



NATIONAL ENDOWMENT FOR THE

Humanities

DIVISION OF RESEARCH PROGRAMS

## **Narrative Section of a Successful Application**

The attached document contains the grant narrative and selected portions of a previously funded grant application. It is not intended to serve as a model, but to give you a sense of how a successful application may be crafted. Every successful application is different, and each applicant is urged to prepare a proposal that reflects its unique project and aspirations. Prospective applicants should consult the Research Programs application guidelines at <http://www.neh.gov/grants/guidelines/collaborative.html> for instructions. Applicants are also strongly encouraged to consult with the NEH Division of Research Programs staff well before a grant deadline.

Note: The attachment only contains the grant narrative and selected portions, not the entire funded application. In addition, certain portions may have been redacted to protect the privacy interests of an individual and/or to protect confidential commercial and financial information and/or to protect copyrighted materials.

Project Title: The Waters of the City of Rome

Institution: University of Virginia, Charlottesville

Project Director: Bernard Frischer

Grant Program: Collaborative Research

**Significance and Impact:** Aquae Urbis Romae addresses issues related to the history of water infrastructure and urban development in Rome over a 2700-year period. The project, an interactive web-based cartographic archive of original research and historic materials, is truly interdisciplinary. It brings together data from archaeology, urban history, geography, classics, and the history of technology in order to address specific questions about the urban development of Rome, and more wide-ranging issues about water and urban development in general. The project systematically incorporates archeological, archival, literary and epigraphic evidence in a series of original chronological and thematic topographic maps of Rome that are being created by the collaborative team for the project. Each water infrastructure feature, such as a fountain, sewer, or bridge, etc., are mapped and linked to an inventory and to bibliographies, scholarly articles, and historic images and texts. The first phase of work has been available since 1999 on a free public web site, which although only partially complete, is significant for several reasons: 1) the site allows each user to follow a series of chronological maps or to create unique thematic maps tailored to personal research questions; 2) it stores computerized data records that are linked to each of mapped features; 3) the cartographic environment of this project has already helped the collaborative team and other scholars to challenge traditional views about the urban development of Rome; and 4) it provides a new model for the study of water infrastructure and urban development in other cities. Under the proposed grant, it will become even more valuable with the addition of real-world coordinates with GIS (Geographical Information System) data, to allow data sharing with other scholars.

To date, the project is complete for the period 753 B.C. to 312 A.D., and is already known to scholars in a wide array of disciplines. A February 2004 review, by the Center for History and New Media, at George Mason University (“a guide to 100 of the best online primary source archives in world history”), states that the site establishes “a visionary goal for any academic website” and that as it expands it will become an even more “invaluable supplement to a syllabus on Roman history, especially a course on Roman architecture and engineering.” In addition to the cartographic data display and linked inventory resources, the site also presents historic maps and images, primary sources, and refereed, on-line occasional articles from contributing scholars that address topics related to Rome’s water infrastructure, such as the role played by Tiber River bridges in the urban development of ancient Rome. [Appendix 1] These articles also link readers to the visual and cartographic resources of the site. The research underpinning the project has also generated print publications that address social, cultural, aesthetic and technological issues related to water distribution, and a major book titled “*The Waters of Rome: Hydraulic Infrastructure and Urbanism in an Early Modern City, 1562-1762*” is forthcoming.

We now seek funding to enhance the cartographic functions of the web site and to continue original research in order to expand the maps and inventory to include another 1300 years of Rome’s water history from approximately 350–1650 A.D. We will start by converting the existing map data (now available on the web) into a new geo-referenced mapping shell that will provide a base for typological and chronological map overlays of water infrastructure features, located with real world coordinates. These coordinates will allow students and scholars in various fields to map their own research to accurate topographic data, which is not possible at this time. Each feature is linked to a unique inventory entry (currently over 800 entries). The inventory presents basic information about the importance of each feature to the urban history of Rome, bibliographic and topographic data, and links to either contemporary photographs or historic maps and images, when available. New, entirely original, map layers for the chronological and thematic functions (and their respective data and images that cover the early Christian, medieval, and early modern periods) will be constructed as overlays for the mapping shell. By the end of the grant period, the mapping shell will provide a working base for approximately 300 chronological and thematic map layers with each feature linked to the expanded inventory of more than 1500 entries, all of which incorporate original research. Once this work is complete, *Aquae Urbis Romae* will be an even more valuable humanities research resource on topics related to water infrastructure and urban development, such as aqueduct construction, integrated water distribution, sewer construction, urban river management, and many other related topics.

## **NARRATIVE DESCRIPTION**

**Substance and Context:** Rome has been praised since antiquity for the abundance and salubrity of its waters, for the technology employed to distribute water for diverse public and private uses, and for the sewers that carried away the city's waste. With highly developed dual distribution and disposal systems, both in antiquity and today, Rome's gravity-flow water infrastructure is a model of efficiency that has been extensively lauded, studied, and copied. In fact, Rome itself revived its own long derelict ancient system during the late sixteenth- and early-seventeenth centuries, reopening ancient springs and resuscitating aqueducts that serve the city to this day using the same simple gravity-flow technology employed in antiquity. With the exception of some fragmentary aqueduct arcades, a few architectural ruins, and the public fountains, this infrastructure is largely hidden from view. Yet, these elements have had a profound influence on Rome – determining where water was distributed, how neighborhoods developed, how waste was handled, and where water-related social and economic activities took place. Finally, Rome's water infrastructure system has been emulated by scores of other cities, and stands as both a physical and theoretical model throughout the world for integrated urban water resource management.

Roman aqueducts and fountains have engaged scholars in fruitful research for centuries and have engendered a rich literature: archaeologists study the ancient aqueducts or baths, while classicists study inscriptions related to water, art historians study the fountains, engineers study the sewers, sociologists study the social life of the fountains, and still others study Roman hydraulic innovation. Yet there is little systematic analysis of the individual elements as a single integrated system. With the exception of a few recent studies of ancient Roman water distribution, (Evans, 1994; Taylor, 2000; and de Kleijn, 2001, for example) the control of water resources and the technology of water distribution and their relationships to Roman urbanism remain virtually unexplored. The situation for medieval Rome is even bleaker with only a handful of intelligent analytical works (Ward-Perkins, 1984; Coates-Stephens, 1998), and while the situation improves for the early modern period (Pecchiai, 1944; Heilmann, 1970; D'Onofrio, 1986; Pinto, 1986; Coffin, 1991) there is still little understanding of how the specific topography of Rome influenced where the individual elements of the system were located and how they interacted

with each other. In a gravity-flow system this information is crucial. This lack of a synthetic approach limits our historical understanding of what is widely regarded as the single most important large-scale urban water infrastructure system in Europe. Furthermore, since nearly all urban settlements founded before the late nineteenth century relied on gravity-flow technology the lessons learned through a close study of Roman water infrastructure will be widely applicable, and can supply a model for investigations in other cities.

NEH Collaborative Research funding will support completion of *Aquae Urbis Romae*, an interactive web-based cartographic archive of original research and historic materials relating to the history of hydraulic infrastructure and urbanism in Rome over a 2700-year period. This project, which is published (and updated annually) by the Institute for Advanced Technology in the Humanities (IATH) at the University of Virginia, is freely available to the public at <http://www3.iath.virginia.edu/waters>. The website is a dynamic repository for archaeological, literary, visual and epigraphic data concerning Rome's water history, all of which is being plotted and incorporated into a database. The ongoing project builds on existing scholarship, innovative research, and extensive archival resources in a wholly original way that demonstrates how physical order was created through the construction of an integrated water infrastructure system of fountains, aqueducts, conduits and sewers. The order existed at the scale of the neighborhood and of the city, as water infrastructure provided an armature to physically organize and effectively control public space, consolidate authority, and implement social change, often under the guise of public health reforms and urban design improvements.

Currently the project is structured around two original digital maps created by project co-director Katherine Rinne and IATH media specialist Chris Jessee, which are the base documents for navigating the site. The first is a street plan of the contemporary city, based on the 1992 Cadastal Plan provided by the *Soprintendenza per i Beni Artistici e Storici di Roma* (Office of Artistic and Cultural Patrimony of Rome), which includes every street and block, within the intramural city. The second plan is a one-meter contour map of Rome that was created using aerial data from the 1992 *Atlante di Roma* (Atlas of Rome) and supplemented with topographic data from over one hundred recent archaeological reports and other maps that provided more precise local data. For proprietary reasons, these maps were redrawn and digitized by Rinne, and

then converted into 3-D computer models by Jesse using “Form Z” software. [Appendix 1 – sample web page of contour map] As valuable as the existing base maps are, they will become far more useful to a variety of students and scholars in the humanities when the historical data is geo-referenced to real-world coordinates.

The web project, which is still under development, can be navigated in four ways: chronologically, typologically, topographically and textually. Chronological navigation is facilitated through a “Time Line” of sequential maps that are “snapshots” of Rome’s water infrastructure during a specific period of its history. Thus far 16 maps are available that cover the period from 753 BCE through 312 CE, that is from the mythical founding of the city to the reign of Emperor Maxentius at the end of the Late Antique Period. Each of these maps telescopes a particular time period, such as the “Early Republican Period”, or the “Age of Augustus” – and range from fifteen to two hundred years depending upon the amount of hydraulic invention and intervention. [Appendix 2 – “Age of Augustus”] Scores of individual water infrastructure elements, represented as image icons, appear on each map. These elements include the routes of aqueducts, the plans of Imperial baths, public fountains, sewer routes, Tiber river ports and bridges, etc., that is, whatever documented features were present during that particular time. The maps grow denser with icons until the end of the Late Antique period. Beginning with the early medieval period the number of elements decreases as water infrastructure deteriorated or was destroyed. Then, beginning in the late sixteenth and early seventeenth centuries, the number of features increases as three ancient aqueducts were restored and many new water features were built to distribute water throughout the city. Research for the maps that cover the early Christian through late medieval periods (approx. 313 – 1400), will be complete before the beginning of the funding period, and research for the early modern period (1400-1700) will be completed during the first six months of the grant period. The new chronological maps created from this original research data will be constructed throughout the funding period.

“Build a Map” is a navigational tool that allows each person to construct his or her own map featuring typological information. A user may choose up to three categories of data, for example – ancient aqueducts, imperial baths, and ancient Tiber River bridges. Those layers are

“captured” and placed over either the base street plan or base topographic plan, to create maps tailored to the specific research interests. [Appendix 3 – base map with aqueducts, baths and bridges] Currently only 20 layers (primarily for the ancient period); out of a planned 60+ layers are available. As with the chronological maps, research for the new typology layers will continue through the first phase of funding and the typology map layers will be constructed throughout the funding period. All of the individual features (represented as icons) located on the “Build a Map” and the “Time Line” maps link directly to the “Inventory”. The Inventory presents basic information about why each feature is important to the urban history of Rome. It also includes bibliographic and topographic data, and links the user to either contemporary photographs or historic maps and images, when they are available. A search engine allows users to search the site by typology, patron, or artist. These search functions will be expanded during the funding period as the newly completed research is synthesized into the new maps.

Currently the “Topography” section consists of a few demonstration maps that allow users to see a 3-D model of the contour map and to “drape” sample maps over the 3-D model. These sample maps can be viewed as static JPG images or as dynamic “Quick-Time” movies. Currently, the “Text” feature links to bibliographies, to primary and secondary sources that have been scanned, and in some cases it is hyperlinked to the existing maps. Additionally a few important historic maps, such as Leonardo Bufalini’s, *La Pianta di Roma*, (Rome, 1551), and prints such as Gianbattista Falda’s *Le Fontane di Roma* (Rome, 1675) are available on the site, while other materials, including hundreds of photographs, have also been scanned although they are not yet linked. Finally, the website includes a nascent, occasional, on-line journal “The Waters of Rome” – a locus for refereed scholarly articles about water infrastructure and urban development in Rome that is vetted by eminent scholars from an array of disciplines including classics, computer technology, urban history, and architectural history.

**History and Duration of the Project:** The idea for “Aquae Urbis Romae” grew out of the frustration of the project director, Katherine Rinne, to locate accurate topographic information related to the history of Rome’s water infrastructure. Her professional work and studio and seminar teaching are based on two premises: that the history of water distribution is the key to the history of urban development; and that urban infrastructure can be the generator of urban

design, rather than simply a hidden necessity of concern only to engineers. In the course of her research it became apparent that the vast body of work on Rome's water infrastructure was chronologically restricted (Early Republican, Imperial, Baroque, etc.), spatially limited (to studies of single neighborhoods or individual features) and typologically focused (baths, or fountains, or aqueducts). Since Rome's water infrastructure is a gravity-flow system, the individual features are of necessity connected across political, economic, cultural, geographic, typological, temporal, and social boundaries. Furthermore, the contemporary system is in large part an expanded version of the early modern system, which is, in turn, a reprise of the ancient system, since the water sources, routes, distribution patterns, and technology have remained fundamentally constant. Therefore, Rinne felt that a spatially, typologically and chronologically synthetic study would lead to a clearer understanding of the urban development of Rome, than that achieved through traditional study and analysis. In addition, since Rome is widely used as a living urban laboratory by thousands of American students each year, she envisioned that this research could be applied directly as the students studied the city firsthand. To further her own original research, Rinne completed an exhaustive block-by-block survey of the hydraulic features of Rome. Over a period of four months in 1994 she systematically walked the entire intramural city to map, draw, photograph, and describe water infrastructure elements located in the public realm. Nearly five hundred features, including hundreds of public fountains, aqueducts, sewers, available water pressure inscriptions (previously undocumented), and flood-marker inscriptions were mapped. She then began archival and library research to further document these features and other elements of the system that are no longer extant.

During the second phase of this project (1995–1997), Rinne created a digital base map of the intramural city at 1/2000 scale using “Canvas” (a 2-D drawing program) and plotted these features. This work was carried out as a Visiting Scholar at MIT with funding from the Graham Foundation (1995). The following year, sponsored by the *Azienda Comunale Energia ed Ambiente* (The Roman Water Board), and funded by the Fulbright Commission (1996 – 1997), she returned to Rome to conduct further research. The third phase of work (1997–2001) focused on creating the prototype web architecture and the digital base maps, scanning and editing historic maps, images and texts, as well as developing the SGML inventory for the more than 500 individual features that she had already documented. With funding from an NEH

Fellowship for Independent Scholars (1997–1998), Rinne began her collaboration with IATH as an Associate Fellow. Working from Rinne’s base map, Chris Jessee at IATH created a web prototype, a 3-D topographic model, and a series of “Quick-Time” animations and Virtual Reality models for the project. Daniel Pitti, IATH Project Director, developed a taxonomy for each of the individual features (aqueducts, fountains, sewers, etc), which in turn was linked to the maps. Student assistants at IATH scanned and edited historic texts and images for the site. With funding from The Dibner Institute for the History of Science and Technology (1998-1999), Rinne continued to expand her research and complete new maps while also writing up her findings, which were published during 2000 and 2001. The fourth phase (2001–2003), with funding from the Guggenheim Foundation, focused on refining the existing web prototype and extending its content to cover nearly 1100 years of history (mid-eighth century BCE to 312 CE), that is, from the early period of inhabitation to the end of the Late Antique period. It was during this phase of work that an occasional, on-line, refereed journal “The Waters of Rome” was launched on the website.

The fifth phase, for which we now seek funding, will expand the capabilities of the website in several ways. First, it will allow co-director Rinne to complete her research in Rome and to synthesize her findings into new chronological and typological maps that she will create for the web project, and to nearly double the number of linked inventory entries. At the same time, NEH funding will allow co-director Frischer to oversee the expanded technical aspects of the project. These include: converting the original 3-D map data into GIS data (Geographical Information Systems), which will be gathered by collaborators in Rome, using a hybrid methodology combining the existing public-domain regional Digital Terrain Map (DTM) for Rome, and supplemented with new measurements provided by GPS (Global Positioning Systems) technology. The points will be chosen and plotted in such a way as to geo-reference the S.a.r.a. Nistri maps of contemporary Rome (scale of 1:500), which are an invaluable resource for archaeologists and historians working in Rome. Created in the 1950’s and 60’s by the *Società Aerofotografie e Rilevamenti Aerofotogrammetrici* (Aerial Photography and Aerial Photogrammetric Surveys Society) for the City of Rome, and updated in 1992 and 1994, the maps are in the public domain but are not available in a digital format. These maps, which contain thousands of elevation levels, would be scanned and vectorized (raster or pixel data is

converted into lines or vectors that can be edited) and then the Universal Transverse Mercator (UTM) coordinates from the GPS survey will be added. When completed, the new maps can be combined with our existing base maps and historic maps, using a program called ArcView, which will create an integrated cartographic library of GIS information. Besides providing increased accuracy on the X-Y axes (because of the higher scale), the information will be even more accurate information on the Z-axis, because of the systematic way in which the S.a.r.a. Nistri maps record elevations throughout the city. This geo-referenced contemporary topography will provide a starting point for scholars who want to then reconstruct earlier topographies, such as Imperial Rome or Baroque Rome. Working from the base data they will be able to add or subtract elevation derived from archaeological and other sources with relative ease.

This conversion is necessary because there is no publicly available GIS information for Rome. Rome is one of the most widely studied cities in the world, yet researchers in all areas of Roman studies have to rely entirely on print publication, or must vectorize their own data to create new base maps, time and again, thereby duplicating labor and wasting time and money. Not only is this topographic information unavailable to universities and to the public, it is even difficult for Roman agencies to share the information that is available to administrative agencies. Because of this, Rinne's existing one-meter contour base maps have already been provided for free to Italian researchers, such as the *Gruppo Nazionale per la Difesa dalle Catastrofi Idrogeologiche* (Italian Group for Natural Hazards Prevention – Tiber River) to aid in their own work. She has also provided her base data to American researchers as well, including the Stanford University, Digital Forma Urbis project. A single publicly available GIS base map would greatly expand the ability of students and other scholars in a variety of disciplines to relate their own research to accurate topographic data, and to compare distinct areas of inquiry, for example, the spread of epidemics, or population data and housing patterns during the medieval and early modern periods, with the location of fresh water resources. Conversion to GIS is necessary to push Rinne's original research to the next phase, as it will allow computer modeling of water distribution throughout the city during different time periods, up to the present day. During the period of the grant the GIS data will be converted through a web interface program, developed in Macromedia's "Flash" that will facilitate map navigation on the web and make the entire project more versatile for all users.

The inventory will also be modified during the NEH funding period to incorporate the new research collected, analyzed and interpreted by Rinne, and in order to make it easier for the collaborators to correct and supplement, and easier for researchers to access and search. The existing inventory data (over 800 unique entries that can currently be searched by type, patron, artist or feature name) will be moved out of the SGML program, DynaWeb, in which it was originally created, into a PostgreSQL database that is easier to correct and supplement. The new inventory will also allow searches by individual water source, time period, precise year, elevation, or geographic location. The conversion to GIS and the development of a new “Flash” interface, as well as the migration of the SGML data, as described above, are necessary in order to make the maps broadly available in a more usable form. These steps will also facilitate the creation of new “Time Line” maps and “Build a Map” layers (with their respective inventories). By the end of the grant period there will be approximately 300 original map layers linked to inventory records for more than 1500 individual water features. These in turn will be geo-referenced to real world coordinates. Over 400 contemporary and historic photographs, which are copyright free and have already been scanned (but not yet edited or mounted on the web), will be linked to the inventory and maps. Three rare historic texts related to Roman water infrastructure, including Andrea Chiesa and Bernardo Gamberini, *Delle cagioni, e de' rimedj delle inondazioni del Tevere* (Rome, 1746), Carlo Fontana, *Utilissimo trattato dell' acque correnti* (Rome, 1696), and Cornelius Meijer, *L'Arte di Restituire a Roma la tralasciata navigatione del Tevere...*(Rome, 1685), which have already been scanned and received publication permission from their owners, will be edited and made available on the website and linked to the maps and inventory. Using an interactive browser-based geographic information system (GIS) will allow researchers to integrate historic maps, such as Leonardo Bufalini, *Roma* (Rome, 1551) reprinted by A. Treviso (Rome, 1560), which is already available on the web site as a series of simple JPG images, with our new GIS base maps. The software will allow visitors to view side-by-side comparisons of contemporary and historic maps, to zoom in to view details, and to print or save the maps. Some rare books are also partially available on the site, such as Raffaele Fabretti's, *De aquis et aquaeductibus veteris Romae* (Rome, 1680) but await final editing to be completed during the funding period. These books have been made available to the

project from libraries (Burndy at MIT, Fiske Kimball Library at University of Virginia) and private collectors, without cost or copy-right restrictions.

#### Collaborators and Staff

1. Katherine Rinne, Co-Project Director
2. Prof. Bernard Frischer, Co-Project Director
3. Daniel Pitti, IATH Associate Director, and expert on database design
4. Worthy Martin, IATH Technical Director
5. IATH Media Designer (mapping and interface)
6. IATH Flash Programmer
7. IATH Database Programmer
8. Dott. Ing. Alberto Nistri, Managing Director, S.a.r.l. Nistri, srl.
9. Dr. Ian Johnson, University of Sydney and ECAL, UC Berkeley, GIS specialist
10. Two Student Research Assistants (IATH): will assist with S.a.r.l.-Nistri vectorization, Canvas to GIS conversion; GIS to Flash conversion; creation of new map layers; entry of new Inventory data; and assist with scanning and editing visual materials as needed.

Aquae Urbis Romae is a collaborative project to be directed jointly by Katherine Rinne, an independent scholar who will oversee research development, and Professor Bernard Frischer, Director of IATH who will oversee technical development and lead research activities in the Colosseum and Forum of ancient Rome. IATH works with faculty and research scholars to successfully design and maintain large-scale, digital projects. Since its founding in 1992, IATH has supported over forty projects in disciplines as diverse as art and architectural history, literature, archaeology, anthropology, and American and World History. IATH has produced several award-winning projects, including *The Valley of the Shadow*, the

*William Blake Archive*, the *Dante Gabriel Rossetti Archive*, and *Uncle Tom's cabin and American Culture*.

**Katherine Rinne:** Rinne has devoted nearly seven years of full-time work to the research and development of this project. She has studied in Rome since 1979, and in 1985 made the initial observations that led to the inception of *Aquae Urbis Romae* in 1994. In the intervening years, Rinne (who trained as an architect), taught architectural history and design studios at the university level, and worked as an urban designer, specializing in the design of urban infrastructure systems. She is the author of articles about the social, cultural, and topographic landscapes of water infrastructure of Rome, including “*Restoratio Romae: Pius V's Restoration of the Acqua Vergine, 1566-1570*”, in *Inventive Intersections*, edited by L. Roberts (forthcoming 2005 from the Royal Netherlands Academy of Arts and sciences). She has completed 4 of the 8 chapters for, “*The Waters of Rome: Hydraulic Infrastructure and Urbanism in an early Modern City, 1562-1762*”, with funding from the National Gallery of Art. A National Science Foundation Fellowship (Oct. 2004-March 2006) is funding current research on this book that will also be incorporated into our web project. Rinne is an associate fellow of IATH, and will be appointed to the UVA faculty as a Research Associate Professor in order to direct the project.

**Dr. Bernard Frischer:** Frischer trained as a Classical philologist and archaeologist. He was a Professor of Classics at UCLA and the University of Virginia and specializes in digital archaeology, especially the creation of scientifically authenticated 3-D computer models of archaeological sites and landscapes. The author of five books and many articles, he was appointed Director of IATH and Professor of Classics and Art History in August 2004. In addition, he has held fellowships from the Woodrow Wilson Foundation, the Michigan Society of Fellows, the American Council of Learned Societies, the National Science Foundation, the Center for Advanced Study in the Visual Arts (National Gallery, Washington, DC), the American Academy in Rome, and the Loeb Classical Library Foundation.

**Daniel Pitti:** Pitti is Associate Director at IATH where he is responsible for coordinating project design and implementation. As principal text and database system designer, he works with Institute fellows, faculty, and staff to develop systems specifications for description and digital representation of primary source materials and secondary analytic and interpretive materials; and to develop standards-based encoding schemes to implement specifications. He serves on the TEI Consortium Board, as well as the advisory boards of several humanities research projects and publications.

**Worthy Martin:** Martin is a Computer Scientist who serves as the Technical Director of IATH. He provides expertise in technical issues for IATH projects, such as software design and applications programming.

**Dott. Ing. Alberto Nistri:** Nistri is the Managing Director of S.a.r.a.-Nistri, srl, Rome. Trained as an engineer he oversees the work to collect aerial data for the largest and most authoritative collection of historic and contemporary aerial maps of Rome.

**Dr. Ian Johnson:** Johnson is a Senior Research fellow at the University of Sydney, and Director of the Archaeological Computing Laboratory in the Spatial Science Innovation Unit. His work focuses on Internet databases and GIS, spatio-temporal data and GIS education for the Humanities. Since 1998, he has overseen development of core technologies for the Electronic Cultural Atlas Initiative.

**Project Methodology:** Ultimately, the goals for this project are to enlarge our general understanding of the urban history of Rome and to encourage a new level of urban analysis based on an acknowledgement of the impact that hydraulic infrastructure exerts on urban development. With this in mind, our research methodology provides an environment for synthetic research and analysis of water infrastructure as an integrated spatial, typological, and chronological continuum. We examine complex groups of features across the city and across time in order to find new relationships within the ensemble of natural water features (such as rivers, springs, and floods) and constructed features (aqueducts, sewers, fountains, conduits, drains, etc.). Our operating premise is that no feature can be studied in isolation, but must be examined within its specific topographic setting and within the larger context of water supply, distribution, and disposal.

Our methodology began with a systematic, block-by-block survey of every extant water feature within the intramural city, which was then carefully plotted and entered into the data inventory. This approach remains our primary strategy and makes our work entirely different and more useful when compared to all other studies of water infrastructure in Rome. As new data is mapped, entirely new relationships between distinct elements will be elucidated, relationships that would not be apparent with traditional methods. While the maps and database currently available to the public are satisfactory up to a point, it is now incumbent upon the team to upgrade our maps – increasing scale, geo-referencing, and adding more detailed elevation information – and to create a more useful interface for our collaborative team and for other scholars and students. Our work thus far represents a solid and innovative beginning, but not an end. The remaining tasks relate specifically to competing original research; increasing the potential of the existing web project through GIS mapping (using the authoritative 1:500 S.a.r.a.-Nistri maps of contemporary Rome); creating original computer models of urban continuity and discontinuity; expanding the database and facilitating its use; and integrating new topology and chronological maps for the Early Christian, Medieval, and Early Modern periods.

**Equipment that is available at IATH for the project:**

1. *Development Server:* Sun Fire 280R Server with dual 1.2 GHz UltraSPARC III processors and 1GB of RAM
2. *Web Server:* Sun Fire 280R Server with dual 1.2 GHz UltraSPARC III processors and 1GB of RAM
3. *Backup Server:* 2 Apple XServe with OS X Server installed
4. *Mailing list server:* Sun Enterprise 420R Workgroup server with four 450-MHz UltraSPARC CPUs and 4GB of RAM
5. *Development:* Three Sun Ultra80 Workstations with dual 450-MHz UltraSPARC processors, six Pentium class PC workstations and six Macintosh workstations
6. *Network Appliance for data storage:* 1.2 Terrabyte Snap server
7. *Raid system for data storage:* 3.5 Terrabyte XServe
8. IATH delivers web content using the Apache web server, Dynatext/Dynaweb, the Jakarta-Tomcat Java server, Apple WebObjects, and the PostgreSQL relational database server. IATH has a full complement of development tools.

**Final Product and Dissemination:** By the end of the funding period, our project will be fully operational and freely accessible on the web. New chronological and typological map layers and their respective inventory articles will have been created from original research completed during the funding period. The new *Aqua Urbis Romae* web site, with GIS maps, geo-referenced data, a Flash interface, and a PostgreSQL database, will be greatly improved. The project will provide increased access to new, fully interactive and integrated topology layers and the Timeline maps will be extended through the Early Modern period (circa 1700). These maps will facilitate links to the expanded inventory of water features and an increased number of historic maps, books, and images. Our website is already known to scholars in a wide array of disciplines and receives a considerable number of “hits” for an academic site (for example, this year the site logged 82,181 hits between April 16 and August 10, a total of 16,904 visits

from 9,717 unique visitors, an average of 696 hits per day). A February 2004 review, by the Center for History and New Media, at George Mason University (“a guide to 100 of the best online primary source archives in world history”), states that the site establishes “a visionary goal for any academic website” and that as it expands it will become an even more “invaluable supplement to a syllabus on Roman history, especially a course on Roman architecture and engineering.”

The project will be self-sufficient by completion of NEH funding, but new materials will be added as they become available and new on-line articles will continue to be published on the website both during and after the period of funding. IATH will continue to host and update the website and Rinne and Frischer will continue as project co-directors. Finally, we plan to publish the base cartographic data, including GIS data, in an affordable CD-Rom, which can be used by other researchers. Currently anyone can download website maps at 72-dpi resolution for study purposes, but the CD-Rom will provide scalable data of publication quality.

**Work Plan:** There are research and technical components to the work plan. The research component includes completing original fieldwork in Rome and analyzing the resulting data to create new maps for the Early Christian to Early Modern periods (330 – 1700 CE). There are two major areas of focus in the technical work plan: the maps, which provide geographical and cartographic information in chronological and typological formats; and the inventory, which contains textual descriptive information about water infrastructure elements. Work performed before and during the grant period can be divided into six parts:

- I. Complete original research and analyze data.
- II. Begin design and specifications for the new textual and graphic content.
- III. Convert original map data into GIS data; convert textual data to PostgreSQL; implement, build, and populate PostgreSQL database; design and implement Flash graphic interface.
- IV. Evaluate design of text and graphic interfaces.

- V. Rebuild and implement the website to reflect new features.
- VI. Analyze and incorporate new research into new chronology and typology layers and develop the Roman Forum/Colosseum urban continuity-discontinuity study.

### **Pre-Grant Activity**

#### **October 2004 to December 2005:**

**Research and Fieldwork:** Dr. Frischer will develop a strategy with Ronne and Dott. Ing. Nistri for the S.a.r.a.-Nistri work effort in Rome. Rinne will conduct archival research in Rome.

**Maps:** Rinne will take a GIS mapping course in preparation for the work that she will carry out in the funding period.

### **Grant Activity**

#### **January 2006 – June 2006:**

**Research and Fieldwork:** Rinne will complete archival research in Rome.

**Maps:** Dr. Johnson will create an initial version of the GIS to Flash conversion. In Rome, Dott. Ing. Nistri will oversee the scanning and geo-referencing of the eighty-one original S.a.r.a.-Nistri maps of Rome. IATH Media Designer will train Rinne and the student assistant #1 to transfer cartographic data from the existing Canvas maps to GIS maps, and will monitor their work.

**Inventory:** Pitti and the IATH Database Programmer will move the existing Dyna Web inventory into a PostgreSQL database and train Rinne and the student assistant #1 to revise existing data and enter new data Pitti will monitor their work, and make needed revisions to the program as necessary.

**Website:** Student assistant #1 will scan and edit archival material, including photographs, prints, and rare books and maps to be included on the website.

July 2006-vDecember 2006:

**Research and Fieldwork:** Rinne will analyze and synthesize archival materials and incorporate the newly collected GIS data.

**Maps:** Working under the direction of Dr. Frischer, the student assistant #2 will start the S.a.r.a.-Nistri vector work. Rinne and the student assistant #1 will continue data conversion from the existing Canvas maps into GIS maps and begin to update existing web documents, including all bibliographies and inventory entries, adding them to the new databases as they are completed. The Media Designer and Flash Programmer will train Rinne and the student assistant #1 to carry out the GIS to Flash conversion, and will monitor their work. Dr. Johnson will continue in an advisory role for the Flash conversion, as necessary.

**Inventory:** Rinne and student assistant#1 will continue to enter new data in the PostgreSQL database.

**Website:** Student assistant #2 continues to scan and edit archival materials for the website.

**January 2007-June 2007:**

**Research and Fieldwork:** Dr. Frischer and Rinne will work together to create the Colosseum-Roman Forum demonstration research project.

**Maps:** The student assistant #2 will continue to work on the S.a.r.a.-Nistri maps, and Dr. Frischer will continue to supervise. Rinne, working with the Media designer to create new Timeline maps for the Early Christian, medieval, and Early Modern periods (a total of twenty-two maps) using research data that has already been collected. Each map will be created using GIS and Flash technology and will be available to view and use with either the topographic base or street map base, and can be viewed as either flat maps or as 3-D contour maps. Rinne will also continue to add data to the GIS database.

**Inventory:** Rinne and the student assistant #1 will continue to expand the inventory entries.

**Website:** Student assistant #2 will complete the scanning and editing of archival material for the website.

**July 2007-December 2007:**

**Research and Fieldwork:** Dr. Frischer and Rinne will work together to create the Colosseum-Roman Forum demonstration research project, assisted by the student assistant #2.

**Maps:** Dr. Frischer will oversee the integration of the S.a.r.a.-Nistri vector work into Flash. The Flash programmer and Media Designer will construct a beta version of the Flash interface. Rinne, working with the student assistant #1, will create new typology layers for the Early Christian, Medieval, and Early Modern periods using research data that has already been collected. These maps are somewhat more straightforward than the Timeline maps, and should take about one week each to create, proof, and test. Rinne will also continue to add data to the GIS database.

**Inventory:** Rinne and the student assistant #1 will continue to expand the inventory entries related to the new typology layers.

**Website:** Dr. Frischer, working with the Media Designer, Rinne, and the student assistant #1 will oversee the final integration of all the new elements that have been created for the website as they are completed.

Throughout the entire pre-grant and grant periods the project advisors (working as always in a pro bono capacity) will continue to solicit, review, and edit articles for the occasional on-line journal. Additionally they will work with Rinne to develop the journal's scope and mission, to find new readers, to search for and hire an editor, and to seek outside funding.

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