DOCUMENT RESUME

ED 392 498 JC 960 162

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TITLE	Environmental Careers: A Pilot Employment Market Survey.
INSTITUTION	Merritt Coll., Oakland, Calif.
PUB DATE	15 Jun 94
NOTE	46p.; For a related document on an environmental technology transfer needs assessment, see JC 960 163.
PUB TYPE	Reports - Research/Technical (143)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Community Colleges; *Curriculum Development; Educational Planning; *Education Work Relationship; *Employer Attitudes; *Employment Opportunities; Employment Patterns; Employment Potential; *Environmental Education; Job Skills; Occupational Surveys; School Business Relationship; *Tech Prep; Two Year Colleges
IDENTIFIERS	*Merritt College CA

ABSTRACT

In June 1994, Merritt College, in Oakland, California, conducted a study to determine career employment prospects for high school graduates and community college students in programs in the college's Environmental Sciences (ES) department and tech prep program. A sample of 178 organizations from the environmental industry was developed and divided into the categories of small businesses, large businesses or corporations, non-governmental organizations or advocacy groups, non-advocacy groups, governmental organizations, research organizations, physical plant management, professional and trade societies, and listing organizations. Telephone interviews were completed with individuals at 69% of the organizations, requesting their perceptions of employment trends and needs. In general, responses indicated that there was a growth in and an ongoing demand for community college graduates in environmental industries, especially through internships and affirmative action programs. Larger government and private sector companies, however, reported less growth than smaller agencies and businesses. Job skills needed by graduates that were commonly cited by respondents included interpersonal, public contact, and teamwork abilities, as well as general understanding of technical and scientific principles and familiarity with the tools of the workplace. Recommendations for improving programs in the department include improving articulation and academic advising efforts, updating curricula, restructuring majors into a broader core with specialty options, upgrading facilities, and improving student support and program coordination. Appendixes include a description of ES programs at Merritt College, a curriculum development proposal, a progress report on the development of environmental programs at the college, and sample tech prep course selections. Contains 30 references. (TGI)

ENVIRONMENTAL CAREERS:

A Pilot Employment Market Survey

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June 15, 1994

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PURPOSE

The Environmental Careers Pilot Market Survey has been initiated to assist strategic program planning for the Merritt College Environmental Science Program in conjunction with the development of Tech Prep programming at Merritt College. The survey was funded by the Perkins Act National Tech Prep Education Program.

The survey was conducted in June 1994 in Oakland, California at the Merritt College Department of Environmental Science and at the office of the Berkeley Creators Association Educational Foundation.

The purpose of the survey is to determine course content and environmental career employment prospects for high school graduates and community college students in a Tech Prep curriculum which integrates academic course material with real world applications.

NATIONAL AND GLOBAL TRENDS IN ENVIRONMENTAL CAREERS

Historical Background

Even though stewardship of the environment has been advocated in ancient oral traditions and in the oldest written documents, large scale human enterprise, from empire building to the Industrial Revolution, has exacted a heavy toll on the world's environment. In response the notion of an environmental career is emerging.

In 19th century North America, gentleman naturalists like Emerson, Audubon, Muir, and landscape architect Olmstead responded to the loss of the landscape. They brought respect for the environment into the literature, land use politics, and designs of the privileged. In the first quarter of the 20th century, some scientists like Aldo Leopold began measuring and understanding ecosystem data, and government agencies became more involved in conservation.

By the late 1950's the educated middle class was aroused to environmental issue awareness by David Brower's publications at the Sierra Club and Rachael Carson's books. Following Carson's Silent Spring and Linus Paulings' nuclear radiation Atmospheric Test Ban Treaty, U.S. Environmental Protection laws have been enacted about 10 times as rapidly as they were in the first half of the 20th century[1]. The broad based Earth Day of 1970 and the current multi-cultural Environmental Justice movement coupled with legislation on every government level has finally brought an environmental interest to virtually every segment of the United States.

Theodore Rozak has pointed out that the news media now has a front page editorial "slot" for environmental events which 20 years ago may not have even

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[1]Greib

been mentioned[2]. In the last two decades what was originally the concern of only a few observers and naturalists has become part of the business of society.

Recent Trends in Environmental Industry Development and Labor Market

It is also generally agreed that in those same 20 years an environmental industry has established itself with remarkable speed, particularly since the 1980's[3]. In 1993 the world environmental market was estimated to be $600 billion with the U.S. share being $134 billion according to the U.S. Chamber of commerce[4]. The Organization for Economic Co-operation and Development estimates a 50% growth in demand world-wide for environmental goods and services by the year 2000[5]. Other sources have estimated the U.S. share at $120 billion in 1989, and growing to $227 billion by 1995[6]. However, since the 1993 figure was $135 billion, the $227 billion prediction appears high assuming the same base figures were used for both estimates. The Environmental Business Journal reported growth in all segments of the environmental industry. These figures translate into about 800,000 environmental jobs nationwide in the private sector at about 2.9% of the Gross National Product. More than 50% of these jobs are in smaller companies. The majority of these figures are for waste management and pollution control because other fields now recognized as part of the environmental enterprise are still either categorized under diverse headings such as agriculture or are poorly documented as in the non-profit or small business sectors. For example Resources Information Products 1994 mailing list for Ecology/Environmental Activists and Organizations has 19,300 entries and the 1987 Harbinger File lists over 900 organizations in California, most of which would not appear in environmental employment statistics, although they obviously provided a significant employment base.

The California portion of the for profit industry in 1993 was reported to be $20 billion or about 180,000 employees[7]. Nationally, the public sector may spend a similar amount[8]. In 1990, the US Environmental Protection Agency (which itself employs over 14,000 people) estimated that the environmental field expanded as much as 40% a year since 1985.

In totaling direct and indirect employment from pollution control, the Worldwatch Institute estimated 3 million jobs were created while increased regulations caused or partially caused fewer than 5% of plant closings for a loss of 33,000 jobs during the same period. The same report suggests that, at least in the start up phase of resource conservation or pollution reduction, many more jobs are

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[2]Rozak
[3]Lovegreen; E.C.O.
[4]Lovegreen
[5]OPW
[6]*In Business*
[7]Lovegreen
[8]Worldwatch Institute

created than lost[9]. For example, aluminum recycling is twice as labor intensive as virgin aluminum production and biomass energy production such as ethanol fuel from corn crops produces a net gain of 55% in jobs over the same amount of fossil fuel production. Recycling solid waste produces about ten times the number of jobs as do landfills. Residential weatherization creates more jobs per dollar than any other capital project.

Nationally and globally, all industries and governments are including environmental planning to some extent in their projections. International markets are now expected to grow faster than the U. S. industry.

The U.S. environmental business is maturing and beginning to stabilize its expenditures[10]. 65% of remediation funds in 1991 were spent by private industry. The multi-billion dollar Department of Defense and Department of Energy and Clean Air Act clean-up projects such as Base Closures are anticipated to create a boost in employment as they are instituted.

However, even with discrepancies in how data is gathered and interpreted, most observers agree that environment related work has unquestionably grown in a decade when the global economy has shrunk. While large corporate employers have reported 600,000 U.S. layoffs in the first quarter of 1994[11], small environmental firms are described as either growing or remaining stable[12].

While the remediation or cleanup industry is expected to grow internationally, sustainable industries (e.g. renewable energy, landscape restoration, organic agriculture) are being predicted as the growth industries for the U.S. economy[13]. This is consistent with Miller's hierarchy of environmental awareness which begins sequentially with conservation of resources (in order to exploit them) and preservation of scenic areas, then moves to pollution cleanup, to control of over consumption and overpopulation, to technical fixes of "spaceship earth" such as elaborate pollution control devices, and finally to impact reduction based on an ecosystem understanding of sustainable planning coupled with environmental restoration. As thinkers are extending the theoretical envelope, the economy appears to be entering the sequence at the clean-up level. As might be expected, the funding and employment market is largest at the beginning of this scale which Miller has put forth in his widely used Environmental Studies text, Living in the Environment. Thus, the largest employers are in resource conservation and pollution control.

Although environmental industry growth during the 1980's has been largely driven by legislated regulations, there is immense potential for an investment-motivated growth of sustainable industries in energy, environmental housing, urban and industrial design, and in agriculture. Environmentally sustainable pro-

[9]Worldwatch Institute
[10]Lovegreen
[11]Gellnor
[12]Lovegreen, OPW
[13]OPW, Worldwatch

duction of goods and energy should also prove more economically stable than regulatory compliance alone which is generally perceived as an expense which yields no income.

Much of global capital is directly related to electrical energy. This investment will increase as the large, less industrial populations become more industrialized. If these new demands both in the U.S. and abroad, are met by the more diverse and decentralized energy sources which also tend to be more labor intensive than fossil fuel production, the labor market will increase. Currently, 1.4% of the U.S. labor force works in conventional energy production. As energy conservation and renewable sources are developed, this sector of the workforce should increase between 2 to 10 times its current level[14]. Energy management has already become a mature industry since its first boost during the energy crisis.

Transportation and building energy conservation is now being driven in part by the Clean Air Act emissions requirements and in part by cost savings and local legislation. In the mid 1970's, conventional energy planners predicted 135 quadrillion British Thermal Units (Quads) of annual energy use by 1990. In fact only 83 Quads were used. This 40% savings was accomplished by energy management and energy efficiency professionals and technicians[15].

Patterns of land use planning are going to tend towards decentralization or localizing energy production, transportation, and food production. It is estimated that half of the industrialized world's energy use is caused by transportation required by distant placement of work from homes and from resources[16]. For example, urban agriculture and rooftop photo voltaic electric generation provide food, energy, and employment at the point of use.

Negative health effects and psychological stress are also associated with high energy and chemical input patterns. "Sustainable" development is countering this trend. For instance, organic farming which uses no chemical fertilizers or pesticides is the fastest growing sector of U.S. agriculture. Environmental design professionals are organizing to meet these new requirements as well as those of less toxic and ecologically damaging materials. The American Institute of Architects has been forming national and local Committees on the Environment (COTEs) to research and publish technical data on this shift toward environmentally sound architecture. The building industry is marketing new, lower impact alternative construction materials.

Unbuilt open spaces are being more intensively managed and their landscapes are being restored with native stream courses and vegetation. The California Department of Water Resources Urban Streams Program has provided the model for national restoration legislation. There are 740 land trusts in the private sector of the U.S. and public open space bonds are being passed regularly. Urban forests total more acreage than all of the holdings of the U. S. Forest Ser-

[14]Worldwatch 104
[15]Worldwatch
[16]Worldwatch 100

vice. There is a high rate of retirement amongst foresters and enrollment in undergraduate forestry programs has declined 50% since the 1975 peak, thus leaving an improving job market[17].

College Environmental Studies faculty are reporting that their programs are full and other departments are re-orienting some of their courses towards environmental themes[18]. The Environmental Studies Department at San Jose State University has the second highest employment placement record on that campus.

In sum, although the global economy has declined steadily since the 1970's and California's economy is only slowly recovering from the recession, the U.S. environmental economy has stabilized in some areas and is growing in others while the world environmental trade is expected to grow dramatically. The environment now occupies a substantial market share and a stable place in the general infrastructure. The mature industries will provide a constant supply of employment opportunities through attrition[19]. Growth industries, although more volatile will continue to provide added bursts of employment. Thus, U.S. and global employment markets in the Merritt College Tech Prep Cluster areas being considered (pollution control, land management and restoration, and environmental systems design and energy management) appear to be well positioned to provide realistic and diverse employment pathways in an otherwise shrinking economy.

CAREER CLUSTERS AND MERRITT COLLEGE MAJORS

This study takes a preliminary look at three groups or "clusters" (Tech Prep) of environmental work which are both established in the San Francisco Bay Area and for which Merritt College Department of Environmental Science has approved majors. These majors are Environmental Hazardous Material Technology (EHMT), Environmental Management and Restoration Technology (EMART), and Environmental Design and Energy Technology (ETECH).

The concept of a cluster of related job titles is timely because Americans are changing jobs more often than they have in the past. Skills learned in one specific setting need to be understood in their general character so they can be transferred to other workplaces.

This is especially true for environmental careers because the field is new, changing rapidly and by nature its areas if specialty are interconnected in systems. For example, work in energy also requires an understanding of air and water quality, and land use.

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[17]Waterfront Age
[18]Consortium
[19]Bolles, Lovegreen

"Career Pathways" are the options open to an individual to enter into environmental employment through education and training and then to be able to move horizontally from one related area to another and also to move vertically from an entry level position to a more senior position.

SURVEY PROBLEM STATEMENT AND SAMPLE SELECTION

The sample universe list was drawn from resources in the collection of the Merritt College Environmental Careers Course taught by Robin Freeman. Potential informants were selected on the basis that they had chosen to list or advertise in a venue accessible to those interested in the environmental industry, thus biasing the sample towards those more likely to respond favorably to being interviewed and to possible subsequent contact from students and college personnel.

The sample was organized into 9 cohorts or categories by type or size of organization or business. The sample was further prioritized by local area codes and a reasonable chance of interviewing someone knowledgeable who was known, or the organization was small enough that there would not be extensive telephone transfers or other delays. The telephone interviewers, themselves environmental science students or faculty were instructed to then choose respondents which interested them. If respondents were busy, interviewers used a shortened form of the questionnaire.

Topics: Problem: 1) What is the employment trend in the Bay Area in pollution management, energy management and environmental design, and land management and restoration including metropolitan food systems and agroforestry? 2) Are there, or could there be, positions for secondary school and community college students or graduates?

Null Hypotheses: 1) There will not be enough entry level environmental job openings in the Bay Area to hire students from EMART, EHMT, and ETECH at Merritt College 2) There will not be enough potential employers who are willing to provide information on the skills required for employment.

RESULTS

Universe Sample List Draft #3	178 entries 9 cohorts
Interviews Attempted	67
Interviews Completed	46
Completion Rate	69%
30% long interviews	
70% short interviews	
% of Universe Selected for Pilot Study	38%

PRIMARY SOURCES:
Cohort #1 Small Businesses
12 respondents

This group showed a balanced mix of career clusters in EMART, EHMT, and ETECH. About half provide services locally with the remainder functioning nationally and one internationally. The average age of these businesses was 19 years and they employ an average of 15 people with the median being 10 (i.e. half more and half fewer) About half have either hired recently or expect to soon. One third hire from college searches, a third from word of mouth referrals, and the remainder includes resumes and newspaper ads. One quarter of those who replied reported a low to moderate ethnic mix in their workforce. 80% of those who answered the question described a low turnover rate in their employees. 91% will hire Community College (CC) graduates and 2/3 will hire high school graduates or students. Over half stress communication, writing, and marketing skills and the same portion also look for technical scientific skills and one third want some drafting training. About half of respondents mention that a willingness to learn is important. 27% suggested students should have some business skills and 64% specifically require some computer literacy including a variety of spreadsheets and word processing. 18% use Auto CAD (computer assisted design). The median entry level salary is $20,000/yr. 50% report a low to moderate growth while 33% have remained stable and 17% have become smaller. All of those who responded to this question predicted growth in their field overall. They generally reported that economic trends, legislation, government programs, and environmental trends affect their size. Almost half of the respondents were aware of the Merritt Environmental Science program.

Cohort #2 Large Business and Corporate
4 respondents and one published employment description

This group was also evenly balanced among the three clusters or majors. Environmental consultants, Public Utilities, and a Biotech firm were represented. The median age was about 25 years in business. They had an average of 25,000 employees, over a range of 85 to 75,000. They reported 60 to 70% technician level employees. One corporation reports a hiring freeze while another has recently hired and plans to hire more. They expect to hire financial and technical employees. They locate applicants from college recruiting, newspaper ads, and referrals. They report having a moderate ethnic mix. One reported having an affirmative action program. They all employ CC graduates and some high school students.

They all value interpersonal or team negotiating skills, hands on field experience, writing, math, and computer literacy in word processing, data and spreadsheet and 25% would like Arc Info (a computer mapping program or geographic infor-

mation system) experience. The pay is $20,000/yr plus benefits and up for the entering technician level. One firm suggested developing multiple skills. The smallest firm reports growth while the largest has a hiring freeze. None of the respondents themselves had heard of Merritt's environmental programs.

Cohort #3 Non-Governmental Organizations (NGO's), Advocacy (activities including electoral lobbying).
3 respondents

This cohort was also balanced between the clusters. The respondents were largely for public awareness and opinion influence in purpose. Their average age was 18 years with about 10 employees. They all had recent hires and expect to hire in the future. 2/3 advertise in Opportunity NOCS and also use college mailings and word of mouth referrals. They report a low level of multi-cultural mix and a high turnover of employees. All those replying will hire CC graduates and half will hire high school students. They emphasize teamwork and networking skills along with a broad range of general knowledge, such as a Liberal Arts degree. Salaries began at $17,000 to 18,000/yr, and 2/3 were aware of Merritt College environmental programs.

Cohort #4 NGO, Non Advocacy (organization does not lobby).
1 respondent (The Nature Conservancy)

This organization operates in California with 150 employees and 18 interns. They hire from an "outreach" list and seek to increase their ethnic diversity. They will employ CC grads and look for teamwork and the ability to work with the public and flexibility. They suggested a Biological Sciences background. The size of the organization is dependent on government funding. They had not heard of Merritt College.

Cohort #5 Governmental Organizations
8 respondents

Although all three career clusters were represented, most of the respondents were EMART oriented. The group included various public services in resources and land management and some utilities. All have mandated service areas in the Bay Area and most are over 60 years of age. 1,500 employees is the median. The East Bay Regional Park District hires 200 summer interns and the US Geologic Survey has 2,000 to 3,000 technician level employees. They have a Federal downsizing hiring freeze which allows them to hire students only. 63% of this cohort report recent and anticipated hiring. They hire through college recruiting, EDD, Cpportunity NOCS and their personnel offices. They report a moderate ethnic diversity and the 3 largest have affirmative action programs. Most will hire CC and HS grads and a few will hire HS students. They suggest skills in public contact, writing, hand tool use, word processing, Auto CAD, field sampling skills, first aid, biological science and chemistry. They are affected by government

trends and 50% were aware of Merritt's environmental majors largely through their having members on Merritt's environmental advisory boards.

Cohort #6 Research Organizations
3 respondents

Two out of the three contacted hire CC grads and HS students, especially those with scientific training. The third is a senior level policy funding organization, and hires primarily advanced degree scientists. All have a national service area, and have been in existence for over 30 years. One hires numerous technicians among its 3,000 employees, and publishes a weekly employment opportunity bulletin. One reported having an affirmative action program. The two respondents which hire CC graduates or lower suggested chemistry, electronics, engineering, regulatory negotiation and hazardous materials management, and experience as important background areas.

Cohort #7 Physical Plant Management
1 respondent (Stanford University)

This Energy Resources organization had 7 employees and will hire CC grads and train them on the job at a salary of $18,000 to $20,00/yr.. Applicants need basic technical math, writing and computer skills.

SECONDARY SOURCES:
Cohort #8 Professional and Trade Societies
8 sources

These were mostly EMART related clusters, though all three were represented. 87.5% are national or international organizations, and 100% have publications. They were an average of 27 years old with an average membership of 3,240 and average growth rate of 17% a year. They hire only a few organizational staff themselves and generally not in the Bay Area. However, their membership includes many Bay Area environmental employers. Their publications list job openings, and their meetings and conferences provide empioyment contacts and insight into current training and technology. The California Association of Environmental Professionals has 1,400 members, 300 of whom are in the Bay Area.

Cohort #9 Listing Organizations
8 sources

The employment listing publications in this sample have a range of 3,200 to 28,000 subscribers nationwide. One organization reported a decrease in listings of 50% during the recession and that their listings have stabilized at that level. Another organization reports a 50% annual growth in its publicly available listings.

The Employment Development Department Labor Market Information service publishes Occupational Outlook for Alameda County. They have no jobs with "environment" in their titles or in the cluster headings. There may be environmental jobs in "Manufacturing and Other Related Industries" under Chemical, Biological, Agricultural technicians and technologists-except health. This corroborates what Dr. Ray suggested that in the mainstream listing data bases one would have to search by description of duties rather than title. However, the EDD office in Hayward did list 15 technician level jobs in an inquiry posted 2/93. These jobs were for the US Forest Service and paid $6.50 to $8.50/hr. They called for map reading, compass, map drawing, computer operation, surveying and plant, water, forest, insect, fish and wildlife sampling and use of identification keys, nursery, tree and habitat and fire maintenance hand work, supervision of small crews, and they have an affirmative action program.

In 1985, San Francisco Focus magazine reported some 200 "Boutique" small, often organic farms in California. In 1994 the Ecology Center in Berkeley which hosts 50 farmers at its markets three times a week, cites a membership in the California Certified Organic Farmers (CCOF) of 750 member farms mostly in Northern California with other certifying organizations in Southern California. The membership is expected to grow more after federal law in 1995 will require both government registration and certification by a third party such as CCOF to qualify as an organic farm.

A 1992 survey of 43 hazardous materials generating businesses conducted by Merritt College showed that these mostly industrial companies have hazardous materials employees especially in the medium to larger firms. 25% have 25 or more employees working with these materials. 54% of the firms expect to hire 1 to 5 HAZMAT technicians in the next five years. 83% express a need for HAZMAT courses given locally and 74% would send their employees to a Community College for training.

The Oakland Naval Air Station Job-TRACK listed 3 City and County EHMT openings as of 5/94, 2 of which will hire CC grads.

The federally published Directory of Environmental Information has 1,700 resource listings, 250 of which are environmental newsletters, 140 are databases, and 150 are trade, professional , and scientific organizations.

In spite of substantial growth, environmental careers are still new enough that the standard labor statistics have not yet classified them under their own heading. The Government Information Services (GIS) library at the University of California in Berkeley has the Bureau of Labor Statistics (BLS) Directory and also the Dictionary of Occupational Titles which list only "Environmental Engineer". This title and "Ecologist" may be the oldest environmental job titles. Most of the environmental field is not listed as such in these publications yet. However, there is a separate Directory of Environmental Industries and Markets at the GIS library.

In a Dialogue Database search conducted 6/94 by consulting labor and employment statistician Dr. Rose Ray, no specific "environmental jobs" were pulled up

when a general search under benchmark or standard job titles was conducted. Dr. Ray suggested that in these large general statistical listings, environmental jobs would have to be identified by description of tasks performed. The BLS search did not even list environmental engineers as a category. Thus environmental employment statistics are best found in the environmental literature itself.

INTERNSHIPS AND CO-OPS: ENTERING THE JOB MARKET

Most reports describe the new jobs as opening up in local agencies and businesses; however several Federal and State agencies are also recruiting for their Affirmative Action programs. Entry level jobs are reported as being available for technicians doing the field work of sampling and data collection, installation, maintenance, and support services. These jobs begin at the $15,000 to $22,000 range and, like the more senior positions, employers want applicants who have a technical background in their specialty, but are also familiar with several related areas, since all environmental work interrelates and firms must be able to move quickly between sub-specialties as demands change. Those individuals who wish to work in any supervisory position or as project managers need to be generalists with both technical understanding and strong Liberal Arts skills in writing, interpersonal communication and a willingness to take responsibility to solve problems in technical and business arenas.

All sectors report that, in addition to education and experience, enthusiasm and direct personal contact are most important in successfully being hired. Career professionals[20] warn against choosing a field simply because it appears to have the most openings. Job application by numerical rather than a personal analysis accounts for fewer than 10% of placements. For example, only one placement results on average from 1,470 mailed resumes. Since 80% of Americans report substantial dissatisfaction with their work, careful matching of one's own skills and interest preferences with a job type by means of classes, internships, volunteering, or short term or part time jobs is recommended as gleaning both the highest rate of enthusiasm and placement[21]. Fortunately, these opportunities are standard practice in most environmental industries, professions., and educational programs.

Several Bay Area agencies have programs designed especially for hiring students and those newly entering the environmental field. There are also programs for recruiting from under-represented populations. Programs have various names such as internships, co-op education, summer interns, affirmative action, multi-cultural, volunteer and docent programs. Some are paid like the National Parks Service Ranger Intake Program, the Student Conservation Association internships, the Environmental Careers Organizations internships, the East Bay Municipal Utilities District (EBMUD) and the East Bay Regional Park District (EBRPD) and Pacific Gas and Electric's (P.G. & E.) summer internships and co-ops. Some are career ladder entry points such as EBMUD's Affirmative Action program in the engineering track or the United States Forest Service's Com-

[20]Bolles, E.C.O.
[21]Consortium, Bolles, E.C.O.

mencement 2000 program which also ties into a primary through college education "pipeline".

These paid entry programs, especially in national organizations, generally are competitive and have relatively few placements. For instance, the Student Conservation Association placed only 6 people from California in 1993.

Local programs such as EBRPD, the East Bay Conservation Corps, and the California Conservation Corps are more accessible. However, unless a program is specifically a career ladder entry point, it will typically be limited in time from one or two months to a year and does not necessarily lead to further employment at that agency.

Most college Environmental Studies programs require internships. In addition to the industry programs, these college internships are filled by a wide range of internship opportunities which are arranged informally through direct contact or "networking". These contacts which are made through shorter volunteer efforts, site visits, telephone conversations, workshops, classes, conferences, and professional and trade organizations are repeatedly mentioned as fruitful paths towards employment.

There are also numerous volunteer opportunities both in non-profit organizations and Government agencies such as the Volunteers in Science program at the United States Geologic Service or volunteer interpretive programs in national and other parks. These often lead to employment opportunities.

CONCLUSIONS

Problem Topics and Null Hypothesis

1) National literature and local respondents both report growth in environmental industries. The employment trend in this pilot study for the Bay Area coincides with the trends reported in the environmental literature. In the three employment group clusters surveyed, stable size or modest growth was recorded for approximately the last two years after a short period of little growth or size reduction, which in turn followed a decade of rapid growth. Most respondents predict more growth in the future. The larger government and private sector corporations are growing the least while growth is found in smaller government agencies and smaller businesses.

2) 71% of all respondents hire community college graduates and many are willing to hire high school and community college students.

3) Because of growth, attrition, and intern and affirmative action programs as well as a substantial ratio of technician to senior staff there is and will be an ongoing demand for employees with EMART, EHMT, and ETECH cluster training.

4) The Bay Area environmental industry responded with willingness to provide information to environmental educators. There was a high rate of response to our survey (69%), and some 90% of those who were asked were willing to comment on our curriculum content and 100% of those who were asked wished to receive a copy of the survey report. In addition, several respondents were asked if a site visit could be arranged and all of these were willing to host educators at their workplace.

In this pilot sample there was no striking difference between the related clusters of work. The greater differences were between size, and secondarily between private and public sector employers. The greatest variety and number of employment opportunities are with the smaller organizations. Larger organizations are making fewer career hires, but do have paid intern and affirmative action hiring programs, especially in the public sector.

Skills Requested By Employers

The interpersonal, public contact, teamwork, negotiating, and writing skills and the general grasp of the technical and scientific principals and basic familiarity with the tools of the workplace, hands on field methods and computer literacy as well as business concepts and general knowledge and ability to communicate across specialties, flexibility and a willingness to learn in a rapidly changing field closely resemble the goals of the "Tech Prep" experiential integrated curriculum model. They were also the goals of the early proponents of public education, most notably John Dewey.

Teaching Methods

The study did point out important implications for teaching methods. Again these are along the lines of the current Tech Prep models. They are not foreign to the sciences because of the use of laboratory settings, nor are they unfamiliar to vocational programs. They may differ most in 1) the use of real world problems to solve and 2) emphasizing problem solving over lecture and memorization. Classroom experience suggests that shifting curriculum in this direction will require more faculty/industry contact and teaching methods which help the students make the transition between the traditional classroom and one which more closely resembles the workplace.

Future Studies

The data collected in the study could be enhanced and turned into industry profiles. Also, several other numerical comparisons between cohorts and, for instance, types of skills required, would be useful. The contacts suggested by the respondents should be pursued. The survey sample could be expanded to include new data and the information gathered can be used to arrange site visits, course development, and student career information and as the basis for industry

/education consortia. Respondents also suggested that some industry missions need to be expanded to include the concerns of their affirmative action recruits and that surveys should be conducted biannually, possibly the duty could be rotated among those organizations which need the surveys.

RECOMMENDATIONS

In contrast to a general trend of economic downsizing, environmental employment has grown. In response, Merritt College created an Environmental Sciences Department from merging its long standing Environmental Field Studies program with the Environmental Energy Technology program formerly at Vista College. New courses were piloted and added and the first students were graduated in the Spring of 1994. The results of this study suggest several possible actions to improve the program.

First, it appears that the general types of courses , faculty , policies, and equipment which have been assembled for the first years of the new Merritt Environmental Science Department established an appropriate direction.

Second, there is both a stable and growing environmental employment market, and Environmental Studies programs at Bay Area 4 year colleges are impacted. Since the Merritt program is new and not well known the first priority should be outreach to potential students. More work on articulation, agreements, and academic advising is needed.

Third, this review of industry and educational trends suggests some new curriculum development , some restructuring of majors, and some links with other departments, institutions, and industry.

Fourth, the environmental education and laboratory facility known as the Self Reliant House and Garden needs to be completed, from which student support and program coordination can be centralized.

Fifth, this survey should be followed up with additional contacts and with site visits. The additional contacts should be those suggested by respondents, from local listings and from local chapters of industry organizations. Site visits to employers should be arranged in order to write industry job profiles and involve advisors in our program. Finally, these recommendations should be prioritized into short and long-range sequences.

The third and fourth recommendations should be sequenced so they support enrolling new students. Each action should accomplish several of the objectives, for instance, hosting and industry meeting should provide publicity to attract new students, and it should also provide advisors, employer contact, and faculty and student information on industry trends as well as possible new faculty and educational projects or field sites.

OUTREACH

• Coordinate Merritt faculty contact with feeder high schools which serve underrepresented communities[22]. Use Tech Prep, Commencement 2000, Urban Habitat, etc. to initiate field trips, summer programs, and guest faculty exchanges through which Merritt faculty, High School faculty, and High School students meet and students can be recruited.

• Co-sponsor and host events such as organizational meetings, workshops, displays and demonstrations with professional organizations, industry, and community organizations to which the public is invited and are announced in in-house publications. For example, the Northern California chapter meeting of the Society for Ecological Restoration, or the East Bay Chapter of the American Institute of Architects Committee on the Environment workshops which have been or will be held at Merritt; apply for Earth Island Center status from the Earth Island Institute.

• Articulate the Merritt programs with four year schools and circulate course announcements and catalogs through institutions, organizations, and publications.

• Provide resources for faculty and students to attend and present papers at conferences and for publication.

CURRICULUM DEVELOPMENT

• Update and develop new courses. Use industry profiles, validated Tech Prep objectives, Survey results, and Advisory Board and Faculty recommendations for course updates and new course development. (see Appendices DACUM Resource Center Curriculum Guide for Environmental Sciences Tech Prep, also Draft Proposal of Program Revision and Expansion of Merritt Environmental Sciences, Merritt Majors description)

• Develop an accelerated customized EHMT Certificate program to meet special needs such as Base Closure re-employment and clean up requests. Otherwise adapt the existing Partnership for Environmental Technology Education (PETE) curriculum to Tech Prep objectives and Survey Results. Include an exploration of other cluster areas such as Restoration, Environmental Impact and Re-use Planning and energy technology so that certificate graduates can continue to explore other related fields as the employment market changes.

• Update, revise, and streamline ETECH program to include separate Energy and Environmental Design options. Include information from Survey Results and emerging technologies such as Daylighting as per the 1994 American Solar Energy Society and Passive Solar Industries Conference.

[22]Freeman, R.

• Develop an Environmental Engineering Series as an option for the ETECH and EHMT (see DACUM) streamlined majors leading the students to a four year degree. These transfer articulations should be part of a long range plan for Merritt.

• Coordinate international trade course content with Vista College.

• Develop short introductory courses co-sponsored with industry and/or high school faculty to be used as outreach. Include summer and weekend industry site visits and field experience for both high school and adult recruitment. For example, the Merritt Watercourse Restoration and Monitoring course could work for a weekend with the Castlemont High creek restoration group, or the Environmental Design faculty could work on the design and installation of Castlemont's agriculture program. Merritt's marine biologist could lead a High School trip to a salt marsh restoration site.

• Develop entrepreneurial program content for job creation in existing clusters.

• Develop, upgrade or coordinate with other departments the following technical courses suggested by Survey Respondents:
New Courses: Environmental Chemistry and Math. **Coordinated Upgrade Courses:** Computers (including word processing, spreadsheet and database management, Geographic Information Systems computer mapping, Computer Assisted Design, and environmental and building systems predictive models). **Enhance Existing Field Courses with:** Field data and sampling in land based and marine environments, Photography, Map making and reading, Field equipment operation and maintenance including small boats. **Long Range:** Water Resources, Restoring Land and Aquatic Environments, Land and Aquatic Resource Management including Metropolitan Food Systems, Agroecology and Agroforestry.

• Develop, upgrade or coordinate the following liberal arts courses: Basic Business, Planning including environmental risk management, interpersonal communication including writing. General report, descriptive, and technical writing, **Long Range:** Urban issues/ethics/American Studies such as U.C. Conservation Resource Studies course "Race, Poverty, and the Environment", Cultural and Multi-cultural courses like the Algebra Project model, Collaborative planning and teamwork training in special courses and also integrated into teaching methods should be added into a long-range plan.

• Expand the use of campus and near campus sites (including high school campuses) as real world laboratories as per Tech Prep model. For example, Arroyo Viejo Creek adjacent to Castlemont High, The Merritt College Collaborative Planning process or the city and regional parks adjacent to Merritt's campus.

• Incorporate an "infrastructure study" (i.e. integrating study of local energy, resource, waste, supply, economic, political systems) into Lab and Planning courses.

RESTRUCTURING

- Provide specialized lab and meeting space in a completed self-reliant house for program identity and function.

- Coordinate the agriculture, forestry, and ecological landscape restoration courses with Merritt Colleges Landscape Horticulture Department by sharing existing courses between departments.

- Coordinate Environmental Design and Energy Management courses with Laney College Architectural Technology courses as needed for environmental design.

- Provide summer and weekend short courses (see Outreach).

- Provide Tech Prep professional development workshops for faculty.

- Restructure current majors and core courses into a broader core with specialty industry coordinated options similar to other Tech Prep programs.

- Provide options and training consistent with future trends predicted for the industry so graduates will have current marketable skills five years from their entering the program (Survey, Tech Scan appendix).

LINKS AND NETWORKS

- Build the Environmental Employer Advisory Board and the Affirmative Action Environmental Science Task Force.

- Coordinate field methods courses with Environmental Studies Consortia networks for exchange access to off-campus field sites. (also see facilities and equipment)

- Coordinate programs with outdoor Challenge and confidence building courses such as boatbuilding and Outward Bound (see Innovation Abstracts, Woodenboat).

- Should be articulated in high schools.

- Complete the Guide to Northern California Environmental Studies Programs.

- Develop an Industry Profile through faculty and student site visits.

- Co-sponsor events (see Outreach).

- Apply for Earth Island Institute Center status.

• Establish a curriculum and problem solving collaborative with industry, research, environmentalists, government, community, students, staff and faculty.

FACILITIES AND EQUIPMENT

• Move the Environmental Programs Educational and Student center of activities to the Self Reliant House and Garden Demonstration and Lab facility as soon as possible.

• Obtain energy, agriculture, daylighting, design technical tools and equipment for the Demonstration and Lab Facility.

• Look for future industrial lab space in A building as environmental engineering courses are developed.

• Share facilities with Environmental Studies Consortia, for example Marine and Aquatic pollution mitigation and ecosystem restoration field courses could add Skaggs Island wetlends and College of Marin's Bolinas Ocean Marine Lab to the creek and Lake Merritt Institute sites already in use by Merritt programs. Other schools can use our energy and agroecology and lake and creek sites.

• Purchase computer programs and field computer and measurement equipment as per Survey and industry profiles.

STUDENT SUPPORT

• Provide additional academic and career counseling with faculty and industry advisors.

• Provide transportation to campus from high school sites and to off campus field sites.

• Develop a local Environmental Employment Resource Guide for students based on this Survey and on following up the resources gathered by the survey. Include student internship reports.

• Develop a student-run job listing project with a faculty advisor. Provide regular updates.

• Initiate an alumni information and support program.

• Use the Self-Reliant House facility for a student meeting and information center.

• Develop an Environmental Sciences Student Association.

PROGRAM COORDINATION

- Study and develop long term faculty and staffing needs (also Contract and/or part-time outside funding).

- Provide logistics and administrative assistance (possibly students).

- Provide outreach, curriculum development, student services, department facilities, logistics of off site travel, networks and links, using funds for coordination shared between several positions.

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APPENDIX ONE

DESCRIPTION OF MERRITT COLLEGE ENVIRONMENTAL SCIENCE PROGRAMS

Environmental Hazardous Materials Technology (EHMT)

This program responds to the needs of employers, employees, regulators, and commercial public handlers of hazardous substances in the central Bay Area. The program can lead to either a Certificate, or to a 2-year vocational competency-based Associate in Science Degree. The program will prepare students for entry-level jobs that provide technical support on handling hazardous materials. Comprehensive objectives include providing fundamental knowledge of regulatory requirements of federal, state, and local agencies, proper handling procedures for hazardous substances, and appropriate health and safety practices. The Merritt College EHMT program is part of a statewide consortium of community colleges offering essentially the same program. This means that one can complete the certificate program at more than one consortium college with a guarantee of full transferability of the required courses.

Environmental Design Energy Management Technology (ETECH)

This two year program emphasizes energy-efficiency and ecological sustainability in the built environment. It is designed to prepare students for employment in the field of energy management, or in building design and construction, or to transfer to 4 year institutions. Opportunity is provided to link this major cooperatively with Laney College's Architectural Technology major.

Environmental Management and Restoration Technology (EMART)

This program is designed to prepare students for employment in the fields of environmental assessment, monitoring, management, and restoration. Graduates will be employed by private enterprises (a wide variety of industries and consulting firms), environmental organizations, and public agencies (parks, forests, will lands, urban and regional planning agencies, etc.). They will be hired to assess and monitor environmental quality, help prepare environmental impact reports (EIRs), assist planners and managers, and perform environmental restoration work, in urban/suburban, rural, and wildland settings.

APPENDIX TWO

UCD/DOD GRANT 6/94 MERRITT COLLEGE – NARRATIVE
FIRST YEAR ACTIVITIES Chas Ford

I Curriculum Development & Enhancement
II Delivery – Summer 1995 Workshop
III Student Internship Stipends

I Curriculum Development & Enhancement

The Merritt College Environmental Sciences Department *(MCESD)* has this month completed the third year of offering a major (an Associate in Science Degree and a Vocational Certificate) in Environmental Management and Restoration Technology (EMART). EMART is in serious need of revision. This grant project will afford the support necessary to do this swiftly, and with the opportunity to share this curriculum with other colleges.

Merritt College has signed an agreement with the Naval Aviation Depot, Alameda, CA to provide the Hazardous Materials Management Tech program (known nationally as the "P.E.T.E." Program) to up to 100 civilian employees faced with a Reduction In Force. We expect to be asked by other command units at the Alameda Naval Air Station to provide similar training.

Merritt College is in the process of developing a number of additional Environmental Technologies (ET) majors specializations that are not involved in this grant project.

MCESD PROPOSES TO (working in consort with DoD Grant Consortium):

1) Rename the Merritt College environmental program (conforming to the "PETE" consortium pattern) *"Environmental Technologies (ET)"*.
2) Expand and split the EMART major into (a) a common core of courses, and (b) create three new areas of specialization:
   - o Ecological Risk Assessment (incl. ~5 new courses),
   - o Environmental Restoration (incl. ~3 new courses), and
   - o Environmental Management (broad based "generalist" training with required courses in Business Administration–intended as preparation for entry-level management positions with environmental non-governmental organizations and with government agencies).

DRAFT PROPOSAL OF PROGRAM REVISION & EXPANSION

Common Core Courses:	Units
ENVST 11 Intro. to Sustainable Environmental Systems	3
ENVST 12 Urban Ecology	2
EMART 15 Intro. to Environmental Law	3
ENVST 16 Environmental Careers	1
ENVST 19 Environmental Writing	2
EMART 44 Environmental Impact Reports	3
*ET 17 Principles & Practices of Environ. Mgt. (NEW COURSE)	3 u.
GEOG 1 *or* Any Geology course of 3 units or more	3
CIS 205 Computer Literacy (or equal)	1
*CHEM 11 Environmental Chemistry (NEW COURSE)	5
_____ Environmental Field Studies Course/s	2
MATH 203 Intermed. Algebra	4
MATH 13 Intro to Statistics	4
*ET 29 Internship (NEW COURSE)	2-6 u.

NOTE: Cannot assure dev. of CHEM 11 – (other Dept.)

Ecological Risk Assessment — Proposed Specialized Courses (*=New; Dev. by DoD project)

BIOL 29	Biology of the Living World	4 (semester) units
ET 28	Environmental Field Methods (NEEDS REVISION)	3-5 u.
*ET xx	Intro. Geographic Information Systems	3
*ET xx	Intro. Ecological Risk Assessment	3
*ET xx	Advanced Ecol Risk Assmt.	3
*ET xx	Environmental Toxicology	3
*HORT xx	Native Plant Identification	3
*BIOL xx	Identification & Sampling of Animals in Field	3

Environmental Restoration — Proposed Specialized Courses (*=New; Dev. by DoD project)

BIOL 29	Biology of the Living World	4 (semester) units
HORT 5	Native Plants	3
*ET xx	Intro. Geographic Information Systems	3
*ET xx	Environmental Restoration	3
	CHOICE OF *THREE* OF THE FOLLOWING:	
FORESTRY 10	Intro Forest & Wildlands Conservation	3
ET 22	Restoration Landscaping	2
ET 23A-C	Restoration & Monitoring of Watercourses	2-6
*ET xx	Marsh & Wetlands Restoration	2-3
*Integrated Pest Management		2-3

Environmental Management — Proposed Specialized Courses

BUSINESS courses		9-16 units
CIS 1	Intro. to Computer Info Systems	4
*ET xx	Intro. Geographic Information Systems	3
ET xxs	_____ units of additional Env Tech (choice)	~9 u.

IN DEVELOPING THESE MAJORS, MCESD will work most closely with colleagues at DQ Univ. and at Solano College, to whom the programs will be "delivered" in the Summer 1995 Workshop.

FOR EACH OF THE THREE MAJORS SPECIALIZATIONS, MCESD WILL PRODUCE:

- A detailed curriculum description
- A sample advertising brochure

FOR EACH ET COURSE (this excludes basic subjects already in place at most colleges), MCESD WILL PRODUCE:

- A detailed course outline, based on skills objectives
- A list of text(s), other books, and other media materials (esp. Multi-media)
- Several lab or field exercises for lab and field courses.

3) Enhance laboratory and field courses by Purchasing a Limited Quantity of Lab and Field Equipment, common to Ecol. Risk Assmt, Env. Restoration, and Haz Mat Mgt. Emphasis on ENVIRONMENTAL SAMPLING and MONITORING EQUIPMENT. Also include a Multi-media Computer Station with LCD Projector, Printer, & Scanner

APPENDIX THREE

MERRITT COLLEGE

STATUS OF ENVIRONMENTAL PROGRAMS

by C. Ford & R. Freeman

(Rev. 5/94)

HORIZONTAL BAR GRAPHS INDICATE

PERCENT EXISTING and PERCENT TO BE DEVELOPED

0% 50% 100%

I. Environmental Majors Transfer Program, including 2+2+2 Programs

II. ENVIRONMENTAL SCIENCES DEPT. -- ASSOCIATE DEGREES & VOCATIONAL CERTIFICATES:

1. Environmental Management & Restoration Technology (EMART)
2. Environmental Hazardous Materials Technology (EHMT)
3. Environmental Design & Energy Technology (ETECH)
4. Human Ecology (listed under ENVST)
5. Solid Waste Management Technology (SWMT)
6. Environmental Health Technology (EHT)

III. LANDSCAPE HORTICULTURE DEPT. -- ASSOCIATE DEGREES & VOCATIONAL CERTIFICATES:

1. Landscape Gardening and Maintenance
2. Landscape Design and Construction
3. Nursery Management
4. Floral Design
5. Urban Forestry
6. Metropolitan Food Systems

IV. The Environmental Studies Field Program

V. Self-Reliant House Resources & Environment Education Center

VI. US Forest Service's "Commencement 2000" "K-Cal Pipeline" Program

VII. "Tech Prep" "Pipeline" Program (2+2+2)

VIII. Area High Schools Field Research Program/Oakland Mayor's "S.A.I.L." Program

IX. HazMat Training Program for Naval Aviation Depot - Alameda

X. David Brower/Ron Dellums Institute (at Self-Reliant House)

XI. Joint Degree/Certificate with Laney College's Engineering & Architectural Technology Program

APPENDIX 4

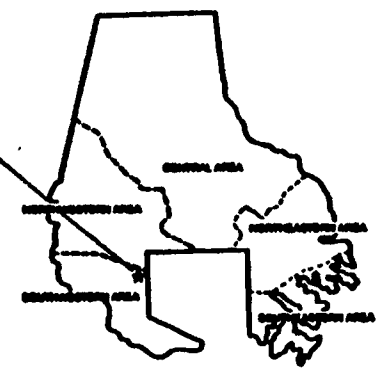
Special Features

- The campus has outdoor study areas including a wetland and a watershed.
- Students can participate in nationally recognized apprenticeship programs and local intern and mentor programs.
- The Physical Education program includes an outdoor challenge and fitness course.
- All students can earn 32 credits in four years.
- Access to local and state off-campus outdoor education sites is available.
- Five state-of-the-art computer labs featuring IBM Novell LAN, MacIntosh LC 520 LAN, and CD-ROM technology are in use.
- Our computerized library is linked to local and national research networks.
- Extensive community and business partnerships are an integral part of all programs.
- All courses feature the application of knowledge.
- Tech Prep courses are sequenced with opportunities to earn college credit or apprenticeship hours while in high school.

Western School of Technology and Environmental Science
100 Kenwood Avenue
Baltimore, MD 21228-3610
Phone: (410)887-0840
FAX: (410) 887-1824

Western

School of Technology and Environmental Science



DISCOVER YOUR ENVIRONMENT

Environmental Science
A Typical Student's Course Selections

Grade 9	Grade 10	Grade 11	Grade 12
Environmental Biology	Environmental Chemistry	Environmental Physics	Science Elective
Ecology	Environmental Science	Intro. to Research Science Elective	Science Elective
English	English	English	English
Geometry	Algebra II/Trig.	Pre-Calculus	Calculus
Contemporary America	World History	U. S. History	CCPI (.5) Environmental Ethics (.5)
Foreign Language	Foreign Language	Elective	Elective
Tech. Ed. Comp. Info. Proc.	Fine Arts	Elective	Elective
Physical Education	Health (.5) .5 Elective	Elective	Elective

8 Science credits plus Introduction to Research are required.
Environmental Ethics is required.

Recommended Science Electives are:
AP Biology, AP Chemistry, AP Physics, The Chesapeake Bay, Oceanography, Meteorology, Microbiology, Geology, Habitat Restoration, Waste Management, Hazardous Material Handling, and Research Internship

Tech Prep
A Typical Student's Course Selections

Grade 9	Grade 10	Grade 11	Grade 12
Career Exploration	Tech. Prep.	Tech. Prep.	Elective
Tech. Ed. Comp. Info. Proc.	Foundation Courses	Specialization Courses	Elective
English	English	English	English
Algebra I	Geometry	Algebra II/Trig.	Elective
Contemporary America	World History	U. S. History	CCPI (.5) Environmental Ethics (.5)
Environmental Biology	Environmental Chemistry	Ecology of Maryland	Elective
Foreign Language or Elective	Foreign Language or Elective	Elective	Elective
Physical Education	Health (.5) .5 Elective	Elective	Elective

4–9 Tech. Prep. credits are required.
Environmental Ethics is required.

Career & Technology Completer Programs are offered in the following areas:
Automotive Technology, Computer Information Technology, Construction Technology (Cluster), Cosmetology, Culinary Arts, Electronics, Environmental Technology, Graphic Communications (Cluster), Health Science, Information Systems Management, and Medical Assistant

BALTIMORE COUNTY HIGH SCHOOLS

Content Area	9th Grade	10th Grade	11th Grade	12th Grade
English	English 9	English 10	English 11	English 12
Math	Alg. I	Geometry	Alg. II	(Statistics) or (Envir. Alg.)
Science	Environmental Biology	Ecology of Maryland	Environmental Chemistry	(Env. Science) or (Geology) or (Plants & People) or (Chesapeake Bay)
Social Studies	Contemporary America	World History	U.S. History	CCPI (.5) Environmental Ethics (.5)
Tech-Prep Core	Career Exploration Environmental Technology Carp/Plumbing/ Electronics	Environmental Technology I (1 credit)	Environmental Technology II (2 credits)	School to Career Transition: Independent Research or Internship or Mentor Experience or Community College
Required Courses	Technology Ed. (.5) CIP (.5)	Facility & Maintenance Repair (.5) Fundamentals of AC/DC (.5)		
	Physical Education	Health (.5) Elective (.5)	Technical Writing (.5) Oral Communication (.5)	
	Foreign Language	Foreign Language	Fine Arts	

:er Pathways

COMMUNITY COLLEGE STUDIES

Option 1. Ecological Restoration

First Year		Second Year	
First Semester	Second Semester	First Semester	Second Semester
English 101	English 102	Eap 101	Eap 106
Env 101 (Int. Env. Sci.)	Std in Hum Val (Spe 101) (lang, mus, art, phil)	Std in Group & Institutions Eco 122 Pos 101 Am Gov	Elective
Bio 121 Fund Biology I	Bio 123 Fund Biology II	Bio 141 Microbiology	New Course Wetlands Ecology
Che 121/122 Intro. Inorgan. Chemistry	Che 146/147 Intro. Organ. Chemistry	New Course Plant Taxonomy and Ecology	Env 142 Haz. Mat/Wst Management Regulations
Math 131 Statistical Methods	Sur 101/121 Surveying and Typographic Mapping	New Course Plants, Microclimates and soil types	New Course Landscape and Habitat Design
Life Fitness			

CCC Program in Environmental Technology

Option 1. Ecological Restoration
Option 2. Environmental Engineering
Option 3. Hazardous Materials Management
Option 4. Recycling and Waste Minimization
Option 5. Site Remediation

All options* will consist of four semesters taking five, three-credit courses plus Life Fitness and Labs (1 hour each) for a total of 63-65 credit hours.

*Pending state and college approval

Option 2. Environmental Engineering

First Year		Second Year	
First Semester	Second Semester	First Semester	Second Semester
English 101	English 102	Eap 101	Eap 106
Env 101 (Int. Env. Sci.)	Std in Hum Val (Spe 101) (lang, mus, art, phil)	Std in Group & Institutions Eco 122 Pos 101 Am Gov	Elective
Bio 121 Fund Biology I	Math 172 Calculus II	Bio 271 Intro to Toxicology	Env 261 Pollution Cont/Disposal Technologies
Che 121/122 Intro. Inorgan. Chemistry	Che 146/147 Intro. Organ. Chemistry	Env 141 Intro. Haz Mat/Wst Management	Env 142 Haz. Mat/Wst Management Regulations
Math 171 Calculus I	Phy 111 General Physics I	Phy 112 General Physics II	Phy 214 General Physics III
Life Fitness			

Option 3. Hazardous Materials Management

First Year		Second Year	
First Semester	Second Semester	First Semester	Second Semester
English 101	English 102	Eap 101	Eap 106
Env 101 (Int. Env. Sci.)	Std in Hum Val (Spe 101) (lang, mus, art, phil)	Std in Group & Institutions Eco 122 Pos 101 Am Gov	Elective
Bio 121 Fund Biology I	Bio 123 Fund Biology II	Bio 271 Intro to Toxicology	Cst 100 Hazard Recog and Control
Che 121/122 Intro. Inorgan. Chemistry	Che 146/147 Intro. Organ. Chemistry	Env 141 Intro. Haz Mat/Wst Management	Env 142 Haz. Mat/Wst Management Regulations
Math 101 Precalc. Math	Math 131 Statistical Methods	Phy 121 Industrial Physics	Env 261 Pollution Cont/Disposal Technologies
Life Fitness			

School to Career Pathways

COMMUNITY COLLEGE STUDIES

(continued)

Option 4. Recycling and Waste Minimization

First Year		Second Year	
First Semester	**Second Semester**	**First Semester**	**Second Semester**
English 101	English 102	Exp 101	Exp 106
Env 101 (Int. Env. Sci.)	Std in Hum Val (Spe 101) (lang, mus, art, phil)	Std in Group & Institutions Eco 122 Pos 101 Am Gov	Elective
Bio 121 Fund Biology I	Bio 123 Fund Biology II	Bio 141 Microbiology	New Course Composing Technologies
Che 121/122 Intro. Inorgan. Chemistry	Che 146/147 Intro. Organ. Chemistry	Env 141 Intro. Haz Mat/Wst Management	Env 142 Haz. Mat/Wst Management Regulations
Math 131 Statistical Methods	Man 131 Small Business Management	Law 111 Business Law	New Course Recycling Opportunities and ethics
Life Fitness			

Option 5. Site Remediation

First Year		Second Year	
First Semester	**Second Semester**	**First Semester**	**Second Semester**
English 101	English 102	Exp 101	Exp 106
Env 101 (Int. Env. Sci.)	Std in Hum Val (Spe 101) (lang, mus, art, phil)	Std in Group & Institutions Eco 122 Pos 101 Am Gov	Elective
Bio 121 Fund Biology I	Bio 123 Fund Biology II	Bio 141 Microbiology	Bio 271 Intro to Toxicology
Che 121/122 Intro. Inorgan. Chemistry	Che 146/147 Intro. Organ. Chemistry	Env 141 Intro. Haz Mat/Wst Management	Env 142 Haz. Mat/Wst Management Regulations
Math 161 Precalc. Math	Math 131 Statistical Methods	New Course Soil & Fluid Dynamics	New Course Remediation Technologies
Life Fitness			

Clusters	Entry Level High School Preparation	Technician Community College Preparation	Professional Four Year Degree Preparation
Ecological and Biological Management	Conservation Associate Data Management Technician Landscape Contractor Forestry Technician Nursery Worker Survey & Mapping Technician Park Technician Soil Conservation Technician	→ → → → Propagator → → → Landscape Designer Drafter/CAD Operator Civil Engineering Technician Geological Technician Biological Specialties	Natural Resources Specialist → Forester Horticulturalist Surveyor Soil Scientist Landscape Architect Engineering Specialties Geologist → Planner Ecologist Geomorphologist Hydrologist Geographer
Pollution Control and Waste Management	Lab Assistant/Aid Well Installer Hazardous Waste Operator/Sampler/Technician	→ → Occupational Safety & Health Technician Air Quality Technician Air Pollution Control Technician Lab Technician Field/Sampling Technician Drafter/CAD Operator Pollution Control Operator Instrument Technician Radiation Technician Heating/Ventilation/Air Conditioning Technician Water/Wastewater Operator Biological Technician Chemical Technician Recycling/Waste Utilization Officer Risk Manager Compliance/Enforcement Officer	Safety Engineer Industrial Hygienist Sanitary Engineer Biologist Chemist Chemical Hygiene Officer → → → Toxicologist Engineering Specialties Environmental Sanitarian Environmental Scientist Environmental Engineer

Future Trends

This group was asked to identify the future trends and issues related to this field.

- They saw increasing regulation, with several related impacts
  - some legislation (clean air & clean water acts) will create jobs at the entry, technician and professional levels
  - the flow of government money relative to regulations impacts the job market very directly
  - regulation and restoration are occurring more frequently in policy, planning and implementation requirements
- There are more dollars going into non-regulatory, proactive environmental efforts
- There are new technologies and instrumentation emerging regularly
- Hazardous waste is moving from study/research phases to implementation and will create needs for more waste handling and clean-up personnel
- There are increasing demands for various certifications
- There is more emphasis on non-point sources of pollution, with a more regional/global perspective as planning and implementation of environmental activities/policies occur.
- The limits to our water supply will create an awareness of and a need for water generation and water quality
- There appears to be increasingly more positive changes in environmental "valuing", land use and sensitivity to environmental issues
- Bio-diversity is an increasing area of concern
- Waste minimization & waste utilization is becoming more important
- Risk management and environmental auditing are becoming more important for accountability and legal liability issues
- There is a real continuing need for, and provision of, public education about environmental issues
- There is an increasing public awareness of and demand for more action on environmental issues

- There is a growing need for more research and development, and subsequent marketing of products and "discoveries"
- There is an explosion in the so-called "green market" with subsequent growth in providers of services and products
- Bio-remediation, biological control and genetic engineering will likely increase to help solve environmental problems
- Global remediation may be an emerging need
- There is an increasing need for employees to be multi-skilled across several areas to insure against employment changes and declines

Curriculum Recommendations

The group cited several suggestions for curriculum development; given the cross-over between jobs and industry segments, the group supported equally a focus on both cluster areas.

- The curriculum should be problem-focused, with real-world problem-solving applications that demand a combination of technical critical thinking and communication skills.
- Field experiences/cooperative education opportunities should be built into the curricula.
- The instruction should be available to life-long learners - adults, workers, students.
- The program should have instrumentation and sampling labs with real world equipment.
- Given the emphasis on and value of certifications, the curriculum should prepare students for these, if not incorporate them into the program
- Technical writing and verbal communication skills are extremely important.
- The curriculum should include basic statistics and formatting of data.
- The curriculum should provide opportunities to
  - review/discuss current environmental issues and impacts
  - insure that the emphasis on environmental issues cuts across all curricula at the school

- develop a balance between the technical skills and broader philosophical issues.

Next Steps

Given the difficulty of both the planning group and the Tech Scan panel to easily classify clusters and jobs within this broad field, the curriculum development, student advisement and public awareness activities related to this effort might be benefitted by a more systematic review of the clusters and preparation levels generated. An association or group of employers might be asked to review/enhance the current scheme to insure completeness and accuracy across the public and private sectors in the environmental science area.