# Environment and Natural Resources Trust Fund
# 2018 Request for Proposals (RFP)

**Project Title:** **ENRTF ID: 125-C**

RAPID: Google for the Environment

**Category:** C. Environmental Education

**Total Project Budget: $** 228,000

**Proposed Project Time Period for the Funding Requested:** 2 years, July 2018 to June 2020

**Summary:**

We will develop RAPID, the Environmental Google, to help maintain the lowest levels of chemicals in the environment, and to be used by government agencies, science teachers, researchers, and citizens.

**Name:** Lawrence Wackett

**Sponsoring Organization:** U of MN

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Saint Paul MN 55108

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**Web Address**

**Location**

**Region:** Statewide

**County Name:** Statewide

**City / Township:**

**Alternate Text for Visual:**

Visual of RAPID and descriptions of the usefulness of a RAPID system from different sources

| | | | |
|---|---|---|---|
| _____ Funding Priorities | _____ Multiple Benefits | _____ Outcomes | _____ Knowledge Base |
| _____ Extent of Impact | _____ Innovation | _____ Scientific/Tech Basis | _____ Urgency |
| _____ Capacity Readiness | _____ Leverage | _____ TOTAL | _____% |

**PROJECT TITLE:** RAPID: Google for the Environment

## I. PROJECT STATEMENT

Here we propose to develop the "Environmental Google" search tool and database that will allow better control of chemicals by rapidly matching natural control agents to individual chemicals, to maintain the lowest possible levels in the environment. There are 100,000 individual chemical substances used in making the products we encounter every day. They include pharmaceuticals, crop chemicals, cleaning products, and personal care products. Many of these novel chemicals end up in our waters and are difficult to remove in water treatment plants because the biological treatment stage is not acclimated to the exotic chemicals that show up. We have begun to develop an approach by which we can take any chemical and identify ideal biological treatment methods to break it down. This free website uses computer software to match chemicals with the best treatment. It is analogous to Google. Google searches for key words and prioritizes the matches to give an ordered list of "best fit" matches. Our web tool, called RAPID, matches a chemical with key features of different biological treatments and delivers best treatment options. The prototype algorithm has been reviewed favorably by knowledgeable international scientists. In this project, we will improve the system to deliver results to users faster, making it more like Google. Secondly, we will host the software and results on a RAPID database, maintained at the University of Minnesota. It will be available all over the world, like Google. In addition, we will provide support to Minnesota State agencies on using the system and implementing treatments that may arise from their search results. We will also work with a high school teacher to use RAPID in environmental education. While this proposal is most appropriate for the water resources section, it also impacts other areas that LCCMR provides funding for: data and information, environmental education, and methods to restore land and water.

## II. PROJECT ACTIVITIES AND OUTCOMES

**Activity 1:** Producing website usable to everyone **Budget: $ 60,000**

The RAPID system has currently been tested by scientists and shown to perform well. The goal of Activity 1 is to develop a website front-page with a very easy-to-use interface that is intuitively clear without instructions. It will then be usable and used by government agencies, remediation experts, students, and member of the public.

| Outcome | Completion Date |
|---|---|
| 1. Establish user-friendly web interface for RAPID users | December 1, 2018 |

**Activity 2:** Beta-test new web interface with government agencies, high school students **Budget: $ 30,000**

To determine if the initial design and use of the web interface is ideal, it is necessary to test, score, and tweak the design as necessary. This will be accomplished by having people in state agencies and high schools test and provide feedback. We have already made appropriate contacts with people eager to serve as beta-testers.

| Outcome | Completion Date |
|---|---|
| 1. Users will provide feedback from short survey | March 1, 2019 |
| 2. Programmer will respond, fix, and improve based on beta-tester feedback | April 1, 2019 |

**Activity 3:** Develop faster algorithm to allow users to obtain more immediate results **Budget: $ 90,000**

RAPID makes complex calculations as part of its algorithm in the software. The goal of this phase of the project is to streamline the system so that the user receives an answer to their queries in a very short period. This will make the system much more usable and used.

| Outcome | Completion Date |
|---|---|
| 1. Carry out programming work to streamline data processing and enhance computational access and implementation | April 1, 2020 |

**Activity 4:** Establish the rapid algorithm on the RAPID website **Budget: $ 48,000**
With feedback from users and a faster, more user-friendly algorithm developed, the entire system will need to be implemented on the RAPID website.

| Outcome | Completion Date |
|---|---|
| 1. Programming and web design will be carried out by computer programmer hired for this project with help from a graduate student already funded from a federal agency and the project managers. | June 30, 2020 |

**III. PROJECT STRATEGY**

**A. Project Team/Partners**

The project will be headed by Professor Lawrence Wackett and co-managed by Associate Professor Alptekin Aksan. A computer scientist programmer, Dr. Jon Badalamenti, will write code to help develop and implement the algorithm for and on the RAPID databases. University of Minnesota graduate students, Mr. Diego Escalante and Ms. Serina Robinson, will also work on the project. Ms. Robinson has funding from a federal agency for the next three years and her efforts will provide leverage for this project without LCCMR fund. Mr. Escalante will require a graduate student stipend to cover his work on this project. A key member of the team is Dr. Mark Ferrey from the Minnesota Pollution Control Agency (MPCA). Dr. Ferrey will be not receive funds, as he will be paid as part of his normal salary at the MPCA. He works on monitoring pollutants of emerging concern, which is one of the ideal uses of the RAPID system under development here. Dr. Ferrey knows the key medicines, crop chemicals, cleaning products, and personal care products that are emerging as major contaminants in Minnesota ponds, lakes, rivers and streams. He will provide data for our use and take output from RAPID to augment his work. Another key member of the team is Ms. Kathryn Kahn, a high school science teacher in St. Paul, Minnesota. Ms. Kahn will direct classes at Como Park High School in the use of RAPID. The students will learn about computational methods and environmental science and we will obtain needed feedback about the ease of use of our software and website.

**B. Project Impact and Long-Term Strategy**

Through this project we will: (1) advance the state's economy by developing contaminant mitigation technologies for chemicals identified by the Minnesota State agencies as Chemicals of High Concern, (2) leverage the existing strengths at the University of Minnesota, (3) engage major water treatment companies in the state (e.g. Ecolabs, 3M, Dow Water) and existing small and new start-up companies, (4) improve the health and well-being of Minnesota's citizens by developing new methods remediate pollutants and (5) educate and increase awareness of Minnesota students regarding environmental chemicals and what they can do about them. This project will help state agencies in their work, and provide an international resource for environmental protection. With the “Minnesota” name on the top of the RAPID database and algorithm, this will help bring attention and distinction to the state. Once established, the algorithm and database will be continued beyond the lifetime of the LCCMR funding by maintaining it on a general-use University of Minnesota computer server. The server is continually maintained by dedicated computer science staff. The RAPID algorithm and database will serve as a focal point for further expansion of function as needs arise. We believe that this expansion will be attractive for funding by private foundations and federal agencies.

**C. Timeline Requirements**

This project will take 24 months to carry out as described above. Thereafter, it is expected that the products of the project will be maintained at the University continuously and be available to state agencies, the private sector and to citizens of the state and beyond.

# 2018 Detailed Project Budget

**Project Title: RAPID: Google for the Environment**

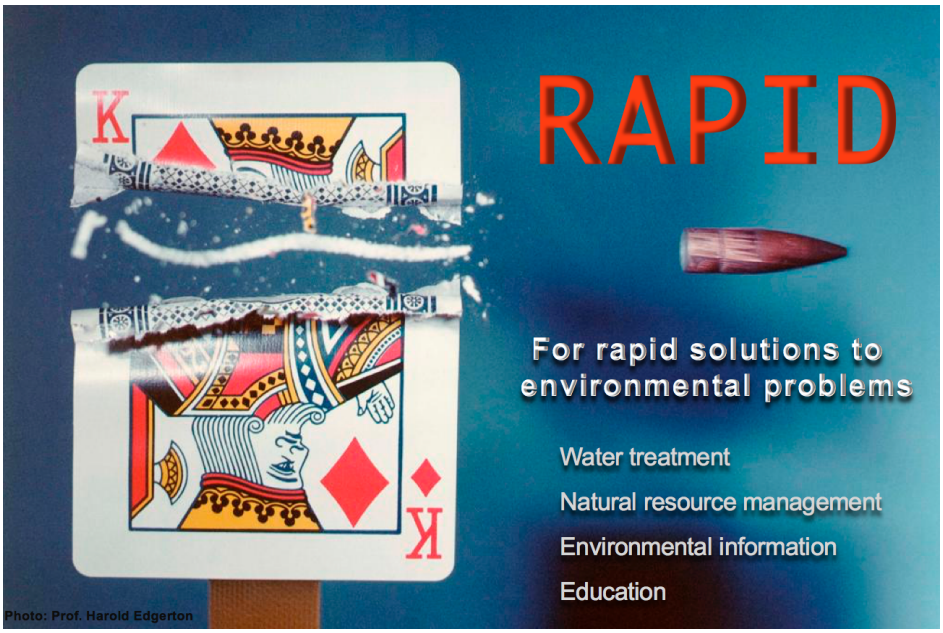
**IV. TOTAL ENRTF REQUEST BUDGET 2 years**

| BUDGET ITEM | AMOUNT |
|---|---|
| **Personnel:** | |
| Post Doctoral Programmer ($60,000 Salary + $12,839 Fringe for 2 years) - Dr. Jon Badalamenti | $ 145,678 |
| Graduate student - Part-time for 2 years - Diego Escalante | $ 37,322 |
| **Professional/Technical/Service Contracts:** Funds are requested for service provided by the University of Minnesota's Supercomputing Institute. The Institute provides high-speed computing and trained personnel to assist. | $ 30,000 |
| **Equipment/Tools/Supplies:** Funds are for commercial software to aid in the linking of our written software into a cohesive package with easy user interface. | $ 15,000 |
| **Acquisition (Fee Title or Permanent Easements):** *In this column, indicate proposed number of acres and and name of organization or entity who will hold title.* | |
| **Travel:** . | N/A |
| **TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =** | $ 228,000 |

**V. OTHER FUNDS**

| SOURCE OF FUNDS | AMOUNT | Status |
|---|---|---|
| **Other Non-State $ To Be Applied To Project During Project Period: Area II Potato Growers** | N/A | N/A |
| **Other State $ To Be Applied To Project During Project Period** | N/A | N/A |
| **In-kind Services To Be Applied To Project During Project Period:** Faculty salary time paid by the University of Minnesota that the PI will devote to the project over the summer months. In addition, graduate student, Ms, Serina Robinson, has obtained a National Science Foundation predoctoral scholarship to conduct computer-based research in the PIs lab and she will devote some of her time to this project | $125,000 | Secured |
| **Past and Current ENRTF Appropriation:** This proposed project extends the activities of an LCMR project funded in 2005 entitled "Improving Water Quality on the Central Sands." Based on that project, changes to production practices have been made to reduce nitrate leaching, but equipment and fertilizer technology suggested to be used in this proposal were not available at that time. | N/A | N/A |
| **Other Funding History:** Funding to establish the data for RAPID had been supplied by the Informatics Institute at the University of Minnesota. | $ 50,000 | Spent |
| **Remaining $ From Current ENRTF Appropriation** | N/A | N/A |

## RAPID: Google for the Environment




RAPID will be useful and used. What people say about it:

**Dr. Mark Ferrey, Minnesota Pollution Control Agency**
"I'm excited about what you can do with it."

**Ms. Kathryn Kahn, St. Paul High School science teacher**
"What a great project!!! I think that a higher level class would be best to try out the Environmental Google, the AP Environmental and the accelerated bio or the AP bio."

**KARE11 News – March 5, 2017**
"The Minnesota Daily reports that scientists from the Wackett Lab are using a predictive method to determine the correct enzymes that break down pharmaceuticals in water."

**Prof. Kathrin Fenner, Swiss National Institute for Water Research**
"The goal of the workshop that will take place at Eawag, Dübendorf, Switzerland is to exchange information on predicting biotransformation of organic contaminants" –
on international meeting to discuss RAPID, funded by European Union grant

**Dr. Kelly Aukema, in Star Tribune, March 5, 2017**
"this information can be used for the design of better waste water treatment for the removal of chemicals of emerging concern – both here in (Minnesota) and around the world."

**College of Biological Sciences, University of Minnesota, January, 2017**
"an unsettling number [of pharmaceuticals] are found in water – with largely unknown consequences for people and wildlife who ingest them. Now, University of Minnesota researchers have come up with a promising new strategy for dealing with this dilemma."

**PROJECT MANAGER QUALIFICATIONS AND ORGANIZATION DESCRIPTION**

**Project Title:** RAPID: Google for the Environment

## PROJECT TEAM

***Project Manager***

**Lawrence P. Wackett, Distinguished McKnight University Professor**

BioTechnology Institute, University of Minnesota, St. Paul, MN

Lawrence Wackett is McKnight Distinguished Professor of Biotechnology with 29 years of experience in biological methods for environmental cleanup

***Project co-Team Manager***

**Alptekin Aksan, Associate Professor**

Mechanical Engineering, University of Minnesota, Minneapolis, MN

Alptekin Aksan brings strong expertise in mathematics, engineering, and computational modeling that will be crucial to carry out the current project

***Project personnel***

**Graduate Researcher (funded) - Ms. Serina Robinson**

National Science Foundation pre-doctoral fellow
M.S. candidate in Computational Biology; Ph.D. candidate in Microbiology
B.S. Chemistry, *summa cum laude*, St. Olaf College, Northfield, MN
Fullbright Research Scholar in Norway
**Research Experience:** Strong background in Computer Science, Chemistry, Microbiology and Norwegian language (2nd major in college)

**Computer Scientist - Dr. Jon Badalamanti**

B.S., Penn State University
Ph.D., Arizona State University
**Research Experience:** Computer methods for analyzing biological systems

***Project Team Description***

The project and co-project managers have a combined 35 years of experience in developing web-based environmental tools, environmental cleanup and instituting engineering practices to implement solutions to real-world problems. They are also well-connected with Minnesota State agencies, Minnesota industry, and seek to see their research translated for the improvement of society.

## ORGANIZATION DESCRIPTION

The University of Minnesota supports this research project with laboratory space, infrastructure, administrative support, and the facilities of the Minnesota Supercomputing Institute and the Institute on the Environment. The University, under President Eric Kaler and research Vice President Allen Levine, are dedicated to promoting University research that directly benefits society, especially the state of Minnesota and its citizens. We expect that we will receive outstanding support throughout the University for all phases of this project.