World Water Forum College Grant Program
2007 Grant Proposals

College	Pasadena City College (2)
Faculty	Dr. Russell Difiori
Project	Multi-stage Strategy to Improve the Water Quality of Urban Runoff

GRANT PROPOSAL – WATER QUALITY

A. APPLICANT INFORMATION

College	Pasadena City College
Address	1570 E. Colorado Boulevard
City, State, Zip Code	Pasadena, CA 91106-2003
Website	http://www.pasadena.edu
Make Check Payable To:	Pasadena City College Foundation

B. PROJECT TYPE

Applicant	Check One
First Time – Local Project	√
First Time – Global Project	
Existing Project – Local Focus	
Existing Project – Global Focus	

C. STUDENT PROJECT MANAGER

Name	Mark Ortega
Undergraduate or Graduate	Undergraduate
Department	Natural Sciences Division
School Address	Pasadena City College, 1570 E. Colorado Boulevard
Telephone	N/A
Mobile Phone	N/A
Email Address	msobruin@ucla.edu
Home Address (optional)	N/A

D. FACULTY PROJECT MANAGER

Name	Russell Di Fiori
Department	Natural Sciences Division
School Address	Pasadena City College, 1570 E. Colorado Boulevard
Telephone	(626) 585-7176
Mobile Phone	N/A
Email Address	redifiori@pasadena.edu

E. ORGANIZATIONAL BACKGROUND (1-2 pages):

Established in 1924, Pasadena City College (PCC) is a comprehensive, public two-year community college serving the culturally and economically diverse urban community of the Pasadena Area Community College District, which has a population of approximately 390,000. In fall 2006, the college enrolled over 29,000 students, including more than 25,000 credit students. More than 75% are minorities, and 47% are first-generation (the first in their families to attend college). PCC's academic programs encompass 60 program areas, and it offers 76 certificate programs in career and technical education fields.

The mission of the college is successful student learning. PCC seeks to foster a creative learning environment that is technologically challenging and intellectually and culturally stimulating, and to offer learning activities designed to improve the economic condition and quality of life of the diverse communities within the college's service area.

The college's Natural Sciences Division provides supportive, excellent science education, where students learn science by direct experience with the methods and processes of inquiry. Classes are taught to ensure that students learn not only the important relevant facts, but also the process of science and how to develop their critical thinking skills. Courses are offered in 12 basic science disciplines: anatomy, astronomy, biology, chemistry, environmental technology, geology, laser optics technology, microbiology, nutrition, physical science, physiology, and physics. The Division also offers vocational programs which can lead to certification for employment in biological technology, environmental technology or laser/fiber optics technology.

A current focus of the Natural Sciences Division is to expand and enhance field science programs in biology and geology. The field science faculty team has a wide diversity of expertise from disciplines that include Geology, Biology, English and Math. One of the premier field science offerings at PCC is its Baja Science Program, a rigorous science curriculum designed around the philosophy that students learn best by experiencing and doing science rather than just reading about it. Students in the program learn by both traditional methods and field projects in an active learning environment. The program is in its fifth year and has gained national recognition. Many of the PCC students who have gone through this program have subsequently completed independent research that has been presented and won awards at the Southern California Academy of Sciences.

The Division also has begun adding and modifying courses to enhance future interdisciplinary programs in the field sciences. One of the newest courses being added to the curriculum is Ecological Methods. In addition, through a grant from The Ralph M. Parsons Foundation, the college has established a suite of technology that supports investigative learning in field courses and organized the technology into portable modules that can be employed by a variety of courses and programs. The modules contain equipment for field data collection, computers for data processing and analysis, power to run the technology in the field, and safe transportation to bring the equipment to remote locations.

The project outlined in this proposal will not be the college's first effort to contribute to water conservation research through MWD's College Grants Program. In August 2005, a PCC project

team began creating an artificial wetland that could be used to filter a broad range of water pollutants. The MWD-funded effort produced remarkable results. Water flowing through the wetland was significantly reduced in nitrates, phosphate, and metals. The student project team wrote extensive papers on their work and presented their findings at MWD in January 2006. Several of the students attended the World Water Forum in Mexico City in the Spring of 2006 to share their ideas and learn more about global water issues.

Management of the funds for the proposed project will be provided by The Pasadena City College Foundation. The Foundation was incorporated in 1979 as a 501(c)(3) non-profit, charitable, public-benefit foundation to bridge the gap between the needs and resources of Pasadena City College (PCC). The Foundation's mission is to obtain private funding (from individuals, corporations, and local foundations) for PCC programs, facilities, equipment, faculty and students, and to assist the college in serving the community of which it is a part. The Foundation also manages (at no fee) grants and donations from private funding sources.

F. PROJECT DESCRIPTION (3-5 pages):

Project Name
Multi-stage Strategy to Improve the Water Quality of Urban Runoff

Problem
As the human population globally becomes more and more concentrated into major urban centers, the challenge of developing cost effective treatments of urban runoff is becoming vital to the sustainability of safe water supplies and local natural environments. In fact, 2008 marks the first year in human history when more people live in cities than in rural areas. Los Angeles is currently growing at a rate of about 4.6% per year. As we pack more people into tighter areas, the per capita effect on the local watershed is going to increase.

Focusing on our local watershed, in the summer of 2007 the Arroyo Seco Foundation found nitrates and iron to be the most abundant chemical of concern in the Arroyo Seco (Pasadena Star News, October 2007). In a September 2007 meeting concerning the Hahamongna Watershed Park region of the arroyo, Rosa Laveaga of the City of Pasadena's Department of Public Works identified the waste outfall from the Rose Bowl Riders and Tom Sawyer Camp's equestrian facilities as being major sources of nitrate pollution along with Flint Canyon wash. Nitrates along with phosphates can lead to eutrophication of the waterways killing off local aquatic fauna and causing dangerous phytoplankton blooms in the outfall of the Los Angeles River at Long Beach. Nitrates have been implicated in the loss of amphibian and fish populations worldwide, and nitrates leaching into the groundwater can also cause methemoglobinemia (blue baby syndrome) in newborns.

Beyond the equestrian inputs there are also the traditional urban runoff problems from water that comes from yards and local businesses. There are three (3) main urban drainages that enter Hahamongna Watershed Park carrying the chemicals and trash from that particular part of the city. These pollutants ultimately end up in our ground water or are flushed out to sea in Long Beach. Chemicals in these outfall include iron, nitrate (Arroyo Seco Foundation, 2007), chlorine, lead and chromium (Pasadena City College, 2007). Based upon this research, we can

conclude that urban runoff and equestrian outfall are having a significantly negative impact on the water quality in Hahamongna Watershed Park and the larger Arroyo Seco.

Solution

Based upon preliminary results from our research (Fall, 2007), we propose a multistage strategy for dealing with the chemicals of concern in Hahamongna Watershed Park. The three main steps in our strategy include charcoal filtration, bioreactors, and subterranean wetlands. Specifically in this project we will test various configurations of these technologies to find the optimal strategy and necessary scale of each to deal with the contamination levels measured in Hahamongna Watershed Park.

The charcoal filtration approach is as simple as running the contaminated water through charcoal and this process will remove some of the nitrate, phosphate and other ions. The charcoal does not have to be special; we have done some preliminary testing and barbeque charcoal alone works fine. We will have to test the longevity and scale of the effects to see if this is a feasible component to a sustainable urban runoff treatment plan.

The bioreactors are essentially tubes or containers with sediment and local bacteria in them creating an optimal environment for decomposing the chemical we are targeting. The trick in this phase of the project is to create the conditions that favor the bacteria that will do the job you want at the right scale. We will build both aerobic and anaerobic chambers of various sizes ad seed them with local biofilms (bacterial communities) collected in the watershed and test the efficiency of each in removing the targeted chemicals. In the end we will be able to select the optimal strategy and scale for building bioreactors to treat the targeted pollutants in each of the outfall areas.

The final component of our strategy is the subterranean wetland that will function much like a leach field but with specific local plant species targeted to removing chemicals of concern, especially nitrate. We will create a mini aquifer 30-40cm below the surface to hold the contaminated water so the plants above can have the necessary time to clean the water. This design would eliminate the risk of surface water that might increase the risk of disease vectors like mosquitoes. The subsurface wetland would have a membrane below that would trap the water and gravel soil and plants above. Several species of plant from the park will be tested to determine the most efficient and durable plants for this application.

Our experiments will be carried out in and around the planting beds of the environmental studies site currently approved for our use by the City of Pasadena located in Hahamongna Watershed Park. We have additional agreements with the Rose Bowl Riders and the Tom Sawyer Camp who will allow us access to the equestrian sites and help with some of the logistics like the use of tractors for collecting gravel and horse manure.

Timeline

In the Spring of 2008 we will begin construction of the 3 main components of the project. It will take about 4 weeks after getting the materials to have the tanks and wetland in place to begin testing. We will use actual runoff water cycled through the various configurations of the 3 treatments using a solar powered pump system. Throughout the summer and early Fall 2008 we

will test various configurations and plants for the wetland. We will analyze all of the data and come up with our ultimate recommendation concerning these technologies by late Fall of 2008. The students will present these results at an appropriate professional scientific conference.

Team Leaders

In the Fall of 2007 all of the students participating in this project did preliminary research to test the efficacy of their proposed application in improving water quality. Mark Ortega has rigorously tested the effects of charcoal in removing nitrate from water samples. His work shows great promise as a simple first step in water treatment. He will lead a team working on both the filtration and green algal testing.

John Campo and his research team developed a method of testing the effects of biofilms on water quality and did some preliminary tests on the local biofilms in Hahamongna Watershed Park. John will be directing one of the biofilm teams building a set of bioreactors, collecting the biofilms, and running the water quality tests. Brittany Taunton has a B.S. in chemistry from Occidental College and has mastered testing the fine scale changes in water chemistry. She will be in charge of the water chemistry lab team making sure our water quality measurements are accurate. Briana Lupia and her research team have built both subterranean and surface artificial wetlands to test the effect on manure outfalls. Briana will be the lead for constructing and running the artificial wetland.

All of these initial research efforts showed excellent results and great promise on small scales and will be scaled up in this project.

Faculty Mentor

Russell Di Fiori has been a member of the college's Natural Sciences Division faculty since 1995. He is the lead instructor for Biology 1A, Evolution and Ecology, and teaches Environmental Science in PCC's new multidisciplinary Environmental Studies Program. He and his students currently play a key role in developing projects that address water quality issues under an agreement with the City of Pasadena. He was the advisor on the MWD grant awarded in 2005 to study the efficacy of using artificial wetlands to improve water quality and, most recently, headed the project funded by The Ralph M. Parsons Foundation to develop portable field technology modules to be used for field studies in biology and geology courses.

G. PROJECT MANAGEMENT TEAM

	NAME	TITLE	ADDRESS	PHONE & EMAIL
1	Mark Ortega	Water filtration	See note below	msobruin@ucla.edu
2	John Campo	Biofilm testing	See note below	johncampo9@yahoo.com
3	Brittany Taunton	Water chemistry	See note below	britaunton@gmail.com
4	Briana Lupia	Wetland development	See note below	breelupia@yahoo.com

Note: All student project team members may be addressed c/o Pasadena City College, Natural Sciences Division, 1570 E. Colorado Boulevard, Room U402, Pasadena, CA 91106-2003.

H.1. PROJECT BUDGET (ALL SOURCES)

The budget for this project is $13,000. We are requesting $10,000 in grant funds from MWD. Matching funds of $2,650 have already been raised through students, faculty, other grant projects, and Natural Sciences Division funds. The project team hopes to raise an additional $350 for a total match of $3,000.

DESCRIPTION	AMOUNT	NOTES
GRANT FUNDS REQUESTED FROM MWD	$ 10,000	Includes equipment, supplies, conference registration, and dissemination
ADDITIONAL SOURCE OF FUNDS (Donations from students and faculty, other grant funds, Division funds	$ 2,650	Includes match for the following budget items: $500 for canopy; $500 for hardware; $300 for gravel, soil, membrane; $150 for containers & piping; $1,200 for YSI spectrophotometer & reagent
PROJECT TOTAL	$ 12,650	

H.2. PROJECT BUDGET (GRANT FUNDS REQUESTED FROM MWD)

The canopy is necessary to prevent rainwater from diluting the water in the experiment. The solar power pump will be re-circulating the water during the experiments. The YSI spectrophotometer is used to accurately measure the finest changes in water quality in the experiment. Expenditures will be as follows:

LINE ITEM	AMOUNT	DESCRIPTION
SUPPLIES	$ 3,000	Hardware ($500); gravel, soil, and membrane ($1,500); containers and piping ($1,000)
CONFERENCE REGISTRATION AND DISSEMINATION	$ 2,000	Production of posters and media; presentation by student team to at least one professional conference
EQUIPMENT	$ 5,000	Canopy ($1,000); solar powered pump and equipment ($1,200), YSI spectrophotometer and reagent ($2,800)
TOTAL	$ 10,000	

I. SIGNATURE BLOCK – WATER QUALITY PROPOSAL

	NAME	SIGNATURE	DATE
Faculty Project Manager	Russell Di Fiori		12/12/07
Student Project Manager	Mark Ortega		12/12/07
Member Agency Representative	Nancy Long Pasadena Water and Power Customer Relations		12/12/07