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Communications Guidelines for Environmental Resources Engineering (ERE) Students

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As an engineering professional, you need to communicate your ideas effectively to a wide variety of audiences. We have prepared these guidelines to provide you with our ideas and expectations on this important subject. We will expect you to refer to these guidelines as you practice your communications skills while a student in our program.

Version 2011.10

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Introduction

Background & Motivation

As engineering educators we are motivated to provide you with the best education possible. One area of training that cuts across all of your undergraduate program activities is communication. While you take at least two writing classes at ESF, your efforts to improve your communication must be practiced in all of your classes and undergraduate activities. Effective communication is a critical educational program outcome that you can achieve through practice. Obtaining this set of skills will differentiate you from students who may have mastered the math and science but failed to master communication.

This guide is intended to help you practice and perfect your communication. We are told by the employers of our graduates that our program generates great engineers because they have the right balance of effective communication and core engineering and critical thinking skills. To master effective communication you must practice. We expect you to practice effective communication skills throughout your four year program and beyond.

We created this document for five reasons:

1. To articulate our expectations on effective communications to our engineering students,
2. To provide a reference for our students as they practice their communications skills,
3. To formalize the communications training our students encounter throughout the curriculum,
4. To encourage our students to maintain a portfolio of good communication products, and
5. To demonstrate to our external constituents our commitment to produce engineering graduates who recognize the importance of effective communications and who have practiced communications skills throughout their program.

Scope of Guidance

This publication is a how-to for basic communication, and you are encouraged to supplement it with additional guidance on how to communicate effectively. Some supplementary topics to consider include: determining your message (we cover audience and media in this guide); using active listening to understand others (and to make sure they understand you); reducing communication noise (this is not just background distractions); and utilizing nonverbal communication (consider body language as one example). This guide will provide some basic background information on communication and then focus on written, oral, and graphic communication skills.

Beyond this guide, you can find additional communications resources such as:

1. Basic rules of writing are provided by Strunk and White [2009] in *Elements of Style*.
2. Professional letters are discussed and illustrated by Meyer [1998].
3. Scientific writing basics and techniques are discussed by Alley [1996].
4. Engineering report basics and techniques are discussed by Michaelson [1990].
5. Oral presentation skills are presented in a comic by Egan [1997] and in a novel by Kliem [1995].
6. Data presentation and graphics are discussed by McLeary et al. [2000] and Tufte [2001].
7. Writing guidance is available at the Online Writing Lab, owl.english.purdue.edu/owl, [*Purdue University*, 2011] and through the ESF Writing Program.

Attributes of Effective Communication:

There are specific factors you need to consider when preparing professional communications, such as anticipating (and maybe reassessing) your audience, determining your message, and selecting your media. These basic factors can be applied to many forms of communication.

Anticipating your audience

You need to think about the audience you will address. Here are some questions to consider:

1. What is the audience knowledge level, considering a spectrum of expert to general?
2. Will they be familiar with your project problem, goal, and constraints?
3. Will they be familiar with the methods you used or alternatives?
4. Are they expecting oral or written communication?
5. Are tables, graphics, and references expected?
6. Do you want them to ask questions?
7. How will you determine if they support your conclusion or recommendation?

Determining your message

You need to know your message before you can communicate it to others. Take time to work through these steps to determine your message and how you want to deliver that message.

1. Know the purpose or goal of the communication – determine your message.
2. Know the expected format and media for the communication.
3. Develop the communication so it is concise and on topic.
4. Review the communication to ensure it is complete.
5. Edit, refine, and practice the communication.
6. Make backup copies to safeguard your work.

Selecting your media

After the audience and message analysis, the next step is to select the format for the message. In the context of the engineering profession, these are most likely to be

1. Written, as in email, memos, letters, research papers, or lab and engineering reports,
2. Oral, as in telephone calls, informal talks, and formal presentations, or
3. Graphic, as in tables, graphs, illustrations, and maps, portraying data.

Of course, these media may be combined; written and oral forms frequently include graphics.

Engineering professionals are expected to be proficient with various means to produce reports and presentations, such as word processing programs (e.g., Microsoft Word, OpenOffice Writer), page layout software (e.g., Microsoft Publisher, Scribus), presentation programs (e.g., Microsoft PowerPoint, OpenOffice Impress), and programs to generate graphics (e.g., Microsoft Excel, OpenOffice Calc, AutoCAD, Google Sketchup).

If you strive to use these tools when completing your communications you will become competent in their use. Mastering the tool allows you to focus on generating the engineering content that is the basis for the message.

Written Communications

General Considerations

Written communications take several forms. We present common types of written communication, with guidelines and examples for each. We presume you know your audience and message.

Notebook

Documenting your work in a notebook may be the most overlooked form of communication. You should document your work efforts so that you can retrace your work at some later date. For example, if you are completing homework and need to manipulate a spreadsheet or a computer program, you should document the changes you make in the code and input files as you work through a problem or design. A systematic approach to internal and external documentation will allow you to work more productively, and save time if you have to revisit the project. It will also allow others to understand your work in the event someone else assumes your tasks. You should also backup any electronic revisions of your communications. If you use a paper notebook, put your name on the book to ensure it is returned to you if lost. If you use a digital notebook, make backup copies (use the file name to date them; Endreny_Notes-YYYYMMDD_HH.txt) on an external drive to protect your efforts.

Email

Email has typically been appropriate for short, rapid communications, such as a request for a meeting, a short question, a request for a letter of recommendation, etc. Email is increasingly a substitute for letters, which we discuss later. In situations of rapid communication you may use other web tools, such as Blackboard for course communication, Doodle for scheduling meetings, Twitter when widely posting a newsfeed, Facebook (Pages or Groups) when more narrowly posting a newsfeed, or LinkedIn when soliciting business information. Typically these public internet communication tools are not appropriate when transmitting more complex information, or when sending information that is privileged or business confidential.

Your professional email communications should

1. Have a short, informative subject line,
2. Have a greeting appropriate to the addressee,
3. Use correct English in the body, with correct spelling and complete sentences, and
4. Have the equivalent of a signature bar, with your full name and contact information.

Caution: Professional email communications represent a record of professional activity, and can, under certain circumstances, be reviewed at the request of clients or other interested parties. Use common sense when communicating via email; assume the messages you send and receive are permanent and public and don't say anything in email that you would not want to be made public or forwarded to others. To clarify email etiquette, search this topic on the OWL website [*Purdue University*, 2011].

Consider the figures on the next page. **Figure 1** is a poorly written email, and **Figure 2** is an appropriate professional email. The first email does not use correct English, has not been spell-checked, and has no subject, greeting, or signature line.

From: EREStudent01@syr.edu

To: jhassett@esf.edu

will you please allow me to use you as a refernce in my job search? i wanted to ask you in person, but i wasn't sure when you'd around your office in the summer. i'd be happy to come in and meet with you to further discuss my plans or any questions you may have. or, if email is easier for you, just write back and let me know what you'd like to know.

Figure 1: Example of Poorly Written Professional Email

From: EREStudent01@syr.edu

To: te@esf.edu

Subject: Request for Reference

Dear Dr. Endreny,

Since you have been my academic advisor and have taught me Engineering Hydrology and Hydraulics, I would like to list you as a reference in my summer internship search. Would you give me permission to list you (with your ESF affiliation) as my reference on my resume and cover letters?

Please let me know by next Tuesday (Oct 5) if this is a problem. I am available to discuss this in person or via email or phone if you have questions. I can certainly send you another email listing the companies receiving my application and let you know what I am most proud of with respect to my work under your supervision.

Sincerely,

EREStudent01

EREStudent01@syr.edu | (315) 555-1212 | SUNY ESF ERE

Figure 2: Example of Properly Written Professional Email

Memos

A memo communicates with an internal audience relatively simple information. A memo should communicate a specific question, answer to a question, or other piece of information, and thus is usually no more than one page in length.

Here are some guidelines to consider in generating a memo.

1. The memo should contain To, From, and Subject lines, and be dated and signed.
2. The body should be written in a concise manner, with correct English usage.
3. If a reply or some other action is required, that should be clearly stated.
4. The memo should be printed on a formal letterhead if it represents the organization.
5. Use subheadings (vary font as bold or underlined) to break content into logical subsections.

Many word processing packages have memo templates. The OWL website [*Purdue University*, 2011] has memo guidance. **Figure 3** below is a memo example.

BRIEFING MEMORANDUM

Date: **January 20, 2011**
To: **GCDAMP - Technical Workgroup**
From: **John Hamill, Chief and Ted Melis, Deputy Chief, both at USGS Grand Canyon Monitoring and Research Center; (o) 928-556-7364 or (c) 928-607-5253**

SUBJECT: **Summary of upcoming U.S. Geological Survey Circular 1366 on the results of three high-flow experiments released from Glen Canyon Dam, Arizona**

BACKGROUND

Three high-flow experiments (HFEs) were conducted by the U.S. Department of the Interior at Glen Canyon Dam, Arizona, in March 1996, November 2004, and March 2008. These experiments, also known as artificial or controlled floods, were scheduled releases of water from Glen Canyon Dam above powerplant capacity that were designed to mimic some aspects of pre-dam Colorado River seasonal flooding. The goal of these experiments was to determine whether high flows could be used to benefit important physical and biological resources in Glen Canyon National Recreation Area and Grand Canyon National Park that are being adversely affected by the operation of the dam. Examples of these downstream resources include native species, such as the endangered humpback chub (*Gila cypha*), sandbar habitats, cultural sites, and recreational resources. The report summarizes and synthesizes the extensive body of results published since 1996 and outlines a possible strategy for initiating future HFEs.

FINDINGS

Sediment and Sandbars

Five key sediment conclusions have important implications for designing future HFEs:

1. HFEs effectively build sandbars by transferring sand from the riverbed to sandbars either by eroding existing low-elevation sandbars or by using tributary-supplied sand.
2. HFEs conducted soon after tributary flooding accompanied by sand enrichment are effective at increasing sandbar area and volume and less likely to result in the erosion of low-elevation parts of sandbars.
3. Sandbars are rebuilt relative quickly (hours to a few days) under sand-enriched conditions but then also tend to erode quickly over days to months following an HFE.
4. Monitoring data show that sandbars erode more quickly as release volumes and daily fluctuations increase; the rate of erosion is reduced when tributary sand production occurs following sandbar building.
5. From February 1996 and October 2008 many of the sandbars at long term study sites in Grand Canyon experienced slight increases in size (both area and volume) over that period despite ongoing erosion of the deposits. This increase occurred during a period of variable basin hydrology which included 6 years of above annual minimum releases and 7 years of minimum annual releases.

Figure 3: Example of a Professional Memorandum

Letters

Letters are often your best chance to get your message to a potential client or employer. In many cases a letter is a brief transmittal or cover letter with a more detailed document, such as a resume or report. A longer letter may cover several points about a specific project.

A professional letter should contain

1. A heading
    a. For Letters give the date, and the title and address of the recipient,
    b. For emails confirm your target company, "Regarding: Company Name Job Search
2. An appropriate greeting using Mr. or Ms. with last name (avoid generic greetings),
3. A concise, informative body, usually ending with contact guidance, and
4. An appropriate closing, a signature, and your typed name, address, and contact information

The letter may be sent as a paper document, an electronic PDF attachment to an email, or increasingly as the email itself. If you have letterhead, use it when appropriate. **Figure 4** gives guidance for an emailed resume cover letter, where the date is embedded in the transmittal. The same basic guidance could be used for a paper or PDF cover letter, but with an actual signature and no subject line. **Figure 5** shows a professional letter sent to a faculty member regarding a conference.

Subject: Job Title – Application from Your Name

Employer Confirmation:
Regarding: Job Search at Company Name

Greeting (call to get the recipient's last name if not known):
Dear Mr. or Ms. Last Name:

First Paragraph:
Explain you are applying for the job as posted (specify where you saw the job posting in case they have multiple postings or are curious about their advertising effectiveness). Let them know you have read about their company and are excited by their mission and are eager to get an interview. Mention any unique contact you have with the company, such as a parent or friend working there or your geographical proximity and familiarity with their community engagement.

Middle Paragraph(s):
Describe how your experience and training match the tasks and needs identified in the job description. Make your prior experience as engaging and relevant as possible. Give specific examples of your skills, experience, accomplishments, and the value you can add to an organization. Make sure your resume clearly supports but does not simply reiterate your claims.

Conclusion:
Explain that your resume is attached to the email. Express your gratitude for the opportunity to apply for this job. Tell the employer they can reach you with the contact information given below. Assure the employer you will email or call to confirm your application status.

Closing:
Sincerely,

Name
[electronic signature]

FirstName LastName
Street Address, City, State, Zip Code
Email | Cell or Phone Number | LinkedIn

Figure 4: Example of an Email Cover Letter

NATURAL CHANNEL SYSTEMS
Adaptive Management of Stream Corridors

4th International Conference on Natural Channel Systems

August 27, 2010

Dr. Ted Endreny,
Professor and Graduate Coordinator
Department of Environmental Resources Engineering
State University of New York, College of Environmental Science & Forestry
423 Baker Labs, One Forestry Drive,
Syracuse, New York 13210-2778 USA

Dear Dr. Endreny:

This letter will confirm that you have been accepted as one of the speaker/presenters at our Natural Channel Systems Conference on Monday, September 27th during the session on Natural Channel Systems Tools for Design and Function.

Dr. Peter Ashmore indicated to the Program Committee that your expertise and knowledge of stream hydraulics and the relation of flow conditions to the hyporheic zone of streams would be germane to our focus on stream form and function and biodiversity.

The conference will have approximately 200 registrants from across Canada, the USA and England. There will likely be approximately 10 current university and/or college students attending through student registration as well as additional student helpers that will have the opportunity to attend some of the conference as well.

We look forward to your presentation at the conference.

Sincerely,

Ed Gazendam, Co-chair
4th International Natural Channel Systems Conference

Figure 5: Example of a Professional Letter

Resumes

Resumes are also called curriculum vitas (CVs) in some environments. Your resume is your chance to get an internship or a job. Make it work for you and don't let it limit you. Use a format and select the content to highlight your experience and maximize your recruitment potential.

Resumes may be formatted chronologically or functionally. For each you may also include other sections such as, Education, Skills and Clubs, Honors and Awards, and Volunteer Experience.

Chronological Resume Format

If you have had relevant job experience this format may be appropriate. List each job in chronological order, most recent first. The listing might give your title, company name, company location, and dates of employment. Below each chronological listing explain your work duties and achievements you accomplished. Within one company you can provide additional dates if they show advancement, moving from assistant to associate, for example.

Functional Resume Format

If you have had few relevant jobs but have had training and professional experience through coursework and other experiences, this format may be appropriate. Create a category titled, Engineering Skills, and below this list your specific skills and accomplishments. You want to use strong adjectives and provide useful details regarding your abilities. You may then create a separate category called Employment History where you list non-relevant jobs that document you have held some steady employment.

Resume examples are provided in **Figure 6**, **Figure 7**, and **Figure 8**.

Joe Surveyor

School Address
794 Ackerman Avenue
Syracuse, NY 13210

jsurveyo@syr.edu
315.555.7777

Permanent Address
175 Willow Road
Mytown, NY 12345

EDUCATION

State University of New York College of Environmental Science and Forestry, Syracuse NY
Bachelor of Science, Environmental Resources and Forest Engineering, expected graduation: May 2010

Academic Awards
ESF Foundation Award 2006, ESF College Scholarship 2005-06, Henry H. Buckley Student Scholarship 2004, William Washburn Optimist Scholarship 2004, Project Lead the Way Engineering Scholarship 2004

Related Coursework
Mechanics of Materials, Engineering Graphics, Fluid Mechanics, Surveying, Thermodynamics, Hydrology and Hydraulics, Remote Sensing, Storm Water Management, Engineering Decision Analysis, Geotechnical Engineering, Structures

WORK EXPERIENCE

Civil Engineering Intern, City of Syracuse *Summer 2008*
- Surveying and reduction of surveying calculations
- Installation and collection of data from flow meters in sewers
- Locating and inspecting manholes, catch basins and storm sewer outfalls
- Inspection of paving, storm and sanitary construction projects
- AutoCAD drawings of paving projects

Research Assistant, New York Water Environment Association (*Syracuse, NY)* *Spring 2008-present*
- Gather, update and organize data from Association members
- Archive articles in *Clearwaters* magazine

Assistant Coach, Bill Jones Youth Ski League (*Syracuse, NY)* *Fall 2007-present*
- Teach cross country skiing to young children and teenagers in groups of 15 or more

Peer Tutor, SUNY ESF (*Syracuse, NY)* *Fall 2008-present*
- Tutor undergraduate students in the principles of economics and chemistry

Mapping Intern, Monroe County Department of Planning (*Syracuse, NY)* *Summer 2007*
- Located and qualitatively analyzed condition of sanitary and storm water manholes and lines
- Utilized high quality GPS units to plot location of manholes
- Created ArcGIS maps of locations and flow of sanitary manholes and lines
- Placed traffic counters on roads and retrieved information about their use

Carpenter Apprentice, Smith Construction (*Syracuse, NY)* *Summer 2007*
- Demolition of exterior/interior walls
- Repair and replacement of roofs, floors, siding, drywall and trim

SKILLS

Proficient in Mathcad, AutoCAD, MATLAB, ArcGIS, and Microsoft Office
Eagle Scout, Boy Scouts of America

ACTIVITIES

Syracuse University Ski Team (Captain)
SUNY ESF Engineering Resources Engineering Club
SUNY ESF Cross Country Team

Figure 6: Example of Resume with Chronological Listing

Joe Surveyor

E-mail: surveyor@hotmail.com 30 Jones Rd
Cell: (515) 555-7777 Syracuse, NY 13601

Education

B.S., **Environmental Resources and Forest Engineering**, anticipated December 2009
State University of New York, College of Environmental Science and Forestry
Syracuse, NY, Current GPA: 3.7

Experience

Highway Safety Research Intern, June – August 2010
Research Experience for Undergraduates, National Science Foundation Grant
Syracuse State University – Transportation Institute, Syracuse NY

Worked on a team to understand driver's speed selection in hazardous conditions

- Researched and evaluated methods of measuring driver speed
- Manually installed speed tubes and traffic counters to record driver speed
- Worked with mentor to analyze and interpret data
- Developed a scientific report and presentation on findings

Research Hydrologist Intern, June – August 2009
Research Experience for Undergraduates, National Science Foundation Grant
US Forest Service, Crystal Stream Research Foundation
Syracuse State University, Syracuse NY

Independent research on stream channel connectivity over time

- Conducted extensive field surveys for input into GIS layers
- Developed watershed maps, as part of interdisciplinary team, relating landscape characteristics to flow frequencies
- Worked with USGS site in Vermont to make past and current research at site more accessible to public

Buffet Attendant/Short-order Cook, October 2009 – ongoing
Syracuse University Food Services – Syracuse NY

- Promptly and accurately followed directions in a fast paced environment
- Acted as liaison between customers and management
- Closed food prep and serving areas nightly

Property Maintenance Technician, summer 2005 – 2007, 2009
Young Associates Ltd – Syracuse NY

- Worked as part of 20+ member team maintaining three apartment complexes and over 50 commercial properties
- Often given responsibility of accomplishing job independently
- Maintained an immaculate attendance record

Leadership and Service

Environmental Resources Engineering Club, 2005 – 2007

Figure 7: 2nd Example of a Resume with Chronological Listing

Joe Engineer

(000)111-2222 ■ 00 Forestry Dr. Syracuse, NY 13210 ■ engineer@syr.edu

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Objective

To earn an entry-level engineering position at a consulting firm that is focused on environmental resource management and restoration.

Education

SUNY College of Environmental Science and Forestry (SUNY ESF) GPA: 4.0
Syracuse, NY
Enrolled in a B.S. program for Environmental Resource and Forest Engineering in August, 2007.
76 Credit Hours Passed at SUNY-ESF, 26 Standing Credit

Work Experience

Sycamore Associates, LLC Ithaca, NY May–Aug. 2009
Intern – Environmental Group

- Conducted environmental analysis on sites with soils and groundwater containing USEPA and NYSDEC contaminants.
- Compiled reports summarizing the results or the analysis including figures generated using ArcGIS mapping software.
- Assisted in the office with traditional intern paperwork.

Green Infrastructure and Green Collar Jobs Rochester, NY Apr.–Sep. 2010
Website Developer

- Developed a biorentention design calculator based on existing nation-wide precipitation and soil databases as well as site-specific Google Maps area remotely sensed data.
- Designed and coded website describing Low Impact Development opportunities for stormwater management.

Additional Activities

SUNY ESF Chapter of Engineers Without Borders Dec. 2007-Present
President: 2010-Present, Secretary: 2007-2009

- Coordinated the design, fundraising, and initial implementation efforts of a community water supply system in Buena Vista, Honduras.
- Organized and oversaw domestic stormwater management and other service projects

Syracuse University Football Club Jul. 2007-Present
President: 2009, Social Secretary: 2007-2008

- Organized recruitment and publicity for one of the top sixteen collegiate rugby clubs in the nation.

Figure 8: 3rd Example of Resume with Chronological Listing

Reports and Research Papers

General Considerations

You will undoubtedly contribute to and author many reports or research papers during your engineering career. The report and research paper are technical documents that typically follow standard format guidelines, however the client or journal receiving your technical document may require specific adjustments.

Citations and References

Document all claims with your data or citations to other authorities. Each citation has a reference, and your technical document must use a consistent citation / reference style. Citations should account for personal communication (e.g., email, phone, etc) and websites where you obtained information. A common citation style is Chicago Manual of Style [*Purdue University*, 2011], however there are many styles specific to engineering and science, including the American Geophysical Union (AGU) style shown in **Table 1** [*AGU*, 2011]. Software tools, such as RefWorks™ or EndNote™, can manage your document citations and references and the styles.

In the text you place the citation within brackets or parenthesis [Abad et al., 2008] if it comes after a claim, as in, *"The river restoration structure changed the sediment scour location from the outer channel to the center of the channel [Abad et al., 2009]."* If you want to start the clause with the citation, pull the author out of the brackets or parenthesis but leave the date in, such as, *"Eagleson [2002] demonstrated how microclimate regulates the shape and size of tree canopies."* At the end of the report you present your complete reference for each citation, as shown below.

References:

Abad, J. D., B. L. Rhoads, I. Guneralp, and M. H. Garcia (2008), Flow Structure at Different Stages in a Meander-Bend with Bendway Weirs, *Journal of Hydraulic Engineering*, *134*(8), 1052-1063.

Eagleson, P. S. (2002), *Ecohydrology: Darwinian Expression of Vegetation Form and Function*, 443 pp., Cambridge, New York.

Table 1: Example Citations, based on American Geophysical Union Referencing Style

Source of Information	Example of Citation
Journal article	Abad, J. D., B. L. Rhoads, I. Guneralp, and M. H. Garcia (2008), Flow Structure at Different Stages in a Meander-Bend with Bendway Weirs, *Journal of Hydraulic Engineering*, *134*(8), 1052-1063.
Newspaper article	Leahy, E. (2010), Developing Syracuse, in *Syracuse City Eagle*, edited, p. 2, Eagle Newspapers, Syracuse.
Chapter in edited book	Engman, E. T. (1993), Remote Sensing, in *Handbook of Hydrology*, edited by D. R. Maidment, pp. 24.21-24.23, McGraw Hill, New York.
Book	Eagleson, P. S. (2002), *Ecohydrology: Darwinian Expression of Vegetation Form and Function*, 443 pp., Cambridge, New York.
Book, edited	Maidment, D. R. (Ed.) (1993), *Handbook of Hydrology*, McGraw-Hill, New York.
Proceedings	Feng, S., A. B. Krueger, and M. Oppenheimer (2010), Linkages among climate change, crop yields and Mexico-US cross-border migration, *Proceedings of the National Academy of Sciences*.
Dissertation/thesis	Fabian, M. (2009), Variation in Hyporheic Exchange with Discharge and Slope in a Tropical Mountain Stream, MS Thesis, 72 pp, SUNY ESF, Syracuse, NY.
Software manual	USACE (2008), HEC-RAS River Analysis System User's Manual Version 4.0*Rep. CPD-68*, U.S. Army Corps of Engineers Hydrologic Engineering Center, Davis, CA.
Website	NASA (2003), Readme for TRMM Product 3B42 (V6), edited, National Aeronautics and Space Administration. Accessed 23 April 2010, Available at: http://daac.gsfc.nasa.gov.
Federal regulation	US Congress (1999), Federal Register: Storm Water Phase II Final Rule, *Rep. Vol. 64 No. 235 #68722*, Washington, DC.
Personal Communication	Reichheld, B. (2010), NYC DEP Stream Restoration Project Plans for 2011, Personal Communication, November 2011, edited, Syracuse, NY.

Components of the Report

A formal engineering report will most likely contain the following items.

1. A cover page, with title, authors, affiliation, contact information, report number, and date
2. A forward or an executive summary and possibly acknowledgements
3. A table of contents, and a list of tables and figures with captions and page numbers
4. The body, organized in a logical manner (e.g., introduction), with headings and subheadings
5. Tables and figures placed into the body at appropriate locations to support the text
6. A list of references (See **Table 1** for examples of reference styles)
7. Optional appendices containing data supporting the findings

Components of the Research Paper

A research paper will most likely contain the following items.

1. A cover page, with title, authors, affiliation, contact information, date, and key words
2. An abstract that summarizes the research motivation, methods, results, and conclusions
3. The body, with introduction, methods, results, discussion, conclusions and any subheadings
4. A list of references (See **Table 1** for examples of reference styles)
5. A list of tables and figures with the captions (n.b. captions go above table, below figure)
6. Tables and figures placed on separate pages (1 per page) after the list of tables and figures
7. Optional appendices if ancillary data or derivations should be included to support the findings

Word-processing software packages have features to generate headings, sub-headings, page numbers, table and figure captions, and table of documents..

As you review professional reports and research papers consider how the structure of their components conveys the message to the audience. Look over technical documents of professors, engineering firms, and government agencies. In **Figure 9**, **Figure 10**, **Figure 11**, and **Figure 12** we present a report cover page, table of contents, forward, and introduction from the US Environmental Protection Agency Stormwater Management Model user's manual [*Rossman*, 2010]. Most government agencies have their reports online. Your professors publish their research reports as journal articles, which are typically peer reviewed (e.g., refereed) to ensure scientific integrity, proper grammar, and stylistic formatting. You can find these journal articles using the Moon Library journal search tools, such as Web of Science™, or by browsing the ERE faculty websites. **Figure 13** shows the first page of a refereed journal article with the title, author affiliation, abstract, and introduction.

Avoid Plagiarism

You do not of the excuse of ignorance regarding plagiarism. You must give citations and references for all sources of information in your communications. To not properly cite others' work is plagiarism. You must attribute words, ideas, interpretations, information, and knowledge that are not your own to the appropriate author or source.

EPA United States
Environmental Protection Agency

EPA/600/R-00/057
September 2000

EPANET 2

USERS MANUAL

By

Lewis A. Rossman
Water Supply and Water Resources Division
National Risk Management Research Laboratory
Cincinnati, OH 45268

NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OH 45268

Figure 9: Example Cover Page of Report

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Figure 10: Example Table of Contents of Report

FOREWORD

The U.S. Environmental Protection Agency is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory is the Agency's center for investigation of technological and management approaches for reducing risks from threats to human health and the environment. The focus of the Laboratory's research program is on methods for the prevention and control of pollution to the air, land, water, and subsurface resources; protection of water quality in public water systems; remediation of contaminated sites and ground water; and prevention and control of indoor air pollution. The goal of this research effort is to catalyze development and implementation of innovative, cost-effective environmental technologies; develop scientific and engineering information needed by EPA to support regulatory and policy decisions; and provide technical support and information transfer to ensure effective implementation of environmental regulations and strategies.

Water quality impairment due to runoff from urban and developing areas continues to be a major threat to the ecological health of our nation's waterways. The EPA Stormwater Management Model is a computer program that can assess the impacts of such runoff and evaluate the effectiveness of mitigation strategies. The modernized and updated version of the model described in this document will make it a more accessible and valuable tool for researchers and practitioners engaged in water resources and water quality planning and management.

Sally C. Gutierrez, Acting Director
National Risk Management Research Laboratory

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Figure 11: Example Forward of Report

CHAPTER 1 - INTRODUCTION

1.1 What is SWMM

The EPA Storm Water Management Model (SWMM) is a dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas. The runoff component of SWMM operates on a collection of subcatchment areas that receive precipitation and generate runoff and pollutant loads. The routing portion of SWMM transports this runoff through a system of pipes, channels, storage/treatment devices, pumps, and regulators. SWMM tracks the quantity and quality of runoff generated within each subcatchment, and the flow rate, flow depth, and quality of water in each pipe and channel during a simulation period comprised of multiple time steps.

SWMM was first developed in 1971[1] and has undergone several major upgrades since then[2]. It continues to be widely used throughout the world for planning, analysis and design related to storm water runoff, combined sewers, sanitary sewers, and other drainage systems in urban areas, with many applications in non-urban areas as well. The current edition, Version 5, is a complete re-write of the previous release. Running under Windows, SWMM 5 provides an integrated environment for editing study area input data, running hydrologic, hydraulic and water quality simulations, and viewing the results in a variety of formats. These include color-coded drainage area and conveyance system maps, time series graphs and tables, profile plots, and statistical frequency analyses.

This latest re-write of SWMM was produced by the Water Supply and Water Resources Division of the U.S. Environmental Protection Agency's National Risk Management Research Laboratory with assistance from the consulting firm of CDM, Inc

1.2 Modeling Capabilities

SWMM accounts for various hydrologic processes that produce runoff from urban areas. These include:

- time-varying rainfall
- evaporation of standing surface water
- snow accumulation and melting
- rainfall interception from depression storage
- infiltration of rainfall into unsaturated soil layers
- percolation of infiltrated water into groundwater layers
- interflow between groundwater and the drainage system
- nonlinear reservoir routing of overland flow

[1] Metcalf & Eddy, Inc., University of Florida, Water Resources Engineers, Inc. “Storm Water Management Model, Volume I – Final Report”, 11024DOC07/71, Water Quality Office, Environmental Protection Agency, Washington, DC, July 1971.
[2] Huber, W. C. and Dickinson, R.E., “Storm Water Management Model, Version 4: User’s Manual”, EPA/600/3-88/001a, Environmental Research Laboratory, U.S. Environmental Protection Agency, Athens, GA, October 1992.

Figure 12: Example Content of Report- Introduction and Body

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Short note

Monitoring soil moisture and water table height with a low-cost data logger

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1. Introduction

Comprehensive temporal data sets are often needed in geosciences to understand and model environmental phenomena. Time series data sets in the geosciences have traditionally been captured by costly commercial sensors and data loggers ($100–1000s). Dedrick et al. (2000) presented a less costly ($10 s) and publicly available device known as the Hobart and William Smith Data Logger (HWSDL) (Halfman and McKinney, 2001). Parts list, plans, schematics, manuals, software and other essential items to build your own HWS Data Loggers are available on the Internet to educators and researchers.[1] Two recent projects required adaptations of the HWS Data Logger technology to: (1) record soil moisture by incorporating a dielectric aquameter, and (2) record subsurface water levels by reworking the circuit board layout and instrument housing to fit the logger and a pressure transducer sensor into a 5 cm (2 in) diameter well.

The HWSDL includes three independent components, a logger, a sensor and a reader. The original design utilized an 8-bit digital value and had a storage capacity of 4K. An upgraded version increased the data resolution to 12-bit values and memory capacity to 16K (McKinney and Halfman, 2002). This work incorporates these upgrades into two new sensor designs. The updated logger is based on Microchip's PIC16C773 microcontroller, which digitizes and records an analog voltage from a sensor at a programmable sample period. The unit is still powered by AA and 9 V batteries. The logger stores the data in a non-volatile EEPROM (24LC256, Microchip Technologies). The system interfaces to a PC compatible computer and communication is performed through the computers RS-232 serial port to transfer sample period information and collected data. Data sets are saved on the PC as delimited text files.

A variety of sensors exist for the HWSDL system, including devices for measuring temperature, light intensity, and water pressure (see footnote 1). All sensors have a number off eatures in common. To save battery life the sensor toggles on and offby solid-state relay connected to a control line from the loggers microprocessor. The control line is turned on (+Vss) approximately 0.5 s before sample time to provide power to sensor circuit. This allows the sensor to warm up, stabilize and then provide output to the logger. It is turned off(ground) after digitizing and storing sensor output. An optional LED illuminates whenever the control line is on (Dedrick et al., 2000). Sensors transmit an analog signal to the logger, and the logger digitizes this signal as the ratio of the signal to the reference voltage (usually 5 V). This digital value is calculated as

$$\text{Digitized value}^{*}\ ¼ \left[\frac{V_{out}}{V_{ref}}\right] \times 255^{þ}, \qquad (1.1)$$

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[1]HWS Data Logger Web Site. http://academic.hws.edu/geo/logger/logger.html.

doi:10.1016/j.cageo.2005.05.009

Figure 13: Example First Page of Journal Article with Abstract & Introduction

Oral Communications

General Considerations

Oral communications include simple telephone calls, short, informal presentations within a work group, or formal presentations to students, professors, clients, or other professional audiences. You must have a clear idea of what you want to say, and how you want to say it. This takes forethought, and then practice.

Telephone Communications

A telephone call is often the first contact an engineer has with a client, and for that reason alone telephone protocol and etiquette are important. Indeed, in every telephone call you make, you are representing yourself and your organization, and you should therefore consider carefully the purpose of the call, and organize your thoughts before you call.

Begin every telephone message by introducing yourself, and stating clearly the purpose of the call. If necessary, have your questions written beforehand, to make sure you get the necessary information. Be ready to take notes, and always end by thanking the person you talked with.

Telephone calls may be recorded or logged by the company for quality control purposes. Most companies will direct you to voicemail if they are unable to receive your call. In that case you should be ready to leave a clear voicemail message and possibly try connecting at a later time.

Figure 15 below is a transcript of an student requesting help with a senior design project.

STUDENT: Hello, my name is Josephine Scholar, and I am a senior engineering student at SUNY ESF in Syracuse. If you have time, I'd like to ask you some questions pertaining to your product line and how it might relate to our senior engineering design project.

SALES REPRESENTATIVE: Ok, I've got a few minutes. Go ahead.

STUDENT: We need to specify a pump, and I wonder how we can obtain pump characteristic curves and other performance data for your products.

SALES REPRESENTATIVE: We have most of our technical data posted on our website, and some new products are coming out next week. To get more information visit the TechSpecs link on our main webpage, *www.pumpsgalore.com*. If you are online now I can walk you through this navigation to find the data you need.

STUDENT: We'll try that. Thank you very much for your time and help.

Figure 15: Example of a Telephone Conversation

Presentations

General Considerations

Engineers make presentations for many purposes, and a well designed and skillfully delivered presentation makes a very positive impression. The ability to make effective presentations, like any other skill, requires practice. We provide here some general guidelines for effective presentations, similar to those of Toastmasters International [2011]. They are: (1) know your message; (2) know your audience; (3) prepare and practice your talk; (4) arrive early to know the room and test the equipment; (5) speak at an interested but relaxed pace; (6) visualize and realize the audience wants you to succeed; (7) avoid apologizing for simple errors; and (8) smile and project confidence as you deliver your message.

Informal presentations

Even informal presentations to your classmates should have a structure. At the very least, an oral report for class should:

1. Begin with an introduction, as in ‘Hi, my name is __ and I will be talking about __ today.’
2. Be based on an outline.
3. Include visual aids, if appropriate.
4. Come to a definite conclusion. Don’t end by saying something like, ‘Well, that is all I have.’

Formal presentations

You will make many formal presentations during your career, and you will have opportunities to practice and perfect them during your program. Consider the guidelines in **Table 2** below.

Table 2: General Guidelines for Presentations

Topic	Guidance	Comments
The talk	Know your audience	Determine what and how information will interest the audience. Keep to one theme. Limit jargon and simplify technical details.
	Remember, you are the communicator	Don’t read your slides. Use slides to support your verbal message.
	Use nervousness to your advantage	Feeling nervous is good – it means you want to give a good talk. Before the talk calm yourself by preparing out loud and in front of pals. During the talk calm yourself by making eye contact (~5 s duration) with audience members or using exaggerated physical movements; both tend to relax the speaker as well as exhibit confidence. Speak clearly and do not drop volume at the end of your sentences.
	Practice your talk several times with your visuals	Visuals enable you to remember your story line. Anticipate the slide transition. Each time gets easier.
Topic	**Guidance**	**Comments**
Visual aids	Use image projector	Test the equipment 30 min or more prior to the talk to ensure functionality. Arrange to have a local technician on call to troubleshoot any problems.
	Keep it simple	Images (slides) should have a uniform look or theme. Limit text to 3-5 words/line, with a maximum of 10-15 words/slide. Use text to capture idea; use voice to embellish idea, not to repeat slide. Estimate one minute/slide with text to keep audience engaged.
	Use graphics	Visual images increase audience interest. Try to use a graphic element on at least every other slide. Free, publically available graphics are widely available. Simplify complicated drawings and diagrams, if necessary.

Opening the presentation

Begin by introducing yourself and your presentation title, if this was not done by your host. This should be in coordination with your title slide. Then transition to your next slide that motivates the presentation by relating the goal and constraints and suggesting your design solution. Consider asking the audience for feedback to gauge their familiarity with the problem or interest in the solution to the problem, and have a friendly response if you don't get the audience participation you expected. It is great if you can make them laugh at a polite and relevant ice-breaker joke.

Body of a Presentation

In scientific talks the expected order of topics and slides is: Title, Motivation, Problem Statement, Methods, Field Site, Results, Discussion, and Conclusions. In engineering design the order of topics and slides is: Goal, Constraints, Design Approach, Alternative Designs, Evaluation of Designs, Final Design, and Conclusions.

Closing the presentation

End by summarizing your talk and listing the key concluding points or findings. The adage is, tell them what you are going to say, say it, and then tell them what you said. Ask the audience if there are any questions. If the question may not have been heard by the entire audience, repeat the question for all to hear before responding. If a decision is needed from the audience on your talk, such as agreeing to your design, then explain the feedback timeline. Possibly point out the benefits to the audience for having the knowledge of your presentation.

Relate to the audience

Questions are a good way to relate to the audience. **Table 3** below provides guidelines on how to handle questions.

Table 3: Relating to Your Audience

Component of Presentation	Guidelines for Presentation
What to do with Questions	Anticipate questions. Before the talk, imagine tough, challenging, and embarrassing questions and practice answering each out loud until you feel secure. If possible, have an associate grill you. Acknowledge questions. Concentrate on the individual asking the question, possibly summarizing the question to the audience to hear. Listen between the lines to understand their motivation. Answer questions succinctly. Limit your response to allow time for more questions. Be ready to corroborate the evidence you need to support your answer. Ask questions. If a question asked of you is not clear, ask for clarification. You should also check with the audience if you are clear in your response. Admit what you do not know. No one expects you to be omniscient. You are better off saying that you do not know the answer than give an incorrect response. You can promise to get back to the person with the correction information on a certain date. Be sure to make good on your promise
What to avoid with Questions	Don't argue with anyone. State your response and end it there. The audience doesn't want a fight. Don't grade questions by telling the questioner, "Oh, that's a good question," but not telling all others that theirs are too. Simply answer the question. Don't allow one person to keep asking question after question. One or two questions from the same person is enough. Simply say, "Thanks for your interest, but let me see if others have questions." Don't begin your answer to a question with a put-down like "We all know…" or "Everyone should know…" It may unintentionally insult or embarrass the questioner. Don't put your hands on your hips while you are speaking. This may be interpreted by the audience as talking down to them.

Graphics Communications

General Considerations

Engineers use various forms of graphics to assist in communicating their ideas and concepts. We present here some guidelines to consider in preparing graphics for your written and oral communications. In every case, a good general rule is that the table, graph, or map, should have enough information to be understood as a separate item if removed from the larger report.

Tufte [2001], a master of graphics, defines graphical excellence as:

- Graphical excellence is the well-designed presentation of interesting data - a matter of *substance*, of *statistics*, and of *design*.
- Graphical excellence consists of complex ideas communicated with clarity, precision, and efficiency.
- Graphical excellence is that which gives the viewer the greatest number of ideas in the shortest time with the least ink in the smallest space.
- Graphical excellence is nearly always multivariate.

Tables

A table is a convenient way to present data. Tables need sequential numbering and an informative caption and must provide units for any numbers. When used in a report, tables should be referenced and explained in the report and not left to stand alone. For example, consider this following example in **Figure 16**, showing use of a table in the EPA SWMM manual [*Rossman*, 2010], where the text introduces varieties of weirs and then references Table 3-2.

Four varieties of weirs are available, each incorporating a different formula for computing flow across the weir as listed in Table 3-2.

Table 3-2. Available types of weirs.

Weir Type	Cross Section Shape	Flow Formula
Transverse	Rectangular	$C_w L h^{3/2}$
Side flow	Rectangular	$C_w L h^{5/3}$
V-notch	Triangular	$C_w S h^{5/2}$
Trapezoidal	Trapezoidal	$C_w L h^{3/2} + C_{ws} S h^{5/2}$

C_w = weir discharge coefficient, L = weir length, S = side slope of V-notch or trapezoidal weir, h = head difference across the weir, C_{ws} = discharge coefficient through sides of trapezoidal weir.

Figure 16: Example of Citing a Table in the Text and Formatting the Table

Graphs as Figures

A graph is means to present data as information. Use your analytical skills to ensure your graphs accurately communicate the information in the data. Consider **Figure 17** below where the EPANET manual [*Rossman*, 2000] compares the shape of four pump curves by showing four graphs in one figure.

EPANET will use a different shape of pump curve depending on the number of points supplied (see Figure 3.2):

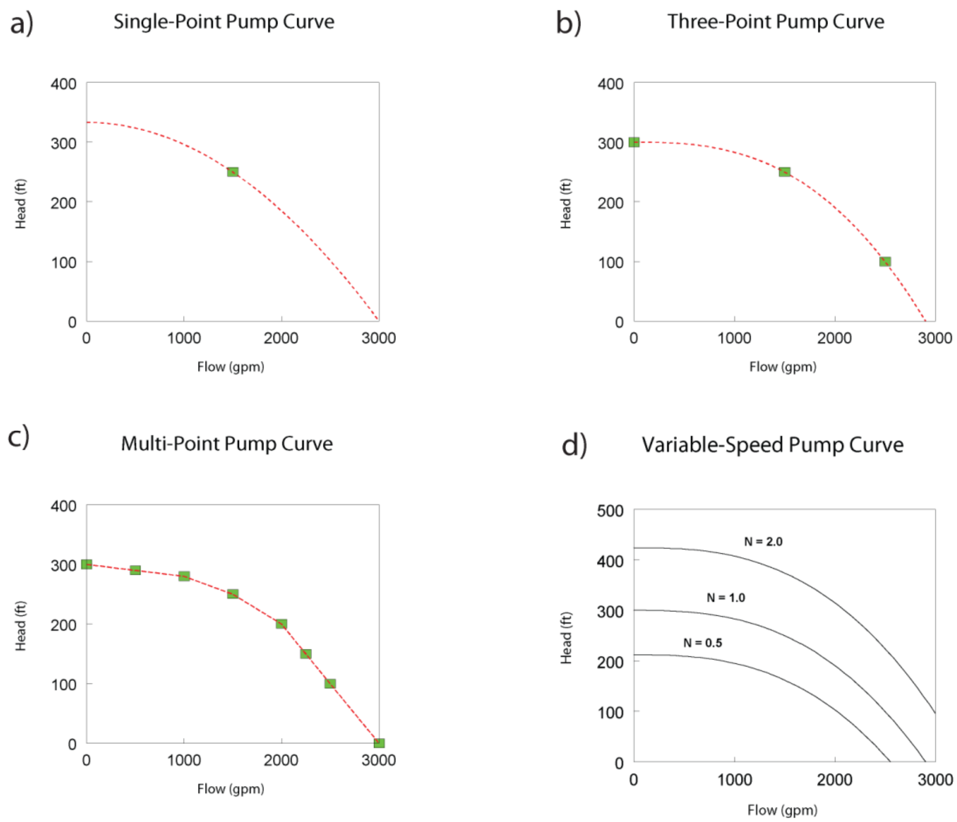

Figure 3.2 Four Example Pump Curves. a) Single-Point b) Three-Point, c) Multi-Point, and d) Variable Speed.

Figure 17: Example of Four Graphs Used to Show Curve Sensitivity to Number of Data.

Maps, Engineering Drawings, and Illustrations as Figures

Your data, ideas, and results are sometimes communicated using maps, engineering drawings, and illustrations. The craft of creating engineering drawings has a rich tradition, and the technology with which drawings are created is evolving rapidly. In your freshman year you learn computer assisted drafting and design (CADD) methods to illustrate complex systems. Later you learn geographic information system (GIS) methods to manipulate spatial data relations, often making maps. **Figure 18** below shows a map created for a watershed research report [*T A Endreny and Higgins*, 2008] that was concerned with spatial relationships. **Figure 19** shows an engineering drawing of electrical boards in a report [*Riley et al.*, 2006] on how to change their design. **Figure 20** shows an illustration created for a river restoration report [*T Endreny et al.*, 2011] to communicate the change in complexity of subsurface flow paths when a hydraulic jump is present.

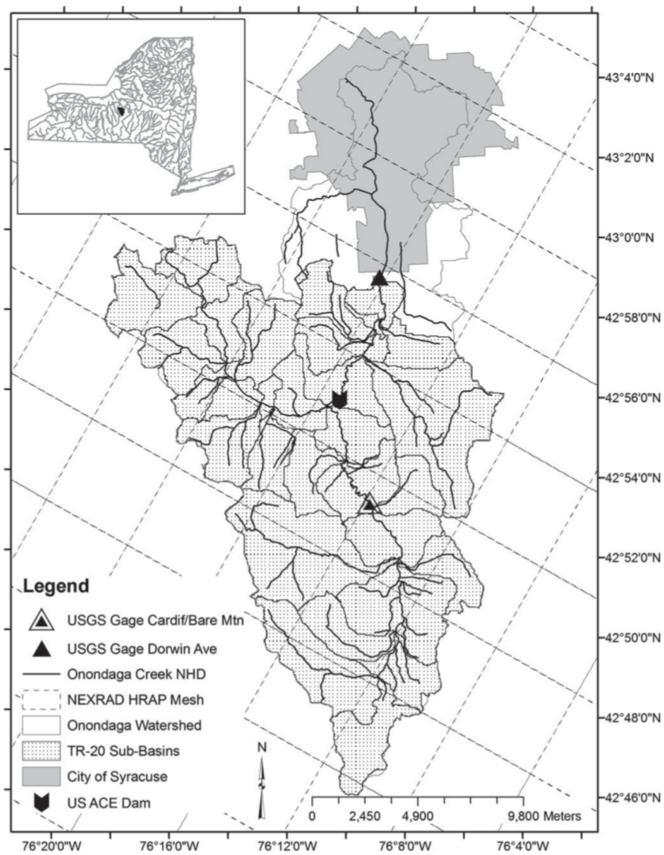

Fig. 1. Onondaga Creek Watershed, with dam, two USGS gauging stations, and City of Syracuse. Twenty-five NEXRAD HRAP bins are overlapping 30 subwatersheds. (Inset) Watershed location within New York State, and the grid around the edge has UTM zone 18 Northing and Easting coordinates.

Figure 18: Example of a Map Created in GIS for a Research Report

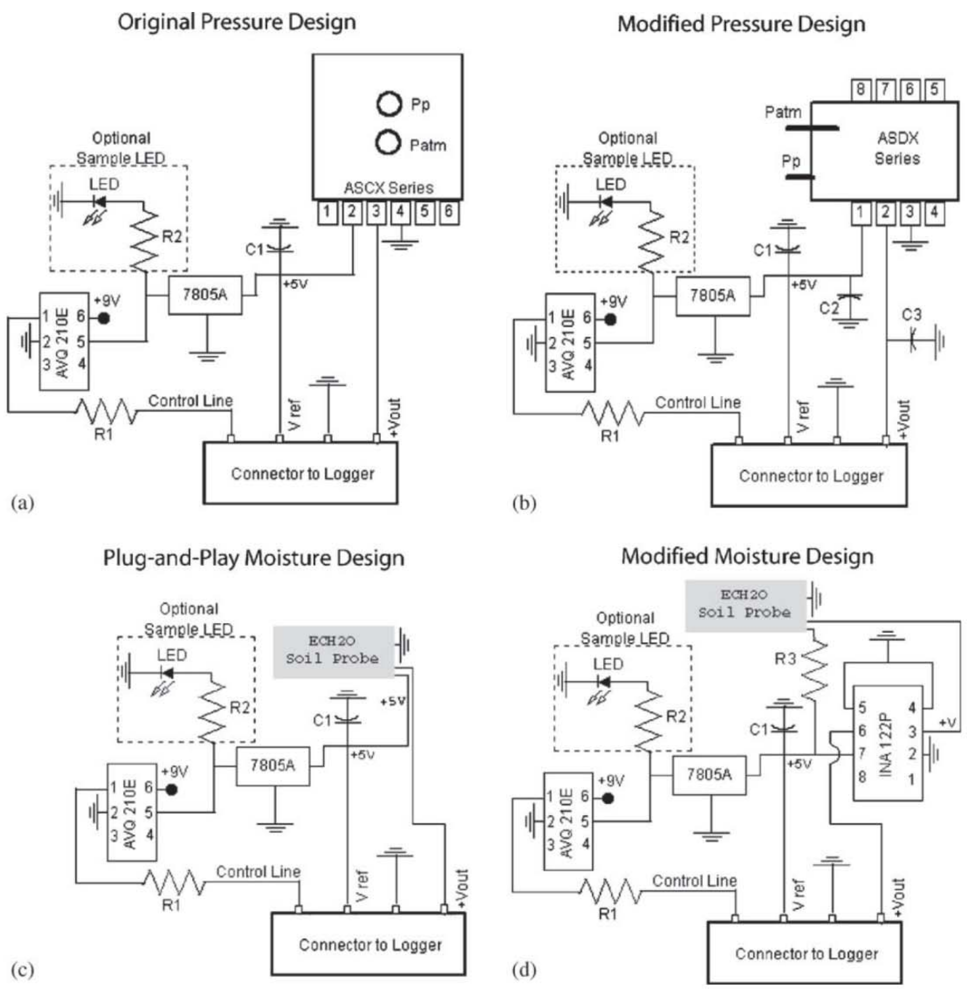

Fig. 1. HWS Data Logger sensor board (A) as it was originally created for water pressure sensing, and adaptations (B) for pressure sensing in 2-in diameter well, (C) for soil moisture sensing with little modification, and (D) for soil moisture sensing with amplification. Designs shown will work with any variable-resistance/variable-voltage sensor. Power is from separate 9 V battery, regulated to 5 V. V_{ref} is voltage reference line used to scale maximum 8/12-bit data value to 255/4096, respectively. Voltage in this line cannot exceed voltage supply to microcontroller by more than 0.3 V and has a minimum acceptable value of 3.0 V. V_{out} is data voltage from sensor to logger, which should have a maximum range from ground to V_{ref} to increase analog-to-digital resolution.

Figure 19: Example of Engineering Drawings to Communicate Sensor Board Changes

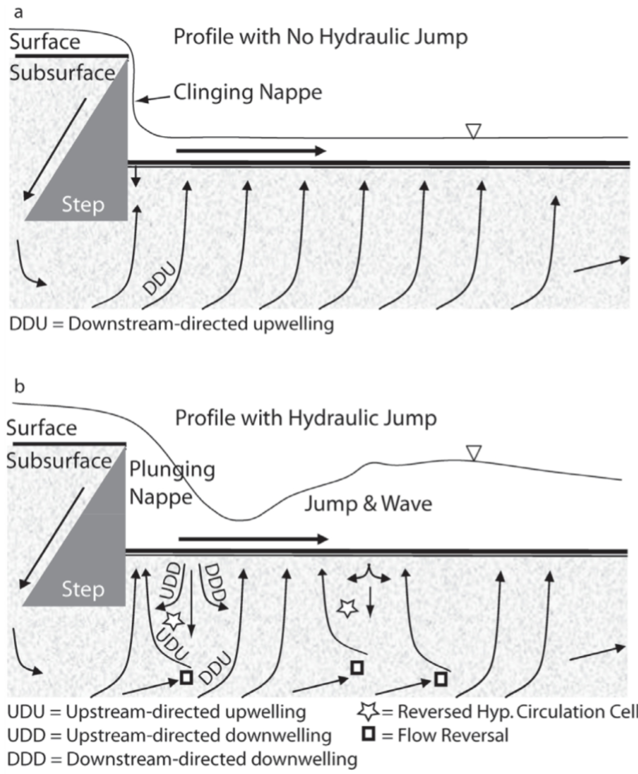

Figure 20: Example of an Illustration used to Compare the Complexity of Flow Paths

Communication in Courses

Student Practice

As students in our program you will have opportunities to learn and practice your communication skills. Below we identify some of the courses that emphasize communications skill development and practice.

- EWP 190 is a freshman course emphasizing writing; refer to **Table 4** for common grammar errors and examples
- ERE 133 is a freshman course emphasizing graphics creation, engineering design planning, and technical communication
- EWP 290 is a sophomore course emphasizing critical thinking and technical writing
- ERE 335 is a junior course emphasizing programming documentation and notebooks
- ERE 340 is a junior course emphasizing memos, lab reports, and oral presentations
- APM 395 is a senior course emphasizing data graphing and presentation
- ERE 489 is a senior course emphasizing notebook documentation, engineering reports, poster and oral presentations with engineering drawings and graphics

Table 4: Common Grammatical Errors with Notations, Meaning, and some Examples

Error	Notation	Example
Agreement	AGR	Everyone who plays the lottery has their chance to win.
Fragment	FRAG	If a dog whined for even thirty seconds.
Misplaced modifier	MM	Concentrating on his studies, the music was not even heard.
Comma splices	CS	Sports makes a person strong and brave, on the other hand, art makes a person gentle and sensitive.
Faulty pronoun reference	REF	Chris sent Bill a letter every day he was in the hospital.
Illogical predication	ILL	The double helix model of DNA is an example of hard work.
Parallel structure	//STR	I like running, cycling, and to swim.
In need of condensing	WORDY	
Rough transitions from one idea to the next	CHOPPY	
Missing point	UNCLEAR	
Tortured syntax	AWKWARD	
Fine writing	GOOD	

To gain expertise in communications you should:

1. Commit to a goal of becoming an effective communicator.
2. Develop, practice and reflect on your communications skills.

Student Portfolio

You are encouraged to keep a record of your communications products You can keep this record your work by maintaining an electronic portfolio of your reports and presentations. The portfolio may help you reflect on your learning process, it may provide an illustrated guide of communication types and styles, and it may be used as evidence of your accomplishments when you apply for internships and jobs.

Student Obligation & Faculty Feedback

We expect you to take the development of your communications skills seriously. You should be the primary editor of your writing. You will have this role through most of your professional career. It is to your advantage to practice self editing so you can independently revise and improve your communication effectiveness. As you implement self editing the ERE faculty will keep high expectations for your performance and provide meaningful feedback to help you build your skills.

The ERE courses and faculty provide you an opportunity to improve the clarity of your critical thinking and writing. The goal of our written feedback is to help you become independent in editing your own work. To that end, you may want to use the Writing Resource Center in Moon Library to work on writing issues with your work. As you practice and deliver your communications you must critically reflect on their effectiveness. As you read or listen to the communications of your classmates and others, critically reflect on their communication effectiveness and provide constructive feedback. Continually strive to improve. If you can improve communications you can improve this world.

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