The Harold C. Fritts Award for Lifetime Achievement in Dendrochronology. Presented at the 9th International Conference on Dendrochronology, Melbourne, Australia, January 17, 2014.

NATIONAL/INTERNATIONAL SERVICE

1974-	Internal or External Examiner of various higher degree candidates of the UK Council for National Academic Awards and the Universities of Oxford, Durham, East Anglia, Ulster, Aix-Marseille, Amsterdam, Auckland, New Zealand, Queen's University Belfast, and of the Chinese Academy of Science.
1972-78	Secretary, Energy and Production Biology Group, member of the meetings committee: British Ecological Society.
1978-82	Organizer, Global Dendroclimatology Workshop.
1978-85	External Examiner (CNAA) for degree studies in ecology, New College, Durham.
1980-86	External Examiner in ecology for Membership of the Institute of Biology, U.K.
1982-85	Member, Terrestrial Life Sciences Grants Committee, Natural Environment Research Council, U.K.
1983-86	Member, Combined Studies (Science) Board, Council for National Academic Awards, U.K.
1984-85	Member, Advanced Courses Review Panel, Natural Environment Research Council, U.K.
1984-86	Member, Council of the British Ecological Society.
1988-	Member, U.S. National Committee for the International Union for Quaternary Research, National Research Council
1988	Member, working group meeting on 'Techniques for extracting environmental data from the past' set up by ICSU's Special Committee for the International Geosphere-Biosphere Programme
1988-1989	Member, Organizing Committee, 1989 Global Change Institute, Universities' Corporation for Atmospheric Research
1989-1992	Member, National Oceanographic and Atmospheric Administration (NOAA) Paleoclimatology Advisory Panel
1990	Member, Advisory Panel for Meeting on Earth System History, National Science Foundation.
1990	Member, Technical Advisory Panel, Western Region of the National Institute on Global Environmental Change, US Department of Energy
1991	Organizer (with H.Diaz) Medieval Warm Period Workshop
1991-1993	Guest editor (with H.Diaz) special issue of *Climatic Change.*
1992-1994	Chair, program committee, International Conference on Tree Rings, Environment and Humanity, Tucson, Arizona, May 1994.
1992-1995	Member, Board of Trustees, National Institute of Global Environmental Change (NIGEC)
1993	Chair, search committee for new national Director, NIGEC
1993-1997	Member, Committee on Geophysical and Environmental Data, U.S. National Research Council
1995	Member, Academic review panel for Quaternary Research Center, University of Washington
1995-1998	Member, Biometeorology Committee, American Meteorological Society (AMS)

1995-1998	Member, AMS Glossary revision committee
1996-1999	Member, joint working group between the PAGES core project of the International Geosphere-Biosphere Program and the CLIVAR project of the World Climate Research Program
1996	Member, United States delegation, conference of World Climate Research Program, Geneva, Switzerland.
1999-2001	Contributing author, Third Assessment Report, Intergovernmental Panel on Climate Change (IPCC).
1999-2005	Member, steering committee, National Science Foundation, PARCS.
2000-2004	Vice-President, International Tree-Ring Society
2003-4	Chair, Organizing Committee, international conference "Tree Rings and Climate: Sharpening the Focus", Tucson, Arizona, April 2004.
2005-6	Member, Advisory Committee, 7th International Conference on Dendrochronology, Beijing, PRC, June 2006.
2009	Chair-elect, Section E, Geology and Geography, AAAS
2010	Chair, Section E, Geology and Geography, AAAS
2011	Retiring Chair, Section E, Geology and Geography, AAAS
2012-	Associate Editor, Tree-Ring Research
2013-14	President, Global Environmental Change Focus Group, AGU.
2013-14	Member, Council of The American Geophysical Union (AGU)

Reviews of grant proposals for NSF, NOAA, NIGEC, agencies in Austria, New Zealand, India, UK, New Zealand. Reviews of manuscripts for journals including Nature, Proceedings of the National Academy of Sciences (PNAS), Geophysical Research Letters, Canadian Journal of Forest Research, The Holocene, Quaternary Research, Journal of Climate, Climate Dynamics, Climatic Change, Climate Research, Quaternary Science Reviews.

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Google Scholar profile as of July 28, 2014

http://scholar.google.com/citations?user=gcVoIaAAAAAJ

Citations	11792	5766 since 2009
h-index	47	36 since 2009
i10-index	100	71 since 2009

h-index is the largest number h such that h publications have at least h citations.
i10-index is the number of publications with at least 10 citations.

Key to symbols in list of publications
*** refereed journal articles**
 # scholarly books
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