APPENDIX 5
Socio-Economic

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Issue: 1,3-Butadiene
Author: John Posey
Version: 03/28/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**1,3-Butadiene**
Description of stressor	1,3-Butadiene is a colorless gas with a mild gasoline-like odor. It is used in the production of rubber and plastics. It is also used in copolymers including acrylics. 1,3-Butadiene can be released into the atmosphere through both smokestack and tailpipe emissions. (See ATSDR, 1995).
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Acute direct exposure to 1,3-butadiene causes irritation to the eyes. Acute short-term exposure through inhalation causes irritation of throat and lungs, as well as neurological effects such as blurred vision and dizziness. Chronic exposure can lead to cancer. (See ATSDR, 1995). 1,3-Butadiene is also extremely flammable. The *Handbook of Toxic and Hazardous Chemicals and Carcinogens* states that "because of low flash point, 1,3-Butadiene's fire and explosion hazard may be more serious than its health hazard." (Sittig, 1991). Other potential health effects include dermal irritation, birth defects, heart impairments, blood disorders, pulmonary impairment and neurological impairment (ATSDR, 1995). It is not possible to quantify the risks associated with these potential effects.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	The principal socio-economic impact of 1,3-butadiene is the costs associated with cancer due to chronic exposure from mobile sources. A secondary cost is the possible impact of 1,3-butadiene on the value of properties located near industrial sources of atmospheric 1,3-butadiene.
Key impacts selected (critical socio-economic effects)	Costs Incurred, Property Values.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Inhalation is the principal exposure pathway.
Quantification of exposure levels statewide	In 1996, EPA estimated that the median ambient concentration of 1,3-butadiene in NJ was 0.0663 micrograms per cubic meter (EPA, 2000). The average level was .085. Statewide, the 1990 median ambient level of 1,3-butadiene was 0.19 micrograms per cubic meter, which was 53 times the target levels established by the Clean Air Act of 1990. The target level established by the Clean Air Act is 0.0036 micrograms. (The target level is the ambient concentration that would be expected to produce one case of cancer per million people exposed.) Assuming the average person breathes about 20 m^3 of air per day, an ambient level of .0036 $\mu g/m^3$ would result in an intake of about .05 μg. (See HHTWG)

Specific socio-economic entities at increased risk	Urban and industrial areas are at greater risk. Areas near oil refineries also face greater risk.
Quantification of exposure levels to entities at increased risk	The 1996 modeled concentration in Hudson County was estimated at 0.203 micrograms per cubic meter. The concentration for Essex County was 0.128 micrograms. (EPA, 2000). The Human Health Technical Work Group (HHTWG) notes that an average ambient concentration in the range of 0.07 ppb (about 0.15 $\mu g/M^3$) was measured in Camden in 1997. HHTWG calculates that a person exposed to this concentration 24 hours a day would inhale about 3 μg of 1,3-butadiene.
Dose/Impact-Response Assessment	
Quantitative/Qualitative impact-assessment employed	I rely on published risk assessments which use formulas similar to the following: $R_{ij}=C_{ij} * IUR_j$, where R_{ij} is the estimate of individual lifetime cancer risk from pollutant j in census tract i., C_{ij} is the concentration of hazardous air pollutant j in $\mu g/m^3$ in census tract i., and IUR_j is the inhalation unit risk estimate for pollutant j in $(\mu g/m^3)^{-1}$. (See Morello-Frosch, 2000.) Following is a description of the methods and sources used for documenting costs of cancer: The most recent available estimates from the National Institutes of Health are contained in a 2001 article by Brown, Lipscomb and Snyder in the Annual Review of Public Health (22:91-113). The following facts are reported: 1) For 1990, the direct medical costs associated with cancer were estimated to be 27.5 billion. Morbidity costs (i.e., lost workdays) were estimated at 9.9 billion. Mortality costs (which are not to be included in NJCRP assessments) were estimated at 58.8 billion. The total was about 96.1 billion. These figures are based on national-level Cost of Illness (COI) survey data. 2) Using COI surveys, it was estimated that direct medical costs associated with cancer rose 51.67% between 1985 and 1990, and rose 50.05% between 1990 and 1995 (nominal dollars). This yielded an estimated direct medical cost of 41.2 billion in 1995. (Assuming a similar 50% rise between 1995 and 2000, the direct cost in 2000 should be around 61.8 billion. If morbidity costs as a proportion of direct costs remain similar, then we could expect morbidity costs in 2000 to be about 22.2 billion.) 3) The authors attempted to check the validity of these macro-level estimates by using a "bottom-up" approach based on SEER-Medicare data for 1996. They found that the direct costs of cancer in 1996 were around 42.39 billion, which I think is remarkably close to the 1995 COI estimate. 4) The authors report that there were about 1.4 million new cases of cancer in 1997. Therefore, to assign a cost estimate to a general cancer risk, I will assume that the cost per case is $84 billion / 1.4 million cases = $60,000 per case.
Risk Characterization	
Risk estimate(s) by socio-economic entities at risk	Score

Property Values	***a)***	Severity: Since 1967, there have been dozens of articles which contain estimates of the impact of air pollution on property values. Two principal methods have been used. *Hedonic valuation* is a method whereby numerous determinants of property value are entered into a multivariate regression model. If the list of independent variables includes a measure of particles in micrograms per square meter, then the parameter attached to this variable may be seen as the amount that 1 additional microgram per meter^3 will decrease the value of a house. *Contingent valuation* is essentially a survey method, in which assessors or property buyers are asked how much more or less they would pay for a significant improvement (or deterioration) in air quality. For example, a literature review by Acks (1995) refers to a classic 1975 regression by Nelson which indicated that in the Washington DC area, a doubling of oxidant pollution levels would decrease property values by 1.7%. A meta-analysis by Smith and Huang (1995) included a review of 83 hedonic regression studies. They report that in these studies, the mean Marginal Willingness To Pay (MWTP) for a reduction in suspended particles is $109.90 per microgram/m^3. Chattopadhyay (1999) estimates that all things being equal, a household will pay between $2,037 and $3,350 to live in an area with 25% less air pollution. Harrison and Rubenfeld (1978) offer the figure of $1,816 to $2,846 for a 25% reduction. Although there are a wide variety of studies in this vein, they offer little guidance with respect to the problem of estimating the property value loss attributable to one pollutant, such as 1,3-butadiene. There are two possible hypotheses which, on their face, seem equally plausible. First, one might argue that a specific chemical will only affect property values if the general population is aware of that chemical. Since the general public is not terribly aware of 1,3-butadiene, it may be argued that butadiene can have little impact on property values. A second hypothesis would be that 1,3-butadiene constitutes a certain amount of the total suspended matter in the atmosphere, and that this percentage can be applied to overall hedonic estimates of the impact of suspended particles. Assuming generously that butadiene contributes 10% of the particulate pollution problem on average, and that property values are suppressed by $3000 relative to what they might otherwise be on average, then the unit impact is on the order of $300 per household. Given that there are 2,794,711 occupied housing units in NJ (2000 Census), this yields an impact estimate of about $838 million. This is well below the $2.18 billion threshold for a Medium impact, suggesting that the score should be "1" or Low. Without a firmer theoretical base, it is probably futile to try to estimate the property value impact of a specific chemical. Additional research on this problem would be useful. One possible direction would be to enter health impacts into hedonic regressions. It may be that at some level, the health impact of environmental risks is factored into prices of homes. If a researcher could estimate a parameter for the property value loss associated with an additional 1/10,000 risk of cancer, then this type of figure could be applied to a wide variety of carcinogens. In the absence of stronger theoretical and empirical guidance, it seems prudent to give a score of "1" to butadiene, while acknowledging that the level of uncertainty is high.	1
	b)	Duration/irreversibility	1
	c)	Scale	3
	d)	Uncertainty	3
Employment	***a)***	Severity: No effect hypothesized.	0.1
	b)	Duration/irreversibility	1

	c) Scale	3
	d) Uncertainty	1
Costs Incurred	Severity: The EPA's Cumulative Exposure Project has published estimates of 1990 1,3-butadiene levels for each state. In NJ, the figure was 0.19 micrograms per cubic meter. This is 53 times the EPA target level of .0036 micrograms. The EPA target is set at the level of exposure at which one case of cancer would be caused per million persons over a lifetime. At 1990 levels, the NJ butadiene level would be expected to cause 53 cases of cancer per million persons. There are 8.1 million persons in NJ. Thus, the lifetime cancer incidence due to butadiene is expected to be 53 * 8.1 million = 429 cases. If we assume that these lifetime cancer cases will occur over a 70 year period, then this implies that there would be 429/70 = 6 cases of cancer annually. It may be that this estimate overstates the risk. Exposure to 1,3-butadiene is probably greater in the outdoors than indoors. Since most people spend most of their time indoors, the average exposure to 1,3-butadiene is probably less than a constant exposure to the outdoor ambient level. 1996 data indicates that 1, 3- butadiene levels fell by more than half between 1990 and 1996. This would indicate that the current risk is about 3 cases of cancer per year. As noted above, NIH figures indicate that the "average" cost of a case of cancer is about $60,000. If there are 3-6 cases of cancer in NJ each year attributable to 1, 3- butadiene levels, then the economic cost associated with these cases is significantly lower than $1 million per year. NJCRP guidelines call for a score of "1" to be given to costs of less than $16 million.	1
	a) Duration/irreversibility: Some cancer is incurable.	2
	b) Scale: Statewide	3
	c) Uncertainty: I am moderately confident that medical costs associated with 1,3-butadiene are less than $16 million.	2
Aesthetic Levels	***a)*** Severity: No effect hypothesized.	0.1
	b) Duration/irreversibility	1
	c) Scale	3
	d) Uncertainty	1
Psychological Impacts	***a)*** Severity: No effect hypothesized.	0.1
	b) Duration/irreversibility:	1
	c) Scale:	3
	d) Uncertainty	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	M: Additional basic research on the property value impacts of health risks could yield better estimates of the impact on property value. Additional epidemiological research could result in a more accurate assessment of the number of cancer cases caused by 1,3-butadiene in New Jersey each year.	
Potential for future changes in the underlying risk from this stressor	+ Industry reports indicate that the demand for 1,3-butadiene is growing rapidly. Industrial use of butadiene rose nearly 10 times in the 1990s. However, federal regulations issued in 1996 are expected to reduce butadiene emissions from factories by 20%. (See *Chemical Week*, 2000).	

(+++, ++, +, 0, -, --, --- where + is improvement), and brief description	Efforts to reduce tailpipe emissions also help to reduce 1,3-butadiene. EPA estimates indicate that butadiene levels in NJ fell from 0.19 micrograms per cubic meter in 1990 to 0.0663 micrograms in 1996.
Potential for catastrophic impacts (H,M,L) and brief description	L. It should be noted, however, that 1,3-butadiene is highly explosive, so fires and explosions are a possibility, especially around refineries. (McElligott, 2000).
Incidence of impacts (affected sub-groups, variability, equity issues)	1,3-Butadiene levels are greatest in industrial areas such as Hudson County, which also contain a disproportionate number of low-income households. The increased risk faced by families in poverty would appear to make 1,3-butadiene a significant environmental justice issue.
Extent to which threat is currently regulated	See Federal and State regulations, below.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	H: Refineries and makers of plastics, rubber and acrylics are a major contributor.
Small business industry	M:
Transportation	H: 80% of atmospheric 1,3-butadiene comes from incomplete combustion. There is also a small amount in gasoline.
Residential	L: There is a small amount of 1,3-butadiene in wood smoke.
Agriculture	L
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	L
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L

Non-local air sources incl. deposition	M: 1,3-Butadiene in New York City is present at levels greater than 100 times the Clean Air Act's target levels. 4 of the 5 boroughs in New York City are among the top 10 most polluted counties, according to the EPA. It is likely that some of this pollution originates in New York, and drifts across the Jersey border.
Biota sinks	L
References	**Hedonic Valuation:** Kenneth Acks. "Valuation of Environmental Damages to Real Estate." 1995. Www.damagevaluation.com/text/html/valredi4.htm Martin Brown, Joseph Lipscomb and Claire Snyder. "The Burden of Illness of Cancer: Economic Cost and Quality of Life." *Annual Review of Public Health*, Vol. 22, pp. 91-113. 2001. Sudip Chattopadhyay. "Estimating the Demand for Air Quality: New Evidence Based on the Chicago Housing Market." *Land Economics*, Vol. 75(1) pp. 22-38. February 1999. Phil Graves, James Murdoch, Mark Thayer, and Don Waldman. "The Robustness of Hedonic Price Estimation: Urban Air Quality." *Land Economics*, Vol. 64(3) pp. 220-233. August 1988. David Harrison and Daniel Rubinfeld. "The Air Pollution and Property Value Debate: Some Empirical Evidence." *Review of Economics & Statistics*, Vol. 6 (4) pp. 635-38. November 1978. James Murdoch and Mark Thayer. "Hedonic Price Estimation of Variable Urban Air Quality." *Journal of Environmental Economics and Management*, Vol. 15 pp. 143-146. 1988. V. Kerry Smith and Ju-Chin Huang. "Can Markets Value Air Quality? A Meta-Analysis of Hedonic Property Value Models." *Journal of Political Economy*, Vol. 103(1) pp. 209-227. 1995. **Butadiene:** U.S. Agency for Toxic Substances and Disease Registry (ATSDR), 1995. ToxFAQs: 1,3-Butadiene. http://www.atsdr.cdc.gov/tfacts28.html U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. "1,3 Butadiene." Www.epa.gov/ttn/uatw/hlthef/butadien.html (no date). U.S. Environmental Protection Agency. "1996 Emissions of 1,3-Butadiene (CAS#106990)." August 29, 2000. New Jersey Department of Health and Senior Services. "Hazardous Substance Fact Sheet." (no date.) Http://www.state.nj.us/health/eoh/rtkweb/rtkhsfs.htm Marshall Sittig. *Handbook of Toxic and Hazardous Chemicals and Carcinogens*. Park Ridge, NJ: Noyes Publications. 1991. S. Gangolli, ed. *The Dictionary of Substances and Their Effects*, 2nd Edition. London: Royal Society of Chemistry. 1999.

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Current Policy and Regulatory Framework	
Federal	The following is taken from *Health & Safety: A NEWSLETTER FROM THE UNIVERSITY OF IOWA HEALTH PROTECTION OFFICE, March 1997 Vol. 12 No.1* On November 4, 1996, the Occupational Safety and Health Administration (OSHA) issued its new standard for the Occupational Exposure to 1,3-Butadiene (29CFR1910.1051). This new standard became effective on February 1, 1997. The most significant part of the new OSHA standard is implementing a reduction in the permissible exposure limit (PEL); from 1000 parts per million (ppm) down to 1.0 ppm. OSHA's new standard is very similar in format to its other chemical specific standards. The major provisions are: 1) Establish the following PEL: 1.0 ppm as an 8-hour time weighted average, 5 ppm over any 15 minute period, and 0.5 ppm as an action level. 2) Require initial and periodic exposure monitoring of all operations that use 1,3-butadiene. 3) Establish regulated areas where exposure to 1,3-butadiene does or can exceed the PEL. 4) Establish and implement a compliance plan to reduce exposures below the PEL. 5) Establish and implement a written exposure goal program to reduce exposures below the action level. Other issues addressed include respiratory protection, personal protective equipment, emergency planning, medical surveillance, hazard communication (MSDSs, labels and training), and record keeping. In addition, target levels for 1,3-butadiene have been established by the Clean Air Act of 1990. Targets are set to the level at which a substance will cause one case of cancer per million persons. The target level for 1,3-butadiene is .0036 micrograms per cubic meter.

Issue: 1,3-Butadiene
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State & Local	1,3-Butadiene is on the Hazardous Substances List of the NJ Department of Health and Senior Services because of its carcinogenic properties, and because of its volatility. Manufacturers are required to report on 1,3-butadiene storage and use under the New Jersey Worker and Community Right to Know Act, N.J.A.C. 7:1G-1.2.

1, 3- Butadiene is a carcinogenic substance that enters the atmosphere through smokestack and tailpipe emissions. It is used in the production of plastics, rubber, and acrylics, but 80% of 1,3-Butadiene comes from car and truck exhaust. 1,3-Butadiene is formed as a byproduct of incomplete combustion. The state's oil refineries also emit butadiene. 1,3 butadiene is present in every part of New Jersey in concentrations ranging from four to 707 times the cancer benchmark. Concentrations are greatest in Hudson and Essex Counties. The best information available indicates that 1, 3- Butadiene is responsible for less than 10 cases of cancer per year in NJ.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	1	0.1	1	0.1	0.1
Duration/ Irreversibility	1	1	2	1	1
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	3	0.3	6	0.3	0.3

Average Risk (0 – 5 years)	Average Risk (5 years plus)
1.98	**1.98**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	3	1	2	1	1	1.6

Trend: +

Catastrophic Potential: L

Issue: Acid Precipitation
Author: John Posey
Version: 01/01

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Acid Precipitation**
Description of stressor	Acid precipitation results from both NOx and SOx. These chemicals enter the atmosphere from both tailpipe and smokestack emissions.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Acid rain can harm the ecological integrity of lakes and forests. Acid deposition in urban areas can harm buildings and statues. Serious damage to lakes and forests caused by acid rain has been reported in the Adirondacks, the Smoky Mountain National Park, and several places in Europe.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Acid rain may lead to a loss of jobs in ecotourism. Destruction of lakes may lead to a reduction in lakeside property values. Human health impacts may lead to medical costs. Visibility impairment may be considered an aesthetic impact. The destruction of building materials and statues may impose economic costs. Acid rain has also been linked to agricultural damage.
Key impacts selected (critical socio-economic effects)	Employment, property values, costs incurred, aesthetic impacts.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Impacts on lakes and forests result both from acid rain and from dry deposition.
Quantification of exposure levels statewide	The following SO2 ambient concentration measurements are reported by EPA: COUNTY PPM ATLANTIC 0.0029 BERGEN 0.0057 BURLINGTON 0.0049 CAMDEN 0.0066 CAMDEN 0.0038 CUMBERLAND 0.0039 GLOUCESTER 0.0062 HUDSON 0.0048 HUDSON 0.0087 MIDDLESEX 0.005

	MORRIS 0.0044 UNION 0.0065 UNION 0.0085
Specific socio-economic entities at increased risk	The highest readings come from Hudson and Union County.
Quantification of exposure levels to entities at increased risk	These counties have measurements that are three times as high as those in Atlantic County.
Dose/Impact-Response Assessment	
Quantitative/Qualitative impact-assessment employed	For impact on environmental quality, I rely on a longitudinal study of pH levels in southern NJ conducted by Cerceo.
Risk Characterization Risk estimate(s) by socio-economic entities at risk	Following is an excerpt of a study by Cerceo published in American Environmental Laboratory, February 1999. It applies both to property values and to employment. To my knowledge, this is the only study of acid rain that specifically discusses NJ. I conclude from this information that acid rain has not yet begun to affect lakes and forests in NJ. Property value and employment impacts, therefore, are probably minimal: In this investigation, rainwater acidity measurements were conducted on a continuous basis for over 15 years in the southern New Jersey towns of Westmont and Gibbstown. The first community is nine miles directly east of Philadelphia, while the second is 15 miles southeast of the city. Both locations are in the path of airborne pollutants carried by prevailing easterly winds. Rainwater was collected in wide-mouth, glass vessels for 24-hr periods, after which measurements were conducted on the model 130 digital pH meter (Corning Inc., Corning, NY) and by Color pHast pH strips (EM Science**,** Gibbstown, NJ). Average pH results on a seasonal and yearly basis were determined by weighted averages. This procedure requires that pH be converted to hydrogen ion concentration, the mean concentration computed by taking into account the amount of precipitation at each site, then converting back to pH. The effect on aquatic bodies (Newton Creek and the Cooper River, both in the We s t m o n t , NJ, area) was monitored by checking their pH, followed by an acid titration to determine total buffering capacity. The pH of drinking water at the sites mentioned above was monitored on a continuous basis during this time period. To obtain a measure of the effect of acid rain on plant growth in the region, selected seedling of juniper, dwarf Alberta spruce, yew, and arborvitae were planted in May of 1978 in Westmont, NJ. Existing deciduous flora native to this area were continuously observed for any detrimental physical changes over this period.

		Score
	Fifteen years of monitoring showed no change in the pH ranges of Newton Creek and the Cooper River (pH 6.8–7.2) and the quality and growth of deciduous flora (such as maple, locust, oak, and dogwood) native to the Southern New Jersey/Philadelphia area. More specifically, juniper, dwarf Alberta spruce, yew, and arborvitae planted 20 years ago and monitored for growth and quality on an ongoing basis continue to flourish. This geographic area is all part of the Delaware Valley, the elevation of which is approximately sea level and contains relatively deep soil of good buffering capacity. Tap water in the area, which is tracked from underground aquifers, has also been in the range of pH 6.8–7.2.	
Property Values	Severity: If acid depositions caused serious harm to freshwater ecosystems, then homes close to lakes and rivers could suffer a reduction in property value. However, the data from Cerceo indicates that this has not yet occurred in NJ.	*0.1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty	2
Employment	Severity: Jobs in ecotourism could potentially suffer if acid rain affected forest and freshwater environments. Cerceo's data indicates that this is not yet happening in NJ.	*0.1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty	2
Costs Incurred	Severity: Acid deposition can be harmful to structures made out of limestone or marble. The principal effects are aesthetic. Acid rain can cause discoloration, and can eat away at inscriptions and carvings in stone. Buildings, monuments and tombstones can all be affected by acid deposition. It is theoretically possible for acid deposition, over a very long period of time, to lead to structural failure in stone buildings. According to NAPAP, more than 900,000 properties of "aesthetic and historical value" are potentially at risk for damage by air pollution. Dry deposition causes more damage than wet deposition, or acid rain. This does not include 10 to 30 million tombstones. Dry deposition is more harmful to structures than wet deposition, or acid rain. Once stone is wet, dissolution generates chemicals that neutralize the acid in the rain before it can attack the stone's surface. NAPAP asserts that the effects of acid deposition are much less than the natural dissolution effects of non-acidic rain. NAPAP further contends that the effects of acid deposition on structures are primarily aesthetic. Thus, the NAPAP report discounts damage to structures other than monuments and culturally significant structures. The report indicates that damage such as discoloration can be remedied fairly easily for most buildings. A 1999 EPA report, "Benefits and Costs of the Clean Air Act," also minimizes the direct costs due to acid deposition on buildings. The report concludes that this damage "can not be quantified and/or monetized for a variety of reasons."	*1*

	A few economists have attempted to estimate the damage caused by acid deposition on structures. These include Callaway and Englin (1990) and Morey et al. (1997). These studies use Willingness to Pay (WTP) surveys, and focus exclusively on damage to culturally significant structures. These studies are not directly relevant to the problem of acid deposition on buildings of purely functional value. Nor do the economic costs estimated by WTP fit the criteria for "direct economic costs" established by NJCRP. For all of these reasons, it appears that the economic costs of acid deposition on buildings should be considered minimal for the purposes of NJCRP.	
	Duration/irreversibility:	1
	Scale	3
	Uncertainty	1
Aesthetic Levels	Severity: Damage to culturally significant buildings and monuments could reasonably be considered an aesthetic impact. However, acid deposition causes less damage than does natural rain, and any damage caused by acid deposition occurs over a very long time. In the next five years, acid deposition by itself will probably not cause significant aesthetic damage in NJ.	*1*
	Duration/irreversibility: It is usually possible to fix damage to buildings through the replacement of original materials. However, the loss of the original materials itself may be considered an aesthetic loss. Lost tombstone carvings are probably irreplaceable.	1
	Scale:	3
	Uncertainty:	2
Psychological Impacts	Severity: No impacts hypothesized	*0.1*
	Duration/irreversibility:	1
	Scale:	3
	Uncertainty: I am fairly confident that this assessment is valid.	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	M: It would be helpful to supplement Cerceo's study with a similar study in northern NJ.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	++ SO2 emissions reductions have been significant in the first ten years of the Clean Air Act. EPA reports that emissions from the 263 highest-emitting units shrank from 8.7 million tons in 1990 to 4.8 million tons in 1997. Additional reductions are expected by the year 2010.	
Potential for catastrophic impacts (H,M,L) and brief description	L: Acid rain is causing catastrophic damage to the Adirondacks, and has severely disturbed European forests and lakes.	
Incidence of impacts (affected sub-groups, variability, equity issues)	None.	

Extent to which threat is currently regulated	Beginning in 1995, the EPA has operated a market-based allowance trading system. Under the system, regulated utilities are given a certain allowance that determines the amount of SO2 the utility is allowed to emit. Utilities that reduce emissions to levels beneath their allowance may sell their excess allowances to non-complying utilities. Allowances are fully marketable commodities. Once allocated, allowances may be bought, sold, traded, or banked for use in future years. EPA claims that "the market-based allowance trading system capitalizes on the power of the marketplace to reduce SO2 emissions cost-effectively and uses economic incentives to promote conservation and the development of innovative technology."
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	M
Small business industry	L
Transportation	H
Residential	L
Agriculture	L
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	L
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. Deposition	H
Biota sinks	L

References	John Callaway and Jeffrey Englin. "Economic Valuation of Acid Deposition Damages." *Contemporary Policy Issues* VIII, July 1990. Eugene Cerceo. "Acid precipitation and climate warming in southern New Jersey: Some global perspectives." American Environmental Laboratory. February, 1999. L.G. Chestnut and R.L. Dennis. "Economic Benefits of Improvements in Visibility: Acid Rain Provisions of the 1990 Clean Air Act Amendments." *Journal of the Air and Waste Management Association*, 47(3). 1997. James L. Regens. "Acid Deposition." *Keeping Pace with Science and Engineering*, pp. 165-188. National Academy Press, 1993. Minnesota Pollution Control Agency. "Criteria Air Pollutant: Sulfur Dioxide (SO2) in Minnesota." 1997. http://www.pca.state.mn.us/air/emissions/so2.html Edward Morey, Kathleen Rossmann, Lauraine Chestnut and Shannon Ragland. "Valuing Acid Deposition Injuries to Cultural Resources." Prepared for National Acid Precipitation Assessment Program. May, 1997. http://spot.colorado.edu/~morey/monument/ National Science and Technology Council. "National Acid Precipitation Assessment Program Biennial Report to Congress: An Integrated Assessment." May, 1998. www.nnic.noaa.gov/CENR/NAPAP US EPA, Acid Rain Program. "Allowance Trading System Fact Sheet." November, 2000. www.epa.gov/acidrain/allsys.html US EPA, Acid Rain Program. "Human Health Benefits from Sulfate Reduction Under Title IV of the 1990 Clean Air Act Amendments. November, 1995. www.epa.gov/acidrain/effects/healthx.html US EPA, Clean Air Market Program. "The Clean Air Markets Division." November 15, 1999. www.epa.gov/airmarkets/transition.html US EPA, Clean Air Markets Program. "State Summary SO2 Emissions Data by Plant." www.epa.gov/acidrain/emission/nj/nj_so2.htm US EPA, Office of Air and Radiation. "1997 National Air Quality Trends Brochure—Acid Rain." www.epa.gov/oar/aqtrnd97/brochure/acidr.html US EPA, Office of Air and Radiation. "1997 National Air Quality: Status and Trends." www.epa.gov/oar/aqtrnd97/brochure/so2.html US EPA, Office of Air and Radiation. "1997 National Air Quality Trends Brochure—Visibility." www.epa.gov/oar/aqtrnd97/brochure/vis.html US EPA, Office of Air and Radiation. *Benefits and Costs of the Clean Air Act: Final Report to Congress on Benefits and Costs of the Clean Air Act, 1990 to 2010*. 1999. www.epa.gov/oar/sect812/ US EPA, Region 5. "Sulfur Dioxide." www.epa.gov/ARD-R5/naaqs/so2.htm
Current Policy and Regulatory Framework	

Issue: Acid Precipitation
Author: John Posey
Version: 01/01

Federal	There are three National Ambient Air Quality Standards (NAAQS) for SO2: an annual arithmetic mean of 0.03 ppm (80 ug/m3); a 24-hour level of 0.14 ppm (365 ug/m3); and a 3-hour level of 0.50 ppm (1300 ug/m3). The first two standards are primary (health-related) standards, while the 3-hour NAAQS is a secondary (welfare-related) standard. The annual mean standard is not to be exceeded, while the short-term standards are not to be exceeded more than once per year.
State & Local	

Oxides of sulfur and nitrogen cause acid deposition. Deposition can be either wet (i.e., acid rain) or dry (i.e., the settling of particulates on buildings or flora). Acid rain has caused severe damage to lakes and forests in Europe and in the Adirondacks. However, available evidence from a longitudinal survey of acid levels in NJ indicates that acid rain has not impaired the ecological integrity of forests or aquatic ecosystems in this state. In addition, dry deposition can cause damage to structures made out of marble or limestone. However, most damage is cosmetic, and does not affect the functional value of buildings. Damage to culturally significant buildings and monuments might reasonably be considered an aesthetic impact. However, damage caused by acid deposition is less than that caused by natural non-acidic rain. There is little evidence to indicate that acid depositions are causing measurable socio-economic impacts in NJ. Sulfur dioxide gas, which has significant human health and aesthetic impacts, is dealt with in a separate writeup.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	0.1	1	1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	0.3	0.3	3	3	0.3

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
1.38	**1.38**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	2	2	1	2	1	1.6

Trend: ++

Catastrophic Potential: L

Issue: Acrolein
Author: John Posey
Version: 01/01

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework **Findings/Notes**

Hazard Identification	
Stressor	**Acrolein**
Description of stressor	Acrolein is a yellowish liquid with a piercing odor. It is used in making plastics, drugs and tear gas. It is also used in some herbicides used in irrigation canals. Acrolein is also present in tobacco smoke, but tobacco-related health effects are covered in a separate writeup.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Acute exposure can be fatal. Acute exposure is usually work-related. For example, in 1999, a worker who used an acrolein-based pesticide was killed after inhaling large amounts of the substance following a spill (Associated Press, 1999). Chronic exposure can lead to permanent lung damage. Acrolein can be formed when any organic substance is burned. A French medical journal reports that a toddler was exposed to life-threatening acrolein poisoning when hot oil was left on a burning stove for a period of hours, and some concern has been voiced over exposure of restaurant workers (Mahut et al., 1993). Acrolein appears to pose little risk when ingested, and effects on fish and mollusks are considered minimal. The Canadian Department of the Environment (2000) finds that "Acrolein is rapidly metabolized by organisms and does not bioaccumulate." Nordone (1998) exposed fish to high doses of acrolein, and reported that "the metabolism of acrolein is so rapid in the edible tissues of these species that neither acrolein nor its major oxidative and reductive metabolites, acrylic acid and allyl alcohol, respectively, were detected." Eisler (1998) reports that "acrolein degrades quickly in soils and in plant tissues; in water the half-time persistence is usually less than 50 hours…." Chronic exposure to acrolein causes respiratory dysfunction in animals, and is assumed to produce similar effects in humans. Assessments of human health impacts are based on animal studies. Beauchamp et al., (1985) provides a detailed literature review of animal toxicity studies. Respiratory dysfunction observed in animals exposed to chronic subacute levels of acrolein included respiratory rate depression, bronchoconstriction, lesions in the respiratory tract (including lesions in trachea, bronchi and lungs), depression of mucociliary functions, edema (abnormally high amounts of fluid in intercellular tissue) in the larynx, and squamous metaphasia (the replacement of normal cells with flat, scale-like cells) in the trachea. Rats and rabbits exposed to subacute and chronic exposures experienced inflammatory lung lesions including septic bronchitis, bronchiolitis and bronchopneumonia. In addition, acrolein appears to depress immunological functions in the lung, resulting in depressed resistance to pathogens such as salmonella. Ghilarducci and Tjeerdema (1995) provide a more up to date overview of the toxicology of acrolein. These authors find that subacute chronic exposure to acrolein causes tissue irritation in the upper respiratory tract, nasal passages and lungs. Other respiratory functions included pulmonary edema and exposure-related lesions.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Medical costs due to chronic exposure are the principal impact assessed here. (Acute exposures in NJ appear to be very rare.) In addition, there is some evidence that air pollution in general reduces property values. To the extent that acrolein contributes to an overall level of pollution, acrolein may be considered a threat to property values. The effect on property values is very difficult to measure, however.

Key impacts selected (critical socio-economic effects)	Costs incurred, property values.	
Exposure Assessment		
Socio-economic entities exposure routes and pathways considered	As noted above, acrolein can cause respiratory damage when it is inhaled. Inhalation of acrolein as a particle is the main exposure route. According to the EPA Cumulative Exposure Project, 55% of atmospheric acrolein in NJ comes from area sources, while 45% comes from mobile sources. Less than 1% results from point-source pollution.	
Quantification of exposure levels statewide	The EPA has established a health benchmark known as a Reference Concentration (RfC) of .02 micrograms per cubic meter. This RfC is based on the animal studies cited above. EPA estimates that exposure to chemical levels at or below the RfC will not result in the occurrence of chronic noncancer effects. Exposure to levels over the RfC may result in adverse health consequences, although there is no estimate of the number and type of maladies that will result. (EPA, 2001.) In 1990, the statewide ambient acrolein level was .37μg/m^3, 19 times higher than the RfC. In 1996, the EPA modeled ambient concentration average estimate was .163μg/m^3, just over 8 times the RfC (NJDEP, 2000). It should be noted that exposure is defined as concentration multiplied by time. Thus, the concentrations reported here are not identical to the exposure level. Estimating the actual exposure would require an estimate of the amount of time spent indoors as opposed to outdoors. Still, exposure is a function of ambient concentrations, and for the purposes of this writeup concentration may be used as an adequate proxy for exposure.	
Specific socio-economic entities at increased risk	Urban areas have higher concentrations. In 1996, the highest recorded levels were in Hudson and Essex Counties.	
Quantification of exposure levels to entities at increased risk	Hudson county: .393μg/m^3. Essex County: .242 μg/m^3. Source: NJDEP, 2000.	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	Epidemiologists compute hazard ratios by dividing the RfC by the corresponding Reference Exposure Level. The formula is as follows: $HR_{ij} = C_{ij}/RFC_j$, where HR_{ij} is the hazard ratio for pollutant j in tract i, C_{ij} is the concentration in μg/$m^3$of pollutant j in tract i, and RfC_j is the reference concentration for pollutant j in μg/m^3. (Morello-Frosch, 2000)	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score

Property Values	Severity: Severity: Since 1967, there have been dozens of articles which contain estimates of the impact of air pollution on property values. Two principal methods have been used. *Hedonic valuation* is a method whereby numerous determinants of property value are entered into a multivariate regression model. If the list of independent variables includes a measure of particles in micrograms per square meter, then the parameter attached to this variable may be seen as the amount that 1 additional microgram per meter^3 will decrease the value of a house. *Contingent valuation* is essentially a survey method, in which assessors or property buyers are asked how much more or less they would pay for a significant improvement (or deterioration) in air quality. For example, a literature review by Acks (1995) refers to a classic 1975 regression by Nelson which indicated that in the Washington, D.C. area, a doubling of oxidant pollution levels would decrease property values by 1.7%. A meta-analysis by Smith and Huang (1995) included a review of 83 hedonic regression studies. They report that in these studies, the mean marginal willingness to pay (MWTP) for a reduction in suspended particles is $109.90 per microgram/m^3. Chattopadhyay (1999) estimates that all things being equal, a household will pay between $2,037 and $3,350 to live in an area with 25% less air pollution. Harrison and Rubenfeld (1978) offer the figure of $1,816 to $2,846 for a 25% reduction. Although there are a wide variety of studies in this vein, they offer little guidance with respect to the problem of estimating the property value loss attributable to one pollutant, such as acrolein. There are two possible hypotheses which, on their face, seem equally plausible. First, one might argue that a specific chemical will only affect property values if the general population is aware of that chemical. Since the general public is not terribly aware of acrolein, it may be argued that acrolein can have little impact on property values. A second hypothesis would be that acrolein constitutes a certain amount of the total suspended matter in the atmosphere, and that this percentage can be applied to overall hedonic estimates of the impact of suspended particles. Assuming generously that acrolein contributes 10% of the particulate pollution problem on average, and that property values are suppressed by $3000 relative to what they might otherwise be on average, then the unit impact is on the order of $300 per household. Given that there are 2,794,711 occupied housing units in NJ (2000 Census), this yields an impact estimate of about $838 million. This is well below the $2.18 billion threshold for a Medium impact, suggesting that the score should be "1" or Low. Without a firmer theoretical base, it is probably futile to try to estimate the property value impact of a specific chemical. Additional research on this problem would be useful. One possible direction would be to enter health impacts into hedonic regressions. It may be that at some level, the health impact of environmental risks is factored into prices of homes. If a researcher could estimate a parameter for the property value loss associated with an additional 1/10,000 risk of lung disease, then this type of figure could be applied to a wide variety of carcinogens. In the absence of stronger theoretical and empirical guidance, it seems prudent to give a score of "1" to acrolein, while acknowledging that the level of uncertainty is high.	*1*
	Duration/irreversibility: easily reversed	1
	Scale: statewide problem	3
	Uncertainty: The possibility that acrolein warrants a severity rating of 2 or 3 is low. While our understanding of the precise effects is fairly limited, the impact of that lack of understanding is not likely to be profound.	2
Employment	Severity: No effects hypothesized.	*0.1*
	Duration/irreversibility: easily reversed	1

	Scale: statewide	3
	Uncertainty: low	1
Costs Incurred	Severity: *Mortality, Cancer, Developmental Disorders:* There is little available evidence concerning the number of illnesses or deaths attributable to atmospheric acrolein. A 1988 study by the National Academy of Sciences concluded that "there is no information on human carcinogenicity or other chronic effects of acrolein…." The EPA Office of Air Quality Planning and Standards states that "no information is available on the reproductive or development effects of acrolein in humans….no information is available on the carcinogenic effects of acrolein in humans." *Respiratory Disorders:* There is a consensus that chronic exposure to atmospheric acrolein will cause respiratory dysfunction, but there are no epidemiological studies available that quantify the number of illnesses, or their seriousness. EPA explains that the health threshold under the Clean Air Act is "based on squamous metaplasia and neutrophilic infiltration of nasal epithelium in rats." Morello-Frosch (2000) computed a "total hazard index" representing the combined non-cancerous effects of 188 hazardous air pollutants listed in the Clean Air Act. Using this index on California data, acrolein was found to be the largest contributor to estimated noncancer risk, accounting for 89% of the hazard index. This means that acrolein alone accounted for 89% of the risk associated with the 188 hazardous air pollutants in the study. The Bergen Record sponsored a similar study of toxic air pollutants in NJ in 1999. This report also focussed special attention on acrolein. The study found that "only a few such pollutants are present at high enough levels to be potential causes of other [non-cancer] problems. Chief among these substances is acrolein….The only pollutant that exceeds the chronic health benchmark in every census tract in the state is acrolein—a yellowish flammable liquid with an unpleasant, extremely pungent odor….In New Jersey, acrolein ranges from 1.7 times the health benchmark in Cape May to 404 times in Salem County." Beauchamp et al., (1985) review studies of the effects of chronic subacute exposure to acrolein on several mammals. Studies have found that low-level acrolein exposure can lead to the following respiratory disorders: lesions in the respiratory tract, trachea, bronchi and lungs; bronchitis; bronchiolitis; bronchopneumonia; squamous metaplasia; interstitial pneumonitis; inflammatory lung lesions; septic bronchitis; necrotizing bronchitis; and impairment of pulmonary function. Ghilarducci and Tjeerdema (1995) review more recent studies. These findings are consistent with those described in Beauchamp et al. Conditions associated with chronic subacute exposure to acrolein include tissue irritation in the upper respiratory tract, pulmonary edema, severe irritation and lesions in lung tissue. However, HHTWG advises that the types of lung damage mentioned in the above articles are unlikely to produce hospitalization, and the HHTWG writeup on acrolein does not include an estimate of the number of medical cases that may result from acrolein inhalation. Thus, although acrolein levels in NJ exceed EPA target levels by more than an order of magnitude, acrolein cannot be linked to any specific medical costs.	*2*

	b) Duration/irreversibility: Some of the conditions described above (e.g., squamous metaplasia) can abate if the underlying cause is removed. However, it appears possible for acrolein to cause permanent respiratory damage. . c) Scale: Acrolein levels still exceed the EPA safety threshold in every county.	2 ___ 3
	Uncertainty: There is a high degree of uncertainty associated with this assessment.	3
Aesthetic Levels	Severity: No effects hypothesized.	*0.1*
	Duration/irreversibility: easily reversed	1
	Scale: statewide impact	3
	Uncertainty: low	1
Psychological Impacts	Severity: No effects hypothesized.	*0.1*
	Duration/irreversibility: easily reversed	1
	Scale: statewide impact	3
	Uncertainty: low	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	M: Too little is known about the public health effects of chronic acrolein exposure. Research by Morello-Frosch on pollution in California indicates that it is possible that acrolein creates significant medical costs. Basic epidemiological information is needed.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	0 HHTWG reports no discernible trend.	
Potential for catastrophic impacts (H,M,L) and brief description	L: Available reports on the dangers of acrolein do not indicate that there is a serious risk for a widespread loss of life or environmental cataclysm due to acrolein.	
Incidence of impacts (affected sub-groups, variability, equity issues)	The highest concentrations in the state are in Hudson and Essex Counties. These are urban counties with a disproportionate number of low-income households. Thus, acrolein is a potentially significant environmental justice issue.	
Extent to which threat is currently regulated	See Federal and State regulation, below.	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		
NJ Primary Sources		

Large business/industry	L
Small business industry	M: 55% of acrolein comes from area sources, of which small businesses such as restaurants are possible contributors.
Transportation	H: According to EPA, 45% of acrolein in the environment comes from mobile sources.
Residential	M: Residential practices such as outdoor grilling and fireplace use may contribute to area sources.
Agriculture	L: Although acrolein is sometimes used as a pesticide, the substance biodegrades rapidly in water and soil, and is metabolized easily by animals.
Recreation	L: Most acrolein comes from cars or industries, but jet skis produce disproportionate amounts of the substance.
Resource extraction	L
Government	L
Natural sources/processes	L: Though acrolein can be formed by any burning substance, most acrolein in the atmosphere comes from cars or industry.
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. Deposition	M: 55% of the acrolein in the atmosphere comes from area sources.
Biota sinks	L
References	Associated Press. "Teacher Dies After Being Exposed to Chemical Used to Kill Moss." August 25 1999. Kenneth Acks. "Valuation of Environmental Damages to Real Estate." 1995. Www.damagevaluation.com/text/html/valredi4.htm Sudip Chattopadhyay. "Estimating the Demand for Air Quality: New Evidence Based on the Chicago Housing Market." *Land Economics*, Vol. 75(1) pp. 22-38. February 1999. R. Eisler. "Acrolein Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review." *Biological Report*, vol. 23. 1994. National Academy of Sciences. *Air Pollution, the Automobile, and Public Health*. 1988. S. Gangolli, ed. *The Dictionary of Substances and their Effects*, 2nd edition. London: Royal Society of Chemistry, 1999. B. Mahut, C. Delacourt, J. de Blic, TM Mani, P. Scheinmann. "Bronchiectasis in a Child after Acrolein Inhalation." *Chest*, vol. 104 no. 4. October 1993.

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Current Policy and Regulatory Framework	
Federal	The OSHA limit for occupational exposure to acrolein in 0.1 ppm over an 8 hour work shift. NIOSH recommends that the level of 0.3ppm not be exceeded during any 15-minute work period. The EPA, under the 1990 Clean Air Act, has established the target level of 0.02 micrograms per cubic meter.
State & Local	The NJ Department of Health and Senior Services consider acrolein a hazardous substance. The New Jersey Right to Know Act requires industries to report on the amount of acrolein to which workers and communities are exposed.

Issue: Acrolein
Author: John Posey
Version: 01/01

Issue description: **Acrolein** is used in the production of plastics, drugs, tear gas, and certain herbicides. It can also be formed when any organic substance is burned. Acute exposure can be fatal, but this is rare. Chronic exposure can result in permanent lung damage. Most of the social cost of the substance results from atmospheric levels of acrolein. Most of the acrolein in the atmosphere comes from smokestack or tailpipe emissions. In 1996, the statewide level of atmospheric acrolein was eight times higher than the EPA reference concentration, and each county in the state exceeded this threshold. There is some evidence from California that of all pollutants on the EPA Hazardous Air Pollutant (HAP) list, acrolein is one of the most significant dangers to health. Unfortunately, there are no available estimates of the number of illnesses or deaths that are caused by acrolein. Still, toxicological studies in many mammals reveal that acrolein can cause several different types of damage to the respiratory system, including lesions throughout the upper respiratory tract, bronchopneumonia, bronchitis and bronchiolitis. If acrolein accounts for just 1.5% of the respiratory hospitalizations that are potentially connected to these conditions, then the economic cost of acrolein-related illness exceeds the threshold for "moderate" impact ratings under NJCRP guidelines. Uncertainty, however, is high.

Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	0.1	1	0.1	0.1
Duration/ Irreversibility	1	1	2	1	1
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	3	0.3	6	0.3	0.3

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
1.98	**1.98**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	2	1	3	1	1	1.6

Trend: ++
Catastrophic Potential: L

Issue: Arsenic
Author: Branden Johnson
Version: 05/22/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor –Specific Risk Assessment

Socio-economic Risk Assessment Framework **Findings/Notes**

Hazard Identification	
Stressor	**Arsenic** (all forms)
Description of stressor	Toxic metal that occurs naturally in soil, but also has been used extensively as a pesticide and can be released to the environment by mining, smelting, and combustion of fossil fuels.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Potentially toxic levels (to the organism or to its consumers) have been observed in Spartina, a wetlands grass, earthworms, freshwater mollusks, tadpoles, turtles, fish, and birds, and mammals at least in the form of poisoning of cattle eating ashes of arsenic-treated posts. In humans, arsenic can induce not only acute poisoning in large doses, but also dermatitis, polyneuropathy (e.g., pain and tenderness in limbs), and cancers of the skin, lung, liver, kidney, and urinary bladder. Exposure can occur through dermal contact, inhalation, and ingestion of contaminated water or soil (among very young children particularly, in the latter case). Arsenic is probably ubiquitous in New Jersey, through its natural occurrence, heavy use in pesticide applications (particularly in Gloucester and Burlington counties, but also Cumberland, Hunterdon, Monmouth, and Salem counties for fruit production, and there and elsewhere for vegetable fields, turf farms, and golf courses), historical releases to the air or water by copper smelting and other industries (including perhaps long-range air transport), and use of arsenic-treated posts for fences and dock supports, among others. Arsenic concentrations appear to vary widely: for example, natural sources can produce levels exceeding the State's cleanup standard for human-contaminated soil by many-fold, although the most contaminated sites appear to be human in origin (e.g., some waste sites). Some 15 million pounds of arsenic were applied to NJ soils in the form of pesticides from 1900 to 1980 (Murphy and Aucott, 1998), but are no longer used; and this is a factor in the difficulty of distinguishing natural from human-caused arsenic concentrations (the soil cleanup standard, set based on natural levels, applies only to cleanup of human-caused concentrations). A 1996-98 survey found levels above this standard in 38% of samples from current and former agricultural sites; NJDEP has estimated that up to 5% of the State's area might be affected by historical pesticide use of arsenic, and arsenic will persist in the environment indefinitely. A soil concentration of 0.4 parts per million over a lifetime is estimated to result in a 1 in a million extra cancer risk due to exposure to residential soil; at the soil cleanup standard of 20 ppm, lifetime exposure would result in a 50 in one million extra cancer risk. Ingestion of 1 part per million can cause illness in children; twice that can cause death. On inhalation risk, USEPA's Cumulative Exposure Project estimated on the basis of modeling 1990 data (thus not on the basis of measures of actual exposure) that average state cancer risk was 3 in one million (maximum 21 in one million); 15 NJ counties averaged at or above 1 in one million risk, with Hudson County highest at 6 in one million. No NJ utility water and few private wells appear to exceed the current drinking water standard of 50 ppb, but it is being revised by USEPA to reduce risk back towards 1 in one million, which it now appears to exceed over a lifetime's consumption. The eventual new standard will be between 2 ppb (which might pose a risk of 1 in 100,000; 67% of 357 utility wells tested in NJ exceeded this level) and 10 ppb (13% of tested wells exceeded this level).
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Property Values; Employment; Costs Incurred; Aesthetic Levels; Psychological Impacts

Key impacts selected (critical socio-economic effects)	Property Values: Hazardous waste sites, and residential sites that become known as contaminated from historical pesticide use, might lower values of overlying or nearby properties. Employment: In the absence of any qualitative or quantitative Ecological estimate of impacts on NJ plant or animal populations, it is difficult to estimate employment impacts, but these might occur for natural resource-associated jobs. Costs Incurred: Medical costs of cancers and other human illnesses must be considered. Aesthetic Levels: No significant impacts. Psychological Impacts: Worry from revelations of elevated arsenic exposures might be high, particularly given arsenic's cultural familiarity as a "poison."	
Exposure Assessment		
Socio-economic entities: exposure routes and pathways considered	The primary route considered is through health effects; given the lack of Ecological impact estimates, the socioeconomic effect of the latter is considered largely for Employment impacts.	
Quantification of exposure levels statewide	Spatial: As noted above, arsenic is assumed to be ubiquitous (but in highly variable amounts) throughout New Jersey due to natural and human sources in air; effects mediated by soil and water exposures are assumed to be more localized but still common. Temporal: Arsenic does not break down in the environment, and thus lasts indefinitely. This means that health and ecological impacts are likely to continue as long as significant amounts of arsenic remain in the environment; however, socioeconomic impacts are likely to be shorter-lived, as when cleanup of waste or historic sites remove exposure.	
Specific socio-economic entities at increased risk	As noted above, six counties are at higher risk of elevated levels of arsenic in soil due to agricultural pesticide use, although isolated sites of soil risk might arise elsewhere due to natural sources or hazardous waste sites or industrial emissions. Two-thirds of NJ counties have estimated levels of arsenic in air above the usual 1-in-a-million extra cancer risk of potential concern to regulators. A significant proportion of drinking water supplies (both utilities and private wells) are probably at excess risk of cancer from arsenic contamination, even though the current public health standard is not exceeded, because this standard has now been determined to be insufficiently protective. Other than these large-scale variations—e.g., residents of former orchards, or of counties at higher imputed air levels—there is no current evidence to suggest that particular subpopulations of humans are at increased risk. No available evidence allows for speculation about non-human species, if any, at elevated risk.	
Quantification of exposure levels to entities at increased risk	See above. Other than the risk estimates offered on the first page, there is no quantification of exposure levels.	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	Except where health risk estimates might be linked to medical cost estimates, the primary approach used here is to estimate the degree of impact that would be needed to move from one category to another (e.g., a minimum of 20,000 jobs lost in relevant economic sectors to shift from a Severity score of 1 to 2), and then determine whether that degree of socioeconomic impact is plausible. This sensitivity analysis approach requires certain assumptions (e.g., the proportion of jobs in an economic sector that might be related to issue-relevant impacts), and depends very heavily on the plausibility of the divisions between categories.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score

Property Values—no significant impacts	Severity—Hazardous waste sites or former farms/orchards that have become residential sites appear to be the only sites of arsenic that could pose property value impacts. However, this impact is attributable, in the case of the waste site, to the official designation of the site itself, which on average contains many other chemicals than arsenic themselves, and thus cannot be attributed entirely to arsenic. It is thus assumed, given the myriad chemicals involved at such sites, that any property value impacts from arsenic will constitute on average no more than a small proportion of the total impacts. This estimate is based on the assumption that for most, if not all, such sites in NJ the complete elimination of arsenic would not alter the sites' property value impacts absent the removal of the other hazardous chemicals on-site, and that arsenic are unlikely to occur at every such site. Former farms are likely to be more heavily dominated by arsenical pesticides, although these also might not comprise all contaminants at such sites (e.g., dieldrin, DDT and DDE have also been found there and might still pose concerns, if much lower, if arsenic disappeared from those sites). The 1997 Known Contaminated Sites list from NJDEP lists contaminated sites statewide (e.g., <u>every</u> community in Atlantic County). 1998 property values statewide in NJ were $518.3 billion. Assuming a 5% drop in property values near arsenic-contaminated sites, and assuming this occurs on 10% of NJ's land area (the maximum estimate of 5% for former-farm sites, and a comparable amount for hazardous waste sites), that would mean a drop of $2.6 billion, considerably less than the threshold of $12.96 billion for assigning a Medium score (2). Greenburg and Hughes (1993:47, Table 1) surveyed tax assessors in all NJ municipalities (response rate 26%). Since 1980 the typical hazardous waste site has had "no impact" on property values, according to 66% of the assessors for properties within ¼ mile of the site, 86% for properties from ¼ to 1 mile, and 93% for properties from 1-3 miles from the site. By contrast, lowering of property values "a good deal" (more than 25%) occurred in the communities of 7% of assessors for properties within ¼ mile and from none of them for other properties; a lowering of "somewhat" (5-25%) was reported by 21%, 9% and 2% of the assessors for the three distances, respectively. These results suggest that the 5% assumption is not inappropriate.	*1*
	Irreversibility—Property value studies show that these values rebound once cleanup has been completed.	1
	Scale—Although waste sites occur throughout the state, the property value impacts themselves are limited to properties in the immediate vicinity of the sites.	1
	Uncertainty	2

Employment	Severity: A threshold of 20,000 jobs is needed to assign a medium (2) score. The 1997 statewide total of jobs at most likely to be affected were 29,000 (agriculture--includes production of livestock and crops, services, forestry, and fishing/ trapping/hunting), plus 74,000 (hotel and other lodging) and 38,000 (amusement and recreation services) for recreational users of potentially affected resources. I assumed that jobs could be affected statewide, given the geographic scope of arsenic. If all of these jobs were related to resources affected by arsenic, the minimum impact on those resources of the plants would have to be 14% to yield 20,000 jobs. However, less than all hotel/lodging and amusement/recreation should be affected (e.g., business trips, beach trips, etc. won't be relevant). Assuming 10% of these latter two job categories are relevant (e.g., to use of these services by birders or non-resident anglers), then that minimum impact level is 45%. This seems implausible on current evidence.	*1*
	Irreversibility: Although the potential for substitution of jobs is high in a booming economy, its persistence is uncertain, and potentially affected jobs in natural resource use sectors (like farming or fishing) could be already operating with marginal profits, making even small impacts more consequential than otherwise. Thus I am rating the irreversibility as Medium.	2
	Scale—statewide, given wide occurrence of arsenic and lack of any evidence suggesting more concentrated ecological impacts than that	3
	Uncertainty—ecological impacts are very poorly documented	3
Costs Incurred	Severity: If we take at face value the earlier figures about the proportion of NJ land that exceeds 20 ppm and the risk estimates for soil exposure, and assume that the rest of NJ's area is at the 0.4 ppm level that produces a 1-in-a-million added cancer risk and that the population is distributed similarly, that implies about 8 additional cancer cases at the higher level, and another 8 at the lower level, across the full NJ population of 8 million people. If we assume 1-in-a-million risk for air exposure for all NJ residents, which overestimates the average risk at the county level, that would be another 8 cancer cases; this would rise to 48 cases if all residents were exposed to air concentrations of arsenic equal to the Hudson county average. Let us assume the probable overestimates, based on earlier health and monitoring estimates, that 13% of all water consumers in NJ have been consuming arsenic at 50 ppb, 54% at 10 ppb, and 33% at 2 ppb. Assessed over the state's entire population, these would imply a maximum of 260, 216, and 26 cancer cases from drinking water, respectively. Overall, these very rough estimates sum to 526-566 cancer cases.	

	If we assume these average the 1997 NJ in-patient (i.e., hospital) medical costs for lung cancer, of $13,818 for "respiratory neoplasm," this would sum to $7.3-7.8 million; at the cost of $23,322 for each bladder cancer case (which might allow for the out-patient medical costs excluded from these DHSS in-patient estimates) these figures would sum to $12.3-13.2 million. The threshold for a Medium (2) score is $16,000,000 statewide. Given that it is impossible to estimate ecological costs (other than Employment impacts) that might arise from arsenic in the environment, and the uncertainty in estimating medical costs even with the overestimates used above, it is prudent to judge Severity as Medium. [Note added by John Posey, 7/13/01: NIH figures published in 2001 (See Brown et al.) indicate that the "average" cost of a case of cancer is around $60,000 per case (see the "quantitative and qualitative impact assessment employed" section in the writeup on 1,3-butadiene for additional information on this calculation.) If applied to this risk assessment, this would result in an upward revision of the estimated cost associated with arsenic-related cancers. However, the upward revision would not be great enough to change this severity rating."	*2*
	Irreversibility—likely to have moderate effect on an individual's standard of living	2
	Scale—	3
	Uncertainty	3
Aesthetic Levels—no significant impacts	Severity	*1*
	Irreversibility	1
	Scale	1
	Uncertainty	1
Psychological Impacts—no significant impacts	Severity--high worry likely for average New Jerseyan about hazardous waste sites' or historic-pesticides-areas' impact on family and community; for simplicity this score will be assigned on the presumed effect of "hazardous waste sites," even though arsenic is a small portion of all hazardous components of such waste across the state, because people are unlikely to discriminate their worry by individual chemicals; this approach will lead to gross double-counting of worry's severity across environmental issues, but is more straightforward than chemical-specific worry scores. Drinking water worry might be high also, if the public learns about the reduction in a public health standard because it now seems to have been inadequately protective.	*3*
	Irreversibility—worry appears to disappear slowly for those who lived in the neighborhood of a hazardous waste site before it was identified and remain there after it is remediated; however, people who move into such a neighborhood after cleanup tend to see the area as better than their previous neighborhood and not be worried; between old residents moving out of a contaminated area to avoid further worrying and new residents moving in after cleanup, the irreversibility of worry in this case is assumed to be moderate at worst.	2
	Scale—hazardous waste sites occur statewide but with only very localized impacts on worry; former agricultural sites are less widespread, although still extensive.	1
	Uncertainty—such worry is well-established	1

Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description (data gaps; highlight significant data needs)	H: Ecological impacts are the biggest gap, since there are no data on whether these occur in NJ, much less with what severity or geographic scope. Bringing air exposure data up to date, particularly with confirmatory monitoring rather than modeled data, also would be of great help.
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, ---, where + is improvement) and brief description	++: The projected lowering of the drinking water standard for arsenic should reduce arsenic risks to health substantially, even if that reduction's magnitude is uncertain. The other health and ecological risks, and their socioeconomic outcomes, are likely to endure indefinitely, if declining slowly as waste sites are cleaned up and problems with former orchards resolved through covering or removal of exposed and contaminated soils.
Potential for catastrophic impacts (H,M,L) and brief description	Low: Although the Ecological analysis characterized arsenic as having potentially Medium catastrophic impacts on aquatic systems where massive amounts are released to the environment from human activities, it is likely that any socio-economic impacts will have Low catastrophic potential. If particular ecosystems reach a catastrophic "tipping point" (e.g., where a threatened plant becomes too few in number to survive, and rapidly decreases to extinction), the consequent socio-economic impacts are likely to be small enough and restricted enough in geographic extent to not count as catastrophic.
Incidence of impacts (affected sub-groups, variability, equity issues)	As noted above, equity issues are deemed to be relatively insignificant.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	The following discussion is largely adapted from divergent estimates in the Health and Ecological analyses of Arsenic.
Large business/industry	M: 1997 data show 49 facilities reporting arsenical compounds stored onsite in amounts of 500 pounds or more; only one facility has had reportable fugitive releases (5 lbs. 1995, 2 lbs. each in 1996 and 1997)
Small business/industry	M: discharge in effluent from metal/fabricated metal products, wood preserving, and battery manufacturing; fugitive emissions?
Transportation	L
Residential	L-M (latter figure from past uses)
Agriculture	H (past use)
Recreation	M (golf course applications)
Resource extraction	L in NJ, higher elsewhere (and affecting NJ through long-range transport)
Government	L-M (latter figure from past uses)

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Natural resources	M-H from natural geologic formations
Orphan contaminated sites	M
Diffuse Sources	
Sediment sinks	M statewide, H in certain locations
Soil sinks	M statewide, H in certain locations
Non-local air sources incl. deposition	M global atmospheric transport from mining, manufacturing, and fossil fuel combustion.
Biota sinks	Relatively few plants and animals will sequester arsenic; in most cases it will cycle quickly back to the environment.
References	Greenberg, Michael and James Hughes. "Impact of hazardous waste sites on property value and land use: Tax assessors' appraisal." The Appraisal Journal. January 1993, pp. 42-51. Murphy, E.A. Aucott, M. 1998. An assessment of the amounts of arsenical pesticides used historically in a geographical area. Science of the Total Environment. July 30, 1998. vol. 218, no. 2-3, pp. 89-101.
Current Policy and Regulatory Framework	
Federal	Arsenical pesticides were banned. Arsenic is included in federal regulations on air emissions, hazardous waste, and other environmental programs.
State & Local	New Jersey has adopted the soil cleanup standard, which it applies in remediation of hazardous waste sites, and convened a Task Force to recommend policies to address the challenge of historic agricultural pesticide contamination. Industrial storage and releases are tracked and regulated, although small amounts fall below reporting thresholds. Some counties (e.g., Burlington) have instituted rules on soil testing.

Issue description: Arsenic is a toxic metal that occurs naturally in soil, but also has been used extensively as a pesticide and can be released to the environment by mining, smelting, and combustion of fossil fuels. NJDEP has estimated that up to 5% of the State's area might be affected by historical pesticide use of arsenic, and arsenic will persist in the environment indefinitely. A soil concentration of 0.4 parts per million over a lifetime is estimated to result in a 1 in a million extra cancer risk due to exposure to residential soil; at the soil cleanup standard of 20 ppm, lifetime exposure would result in a 50 in one million extra cancer risk. Ingestion of 1 part per million can cause illness in children; twice that can cause death. On inhalation risk, USEPA's Cumulative Exposure Project estimated on the basis of modeling 1990 data (thus not on the basis of measures of actual exposure) that average state cancer risk was 3 in one million (maximum 21 in one million); 15 NJ counties averaged at or above 1 in one million risk, with Hudson County highest at 6 in one million. No NJ utility water and few private wells appear to exceed the current drinking water standard of 50 ppb, but it is being revised by USEPA to reduce risk back towards 1 in one million, which it now appears to exceed over a lifetime's consumption. The eventual new standard will be between 2 ppb (which might pose a risk of 1 in 100,000; 67% of 357 utility wells tested in NJ exceeded this level) and 10 ppb (13% of tested wells exceeded this level).

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Socio-economic Impact Evaluation of Environmental Issue:

Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).

Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	1	2	0.1	3
Duration/ Irreversibility	1	2	2	1	2
Scale (spatial, population)	1	3	3	1	1
Subtotal Risk	1	6	12	0.1	6

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
5.02	**3.22**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	2	3	3	1	1	2

Trend: ++

Catastrophic Potential: L

Issue: Asian Longhorned Beetle
Author: John Posey
Version: 11/00

NJ Comparative Risk Project
Socie-economic TWG
Stressor-Specific Risk Assessment

Stressor: **Asian Longhorned Beetle**

The Asian Longhorned Beetle is an insect that is indigenous to China. Officials believe that it entered the United States in wooden crates shipped from China. It was first discovered in Brooklyn in 1996. Since then, it has been found in Chicago and Long Island. The ALB causes serious damage to trees. It prefers maple trees, but has been known to attack other hardwoods. Because it is not native to this hemisphere, it has no natural enemies. No chemical control has yet been identified. The only treatment is the complete removal and incineration of infected trees. In the Brooklyn case, the removal and replacement of infested trees cost the state government $2.5 million.

The New Jersey Department of Agriculture aggressively monitors forests in the state in order to detect any ALB infestation. Since 1997, state inspectors have surveyed hardwood trees for signs of damage. In FY 2001, $180,000 was allocated toward participation in Cooperative Agricultural Pest Survey (CAPS) with USDA. Thus far, no live ALBs have been found in NJ forests. However, in 1998 a related beetle was found in a warehouse in New Brunswick. The crates containing the insect were burned, insect traps were placed, and surveyors inspected trees within a quarter-mile radius.

About 42% of New Jersey's 4.2 million acres are forested. Thus, if an unchecked ALB infestation occurred, the economic impact could be enormous. However, this worst-case scenario is unlikely. ALB outbreaks have been rare and isolated in the U.S. since their discovery in 1996. USDA now requires special treatment of all wooden crates shipped into the U.S. Thus, the threat of new insects arriving has decreased. USDA also quarantines affected areas, and regulates the interstate movement of regulated articles from quarantined areas. In addition, both the NJ Department of Agriculture and USDA continually monitor state forests for any outbreak of ALB infestation. The ALB appears to spread fairly slowly. Any new infestation would likely be detected before it became widespread. The remediation of the infestation would create some costs, but the damage would probably be limited.

Existing state and federal efforts to control the ALB seem eminently sensible. Assuming these efforts continue, future socio-economic impacts will continue to be minimal.

References:

Arthur Brown. "Report to the State Board of Agriculture." July, 2000. www.state.nj.us/agriculture/sboa0007.htm

Mark McGarrity. "Meet the Beetles: Tree-Eating Asian Longhorns Inching Their Way Toward New Jersey." *Newark Star-Ledger*. June 3, 1997.

New Jersey Department of Agriculture. "News Release: AG Secretary Visits First Line of Defense Against Foreign Plant Pests." September 15, 1999. www.state.nj.us/agriculture/p90916b.htm

New Jersey Department of Agriculture. Annual Report 1998: Plant Industry. www.state.nj.us/agriculture/annual98/plant.htm

New Jersey Department of Agriculture. Annual Report 1999: Plant Industry. www.state.nj.us/agriculture/annual99/plant.htm

New Jersey Department of Environmental Protection, Division of Parks and Forestry. "New Jersey Forest Health." 2000. www.state.nj.us/dep/forestry/service/njfs_forest_health.html

United States Department of Agriculture, Animal and Plant Health Inspection Services. "Asian Longhorned Beetle: Plant Protection and Quarantine." September, 1998. www.aphis.usda.gov/oa.alb

Issue: Asian Longhorned Beetle
Author: John Posey
Version: 11/00

United States Department of Agriculture, Animal and Plant Health Inspection Services. "Federal Quarantine Areas and Regulations." September 28, 2000. www.aphis.usda.gov/oa.alb

Issue description: Asian Longhorned Beetle (ALB): The ALB is an insect that is indigenous to China. It was first discovered in the United States in 1996. Thus far, it has only been detected in Brooklyn, Long Island, and Chicago. The ALB causes serious damage to hardwood trees. Its preferred tree is the maple. The ALB has no natural enemies in this hemisphere, and there is no known chemical treatment. If left unchecked, the ALB could do serious damage to northeastern forests. In cooperation with USDA, the NJ Department of Agriculture aggressively monitors NJ forests in order to detect any ALB infestation. Thus far, no ALB has been found in NJ forests. Assuming that detection efforts remain in place, the socio-economic impact of the ALB should continue to be minimal over the next five years.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	1	0.1	1	1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	1	0.1	1	1	0.1

Average Risk (0 – 5 years)	Average Risk (5 years plus)
0.64	0.64

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	1	1	1	1

Trend: -
Catastrophic Potential: M

Issue: Benzene
Author: John Posey
Version: 01/01

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Stressor: **Benzene**

The following description is taken from the Agency for Toxic Substances and Disease Registry (ATSDR): "Benzene is a naturally occurring substance produced by volcanoes and forest fires and present in many plants and animals, but benzene is also a major industrial chemical made from coal and oil. As a pure chemical, benzene is a clear, colorless liquid. In industry, benzene is used to make other chemicals, as well as some types of plastics, detergents, and pesticides. It is also a component of gasoline."

EQTWG declined to produce a write-up on benzene. Therefore, this write-up is predicated on the assumption that the principal socio-economic impacts related to benzene will be associated with human health effects.

ATSDR states the following about human health effects: "From overwhelming human evidence and supporting animal studies, the U.S. Department of Health and Human Services has determined that benzene is carcinogenic. Leukemia (cancer of the tissues that form the white blood cells) and subsequent death from cancer have occurred in some workers exposed to benzene for periods of less than 5 and up to 30 years. Long-term exposures to benzene may affect normal blood production, possibly resulting in severe anemia and internal bleeding. In addition, human and animal studies indicate that benzene is harmful to the immune system, increasing the chance for infections and perhaps lowering the body's defense against tumors. Exposure to benzene has also been linked with genetic changes in humans and animals. Animal studies indicate that benzene has adverse effects on unborn animals. These effects include low birth weight, delayed bone formation, and bone marrow damage."

Benzene is one of the 188 Hazardous Air Pollutants (HAPs) listed in the clean air act. As such, it is monitored by the EPA Cumulative Exposure Project (CEP). NJDEP reports that since the passage of the Clean Air Act in 1990, air toxics have decreased steadily. According to DEP, "New Jersey sources have reduced their total air toxic emissions by almost 60% since 1990." Benzene appears to have followed this trend. According to CEP, atmospheric benzene levels in 1990 were estimated at 3.3 micrograms per cubic meter in NJ. In 1996, this level had dropped to 1.66 micrograms, a 50% reduction.

Even so, benzene levels in NJ remain above benchmarks established by EPA. The EPA safety threshold for benzene is .12 micrograms per cubic meter. This benchmark is considered to be the level at which 1 lifetime case of cancer will occur per million persons. Since the NJ level is about 13.8 times higher than the benchmark, this indicates that the lifetime cancer rate attributable to benzene will be 13.8 per million. Since there are about 8.1 million persons in NJ, we may expect 104 lifetime cases of benzene-related cancer. If we assume that lifetime cancer incidences are spread out over approximately 70 years, then we may expect 1 to 2 cases of benzene-related cancer each year in NJ. According to NIH, an average case of cancer costs about $60,000 (see write-up on 1, 3 -butadiene for additional information on this calculation). Thus, the worst case costs associated with Benzene are significantly lower than $1 million per year. NJCRP guidelines require an impact of $16 million or greater for a "moderate" impact rating.

Non-cancer effects are more difficult to quantify. However, there is little indication that benzene is causing even moderate non-cancer medical costs to occur. A study by Morello-Frosch et al. attempted to quantify the relative hazards posed by HAPs in California. With respect to non-cancer risk, the authors concluded that benzene was not among the 9 most serious HAPs. Benzene contributed less than 0.2% of the total non-cancer hazard related to HAPs. Assuming that NJ has some semblance to California's urban areas, it is unlikely that Benzene causes serious non-cancer health costs in NJ.

Another possible concern is the effect of benzene-contaminated soil. It may be theorized that brownfields containing benzene may depress the market value of nearby properties. However, it is difficult to document how much benzene contributes to the problem of brownfields in NJ. The Superfund National Priorities List currently contains 577 NJ properties. In none of these is benzene or naphtha listed as a chemical of concern. More broadly, repeated searches of economic literature were unable to find even one article discussing the relationship between benzene and property values. Thus, there is currently no basis for concluding that benzene is a serious threat to property values in NJ.

No impacts are hypothesized with respect to employment and aesthetics. There is no evidence that the public is seriously worried about benzene.

Issue: Benzene
Author: John Posey
Version: 01/01

References:

Martin Brown, Joseph Lipscomb and Claire Snyder. "The Burden of Illness of Cancer: Economic Cost and Quality of Life." *Annual Review of Public Health volume* 22 pp. 91-113. 2001.

Rachel Morello-Frosch, Tracey Woodruff, Daniel Axelrad, and Jane Caldwell. "Air Toxics and Health Risks in California: The Public Health Implications of Outdoor Concentrations." *Risk Analysis*, volume 20, number 2. 2000.

NJDEP. "Air Toxics Improvement in New Jersey Since 1990." www.state.nj.us/dep/airmon/airtoxics/improve.htm

NJ Department of Health and Senior Services. "Hazardous Substance Fact Sheet: Benzene." November, 1994. http://www.state.nj.us/health/eoh/rtkweb/rtkhsfs.htm

U.S. Center for Disease Control, Agency for Toxic Substances and Disease Registry. "Public Health Statement: Benzene." May, 1989. www.atsdr.cdc.gov/ToxProfiles/phs8803.html

U.S. EPA. 1996 Modeled Ambient Concentrations for Benzene. www.epa.gov/ttn/uatw/nata/tablconc.html

U.S. EPA. "Carcinogenic Effects of Benzene: An Update." April 26, 2000. www.epa.gov/ncea/benzene.htm

U.S. EPA. "Press Release: EPA to Regulate Benzene, a Suspected Cause of Leukemia." May 31, 1977. www.epa.gov/history/topics/benzene/01.htm

U.S. EPA. Superfund Advance Site Query. 2000. http://oaspub.epa.gov/oerrpage/advquery

Issue: Benzene
Author: John Posey
Version: 01/01

Issue description: Benzene is a colorless liquid that is considered by the U.S. Department of Health and Human Services to be a carcinogen. Benzene occurs naturally, but most benzene in the environment is anthropogenic. Major sources of environmental benzene are chemicals manufacturing, tobacco smoke, and certain household products such as glues and cleaners. Available evidence indicates that benzene causes 1-2 cases of cancer in NJ each year. Non-cancer health costs are also probably low. The Superfund list does not indicate that benzene exists at any NJ sites on the National Priorities List, and there is no indication that Benzene measurably affects property values in NJ. It should also be noted that atmospheric benzene levels have dropped 50% since the passage of the Clean Air Act in 1990. Even so, atmospheric benzene levels in NJ remain nearly 14 time higher than the benchmark set by EPA. Still, the overall, socio-economic impacts of benzene are probably minor.
Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	1	0.1	1	0.1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	1	0.1	1	0.1	0.1

Average Risk (0 – 5 years)	Average Risk (5 years plus)
0.46	0.46

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	2	1	2	1	1	1.4

Trend: +
Catastrophic Potential: L

Issue: Brown Tide
Author: Clint Andrews
Version: 04/16/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Brown Tide**
Description of stressor	Rapid growth of a class of single-celled algae in shallow salt-water estuaries can discolor the water and dramatically reduce its clarity. Although the algae are present year-round throughout coastal New Jersey, the blooms are seasonal and have appeared most often in Barnegat Bay and Little Egg Harbor, NJ. See the Ecological TWG report for full details.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	There are no known human health risks. There are significant ecological risks to benthic communities, especially to hard clams, bivalves, and the eelgrass beds that provide nursery habitat for many species of fish and shellfish. See the Ecological TWG report for full details.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Property Values; Earnings/Employment; Costs Incurred; Aesthetic Levels; Social Cohesion; and Social Capital. Note that these are not additive, instead they are in many cases parallel measures of a single underlying phenomenon. For example, residential property values are said to represent the capitalized value of a stream of locational amenities such as recreational opportunities. Earnings and employment are closely linked and are dependent on the level of recreation industry activity.
Key impacts selected (critical socio-economic effects)	Property value, earning/employment
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Economic and social actors that depend on marine/estuarine aquatic ecosystems for economic and amenity benefits. Owners of bay-front residential property, commercial shellfish producers, and recreational users of bay waters.
Quantification of exposure levels statewide	Spatial: To date, blooms have occurred only in lower Barnegat Bay and Little Egg Harbor. Temporal: Blooms typically occur from May to July, and again in September. They do not occur with the same intensity every year. Blooms of prolonged duration (1-2 months or more) are common only at the two sites mentioned above.
Specific socio-economic entities at increased risk	Users of shallow estuaries including but not limited to Barnegat Bay and Little Egg Harbor.
Quantification of exposure levels to entities at increased risk	Exposure to brown tide blooms currently occur only in waters in the southern part of Barnegat Bay and Little Egg Harbor during months of May to July and again, a second bloom is possible in September; blooms potentially could occur in any shallow estuary with similar characteristics and/or environmental variables. Yearly prolonged blooms (greater than 1-2 months) in Barnegat bay and Little Egg Harbor wipe out the shell fish industry, reduce tourism and reduce property values. **Bay-front residential property, Commercial shellfish producers and Recreational users of bay waters** will be affected.

Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	Socioeconomic impacts are a function of both the spatial extent and the duration of the brown tide event. We assume that there is a linear relationship between spatial extent and socioeconomic impacts: Impacts increase as the size of the bloom increases. We assume that duration has a nonlinear (or threshold) effect: Blooms lasting less than 1-2 months affect shellfish production and recreational users only for the duration of the bloom. However, longer-lasting blooms have catastrophic impacts (they endanger shellfish colonies, kill the vital eelgrass, permanently repel recreational users, and affect property values).	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values	**Severity** Some of the research on aesthetics suggests that 15-20% of a waterfront house's value is tied to its recreational and aesthetic (RA) value. An aggregation of RA prices for all homes within 2,000 feet of the lake composes 15% of the total market price of housing (Lansford and Jones, 1995). We assume that the occurrence of brown tide (once a year) will devalue the property value related to the RA characteristics. The total equalized value of real property in municipalities on lower Barnegat Bay and Little Egg Harbor was $13.3 billion in 1998 according to property tax data maintained by NJDCA at <http://www.state.nj.us/dca/lgspages/taxes/taxsmenu.htm>. Municipalities included are: Barnegat, Barnegat Light, Beach Haven, Beachwood, Berkeley, Eagleswood, Harvey Cedars, Island Heights, Lacey, Little Egg Harbor, Long Beach, Ocean, Ocean Gate, Pine Beach, Seaside Heights, Seaside Park, Ship Bottom, South Tom's River, Stafford, Surf City, and Tuckerton. Most of the real property within these municipalities is within 2000 feet of the water. This suggests that the maximum impact of a prolonged brown tide bloom persisting over several seasons would be 15% of that total, or about $2 billion. That assuredly overstates the impact because many of those municipalities are also on the ocean, which is unaffected by brown tides. Since the threshold for a medium property value impact is $2.2 billion, it is reasonable to assert that brown tide has a low statewide impact on property values.	1
	Duration/irreversibility Temporal: The ecological impact of a prolonged brown tide event may not be reversible on a decadal time scale. Once the eel grass beds succumb, then they regenerate only very slowly. Long Island's eel grass beds were wiped out several years ago by a combination of brown tide and other stressors, and they have not recovered. New Jersey's could reach that state in the next 5 years, if persistent blooms continue. However, there is a strong possibility that socioeconomic actors can easily adapt to those impacts. In addition, the brown tide event itself is short-lived relative to the housing stock.	1
	Scale Geographic: The loss of housing value would be localized around Barnegat Bay and Little Egg Harbor. Since real estate markets respond to changing conditions, it is likely that the net effect on real estate values statewide would be negligible. Other coastal municipalities would enjoy increasing value while those around Barnegat Bay would lose value; that is, it would be a simple transfer.	1

	Confidence Low confidence in this estimate because we relied on literature about the proportion of recreational and aesthetic values of total property value and we assume that the occurrence of brown tide will totally destroy the recreation and aesthetics in these areas.	3
	Employment: Total potential employment losses from an extended brown tide event are substantially less than the 20,000 job threshold for a medium impact. In addition, there is no evidence that current actual losses approach the potential losses. Therefore, brown tide receives a low employment impact score. Details follow below.	*1*
	Commercial Fisheries Severity Shellfish harvest drops substantially (>50%) under a prolonged bloom. While there are no data on the actual drop in earnings suffered by NJ fishermen due to brown tides, a study estimated impacts at $2 million in 1988 $ for New York State (Kahn & Rockel, 1988). According top the National Marine Fisheries Service <http://www.st.rmfs.gov/ows-commercial/>, the total dockside value of NJ's commercial fish harvest was $90,919,000 in 1998. 28% of this value was finfish and 72% was shellfish. Of the shellfish, one third of the value ($21,803,000) was harvested within 3 miles of shore. A majority of the surf clam harvest (57%, worth about $6,000,000) was taken from an area 1 to 2 miles offshore between Absecon and Barnegat inlets. Thus a prolonged brown tide event in Ocean County waters could plausibly reduce the value of NJ's harvest by a few million $. Net 1997 earnings (wages, salaries, proprietors' income) by commercial fisherman in Ocean County, NJ were $2,986,000 according to the Bureau of Economic Analysis (BEA) <http://www.bea.doc.gov/bea/regional/reis/ca05/34/ca05_34029.htm>. This amount sets a cap on the potential impact of brown tide on earnings. No study of the employment impacts of a prolonged brown tide event in NJ has been conducted. The maximum direct employment impact on commercial fisheries can be estimated as follows using 1997 *County Business Patterns* <http://tier2.census.gov/cbp/cbpcou34.htm>: For Ocean County, NJ: Fishing, hunting, and trapping (SIC Code 0900) employs 19 and has an annual payroll of $312,000 at 21 establishments. Manufacturing of fresh or frozen prepared fish (SIC Code 2092) employs between 0 and 19 at 2 establishments (payroll data are suppressed). Wholesale trade in fish and seafood (SIC Code 5146) employs 61 and has an annual payroll of $1,581,000 at 7 establishments. Summing these 3 categories, employment is between 80-99 with an annual payroll greater than $1,893,000 at 30 establishments in the one NJ county affected by brown tides. Assuming that indirect employment impacts will roughly double the above estimate, the maximum employment impact of a prolonged brown tide bloom totals about 200 jobs. Recreational Fisheries Severity There are no data on the actual drop in earnings suffered by NJ due to the effect of brown tides on recreational fishing. One way to estimate impacts is to use data from the National Marine Fisheries Service (NMFS) http://www.st.nmfs.gov/st1/econ Based on an annual survey, NMFS estimates that nearly 786,000 anglers participated in NJ's marine recreational fishery in 1998. During this year they made over 4.3 million saltwater fishing trips, 62% in private or rental boats, 11% in party or charter boats, and 27% fished from shore. A vast majority participated during the months when brown tide blooms typically occur	

Some 45% came from out-of-state. According to the 1994 survey, average expenditures per angler for private/rental boaters were $15.30 for lodging, $34.80 for boat fees, and $8.80 for travel expenses. Average expenditures per angler for party/charter boaters were $36.10 for lodging, $45.20 for boat fees, and $7.80 for travel expenses. Average expenditures per angler for shore fishing were $36.90 for lodging and $6.50 for travel expenses. Total annual expenditures can therefore be calculated as about $46 million ($18.4 million for lodging, $20.9 million for boat rentals, $6.3 million for travel expenses). Note that this excludes food and other recreational expenditures. Thus a prolonged brown tide event could plausibly reduce the earnings of NJ's shore economy by tens of millions of $. No study of the employment impacts of a prolonged brown tide event in NJ has been conducted. The maximum direct employment impact can be estimated as follows using 1997 *County Business Patterns* <http://tier2.census.gov/cbp/cbpcou34.htm>: For Ocean County, NJ: Hotels and other lodging places (SIC Code 7000) employs 725 and has an annual payroll of $12,181,000 at 101 establishments. Marinas (SIC Code 4493) employs 303 and has an annual payroll of $8,554,000 at 80 establishments. Summing these 2 categories, employment is 1028 and has an annual payroll of $20,735,000 at 181 establishments in NJ. Assuming that indirect employment impacts will roughly double the above estimate, the maximum recreational-fishing-related employment impact of a prolonged brown tide bloom totals about 2000 jobs.	
Irreversibility <u>Commercial Fisheries</u> Although ecological impact is not reversible on a decadal time scale, socio-economic impact is reversible if fishing can switch to offshore or other economic activities. In addition, the price of shellfish may increase due to a drop in supply. <u>Recreational Fisheries</u> Although ecological impact is not reversible on a decadal time scale, socio-economic impact is somehow reversible if fishing can switch to offshore or other economic activities. Scale <u>Commercial Fisheries</u> Net 1997 earnings by commercial fishermen in NJ as a whole were $19,206,000 according to the BEA <http://www.bea.doc.gov/bea/regional/reis/ca05/34/ca05_34000.htm>. So Ocean County represents 16% of the state's fishery earnings. Net 1997 earnings across all industries in Ocean County were $4,474,328,000, so commercial fishing represents only 0.07%. According to the 1997 *County Business Patterns* for all of NJ: Fishing, hunting, and trapping (SIC Code 0900) employs 188 and has an annual payroll of $5,474,000 at 78 establishments. So Ocean County represents 10%, 6%, and 27% of the statewide totals respectively. Manufacturing of fresh or frozen prepared fish (SIC Code 2092) employs 379 and has an annual payroll of $6,652,000 at 8 establishments. So Ocean County represents between 0-5%, 0-100%, and 25% of the statewide totals respectively. Wholesale trade in fish and seafoods (SIC Code 5146) employs 864 and has an annual payroll of $27,851,000 at 108 establishments. So Ocean County represents 7%, 6%, and 6% of the statewide totals respectively.	1

	Summing these 3 categories, employment is 1431 and has an annual payroll of $39,977,000 at 194 establishments in NJ. So Ocean County represents between 6-7%, 5%, and 15% of the statewide commercial fishery-related industry totals respectively. Within Ocean County (101,619 employees, $2,493,446,000 annual payroll, 10,578 establishments), these three industries account for 0.1%, >0.08%, and 0.3% of county totals respectively. Assuming that indirect employment impacts will roughly double the above estimate, the maximum employment impact of a prolonged brown tide bloom on commercial fisheries remains nearly invisible at the countywide level. Recreational Fisheries Assume that the $46 million in expenditures is lost to Ocean County alone due to brown tides. Net 1997 earnings across all industries in Ocean County were $4,474,328,000, so recreational fishing impacts would represent 1% of the county total--a fair-sized local shock. It would be only a few hundredths of a percent of overall earnings in New Jersey. According to the 1997 *County Business Patterns* for all of NJ: Hotels and other lodging places (SIC Code 7000) employs 74,313 and has an annual payroll of $1,742,925,000 at 1,396 establishments. So Ocean County represents 10%, 1%, and 7% of the statewide totals respectively. Marinas (SIC Code 4493) employs 853 and has an annual payroll of $24,718,000 at 216 establishments. So Ocean County represents between 36%, 35%, and 37% of the statewide totals respectively. Summing these 2 categories, employment is 75,166 and has an annual payroll of $1,767,643,000 at 1612 establishments in NJ. So Ocean County represents between 1%, 1%, and 11% of the statewide recreational fishery-related industry totals respectively. Within Ocean County (101,619 employees, $2,493,446,000 annual payroll, 10,578 establishments), these two industries account for 1%, 1%, and 2% of county totals respectively. Assuming that indirect employment impacts will roughly double the above estimate, the employment impact of a prolonged brown tide bloom becomes a noticeable economic shock at the county level, although it remains nearly invisible at the state-wide level (which totals 3,300,923 employees, $ 116,409,839,000 annual payroll, 229,349 establishments).	1
	Confidence Have medium confidence in this estimate because we had to guess the fraction of the total NJ shellfish industry likely to be affected.	2
Costs Incurred Incurred -- no significant impact, so not studied	**Severity**	*0.1*
	Duration/irreversibility	1
	Scale	1
	Confidence	3
Aesthetic Levels	**Severity** Murky brown water caused by blooms has a fairly high adverse effect for boaters and fishermen who regularly use the bay waters. We assume that recreational and aesthetic values will be lost because of the brown tide. Its Impact on property value is reflected in property vale loss already. Current aesthetic impacts are not severe but they may become so in the future.	*1*
	Duration/irreversibility This impact is partly reversible. It affects mostly one region for a couple of months per year.	1

	Scale Geography: Fairly localized.	1
	Confidence Moderately high.	2
Psychological Impacts--no significant impact, so not studied	**Severity**	*0.1*
	Duration/irreversibility	1
	Scale	1
	Confidence	2
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	L: Actual effect on property values, earnings, and employment in NJ is unknown so we had to rely on scenarios extrapolated from the literature. But values are not near breakpoints.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	- If brown tide blooms become pervasive, then they could disrupt shore communities, although they are unlikely to be economically significant on a statewide basis.	
Potential for catastrophic impacts (H,M,L) and brief description	L	
Incidence of impacts (affected sub-groups, variability, equity issues)	Affects bay-shore property owners, shellfish producers, and recreational users on Barnegat Bay, Little Egg Harbor, and a few other places.	
Extent to which threat is currently regulated	Unregulated (natural source)	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		
NJ Primary Sources		

Large business/industry	L
Small business industry	L
Transportation	L
Residential	L
Agriculture	L
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	H--Follows natural cycle, does not seem to be significantly affected by anthropogenic sources such as runoff. Details see ecological quality TWG report.
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L
Biota sinks	L
References	Lansford, N.H. and Jones, L., 1995, Recreational & aesthetic value of water using hedonic price analysis, Journal of Agricultural and Resource Economics. 20(2):341-355 Clark, D.E. and T. Allison. 1999. Spent nuclear fuel and residential property values: The influence of proximity, visual cues and public information. Papers in Regional Science 78: 403-421. Kahn, J. and M. Rockel. 1988. Measuring the economic effects of brown tides. Journal of Shellfish Research 7: 677-682. Web sites for economic and fisheries data shown in text above.
Current Policy and Regulatory Framework	
Federal	None.
State & Local	Monitored by NJDEP, but nothing to regulate.

Issue: Brown Tide
Author: Clint Andrews
Version: 04/16/00

Issue description: Brown Tide Blooms caused by rapid growth of a class of single-celled algae in shallow salt-water estuaries can discolor the water and dramatically reduce its clarity. Although the algae are present year-round throughout coastal New Jersey, the blooms are seasonal and have appeared most often in Barnegat Bay and Little Egg Harbor, NJ. This could lead to localized loss of bayfront property value and fishing-related employment, but it has not to date to any significant extent.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	1	0.1	1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	1	1	0.1	1	0.1

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
0.64	**1.44**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	3	2	3	2	2	**2.4**

Trend: -
Catastrophic Potential: L

Issue: Cadmium
Author: John Posey
Version: 08/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Cadmium**
Description of stressor	Cadmium is a metal used in plating, batteries, pigments, plastics, and alloys. It has been associated with kidney disorders in humans and with disruption of aquatic ecosystems.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Ingestion of unsafe levels of cadmium over a long period of time can result in a kidney dysfunction known as low molecular weight proteinuria. High cadmium levels in aquatic ecosystems can lead to increased mortality among invertebrates at the base of the food chain. This has the potential to affect the jobs of fishermen and ecotourism.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Costs incurred, property values, employment, aesthetics, worry.
Key impacts selected (critical socio-economic effects)	Costs incurred, worry.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Cadmium tends to bioaccumulate in shellfish. Consequently, people who eat a lot of shellfish over a long period of time face a relatively high risk of contracting disorders associated with cadmium. Cadmium poisoning that results in kidney dysfunction will be associated with medical costs. Reports of high cadmium levels in shellfish have resulted in public uproars in other countries. Cadmium also bioaccumulates in fish. However, shellfish, as bottom dwellers, are more likely to come into contact with cadmium in sediment.
Quantification of exposure levels statewide	The Human Health Technical Work Group (HHTWG) estimates that only a few hundred persons dependent on shellfish for subsistence are at risk of ingesting unsafe amounts of cadmium.
Specific socio-economic entities at increased risk	1) Subsistence shellfishers. 2) Smokers: "Smokers have about twice the average exposure because tobacco concentrates cadmium and because cadmium is absorbed more efficiently when inhaled than when ingested."
Quantification of exposure levels to entities at increased risk	Difficult to quantify. Risks due to cadmium are best considered as a statewide problem.
Dose/Impact-Response Assessment	

Issue: Cadmium
Author: John Posey
Version: 08/00

Quantitative/Qualitative impact-assessment employed	Review of toxicological and industrial ecological literature on the effects of cadmium.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		*Score*
Property Values	a) Severity: If the public became alarmed about the level of cadmium in shellfish, it could lead to a loss of jobs in shellfish harvesting. If this occurred, then seaside towns in which shellfishers live could suffer depressed property values. However, it is unlikely that this will occur. HHTWG reports that only persons who depend on shellfish for subsistence are at risk of cadmium poisoning. If so, then a person with a normal diet will not face any great risk from occasional consumption of NJ shellfish. Thus, if we assume with economists that people are rational, then there is little reason to fear a cadmium-induced decline in demand for NJ shellfish.	1
	b) Duration/irreversibility:	1
	c) Scale	1
	d) Uncertainty: I am moderately confident that cadmium poses only minimal threats to property values.	2
Employment	a) Severity: There are two routes by which cadmium could threaten jobs. First, if shellfish accumulate high levels of cadmium, then this could lead to a reduced demand for NJ shellfish. Second, if cadmium reduced the number of fish that are popular with recreational fishers, then this could lead to a reduction in ecotourism jobs. EQTWG indicates that freshwater ecosystems are particularly susceptible to cadmium. As asserted above, concern over cadmium is unlikely to cause a decrease in demand for NJ shellfish in the next five years. It is possible that cadmium could affect freshwater ecosystems, but this hypothesis remains highly speculative. Thomas and Spiro (1994) offer the following conclusion: "What lessons can we draw for the industrial ecology of cadmium? …. There is little knowledge of ecosystem damage, and it might be greater than we now realize….While there may be significant human or ecosystem exposures due to cadmium in products or in mining or manufacturing wastes, such exposures have yet to be identified and understood. Clarification of these issues is needed before we can understand which cadmium products, if any, might be leading to increased exposure, and what steps, if any, should be taken to reduce cadmium exposure." The Ecological Quality Technical Work Group (EQTWG) reports that cadmium levels in most freshwater environments in NJ are at or below the danger threshold. 5 of the 8 ecosystems in the state were rated as follows with respect to cadmium: "ecosystem exposed but structure and function hardly affected." The remaining 3 ecosystems were rated as "adverse affect on structure and function of system: population abundance and distributions reduced, short time for recovery." Thus, there is little evidence that cadmium poisoning will result in a measurable loss of jobs in the next 5 years.	1
	b) Duration/irreversibility	1
	c) Scale	1
	d) Uncertainty: I am moderately confident of this assessment.	2

Costs Incurred	a) Severity: HHTWG estimates that only a few hundred persons dependent on shellfish for subsistence are at risk of ingesting unsafe amounts of cadmium. A 1993 World Health Organization report indicates that ingested cadmium has not been linked to cancer, developmental disorders or mutation. However, ingestion of unsafe levels of cadmium over a long period of time can result in a kidney dysfunction known as low molecular weight proteinuria. The WHO report states the following: "The estimated critical concentration in the renal cortex at which the prevalence of low-molecular-weight proteinuria would reach 10% in the general population is about 200 mg/kg; this would be reached after a daily dietary intake of about 175 µg per person for 50 years, as calculated by regression analysis of cadmium intake and mean kidney cadmium concentration in various countries. It was estimated that a daily intake of 100 µg of cadmium per person would lead to the critical cadmium concentration in the renal cortex being exceeded in 2% of the population." In some cases, low molecular weight proteinuria can lead to kidney failure. If there are 500 persons who depend on New Jersey oysters for subsistence, and if these 500 persons eat over 100 micrograms of cadmium per day for 50 years, then about 10 of these persons will experience some form of kidney dysfunction. According to Bruns et al. (1998), "for the period from July 1994 to July 1995, annualized cost per dialysis patient-year averaged $63,340." Even if the cost of kidney treatment is $100,000, then the total cost of the disease will be $1 million. This calculation is highly speculative, however. It is not known how many persons have subsisted on New Jersey oysters for several decades. Occupational exposure to cadmium is another potential source of medical costs. Occupational exposure is greatest for metal platers and smelters, who face the risk of inhaling cadmium. Cadmium is much more dangerous when it is inhaled than when it is eaten. Occupational exposure to cadmium is strictly regulated by OSHA (see regulation, below). As a result, inhalation of cadmium by workers is no longer a common problem.	1
	b) Duration/irreversibility: According to OSHA (1992), "several studies indicate that the onset of low-molecular weight proteinuria is a sign of irreversible kidney damage (Friberg et al., 1974; Roels et al., 1982; Piscator 1984; Elinder et al., 1985; Smith et al., 1986). Above specific levels of B(2)-M associated with cadmium exposure it is unlikely that B(2)-M levels return to normal even when cadmium exposure is eliminated by removal of the individual from the cadmium work environment (Friberg, Ex. 29, 1990)."	3
	c) Scale: Highly localized.	1
	d) Uncertainty: SETWG guidelines call for a severity score of "2" to be given only to impacts greater than $16 million. I am moderately confident that the health costs associated with cadmium are lower than $16 million.	2
Aesthetic Levels	a) Severity: No aesthetic impacts are hypothesized.	0.1
	b) Duration/irreversibility	1
	c) Scale	1
	d) Uncertainty	1

Psychological Impacts	a) Severity: There have been episodes in other countries in which the general public became alarmed about cadmium in oysters. In April, 2000, the New Zealand Ministry of Health issued a report urging caution in the consumption of oysters. The report estimated that eating more than 7 oysters per week over a long period of time could produce a harmful build-up of cadmium in humans. A Green Party member of parliament created a national furor by publicizing and politicizing the report. High cadmium levels in shellfish have also created anxiety among consumers in Hong Kong (see Templar, 2000). Thus, the potential exists for the public to become alarmed about cadmium. Still, this has not happened in the US to date, and there is no strong reason to believe that it will occur in the next five years.	1
	b) Duration/irreversibility: I would expect such an episode to be short-lived.	1
	c) Scale: Unknown.	1
	d) Uncertainty:	2
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	H: There are two key data gaps. First, as Thomas and Spiro note, the effect of cadmium on ecosystems is still not well documented. Second, as EQTWG notes, there is no ongoing measurement of cadmium levels in different ecosystems in NJ.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	+ Thomas & Spiro: "Although the continuing deposition of cadmium onto agricultural land leads to the expectation of gradually increasing cadmium exposure, over the past decade measurements of average cadmium intake per day have dropped from 30 micrograms/day to 15 micrograms/day or less….Although much of this decrease can be attributed to improvements in analytical techniques, there is some indication that there has been a real drop in cadmium intake in places where high air concentrations of cadmium have been reduced…."	
Potential for catastrophic impacts (H,M,L) and brief description	L: EQTWG indicates that risk of catastrophe is low.	
Incidence of impacts (affected sub-groups, variability, equity issues)	Since subsistence fishermen are in low socio-economic strata, cadmium probably has a disproportionate effect on poor individuals.	
Extent to which threat is currently regulated	According to EQTWG, "control of cadmium discharges and the remediation of cadmium-contaminated hazardous waste sites are regulated under the Industrial Site Recovery Act (ISRA), Spill Compensation and Control Act, Solid Waste Management Act (SWMA), Water Pollution Control Act (WPCA), Resource Conservation and Recovery Act (RCRA), Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended by Superfund Amendments and Reauthorization Act of 2986 (CERCLA) and the Hazardous Site Discharge Remediation Act." The following comes from a 1992 OSHA document, "Occupational Exposure to Cadmium." "Workers in a wide variety of industries—from manufactures of plastics, ceramics, and paint to industries involving electroplating, metal machining, and welding—are exposed to cadmium. OSHA moved to protect these workers from cadmium exposure as early as 1971, when it adopted the American National Standards Institute's (ANSI) threshold limit values (TLVs) for cadmium as a national consensus standard….The consensus standard established, for general industry, an 8 hour time-weighted average (TWA) permissible exposure limit (PEL) of 100 micrograms per cubic meter of air…and a ceiling concentration of 33 micrograms per cubic meter for cadmium fumes; it also set a TWA PEL of 200 micrograms per cubic meter and a ceiling of 600 micrograms per cubic meter for cadmium dust. The standard for the construction industry	

	was a TWA PEL of 100 micrograms for cadmium oxide fumes and 200 micrograms for metal dust and soluble salts. OSHA decided to reduce these limits in response to a June 18, 1986 petition by the Health Research Group of Public Citizen and the International Chemical Workers Union, as well as evidence of adverse health effects at the then existing PELs….In February 1990, OSHA published a notice of proposed rulemaking on cadmium. Based on OSHA's review of major epidemiological studies of lung cancer and renal dysfunction among workers and studies of animals exposed to cadmium, and based on the agency's quantitative risk assessment, OSHA proposed PELs of either 5 micrograms/cubic meter or 1 microgram/cubic meter to reduce the level of worker exposure to cadmium by more than 95 to 99%. OSHA's final rule establishing a new PEL of 5 micrograms and other protective provisions for cadmium was published on September 14, 1992, in the Federal Register under Title 29 CFR, Part 1910.1027 and is effective as of December 14, 1992."
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	H: Alloys, pigments, smelting and plating.
Small business industry	H: Alloys, pigments, smelting and plating.
Transportation	L
Residential	M: Paints and batteries.
Agriculture	M: Thomas and Spiro report that "the cadmium content of U.S. cropland is increasing by about 1% annually…."
Recreation	L
Resource extraction	L
Government	L: Municipal incinerators may contribute.
Natural sources/processes	L
Orphan contaminated sites	M
Diffuse Sources	Source for the following assessments is EQTWG.
Sediment sinks	M: Historical activity has resulted in elevated levels of cadmium in sediments.
Soil sinks	M: Cadmium from industrial plants can remain in the soil.
Non-local air sources incl. Deposition	M: Atmospheric deposition in the state is still a problem.
Biota sinks	M: Bioconcentration in aquatic organisms is important.
References	Frank J. Bruns, Patricia Seddon, Melissa Saul, and Mark L. Zeidel, 1998. "The Cost of Caring for End-Stage Kidney Disease Patients: An Analysis Based on Hospital Financial Transaction Records." *Journal of the American Society of Nephrology*, May 1998, Vol. 9, No. 5. New Zealand Ministry of Health, 2000. *1997/98 New Zealand Total Dietary Survey*. Templer, Robert, 2000. "Food for Thought: A Lust for Oysters." *Asian Wall Street Journal*, 6/16/2000. U.S. Department of Labor. OSHA Regulations (Standards - 29 CFR) Substance Safety Data Sheet - Cadmium - 1910.1027 App A.

	U.S. Department of Labor, Occupational Safety and Health Administration, 1992. "Occupational Exposure to Cadmium." Valerie Thomas and Thomas Spiro, 1994. "Emissions and Exposure to Metals: Cadmium and Lead," in R. Socolow, C. Andrews, F. Berkhout and V. Thomas, *Industrial Ecology and Global Change*. Cambridge University Press. World Health Organization, 1993. *Guidelines for Drinking Water Quality*, 2nd ed. Volume 1: Recommendations.
Current Policy and Regulatory Framework	See Regulation, above.

Issue description: Cadmium is a metal used in plating, batteries, pigments, plastics, and alloys. It has been associated with kidney disorders in humans and with disruption of aquatic ecosystems. Cadmium bioaccumulates in mollusks, and poses a potential threat to persons for whom shellfish constitute a large part of the diet. Available evidence does not indicate that cadmium poses a threat to employment or property values. Further, best estimates indicate that the cost of illnesses associated with cadmium are low. However, much is not known about the effect of cadmium on ecosystems. Additional research on this question, including ongoing measurements of cadmium in NJ ecosystems, would be valuable.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	1	1	0.1	1
Duration/ Irreversibility	1	1	3	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	1	1	3	0.1	1

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
1.22	**1.22**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	2	2	2	1	2	1.8

Trend: +

Catastrophic Potential: L

Issue: Carbon Monoxide (CO)
Author: John Posey
Date: March 2001

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Carbon Monoxide (CO)**
Description of stressor	CO is a colorless, odorless, and poisonous gas formed when carbon in fuel is not burned completely. It is a component of motor vehicle exhaust which contributes about 60% of CO emissions nationwide. In urban areas as much as 95% of CO emissions may come from automobile exhaust.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	At high levels of exposure, CO can be deadly. Nationally, there are about 1100 accidental deaths from CO emissions each year. CO has also been linked to congestive heart failure, especially among the elderly.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	The principle impact considered will be the costs of illnesses associated with CO.
Key impacts selected (critical socio-economic effects)	Costs Incurred.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	CO is inhaled.
Quantification of exposure levels statewide	EPA monitoring devices throughout the state have recorded the following average annual levels (in parts per million): Monitor County Average PPM 1 Bergen 1.22 2 Bergen 0.75 3 Burlington 0.76 4 Camden 0.57 5 Camden 0.28 6 Hudson 1.18 7 Hudson 1.60 8 Middlesex 0.89 9 Middlesex 0.80 10 Monmouth 0.77

	11 Morris 0.99 12 Union 1.25		
Specific socio-economic entities at increased risk	The only counties with average levels greater than 1 PPM were Hudson, Union and Bergen.		
Quantification of exposure levels to entities at increased risk	Levels recorded in Hudson County (2) were more than five times higher than those recorded in Camden County (2).		
Dose/Impact-Response Assessment			
Quantitative/Qualitative impact-assessment employed	I rely on epidemiological literature that correlates cases of congestive heart failure with ambient CO concentrations.		
Risk Characterization			
Risk estimate(s) by socio-economic entities at risk			*Score*
Property Values	a) Severity: No impact hypothesized		0.1
	b) Duration/irreversibility		1
	c) Scale		3
	d) Uncertainty		1
Employment	a) Severity: No impact hypothesized.		0.1
	b) Duration/irreversibility		1
	c) Scale		3
	d) Uncertainty		1

Costs Incurred	a) Severity: A study of congestive heart failure in 7 urban areas in the U.S. found that 5.7% of all cases of congestive heart failure in those areas may be blamed on elevated ambient concentrations of CO. Risk is greatest for persons over the age of 65. The study also found that the average cost of medical treatment for these cases was slightly more than $10,000. In NJ, there are roughly 13,500 cases of congestive heart failure each year. If 5.7% are caused by CO, then this would amount to approximately 750 cases at a cost to the NJ economy of about $7.5 million. In addition, a report published by the U.S. Department of Health and Human Services states that CO poisoning accounts for about 1100 accidental and 2500 intentional deaths annually, with an estimated 40,000 emergency department visits for the condition each year. Varon and Marik estimate that up to one third of all cases go unreported or undiagnosed each year. From 1979 to 1988, 57% of unintentional CO deaths were caused by motor vehicle emissions in closed or semi-closed areas. Other sources of CO poisoning include residential furnaces and hot water heaters. State-specific data was unavailable. Varon writes that "the incidence of non-lethal CO poisoning is not well established…." However, if NJ has an amount of CO poisoning proportional to its population, then we could expect about 30 deaths and 1200 emergency room visits each year. It is difficult to estimate the cost of an average emergency room visit for CO poisoning. However, according to Marzella and Myers, the typical treatment for severe CO poisoning is to administer 100% oxygen at 2.8 atmospheres for 46 minutes. These authors write, "at this pressure, enough oxygen is dissolved in the plasma to provide immediate and adequate tissue oxygenation." In 1999, the National College of Hyperbaric Medicine asked the Health Care Financing Administration (HCFA) to establish a payment rate to hospitals of $374 per hyperbaric treatment. If each hyperbaric treatment costs $374, and if there are 1200 cases of CO poisoning requiring this treatment each year, then the total cost of treatment amounts to just under $500,000 each year. If this is added to the cost of heart failure linked to CO, then the total cost of CO to the NJ economy is about $8 million each year. It may be that this is an underestimate. The number of cases of CO poisoning resulting in permanent neurological impairment is not known. Lost wages on the part of brain-damaged CO patients could add to the economic cost of CO. However, Marzella and Myers indicate that most non-fatal CO poisoning patients recover, so I am not including the possibility of lost wages in this assessment. NJCRP guidelines call for a score of "1" to be given to any stressor that results in economic costs under $16 million. (HHTWG has produced a lower estimate of the number of CO poisoning cases. HHTWG estimates that there are about 4-25 fatalities, with between 300 and 1200 non-fatal cases. These lower numbers reinforce the severity rating of "1" .)	1
	b) Duration/irreversibility	1
	c) Scale	3
	d) Uncertainty: I am moderately confident that these figures approximate reality.	2
Aesthetic Levels	a) Severity: No impact hypothesized.	0.1
	b) Duration/irreversibility	1

	c) Scale	3
	d) Uncertainty	1
Psychological Impacts	a) Severity: No impact hypothesized	0.1
	b) Duration/irreversibility:	1
	c) Scale:	3
	d) Uncertainty	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	L	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	++ Long term improvements in CO have occurred over the last 30 years. Between 1988 and 1997, ambient concentrations decreased 38% nationwide, and the estimated number of exceedances of the national standard decreased 95%. CO emissions from highway vehicles have decreased 29%.	
Potential for catastrophic impacts (H,M,L) and brief description	L	
Incidence of impacts (affected sub-groups, variability, equity issues)	Persons over the age of 65 are at greatest risk of congestive heart failure due to elevated CO concentrations.	
Extent to which threat is currently regulated	CO is one of six "criteria air pollutants" regulated by the National Ambient Air Quality Standards (NAAQS) established under the clean air act of 1990. The standards established under NAAQS are 9 ppm for any 8 hour period, and 35 ppm for any 1 hour period.	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		
NJ Primary Sources		
Large business/industry	M	
Small business industry	L	
Transportation	H	

Residential	M Much of the catastrophic exposure that exists occurs in the home.
Agriculture	L
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	L
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L
Biota sinks	L
References	American College of Hyperbaric Medicine. "Issue Paper: Proposed Reimbursement Changes for Hyperbaric Oxygen Therapy." April, 1999. www.hyperbaricmedicine.org/issue_paper.htm American Heart Association. "2001 Heart and Stroke Statistical Update." www.americanheart.org/statistics/othercvd.html Louis Marzella and Roy Myers. "Carbon Monoxide Poisoning." *American Family Physician* 34(5), November, 1986. Robert Morris, Elena Naumova and Rajika Munasinghe. "Ambient Air Pollution and Hospitalization for Congestive Heart Failure among Elderly People in Seven Large US Cities." *American Journal of Public Health* 85(10), October 1995. James D. Ralston and Neil B. Hampson. "Incidence of Severe Unintentional Carbon Monoxide Poisoning Differs Across Racial/Ethnic Categories." *Public Health Reports* (U.S. H.H.S) 115, January/February 2000. Joel Schwartz. "Is Carbon Monoxide a Risk Factor for Hospital Admission for Heart Failure?" *American Journal of Public Health* 85(10), October 1995. U.S. Environmental Protection Agency. Benefits and Costs of the Clean Air Act, 1990 to 2010. http://www.epa.gov/oar/sect812/ U.S. Environmental Protection Agency. AIRS: Aeromatic Information Retrieval System. www.epa.gov/aqspubl1 U.S. Environmental Protection Agency, Office of Air and Radiation. "1997 National Air Quality: Status and Trends." December, 1998. www.epa.gov/oar/aqtrnd97/ Joseph Varon and Paul Marik. "Carbon Monoxide Poisoning." *Internet Journal of Emergency and Intensive Care Medicine* 1(2), April 1997.

Issue: Carbon Monoxide (CO)
Author: John Posey
Date: March 2001

Current Policy and Regulatory Framework	See "Regulation," above
Federal	
State & Local	

Issue description: CO is a colorless, odorless, and poisonous gas formed when carbon in fuel is not burned completely. It is a component of motor vehicle exhaust which contributes about 60% of CO emissions nationwide. In urban areas as much as 95% of CO emissions may come from automobile exhaust. At high levels of exposure, CO can be deadly. Nationally, about 1100 persons each year are killed from CO emissions, usually caused by malfunctioning heating systems. CO has also been linked to congestive heart failure, especially among the elderly. A study of congestive heart failure in seven urban areas found that 5.7% of hospitalizations for congestive heart failure were linked to elevated levels of ambient CO. If these estimates apply to NJ, then CO may be blamed for approximately 750 cases of congestive heart failure in NJ each year. This imposes a cost of approximately $7.5 million on the NJ economy.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	0.1	0.1	1	0.1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	0.3	0.3	3	0.3	0.3

Average Risk (0 – 5 years)	Average Risk (5 years plus)
0.84	**0.84**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	2	1	1	1.4

Trend: ++

Catastrophic Potential: L

Issue: Catastrophic Radioactive Release
Author: John Posey
Version: 10/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Stressor: **Catastrophic Radioactive Release**

There are four nuclear power plants in NJ, and another six in nearby counties of other states. Virtually the entire state of NJ lies within 50 miles of at least one of these nuclear plants. If one of these plants were to accidentally release large volumes of radioactive gasses, the ecological effect and human health effects could be disastrous. At Chernobyl, radiation was high enough to kill trees in nearby forests. These trees had to be buried as radioactive waste. Forest animals were killed both directly by radiation and indirectly through loss of habitat. Radionuclides contaminating large bodies of water tend to accumulate in bottom sediments, benthos, aquatic plants and fish.

The human health effect of the Chernobyl accident has been studied by John W. Gofman, M.D., Ph.D., an emeritus professor of medicine and molecular biology at the University of California, Berkeley. Following the 1986 accident, over 100,000 persons had to be evacuated. Gofman estimates that 475,000 cancer deaths will ultimately result from the radiation leakage at Chernobyl out of a total exposed population of 75 million persons.

The 1979 accident at Three Mile Island is the most serious nuclear catastrophe in U.S. History. The Nuclear Regulatory Agency believes that the health effects of this accident were minimal. Following is a synopsis of the NRC assessment:

"Detailed studies of the radiological consequences of the accident have been conducted by the NRC, the Environmental Protection Agency, the Department of Health, Education and Welfare (now Health and Human Services), the Department of Energy, and the State of Pennsylvania. Several independent studies have also been conducted. Estimates are that the average dose to about 2 million people in the area was about only about 1 millirem. To put this into context, exposure from a full set of chest x-rays is about 6 millirem. Compared to the natural radioactive background dose of about 100-125 millirem per year for the area, the collective dose to the community from the accident was very small. The maximum dose to a person at the site boundary would have been less than 100 millirem.

"In the months following the accident, although questions were raised about possible adverse effects from radiation on human, animal, and plant life in the TMI area, none could be directly correlated to the accident. Thousands of environmental samples of air, water, milk, vegetation, soil, and foodstuffs were collected by various groups monitoring the area. Very low levels of radionuclides could be attributed to releases from the accident. However, comprehensive investigations and assessments by several well-respected organizations have concluded that in spite of serious damage to the reactor, most of the radiation was contained and that the actual release had negligible effects on the physical health of individuals or the environment."

Clearly, an accident on the scale of Chernobyl would be catastrophic to NJ. However, to date there has never been an accident on this scale in the U.S. Thus, while eternal vigilance is certainly called for, there is no reason to believe that such a catastrophe will affect NJ in the next five years. The socio-economic impact of catastrophic radiation release, then, may be considered low for the purposes of NJCRP.

It is also appropriate to note the issues of transportation, storage and treatment of radioactive waste. Progressive groups such as Public Citizen and the United Electrical, Radio and Machine Workers of America have expressed concern over the transportation of radioactive waste. The Nuclear Waste Project Office of the State of Nevada cites a 1985 report by the U.S. Department of Energy which estimates that a severe accident involving one cask of spent nuclear fuel could, under worst-case conditions, release enough radioactive material to contaminate a 42 square mile area. Cleanup costs for such an accident in a rural area could exceed $620 million, requiring 460 days for cleanup and recovery time. A similar accident in an urban area could cost $2 billion. It could cost as much as $9.5 billion to clean up an average city after an accident involving a worst-case crash of a train carrying nuclear waste. As with a nuclear accident, a serious accident involving radioactive waste could be catastrophic. However, the Congressional Research Service has concluded that the probability of such an event is very low. Casks involved in transporting spent fuel must pass a battery of stringent safety tests, including a 30 foot drop test, a

puncture test, an engulfing fire test and an immersion in water test. Based on these and other safety requirements, and on the past record of safety, CRS concludes that a catastrophic accident is highly unlikely.

It is worthwhile to consider the mathematical properties of risk. Risk may be thought of as the product of the probability of occurrence and the consequence of occurrence. Catastrophic radiation is a classic example of a high consequence-low probability event. In the case of catastrophic radiation, the probability of the occurrence is very low, but the consequence would be very high. The expected value calculation may result in a very low number, but this number can be misleading. Many people would incur a greater cost to avoid a high consequence event than would be predicted by a straight expected value calculation. Descriptively, the divergence of peoples' preferences from the predictions of the expected value model reflects the presence of ambiguity (low confidence in estimates of probabilities and consequences), systematic biases in risk perception due to human cognitive limitations, and labile preferences regarding risk tolerance. Prescriptively, the divergence implies that preferences depend on not only technical factors, but also on the credibility, legitimacy, and voluntaryness of the institutional arrangements for managing such risks.

Sources:

Nuclear Regulatory Agency, "Three Mile Island 2 Accident." www.nrc.gov/OPA/gmo/tip/tmi.htm

John W. Gofman. Radiation-Induced Cancer from Low-Dose Exposure. 1990.
http://www.ratical.org/radiation/CNR/RIC/contentsF.html

Mark Holt. Report for Congress: Transportation of Spent Nuclear Fuel. Congressional Research Service, May 29, 1998. www.cnie.org/nle/eng-34.html

Howard Kunreuther. "A Conceptual Framework for Managing Low-Probability Events." Pp. 301-320 in Sheldon Krimsky and Dominic Golding, eds. *Social Theories of Risk*. Westport, CT: Praeger. 1992.

State of Nevada, Nuclear Waste Project Office. "Why Nevada is Opposed to Yucca Mountain." www.igc.org/citizenalert/fctshts/yucca2.html

Issue: Catastrophic Radioactive Release
Author: John Posey
Version: 10/00
Catastrophic release of radiation: There are four nuclear power plants in NJ, and another six in nearby counties of other states. Virtually the entire state of NJ lies within 50 miles of at least one of these nuclear plants. If one of these plants were to accidentally release large volumes of radioactive gasses, the ecological effect and human health effects could be disastrous. Adjacent properties could be irreversibly damaged, medical costs could skyrocket, and widespread worry could ensure. An accident on the scale of Chernobyl would kill thousands, and destroy forests and wetlands. However, an accident on this scale has never occurred in the U.S. The probability of such a catastrophe occurring in or around NJ in the next 5 years, then, is very low, and so is its expected value (measured as probability x consequences).

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	1	0.1	1	0.1	1
Duration/ Irreversibility	3	1	1	1	1
Scale (spatial, population)	1	1	3	1	3
Subtotal Risk	3	0.1	3	0.1	3

Average Risk (0 – 5 years)	Average Risk (5 years plus)
1.84	1.84

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	1	1	1	1

Trend: 0

Catastrophic Potential: M

Issue: Chromium: Cr^{+3}, Cr^{+6}
Author: Branden Johnson
Date: May 12, 2000

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Chromium: Cr^{+3}, Cr^{+6}**
Description of stressor	Chromium (Cr) is a metallic element which is largely found in the environment in two valence states, Cr^{+3}, and Cr^{+6}. Cr^{+3} is a trace nutrient necessary for sugar metabolism and insulin regulation, and is used in pigment manufacture, leather tanning, as a vitamin supplement (chromium picolinate), and in production of chrome-steel alloys. Cr^{+6} is rarely found naturally, and has no known biological role; it is produced from Cr^{+3} ores. It is used in pigment manufacture, production of chromic acid, cement manufacture, pressure treated wood, anti-corrosives, cutting oils, and metal plating, and is a common trace constituent of detergents and some soaps.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Both valence states are significantly toxic to microflora (in freshwater, estuarine and marine ecosystems), macrophytes, invertebrates, fish and mammals (including humans). Cr^{+3} seems more toxic to fish, Cr^{+6} more toxic to plants and mammals. Human activity has elevated Cr levels in many surface waters and soils in New Jersey, particularly in urban/industrial areas (best identified in Hudson County; although metal plating operations elsewhere in the state might have elevated Cr levels too, whether and to what degree is unknown). Potential ecological impacts are judged to affect biological integrity and biodiversity, through acute or chronic toxicity changing composition, diversity, and function of normal plant and animal populations and communities. It is unknown whether such effects have occurred in New Jersey; the Ecological TWG rated the severity of impacts mostly low (1-2 on a 5-point scale) based on hazard quotients (ambient levels of Cr^{+3} divided by benchmark criteria), but rated soil in Liberty State Park at 5 and a Hackensack River stretch at 4. The Health TWG identified three possible risk scenarios for Cr^{+6} in NJ. First, exposure to Cr^{+6} via waste sites in Hudson County (particularly Jersey City) might result in a lifetime cancer risk from breathing total Cr in outdoor air of 4.8-8.4 in 100,000; an unknown risk of non-cancer effects from ingestion; and an unknown risk of allergic contact dermatitis due to contact, particularly for "sensitized" people (1-2% in the general public—given the rough Health estimate of 1,000-2,000 people living within 1-2 blocks of known Jersey City Cr sites, this would suggest an incidence of about 10-40 cases; higher proportions among cement manufacturing, construction, and other workers who have sustained high, sensitizing exposures). Remediation of sites in Jersey City has reduced exposures (e.g., Cr levels in indoor household dust returned to background levels after remediation) but it cannot be guaranteed that Cr^{+6} will remain under protective caps or that all such sites have been found; as noted above, other sites elsewhere in NJ might exist but the extent of contamination, if any, is unknown. Second, two sporadic incidents of exceedances of the total Cr standard in the Camden water supply (50,000 people served) and sporadic exceedances in five "non-community" water supplies in New Jersey (e.g., serving public institutions) have occurred. Although these exceedances were calculated to result in twice the dose to an adult allowed by the relevant Reference Dose (RfD), the RfD is set based on long-term exposure, so that the apparently short-term, sporadic exposures to Cr in drinking water identified in New Jersey are unlikely to pose significant health risks. Third, USEPA estimates of ambient air levels of Cr in NJ, if one assumes that all of this Cr is the Cr^{+6} variety, suggest a statewide population-weighted lifetime cancer risk from inhalation of 1.7 in 100,000, with a maximum risk (in the Passaic County census tract with the highest predicted ambient levels) of 4.8 in 10,000; these estimates probably overstate the risk.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Property Values; Employment; Costs Incurred; Aesthetic Levels; Psychological Impacts

Key impacts selected (critical socio-economic effects)	Overall, ecological impacts were deemed uncertain enough (e.g., high ambient levels in a small minority of the few locations from which samples were taken), but with no evidence collected yet on actual impacts on plants, animals, etc.) that they were not taken into account in scoring socio-economic impacts unless health and other impacts are close to thresholds for higher scores. Property Values: These impacts might affect properties near Hudson County sites. Statewide ambient air levels and sporadic drinking water exceedances were not deemed to have property value impacts. Employment: When the Hudson County Cr problem was first publicized, local government expressed concern about depression of local development opportunities (and thus construction and other employment) as a result. Costs Incurred: Medical costs for cancer or dermatitis should be expected. Aesthetic Levels: Chromium deposits in the soil turn the soil yellow, which might be deemed undesirable by some. Psychological Impacts: As with many other environmental health issues, identification of Cr waste sites or exceedances of the Cr RfD in drinking water might raise worry; to a lesser extent worry also might rise about ambient air levels, although it is likely to be submerged in air pollution concerns generally. Worry about ecological effects, particularly given their current lack of specificity, is deemed to be insignificant.	
Exposure Assessment		
Socio-economic entities: exposure routes and pathways considered	People exposed by living near waste sites or drinking contaminated water or breathing air with elevated levels are potentially at risk.	
Quantification of exposure levels statewide	Temporal: Chromium exposure should gradually diminish with remediation of contaminated sites, but the pace and uncertain completeness of that remediation, and air deposition from non-local sources, it should endure for some time. Geographic: Although air deposition is statewide, and several possible exposure routes are not well-characterized in extent (e.g., metal-plating impacts outside Hudson County; drinking water supplies that are not tested regularly, such as private wells), the primary impacts would fall in Hudson County, specifically Jersey City and (to a much lesser extent) Bayonne.	
Specific socio-economic entities at increased risk	Dwellers in homes (and others affected by ecosystem impacts) near contaminated sites; consumers of water from sporadically contaminated supplies (e.g., Camden City)	
Quantification of exposure levels to entities at increased risk	Not feasible, except as discussed under Risk Characterization.	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	The most feasible approach is to estimate whether it is plausible that Cr's effects on Health or Ecological impacts would have the degree of socio-economic impact needed to move from one category to another (e.g., a minimum of 20,000 jobs lost in relevant economic sectors to shift from a Severity score of 1 to 2). In a few cases (e.g., multiplying estimated dermal-sensitive people exposed to Hudson County sites by medical costs for allergic reactions) a more direct estimate is feasible. The sensitivity analysis approach (estimating the value needed to switch from one category to another) requires certain assumptions (e.g., the proportion of jobs in an economic sector that might be related to issue-relevant impacts), and depends very heavily on the plausibility of the divisions between categories.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		*Score*

Issue: Chromium: Cr^{+3}, Cr^{+6}
Author: Branden Johnson
Date: May 12, 2000

Property Values—no significant impacts	a) Severity: 1998 property values for Jersey City were $5.5 billion; Bayonne added $2.4 billion. The threshold for a Medium (2) score is about $13 billion (2.5% of total). Since total loss of property values in these two cities never occurred (or was likely to occur), a score of 1 (Low) is appropriate.	1
	b) Irreversibility: Highly reversible (note that Jersey City development has boomed since the chromate sites were initially identified).	1
	c) Scale	1
	d) Uncertainty	1
Employment	a) Severity: A threshold of 20,000 jobs is needed to assign a medium (2) score. The 1997 Hudson County total of construction jobs were 4,400. There is no evidence that all of these jobs disappeared as a result of concern about chromium waste sites; if they had, one would have to assume more than 4.5 other job types were affected by any job loss in order to exceed that threshold. This is a larger job multiplier than economists usually assume.	1
	b) Irreversibility: Construction jobs are highly substitutable in a booming economy; however, they are also vulnerable in a declining economy, as well as being highly seasonal. Thus I am rating the irreversibility as Medium.	2
	c) Scale—very localized	1
	d) Uncertainty	1
Costs Incurred	a) Severity—Earlier estimates were that perhaps up to 40 people in Hudson County in the general public might be sensitized to chromium exposure, and thus vulnerable to resultant dermatitis. At an average 1997 in-patient cost in New Jersey of $6,664 for "minor skin disorders without chronic care" needed (allergy reaction costs are lower, so the skin disorder costs were used), this suggests a rough impact of $266,560. Note that this figure excludes costs that sufferers might incur before or after seeking in-patient care. As for lung cancer costs, 1997 in-patient costs were $13,818 for "respiratory neoplasm," and $11,520 for "radiotherapy" and $8,734 for "chemotherapy." At the statewide estimated average risk of total-Cr inhalation of 1.7 in 100,000 (which assumes that all such Cr is Cr^{+6}, a likely overstatement), statewide occurrence of cancer would be 136 out of 8 million. At the Hudson County waste site estimated risk of 4.8-8.4 in 100,000, and the U.S. Census July 1999 estimate of 552,819 (www.census.gov as of 5-15-00), occurrence of cancer would be 27-46. Together, if we sum neoplasm and radiotherapy costs (as the more expensive therapy) and apply them to each potential cancer case, this sums to a maximum of $4.6 million for in-patient medical costs. If we double the total estimated dermatitis-plus-cancer costs to account for the greater sensitivity of some workers to dermatitis and the out-patient costs, this would amount to about $9.8 million. This is lower than the $16 million statewide threshold for a score of 2. Because drinking water exposure above the RfD (which assumes lifetime exposure) was transient, and a risk estimate was not feasible for such ingestion, it is not possible to estimate any such costs. If we assume that the cancer risk is the same for ingestion of contaminated water as for inhalation of contaminated air (note that the RfD is concerned with non-cancer risks), across the 50,000 residents of Camden this yields a total cost (under the same assumptions as above) of $213,000, not enough to raise the costs above the threshold. [Clarification added by John Posey, 7/13/01: The cancer risk cited above is a lifetime cancer risk. The length of a lifetime is typically assumed to be 70 years. Thus, the 136 cases should be divided by 70, resulting in an estimate of 1-2 cancer cases per year. This does not change the severity rating assigned earlier.]	1
	b) Irreversibility—Lung cancer is more difficult to reverse (but not impossible to do so) than dermatitis, which disappears when exposure ends.	2
	c) Scale—local	1
	d) Uncertainty	3

Issue: Chromium: Cr^{+3}, Cr^{+6}
Author: Branden Johnson
Date: May 12, 2000

Aesthetic Levels—no significant impacts	a) Severity—although having yellow soil in one's backyard might be disconcerting, it seems far less an aesthetic impact than noxious smells or haze.	1
	b) Irreversibility—the yellowness of the soil is not eradicable; with normal soil and moisture conditions chromium would be drawn upwards and concentrated at the surface even if contaminated soil is covered with fresh, clean fill, and because of its phytotoxicity grass would not grow over such yellow spots; only covering with cement or a building would hide any blemish that might be imposed by chromium.	2
	c) Scale—localized in very small areas of Jersey City and Bayonne	1
	d) Uncertainty	1
Psychological Impacts—no significant impacts	a) Severity—As part of "hazardous waste," chromium in Hudson County can hypothetically elicit great worry. Fieldwork around these waste sites in the late 1980s-early 1990s by this analyst (as part of an exposure study by NJDEP) suggested that such worry was lower than expected given other (non-chromium) sites' experience. Worry about inhalation risks is expected to be low, given the lack of confirmation of these federal modeling estimates. Drinking water might spark more worry, although survey experiments (Johnson, 2000) suggest a clear explanation of the transience of these exceedances might—at least among middle-class audiences—reduce that worry.	2
	b) Irreversibility—worry should decline when exposure is "visibly" removed (e.g., yellow soil is paved over; trusted authorities report that it no longer occurs).	1
	c) Scale--localized	1
	d) Uncertainty—no estimate of worry is ever anything but uncertain	3
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description (data gaps; highlight significant data needs)	M: Data on actual ecological impacts would be most valuable, since it is difficult to tell on available evidence whether these are non-existent or large. That makes estimating the consequent socio-economic impacts extremely difficult. Of secondary value would be better information on dermal exposures and sensitivity, and perhaps the fraction of inhalable Cr that is Cr^{+6}.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, ---, where + is improvement) and brief description	+: Because the highest known demonstrated exposures are in Hudson County, whose sites are being (or have been) largely remediated, these exposures and impacts should decline. The largest uncertainty in this estimate has to do with the validity of the CEP estimates of inhalable Cr in New Jersey, and the degree to which sources of this Cr are in state or out-of-state.	
Potential for catastrophic impacts (H,M,L) and brief description	Low: Both Health and Ecological analyses estimated the catastrophic potential as low, and the likelihood of catastrophic socioeconomic impacts, which would stem entirely from those, should be even lower.	
Incidence of impacts (affected sub-groups, variability, equity issues)	Hudson County residents are the most obvious affected entities; sites occurred in yards or commercial properties in working-class neighborhoods, on lots near public housing, and on large industrial sites (where chromate producers had formerly operated). Thus to some degree these residents tended to be from low-income or minority populations. Camden City water supply customers who were exposed to brief exceedances also tend to be low-income and minority. Air exposures, on the other hand, are likely to be more equitably distributed, although without more detailed information on exposures its equity cannot be guaranteed.	
Relative Contributions of Sources to Risk (H,M,L); include any		

information/details on sources	
NJ Primary Sources	
Large business/industry	M - plating industry, fossil fuel combustion
Small business/industry	M - plating industry
Transportation	L
Residential	L/M - fuel oil combustion, use of Cr^{+6} as an anti-corrosive in large air conditioning systems
Agriculture	L
Recreation	L
Resource extraction	L
Government	L/M - fuel oil combustion, use of Cr^{+6} as an anti-corrosive in large air conditioning systems; publicly-owned waste treatment plants
Natural resources	L
Orphan contaminated sites	M/H - Jersey City chromate production waste sites
Diffuse Sources	
Sediment sinks	L
Soil sinks	M – chromium can remain in the soil for long periods, until activated by sources such as acid rain.
Non-local air sources incl. deposition	M - potential medium and long-range transport
Biota sinks	L
References	
Current Policy and Regulatory Framework	
Federal	
State & Local	

Issue: Chromium: Cr^{+3}, Cr^{+6}
Author: Branden Johnson
Date: May 12, 2000

Socio-economic Impact Evaluation of Environmental Issue:

Chromium is a carcinogen that gained some public attention because of the movie "Erin Brockovich." Inhalation of chromium can contribute to lung cancer. Ingestion of chromium in drinking water may contribute to other cancers. In addition, skin exposure may lead to dermatitis. In a state the size of NJ, about 100 people may be expected to develop chromium-related cancer at some point in their lives. Annual health care costs related to chromium are probably less than $16 million.

Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	1	1	1	1	2
Irreversibility	1	2	2	2	1
Scale	1	1	1	1	1
Subtotal Risk	1	2	2	2	2

Average Risk (0 – 5 years)	Average Risk (5 years plus)
1.8	**1.8**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Confidence
Uncertainty	1	1	3	1	3	2.6

Trend: +

Catastrophic Potential: L

Issue: Copper
Author: John Posey
Version: 07/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Stressor: **Copper**

Copper is commonly used as a pesticide, particularly for control of algae. Copper also enters the environment through its use in industry. Copper has a low toxicity for humans, although human health effects related to extreme levels of copper in drinking water have been noted. For example, some well waters in Germany have had copper contamination from natural sources. In addition, in areas with naturally corrosive drinking water, leaching of copper pipes may result in excess levels of copper in drinking water. In such cases, the most common symptoms are headaches, nausea, and diarrhea. Inhalation is also possible, usually in occupational settings.

Copper contamination can affect biological integrity and biodiversity. Laboratory tests indicate that copper can kill algae, certain plants, and certain invertebrates. However, it can be difficult to isolate effects of copper poisoning, since high levels of copper usually occur with high levels of other toxic chemicals. For example, oil spills result in elevated copper levels in mollusks, but this is not the most serious danger posed by oil spills.

Copper is sometimes used to coat the hulls of boats to deter the growth of algae. The most common defoulant in recent decades was tributyl tin (TBT), which has recently been banned in most countries. Copper-based defoulants are currently popular, although the search is on for more eco-friendly defoulants. The Center for Marine Conservation advocates the use of other types of boat defoulants, such as paints containing silicon, Teflon, or cayenne pepper. The June 2000 *Sea Magazine* contains an article on a new type of copper-epoxy coating that meets EPA standards.

EQTWG characterizes the risks posed by copper as minimal. EQTWG reports that several industrial sites in NJ have elevated levels of copper in soil or nearby sediments. However, it finds that "there is no indication that ambient levels, apart from such specific sites, are above guidelines for ecological harm. Moreover, data availability for the State as a whole is probably not adequate to justify quantification with any degree of confidence."

EQTWG further reports the following:

- *Assessment of severity:* "Copper is widespread in the environment, as a result of human activity, and will remain so for the foreseeable future; however evidence does not exist of severe ecological effects."
- *Assessment of frequency of effects:* "Sub-chronic effects may be very frequent due to the ubiquity of copper in the environment; however, as noted above, no evidence that substantial environmental effects result."
- *Potential for additional data to result in a significant future change in this risk estimate:* "Although statewide data is inadequate, the data that does exist does not indicate an environmentally significant problem for this metal. Moreover, the trend data available, although meager, imply that copper concentrations are decreasing in surface water. Thus, additional data probably will not change the risk assessment."

It should be noted in addition that HHTWG declined to produce a short report or a writeup on copper.

Given the opinions of the other TWGs, it appears that there is little utility in producing a full impact assessment by SETWG. Costs associated with copper-related illnesses appear to be minimal. Moreover, there is no evidence that copper has a serious enough effect on the ecosystem to threaten employment (in shellfish harvesting, for example) or property values. There is similarly little reason to believe that copper produces serious aesthetic impacts in NJ, or that it produces a great deal of anxiety in the public.

References:

Robert Brady. "In Future, Ships and Barnacles Will Benefit from Fouling Release Systems." Polymers Paint Colour Journal, 3/1/2000.

Issue: Copper
Author: John Posey
Version: 07/00

Leslee Jaquette. "The Future of Boat Bottoms." Sea Magazine, June 2000.

Center for Marine Conservation. "Tips to Keep Your Boat in Top Shape." (http://www.tntwebcraft.com/ccso/CMC.htm)

Issue description: Copper is a naturally occurring element with a wide variety of industrial uses. Copper can also enter the environment through its use as a pesticide. HHTWG declined to produce a writeup or paragraph on copper, indicating that experts deem copper a minimal threat to human health. The EQTWG writeup indicates that copper is unlikely to produce serious environmental effects. EQTWG also maintains that the use of copper in pesticides is decreasing, leading to a decrease in overall environmental copper levels. These considerations indicate that copper is a minimal threat to NJ, and is unlikely to pose measurable negative economic or environmental impacts.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	0.1	0.1	1	0.1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	0.1	0.1	1	0.1	0.1

Average Risk (0 – 5 years)	Average Risk (5 years plus)
0.28	0.28

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	1	1	1	1

Trend: 0

Catastrophic Potential: L

Issue: Cryptosporidium
Author: Clinton Andrews
Version: 04/16/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Cryptosporidium Parvum** exists in drinking and recreational waters.
Description of stressor	Cryptosporidium ("Crypto") is an intestinal parasite that can cause gastrointestinal illness. Oocysts of this parasite are present in the feces of infected humans and animals and are present in all surface waters. (An oocyst is a dormant, or inactive, form of crypto.) They are resistant to most chemical disinfectants used during water treatment.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	For people with normal immune systems: infection without illness or else gastrointestinal illness, diarrhea, sometimes with nausea, cramps and vomiting. Resolution of symptoms occurs within a few days to a week or more, infrequently requiring hospitalization. For persons with weakened immune systems: severe, prolonged (weeks to months) gastrointestinal illness, unrelenting cholera-like diarrhea, potentially life-threatening. Crypto also causes gastrointestinal distress in animals but it is not considered a major ecological risk. You can get infected with crypto when you put anything in your mouth that has been in contact with feces from an infected animal or person.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Property Values; Employment; Costs Incurred; Aesthetic Levels; Worry.
Key impacts selected (critical socio-economic effects)	Costs Incurred, Worry
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Medical bills, lost time at work or school, and worry about the severity of health impacts may affect individuals exposed through contaminated drinking water, swimming in contaminated surface water, oral-fecal human contact during bathing, day-care, hospitalization, or sex, or, rarely, through ingestion of contaminated food.
Quantification of exposure levels statewide	Spatial: Potential exposure through drinking water and swimming occurs statewide and affects millions of people. Potential exposure during bathing, day-care, hospitalization, sex, or through the ingestion of contaminated food also occurs statewide but involves a much smaller fraction of the population. Temporal: Exposure pathways such as outdoor water recreation are seasonal; other exposure pathways are in place all year long but outbreaks of illness are typically sporadic (1).

Specific socio-economic entities at increased risk	Persons with weakened immune systems (persons with AIDS, bone marrow and organ transplant patients, cancer therapy patients, persons on high-dose steroid therapy, persons with inherited immune dysfunction syndromes) are vulnerable to more serious illness if infected. According to an EPA reviewer, "children should be added to the list of individuals at increased risk….The child immune system is developing and is not as adept at fighting off infection….We also recommend that elderly populations be added into the sensitive population category."
Quantification of exposure levels to entities at increased risk	Same as statewide exposure levels.
Dose/Impact-Response Assessment	
Quantitative/Qualitative impact-assessment employed	
Risk Characterization	

Risk estimate(s) by socio-economic entities at risk		Score
Property Values--not studied, impact assumed to be minimal	Severity	*0.1*
	Duration/irreversibility	1
	Scale	2
	Uncertainty	1
Employment--not studied, impact assumed to be minimal. But see lost work days in Cost Incurred section.	Severity	*0.1*
	Duration/irreversibility	1
	Scale	2
	Uncertainty	1

Costs Incurred	Severity: Low. Drinking water pathway: The HH TWG provides 3 estimates of annual illnesses: 19000, 317, and 24-45, but it attaches a higher probability to the lower estimates. There have been no confirmed reports of Crypto-related illnesses due to drinking water in NJ. Recreational pathway: The most common recreational exposure pathway is in swimming pools and fresh water lakes used by children. For this pathway, the HH TWG reports only one documented outbreak of Crypto-related illness in NJ in recent years (we assumed "recent" = 6 years). They report that 135 people (2/3 children) were infected while swimming in Lake Nummy (Belleplain State Forest, Cape May County) in the mid-summer of 1994. This is equivalent to 135/6 = 23 infections annually on average. For healthy, non-preexposed adults, about 39% of infections lead to illnesses (personal communication with Tom Atherholt, NJDEP). This leads to an expected rate of about 9 illnesses per year. No estimate is available for the other exposure pathways. The NJ DHSS records an average during 1995-9 of 27.3 reported cases of cryptosporidiosis annually from all pathways taken together (2). In 1996, one third of the reported cases involved children (3). Unreported cases could be much more numerous. Total illnesses per year, based on the information above, are likely to be in the range of 30-100 cases on average. The vast majority of cases do not require hospitalization. Using the 1993 Milwaukee outbreak as guidance (403,000 infected; 4,000 hospitalized; 50-100 deaths) we assume that 1% require hospitalization and 0.01% die. Medical Costs Summary: 30-100 illnesses @$100/doctor's visit = $3000-10000 0-1 hospitalizations @ $4000/hospital stay for minor gastrointestinal disorders (1995 NJ Average cost for DRG Code 183 was $4354.20 which we round to $4000, covers a 1.73 day length of stay) (4) = $0-4354 No deaths are likely. Total medical cost for NJ = $3000-14000 per year Lost Time Summary: 30-100 illnesses @2 days lost work/school = 60-200 days 0-1 hospitalizations @4 days lost work/school = 0-4 days Total lost time for NJ = 60-204 days per year Assuming 2/3 of cases are adults earning the 1998 NJ median personal income of $ 33,953 (5) (with 250 working days/year = $136/day) this is = $5440-18496. Total cost range for medical and lost time for NJ = $8440-32496, which we round to $8,000-32,000. This is a very low cost on a statewide basis, representing about 0.00001% of the 1997 Gross State Product ($294 billion (6)).	*1*
	Duration/irreversibility: Low	1
	Scale: The entire population is vulnerable to this problem, but outbreaks are usually quite localized.	2
	Uncertainty: Medium	2

Aesthetic Levels--not studied, impact assumed to be minimal	Severity	*0.1*
	Duration/irreversibility	1
	Scale	2
	Uncertainty	1
Psychological Impacts	Severity: Low. The drinking water pathway seems controllable with filtration and inspections. The problem remains a chronic but low level concern for recreational users of NJ's surface waters, but again individuals can largely control their exposure.	*1*
	Duration/irreversibility: Easily reversible.	1
	Scale: The apparent potential for a large scale outbreak such as in Milwaukee in 1993 causes concern, but provided that there is adequate water filtration such an event is extremely unlikely.	2
	Uncertainty: Medium	2
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	Low. Even if better data show that outbreaks are underreported by an order of magnitude, the socioeconomic impacts will remain negligible. Still, we lack good estimates of the distribution of illnesses among endpoints (doctor's visit, hospitalization, and death).	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	0	
Potential for catastrophic impacts (H,M,L) and brief description	Medium. The 1993 Milwaukee city-wide outbreak demonstrates the potential for large-scale impacts. However, while such an outbreak in NJ would significantly increase worry, it would not impose a very large economic burden.	
Incidence of impacts (affected sub-groups, variability, equity issues)	Persons with weakened immune systems are more likely to suffer severe effects (high health costs, possible death) than the population as a whole, although they are not more likely to be exposed.	
Extent to which threat is currently regulated	The threat is currently very well regulated through existing water treatment facilities and standards in place for public bathing areas.	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		
NJ Primary Sources		
Large business/industry	Low	

Small business industry	Low
Transportation	Low
Residential	Medium
Agriculture	Medium
Recreation	Medium
Resource extraction	Low
Government	Low
Natural sources/processes	Medium A recent report suggests that ground squirrels may shed as much Cryptosporidium as cattle (Applied & Environmental Microbiology, volume 67, page 2840).
Orphan contaminated sites	Low
Diffuse Sources	
Sediment sinks	Low
Soil sinks	Low
Non-local air sources incl. deposition	Low
Biota sinks	M: HHTWG reports that crypto comes from more than 100 animal species.
References	New Jersey Dept. of Health and Senior Services. 2000. New Jersey Reportable Communicable Diseases by Month of Onset, 1996. http://www.state.nj.us/health/chs/stats96/morb17.htm New Jersey Dept. of Health and Senior Services. 2000. New Jersey Reportable Disease Statistics Statewide Totals http://www.state.nj.us/health/cd/trends.htm New Jersey Dept. of Health and Senior Services. 2000. New Jersey Reportable Communicable Diseases by Age New Jersey, 1996 http://www.state.nj.us/health/chs/stats96/morb16.htm New Jersey Dept. of Health and Senior Services. 2000. 1995 Inpatient Acute Care Hospital Statistics. http://www.state.nj.us/health/hcsa/95payl.htm New Jersey Dept. of Labor. 2000. 1998 Per capita personal income. http://www.wnjpin.state.nj.us/OneStopCareerCenter/LaborMarketInformation/lmi10/pci89r.htm New Jersey Dept. of Labor. 2000. 1997 Gross State Product in Current $. http://www.wnjpin.state.nj.us/OneStopCareerCenter/LaborMarketInformation/lmi09/gsp97c.htm Atwill, Edward R. et al. (2001). Quantitative Shedding of Two Genotypes of Cryptosporidium parvum in California Ground Squirrels (Spermophilus beecheyi). Applied & Environmental Microbiology, Volume 67, pp. 2840-2843.
Current Policy and Regulatory Framework	

Issue: Cryptosporidium
Author: Clinton Andrews
Version: 04/16/00

Regulatory Framework	
Federal	
State & Local	

Cryptosporidium is an intestinal parasite that can cause gastrointestinal illness. Oocysts of this parasite are derived from the feces of infected humans and animals and are present in all surface waters. They are resistant to most chemical disinfectants used during water treatment. A major outbreak of crypto in Milwaukee in 1993 caused hundreds of thousands of cases of gastrointestinal illness. Most were fairly mild, however, and did not result in the need for hospitalization.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	0.1	1	0.1	1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	2	2	2	2	2
Subtotal Risk	0.2	0.2	2	0.2	2

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
0.92	**0.92**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	1	2	1	2	1.4

Trend: 0

Catastrophic Potential: H

Issue: Deer
Author: John Posey
Version: 03/28/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Deer**
Description of stressor	Development pressures have resulted in loss of native habitat and food sources. Growth of deer herds has led to damage of natural ecosystems, destruction of crops and human injuries due to auto collisions.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Potentially significant damage to state forests. Income losses in agricultural sector. Medical costs associated with Lyme disease. Repair and medical costs associated with auto collisions.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Property Values, employment, costs incurred, aesthetic levels, psychological impacts.
Key impacts selected (critical socio-economic effects)	Costs incurred.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Property Values: Landscaping damaged by deer can reduce property values and increase home ownership costs. Income: Farmers losing crops will suffer lower profits. Auto Collision Costs: Drivers colliding with deer may incur medical and auto repair costs. Aesthetics: Unpleasant visual effects resulting from damaged vegetation and carcasses; destruction of seedlings in forests Social Cohesion: Conflict over deer control strategies causes political conflict. Employment: Loss of forests could result in reduced employment in logging industry.
Quantification of exposure levels statewide	Spatial: The explosion in deer population is a statewide phenomenon. Areas hardest hit are the high-growth regions, including Somerset, Hunterdon, and Mercer Counties. Temporal: 1) Seasonal: The deer population is greatest in autumn after fawns are born. 2) Secular: The deer population has reached 200,000, more than double the level of twenty years ago.
Specific socio-economic entities at increased risk	Persons who live in high-growth counties.

Quantification of exposure levels to entities at increased risk	This issue is best considered as a statewide problem.	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	Literature search, with special attention to current newspapers.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		*Score*
Property Values: Deer sometimes trample suburban lawns and pilfer from vegetable gardens.	a) Severity: There is no evidence that deer cause significant changes in housing prices.	1
	b) Duration/irreversibility: Highly reversible.	1
	c) Scale: Statewide	3
	d) Uncertainty: Deer damage to suburban gardens may be annoying, but there is no evidence that it affects the decision to buy or sell a home.	1
Employment: Impact of seedling destruction on logging industry.	a) Severity: Foresters report that most hardwood seedlings planted over the last 10 years have been destroyed by deer.[1] This could have a devastating impact on the regeneration of forests. However, the employment impact will be slight for the foreseeable future. There are fewer than 100 loggers in the state, and any impact on mature hardwood harvests will not be felt for several decades.[2]	1
	b) Duration/irreversibility: The failure of the forest to regenerate can lead to permanent loss of forest.[3]	3
	c) Scale: Some 44% of the state is covered by forest.[4] Thus, it must be considered a statewide phenomenon.	3
	d) Uncertainty: The small numbers of individuals engaged in logging give high confidence to the assessment that any employment effects will be small.	1

Costs Incurred	a) Severity: There are four types of costs associated with deer infestation: auto repair costs, agricultural costs, health costs and landscaping costs. Auto Repair Costs: Passenger vehicles collide with deer approximately 20,000 times per year in New Jersey.[5] The average car repair cost following a deer collision is $2000.[6] Thus, the auto repair cost of deer collisions is approximately $40 million per year. Agricultural Costs: A Rutgers survey of 2,100 farms in New Jersey found that the farms surveyed suffered damages ranging from $5 million to $10 million.[7] If these farms are representative of the 9,000 farms in New Jersey, then total damage to the state ranges from $20 million to $40 million. William Dressel, executive director of the New Jersey League of Municipalities, predicts that some farmers will be forced to sell their land and stop farming because of deer: "They literally cannot have productive farming operations because of the deer eating their crops."[8] Health Costs: New Jersey has one of the highest rates of Lyme disease in the country, with 1,722 cases in 1999.[9] Deer are a critical vector for the spread of Lyme disease. The Lyme Disease Foundation estimates that Lyme disease costs the nation some $1 billion each year.[10] Since New Jersey accounts for 7.5% of all cases, the total cost to New Jersey is approximately $75 million. Landscaping Costs: A landscaper estimates that a suburban lawn and garden attacked by deer will suffer between $250 and $750 in landscaping damage.[11] This damage results from deer feeding on trees, shrubs, flowers, and vegetable gardens. There are no published estimates of the number of New Jersey households that are affected by deer-damaged lawns. There are 2.8 million households in New Jersey.[12] If 1% of these suffer $250 worth of lawn damage, then the total cost would come to $7 million. Total: The total cost of problems caused by uncontrolled deer populations probably ranges somewhere between $120 million and $160 million.	2
	b) Duration/irreversibility: Costs are highly reversible.	1
	c) Scale: Costs are statewide.	3
	d) Uncertainty: Auto collision, agricultural costs and health care costs are fairly well documented.	2
Aesthetic Levels	a) Severity: Defoliation and carcasses can make an area less visually attractive. These must be considered relatively minor aesthetic problems. More serious is the potential destruction of forests. This problem may yet be remedied, and is decades away. Still, if deer continue to destroy seedlings, the results could be catastrophic.[13]	2
	b) Duration/irreversibility: Carcasses and suburban defoliation are completely reversible. The loss of forests could be completely irreversible.[14]	2
	c) Scale: Statewide	3
	d) Uncertainty: The long-term effect on forests will not be known for many years.	3
Psychological Impacts	a) Severity: There is no evidence that fear of deer is in any way debilitating. However, some communities report that disagreements over deer-control strategies generate severe political conflict.[15]	1
	b) Duration/irreversibility:	1
	c) Scale:	3
	d) Confidence	3

Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	L: Auto, agricultural, and health costs are fairly well documented. The biggest variable is the long-term impact on forests, which will not be apparent for several decades.
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	0 The adoption of aggressive deer control programs has the potential to reduce overpopulation in the deer herd. However, additional development of rural land will exacerbate the problem of displaced deer.
Potential for catastrophic impacts (H,M,L) and brief description	L: Destruction of seedlings is a potential long-term catastrophe for state forests. Still, EQTWG gives a rating of "Low" under this category, and I defer to their judgment.
Incidence of impacts (affected sub-groups, variability, equity issues)	Although the problem of deer overpopulation is greatest in high-growth counties, the problem affects the entire state. Suburban areas are more greatly impacted than urban areas.
Extent to which threat is currently regulated	Responsibility for managing the state's fish and wildlife resource has been given by legislative action to the New Jersey Fish and Game Council (Council) and the Division of Fish, Game and Wildlife (Division) [N.J.S.A. 23:2].[16] The Council is made up of eleven members -- six sportsmen representatives, three farmer representatives, one public representative and one person from the state's Endangered and Nongame Species Committee. The Council annually establishes seasons, bag or creel limits and methods for hunting and fishing in our state. These seasons and related rules are based on the scientific information provided by the technical staff of the Division. In the 2000-2001 hunting season, the Division wants to eliminate more than 75,000 deer during a series of six hunting seasons.[17] The current deer population is projected to reach 200,000 by autumn, 2000.[18] Traditional herd control methods which rely on hunting are relatively ineffective in suburban areas where hunters cannot go.[19] To address this problem, the Division has established a Community Based Deer Management Program (CBDMP). Under this program, the Division works closely with municipalities to develop deer control strategies. Division agents have killed hundreds of deer in several municipalities. CBDMP also gives municipalities technical assistance in the use of fencing and repellants.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	L
Small business industry	L

Transportation	H – roadways cause increased fragmentation and create additional edge habitat favorable for deer. These areas in turn may act as an attractant to deer, where they are hit by vehicles. New Jersey's increasing human population has resulted in more cars being driven more miles, making deer collisions more frequent.
Residential	H: Residential development has destroyed deer habitats, forcing the animals into areas with high concentrations of humans. Loss of habitat leads to increases in deer population through three processes: 1) Loss of habitat also decreases natural predators who feed on deer. 2) Loss of habitat makes it difficult for hunters to reach deer; hunters cannot traipse through suburban neighborhoods in search of game. 3) Suburban environments are deer-friendly: they provide shrubs and foliage that deer find attractive.
Agriculture	L
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	H: Eradication of deer habitat interacts with natural deer fertility to produce overpopulation.
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. Deposition	L
Biota sinks	L
References	See end notes.
Current Policy and Regulatory Framework	
Federal	
State & Local	In May, 2000, a bill that would have given municipalities the authority to control deer by hiring professional marksmen was defeated.[20] The bill had passed in the House of Representatives earlier in the year. The bill would have relaxed state gun laws to allow marksmen to use silencers, and to shoot across highways. Even an opponent of the bill, Senator Joseph Vitale, conceded that "our state wildlife officials have been unable to control the overpopulation of deer." The sponsor of the bill asserted that the bill's defeat leaves the state with an inadequate deer control program: "This bill creates a sensible management plan. Now we have nothing. We are telling farmers and homeowners there is no intelligent way of handling it. You are on your own."

Issue: Deer
Author: John Posey
Version: 03/28/00

Deer: Development pressures have resulted in loss of native habitat and food sources. Growth of deer herds has led to damage of natural ecosystems, destruction of crops and human injuries due to auto collisions. Costs incurred because of deer total between $120 million and $160 million each year. This figure includes the costs of auto collisions, Lyme disease, agricultural loss, and landscaping. It is difficult to document any impacts for property values, employment, aesthetics, or worry.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	1	1	2	2	1
Duration/ Irreversibility	1	3	1	2	1
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	3	9	6	12	3

Average Risk (0 – 5 years)	Average Risk (5 years plus)
6.6	6.6

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	2	3	3	2

Trend: 0

Catastrophic Potential: L

Issue: Deer
Author: John Posey
Version: 03/28/00

References:

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2. U.S. Census Bureau. County Business Patterns, 1997.
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Issue: Dermo and MSX Parasite in Oysters
Author: John Posey
Version: 09/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Dermo and MSX Parasite in Oysters**
Description of stressor	Dermo and MSX are protozoan parasites that live in the Eastern Oyster population. (Dermocystidium Marinus, a.k.a. perkinsus marinus; and MSX: Multinucleated Sphere X, a.k.a. haplosporidium nelsoni.)
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Dermo and MSX cause high mortality rates among Eastern Oysters. These parasites have killed most of the Eastern Oysters residing along the Atlantic seaboard.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Dermo and MSX have devastated the oyster industry in New Jersey, reducing employment and depriving the state of revenue.
Key impacts selected (critical socio-economic effects)	Employment and costs.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	
Quantification of exposure levels statewide	Oyster yields today are less than half the level of 20 years ago, and less than a tenth of the level of 50 years ago. In 1953, NJ harvested 8.5 million tons of oysters. Dermo and MSX were blamed for a decline in oyster populations that caused harvests to drop to 167,000 pounds in 1960. Harvests rose to 1.7 million pounds in 1979 before another outbreak of parasitic infection all but wiped out the NJ oyster industry. In 1993, the state produced just 585 pounds of oysters. Since then, oyster yields have rebounded to 700,000 pounds. Dermo and MSX are blamed for most of the decline in the oyster population.
Specific socio-economic entities at increased risk	Nearly all oyster fishing in NJ takes place in Delaware Bay. About 29,000 acres of bay bottom are currently leased to commercial oyster fishers.
Quantification of exposure levels to entities at increased risk	Employment losses are heavily concentrated in counties bordering Delaware Bay. However, the revenue to the state economy that is lost because of dermo and MSX must be considered a statewide phenomenon.
Dose/Impact-Response Assessment	

Quantitative/Qualitative impact-assessment employed	My principal method of assessing costs and employment impacts is a comparison of the NJ oyster industry with the CT oyster industry. Today, CT produces about 6.5 million pounds of oysters, which is slightly less than the amount that the NJ oyster industry produced at its height in the 1950s. Today, the NJ oyster industry produces about 700,000 pounds, or roughly a tenth of the CT level. As noted, dermo and MSX are blamed for the reduction in the NJ oyster populations. The economic impact of the CT oyster industry is fairly well documented. Thus, for my analysis, I assume that NJ would be able to support an oyster industry comparable to the CT oyster industry if dermo and MSX were eliminated. These assumptions allow me to estimate the number of jobs lost to dermo and MSX, as well as the total cost to the state economy. Most data on the economic impact of the oyster industry is derived from surveys of fisheries conducted by government agencies such as the National Oceanic and Atmospheric Administration (NOAA).

Risk Characterization

Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: It is possible that the loss of fishing jobs would hurt property values in communities closest to Delaware Bay. There is no available evidence of this, however.	*1*
	Duration/irreversibility	1
	Scale	1
	Uncertainty	1
Employment	Severity: I estimate that New Jersey could support an additional 500 jobs in oyster harvesting if oyster populations would return to the levels seen in the early post-war period. This estimate is based on a comparison of New Jersey and Connecticut. A Connecticut Department of Agriculture report dated March 29, 2000 indicates that the oystering industry in 1993 accounted for more than 600 jobs in Connecticut. These jobs were supported by the harvest of approximately 8.2 million pounds of oysters. Currently, New Jersey dredgers harvest about 700,000 pounds of oysters annually. In 1953, New Jersey harvested some 8.5 million pounds of oysters. If the NJ oyster population rose to the levels that it enjoyed prior to MSX and dermo infestation, then it would produce at least as many pounds of oysters as CT produces today. In addition, about 2000 persons in NJ are employed in the processing and wholesale distribution of fish. The number of jobs in this sector could be expected to increase if oyster yields increased, though it is difficult to estimate the number of jobs that would be created. It is possible that the reduction in oysters could cause a decrease in tourism. However, there is no available evidence that quantifies the number of sportfishers who engage in oyster fishing.	*1*
	Duration/irreversibility: Rutgers University has developed a strain of oyster that is resistant to MSX. Research continues on ways to fight dermo. The wild fluctuations in oyster yields over the last half century indicates that oyster populations could rebound if a way were found to eliminate dermo and MSX. However, it would take decades to bring oyster populations back to their highest historic levels.	2
	Scale: The employment impact is highly localized in communities adjacent to Delaware Bay.	2
	Uncertainty: I believe that it is very reasonable to conclude that a restoration of the oyster population would create several hundred jobs.	3

Issue: Dermo and MSX Parasite in Oysters
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Costs Incurred	Severity: Connecticut's 1993 oyster harvest had a dockside value of about $45 million each year. In addition, the Connecticut Department of Agriculture states that "using standard economic multipliers it is conservatively estimated that Connecticut's oyster farming industry contributes more than $200 million to the State's economy annually." Since NJCRP guidelines discourage the use of multipliers, the total cost assessed here is approximately $40 million. NJCRP guidelines call for a score of "2" to be given to costs between $16 million and $160 million. In addition, it is possible that the decrease in oyster populations could hurt local non-commercial shellfishers, who use oysters to supplement their incomes. There is no evidence about this activity, unfortunately.	*2*
	Duration/irreversibility: Rutgers University has developed a strain of oyster that is resistant to MSX. Research continues on ways to fight dermo. The wild fluctuations in oyster yields over the last half century indicates that oyster populations could rebound if a way were found to eliminate dermo and MSX. However, it would take decades for the oyster population to be restored to its highest historic levels.	2
	Scale: The cost to the state economy would be concentrated in a few shore communities.	1
	Uncertainty: I am moderately confident that a ten-fold increase in the state oyster industry would add at least an additional $160 million to the state economy. The multiplier used by the Connecticut study is about 2.5, a conservative number. The gross domestic product of New Jersey is about $255 billion, according to the U.S. General Services Administration.	2
Aesthetic Levels	Severity	*0.1*
	Duration/irreversibility	1
	Scale	1
	Uncertainty	1
Psychological Impacts	Severity:	*0.1*
	Duration/irreversibility:	1
	Scale:	1
	Uncertainty	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	M: The state of NJ collects little specific information about the number of persons employed in the oyster industry. This makes it difficult to directly assess the employment impact of dermo and MSX. The greatest data gap is the difficulty of disaggregating the effects of dermo and MSX. It would be helpful to know how much of the devastation of the oyster population is caused by each of these protozoa.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	+ This is the rating given by the EQTWG analysis, based on ongoing scientific research.	
Potential for catastrophic impacts (H,M,L) and brief description	L: Dermo and MSX have already inflicted catastrophic damage on the state oyster industry.	
Incidence of impacts (affected sub-groups	Most job loss is concentrated in counties bordering Delaware Bay, though the loss of revenue must be considered a statewide phenomenon.	

(affected sub-groups, variability, equity issues)	
Extent to which threat is currently regulated	The EQTWG reports the following: Specifically, dermo is not regulated. NJDEP's National Shellfish Sanitation Program surveys shellfish growing in waters in the state and classifies them according to the presence and abundance of coliform bacteria and significant sources of potential contamination. Water data are combined with land use, water hydrography and pollution source information to classify the NJ's shellfish growing waters for harvesting. Specifically, MSX is not regulated. NJDEP's National Shellfish Sanitation Program surveys shellfish growing in waters in the state and classifies them according to the presence and abundance of coliform bacteria and significant sources of potential contamination. Water data are combined with land use, water hydrography and pollution source information to classify the NJ's shellfish growing waters for harvesting.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	L
Small business industry	L
Transportation	L
Residential	L
Agriculture	H: These parasites apparently were introduced in the 1950s through oyster bed seeding operations.
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	H: These parasites, once introduced, are difficult to eradicate.
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L

Non-local air sources incl. deposition	L
Biota sinks	L
References	Connecticut Department of Agriculture, 2000. "Economic Benefit of Connecticut's Oyster Farming Industry." www.state.ct.us/doag/business/aquac/oysecono.htm Kimball, Katherine W. "Harmful Non-Indigenous Species in the United States." Testimony before the Committee on Governmental Affairs, United States Senate, 3/15/94. Mondics, Chris. "Drought, Parasites Devastate State's Oyster Crop." *The Record, Northern New Jersey*. 11/13/85. National Marine Fisheries Service, NOAA, 2000. Commercial Fishery Landings Database. www.st.nmfs.gov/commercial/index.html National Oceanic and Atmospheric Administration (NOAA), 1998. *Fisheries of the United States 1998*. "Oysters Are a Dying Breed Off New Jersey." *Louisville Courier-Journal*. 11/09/88. Seagrant Connecticut, University of Connecticut, 2000. "Research: Aquaculture—Food for the Future." www.seagrant.uconn.edu/aqua.html Yozell, Sally. "Invasive Species." Testimony before the Subcommittee on Drinking Water, Fisheries and Wildlife, Committee on the Environment and Public Works, United States Senate, 9/19/96.
Current Policy and Regulatory Framework	See regulation, above.
Federal	
State & Local	

Issue: Dermo and MSX Parasite in Oysters
Author: John Posey
Version: 09/00

Dermo and MSX are protozoan parasites that afflict the Eastern Oyster population all along the Atlantic seaboard. These parasites are blamed for killing most of the oysters in New Jersey waters, resulting in oyster yields that are less than a tenth of the highest postwar levels. The devastation of the oyster industry robs the state of hundreds of jobs. In addition, restoration of oyster harvests to historic levels would contribute over $160 million to the state economy each year. The loss of this revenue must be considered a cost associated with these parasites.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	1	2	0.1	0.1
Duration/ Irreversibility	1	2	2	1	1
Scale (spatial, population)	1	2	1	1	1
Subtotal Risk	1	4	4	0.1	0.1

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
1.84	**1.84**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	3	2	1	1	1.6

Trend: +

Catastrophic Potential: L

Issue: Dioxins/Furans
Author: John Posey
Version: 01/01

NJ Comparative Risk Project
Socio-economic TWG
Stressor Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Dioxins/Furans**
Description of stressor	The term "dioxin" refers to a large group of chemical compounds, of which about 75 are considered dangerous. The most well-studied, and one of the most toxic dioxins, is known as TCDD. Certain types of chemical manufacturing and processing, and other industrial processes can create dioxins.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Dioxin is considered a human carcinogen. It bioaccumulates in both animals and humans.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	The principal impact considered here is the medical cost associated with dioxin-related cancer in humans. Other potential impacts include: 1) property value losses due to contamination or proximity to contaminated sites; 2) employment losses caused by dioxin contamination in fishing waters; and 3) worry.
Key impacts selected (critical socio-economic effects)	Costs incurred, worry, property value, employment.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	According to EPA (July 2000), "EPA estimates that most dioxin exposure occurs through the diet, with over 95% of dioxin intake for a typical person coming through dietary intake of animal fats. Small amounts of exposure occur from breathing air containing trace amounts of dioxin on particles and in vapor form, from inadvertent ingestion of soil containing dioxin, and from absorption through the skin contacting air, soil, or water containing minute levels."
Quantification of exposure levels statewide	The average adult exposure to dioxin is about 1 pg/kg/day. The half-time of elimination is about 8 years.
Specific socio-economic entities at increased risk	Anyone who consumes animal fats may ingest dioxin. In addition, industrial counties seem to have a greater number of contaminated sites than do rural counties.
Quantification of exposure levels to	EPA (July, 2000) estimates that 95% of dioxin intake occurs through dietary intake of animal fats. With respect to geographic distribution, the following list shows the number of dioxin-contaminated sites currently on the National Priorities List (see Superfund Advanced Query, 2000):

entities at increased risk	Bergen: 2 Hunterdon: 1 Burlington: 1 Middlesex: 5 Essex: 3 Morris: 2 Gloucester: 1 Ocean: 1 Hudson: 1 Somerset: 3	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	I rely primarily on a September, 2000 EPA reassessment of dioxin science. This report used a meta-level analysis of dose-response studies conducted in recent years.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values	e) Severity: The popular press contains reports of property values plummeting because of proximity to dioxin. In Rhode Island, the discovery of dioxin in the Woonasquatucket River has affected property values along the shore. The Providence Journal quotes an appraiser who believes that the presence of dioxin could reduce property values by as much as one third (Mockenhaupt, 1999). In Mississippi, owners of properties downstream from a dioxin-producing paper mill have sued the mill for $1 billion to compensate for lost property value, health problems and emotional distress (Copesky, 1991). In academic literature, there are many studies of the impact of contamination on property values, but there is little available specifically about dioxin. Following is a description of a few representative studies of soil contamination in general: Greenberg et al., (2000) estimate that 10% of all towns in New Jersey have at least one brownfield that reduces property values up to ¼ mile away. Simons, Bowen and Sementelli (1999) estimate that residential properties within 300 feet of a leaking underground storage tank (LUST) suffer a 17% reduction in value, while commercial properties within 300 feet of a LUST lose 33% of their market value. Greenberg and Hughes (1993) report that 28% of assessors in towns with hazardous waste sites report that market values are reduced by at least 5% in the area within ¼ mile of the site. McClelland, Schulze and Hurd (1990) use a hedonic regression model to demonstrate that houses in an area around a landfill saw their values reduced by $10,000, or about 8%. Thus, there are various estimates of property value impacts for various types of brownfields. Estimates of property values lost because of proximity to brownfields included “greater than 5%”, 8%, 17% and 33%.	

Since dioxin is considered to be one of the most toxic contaminants, it is reasonable to believe that the properties with or near dioxin contamination experience value losses at the higher end of these estimates. The 33% loss cited by Simons et al., mirrors the estimates cited in the Woonasquatucket case. However, it is difficult to construct a statewide estimate of property value loss because there is no definitive count of the number of dioxin contaminated sites in the state. The National Priorities List currently contains 20 sites in NJ that contain dioxin, but this may be a subset of all the sites with dioxin. Still, it is unlikely that there are enough sites with dioxin to have a measurable impact on property values statewide. Another problem involved in assessing the impact of dioxin is that dioxin rarely occurs in isolation. An examination of NJ sites containing dioxin illuminates the difficulty of assessing the effect of any one chemical upon property values. The Publicly Funded Cleanups Site Status Report 1998 lists 5 sites in NJ that contain dioxin. These sites are listed below, along with the chemicals of concern: Chemical Insecticide Corporation (Middlesex) — Pesticides, Herbicides, Metals, Dioxin Pratt Gabriel (Passaic) — Pesticides, PCBs, Metals, Dioxins, Furans Albert Steel Drum (Essex) — Chlordane, PCBs, Dioxin, VOCs, Pesticides, Metals Brook Industrial Park (Somerset) — VOCs, Pesticides, Metals, Dioxin Higgins Farm (Somerset) — Pesticides, Dioxin, VOCs, Base Neutral Extractable	1
This list shows how difficult it is to isolate the effect of dioxin alone. At each of these sites, dioxin is only one of several dangerous chemicals. While it may be possible to measure the degree to which proximity to these sites affects property values, it would be nearly impossible to determine how much of the property value impact is attributable to each chemical. Because of this conundrum, the problem of contaminated industrial soil is discussed separately in a writeup on Brownfields.	
b) Duration/irreversibility:	1
a) Scale	1
b) Uncertainty:	2

Employment

e) Severity: It is plausible to hypothesize that dioxin may affect employment in the fishing industries. Because of dioxin, PCB or Chlordane contamination, it is illegal to sell striped bass caught in NJ. It is also illegal to harvest blue crab caught in the Newark Bay complex, and American eels from several parts of the state cannot be sold. In addition, the DEP issues advisories to persons who eat fish caught in certain NJ waters. For example, the public is advised not to eat the green glands of any lobster caught in NJ, and American eels caught in NJ waters should not be eaten more than once a week.

1

Thus, dioxin potentially affects employment in two ways. First, it may depress jobs in commercial fishing. Second, it may eliminate service jobs created by recreational fishers.

To assess the impact of dioxin on commercial fishing, I consulted the NOAA commercial fishery database. The download shows, for the state of NJ, the dockside value and the measured weight of fish caught in each of the last 50 years. I focus on the three species most affected by dioxin: blue crab, American eel, and striped bass (see NJDEP, 2000). For each of these species, I compare the current yield with the highest yield in the last half century, adjusted for current dollars. This shows the outer bound of the potential impact of dioxin. Results are shown in the following table:

Species	Highest Year	Greatest Catch (Pounds)	Greatest Catch (1999 Dollars)	1999 Catch (Pounds)	1999 Catch (Dollars)
American Eel	1984	533,600	$629,724	90,252	$142,278
Blue Crab	1974	125,600	$178,826	0	$ 0
Striped Bass	1973	210,872	$791,244	179	$313

(For eels, I omitted the years 1996-97. In these years, there was a sudden increase in demand for baby eels in Asia, and NJ was one of the few states that permitted the harvest of baby eels. Because of this, the average price of eels increased tenfold in 1996-1997. Aside from these anomalous years, 1984 was the high water mark for eels. Also, it is important to realize that these species do not represent all fish caught in NJ; rather, they are the species most closely regulated because of dioxin.)

A rough estimate of the potential employment loss of dioxin may be obtained by subtracting the total dockside value for 1999 from the total value of the highest historical catches. This difference amounts to $1,599,794 - $142,591 = $1,457,203. If we assume that there is 1 job for each $50,000 in dockside value, then this results in a loss of about 29 jobs. It should be noted that not all of the decrease from historical highs can be attributed to dioxin. Some of the loss may be due to other chemicals, some may have been caused by overfishing, and some may be random fluctuation. On the other hand, there may be some other affected species that were left out of these calculations. Thus, 29 jobs are probably the correct order of magnitude. This is clearly far less than the 20,000 jobs considered to be a "moderate" employment under NJCRP guidelines.

The other potential impact on employment is in recreational fishing. Dioxin effectively prevents recreational fishing on the Hudson and on the Passaic. It is difficult to estimate the number of fishing trips lost, but it is unlikely to be a significant figure. There are few statistics available on recreational freshwater fishing in NJ, but freshwater sportfishing is far less significant in NJ than marine sportfishing.

	Studies by WHOI and NOAA indicate that there are about 5.5 million marine sportfishing trips in NJ each year, and that $157 is generated in the economy for each trip. If these numbers are correct, then marine sportfishing contributes approximately $860 million to the state economy each year. If we assume that it takes $50,000 in spending to support 1 job, then there are about 17,000 jobs dependant on marine sportfishing in NJ. These statistics help to calibrate the outer bounds of the employment impact of freshwater recreational fishing losses. If freshwater fishing, in the absence of dioxin, generated half as many fishing trips as marine sportfishing, and if dioxin reduced the number of trips by half, then this would cost the state approximately 4300 jobs. In fact, freshwater fishing probably has a potential to generate far less than half the number of saltwater trips, and limits on the Passaic and Hudson probably reduce freshwater fishing by far less than half. 4300 jobs, then, is probably a vast overstatement. Still, even if this figure is used, it is still far less than the 20,000 break point required for a score of "2" under NJCRP guidelines. _____ a) Duration/irreversibility	1 1
	b) Scale	1
	c) Uncertainty	1
Costs Incurred	a) Severity: There are two types of potential costs to the state economy: medical costs and cleanup costs. Information about medical costs is more reliable than information about cleanup costs. HHTWG estimates that there are between 20 and 200 cases of cancer in NJ attributable to dioxins annually. NIH data indicates that an "average" case of cancer creates an economic cost of about $60,000, including direct medical costs and lost work days (see "quantitative and qualitative impact assessment employed" section of the 1, 3-Butadiene writeup; also see Brown et al., 2001). If this amount is applied to the HHTWG estimate, then the resulting estimated economic cost ranges from $1.2 million to $12 million. It is difficult to produce an estimate of cleanup costs. In addition, since much of the cleanup cost is borne by the federal government, it is not clear that cleanup costs should be considered a cost to the NJ economy. For a rough estimate, it is helpful to look at sites on which dioxin cleanup has recently occurred. Following is a table of the costs involved with each of the five sites cited under the "property values" section above: **Site** **Superfund** **State Costs** Higgins Farm: $14,935,000 $1,379,000 Chemical Insect.: $12,413,000 $1,469,000 Pratt Gabriel: $0 $35,000 Albert Steel $858,000 $2,536,000 Brook Ind Park $11,430,000 $0 Most of these expenditures occurred over a period of several years. Still, if these figures are representative, then it is probably reasonable to conclude that dioxin cleanup costs the state several million dollars each year. It is not clear whether the sum of the cleanup costs and medical costs exceed $16 million, the cut-off point for a "moderate" impact rating under NJCRP guidelines. However, it is also not clear that cleanup costs should properly be considered under NJCRP guidelines. For this reason, I conclude that the most reasonable severity score is a "1."	1

	b) Duration/irreversibility: Dioxin exposure appears to be declining.	2
	c) Scale: Statewide	3
	d) Uncertainty: I believe that these figures are fairly reliable.	2
Aesthetic Levels	a) Severity: No impacts hypothesized.	0.1
	b) Duration/irreversibility	1
	c) Scale	1
	d) Uncertainty	1
Psychological Impacts	a) Severity: There is some evidence that the public is aware of, and concerned about, dioxin. Dioxin contaminated sites such as Love Canal and Times Beach have become part of the national lexicon. The popular press reports widely on dioxin scares, and dioxin emitting incinerators are highly controversial. Based on the high public awareness of the dioxin threat, it seems reasonable to believe that there is a moderate amount of worry about these chemicals.	2
	b) Duration/irreversibility: Worry would be expected to decrease as exposure to dioxin decreases.	2
	c) Scale: Difficult to assess. Concern may be concentrated in older industrial areas.	2
	d) Uncertainty: This assessment is fairly speculative.	3
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	M: The greatest uncertainty revolves around contaminated sites. It would be useful to have a list of known dioxin-contaminated sites in NJ.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	++ According to EPA's 2000 reassessment, "dioxin levels in the environment have declined significantly since the 1970s following EPA regulatory controls and industry actions. EPA's best estimates of emissions from sources that can be reasonably quantified, indicate that dioxin emissions in the United States decreased by about 80% between 1987 and 1995, primarily due to reductions in air emissions from municipal and medical waste incinerators, and substantial further declines continue to be documented. Dietary intake of dioxin also appears to be declining." An earlier EPA document adds, "municipal waste combustors are estimated to have emitted nearly 18 pounds of dioxin toxic equivalents in 1987. By 2002, municipal combustor emissions are expected to be less than ½ ounce per year."	
Potential for catastrophic impacts (H,M,L) and brief description	L: Sites such as Times Beach and Love Canal could reasonably be considered catastrophes with regard to property value losses. Another famous release was in Seveso, Italy (see HHTWG writeup), which resulted from an explosion and caused the deaths of numerous farm animals. The probability of a catastrophe of this magnitude in NJ within the next five years in unlikely.	
Incidence of impacts (affected sub-groups, variability, equity issues)	Dioxin exposure seems to be fairly evenly distributed among the population, although contaminated sites are more likely to be in industrial areas.	

Extent to which threat is currently regulated	See state and local regulations, below.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	1
Small business industry	M
Transportation	L
Residential	L
Agriculture	L
Recreation	L: Recreational fishing may increase an individual's exposure to dioxins. On the other hand, recreational fishing might have the effect of removing dioxins from the ecosystem.
Resource extraction	L
Government	L
Natural sources/processes	L
Orphan contaminated sites	H
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. Deposition	H
Biota sinks	L
References	Jeff Copeskey. "Dioxin and Dollars." *Mississippi Business Journal*. May 27, 1991.

	Michael Greenberg et al. "Brownfields, TOADS, and the Struggle for Neighborhood Redevelopment." *Urban Affairs Review*, May 2000. Kenneth Jones. "Dioxin: A Technical Review." 1998. www.epa.gov/opperspd/nccr/dioxin.htm Wayne Lusvardi. "The Dose Makes the Poison: Environmental Phobia or Regulatory Stigma?" *Appraisal Journal.* April, 1998. McClelland, G. H., W. D. Schulze, and B. Hurd. 1990. "The Effect of Risk Beliefs on Property Values: A Case Study of a Hazardous Waste Site." *Risk Analysis* 10 (4): 485-97. Brian Mockenhaupt. "This Masked Man Is Affecting Property Values: The Stigma of Dioxin." *Providence Journal*. July 29, 1999. NJDEP. "Fish and Crab Consumption Advisories." 1998. Www.state.nj.us/dep/dsr/fish-crab.htm NJDEP. SRP Site Status Report. 1998. www.state.nj.us/dep/srp NOAA. Commercial Fishery Landing Database. http://www.st.nmfs.gov/st1/commercial/landings/annual_landings.html NOAA. "Press Release: Florida Top State for Saltwater Recreational Fishing." September 2, 1998. Www.publicaffairs.noaa.gov/pr98/sep98/noaa98-r146.html Robert A. Simons et al. "The Price and Liquidity Effects of UST Leaks from Gas Stations on Adjacent Properties." *Appraisal Journal*, 4/1/99. Scott Steinback and Jon O'Neil. "Northeast Region Marine Recreational Economics Survey." Woods Hold Oceanographic Institute. 1994. Www.wh.whoi.edu/techniques/recsurvey USEPA. Questions and Answers about Dioxins. July, 2000. www.epa.gov/ncea/dioxin USEPA. Summary of the Dioxin Science Reassessment. Jun 12, 2000. www.epa.gov/ncea/dioxin USEPA. Superfund Advanced Query. http://oaspub.epa.gov/oerrpage/advquery. 2000.
Policy/Regulatory Framework	
Federal	The principal EPA regulations pertain to incinerators and to paper production. Standards for incinerators are established under the National Emissions Standards for Hazardous Air Pollutants (NESHAP) section 129/111. Standards for pulp and paper were established in a 1998 final cluster rule as authorized by the Clean Water Act.
State & Local	The NJ Department of Health regulates the sale of fish caught in dioxin contaminated waters.

Issue: Dioxins/Furans
Author: John Posey
Version: 01/01

Dioxins are a group of highly toxic chemicals that became well known because of sites such as Times Beach and Love Canal. Initially introduced into the environment by chemicals manufacturing and incinerators, animals become exposed to dioxins because of air deposition. Today, 95% of human intake of dioxins comes from the consumption of animal fat. Dioxins cause an estimated 20-200 cases of cancer in NJ each year. Medical costs associated with dioxin are approximately $1.2 to $12 million each year. The cost of cleaning up sites contaminated with dioxin probably costs the state economy another several million dollars each year. It is difficult to isolate the effect of dioxins on property values. However, there is some evidence that the general public is aware of, and concerned about, dioxins. EPA regulations have dramatically reduced dioxin emissions in the last 20 years.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	1	1	1	0.1	2
Duration/ Irreversibility	1	1	2	1	2
Scale (spatial, population)	1	1	3	1	2
Subtotal Risk	1	1	6	0.1	8

Average Risk (0 – 5 years)	Average Risk (5 years plus)
3.22	**3.22**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	2	1	2	1	3	1.8

Trend: ++

Catastrophic Potential: M

Issue: Disinfection By-Products (DBPs)
Author: John Posey
Version: 03/28/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Disinfection By-Products (DBPs)**
Description of stressor	DBPs are created when water treatment facilities disinfect surface water. DBPs remain in the drinking water available to the public. Water treatment facilities usually use chlorine or other chemicals to kill harmful microorganisms in water. However, when the disinfectant comes in contact with naturally occurring organic or inorganic matter, harmful chemical by-products can be created.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	DBPs have been linked to bladder cancer and to neural tube birth defects, of which spina bifida is the most common type.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	This writeup addresses the economic cost of the medical problems associated with DBPs.
Key impacts selected (critical socio-economic effects)	Costs Incurred.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	DBPs enter the body through drinking water. Fetuses can be harmed when mothers drink water contaminated with DBPs.
Quantification of exposure levels statewide	55% of the state uses surface water as its main source of drinking water.
Specific socio-economic entities at increased risk	Bladder cancer can affect virtually any member of the population. Neural tube birth defects affect newborn children.
Quantification of exposure levels to entities at increased risk	HHTWG estimates that DBPs cause about 100 cases of bladder cancer in NJ each year. HHTWG does not supply an estimate of the number of birth defects caused each year. However, the NJ DHHS reports that there are about 45 neural tube birth defects in NJ each year. For purposes of estimating a cost, I will assume that 25-50% of the neural tube defects are caused by DBPs.
Dose/Impact-Response Assessment	
Quantitative/Qualitative impact-assessment	To find the economic cost of the medical problems associated with DBPs, I rely on published cost-of-illness estimates.

employed		
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		*Score*
Property Values	a) Severity: I am unaware of any hypothesized relationship between DBPs and property values.	0.1
	b) Duration/irreversibility	1
	c) Scale	3
	d) Uncertainty	1
Employment	a) Severity: I am unaware of any hypothesized relationship between DBPs and employment.	0.1
	b) Duration/irreversibility	1
	c) Scale	3
	d) Uncertainty	1
Costs Incurred	a) Severity: *Bladder Cancer:* HHTWG estimates that DBPs cause about 100 cases of bladder cancer in NJ each year. Estimates of costs associated with bladder cancer vary. USEPA (1999) uses Cost of Illness (COI) methodology to determine that an average case costs about $177,000. This includes direct medical costs and lost work days, but not lost lifetime productivity due to early death. However, Brown (2001a) of the National Cancer Institute reports that SEER-Medicare data indicates that direct medical costs associated with bladder cancer totaled about $2 billion in 1996, which would be equal to about $2.2 billion in 2000. The American Cancer Society estimates that there are currently about 54,300 new cases of bladder cancer in the US each year. This indicates that direct medical costs are about $40,000. Brown (2001b) further reports that for all cancers, morbidity (i.e., lost productivity) costs represent about 36% of direct medical costs. If direct medical costs are about $40,000, then indirect medical costs would be expected to be about $14,400. Using these numbers, a typical case would be expected to cost about $54,000. This is similar to the estimate of about $60,000 for an average case of cancer used in other writeups (see 1, 3-Butadiene for an account of this estimate). If the figures derived from Brown represent a low estimate, and the EPA figure represents a high estimate, then the cost associated with DBP-related bladder cancer in NJ should range from $5.4 million to $17.7 million. Other writeups rely on the estimates developed by Brown et al. for the National Cancer Institute. Thus, for the purposes of consistency, it seems reasonable to favor the lower cost estimate.	*1*

	Neural-Tube Defects: A Canadian team has estimated that a neural tube defect case cost $42,500 (Canadian) for the first 10 years of life in 1987. The 1987 US/Canadian exchange rate was 1.3154, so the estimate would be $55,904 US for the same year. The American Economic Institute reports that the 1987 US dollar was worth 1.5 times the 2000 US dollar. Thus, the cost per case in 2000 US dollars comes to approximately $83,500 per case for the first 10 years of life, or $8350 per year. If DBPs cause 25-50% of the neural tube defects in NJ, then DBPs may be blamed for 11-23 cases per year. If so, then there are between 110 and 230 cases in the first 10 years of life. The cost estimate for these cases ranges between the following estimates: 110 * 8350 = $918,500 230 * 8350 = $1.92 million Thus the cost of NJ neural tube defects caused by DBPs may be estimated to cost between $2 million and $3 million each year. *Total:* The total cost of DBP-related ailments, then, may be estimated at between $6.5 million and $20 million. This straddles the cut-off point of $16 million required for a "moderate" impact rating under NJCRP guidelines. As noted earlier, consistency among writeups is best served by using the lower estimate of cancer costs. Thus, I conclude that the most reasonable rating for this category is a "1."	
	b) Duration/irreversibility: 77% of bladder cancer cases are non-fatal. Spina bifida is permanent, but treatable.	2
	c) Scale: 55% of the state uses surface water as the main source of drinking water.	3
	d) Uncertainty: I am moderately confident that the cost of DBP related ailments is between $16 million and $160 million.	2
Aesthetic Levels	a) Severity: I am unaware of any hypothesized relationship between DBPs and aesthetics.	0.1
	b) Duration/irreversibility	1
	c) Scale	3
	d) Uncertainty	1
Psychological Impacts	a) Severity: I am unaware of any hypothesized relationship between DBPs and psychological damage.	0.1
	b) Duration/irreversibility:	1
	c) Scale:	3
	d) Uncertainty	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	M: The principal data need is an estimate of costs-of-illness specifically for the state of NJ.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	HHTWG gives a rating of ++.	

Potential for catastrophic impacts (H,M,L) and brief description	HHTWG gives a rating of L.
Incidence of impacts (affected sub-groups, variability, equity issues)	Newborn children are the only population involved with neural tube defects. Anyone can suffer from bladder cancer.
Extent to which threat is currently regulated	In regulations published in the Federal Register on December 16, 1998, the EPA laid down the first set of regulations pertaining to DBPs. Guidelines were established for chlorine, chloramines, chlorine dioxide, chlorite, bromate, and chemicals known as TTHMs and haloacetic acids. These regulations will be phased in by 2004.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	L
Small business industry	L
Transportation	L
Residential	L
Agriculture	L
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	L
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L

Non-local air sources incl. Deposition	L
Biota sinks	L
References	Federal Register, December 16, 1998. Margot I. Van Allen, F. Clarke Fraser, Louis Dallaire, Judith Allanson, D. Ross McLeod, Eva Andermann, and Jan M. Friedman. "Recommendations on the use of folic acid supplementation to prevent the recurrence of neural tube defects." *Canadian Medical Association Journal* 1993; 149: 1239-1243. New Jersey Division of Family Health Services. Special Child Health Services Registry: Birth Years 1985 - 1994. US EPA, Office of Ground Water and Drinking Water. M/DBP Stage 2 Federal Advisory Committee. "DBP Cancer Health Effects." Meeting #2 May 20-21, 1999. http://www.epa.gov/safewater/mdbp/st2may99.html
Current Policy and Regulatory Framework	See "current regulation," above.

Issue: Disinfection By-Products (DBPs)
Author: John Posey
Version: 03/28/00

Disinfection By-products (DBPs) are created when water treatment facilities disinfect surface water. DBPs remain in the drinking water available to the public. Water treatment facilities usually use chlorine or other chemicals to kill harmful microorganisms in water. However, when the disinfectant comes in contact with naturally occurring organic and inorganic material, harmful chemical by-products are created. DBPs are associated with bladder cancer and neural tube birth defects such as spina bifida. HHTWG estimates that DBPs cause about 100 cases of bladder cancer each year. NJ DHHS reports that there are about 45 cases of neural tube birth defects each year. The total economic cost of these diseases is estimated at approximately $6 million to $20 million.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	0.1	0.1	1	0.1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	0.3	0.3	3	0.3	0.3

Average Risk (0 – 5 years)	Average Risk (5 years plus)
0.84	**0.84**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	2	1	1	1.2

Trend: 0

Catastrophic Potential: L

Issue: Dredging
Author: John Posey
Version: 02/01

New Jersey Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Stressor: **Dredging**

According to EQTWG, "dredging is the removal of sediment from the bottom of a water body … for the purpose of increasing water depth, or the widening or deepening of navigable channels to a newly authorized depth or width. Dredging has been used for over a century to facilitate human use of waterways. There are two different classifications of dredging: new dredging, which involves an area that has not previously been dredged (including the deepening of an already existing channel), and maintenance dredging, which is done in order to maintain water depth, or channel width and depth, at original dredging levels. The New Jersey Office of Dredging was established on June 1, 1998 to handle the approval of applications for dredging projects."

EQTWG cites the following statistics:

Note: These numbers are for the 23-month period from June 1, 1998 until May 1, 2000j. (Source: Office of Dredging and Sediment Technology)

NY Harbor: (Most of these projects are state or federally funded.) 43 total projects were approved, corresponding to a total volume of 74,677,502 cubic yards of dredged material. Of these, 6 of the projects are new dredging (not maintenance), and account for 57,560,400 cubic yards of dredged material. Previously, Region 1 had averaged about 4,000,000 cubic yards of dredged material per year. Almost all of the dredged material is disposed of in the Historic Area Remediation Site (HARS) in the ocean, or in underwater or upland Confined Disposal Facilities (CDF).

Atlantic Coastal Basin: 89 total projects resulting in 883,804 cubic yards of dredged material were approved; most were private projects. Of this amount, 66% was disposed of in CDFs, 27% onsite, 3% in "beneficial uses", such as landfill cover, and 4% was disposed of in other ways.

Delaware Bay and River: 29 total projects, amounting to a total volume of 5,604,160 cubic yards of dredged material. 99% of this goes into CDFs, while the other 1% goes to beneficial uses.

EQTWG finds that dredging can harm the environment. First, dredging affects bottom-dwelling plants and animals. The destruction of plants on the bottom can lead to a loss of habitat for fish. Dredging can also disrupt habitats for animals such as crabs, worms and flounders, and can smother fish eggs. Second, dredging causes a suspension of sediments, which can block sunlight. This can also harm habitats. Finally, dredging can lead to a resuspension of contaminants in sediments. These include PCBs and dioxins. Fish, in turn, can take these materials in through their gills. Bioaccumulation of PCBs in fish flesh can be harmful to persons who eat these fish.

It is difficult to demonstrate that dredging has negative socio-economic effects. The most plausible potential impact would be the possibility of eating PCB tainted fish from dredged waters. However, it is illegal to harvest most fish from PCB tainted waters, so this threat applies only to the very small number of subsistence fishers who may defy this ban.

Property Values: Dredging has no known negative impacts on property values.

Employment: EQTWG speculates that dredging may decrease the number of fishing jobs. However, it is unlikely that dredging has a negative net impact on employment. First, most dredging occurs near heavily commercialized waterfronts, where commercial fishing is no longer practiced. Second, EQTWG finds that dredging does not cause permanent loss of fish populations. Third, there are only a few hundred persons employed in commercial fishing in NJ. Even if this sector were wiped out, the impact would still fall far short of the 20,000 jobs required for a moderate impact under NJCRP guidelines. Finally, these jobs must be balanced against the 166,000 jobs in the Port of New York and New Jersey. Dredging helps to ensure that these jobs remain viable.

Issue: Dredging
Author: John Posey
Version: 02/01

Costs Incurred: EQTWG points to medical costs associated with resuspension of sediment contamination, and to sediment disposal costs. The medical costs may be a serious issue. However, HHTWG has declined to produce a report on dredging. The human health impacts will be covered under the writeups on PCBs, dioxins, and PAH. Sediment disposal costs are significant. More broadly, dredging costs state taxpayers a significant amount of money. For example, in July, 1999, Governor Whitman committed $100 million over five years to a dredging project in Kill Van Kull and Newark Bay. However, this amount must be balanced against the $633 million from the Army Corps of Engineers and the Port Authority of New York and New Jersey. Thus, the $100 million investment brought more than six times that amount into the New Jersey economy. Second, the Office of the Governor estimates that the Port generates more than $29 billion in economic activity each year. It appears, then, that there is a net economic benefit to state investment in dredging.

Aesthetic Impacts: Dredging causes a temporary clouding and discoloration of water.

Psychological Impacts: Dredging is a matter of concern to some users of ocean resources. They variously worry that dredge spoil will harm bottom-dwelling wildlife or contaminate shellfish caught for human consumption.

Issue: Dredging
Author: John Posey
Version: 02/01

Dredging can harm the environment by killing plants that live on the bottom of waterways and by suspending contaminated sediments. However, it is difficult to demonstrate negative socio-economic impacts associated with dredging. Dredging probably has a net positive impact with respect to employment and property values. The costs of dredging are fairly small compared to the economic activity supported by these projects. Human Health impacts are not discussed here. The effects of contaminants in sediment may be found in the writeups on PCBs and dioxins.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	0.1	0.1	1	1	1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	0.1	0.1	1	1	1

Average Risk (0 – 5 years)	Average Risk (5 years plus)
0.64	0.64

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	1	1	1	1

Trend: 0

Catastrophic Potential: L

Issue: EHD Virus in Deer
Author: John Posey
Version: 09/00

New Jersey Comparative Risk Project
Socio-economic TWG
Stressor-Specific TWG Assessment

Stressor: **EHD Virus in Deer**

EHD is an infectious viral disease that kills wild animals, especially deer. There is no evidence that humans can become infected with the EHD virus. EHD seems to appear in 20-year cycles. Several major deer kills have been attributed to EHD in recent decades. In 1999, 60 dead deer were found in Salem and Cumberland Counties. In Salem County, eight of the deer were found floating in waterways. They had apparently sought out water to relieve their high fevers. In 1975, 1000 deer were killed in Hunterdon, Warren, Morris and Sussex Counties. In 1955, EHD killed 700 deer in NJ. EQTWG reports that while EHD can have a significant effect on deer populations, the disease does not wipe out entire herds and does not affect domesticated animals. It should be noted that NJ is currently experiencing a large overpopulation of deer. The current estimate of the deer population is approximately 200,000. Thus, the size of the herd is unlikely to be significantly affected, even by the death of 1000 animals.

EHD probably poses only minimal socio-economic impacts:

- *Costs Incurred:* Municipalities and Counties that bear the major responsibility for dead animal removal will incur some costs related to deer killed by EHD. However, major EHD kills appear to be very rare in NJ, and this cost is not likely to be a significant burden for cities and counties. Since humans cannot catch EHD, there are no human health costs associated with EHD.
- *Property Values:* The rarity of major deer kills, and the relatively quick cleanup of deer corpses, indicate that property values are unlikely to be affected by nearby deer kills.
- *Employment:* No effect hypothesized.
- *Aesthetic:* Though it may be unpleasant to look at deer corpses, the problem is very short-lived. In addition, there is currently an overpopulation of deer in NJ. Thus, there is little risk that deer populations will drop so low as to make EHD even a moderate aesthetic impact.
- *Psychological:* No effect hypothesized.

Issue: EHD Virus in Deer
Author: John Posey
Version: 09/00

EHD is a virus that kills deer. It does not affect humans or domesticated animals. EHD appears to recur in 20 -year cycles. The last major deer kill attributed to EHD, according to EQTWG, was the death of 1000 animals in 1975. EHD does not wipe out entire herds. Because of the rarity of major deer kills, and the short-lived nature of the problem, it is unlikely that there are significant negative socioeconomic impacts associated with EHD. It should also be noted that NJ is currently experiencing a large overpopulation of deer.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	0.1	0.1	1	1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	0.1	0.1	1	1	0.1

Average Risk (0 – 5 years)	Average Risk (5 years plus)
0.46	**0.46**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	1	1	1	1

Trend: 0

Catastrophic Potential: L

Issue: Extremely Low Frequency and Electromagnetic Fields (ELF/EMF)
Author: Christine M. Danis
Version: 03/28/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework **Findings/Notes**

Hazard Identification		**Data Sources**
Stressor	**Extremely Low Frequency/Electromagnetic Fields (ELF/EMF)**	
Description of stressor	EMF are produced by the generation, transmission, and use of electrical energy. The U.S. standard of delivering alternating current at oscillations of 60 Hertz (60 cycles per second) places these fields in the extremely low frequency range (ELF).	NIEHS, 1999*, Report on Health Effects from Exposure to Powers-Line Frequency Electric and Magnetic Fields,* NIEHS/DOE.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	The amount of exposure to EMF from electrical distribution lines (60Hz) is much less than exposure from the earth's magnetic field. Exposure from electrical lines is also usually less than voluntary exposure from appliances and cell phones. The National Institute of Environmental Health Sciences (NIEHS) determined in 1999 that exposure to EMF poses a minimal risk, and suggested that exposure may be minimized by prudent avoidance. HHTWG has endorsed this finding. The ecological workgroup determined that all plants and animals are affected to some degree by EMF. Animals are more affected than plants and honeybees and birds appear to be the most sensitive. Livestock are more at risk than wild animals, as they don't have the ability to migrate away from the power lines. The risk and threat scores were low for EMF since the research results are contradictory.	NJCRP Human Health and Ecological Workgroup Reports
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks): Key impacts selected (critical socio-economic effects)	The socioeconomic impacts include the displeasure associated with viewing large metal monsters along our roadways and neighborhoods (aesthetics), the concern people have about the unknown risk associated with EMF exposure (worry), and concerns about a reduction in property value due to aesthetic and worry concerns of potential buyers (property value). Additional socioeconomic concerns associated with the ecological risk information may include concerns of lower productivity by honey producers and farmers with livestock under high-tension wires and concerns that birds will be electrocuted as the perch or nest on the wires. However, these risk estimates are very low due to minimal frequency of effects and the small size of the population that is exposed. Psychological (worry), Aesthetics (indirect) and Property Value	

Exposure Assessment		
Socio-economic entities exposure routes and pathways considered	To assess the impact of overhead wires on property values, I determined the number of miles of overhead transmission wires in NJ, and then calculated the amount of land that lies within 50 meters of these transmission lines. There are 6,262 miles of overhead transmission wires in NJ. The 50 meter buffer represents 240,460 acres. A second potential exposure pathway is from cellular communication towers. These towers are mounted 50 to 200 feet on a tower and usually are set at a distance from the general public. The radiated power from each antenna, 50 to 200 watts, is equivalent to the power of a typical household light bulb. The highest levels of radio frequency are approximately a hundred thousand times less than the established limit for human exposure to radio frequency EMF. Therefore, this exposure pathway was not considered in this evaluation.	" *Power Lines and the Environment – The Electrical Impact,*" Journal of Electrical and Electronics Engineering, Australia – IE Australia & IREE Australia, Vol.8, No.3, September 1988. " Design Guidelines for Reducing Electromagnetic Field Effects from 60-Hz Electrical Power Systems", IEEE Transactions on Industry Applications, Vol. 30, No. 6, Nov./Dec. 1994. *Statistical Yearbook of the Electric Utility Industry, 1984*, Edison Electric Institute, Washington, D.C., Published December 1985/Number 52. Information Ventures, EMF Health Report, '*Cellular Towers-Exposure Levels and Public Health*," Volume 3, Number 2, March/April 1995. Information Ventures, EMF Health Report, 'The EMF RAPID Working Group Report Provides Comprehensive Assessment of Power-Frequency EMF Hazards," Volume 6, Number 4, July/August 1998.
Quantification of exposure levels statewide	All NJ municipalities are affected for property value, worry and aesthetic concerns. State total land area equals 7,419 square miles. There is a minimum of 6,262 circuit miles of overhead transmission wires in NJ. Land within 50 meters of these miles amount to about 240,000 acres.	*Statistical Yearbook of the Electric Utility Industry, 1984*, Edison Electric Institute, Washington, D.C., Published December 1985/Number 52.

Specific socio-economic entities at increased risk	People who live near power lines; but this is not any particular socioeconomic group or geographic location.	Student
Quantification of exposure levels to entities at increased risk	All NJ municipalities are affected for property value, worry and aesthetic concerns. State total land area equals 7,419 square miles. There is a minimum of 6,262 circuit miles of overhead transmission wires in NJ. About 240,000 acres lie within 50 feet of power lines. An evaluation was performed regarding the potential number of suburban homes and other buildings that may exist along the edge of the transmission line right of ways to determine what percent of the statewide area this represents. This approximation provides a basis for determining the loss of property value attributable to EMF in New Jersey. The resultant score for severity, duration/irreversibility and scale were each (1).	" *Power Lines and the Environment – The Electrical Impact,*" Journal of Electrical and Electronics Engineering, Australia – IE Australia & IREE Australia., Vol.8, No.3, September 1988. *Statistical Yearbook of the Electric Utility Industry, 1984*, Edison Electric Institute, Washington, D.C., Published December 1985/Number 52.
Dose/Impact-Response Assessment Quantitative/Qualitative impact-assessment employed	Distance from exposure; shielding techniques; identification of EMF areas within home and office	" *Design Guidelines for Reducing Electromagnetic Field Effects from 60-Hz Electrical Power Systems*", IEEE Transactions on Industry Applications, Vol. 30, No. 6, Nov./Dec. 1994. " *Power Lines and the Environment – The Electrical Impact,*" Journal of Electrical and Electronics Engineering, Australia – IE Australia & IREE Australia, Vol.8, No.3, September 1988. Information Ventures, EMF Health Report, '*Cellular Towers- Exposure Levels and Public Health*," Volume 3, Number 2, March/April 1995. Information Ventures, EMF Health Report, '*Power Frequency EMF's – EMF Measurement and Control in Home and Office*," Volume 2, Number 4, July/August 1994.

Risk Characterization		**Data Source**	
Risk estimate(s) by socio-economic entities at risk			*Score*
Property Values	**a) Severity** – All NJ municipalities are affected for property value, worry and aesthetic concerns. State total land area equals 7,419 square miles. There is a minimum of 6,262 circuit miles of overhead transmission wires in NJ (this area is represented by 240,460.8 acres in NJ). An evaluation was performed regarding the potential number of suburban homes and other buildings that may exist along the edge of the transmission line right of ways to determine what percent of the statewide area this represents. This approximation provides a basis for determining the loss of property value attributable to EMF in New Jersey. There are about 10 million acres of land and 1 million homes in the U.S. that lie close enough to a transmission line that associated EMF levels on the property exceed typical background levels. A loss of even 1% of property value due to EMF concerns could result in a market loss of about $1 billion. An alternative impact calculation can be performed as follows. Assume that there is significant distance decay for property value losses, so that only properties directly adjacent to power lines are affected. If there are 6,262 circuit miles of power lines, of which about 25% go through residential areas, and the average adjacent residence has about 100 feet of frontage, then 6262 x 0.25 x 5280 / 100 = 82,658 residences affected. According to the 1990 US Census, the median value of a single family home in NJ was $217,320 in 2001 dollars. Assuming (very pessimistically) a 10% reduction in property value, then 82658 x 217320 x 0.1 = $1.8 billion. This result brings the statewide impact on property values close but not over the threshold more a Medium impact ($2.2 billion). Thus, this category is assigned a "low" severity rating, with a "high" uncertainty rating.	*Statistical Yearbook of the Electric Utility Industry, 1984*, Edison Electric Institute, Washington, D.C., Published December 1985/Number 52. " *Power Lines and the Environment – The Electrical Impact,*" Journal of Electrical and Electronics Engineering, Australia – IE Australia & IREE Australia, Vol.8, No.3, September 1988. " *Design Guidelines for Reducing Electromagnetic Field Effects from 60-Hz Electrical Power Systems*", IEEE Transactions on Industry Applications, Vol. 30, No. 6, Nov./Dec. 1994. Florig, H. Keith, "Containing the Costs of the EMF Problem," *Science*, Volume 257, July 1992, p. 468.	1

	b) Duration/irreversibility – The use and delivery of electrical power is not expected to change, in fact it will continue to increase in demand. Underground wire installation is approximately 10 times more costly than overhead wires however, the severity associated with the concern is minimal.	CSA Energy Consultants, Existing Electric Transmission and Distribution Upgrade Possibilities, Arlington, VA, July 18, 1995, p. 9.	1
	c) Scale – Impacts are localized in areas throughout the state.		1
	d) Uncertainty – Due to uncertainty of property value calculation and lack of transmission line location data, a value of three was selected indicating low confidence associated with this assessment. No scientific consensus exists for this approach.		3
Employment	**a) Severity –** No direct loss of job data source was hypothesized.		0.1
	b) Duration/irreversibility - No direct loss of job data source was located. Therefore, selected <1-year loss of employment to be conservative.		1
	c) Scale – No direct loss of job data source was located. Therefore, selected localized area or small subpopulation to be conservative.		1
	d) Uncertainty - No scientific consensus or approach was available for employment concerns in NJ. However, I am confident that employment concerns are of a minimal risk.		1
Costs Incurred	**a) Severity – [**Revision, jp 7/17/01]HHTWG estimates that 2-6 cases of cancer are caused by ELF/EMF in NJ each year. NIH data indicates that an "average" case of cancer costs about $60,000. (See 1, 3 -Butadiene writeup for full description of this estimate). If these numbers are correct, then we would expect costs related to ELF/EMF-related cancers to total about $120,000 to $360,000 each year.		1
	b) Duration/irreversibility – No available information.		1
	c) Scale –Localized source minimal percentage, if any, of population affected.		1
	d) Uncertainty - – No consensus on costs incurred exists and no NJ specific data are available. However, confidant that if the scores are incorrect the balance is off by one (High vs. Medium).		2
Aesthetic Levels	**a) Severity** – All NJ municipalities are affected for aesthetic concerns. State total land area equals 7,419 square miles. There is a minimum of 6,262 circuit miles of overhead transmission wires in NJ. There are also many cell-phone and radio communications towers visible around the state. These cause an offense to the visual senses in many areas of the state that is moderately annoying but can be adapted to with little or no expense by the general public.	*Statistical Yearbook of the Electric Utility Industry, 1984*, Edison Electric Institute, Washington, D.C., Published December 1985/Number 52.	2
	b) Reversibility – The use and delivery of electrical power is not expected to change, in fact it will continue to increase in demand. The costs for underground wire installation is approximately 10 times more costly than overhead wires not including right of way purchase or permitting issues. However, the severity of this aesthetic concern is minimal.	CSA Energy Consultants, Existing Electric Transmission and Distribution Upgrade Possibilities, Arlington, VA, July 18, 1995, p. 9.	1

	c) Scale – Less than 30% of the state population is affected by viewing of EMF sources on a consistent basis.	*Statistical Yearbook of the Electric Utility Industry, 1984*, Edison Electric Institute, Washington, D.C., Published December 1985/Number 52.	2
	d) Uncertainty – No consensus on aesthetic concern exists and no NJ specific data are available. However, confident that is the scores are incorrect the balance is off by one (High vs. Medium).		2
Psychological Impacts	**a) Severity**- All NJ municipalities are affected for psychological or worry concerns. Public concern over EMF persists in spite of a lack of documented health effects. In many cases it is a proxy for aesthetic concern.		2
	b) Reversibility – Worry is associated with an unknown concern about EMF.	Florig, H. Keith, "Containing the Costs of the EMF Problem," *Science*, Volume 257, July 1992, p. 468.	1
	c) Scale - Worry is restricted to people in the immediate proximity.	" *Power Lines and the Environment – The Electrical Impact,*" Journal of Electrical and Electronics Engineering, Australia – IE Australia & IREE Australia, Vol.8, No.3, September 1988.	1
	d) Uncertainty – Confident that scores above are correct and may be off by one (low vs. medium).		2
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	M – Better information is needed on transmission line pathways and proximity to buildings.		
Potential for future changes in the underlying risk	O- No major changes anticipated.		

from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description		
Potential for catastrophic impacts (H,M,L) and brief description	L – This is a chronic not an acute issue.	
Incidence of impacts (affected sub-groups, variability, equity issues)	People who live near power lines; but this is not any particular socioeconomic group or geographic location.	
Extent to which threat is currently regulated	Moderate. See policy discussion below.	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		
NJ Primary Sources		
Large business/industry	H – Electric utility companies and communication company cellular towers.	" *Design Guidelines for Reducing Electromagnetic Field Effects from 60-Hz Electrical Power Systems*", IEEE Transactions on Industry Applications, Vol. 30, No. 6, Nov./Dec. 1994. " *Power Lines and the Environment – The Electrical Impact,*" Journal of Electrical and Electronics Engineering, Australia –

		IE Australia & IREE Australia, Vol.8, No.3, September 1988. Information Ventures, EMF Health Report, '*Cellular Towers- Exposure Levels and Public Health*," Volume 3, Number 2, March/April 1995. Information Ventures, EMF Health Report, '*The Cellular Phone Controversy: Real or Contrived*," Volume 1, Number 1, 1993. Sugarman, Ellen, Warning: The Electricity Around You May Be Hazardous to Your Health, Simon & Schuster, New York, 1992.
Small business industry	L – Electrical appliances and communication equipment.	Sugarman, Ellen, Warning: The Electricity Around You May Be Hazardous to Your Health, Simon & Schuster, New York, 1992. " *Power Lines and the Environment – The Electrical Impact,*" Journal of Electrical and Electronics Engineering, Australia – IE Australia & IREE Australia, Vol.8, No.3, September 1988. Information Ventures, EMF Health Report, '*Cellular Towers- Exposure Levels and Public Health*," Volume 3, Number 2, March/April 1995.
Transportation	M – Electrical mass transportation systems.	Student
Residential	M – Electrical appliances and communication equipment.	Information Ventures, EMF Health Report, '*Power Frequency EMF's – EMF Measurement and Control in Home and Office*," Volume 2, Number 4,

		July/August 1994. Sugarman, Ellen, Warning: The Electricity Around You May Be Hazardous to Your Health, Simon & Schuster, New York, 1992.
Agriculture	L- Electrical farm equipment.	
Recreation	NA	
Resource extraction	NA	
Government	M - Ground Wave Emergency Network (GWEN). The GWEN system was designed to protect strategic communication capabilities in the event of a high-altitude nuclear detonation; the system is immune to interference from strong electromagnetic pulses produced by such a detonation.	*Assessment of the Possible Health Effects of Ground Wave Emergency Network*, National Academy of Sciences, 1993.
Natural sources/processes	L - Earth's natural magnetic field.	" *Design Guidelines for Reducing Electromagnetic Field Effects from 60-Hz Electrical Power Systems*", IEEE Transactions on Industry Applications, Vol. 30, No. 6, Nov./Dec. 1994.
Orphan contaminated sites	NA	
Diffuse Sources		
Sediment sinks	NA	
Soil sinks	NA	
Non-local air sources incl. deposition	NA	
Biota sinks	NA	

References	National Institute of Environmental Health Sciences (NIEHS), 1999, *Report on Health Effects from Exposure to Powers-Line Frequency Electric and Magnetic Fields,* NIH Publication No. 99-4493, NIEHS/DOE. CSA Energy Consultants, Existing Electric Transmission and Distribution Upgrade Possibilities, Arlington, VA, July 18, 1995, p. 9. Information Ventures, EMF Health Report, '*Cellular Towers- Exposure Levels and Public Health*," Volume 3, Number 2, March/April 1995. " *Design Guidelines for Reducing Electromagnetic Field Effects from 60-Hz Electrical Power Systems*", IEEE Transactions on Industry Applications, Vol. 30, No. 6, Nov./Dec. 1994. Florig, H. Keith, "Containing the Costs of the EMF Problem," *Science*, Volume 257, July 1992, p. 468. Information Ventures, EMF Health Report, '*Power Frequency EMF's – EMF Measurement and Control in Home and Office*," Volume 2, Number 4, July/August 1994. *Assessment of the Possible Health Effects of Ground Wave Emergency Network*, National Academy of Sciences, 1993. Sugarman, Ellen, Warning: The Electricity Around You May Be Hazardous to Your Health, Simon & Schuster, New York, 1992. " *Power Lines and the Environment – The Electrical Impact,*" Journal of Electrical and Electronics Engineering, Australia – IE Australia & IREE Australia, Vol.8, No.3, September 1988. *Statistical Yearbook of the Electric Utility Industry, 1984*, Edison Electric Institute, Washington, D.C., Published December 1985/Number 52. **Web Site Sources**: http://www.health.gov.bc.ca/reteb/powerf01.html - Ministry of Health of the Government of the province of British Columbia in Canada, Canadian Health Study. http://infoventures.com - EMF Health Report http://www.niehs.nih.gov/emfrapid/home.htm - NIEHS 1998 EMF RAPID Working Group Report http://www.eia.doe.gov/cneaf/pubs_html/feat_trans_capacity/table2.html - DOE, Cost and capacity of transmission lines	
Current Policy and Regulatory Framework	EMF is not regulated, however the states may regulate the EMF limit at the edge of the R-O-W. The American National Standards Institute (ANSI) has an EMF standard; ANSI C95.1-1992, "Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz."	Information Ventures, EMF Health Report, '*Cellular Towers- Exposure Levels and Public Health*." Volume 3.

	The greatest concern regarding EMF exposure is from homeowners and employees who are concerned about internal home and office EMF exposure. Home owners, buyers and offices have a simple means for investigating and identifying EMF "hot spots" with a hand –held gauss meter,. These areas can then be remedied or evaluated, minimizing the worry factor. The State of California has established a procedure for home EMF surveys. The California Protocol consists of making specified spot readings at the center of frequently occupied rooms under normal power conditions. The readings are summarized and an average measure is given for the home. Most California utilities make these home measurements. The advantage of a standardized approach is in the compilation of comparable residential measurements, which can then be used for epidemiological studies. Although the program is off to a slow start regarding the information database, the approach has addressed a means minimizing the unknown. The California Protocol is not the only standardized protocol. The Electric Power Research Institute (EPRI) developed a protocol for residential studies and the Institute of Electrical and Electronics Engineers (IEEE) Magnetic Fields Task Force has recommended a detailed standard protocol. The IEEE report indicates that there can be significant errors made with one time, localized measurements.	Number 2, March/April 1995. Information Ventures, EMF Health Report, '*Power Frequency EMF's – EMF Measurement and Control in Home and Office*," Volume 2, Number 4, July/August 1994. " *Power Lines and the Environment – The Electrical Impact,*" Journal of Electrical and Electronics Engineering, Australia – IE Australia & IREE Australia, Vol.8, No.3, September 1988.
Federal	The American National Standards Institute (ANSI) has an EMF standard; ANSI C95.1-1992, "Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz."	Information Ventures, EMF Health Report, '*Power Frequency EMF's – EMF Measurement and Control in Home and Office*," Volume 2, Number 4, July/August 1994
State & Local	New Jersey has adopted the ANSI C95.1 –1992 standard of 3 kHz/m at edge of the right of way. Cellular towers usually require a permit and variance due to height; the public is notified of the permit and variance application in local papers announcing a public meeting opportunity.	" *Design Guidelines for Reducing Electromagnetic Field Effects from 60-Hz Electrical Power Systems*", IEEE Transactions on Industry Applications, Vol. 30, No. 6, Nov./Dec. 1994. Information Ventures, EMF Health Report, '*Cellular Towers- Exposure Levels and Public Health*," Volume 3, Number 2, March/April 1995.

Issue: Extremely Low Frequency and Electromagnetic Fields (ELF/EMF)
Author: Christine M. Danis
Version: 03/28/00

EMF/ELF: Electromagnetic Fields (**EMFs)** are produced by the generation, transmission, and use of electrical energy. The U.S. standard of delivering alternating current at oscillations of 60 Hertz (60 cycles per second) places these fields in the extremely low frequency range (**ELF**). The exposure pathway evaluated was from overhead transmission wires (> or = 22,000 V) with a 50 m buffer on either side of the centerline distribution, representing an area of 240,460.8 acres in NJ. HHTWG concluded that health risks are minimal. Potential socio-economic impacts include property value losses, aesthetic impacts, and psychological impacts. Calculations indicate that property value impacts are low, though there is high uncertainty associated with this assessment. Power lines constitute a moderate aesthetic impact. Although there is a consensus in the medical community that ELF/EMF pose minimal risks, there is evidence of some public concern over this issue. Therefore, it seems appropriate to assign a "moderate" rating under psychological impacts.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	0.1	1	2	2
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	2	1
Subtotal Risk	1	0.1	1	4	2

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
1.62	**1.62**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	3	1	2	2	2	2

Trend: 0

Catastrophic Potential: L

Issue: Endocrine Disruptors
Author: John Posey
Version: 03/28/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Endocrine Disruptors** [focusing on Phthalates as Hormonally Active Agents (HAA]
Description of stressor	The endocrine system secretes hormones and distributes them through the body through the bloodstream. Endocrine disruptors interfere with the functioning of hormones. This can affect physical development in children and the reproductive system in adults. Phthalates, a groups of chemicals found in plastics, are widely suspected to be EDs.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	There is some evidence that girls today may be experiencing sexual development earlier than in years past. Discussion focuses more on breast development (thelarche) than on first menstruation (menarche). Puerto Rico has seen an epidemic of very premature thelarche. In Puerto Rico, about 8 girls in 1000 experience breast development between the ages of 6 and 24 months. A 2000 study found high levels of phthalates in the blood of these girls. The researchers did not find elevated levels of chemicals associated with pesticides. In the United States, a study by Herman-Giddens et al. found evidence of declining average age of thelarche. Data were analyzed for over 17,000 girls. At age 3, 1% of white girls and 3% of black girls showed some signs of breast development. At age 8, 48% of African-American girls and 15% of white girls had begun thelarche. The mean ages of onset of breast development were 9.96 for whites and 8.87 for blacks. Mean age for pubic hair development (pubarche) was 10.51 and 8.78, respectively. (Breast development and pubic hair development are also known as secondary sexual characteristics.) Menarche occurred at 12.16 years for blacks and 12.88 for whites. This study indicates that thelarche occurs earlier than the age found in at least seven earlier studies. Kaplowitz et al. compare the Herman-Giddens study with earlier findings. A study of California girls in 1928-29 showed a mean age at thelarche of 10.6 years. A 1948 study found a mean age of 10.8 years in Ohio. Finally, a 1969 article by Marshall and Tanner found that first signs of secondary sexual characteristics occurred between the ages of 8.5 and 13 in 95% of girls in a London orphanage, with a mean age of 11.15. However, it is dangerous to conclude from these studies that girls today are developing earlier than girls in the past. Past studies had much smaller sample sizes, and much less ethnic diversity than the Herman-Giddens study. In addition, even if first stages of puberty are occurring earlier, it is not clear that this is the result of sinister elements in diet or the environment. It may be that advances in diet and medicine in the last 50 years have improved girls' health, and that this is causing earlier development. The authors of the 1969 study cautioned that the girls in the study came from low socio-economic classes, and may have experienced poor nutrition at some point in their lives. Poor diet is known to delay onset of puberty. Moreover, some argue that development of secondary sexual characteristics in girls as young as 6 is not necessarily a cause for concern. Nakamoto (2000), Pathomvanich (2000) and Kaplowitz (1999) contend that early breast development is often benign, and not linked to later psychological or physical problems. These authors note that secondary sexual characteristics should not be confused with true sexual maturity. Finally, it is not clear that phthalates are linked to mildly premature thelarche. Other possible causes include diet and pesticides. No biochemical mechanism has been found to link phthalates with premature thelarche.

	Thus, policy-makers must make decisions in a highly ambiguous environment. The sources of uncertainty boil down to three main questions: 1) Are girls today experiencing thelarche at an earlier age than in the past? 2) Do phthalates have anything to do with it? 3) Is premature thelarche harmful? Given the lack of a scientific consensus, the strongest statement that can be safely made is that there is a strong possibility that each of these questions should be answered in the affirmative. 1. *Are girls experiencing earlier thelarche?* It is reasonable to point out limitations of the various studies performed in the last 70 years. These include small sample sizes and possibly unrepresentative samples. In spite of these deficiencies, there is at least prima facie evidence that age of thelarche is decreasing. The Herman-Giddens study collected information on more than 17,000 girls from more than 200 doctors. This may be considered a very formidable study. No previous study had the methodological rigor of the Herman-Giddens study. However, published literature reviews do not reveal a single study prior to 1980 indicating that thelarche occurs as early as in the Herman-Giddens study. Kaplowitz et al. note that the mean age of thelarche reported by Herman-Giddens was more than a year earlier than that reported in any previous study. The authors report that the mean age reported by Herman-Giddens is "significantly earlier than that noted in previous studies." Herman-Giddens, in an interview with a popular magazine, gave a strong interpretation of the results: "This study strongly suggest that earlier puberty is a real phenomenon, and that this has important clinical, educational and social implications." There is no conclusive answer to this question. However, I conclude that there is a strong possibility that the age of thelarche is decreasing. Additional basic research on this question is needed. 2. *Do phthalates have anything to do with it?* The Puerto Rico study represents an extreme case. On that island, there is an epidemic of girls experiencing thelarche as early as 2 years of age. This is not dramatically different from the findings of Herman-Giddens, who reports that 1% of white girls and 3% of black girls experience either thelarche or pubarche by the age of 3. By age 5, the numbers increase to 1.9% and 5.7% respectively. The findings of Colon et al. in Puerto Rico indicate that phthalates are linked to premature thelarche, while there is little evidence that pesticides have a similar effect. Premature thelarche probably results from a combination of genetics, diet, and environmental factors. The Colon study gives some indication that phthalates may be among the environmental factors that can make an impact. 3. *Is premature thelarche harmful?* I will deal with this question in the section on psychological impacts.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Psychological impacts/worry.
Key impacts selected (critical socio-economic effects)	Psychological impacts.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Girls are likely to be exposed to phthalates through exposure to plastics. The use of plastic eating and drinking utensils can lead to ingestion of phthalates. Exposure to plastic toys and other household devices may allow inhalation of phthalates.
Quantification of exposure levels statewide	Given the lack of state-specific data, I will assume that the findings of Herman-Giddens are applicable to NJ. These are summarized in the table below:

	Percentage of Girls Experiencing Pubarche OR Thelarche by Age and Race Age White Black 3 1.0% 3.1% 4 0.9% 7.6% 5 1.9% 5.7% 6 3.7% 14.3% 7 6.7% 27.2% 8 14.7% 48.3%
Specific socio-economic entities at increased risk	Blacks clearly experience thelarche earlier than whites.
Quantification of exposure levels to entities at increased risk	By age 8, black girls are more than three times as likely to experience secondary sexual development.
Dose/Impact-Response Assessment	
Quantitative/Qualitative impact-assessment employed	To assess psychological impacts, I rely on published reports based on interviews with girls experiencing premature thelarche and their families.
Risk Characterization	

Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: No impacts hypothesized.	*0.1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty	1
Employment	Severity: No impact hypothesized.	*0.1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty	1
Costs Incurred	Severity: It is possible that premature thelarche may lead to medical costs. However, current medical practice advises against aggressive treatment of early thelarche for most girls, and there is no cost of illness literature related to premature thelarche. I conclude that medical costs are probably minimal.	*1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty	1
Aesthetic Levels	Severity: No impact hypothesized	*0.1*

	Duration/irreversibility	1
	Scale	3
	Uncertainty	1
Psychological Impacts	Severity: Because of the high uncertainty associated with this issue, the correct psychological impact rating could be 1, 2 or 3; uncertainty is high enough that each of these possibilities must be considered a strong possibility. Thus, the rating assigned here indicates a moderate impact, and the uncertainty rating reflects the degree of ambiguity. If premature development is occurring, the psychological effects could be profound. A report by Girl Scouts of America entitled "Girls Speak Out" addresses the issue of premature sexual development. The report includes many poignant quotes from girls and their mothers on the psychological difficulties associated with early signs of puberty. A Time Magazine cover story (itself a sign of public concern) also contains interviews with girls and families who are dealing with premature development. Parents interviewed indicate that they worry about early puberty. They fear that it will lead to sexual pressures from boys, that it could be linked to shorter adult heights, and that it could affect the girl's self-esteem. These interviews give persuasive evidence that premature sexual development does pose potentially serious psychological impacts for the girls, and creates significant worry in their parents. It is reasonable to conclude that premature secondary sexual development may be leading to moderate psychological impacts.	*2*
	Duration/irreversibility: The psychological effects of "lost childhood" could be very long-lasting.	3
	Scale: This appears to be a nationwide problem, and therefore probably a statewide problem.	3
	Uncertainty: As noted above, there are several sources of uncertainty. First, scientists continue to debate whether mean ages of thelarche really are decreasing. Second, it is difficult to assess the extent to which phthalates are responsible. Third, some doctors believe that early thelarche may not permanently harm girls.	3
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	H: It would be useful to have NJ specific data on age at thelarche. In addition, the Puerto Rico study shows signs for promising future research: It would be beneficial to compare blood phthalate levels among girls experiencing premature thelarche, and those not experiencing premature development. Finally, it would be worthwhile to research possible methods of reducing exposure to phthalates.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	- It appears that decreasing age at thelarche may be a long-term trend.	
Potential for catastrophic impacts (H,M,L) and brief description	M: It is difficult to assess the social impact of changes in the age of puberty, but it is possible to imagine catastrophic effects. The Time Magazine article explains the basis for this fear: "The danger...is that the stages of childhood development--cognitive, physical and emotional--have gotten out of synch. Roban and Conn call this 'developmental compression'...." Psychological development is closely tied to physical development. Social norms pertaining to childrearing and to age-appropriate behaviors are tied to prevailing expectations about psychological development. Thus, changes in the patterns of physical and psychological development could run the risk of causing widespread emotional maladjustment, as well as changes in social and cultural institutions that are difficult to foresee. This viewpoint is expressed by the director of the Citizen's Clearinghouse on Environmental Waste, who asserts that "we are messing with the fundamentals of life, and the weight of evidence	

	points to endocrine disruptors." Widespread changes in psychological development could have significant implications for the social fabric. There is high uncertainty regarding both the probability and the consequences of this potential threat. Still, policy-makers grappling with the ambiguities of this issue should be cognizant of the possibly far-reaching consequences.
Incidence of impacts (affected sub-groups, variability, equity issues)	Black girls experience sexual development much earlier than white girls. It is not known whether this is the result of genetics, diet, or environment. It is likely that it reflects an interaction of each of these three factors. If black girls experience higher rates of premature thelarche because of elevated exposure to phthalates, then this is a classic environmental justice issue.
Extent to which threat is currently regulated	According to EQTWG, there are reporting requirements under EPCRA.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	H
Small business industry	L
Transportation	L
Residential	H: I expect that most childhood exposure to plastics occurs in the home.
Agriculture	L
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	L
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L

Biota sinks	L
References	Ivelisse Colon. Identification of Phthalate Esters in the Serum of Young Puerto Rican Girls with Premature Breast Development." *Environmental Health Perspectives* 108(9), September 2000. Girl Scouts of America. "Girls Speak Out: Teens Before Their Time." 2000. www.gsusa.org/news/GSRINews.htm Marcia Herman-Giddens et al. "Secondary Sexual Characteristics and Menses in Young Girls Seen in Office Practice: A Study from the Pediatric Research in Office Settings Network." *Pediatrics* 99(4), April 1997. Becky Gillette. "Is Early Sexual Development the Price of Pollution?" E: The Environmental Magazine. November, 1997. www.emagazine.com Paul Kaplowitz et al. "Reexamination of the Age Limit for Defining When Puberty is Precocious in Girls in the United States: Implications for Evaluation and Treatment." *Pediatrics* 104(4), October 1999. Michael D. Lemonick. "Teens Before Their Time." *Time*, October 30, 2000. John Nakamoto. "Myths and Variations in Normal Pubertal Development." *Western Journal of Medicine* 172(3), 2000. National Academy of Sciences. Hormonally Active Agents in the Environment. 2000. http://books.nap.edu/html/normonal_agents/ A. Pathomvanich and G. Chrousos. "Early Puberty: A Cautionary Tale." *Pediatrics* 105(1), January 2000. Janet Raloff. "Girls May Face Risks from Phthalates." *Science News*, September 9, 2000. U.S. Environmental Protection Agency, National Science and Technology Council. Endocrine Disruptors Research Initiative Fact Sheet. www.epa.gov/endocrine
Current Policy and Regulatory Framework	See regulations, above.
Federal	
State & Local	

Issue: Endocrine Disruptors
Author: John Posey
Version: 03/28/00

Phthalates are hormonally active agents (HAAs) that have been linked to premature sexual development in girls. There is still much uncertainty regarding this assessment. First, the ages at which girls experienced different stages of sexual development were not well documented in the past. Thus, there is not an irrefutable baseline for determining that the age of development is decreasing. Second, many factors, including environment, diet, and genetics, influence age of sexual maturation. It is difficult to isolate the specific effects of phthalates. Third, some doctors argue that early breast development is not necessarily harmful, although interviews with girls and parents seem to refute this sanguine attitude. Despite uncertainties, there is considerable evidence that girls may be experiencing earlier sexual development today than in the past, that phthalates may be a contributing factor, and that this may be psychologically harmful to the girls. The level of uncertainty surrounding this issue must be stressed. Still, it is reasonable to be concerned about the wide-ranging implications of possible changes in human physical development patterns.

Socio-economic Impact Evaluation of Environmental Issue:

Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	0.1	1	0.1	2
Duration/ Irreversibility	1	1	1	1	2
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	0.3	0.3	3	0.3	12

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
3.18	**3.18**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	1	1	1	3	1.4

Trend: -

Catastrophic Potential: M

Issue: Floatables
Author: John Posey
Version: 03/28/01

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Floatables**
Description of stressor	The term "floatables" includes any anthropogenic floating debris in any body of water. Floatables can be made of plastic, wood, glass, metal, or styrofoam. Floatables pollute rivers, lakes and estuaries in NJ.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	There are few human health risks associated with floatables, although floating medical waste could potentially threaten human health. In addition, floatables pose a potential threat to wildlife through entanglement and ingestion.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	1) Floating debris could affect the value of waterfront property. 2) Floatables have resulted in beach closings, which could affect employment and impose economic costs. 3) Floatables create cleanup costs. 4) Floatables may have an aesthetic impact.
Key impacts selected (critical socio-economic effects)	Property values, employment, costs incurred, aesthetic impact.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	A 1988 study by DEP concluded that most debris washed ashore in NJ originates in the Hudson estuary. Garbage barges from New York City are an important source, and have been a source of contention between New York and New Jersey over the last decade. Rain and stormwater runoff can also contribute to the problem. Finally, improper disposal at offshore dumps can result in marine debris.
Quantification of exposure levels statewide	In the 1980s, large volumes of floating debris were deposited on NJ beaches. A survey conducted in Spring of 1987 found that the northernmost NJ beaches (Sandy Hook and beaches in the Lower Harbor) contained more than 1000 discrete items of trash per half mile. The southernmost beaches (south of Ocean City) contained about 100 items per half mile. In 1988, there were two major beach closings due to floatables. The first resulted in the closing of 35 miles of beach from Atlantic City to Seaside Heights. The second involved a 50 mile stretch of beach in Ocean and Monmouth Counties. In each case, beaches were closed for several days. In response to these problems, Governor Kean initiated a $2 million cleanup program called "Operation Clean Shores." In 1997 and 1998, the program collected 10.8 million pounds of debris. Less than 1 pound in a million consists of medical waste. Since the 1980s, regulations and cleanup activity have reduced the amount of floating debris. Since 1991 there have been no beach closings due to floating debris.
Specific socio-economic entities at increased risk	Although floating debris may affect lakes and rivers, oceanside communities bear the greatest burden associated with floatables.

entities at increased risk		
Quantification of exposure levels to entities at increased risk	For the purpose of this report, I will assume that oceanside communities bear 100% of the burden.	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed		
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: There is no evidence to indicate that floatables have a measurable impact on property values in NJ. For rough calibration, beach closures may be considered a proxy that indicates the seriousness of the problem in a given year. Since there have been no beach closures in the last 10 years, I conclude that there probably have not been measurable property value impacts either.	*1*
	Duration/irreversibility:	1
	Scale:	2
	Uncertainty:	1
Employment	Severity: In the 1980s, there were several occasions on which NJ beaches had to be closed because of floatables. Some have estimated that the economic impact in 1987-88 was between $1 billion and $4 billion. If true, these estimates indicate that floatables may have caused measurable employment impacts in the 1980s. However, there have been no beach closures due to floatables in the last 10 years. I conclude that the current economic impact is therefore minimal.	*1*
	Duration/irreversibility:	1
	Scale:	2
	Uncertainty: I feel pretty confident about this assessment.	1
Costs Incurred	Severity: The cost of the state beach cleanup program is about $2 million per year. The cost of the Army Corps cleaning project is about $30 million, but this does not represent a direct cost to NJ. (In addition, this cost includes the expense of the driftwood cleanup program, which has been ongoing for decades.) Thus, public expenditures on cleanups are far less than the $16 million required to justify a "moderate" rating under NJCRP guidelines. There may be additional cleanup costs borne by companies or individuals. Oceanfront hotels, for example, would need to include beach cleaning as an ongoing maintenance cost, and individuals with oceanfront property would have to bear the cost of removing and disposing of debris. There is no information available on the private costs of marine debris. I consider it unlikely that private sector costs are great enough to meet the threshold of $16 million. Lacking hard information, though, I have a moderate degree of uncertainty.	*1*
	Duration/irreversibility:	1
	Scale:	2
	Uncertainty:	2

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Aesthetic Levels	Severity: A contingent valuation study conducted by Kerry Smith et al. studied individuals' willingness to pay for reductions in marine debris. The study consisted of showing photographs of debris to respondents, and therefore is not easily applicable to the problem of measuring loss in utility due to floatables in NJ. Still, the study indicates that many people do consider the existence of a serious marine debris problem to be a potentially serious aesthetic impact. Although cleanup efforts have greatly reduced the amount of flotsam in the 1990s, there remain isolated occurrences in which floatable "slicks" wash ashore on NJ beaches. Assessing the aesthetic seriousness of these occurrences is an inherently subjective exercise. In my judgment, the impact is not great enough to justify a moderate impact rating for floatables.	*1*
	Duration/irreversibility:	1
	Scale:	2
	Uncertainty: Others, more sensitive to the problem, might reasonably disagree with this assessment. I thus have moderate uncertainty.	2
Psychological Impacts	Severity: Although beaches have been mostly clean in recent years, there remains a residual concern over medical wastes floating onto NJ beaches.	*1*
	Duration/irreversibility:	1
	Scale:	2
	Uncertainty	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	L	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	0 Although the problem has diminished in the 1990s, new threats may emerge in the next decade. The Fresh Kills landfill in Staten Island is scheduled to close in 2002. The City of New York is still working to find an alternative disposal site. One plan called for garbage to be hauled by barge to a landfill in Virginia. If this plan is undertaken, then many additional tons of garbage could be transported through NJ waters, leading to a threat of additional debris.	
Potential for catastrophic impacts (H,M,L) and brief description	L	
Incidence of impacts (affected sub-groups, variability, equity issues)	Oceanfront communities bear most of the burden.	
Extent to which threat is currently regulated	See Federal and State, below	
Relative Contributions of Sources to Risk (H,M,L); include any		

information/details on sources	
NJ Primary Sources	
Large business/industry	L
Small business industry	L
Transportation	H Transportation of garbage is an important contributor.
Residential	L
Agriculture	L
Recreation	L
Resource extraction	L
Government	H Transportation of garbage is an important contributor.
Natural sources/processes	L
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L
Biota sinks	L
References	Gordon Bishop. "Kean Unleashes Barrage at Shore Polluters." Newark Star Ledger, 5/26/89. Michael Kelly. "New Wave of Waste Keeps Beaches Shut at Sandy Hook: Debris by the Bagful." Northern New Jersey Record, 7/29/88. Eve Markowitz. "Combined Effort to Stop Trash Dead in Water." Northern New Jersey Record, 3/8/89. Natural Resources Defense Council. Testing the Waters 2000: A Guide to Water Quality at Vacation Beaches. New York-New Jersey Harbor Estuary Program. Summary of the Comprehensive Conservation and Management Plan. 1996. NJDEP. FY99 Annual Performance Report on the FY99/2000 New Jersey Performance Partnership Agreement.

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Current Policy and Regulatory Framework	
Federal	*Army Corps:* Beginning in 1989, the Army Corps of Engineers began skimming for floatables in New York Bay. The Corps has gathered driftwood from the water for decades. Following the devastating NJ beach closures in 1988, the trawlers affixed a finer mesh to the collection apparatuses, allowing the boats to pick up plastics and smaller objects. The action has been credited for reducing much of the debris affecting NJ beaches. The operation costs US taxpayers about $30 million annually. *Law of the Sea*: Annex 5 of the International Law of the Seas Conference prohibits the dumping of plastics into the ocean, and specifies penalties including fines and imprisonment.
State & Local	*Court Action:* In 1979, the City of Woodbridge, NJ filed suit against New York City. Woodbridge claimed that garbage from the Fresh Kills landfill was floating to NJ, creating a nuisance for citizens of Woodbridge. In 1993, a federal judge approved a consent decree ordering the city to build covered unloading facilities for garbage barges at the Staten Island dump. However, in 1996, the New York Legislature voted to have the facility closed by 2002. New York City then returned to federal court asking that the consent decree be modified to allow deployment of less expensive floatable control equipment. In 1997, a federal judge approved the modification. *Sewage Regulation:* In 1995, DEP drafted regulations that require each community to design and implement plans to remove floatables from sewage effluent. *Operation Clean Shores:* Following the beach closures of 1988, Governor Kean launched a program designed to clean debris from shores. The program used prisoners from minimum security facilities to do the work. The program cost about $2 million per year, and is credited with improving the aesthetic appeal of NJ beaches. *Aerial Surveillance:* NJ monitors floatables through aerial surveillance. The Natural Resources Defense Council has praised the NJ government for its diligence in protecting NJ beaches.

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	Estuary Plan: The 1996 New York/New Jersey Estuary Program Floatables Plan set forth several measures that have been successfully implemented. These include the NJ Clean Oceans program, the continued use of skimmer boats, and public education campaigns about correct methods of waste disposal. The total cost of this plan is $7.4 million, divided between New York, New Jersey, and the federal government.

Floatables are solid wastes that float or remain suspended in the water column. When these wastes are inadvertently or purposefully disposed of and transported in open waterways, they represent a source of pollution that degrades the aesthetic quality of those waterways and may become stranded on beaches. In the 1980s, floatables caused the closing of beaches in NJ, resulting in up to hundreds of millions in economic losses. Since then, the problem has decreased significantly, and there have been no beach closures due to floatables since 1991. An Army Corps of Engineers program that skims floatables out of New York Harbor is credited with causing much of the improvement. The state of NJ also has vigorous cleanup and monitoring programs. Because of these programs, the socio-economic impact of floatables became much less serious in the 1990s.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	1	1	1	1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	2	2	2	2	2
Subtotal Risk	2	2	2	2	2

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
2	**2**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	1	2	2	1	1.4

Trend: 0

Catastrophic Potential: L

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Version: 10/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Formaldehyde**
Description of stressor	The following is taken from a hazard summary produced by the EPA Office of Air Quality Planning and Standards: Formaldehyde is a colorless gas with a pungent odor. It is used predominantly as a chemical intermediate. It also has minor uses in agriculture, as an analytical reagent, in concrete and plaster additives, cosmetics, disinfectants, fumigants, photography, and wood preservation. It was extensively used as an insulating material until 1982 when it was banned by the CPSC. Though the ban was overturned in courts, the CPSC action still stimulated a virtual phaseout of UF foam in insulation.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Formaldehyde is a suspected carcinogen. Chronic exposure can also lead to respiratory dysfunction.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Medical costs associated with cancer and non-cancer health problems.
Key impacts selected (critical socio-economic effects)	Costs Incurred
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	The following is taken from the Agency for Toxic Substances and Disease Registry: "A major source of formaldehyde that we breathe everyday is found in smog in the lower atmosphere. Automobile exhaust from cars without catalytic converters or those using oxygenated gasoline also contain formaldehyde. At home, formaldehyde is produced by cigarettes and other tobacco products, gas cookers, and open fireplaces. It is also used as a preservative in some foods such as some types of Italian cheeses, dried foods, and fish. Formaldehyde is found in many products used every day around the house, such as antiseptics, medicines, cosmetics, dishwashing liquids, fabric softeners, shoe care agents, carpet cleaners, glues and adhesives, lacquers, paper, plastics, and some types of wood products. Some people are exposed to higher levels of formaldehyde if they live in a new mobile home, as formaldehyde is given off as a gas from the manufactured wood products used in these homes.
Quantification of exposure levels statewide	EPA has established a health benchmark of 0.77 micrograms per cubic meter. In 1990, ambient concentrations in NJ were 1.9 micrograms per cubic meter, 25 times higher than the threshold. Levels were almost unchanged in 1996 measurements.
Specific socio-economic entities at increased risk	Urban areas

Quantification of exposure levels to entities at increased risk	The ambient concentration in Hudson County was 4.32 micrograms. The measurement for Essex County was 2.65 micrograms.	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	Comparison of government measurements of ambient concentrations with safety benchmarks.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		*Score*
Property Values	a) Severity: No impact hypothesized	0.1
	b) Duration/irreversibility	1
	c) Scale	1
	d) Confidence	1
Employment	a) Severity: No impact hypothesized	0.1
	b) Duration/irreversibility	1
	c) Scale	1
	d) Confidence	1
Costs Incurred	a) Severity: Formaldehyde poses both a cancer and a non-cancer risk. For cancer risk, EPA estimates that an individual who breathes air containing .08 micrograms per cubic meter would have a one in a million chance of getting cancer over his/her lifetime. In NJ, the average concentration is 1.88 micrograms/m^3. This works out to a risk of about 23.5 in a million. Since there are about 8.3 million persons in NJ, this works out to about 200 lifetime cancer cases, or about 3 per year in NJ. If the cost of an average case of cancer is about $80,000, this works out to an annual cost of about $250,000. According to the EPA, there are several potential negative consequences to exposure to formaldehyde. Acute exposure can lead to eye, nose and throat irritation. Acute exposure can also lead to inflammation and ulceration of the mouth, esophagus and stomach. Chronic exposure has been associated with respiratory symptoms and allergic reactions. In addition, there is some indication that chronic exposure to formaldehyde can result in reproductive and developmental disorders. Women working with urea-formaldehyde resins have been found to be at elevated risk of menstrual disorders. However, a study of hospital equipment sterilizing workers did not report an association between formaldehyde exposure and increased spontaneous abortions, and birth defects have not been observed in animal studies with formaldehyde.	

	Thrasher et al. (1987) report that chronically exposed individuals commonly complain of fatigue, headache, vertigo and upper and lower respiratory irritation. Hilton et al. (1996) report that "formaldehyde causes upper respiratory tract irritation and has been reported in some investigations to be a cause of occupational allergic asthma." Wantke et al. (1996) report that "children attending a primary school showed symptoms such as headache, cough, rhinitis and epistaxis." The school was discovered to have high ambient concentrations of airborne formaldehyde. Norback et al. (1995) conducted a study of air quality in Europe, and concluded that "formaldehyde may cause asthma-like symptoms." Most exposure to formaldehyde comes through indoor air. Lemus et al.(1998) conducted a study of residential exposure to formaldehyde in Louisiana during the winter. Approximately 44% of houses in the study had unsafe levels of formaldehyde. Liu et al (1991) found significant exposure in mobile homes. Wiglusz et al. (1991) found that furnishing fabrics are a major source of indoor air exposure, and conclude that formaldehyde from this source constitutes a "serious hygienic problem." Stock and Mendez (1985) conducted a study of formaldehyde exposure in Texas homes during the summer. They found that about 10% of homes had unsafe levels of formaldehyde. Wieslander et al. (1997) found high levels of formaldehyde in freshly painted homes. Koeck et al. found unsafe levels in 20% of apartments in Austria. Two conclusions emerge from this brief literature survey. 1) Indoor exposure to formaldehyde is significant. 2) Chronic exposure to formaldehyde causes several types of respiratory disorders. Unfortunately, there are no epidemiological studies available that estimate the number of cases of respiratory illness caused by formaldehyde. HHTWG has not attempted to estimate the number of respiratory cases caused by formaldehyde, and HHTWG has advised that the types of disorders mentioned in the above studies are unlikely to result in hospitalization. Thus, although formaldehyde exposure is significant, there is no firm basis for concluding that medical costs associated with formaldehyde exceed $16 million.	1
	b) Duration/irreversibility: unknown	2
	c) Scale: Indoor exposure appears to be a nationwide, and therefore statewide problem	3
	d) Confidence: There is much uncertainty.	3
Aesthetic Levels	a) Severity: No impacts hypothesized	0.1
	b) Duration/irreversibility	1
	c) Scale	1
	d) Confidence	1
Psychological Impacts	a) Severity: No impacts hypothesized	0.1
	b) Duration/irreversibility:	1
	c) Scale:	1
	d) Confidence	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	M The EPA, and the toxicology community in general, have offered little guidance to policy makers about non-cancer impacts. More information is needed about the number of illnesses, and the seriousness of these illnesses, associated with the exceedence of safety benchmarks.	

Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	0 There was virtually no change in ambient concentrations in NJ between 1990 and 1996.
Potential for catastrophic impacts (H,M,L) and brief description	L
Incidence of impacts (affected sub-groups, variability, equity issues)	Formaldehyde concentrations are greatest in urban areas and in mobile homes. Thus, low-income households are most at risk.
Extent to which threat is currently regulated	See federal and state, below.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	H Formaldehyde is used in a variety of chemical manufacturing industries.
Small business industry	M
Transportation	H Formaldehyde is a byproduct of incomplete combustion.
Residential	H Formaldehyde is contained in many household products.
Agriculture	L
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	M Small amounts of formaldehyde occur naturally in the atmosphere, and in the human body.
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L

Soil sinks	L
Non-local air sources incl. Deposition	L
Biota sinks	L
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Current Policy and Regulatory Framework	
Federal	Occupational exposure is regulated by OSHA, and is cited by NIOSH and ACGIH. Monitoring or target levels have been established by DOT and EPA.
State & Local	Industries using formaldehyde are required to report uses and discharges of the substance under the state's Right to Know Act.

Formaldehyde is a colorless gas with a pungent odor. It is used predominantly as a chemical intermediate. It also has minor uses in agriculture, as an analytical reagent, in concrete and plaster additives, cosmetics, disinfectants, fumigants, photography, and wood preservation. It was extensively used as an insulating material until 1982 when it was banned by the CPSC. Though the ban was overturned in courts, the CPSC action still stimulated a virtual phaseout of UF foam in insulation. Formaldehyde is considered a probable carcinogen, and it also poses non-cancer risks. The lifetime cancer risk posed by atmospheric formaldehyde is approximately 200 cases, or roughly 3 per year. There is strong evidence that indoor exposure to formaldehyde is a serious problem nationwide. Chronic indoor exposure to formaldehyde can cause a variety of respiratory symptoms. Surveys conducted in several states, as well as in Europe, indicate that formaldehyde from home furnishings create unsafe levels of formaldehyde in a large minority of residences. There are no epidemiological studies that attempt to quantify the number of medical cases caused by indoor formaldehyde exposure. Thus, there is no strong evidence supporting the claim that health costs associated with formaldehyde are significant. Therefore, a "low" severity rating was assigned under the "costs incurred" category, while the high uncertainty in this category indicates that costs could be much higher.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	0.1	1	0.1	0.1
Duration/ Irreversibility	1	1	2	1	1
Scale (spatial, population)	1	1	3	1	1
Subtotal Risk	0.1	0.1	12	0.1	0.1

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
2.48	**2.48**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	1	3	1	1	1.4

Trend: 0
Catastrophic Potential: L

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Version: 09/00

New Jersey Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Stressor: **Geese**

There are approximately 82,000 resident Canada geese in NJ. In winter, that population can grow to as much as 280,000 because of migratory flocks. The population has risen in recent years because suburbanization provides habitats that are attractive to geese. Geese like large fields with short grass, preferably with access to a fresh water supply. Golf courses are ideal habitats for geese.

Impacts: There are five possible ways that Canada geese could have a socio-economic impact:

1. Bird droppings can be considered an aesthetic nuisance.
2. There may be health effects.
3. Geese can cause damage to agriculture.
4. Geese can cause small airplane crashes.
5. Goose droppings can lead to eutrophication of lakes.

Aesthetics: Although many persons enjoy the sight of Canada geese, others consider these birds to be a nuisance. An average goose leaves about 1.5 pounds of droppings each day. This can be considered an aesthetic impact.

Evaluating the seriousness of impacts related to Canada geese requires some judgment. This is particularly true in evaluating aesthetic impacts. It is difficult not to sympathize with individuals who find their lawns or sidewalks covered with goose droppings. On the other hand, many persons enjoy seeing the geese, and many actually feed the fowl. On the whole, it is difficult to demonstrate that geese have a negative net aesthetic impact.

Health Concerns: Some officials have voiced concern about the health effects of goose droppings. Monmouth County health officials believe that they have documented two cases in which persons ingested giardia parasites contracted through contact with goose feces. One was a police cadet who performed push-ups in a field heavily contaminated with goose droppings. A second was a toddler who visited several ponds to feed geese. The giardia parasite causes diarrhea.

Despite the concerns expressed by Monmouth County officials, medical problems associated with geese appear to be both rare and minor.

Agriculture: The impact of geese on agricultural crops is a third area of concern. USDA estimates that birds cause about $100 million worth of agricultural damage in the U.S. each year. It is not known what proportion of this is caused by geese, but it is unlikely that as much as 10% of the damage caused by birds each year can be attributed to Canada geese. It is also unlikely that as much as 10% of the damage caused by birds occurs in NJ each year. Thus, it is highly unlikely that as much as $1 million in agricultural damage in NJ is caused by Canada geese each year. (Total NJ agricultural output is nearly $700 million per year.) Under NJCRP guidelines, a cost must exceed $16 million to be considered "moderate."

Aviation: Another concern is that there have been isolated reports nationally of small airplane crashes caused by geese. However, these small airplane crashes are rare and isolated. It is sensible for small airports to take measures to drive away threatening fowl. (I have been unable to find any reported incidents in NJ.)

Eutrophication: Perhaps the greatest potential impact of Canada geese is the effect that their feces have upon lakes. The average goose excretes about 1.5 pounds of feces per day. At times of peak population, this can amount to more than 200 tons of goose feces per day.
(280,000 birds * 1.5 pounds/bird * 1 ton/2000 pounds = 420,000/2000 = 210 tons.)

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Goose feces contain high levels of phosphorus. When decomposed goose feces enter lakes through runoff, phosphorus levels in lakes can become elevated. This can lead to eutrophication, the state in which an excess of nutrients alters the ecological balance in a lake. Eutrophication can lead to a loss of water clarity, an increase in algae populations, and possibly fish kills. This can seriously diminish the economic and recreational value of lakes.

Eutrophication is not a trivial concern in NJ. EQTWG reports that there are over 100 eutrophic lakes in NJ. The SETWG writeup on phosphorous concludes that eutrophication may have a moderate socio-economic impact with respect to costs incurred and aesthetics. It is difficult to assess the extent to which geese contribute to the problem of eutrophication in NJ. In its discussion of eutrophication, EQTWG places greater emphasis on fertilizer runoff.

Several studies on the relationship between geese and eutrophication have been done outside of NJ. Kitchell et al. (1999) find that in a New Mexico wildlife refuge, geese increase phosphorous levels by up to 75%. Of course, the impact of geese in New Mexico, an arid and relatively unpopulated state, may not be comparable to impacts in a state such as NJ. Manny et al. (1994) find that in a Michigan lake, geese contribute up to 70% of the phosphorous that enters the lake from external sources. Moore et al. (1998) find that the relative contribution of geese to the phosphorous level depends on climactic conditions. In fall 1994, the watershed supplied 18 times more phosphorous than did geese to a lake in Massachusetts. However, because of a drought the following year, geese supplied 7 times more phosphorous than did the watershed in fall 1995. In an earlier study, Moore et al (1994) find that during February-December 1994, an inlet stream draining a large urban watershed contributed 98.9% of the total phosphorous entering the lake. Geese, then, were a relatively insignificant source of phosphorous in this period. Brutsche et al. (2000) conducted a laboratory study of the relationship between goose droppings and nutrient enrichment. They conclude that "despite fears that eutrophication by Canada geese significantly impacts lakes, this experiment detected no major effects on the snail-epiphyte-macrophyte system."

Because they address eutrophication in an urban, northeastern state, the studies by Moore et al. seem most relevant to NJ. These studies indicate that under conditions of normal rainfall, urban and agricultural runoff contribute much more phosphorous to lakes than do geese. However, in periods of drought, geese can contribute more phosphorous than runoff does. These studies seem to support the emphasis placed on agricultural and urban runoff by EQTWG. Thus, although eutrophication may have a moderate socio-economic impact in NJ, the evidence available indicates that geese are not the most important contributors to this eutrophication.

Other: A reviewer mentions that there may be some welfare cost associated with reduced golf course use.

Regulations: Canada geese are protected under federal and state law. The U.S. Fish and Wildlife Service (FWS), Department of the Interior, is responsible for Canada goose management at the federal level. FWS uses management techniques designed to limit growth of the resident population while protecting migratory fowl. To this end, FWS issues hunting permits at times of the year that migratory fowl will not be affected. The Division of Fish, and Wildlife, Department of Environmental Protection, is responsible for Canada goose management at the state level. The Division promulgates waterfowl hunting regulations within the annual waterfowl regulations administered by FWS. The Division also participates in flyway studies of Atlantic and Resident Population geese to guide goose management in New Jersey. It is permissible to harass Canada geese without a federal or state permit as long as the geese are not touched or handled by a person or dog. Care must be taken to assure that this harassment does not result in any migratory birds being hurt or touched, and particular care must be taken when dealing with goslings. Nesting geese cannot be harassed or chased without a permit.

Conclusion: Although some persons may be annoyed by the presence of geese, it is difficult to demonstrate that there is even a moderate socio-economic impact associated with Canada geese.

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Issue: Geese
Author: John Posey
Version: 09/00

Canadian Geese. There are approximately 82,000 resident Canada geese in NJ. In winter, that population can grow to as much as 280,000 because of migratory flocks. The population has risen in recent years because suburbanization provides habitats that are attractive to geese. Geese like large fields with short grass, preferably with access to a fresh water supply. Golf courses are ideal habitats for geese. There are five possible ways that Canada geese could have a socio-economic impact: First, droppings may be considered an aesthetic nuisance. Second, there are two recent cases of individuals becoming sick because of contact with goose droppings. Third, geese can damage agriculture. Fourth, there have been some reports of geese causing small plane crashes in other states. Finally, goose droppings contain phosphorous, and thus can contribute to the eutrophication of lakes. However, none of these impacts are very serious in NJ.

Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	0.1	0.1	1	1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	2	2	2	2	2
Subtotal Risk	0.2	0.2	2	2	0.2

Average Risk (0 – 5 years)	Average Risk (5 years plus)
0.92	**0.92**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	1	2	1	1.2

Trend: -

Catastrophic Potential: L

Issue: Genetically Modified Organisms (GMOs)
Author: John Posey
Version: 02/01

New Jersey Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Stressor: **Genetically Modified Organisms (GMOS)**

In recent years, Genetically Modified Organisms (GMOs) have been the subject of heated debate, both within the scientific community and in the general public. The term GMO, or biotechnology, refers to the practice of inserting a beneficial gene from one organism into the DNA of another organism. This biotechnology has been used to produce new strains of crops that have heightened resistance to pests or pesticides. Other uses of GMO technology include changing the nutrient content of plants and changing maturation rates. Proponents argue that biotechnology offers the promise of increased agricultural production, resulting in lower costs to consumers, decreased world hunger, and increased profits for agricultural corporations. In the United States, more than half of all soybean and cotton acreage is now planted with GM crops. The use of GM corn declined between 1999 and 2000, from 25 million acres to 19.9 million acres.

New Jersey businesses are heavily involved in GMOs. Genetically altered soybeans are designed to be resistant to a Monsanto herbicide known as Roundup. Monsanto's parent company is Pharmacia of Peapack, NJ. Strategic Diagnostics Inc. (SDI), of Newark, produces a product that allows farmers to test whether soybeans are "Roundup Ready." In addition, several NJ firms export GM products. These include Indopco Inc. of Bridgewater, which enjoys sales of over $1 billion per year. (It is not known how much of these sales consist of GM products.) Unfortunately, no current count exists of the number of NJ acres currently planted with GMOs, or the dollar value of GMOs grown in NJ.

Genetically modified agricultural products are at the center of a series of trade disputes between the U.S. and other countries. In western Europe, particularly, both consumers and governments are concerned about possible threats to human health posed by GMOs. While biotechnology skeptics acknowledge that there is no actual evidence that GMOs are harmful to humans, they point out that much the same could have been said of thalidomide a generation ago. The US State Department, USDA, and US Trade Representative all hold firmly to the opinion that GM products are safe, and that exclusion of these products constitutes an unfair trade practice.

A great deal of controversy has surrounded a finding by Cornell scientists that pollen from GM corn may be harmful to monarch butterflies. The scientists found that caterpillars feeding on milkweed leaves coated with GM pollen suffered higher mortality rates than caterpillars feeding on leaves with no pollen. The Cornell study occurred in a laboratory setting. The finding was challenged by scientists from the University of Illinois. These scientists used a field setting rather than a laboratory setting, and found that GM corn pollen poses no threat to Black Swallowtail butterflies. The US EPA reviewed the findings, and concluded that GM corn poses very little risk to Monarch Butterflies, and may actually have benefits for Monarch Butterfly survival.

Additional controversy surrounds the topic of pesticide use. Proponents of GMOs contend that biotechnology could reduce the use of pesticides through the creation of pest-resistant crops. Critics charge that some current GMOs are engineered to be resistant not to pests, but to pesticides. As a result, GMOs may actually induce farmers to increase their use of pesticides.

Critics raise several scenarios, which they claim could result from the use of biotechnology. First, there may be currently unforeseen toxic or allergenic effects. Second, the use of microbe-resistant strains could lead to microbes that are resistant to the effects of antibiotics. A third and related problem is that GMOs could lead to the creation of new bacteria and viruses. Fourth, the spread of transgenes to related species could create a new breed of herbicide-resistant weeds. These weeds could spread throughout an ecosystem, altering the distribution of plant species and threatening biological integrity and biodiversity. Fifth, there is the "jumping gene" problem. Under this scenario, a genetic enhancement may move from a crop species to a weed species. This could create serious costs, if it led to the development of a highly resistant weed species.

Another scenario involves the possibility of accidental release. In Canada, genetically engineered salmon were accidentally released off Prince Edward Island. It is not clear what long term effect this might have on Atlantic salmon fisheries.

Issue: Genetically Modified Organisms (GMOs)
Author: John Posey
Version: 02/01
One recent case of costs created by GMOs involved a product known as StarLink corn. This product was supposed to be limited to animal feeds, but turned up in human food products. Hundreds of products were recalled, leading to significant economic losses.

The lack of scientific consensus regarding the danger posed by GMOs is illustrated by a pair of open letters released by different scientific organizations. The American Society for Microbiology argues that GMOs have been tested extensively, and that no harmful effects have yet been demonstrated. This group concludes that the benefits of biotechnology far outweigh the risks. By contrast, the Institute of Science in Society has released a letter warning of potentially catastrophic effects of GMOs, and calling for a moratorium on all commercial use of GMOs. This letter is signed by such luminaries as Rutgers ecologist David Ehrenfeld, Harvard geneticist Ruth Hubbard, and George Woodwell, Director of the Woods Hole Research Center.

A survey of public opinion in New Jersey regarding GMOs was conducted by Rutgers University researchers in 1993. At that time, 48% had heard or read "some" or "a great deal" about GMOs. Most approved of the new technology, and believed that it was essentially safe. However, 20% of respondents had negative reactions when asked to voice their initial reaction to genetic engineering in general. Their responses included terms such as "Brave New World," "frightened," "Nazi/Hitler," "mutants" and others. 20% believed that genetic engineering is morally wrong. 84% believe that GMOs should have special labels for consumers. 55% said that they would be willing to eat a genetically engineered apple, while only 27% said that they would be willing to buy genetically engineered baby food. 65% agreed with the statement, "the potential danger from genetic engineering is so great that strict regulations are necessary." 40% believed that GMOs could pose a threat to the environment if they reproduce.

The danger associated with biotechnology is an example of a high cost/low probability outcome. It cannot be proven that GMOs will not lead to an ecological Armageddon, as GMO critics contend. However, available evidence indicates that this is highly unlikely. Thus, evaluating GMOs in terms of the risk categories established for the SETWG requires some judgment. The judgment of this evaluator is that GMOs are unlikely to create adverse economic or aesthetic impacts in NJ in the next five years. Thus, these categories will be ranked as "low impact." However, a reviewer of a draft of this document countered with the following reaction: "[I]t seems reasonable to expect that NJ will experience at least one high-cost problem associated with GMOs, although exactly what that will be is unpredictable. So I would put severity of costs incurred higher."

Regarding psychological impacts, the Rutgers survey indicates that a sizeable minority feels some concern about potential dangers of GMOs. On the basis of this finding, it seems reasonable to consider the psychological impact of GMOs to be moderate.

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Issue: Genetically Modified Organisms (GMOs)
Author: John Posey
Version: 02/01
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Genetically Modified Organisms (GMO): The term GMO refers to the application of genetic engineering to commercial crops. Nationally, over half of all soybean and cotton acreage is planted with GM crops, and nearly 20 million acres of GM corn were planted last year. It should be noted that several NJ companies are heavily involved in GM agriculture. The scientific community has produced numerous studies and statements on the subject, but the results are contradictory and inconclusive. Critics charge that scientists still know too little about the potential risks associated with GMOs. These skeptics point to worst case scenarios in which GMOs could lead to ecological catastrophe through the creation of herbicide resistant weeds and new strains of microbes. Supporters of GMOs note that there is no actual evidence of adverse consequences, while the economic benefits of GMOs are already apparent.

The danger associated with GM agriculture, then, is a good example of a high cost/low probability outcome. While some risk may exist, it is highly unlikely that GMOs will create any adverse economic or aesthetic impacts in NJ in the next five years. However, survey research indicates that there is already widespread worry about the dangers of GMOs. Additional research on the ecological impact of GMOs is warranted.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	0.1	0.1	1	1	2
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	0.1	0.1	1	1	2

Average Risk (0 – 5 years)	Average Risk (5 years plus)
0.84	**0.84**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	3	2	2	1.4

Trend: ---

Issue: Genetically Modified Organisms (GMOs)
Author: John Posey
Version: 02/01

Catastrophic Potential: M

Issue: Green and Red Tides
Authors: John Posey
Version: 03/28/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Green and Red Tides** Note: Brown Tide and Pfiesteria are covered in separate writeups, and will not be addressed in this writeup.
Description of stressor	According to Gastrich, "HABs include species of microscopic, usually single celled eukaryotic plants that live in estuarine and marine waters." These algae can turn waters red or green, hence the nicknames. In NJ waters, red tide is a more serious threat than green tide, as species associated with red tide have been found in NJ waters in recent decades.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	1. Human Health Risks: HABs can cause serious illness or death. The most serious conditions associated with HABs result from eating shellfish taken from waters afflicted with HABs. These conditions include Paralytic Shellfish Poisoning (PSP), Amnesic Shellfish Poisoning (ASP), Neural Shellfish Poisoning (NSP), Diarrhetic Shellfish Poisoning (DSP), and Ciguaterra Fish Poisoning (CFP). However, algaes producing these serious symptoms have not bloomed in NJ waters. In NJ, the most serious health impact is a mild allergic reaction that some bathers have to red tides. 2. Animal Mortality: HABs are associated with shellfish mortality and fish kills.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Possible effects of HABs include: 1) employment losses in the shellfishing and tourism industry; 2) economic costs associated with medical problems and lost productivity; 3) loss of property values in areas affected by HABs; and aesthetic impacts.
Key impacts selected (critical socio-economic effects)	Aesthetics, employment, economic costs.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Unemployment in the shellfish industry can result both from the killing of shellfish by HABs and from reduced demand for shellfish because of the threats of ASP, NSP, and other types of poisoning. Unemployment in the tourism industry can occur if tourists find NJ beaches unsafe or unattractive because of HABs. Property value losses can result from declines in shellfish and tourism industries. The NJ economy may bear economic costs related to lost production in the shellfish and tourism industry, and from direct medical costs associated with HABs. Aesthetic impacts result if NJ beaches and lakes become less attractive.
Quantification of exposure levels statewide	According to the Bureau of Marine Water Monitoring, NJ DEP, there were 9 significant HAB sightings in 1999, not including brown tides and pfiesteria. 4 of these were diatoms, 3 were pseudonitzschia, 1 involved flagellates, and 1 involved a non-toxic chlorophyte with a greenish tint

levels statewide	pfiesteria. 4 of these were diatoms, 3 were pseudonitzschia, 1 involved flagellates, and 1 involved a non-toxic chlorophyte with a greenish tint. EQTWG finds that freshwater algae has a minimal ecological impact.	
Specific socio-economic entities at increased risk	Beach communities, shellfish workers, workers in beach-related tourism businesses, beach goers.	
Quantification of exposure levels to entities at increased risk	Same as statewide.	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	Review of HAB assessments from state and federal government.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		*Score*
Property Values	***e)*** Severity: The primary path through which HABs might affect property values would be through employment losses in ecotourism or shellfish businesses. As noted in the employment section, the best available evidence indicates that HABs are not a serious threat to NJ jobs. A secondary path through which HABs might affect property values would be if beachfront properties became palpably less appealing because of HABs. As noted in the "Costs" section, however, HAB occurrences in NJ have been so sporadic and short-lived that it is highly unlikely that demand for beachfront housing would be reduced by HABs. Thus, available information indicates that HABs will have a minimal impact on property values.	1
	f) Duration/irreversibility	1
	g) Scale	1
	h) Uncertainty	1
Employment	***e)*** Severity: There is little evidence that tourism or fishing employment has been adversely affected by HABs in the last decade. 1: Shellfish Employment: The Woods Hole Oceanographic Institute (WHOI) has produced a list of the approximately 50 incidents of HAB-related animal and plant mortality from 1990-99. Of these, approximately 30 were in the Gulf of Mexico, with additional incidents occurring in North Carolina, Maryland, Eastern Long Island, and Massachusetts. There were no reported incidents in NJ during this time, although an algae associated with fish kills was reported at sub-bloom levels. Thus, it appears that HABs pose little threat to New Jersey's $97 million per year fishing and shellfishing industry. 2. Tourism Employment: As noted in the "Costs" section below, HAB incidents have been so sporadic and short-lived that there is little reason to believe that tourism is adversely affected.	1

	f)	Duration/irreversibility	1
	g)	Scale	1
	h)	Uncertainty	1
Costs Incurred	***d)***	Severity: WHOI researchers cited in the NOAA National HAB Assessment have estimated that HABs have cost the US economy an average of $42 million per year from 1995-99. The WHOI team divides the total cost into four categories: Public Health: $20 million Commercial Fishing: $13 million Recreation & Tourism: $6 million Monitoring and Management: $2 million *Public Health:* Medical costs associated with HABs are primarily related to various types of poisoning, including ASP, NSP, and CFP. However, none of the algal blooms producing these serious illnesses have been found in NJ. These illnesses are concentrated in the Gulf of Mexico. The only type of medical expense associated with HABs in NJ, if any, are costs related to the mild skin irritation that some swimmers experience when swimming in algae-infested water. These costs are so minimal as to be not measurable. The annual Phytoplankton report from the NJ Bureau of Marine Water Monitoring (BMWM) lends support to the assessment that HABs are not a serious health threat in NJ. In 1999, BMWM reported 9 significant algae blooms. Of these, four were diatoms, which BMWM says is "not normally associated with harmful effects." There were 3 reports of Psuedonitzschia, but all were in low enough concentrations that BMWM concluded they were "not likely to pose a human health impact." Of a chlorophyte spotted in NJ waters, BMWM said "no toxic effects are known from this species." On July 28, the following sighting was reported: "A moderate algae bloom was ongoing with a mixture of diatoms, chlorophytes and flagellate species. A few of the flagellates, including Katodinium and Prorocentrum sp, have been associated with "red tide" (red water) although none are of the acutely toxic varieties." Not all of these blooms were visible from beaches, and all dissipated fairly rapidly. Thus, these reports support the conclusion that HABs are not a serious health threat in NJ. A report on HABs by Dr. Mary Downes Gastrich released in May 2000 included the following words: "It is important to point out that there are few cases on record of acute human toxicity from phytoplankton in New Jersey waters with some exceptions of moderate bather discomfort and/or illness reported from specific blooms." Thus, a variety of sources point to the conclusion that NJ does not contribute significantly to the $20 million national HAB public health costs. *Commercial Fishing:* As noted in the Employment section (above), WHOI has not noted any HAB-related animal mortalities in NJ in the 1990s. The vast majority of the costs to commercial fishers have been in FL, TX, and NC. *Recreation & Tourism:* As noted under Public Health in this section, algal blooms in NJ waters in 1999 were sporadic, short-lived, and not serious. It is unlikely that any HABs have been significant enough to have a measurable impact on beach use. NJCRP guidelines call for a score of "1" to be given to any stressor which imposes costs less than $16 million. If the national $42 million WHOI assessment is correct, it seems clear that HABs cost the state far less than $16 million each year.	1

	e) Duration/irreversibility	1
	f) Scale	1
	g) Uncertainty	1
Aesthetic Levels	***e)*** Severity: Algal blooms may affect the quality of life for recreational boaters or persons who live near lakes or near the ocean.	2
	f) Duration/irreversibility: The most serious algal blooms are short-lived.	1
	g) Scale: Since algae can bloom in lakes and in the ocean, the phenomenon is widely scattered throughout the state.	2
	h) Uncertainty: Moderate: These judgments are fairly subjective.	
Psychological Impacts	***e)*** Severity: No effects hypothesized.	0.1
	f) Duration/irreversibility:	1
	g) Scale:	1
	h) Uncertainty	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	L	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	0. However, additional research is needed to document long-term trends, and to assess the possibility that the most harmful HABs found in other states might migrate to NJ.	
Potential for catastrophic impacts (H,M,L) and brief description	L	
Incidence of impacts (affected sub-groups, variability, equity issues)	Beachfront communities bear the brunt of any damage associated with HABs.	
Extent to which threat is currently regulated	See "Regulation," below."	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		

NJ Primary Sources	
Large business/industry	L
Small business industry	L
Transportation	L
Residential	L
Agriculture	L
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	H
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L
Biota sinks	L
References	D. Anderson, P. Hoagland, Y. Kaoru, and Alan White. "Estimated Annual Economic Impacts Resulting from Harmful Algal Blooms (HABs) in the United States." Woods Hole Oceanographic Institution Draft Technical Report. August, 2000. Terry D. Garcia, Assistant Secretary of Commerce for NOAA. Testimony before the U.S. Senate Subcommittee on Oceans and Fisheries Committee on Commerce, Science and Transportation, 5/20/98. NOAA. National Harmful Algal Bloom Assessment. 10/22/99. WHOI. "U.S. Finfish, Shellfish and Wildlife Affected by Toxic or Harmful Microalgal Species." http://www.redtide.whoi.edu/hab/species/speciestable.html NJ Department of Environmental Protection (DEP), Bureau of Marine Water Monitoring. Annual Summary of Phytoplankton Blooms and Related Conditions in New Jersey Coastal Waters Summer of 1999.

	Mary Downes Gastrich. "Harmful Algal Blooms in Coastal Waters of New Jersey." NJ DEP, 5/20/00.
Current Policy and Regulatory Framework	
Federal	According to the NOAA web page: "The Harmful Algal Bloom and Hypoxia Research and Control Act (HABHRCA) was signed into law on November 13th, 1998, becoming P.L. 105-383. The Act recognized that many of our nation's coastal areas suffer from harmful algal blooms (HAB) and hypoxia each year, threatening coastal ecosystems and endangering human health. To respond to these concerns, the act calls for: (1) The Establishment of an Inter-Agency Task Force on Harmful Algal Blooms and Hypoxia (2) A National Assessment on Harmful Algal Blooms (3) A National Assessment on Hypoxia (4) An Assessment and a Plan for Hypoxia in the Gulf of Mexico
State & Local	The DEP Bureau of Marine Water Monitoring monitors algae blooms throughout the summer. State and county officials have the authority to close beaches deemed unsafe because of algae.

Issue: Green and Red Tides
Authors: John Posey
Version: 03/28/00

Harmful Algal Blooms (HABs) addressed in this writeup include red tide and green tide. Certain varieties of these HABs have been associated with fish kills and human health risks in other states. However, fish kills and serious human illness attributable to HABs have not been documented in NJ. Therefore, HABs have little impact on employment, property value, or economic costs in NJ. Still, the occasional appearance of discolored water may be considered a moderate aesthetic impact.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	1	1	1	2	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	2	1
Subtotal Risk	1	1	1	2	0.1

Average Risk (0 – 5 years)	Average Risk (5 years plus)
1.02	**1.02**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	1	2	1	1.2

Trend: 0

Catastrophic Potential: L

Issue: Greenhouse Gases
Authors: Robert Diogo and Clint Andrews
Version: 07/11/02

NJ Comparative Risk Project
Socio-economic TWG
Stressor- Specific Risk Assessment

Hazard Identification		Data Sources
Stressor	**Greenhouse Gases**	
Description of stressor	Many scientists believe that the increase in emissions of "greenhouse gases" (chiefly carbon dioxide, nitrogen oxide, methane, and chlorofluorocarbons) due to human activity is gradually causing a rise in the average temperature of the planet (Global Warming). Most of the human activity causing these emissions is associated with the use of fossil fuels in transportation, buildings, power plants, agriculture and industry. However, large uncertainties exist in regard to the mechanism, occurrence, and effects of global warming. Major impacts are unlikely to be felt during the 5-year horizon of the comparative risk project.	PIRG website: article "Flirting With Disaster. EPA website: Climate Change and New Jersey
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	The complications resulting from global warming are generally long term problems speculated to be a rise in sea level (problems for those living in coastal communities); more severe weather conditions (droughts, floods, and hurricanes); a disruption in land use patterns (e.g., agricultural land might become too dry to farm); and human health impacts such as increased ozone, water quality issues, and increase in disease- carrying insects.	EPA website: Various
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks).	***Property Values; Income; Employment; Costs Incurred; Aesthetic Levels; Social Cohesion; and Social Capital*** Global Warming can affect all of these impact items. This stressor has much more of a generational aspect to it compared to other stressors due to long term nature of possible major effects.	Various
Key impacts selected (critical socio-economic effects)	Considering the uncertainty of global warming, it will be difficult to quantify the negative socio-economic effects. All the impacts will be discussed to some extent although the discussion will concentrate on the economic impacts. The social impacts are not easily quantifiable and little was written on these topics.	
Exposure Assessment		
Exposure routes and pathways considered	Exposure to global warming impacts is all throughout the state although the major focus is on coastal and agricultural regions where global warming can provide the most direct damages.	
Socio-economic entities exposed statewide	Major exposed entities are coastal communities and agricultural communities although everyone could be affected due to possible increased exposure to disease, increased exposure to smog, unstable weather systems, and water aquifer problems (human health issues).	EPA: Climate Change and New Jersey Initiation of Climate Change Programs PIRG: Flirting with Disaster
Quantification of exposure levels statewide	Spatial: Major impact can be felt by coastal and agricultural communities. To some extent, forest areas are also impacted. The land use pattern of the whole state could change. Temporal: Global warming is a problem that will gradually worsen over time. Although extreme weather impacts can be felt at specific times during the year, global warming is really not a seasonal issue but rather a long-term issue. The impacts could last a long period and it is very hard to reverse it in a short period.	**Various**

Specific socio-economic entities at increased risk	Very low-lying wetland and coastal areas are most visibly at risk. Also agricultural and forest areas are at risk.		
Quantification of exposure levels to entities at increased risk	Although It is hard to quantify exposure levels, the following items will be discussed: Economic loss of tourism industry Economic loss of agriculture industry Property damage caused by increase in storms Costs of decrease in forests Water Supply costs Coastal area property values		
Dose/Impact-Response Assessment			
Quantitative/Qualitative impact-assessment employed	Estimates of the impact of global warming are varied due to the indeterminate nature of this stressor and the varied predictions concerning the impact of global warming on the environment. Therefore, much of this assessment is based on expert predictions and includes wide ranges of possible outcomes. No fixed/predictable stress-response curves are available.		
Risk Characterization			
Risk estimate(s) by socio-economic entities at risk	Risk	**Score**	

Property Values	Severity Literatures about the impact of global warming on property values are not found. The largest concern would be the values of property along the coastal region. A possible measurement for the impact on property values might be the cost of protecting the land. EPA quoted the costs of protecting Long Beach Island as $100mm-$500mm for a 1-3 foot sea rise. The cost of non-protection would be $50mm-850mm (a big increase in costs as the sea level rises). This figure can be used to estimate the potential cost for NJ supposing the cost for unit coastline is the same (for NJ, only consider coastal area). Long Beach Island represents slightly less than 10% of the NJ coastline, so total statewide costs can be extrapolated to lie between $500mm - $8.5 billion. The same study talked about the need to secure an amount equal to about $26K per house to build a levee to protect LBI and that a levee would reduce the value of the houses by "a few thousand". This information was used to extrapolate the impact on property values for all the coastal communities of NJ. The high estimate of this impact came to $7.4 billion. If sea level rise occurred, triangulation between the estimates above suggests that it would impose medium impacts on property values (equivalent to a loss in value of $2.18 billion to $21.77 billion). But no such impacts are likely to be felt within the next 5 years. Hence it receives a score of Low.	1	***EPA: Climate Change and NJ.*** Titus, James, "Greenhouse Effect, Sea Level Rise, and Barrier Islands" Coastal Management. 1991
	Reversibility The global warming is global and long term in spatial and temporal scales. The possibility of reversibility is quite low, at least in the predictable future. Though the property value could be protected to some extent if protecting the land by a series of levees can work, whether it could work in the long term is still doubtful. Even if the protection does work, maintenance of such a system would inevitably impact the property values of the municipalities.	**1**	
	Scale Temporally, if the worst case of global warming occurs, it will be a long lasting effect. Even if the land could be protected, the maintenance costs would impact the community in perpetuity. Spatially, the scale of impacted properties would not necessarily just be the coastal communities. The cost estimated above did not account for the agricultural communities in the south that would be impacted. Also areas by rivers (e.g., Raritan, Passaic, such as the areas affected by Hurricane Floyd) would be impacted as well. Wetlands and forest areas will be affected also. But within the 5-year timeframe the scale of impacted properties will be low.	**1**	

	Uncertainty Very low confidence in the estimate. There are too many uncertainties trying to make an estimate on the extent of the impact of this stressor, particularly for the short time frame of five years. Additionally, because of the long- term nature of the stressor, it is difficult to predict how we will try to approach the problem of rising sea levels. Also, in approaching the estimate using the Long Beach Island study, we have assumed all other coastal communities will be impacted in a similar fashion. Moreover, in choosing municipalities along the Atlantic Ocean, we assumed that the total municipality would be impacted when possibly only a portion would be impacted. We have also ignored other areas, which might be impacted (e.g., flood plains by rivers such as the Delaware, Raritan, and Passaic). Lastly, the article on which the estimates is based is relatively old (1991).	3	
Employment	Severity Current employment losses are negligible, hence it receives a score of Low. In the future it is estimated that employment loss will range from 0 to as much as 144,000. These estimates are based on the number of employees working in the agriculture, forestry, hotel, and recreation sectors. The largest impact would be felt in the hotel and lodging sector. The tourism industry in the coastal communities will be badly damaged along with agricultural and forestry economies. A Wharton Economics Forecast Associates (WEFA) economist placed the impact on the United States at $227 billion by 2010 or 1.5% of the GDP. New Jersey's Gross State Product is approximately 3.5% of the national GDP. Therefore, NJ's portion of the impact would be approximately $7.9 billion (this may not income loss only). Using the employment spreadsheet created for this project, the estimate of earning loss ranges from 0 to $3 billion for the impact of global warming on payrolls. Several caveats are suggested for this estimate: 1) it is based on present data while the global warming impact is more future oriented; 2) only shore county data was used for tourism, rather than community data which would overstate the shore county results and understate impacts on counties not along the shore; and 3) the high and low percentage impact estimates are very soft guesses based on certain EPA statements. About $2.3 billion of the $3 billion estimate is probably from the Atlantic City casino industry. In addition, payroll is also not necessarily the only earnings impact; corporate profits would also be impacted. The EPA estimated that agriculture was a $0.7 billion industry in New Jersey, two thirds of which was from crops. They estimated that the impact of global warming could be an increase in production by 25% or a decrease of 38%, with a best guess of a 5.5% decrease by 2060. In current value, this would equate to either an annual increase of $175mm or an annual decrease of $266mm, with a best guess of $38.5mm decrease by 2060. Estimate of the impact of a forest decline in New Jersey ranges from $0 to $200mm by 2060.	1	***"Global Climate Change: What Does It Mean for the Mid-Atlantic States?" Conference Newsletter, 2/26/98*** Bureau of Economic Analysis website. **Titus, James, "The cost of climate change to the United States"1992**

	Reversibility The impact would not be reversible in the forestry or agriculture sectors. The impact on the tourism industry could to some extent be reversible if rebuilding could occur in different areas of the state or special man-made protections are built. If the climate changes at the worst situation, it will be difficult for those industries to reverse their changes caused by global warming. Tourism in coastal areas will be destroyed and can not be recovered in a short term. Negative impacts on agriculture and forestry will finally change the land use pattern of the state.	1
	Scale Though global warming has a long-term impact, the number of people in the state directly affected would be less than 10%. From the WEFA estimate, the loss would be about 1.5%-2% on the overall state's GDP. Some of this impact might be understated while others could be overestimated. For example, if other areas of the country are impacted by global warming, our sales to these states would also decrease. So even though the calculations place the impact on the low range of the risk target, we might not have accounted for all of the impacts. In all, the spatial and temporal scales of global warming in NJ are large if it occurs.	1
	Uncertainty Very low confidence in estimating the employment losses. Some of the data used to quote impact levels are from 8-9 year old studies. Also, the impact of global warming is uncertain. The degree of confidence of this estimate is relatively low.	3

Costs Incurred	Severity Current costs due to climate change are negligible, and hence its score is Low. In the future, costs could be substantial. Water supply from freshwater sources could decrease due to increased evaporation caused by a warmer climate. Also, rising sea levels could increase the salinity of surface and ground water. Central Jersey could be especially hit hard because of the impact on salinity on the Delaware River, which, in turn, impacts the Potomac-Raritan-Magothy aquifer. Estimates from the "Cost of Climate" document placed the cost of cleaning the water at between $744mm-2,072mm. It is anticipated that global warming will produce an increase in severe storms. Therefore, there could be an increase in the property damages from storms. Combined property and crop damage from hazardous weather in 1997 was $60.5mm and in 1996 was $115.7mm. Average damages from floods (none shown for hurricanes for that period of time) from 83-94 was $46mm (this is probably an understatement of the total damages caused by storms). A little over $60mm has been disbursed in relief from Hurricane Floyd for New Jersey residents although expectations are that the costs will run $1 billion. In 1998, insured losses and federal disaster relief totaled $133mm. The EPA website predicted a 3-foot rise in sea level, which would make a 15-year storm do the same damage as 100-year storm. Assuming average costs from storms per year are about $90mm (the approximate average of the 97 and 98 damages), if a 100-year event storm causes $1 billion dollars worth of damage, that would equate to $100mm more per year during the 100 years. If that event now occurs every 15 years, that $1 billion dollar event would occur 6.7 times during the century and average out to $667mm per year. So, under this measure, global warming would increase property costs by $557mm per year. The above calculation does not account for the possibility of an increasing amount of smaller event storms and it also does not account for the ever-increasing damage costs of storms. It also does not account for major catastrophic storms. For example, the estimated damage from a category 4 hurricane (a Hurricane Andrew type storm) hitting Asbury Park was $52.5 billion. Human health would be impacted. The EPA website estimated an increase of 100 summer deaths with only a small offset from the decrease in winter deaths. Deaths and injuries from storms would also increase. There is also an expectation that a warmer, wetter climate would increase the habitat of disease carrying insects, which is difficult to be quantified.	1	***"EPA Global Warming",www.epa.gov/globalwarming/impacts/coastal/index.html*** "EPA Climate Change in New Jersey" ***Titus, James, "The cost of climate change to the United States"1992*** www.nws.noaa.gov/om/severeweather/state9x.pdf www.dir.ucar.edu/esig/HP_roger/sourcebook www.fema.com/hu99/d1295n20.htm. www.state.nj.us/governor/news/p91025c.htm. "Flirting With Disaster", www.pirg.org. Pielke, Roger, & Landsea, Christopher, "Normalized Hurricane Damage in the United States" 1/28/98.
	Reversibility Most of the impacts above would not be reversible.	1	
	Scale The increased storms and water problems in the future could impact the total population. These impacts could last a long time but they will most likely not be felt in the next five years.	1	
	Uncertainty The estimation itself is to some extent believable. Yet the uncertainty of global warming makes it difficult to be confident that the costs will occur as delineated above.	3	

Aesthetic Levels	Severity Current aesthetic impacts due to climate change are negligible, and hence its score is Low. In the future, impacts could be substantial. The coastal beaches are one of the valued treasures of New Jersey and would be sorely missed by the residents of the state. The Pine Barrens might also be in danger. Global warming would have a major impact on the natural beauty of the land in southern New Jersey.	1	
	Reversibility The impact would not be reversible.	**1**	
	Scale It would impact central and southern NJ the most but areas along the rivers will also be impacted although not in the short term.	1	
	Uncertainty Not confident of impact due to uncertainties about global warming.	3	
Psychological Impact (Worry)	Severity Some 78% of NJ residents believe in global warming according to the Star Ledger/Eagleton-Rutgers Poll. The issue is clearly familiar, and we speculate that it arouses moderate worry. Residents of the regions directly impacted by the effects of global warming will suffer a great deal of disruption in their lives. Their communities might be broken apart or moved. We can anticipate situations where rich communities with political clout might be protected better than poorer communities from the impacts of the rising sea.	2	The Star-Ledger/Eagleton-Rutgers Poll, April 9, 2000. Poll No. SL/ERP 75-5 (EP125-5) available online at http://slerp.rutgers.edu/releases/125_5.htm
	Reversibility These types of impacts are probably reparable.	**2**	
	Scale The scale of impact is statewide, although it will most likely be low within the next five years. Severe impacts in the coastal areas and flood plains are likely to come directly from rising sea.	**1**	
	Uncertainty Not confident of impact due to uncertainties about global warming.	**3**	
Data Gaps; highlight significant data needs	Obviously the impacts of global warming are highly speculative in almost every aspect so we can only theorize as to the possible costs.		
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description (data gaps; highlight significant data needs)	H: There would be an excellent chance to improve these estimates as we get closer to understanding what is happening to our climate but it will probably be many years before this will happen.		
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, ---, where + is improvement) and brief	---: The basic drivers of climate change--fossil fuel combustion and land use change--are getting worse rather than better. Climate change has the potential to get much worse in the coming decades.		

description		
Potential for catastrophic impacts (H,M,L) and brief description	L: Although the potential for catastrophic impacts is huge, major impacts are unlikely to occur within the next five years. The analysis above does not contemplate the local problems that might result due to the global wide disruption. Therefore, efforts in NJ should be combined with those in others regions and countries. It imposes the difficulty for the decision-makers to make suitable decisions aiming at preventing global warming. If this cannot be achieved cooperatively, we may face a huge risk caused by global climate change in the future.	
Incidence of impacts (affected sub-groups, variability, equity issues)	Residents of flood plains, coastal areas, and agricultural communities would be impacted. Theoretically, people would feel the impact whether they are rich or poor; however, it will be interesting if political clout impacts the distribution of funds to save certain communities. Also, richer people may have high mobility and capability to avoid the effects.	
Link to other Work Groups	Human health can be affected by the increasing occurrence of some diseases caused by global warming. Ecosystems will be the biggest target of this stressor. Many ecosystems (e.g., coastal ecosystem, forestry, and wetlands) will change their structures and functions.	
Extent to which threat is currently regulated	Regulations are set to reduce emissions from autos and industry but this may only slightly slow down the greenhouse effect. They currently appear to be doing little toward greatly reducing the risk of global climate change. There has been international negotiation in reducing greenhouse gases; however, difficulties exist for a fully accepted framework for all of the countries.	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		
NJ Primary Sources		
Large business/industry	H - Utilities and other industrial businesses are major sources of pollutants.	
Small business industry	M - Small businesses are not as big an emitter of pollutants as larger businesses, but accumulated effect is significant.	
Transportation	H - Autos might be one of the largest sources of this risk.	
Residential	M – Home heating	
Agriculture	M	
Recreation	L	
Resource extraction	L	
Government	L	
Natural resources	H – Natural sources such as solar cycles, changes in ocean circulation, changes in volcanic activity.	

Orphan contaminated sites	L	
Diffuse Sources		
Sediment sinks	L	
Soil sinks	L	
Non-local air sources incl. deposition	H	
Biota sinks	L	
References	Most sources shown in 3rd column.	
Current Policy and Regulatory Framework		
Federal	Clean Air Act Emissions standards. International negotiation is ongoing.	
State & Local	Regulations such as auto inspection laws.	

Issue: Greenhouse Gases
Authors: Robert Diogo and Clint Andrews
Version: 07/11/02
Socio-economic Impact Evaluation of Environmental Issue:

Climate Change/Global Warming: Many scientists believe that the increase in emissions of "Greenhouse Gases" (i.e., carbon dioxide, nitrogen oxide, methane, and chlorofluorocarbons) due to human activity is gradually causing a rise in the average temperature of the planet. Most of the human activity causing these emissions comes from auto usage, power plants, agriculture and other industrial sources. However, large uncertainties exist regarding the mechanism, occurrence, and effects of global warming. Major impacts are unlikely to be felt during the 5-year horizon of the Comparative Risk Project.

Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	1	1	1	1	2
Irreversibility	1	1	1	1	2
Scale	1	1	1	1	1
Subtotal Risk	1	1	1	1	4

Average Risk (0 – 5 years)	Average Risk (5 years plus)
1.6	

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Confidence
Uncertainty	3	3	3	3	3	3

Trend: ---

Catastrophic Potential: L

Issue: Hantavirus
Author: John Posey
Version: 08/00

New Jersey Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Stressor: **Hantavirus**

The following is taken from the HHTWG writeup: "Hantavirus is an airborne viral pathogen contracted via inhalation of aerosols generated from disturbed rodent saliva or excreta (CDC). It causes severe, and often fatal, pulmonary illness. The Centers For Disease Control and Prevention recently reported on 3 fatalities in California which may have been the result of viral infection following contact with rodent feces (Byrd *et al.*, 2000). Risk [in NJ] is considered extremely low. Since hantavirus and hantavirus pulmonary syndrome ("HPS") were first characterized in 1993, until May 28, 1999, CDC has confirmed only 217 cases of HPS in the United States. Most cases have occurred in the southwestern US. There has not been any documented case in NJ (or any in any northeast state with three exceptions). There has been 2 confirmed cases in NY, two in PA, and one in RI (Leslie *et al*, 1999)."

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	0.1	0.1	1	0.1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	0.1	0.1	1	0.1	0.1

Average Risk (0 – 5 years)	Average Risk (5 years plus)
0.28	**0.28**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	1	1	1	1

Trend: 0

Catastrophic Potential: L

Issue: Hemlock Woolly Adelgid (HWA)
Author: John Posey
Version: 07/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Hemlock Woolly Adelgid (HWA)**
Description of stressor	HWA is a tiny insect that feeds on hemlock trees. The pest is devastating NJ's hemlock forests. HWA is a non-native species which originated in Japan.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	HWA threatens to destroy virtually all of the hemlock trees in NJ. There are four possible socio-economic impacts. First, hemlock forests are an attraction for ecotourists, who spend billions of dollars in NJ each year. The loss of ecotourism thus poses potential costs the state economy. Second, the loss of ecotourism potentially threatens employment in the ecotourism sector. Third, loss of ecotourism jobs could threaten property values. Finally, the loss of hemlock could be considered a serious aesthetic impact.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Costs incurred, aesthetics, employment, and property values.
Key impacts selected (critical socio-economic effects)	Costs incurred, aesthetics, employment.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Hemlock forests are concentrated in the northern tip of the state in the area known as the "Skylands" region. HWA has the potential to create a decline in ecotourism in this region. This threat must be evaluated both in terms of employment and in terms of cost to the state economy. Moreover, hemlock forests are one of NJ's great natural treasures. Their loss could be considered a fairly serious aesthetic impact.
Quantification of exposure levels statewide	There are approximately 26,000 acres of hemlock forest in the state. Since the state has more than 1.8 million acres of forest, hemlock is relatively insignificant from a statewide perspective.
Specific socio-economic entities at increased risk	Ecotourism jobs in Sussex and Passaic Counties. Hemlock forests exist in scattered pockets throughout the northern part of the state. Hemlocks are especially prominent in Wawayanda State Park, which includes the Abram Hewitt State Forest. In addition, there are large concentrations of hemlock trees in the Stokes State Forest in Worthington State Park. Within Stokes Forest, the hemlock-rich Tillman Ravine is a tourist draw. The Worthington State Forest and High Point State Park also have a significant number of hemlocks.
Quantification of exposure levels to entities at increased risk	This writeup assumes that 100% of the impact will be in Sussex and Passaic Counties. I maintain that the greatest damage will be to Wawayanda State Park. The Stokes State Forest, the Worthington State Forest, and High Point State Park will suffer a somewhat smaller loss. The remainder of the Skylands region will lose only an insignificant fraction of its hiking traffic.
Dose/Impact-Response Assessment	

Quantitative/Qualitative impact-assessment employed	Estimation of the number of visitors to hemlock forests based on testimony from state and private actors; estimation of economic costs incurred in the event of the loss of these visitors.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk	Available information is not sufficient to quantify the economic impact of hemlock destruction. This writeup aims merely to estimate the correct order of magnitude, using the following assumptions: The most important economic effects of hemlock destruction would result from losses in ecotourism. If destruction of hemlocks makes certain outdoor areas less attractive to ecotourists, then this could affect employment, property values, and economic costs. As noted above, the only areas in the state that would be affected by a loss in ecotourism are the areas of the Skylands region in Sussex and Passaic Counties. Hikers are probably the only ecotourists who would alter their leisure activities because of hemlock loss. Persons engaged in skiing or water sports would not find their experience appreciably diminished because of hemlock loss. Only persons who enter forests with the primary aim of enjoying flora would be less likely to spend time in areas experiencing hemlock loss. Only a small number of hikers, bikers and cross-country skiers would be likely to abandon the Skylands region in the event of hemlock loss. Other species of trees are intermingled with hemlock populations, even in areas where hemlocks are most prominent. Moreover, these other types of trees could take the place of hemlocks if hemlocks were destroyed. Finally, it should be noted that even the hemlock-rich parks have areas that are devoid of hemlocks. Thus, Wawayanda and other forests in the Skylands region would probably still be popular to hikers even if all hemlocks disappeared. Hikers, bikers, and cross-country skiers are a relatively small part of the ecotourism business, even in Wawayanda State Park. Available information indicates that swimming, boating, fishing, and skiing are all more popular than hiking. Thus, dedicated hemlock seekers must be considered a small minority of a small minority of ecotourists. Within the Skylands region, the areas most affected by hemlock loss will be the following parks (1999 attendance figures shown in parentheses): Wawayanda State Park including the Hewitt State Forest (92,784), the Stokes State Forest (468,608), High Point State Park (235,067), and Worthington State Forest (473,712). In the state forests, hikers may account for as much as 50% of the park visits. In Wawayanda, which offers many water sports, the figure is probably closer to 10%. High Point State Park is patronized by many visitors who drive to scenic lookouts, and by many others who enjoy water sports. Hikers probably account for less than 10% of the park traffic there. Collectively, hikers in these parks account for approximately 500,000 visits. This amounts to about 25% of all visits to state parks in the Skylands region. There is a critical missing piece of information: How many of these 500,000 hiking visits would disappear from the Skylands region if hemlocks disappeared? Based on the assumptions above, I offer the "best guess" estimate as 10%. Thus, the estimates below assume that a loss of hemlocks could decrease the total number of hiking visits to the Skylands region by 50,000. A second missing piece of information is the amount of money that is spent by the average Skylands tourist. This writeup will use statewide averages to assess economic impacts, even though the average Skylands tourist may spend less than the average NJ tourist. However, use of statewide figures can help to establish a correct order of magnitude. According to the NJ Commerce and Economic Growth Commission, there were 167 million tourist visits to destinations in NJ in 1999. These visits generated $27.7 billion in revenue for the state, and supported 787,000 jobs. This amounts to revenue of $166 per visit, 212 visits per job, and tourist revenue of $35,197 per job.	Score

Property Values	Severity: It is possible to theorize that destruction of hemlocks could reduce property values. Hemlock loss could lead to a reduction in ecotourism, and this reduction could lead to a decrease in tourism jobs. If this occurred, then unemployed tourism workers might leave the region, causing a decrease in demand for housing and a reduction in property values. Another possible impact is that the loss of hemlocks could make property less attractive, and thereby reduce property values. As argued in "Employment" (below), loss of hemlocks threatens to destroy about 236 jobs in Sussex and Passaic Counties. In December, 1997, there were 212,643 jobs in these counties. Thus, the loss of hemlock-related tourism would destroy slightly more than one job in a thousand in these counties. It is doubtful that such a small loss would have a measurable impact on property values, even in the two counties most affected. It is also unlikely that the loss of hemlocks would reduce the attractiveness of properties enough to diminish their values. There is an abundance of other types of trees in the Skylands region, so most properties with scenic wooded views would continue to enjoy this amenity even if hemlocks disappeared.	*1*
	Duration/irreversibility	1
	Scale: Any impacts which do exist will be highly localized in Sussex and northern Passaic Counties.	1
	Uncertainty: I am moderately confident that destruction of hemlock forests would have a minimal impact on property values.	2
Employment	As noted above, it is possible that the destruction of hemlocks will reduce the number of visits to the Skylands region by 50,000 each year. As noted above, there are about 212 visits per job in the NJ tourism industry. Thus the loss of 50,000 visits could threaten approximately 236 jobs. This must be considered a small impact, even by local standards. In December, 1997, there were 178,881 persons employed in Passaic County, and 33,762 employed in Sussex County, a total of 212,643 jobs. The loss of 236 jobs in these counties would amount to the loss of 1.1 jobs per thousand. Moreover, according to Barbara Langley of the Skylands Tourism Commission, tourism supports 53,000 jobs in the Skylands region. Thus, the loss of hemlocks threatens only 0.45% of all jobs in the tourism industry.	*1*
	Duration/irreversibility:	1
	Scale: The problem is highly localized.	1
	Uncertainty: I am moderately confident that HWA threatens very few jobs.	2
Costs Incurred	As noted above, the average tourist spends $166 dollars per visit in NJ. If 50,000 fewer visits occur in the Skylands region, this could deprive the regional economy of $8.3 million. From a statewide perspective, this is a low impact. (NJCRP guidelines call for a score of "1" to be given to all impacts under $16 million.) From a regional perspective, however, this could be considered a medium impact. The Census Bureau estimates that in 1999 there were 485,064 persons living in Passaic County, and 144,700 in Sussex, a total of 629,764. In these two counties, the loss of $8.3 million would amount to $13.50 per person. NJCRP guidelines call for a score of "2" to be given to all impacts between $2 and $20 per person. Even on the local level, however, it is likely that these estimates overstate the importance of hemlocks to the regional economy. Tourists to Skylands forests probably spend less than the average NJ tourist. Most hikers in the Skylands region are probably day trippers, who spend less for food and lodging than the tourism average statewide. Thus, it is entirely possible that the loss of 50,000 hiking visits would amount to a loss of an economic loss of less than $2 per capita.	*1*

	Duration/irreversibility: Over time, other trees will take over any areas deforested because of hemlock loss.	2
	Scale: Highly localized.	1
	Uncertainty: I am moderately confident that the loss of hemlocks would not create a serious economic cost from a statewide perspective.	2
Aesthetic Levels	Severity: The hemlock forests of NJ are a great natural treasure. The permanent loss of these forests would be very troubling to all persons who care about NJ's natural beauty. However, these impacts are just beginning to be felt and are highly localized to date.	*1*
	Duration/irreversibility: According to EQTWG, the loss of hemlock forests could be permanent.	3
	Scale: Highly localized.	1
	Uncertainty: I am moderately confident that this assessment is valid.	2
Psychological Impacts	Severity: None hypothesized.	*0.1*
	Duration/irreversibility:	1
	Scale:	1
	Uncertainty	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	H: EQTWG indicates that additional research is needed to assess the effect that hemlock destruction may have on the ecosystem as a whole. It is possible that the loss of hemlock forests could lead to greater socioeconomic impacts than indicated here. In addition, too little is known about the ecotourism industry in specific locations. It would be helpful to have county-level statistics concerning the amount of money spent by ecotourists.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	+ EQTWG expresses some optimism that the introduction of natural HWA predators will help to save hemlocks.	
Potential for catastrophic impacts (H,M,L) and brief description	L EQTWG indicates that HWA threatens to destroy all of NJ's hemlock forests. One may argue that this should be considered a catastrophic impact. However, the overall health of the forests will not be affected, and the loss of hemlock groves is certainly not comparable to a catastrophe on the order of Chernobyl. I would characterize the potential impact as serious, but not catastrophic. If other species dependant on the hemlock were to die, and if this were to affect the ecological integrity of the northern forests, then it might be possible to make a case for a catastrophic impact. However, there is no current evidence that this is a genuine possibility.	
Incidence of impacts (affected sub-groups, variability, equity issues)	Affected subgroups are ecotourism workers in Sussex and Passaic Counties.	
Extent to which threat is currently regulated	EQTWG reports no regulations in NJ.	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on		

sources	
NJ Primary Sources	The following relies on EQTWG assessments.
Large business/industry	L-M
Small business industry	L-M
Transportation	L
Residential	M
Agriculture	M
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	H
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L
Biota sinks	L
References	Barbara K. Langley. President, Skylands Tourism Commission. Public Hearing, State Natural Resources and Economic Development Commission. "Ecotourism: Marshalling Resources to Promote New Jersey's Ecotourism Treasures." 3/4/96. New Jersey State Park Service. Attendance Report, Fiscal Year 1999. NJ Commerce and Economic Growth Commission. Press Release, 5/11/00. U.S. Census Bureau. County Population Estimates for July 1, 1999.
Current Policy and Regulatory Framework	EQTWG reports no regulation in NJ.
Federal	
State & Local	

Issue: Hemlock Woolly Adelgid (HWA)
Author: John Posey
Version: 07/00

Hemlock Woolly Adelgid (HWA) is a non-native insect that feeds on hemlock trees. The pest poses a catastrophic threat to NJ's hemlock forests. Hemlock forests are a relatively small part of NJ's total forest acreage. From a purely economic perspective, the loss of hemlock trees would be insignificant. However, the loss of hemlock trees would probably be permanent. This must be considered a moderately serious aesthetic impact.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	1	1	1	0.1
Duration/ Irreversibility	1	1	2	3	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	1	1	2	3	0.1

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
1.42	**1.42**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	2	2	2	2	1	1.8

Trend: +

Catastrophic Potential: L

Issue: Inadvertent Animal Mortality
Author: John Posey
Version: 11/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Stressor: **Inadvertent Animal Mortality**

The principal problem addressed in this report is the killing of animals in traffic accidents. The problems of deer and bird mortality are addressed in other writeups. Another potentially related issue would be the accidental killing of fish and shellfish by boats. However, information on this topic was unavailable. Hence, this report focuses on land animals. There are three types of cost associated with inadvertent animal mortality. First, a traffic accident can result when a car strikes an animal. Second, the sight of animal carcasses on the road can be aesthetically unpleasing. Third, the loss of a beloved pet may be counted as a psychological impact.

According to the National Highway Traffic Safety Administration (NHTSA), there were 37,043 accidents in 1999 in which the "first harmful event" was classified as "animal." These accidents involved a total of 56,668 vehicles, and over 100,000 persons. Thus, the average accident involved 1.5 vehicles. News reports indicate that there are about 19,000 deer-related accidents in NJ each year. As noted, these incidents are discussed in a separate writeup. Thus, if deer-related accidents are subtracted, this leaves about 18,000 other animal-related accidents, involving about 27,000 vehicles. If the average car repair cost associated with such an accident is over $592, then the total cost associated with animal-related accidents exceeds $16 million. Under NJCRP guidelines, this is the threshold for a "moderate" score.

The sight of animal carcasses on roadways can be unappealing. If the animal in question happens to be a skunk, the aesthetic impact can be severe, if short-lived and highly localized. In the U.S., however, most animal carcasses are disposed of by road maintenance crews fairly quickly. In addition, the sight of dead animals is something that most people are exposed to from early childhood, and thus may be considered something that most people are used to. I would conclude that the aesthetic impact of inadvertent animal mortality is fairly low.

According to the Morris Animal Foundation, 9% of pet fatalities are the result of accidents. (This includes non-traffic accidents, although it is reasonable to believe that traffic accidents are the most common type of fatal accident.) The loss of a pet can cause considerable psychological trauma. However, NJCRP guidelines call only for an evaluation of the "worry" caused by a phenomenon. Other types of mental anguish, then, are not properly a part of a SETWG writeup. Thus, the psychological impact of inadvertent animal mortality appears to be low, according to NJCRP guidelines.

No impacts are hypothesized with respect to employment or property values.

The impacts associated with inadvertent animal mortality appear to be fairly low, and there is little evidence regarding these impacts. Thus, SETWG has elected to produce a short report, rather than a full writeup.

References:

Donna Leusner. "Lawmakers Back Putting a Contract Out on Deer." *Newark Star Ledger*. May 5, 2000.

Morris Animal Foundation. "Animal Health Survey Results." 1997.

National Highway Traffic Safety Administration. 1999 Annual Report File. www.nhtsa.dot.gov

Issue: Inadvertent Animal Mortality
Author: John Posey
Version: 11/00

Inadvertent Animal Mortality: This report focuses on animal deaths caused by motor vehicles. Animals cause about 18,000 car accidents in NJ each year. (This excludes accidents caused by deer. This problem is addressed in another writeup.) These accidents involve an estimated 27,000 vehicles. If the average cost of each animal related crash is $592, then the annual repair cost exceeds $16 million, the threshold for a score of "2" under NJCRP guidelines. Although the sight of animal carcasses on a road can be unappealing, these occurrences are so short-lived and localized that the overall aesthetic impact is minimal. Accidents cause 9% of pet fatalities each year. However, the psychological impact associated with the loss of a beloved pet is beyond the purview of SETWG.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	0.1	0.1	2	1	1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	0.3	0.3	6	3	3

Average Risk (0 – 5 years)	Average Risk (5 years plus)
2.52	**2.52**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	3	1	1	1.4

Trend: 0

Catastrophic Potential: L

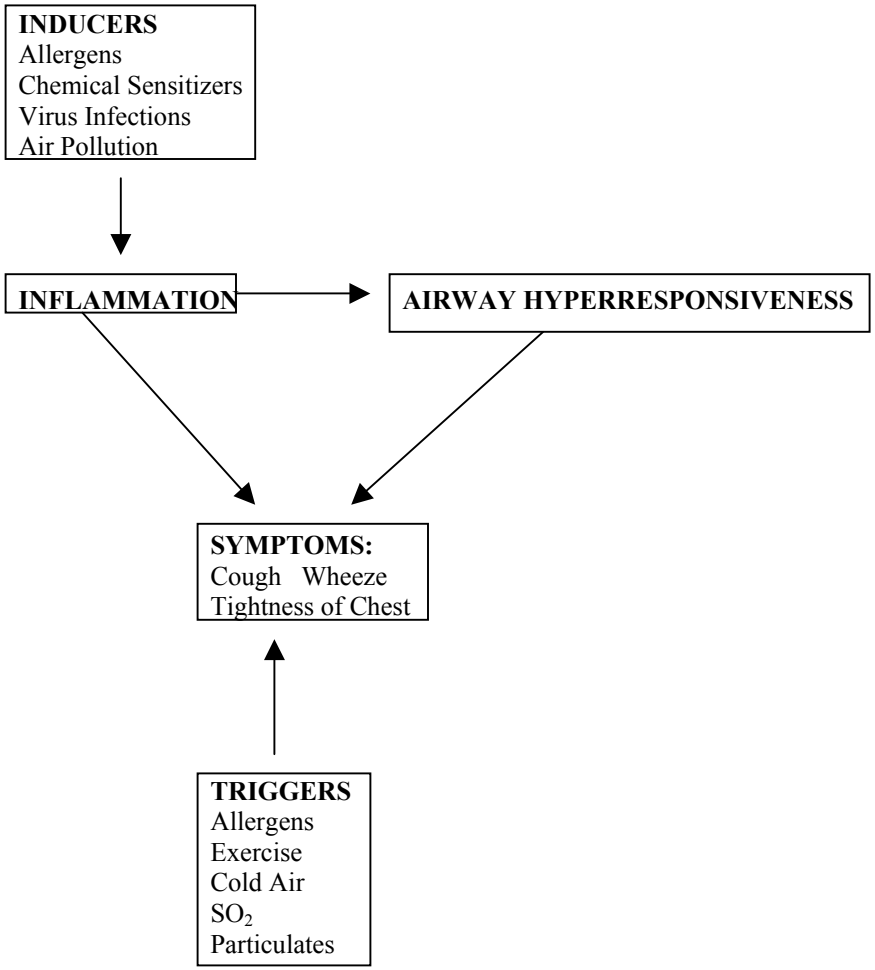
Issue: Indoor Asthma Inducers
Author: John Posey
Version: 07/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor- Specific Risk Assessement

Socio-economic Risk Assessment Framework **Findings/Notes**

Hazard Identification	
Stressor	**Indoor Asthma Inducers**
Description of stressor	HHTWG lists the following inducers of asthma: dust mites, animal/pet dander, mold, rodent protein, cockroach feces and environmental tobacco smoke.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Koren and O'Neill summarize the effect of asthma as follows: "Asthma is a chronic respiratory disease characterized by inflammation, episodes of usually reversible airways obstruction, and bronchial hyperresponsiveness. The disease has significant health, societal and economic consequences." HHTWG reports that asthma killed over 5,000 persons nationwide in 1996. The CDC reports that asthma resulted in 11,340 physician visits nationwide in 1994, of which 3,309 were children. Koren and O'Neill state that approximately 500,000 persons are hospitalized for asthma each year in the US.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	The National Institutes of Health estimate that in 1996, asthma cost the nation $12 billion in direct medical costs, and an additional $2 billion in lost productivity, lost work days, and early death. NJCRP guidelines do not allow the costs of mortality (i.e., lost future productivity) to be included in this analysis, but lost work days and lost productivity are to be included in NJCRP writeups. In 2000 dollars, the direct medical costs are about $13.2 billion, with total costs at about $15.4 billion.
Key impacts selected (critical socio-economic effects)	Costs Incurred.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Allergy & Asthma Magazine reports that costs are broken down as follows: Prescribed medicines: 15.9%. Office Visits: 12.0%. Hospital outpatient visits: 11.0%. Emergency room visits: 6.8%. Hospitalization: 54.4%.
Quantification of exposure levels statewide	HHTWG reports that there are approximately 316,307 cases of adult asthma in NJ, and 122,804 cases of childhood asthma. However, HHTWG stresses that this is based on self-reported data, and is not derived from a complete census or case registry. Nationally, the National Health Interview Study (NHIS), conducted by the CDC and the National Center for Health Statistics, estimates that there were 26.3 million asthmatics in the US in 1998. If NJ has a proportional number, then we would expect about 789,000 persons in NJ to have been diagnosed with asthma.

Specific socio-economic entities at increased risk	HHTWG reports that low-income persons and African Americans are at heightened risk.	
Quantification of exposure levels to entities at increased risk	According to blackhealthcare.com, "in 1993, among children and young adults, African Americans were three to four times more likely than whites to be hospitalized for asthma, and were four to six times more likely to die from asthma."	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	Review of literature based on health care surveys.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		*Score*
Property Values	a) Severity: none hypothesized	0.1
	b) Duration/irreversibility	1
	c) Scale	1
	d) Uncertainty	1
Employment	a) Severity: none hypothesized	0.1
	b) Duration/irreversibility	1
	c) Scale	1
	d) Uncertainty	1

Costs Incurred	a) Severity: The etiology of asthma is very complex. To contract asthma, an individual must be genetically susceptible to the disease. Susceptible individuals are referred to as "atopic." Credible estimates indicate that one third to one half of the U.S. population may be atopic. When a susceptible individual is exposed to certain allergens or pollutants, bronchial inflammation and airway hyperresponsiveness can result. Once an individual has developed this inflammation and hyperresponsiveness, a trigger may set off asthma attacks and other symptoms. Barnes (1998) diagrams the process as follows: 	3

It is important to distinguish between *inducers* of asthma and *triggers* of asthma. Inducers are those allergens and chemicals that lead to inflammation and hyperresponsiveness. Inflammation and hyperresponsiveness, however, do not inevitably lead to asthma symptoms. In order for symptoms to become apparent, it is necessary for the asthmatic individual to come into contact with triggers. Triggers interact with the bronchial inflammation and hyperresponsiveness to create the symptoms of asthma. Medical literature indicates that triggers may exist in both indoor and outdoor environments. It appears, however, that many, if not most, inducers come from the indoor environment. Cockcroft (1998) reports that "allergens are, therefore, now recognized as inducers, along with low molecular weight chemical sensitizers, viral respiratory tract infections and, occasionally, extremely high levels of inhaled noxious gases or fumes. Unlike triggers, inducers cause true asthma exacerbations and circumstantial evidence points to them as causes of asthma. Evidence from several population studies points to inhalant atopic allergens as an important, perhaps *the* most important, cause of airway hyperresponsiveness and asthma." Cockcroft further reports that in non-occupational settings, the important inhalant allergens fall into four groups: pollen, fungal spores, animal danders and household mites (especially dust mites, but also mites in cockroach feces). Pollens come primarily from outdoor sources. However, exposure to fungi, animal danders, and mites come primarily from indoor sources. Several studies support the conclusion that indoor pollutants may be the most important inducers of asthma. The Pollution Effects on Asthmatic Children in Europe (PEACE) project concluded as follows: "In summary it is reasonable to conclude that there is little overall evidence that non-biological outdoor air pollution has an important effect on the initiation of asthma." In addition, the Institute of Medicine has found that the house dust mite is the only indoor agent for which there is "sufficient evidence of a causal relationship" between the agent and the initiation of asthma. I of M further finds that there is "sufficient evidence of an association" between environmental tobacco smoke (ETS) and the development of asthma. Finally, the Institute finds "limited or suggestive evidence of an association" between asthma and both cockroaches and respiratory syncytial virus (RSV). Each of these agents are primarily indoor asthma inducers, with the exception of RSV. Thus, there is evidence that indoor pollutants and allergens may be the most important inducers of asthma. Of these, mites from dust and cockroach feces may be the most significant. As noted above, asthma costs the New Jersey economy an estimated $450 million per year. It is difficult to allocate costs between inducers and triggers, and it is more difficult to determine how to allocate costs among different types of inducers. If costs are divided evenly between inducers and triggers, and if indoor allergens are considered to be the most important inducers, then it is reasonable to conclude that more than a third of the total costs of asthma should be attributed to indoor inducers. If slightly more than a third of total costs are charged to indoor inducers, then the total cost of indoor inducers may be said to exceed $160 million, the threshold for a "high" impact rating under NJCRP guidelines. b) Duration/irreversibility: Allergy & Asthma Magazine reports that 20% of asthma cases account for 80% of the costs associated with the disease. Persons with severe asthma tend to experience chronic difficulties which can be only partially alleviated through medication. Persons with less severe asthma find asthma to be highly manageable with appropriate medication.	2
c) Scale: Asthma is a statewide problem.	3

	d) Confidence: I am very confident that economic costs of indoor asthma polluters exceed $16 million, the minimum required for a "moderate" impact rating under NJCRP guidelines. I am less confident that these costs exceed $160 million, the cut-off point for a "high" impact rating. Still, I think that the estimates presented here are reasonable, and I have moderate confidence in them.	2
Aesthetic Levels	a) Severity: none hypothesized	0.1
	b) Duration/irreversibility	1
	c) Scale	1
	d) Uncertainty	1
Psychological Impacts	a) Severity: In the words of the American Lung Association, "when you can't breath, nothing else matters." Respiratory problems can cause psychological impacts.	2
	b) Duration/irreversibility: As noted, a sizeable minority of asthma cases are chronic.	2
	c) Scale: Asthma is a statewide problem.	3
	d) Uncertainty: I do not feel great confidence about this assessment.	3
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	L. Costs of asthma are fairly well documented.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	0 Unknown	
Potential for catastrophic impacts (H,M,L) and brief description	L	
Incidence of impacts (affected sub-groups, variability, equity issues)	As noted above, "in 1993, among children and young adults, African Americans were three to four times more likely than whites to be hospitalized for asthma, and were four to six times more likely to die from asthma."	

Extent to which threat is currently regulated	Smoking is now prohibited in most public spaces. There is little or no regulation with respect to dust mites, cockroaches, and pet dander.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	L
Small business industry	L
Transportation	L
Residential	H
Agriculture	L
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	H Several natural sources or processes contribute. First, an individual must be genetically predisposed to develop asthma. Second, allergens such as household mites (either dust mites or mites in cockroach feces), as well as pet dander, may be considered natural sources.
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. Deposition	L
Biota sinks	L

References	"Asthma: A Concern for Minority Populations." www.blackhealthcare.com/BHC/Asthma/Description.asp Peter Barnes, Ian Rodger and Neil Thomson, eds. *Asthma: Basic Mechanisms and Clinical Management*. New York: Academic Press, 1998. --Chapter 1: "Epidemiology" by Malcolm Sears. --Chapter 27: "Pathophysiology of Asthma" by Peter Barnes. --Chapter 28: "Allergens" by D.W. Cockcroft. Center for Disease Control. National Ambulatory Medical Care Survey. April, 1998. Heinrich Duhme, Stephan Weiland, and Ulrich Keil. "Epidemiological Analysis of the Relationship between Environmental Pollution and Ashma." Toxicology Letters 102-103 (1998), 307-316. "The High Cost of Asthma Care." Allergy & Asthma Magazine. September 18, 1997. Hillel Koren and Marie O'Neill. "Experimental Assessment of the Influence of Atmospheric Pollutants on Respiratory Disease." Toxicology Letters 102-103 (1998), 317-321. National Institute of Medicine. Clearing the Air: Asthma and Indoor Air Exposures. 2000. Donna Olendorf, Christine Jeryan, and Karen Boyden, editors. "Asthma," in *Gale Encyclopedia of Medicine*. Detroit: Gale Research, 1999.
Current Policy and Regulatory Framework	
Federal	There is virtually no regulation of asthma inducers in the home.
State & Local	There is virtually no regulation of asthma inducers in the home.

Issue: Indoor Asthma Inducers
Author: John Posey
Version: 07/00

Issue description: Indoor Inducers of Asthma Asthma is a very complicated disease which involves the interaction of numerous environmental stressors. In assessing the cost of asthma, it is important to distinguish between *inducers* of asthma and *triggers* of asthma. Inducers cause the inflammation and airway hyperresponsiveness that make individuals susceptible to asthma. Triggers interact with the lung damage caused by inducers to produce asthma symptoms. Indoor allergens and pollutants appear to be the most important inducers of asthma, though both indoor and outdoor stressors may be triggers.
Asthma probably costs the NJ economy about $450 million each year. It is difficult to determine how much of this cost should be attributed to indoor inducers, but it is reasonable to estimate that indoor inducers are responsible for more than a third of the costs. If so, then indoor asthma inducers may be reckoned to cost the NJ economy more than $160 million per year.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	0.1	0.1	3	0.1	2
Duration/ Irreversibility	1	1	2	1	2
Scale (spatial, population)	1	1	3	1	3
Subtotal Risk	0.1	0.1	18	0.1	12

Average Risk (0 – 5 years)	Average Risk (5 years plus)
6.06	**6.06**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	2	1	3	1.6

Trend: 0
Catastrophic Potential: L

Issue: Indoor Microbial Air Pollution
Author: John Posey
Version: 10/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Indoor Microbial Air Pollution**
Description of stressor	Three types of microbes are addressed here: bacteria, fungi and algae. Of the three, algae are the most unstudied and are thought to be the least significant to human health. The difference between fungi and bacteria is that bacteria are procaryotic (without a membrane-bound nucleus) whereas fungi are eucaryotic (with membrane-bound nucleus). The most deadly form of bacteria involved in Indoor Air Quality (IAQ) is associated with legionnaires disease. The most common fungi in indoor environments are cladosporium, penicillium, chrysosporium, alternaria, aspergillus, and stachybotrys. Of these, penicillium and stachybotrys are the most harmful. Penicillium produces allergy symptoms, while stachybotrys produces harmful chemicals, some of which may be carcinogens. Other types of microbes such as viruses and protozoa are not addressed here. The study of fungi is called mycology. Fungal products which result in diseases are known as mycotoxins.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Legionnaires disease is caused by a bacteria that grows in very moist environments. It is spread through Heating/Ventillation/Air Conditioning (HVAC) systems. Indoor microbes are associated with at least three types of diseases: Hypersensitivity pneumonitis, a respiratory illness characterized by scarring of lung tissue; the exacerbation of asthma; and a group of symptoms associated with sick building syndrome (SBS).
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Costs of illnesses.
Key impacts selected (critical socio-economic effects)	Costs of illnesses.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Any building with moisture accumulations can produce mold spores. Homes near large bodies of water may be especially susceptible to microbial infestation. However, offices and schools appear to be more important sources of disease-causing microbes. "Tight buildings" without window ventilation can spread microbial pollution through HVAC systems.
Quantification of exposure levels statewide	HHTWG does not offer estimates of exposure levels. It is difficult to estimate the number of persons breathing unsafe indoor air, as most cases go unreported. However, reports indicate that indoor pollution in general, and microbial pollution in particular, are growing.

Specific socio-economic entities at increased risk	Workers in "tight buildings," and residents of homes with fungus-producing moisture buildup.	
Quantification of exposure levels to entities at increased risk	No quantitative data available.	
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	Review of literature dealing with the epidemiology of hypersensitivity pneumonitis, asthma, legionnaires disease, and SBS.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: I am unaware of a hypothesized link between microbial air pollution and property values.	*0.1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty: I am not certain about the existence or non-existence of a link.	3
Employment	Severity: I am unaware of a hypothesized link between microbial air pollution and employment.	*0.1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty	3
Costs Incurred	Severity: There are several types of illnesses associated with indoor microbial air pollution. These include hypersensitivity pneumonitis (HP), asthma exacerbation, legionnaires disease and SBS. In addition, there are possible links between indoor microbial air pollution and pulmonary mycosis and pulmonary hemorrhage, although it is difficult to quantify the links between indoor air and pulmonary diseases. Thus far, there have been no reported cases of legionnaires disease in NJ. Though this deadly disease remains a threat, there are no demonstrable costs associated with this disease in NJ to date. The CDC reports that there were 5 deaths in NJ caused by HP in the last available reporting year. There is a dearth of cost-of-illness literature on this disease. Although HP can be a life-threatening disease, there is no available evidence indicating that it imposes a major cost on the NJ economy. It is possible to arrive at rough estimates of the costs of microbe-induced exacerbation of asthma. The National Institutes of Health estimate that asthma costs the nation about $15 billion each year. If NJ bears a proportional share of the costs, then we would expect the economic cost in NJ to be about $450 million each year. The Institute of Medicine has analyzed the epidemiology of asthma in the U.S. It finds that microbial pollution is not one of the four indoor stressors for which there is evidence of a causal relationship or an association with the development of asthma. It further finds that microbial pollution is not one of the four pollutants for which there is evidence of a causal relationship with the exacerbation of asthma. However, it does find "sufficient evidence of an association" between fungi and the exacerbation of asthma. This evidence indicates that indoor microbial pollution is not one of the 5 most important causes of asthma, but it is among the 10 most important factors.	

It seems reasonable, then, to estimate that indoor microbial pollution accounts for 5-10% of the total costs of asthma, which would place the total cost at $22.5 million to $45 million.

SBS results in symptoms which include shortness of breath, headaches, watery eyes, runny nose, and nausea. Fisk and Rosenfeld estimate the cost of SBS to the U.S. economy at approximately $115 billion. Direct health care costs account for $30 billion. Sick leave and restricted activity at work costs the economy an additional $35 billion. In addition, these scholars estimate that the cost of lost productivity due to SBS is approximately $50 billion. If NJ is approximately 2% of the U.S., then the cost to the NJ economy is approximately $2.3 billion.

However, SBS results from the interaction of a variety of organic and inorganic pollutants. Thus, it is necessary to estimate how much of the cost of SBS should be attributed to indoor microbes. A study conducted by Straus and Cooley gives some guidance on the formation of this estimate. These microbiologists investigated 48 schools at which there were complaints about air quality. In 5 of these schools, there were highly elevated concentrations of penicillium spores. In another 11 schools, there were elevated levels of stachybotris. Thus, in 16 out of 48, or 33% of the schools, there were measurable elevations in spore counts of two types of fungus. It is not clear from this data that fungi were the only cause of building-caused illness. It is possible that microbial pollution was only a secondary cause in many of these cases.

Thus, one study finds that fungus spores were elevated in 33% of SBS sites, while a second finds that fungus spores were the primary cause of SBS at only 5% of all sites. If we assume that these studies are not contradictory, then it follows that indoor microbial pollution is the primary cause of 5% of cases of SBS, and is a secondary cause of 25-30% of cases. Based on these figures, it seems reasonable to guess that indoor microbial pollution accounts for approximately 10-20% of the cost of SBS. In NJ, this works out to an estimated range of $230 million to $460 million.

The total cost of indoor microbial air pollution, then, may be estimated at $250 million to $500 million. NJCRP guidelines call for a score of "3" to be given to stressors causing more than $160 million in damage.

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3

1

	Duration/irreversibility: Most effects of SBS are highly reversible given appropriate remediation.	
	Scale: Indoor pollutants must be considered a statewide problem.	3
	Uncertainty: I am moderately confident that the cost of indoor microbial air pollution is greater than $160 million.	2
Aesthetic Levels	Severity: I am unable to demonstrate the existence of aesthetic impacts related to indoor microbial air pollution.	*0.1*
	Duration/irreversibility	1
	Scale	3
	Uncertainty	3
Psychological Impacts	Severity: Shortness of breath and watery eyes might reasonably be assumed to create feelings of anxiety in sufferers.	*2*
	Duration/irreversibility: These feelings are highly reversible once symptoms abate.	1
	Scale: This is probably a statewide problem.	3
	Uncertainty: I am not very confident about this assessment.	3
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	M Diseases like asthma and SBS are very complex. In analyzing the development and exacerbation of these diseases, it is difficult to assess the relative importance of indoor microbial pollution, as opposed to chemical pollutants. The principal data need is just such an assessment.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	- Several sources indicate that indoor air pollution, as a whole, is increasing.	
Potential for catastrophic impacts (H,M,L) and brief description	L	
Incidence of impacts (affected sub-groups, variability, equity issues)	Office workers in tight buildings seem to face the greatest risk.	
Extent to which threat is currently regulated	"No regulations," according to HHTWG.	

Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	M: The problem is greatest in "tight" buildings such as hotels and office buildings.
Small business industry	M: (See above).
Transportation	L
Residential	M
Agriculture	M
Recreation	M
Resource extraction	L
Government	M
Natural sources/processes	M
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	M: HHTWG notes that the source of the spores is soil/vegetation.
Non-local air sources incl. Deposition	L
Biota sinks	L
References	National Institute of Medicine. Clearing the Air: Asthma and Indoor Air Exposures. 2000. "The High Cost of Asthma Care." Allergy & Asthma Magazine. September 18, 1997. Center for Disease Control. "Work Related Lung Disease Surveillance Report." 1999. William Fisk and Arthur Rosenfeld. "Improved Productivity and Health from Better Indoor Environments." Lawrence Berkeley National Laboratory Center for Building Science News. Spring 1997. L. Oliver and Bruce W. Shackleton. "The Indoor Air We Breath: A Public Health Problem of the '90s." Public Health Reports. September/October 1998. "Is Your Office Killing You?" Business Week. June 5, 2000. David Straus and J. Danny Cooley. "The Role of Fungi in Sick Building Syndrome." The Science Corner. October, 1998.
Current Policy and Regulatory Framework	"No regulation" according to HHTWG.

Issue: Indoor Microbial Air Pollution
Author: John Posey
Version: 10/00

Federal	
State & Local	

Indoor Microbes: Spores from mold and fungi are associated with several illnesses, including hypersensitivity pneumonitis, exacerbation of asthma, legionnaires disease and the collection of symptoms known as sick building syndrome (SBS). While indoor microbial pollutants are not the principal cause of asthma development, there is convincing evidence of an association between spores and asthma exacerbation. Microbes also appear not to be the primary cause of SBS symptoms, but evidence indicates that it is reasonable to blame indoor microbes for 10-20% of the cost of SBS. The total cost of indoor microbial air pollution to the NJ economy is estimated at $239 million to $478 million.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	0.1	3	0.1	2
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	0.3	0.3	9	0.3	6

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
3.18	**3.18**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	3	3	2	3	3	2.8

Trend: -

Catastrophic Potential: L

Issue: Invasive Plants
Author: Branden Johnson and Clint Andrews
Version: 05/09/01

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework **Findings/Notes**

Hazard Identification	
Stressor	**Invasive Plants** specifically including (1) multiflora rose, (2) tree-of-heaven, (3) Asiatic bittersweet, (4) phragmites, (5) Japanese honeysuckle, (6) garlic mustard, (7) purple loosestrife, (8) Norway maple, (9) Japanese stilt grass, and (10) Japanese barberry. NOTE: Due to time constraints and judged similarity of socioeconomic impacts, this assessment combines issues treated separately by the Ecological TWG (and not at all by Health TWG).
Description of stressor	These plants are largely non-native to North America, with the exception of phragmites, but have been found in or deliberately introduced into the U.S. some 100-200 years ago. They vary widely in type—reed, grass, 2 vines, 2 herbaceous plants, 2 trees, shrub—but share some attributes: fast-growth and high reproductive potential and persistence (e.g., where seeds are involved, eradication of the full-grown plant still allows quick recovery from large stores in the seed bank in the soil). The consequence is the crowding-out of other plants, or a change in ecosystem characteristics that makes it difficult for those plants to compete successfully, and resulting changes in wildlife populations as the habitat alters. Only the central Pine Barrens appears to be largely free of these invasive species. Zampella (2000) says purple loosestrife has been found in only one spot in the Mullica River basin, and phragmites in heavily disturbed areas but not in acid-freshwater areas.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	The ecological impacts, according to the Ecological TWG, are varied: Multiflora rose (shrub) forms an impenetrable thicket in old fields, forest edges, open woodlands, roadsides, riparian and other disturbed areas, and is considered locally prevalent throughout the state except the central Pine Barrens. It can hinder the passage of larger animals, including for predation; expand the winter range of fruit-eating birds; increase shelter for birds and small mammals, particularly rodents; hinder (directly or through rodent feeding) development of native "pioneer, edge, and understory" trees, shrubs and herbs, potentially rendering land unusable for agriculture or forest products. Tree-of-heaven or ailanthus (tree) also invades disturbed lands, and is considered highly prevalent in northern and central New Jersey and in southern urban areas, and less common in the coastal plain. It hinders growth of native pioneer species that are important wildlife food sources and makes toxic (through release of allelopathic compounds) neighboring plants and leaf foragers, while providing no food value to wildlife itself. It could have economic impacts on the forest products industry. Asiatic bittersweet (vine) is common in moist open woods, woodland edges, stream banks, dunes and roadsides, in all disturbed upland habitats outside of the central Pine Barrens. It can damage mature trees, delay old-field succession, and harm native and endangered plants through habitat alteration (and, in one case, interbreeding). Forestry can be harmed. Phragmites (reed) inhabits both salt and freshwater marshes, swamps, wet shores, roadside ditches, and in general disturbed moist areas. Its impacts are uncertain, but could include out-shading vegetation, in particular of low-lying herbaceous species in salt and brackish water marshes; raising the elevation of marshes and creating small dikes that reduce tidal habitat for larvae of transient fish species; reducing bird species, particularly marsh specialists; lowering forage for mammals; and interfering with hayfarming, through direct competition (50% or more of fields can be lost to phragmites invasion) or possibly through increased severity and frequency of fires. However, recent papers (Weinstein et al., 2000; Windham, 2000) suggest that phragmites appears to provide more nutrient flux, including to fish species that live most or all of their lives outside of marshes, than previously suspected; this does not resolve the question of impacts directly on habitat, but makes the reed's impacts less definitively negative. For example, a phragmites control proposal by the Academy of Natural Sciences to the U.S. Army Corps of Engineers (Brandeth, 2000), concerning Cape May Point, estimated a normalized habitat value for the current phragmites marsh of

	0.3, while with the control project (which assumed complete eradication of the species), the marsh's value would be 0.6-0.9 (on a scale of 0 to 1). This is a site-specific estimate and cannot be extrapolated to other sites in the state, but gives some idea of the presumed impact of phragmites. Japanese honeysuckle (vine) can reduce tree regeneration and damage or kill young woody vegetation, and create opportunities for invasion by other non-native species, in all disturbed upland habitats except central Pine Barrens (although less common south of Monmouth County). Understory and rare plant populations are at particular risk. Forestry can be affected, including even mature trees if other vines present "ladder" into the tree canopy. Garlic mustard (herbaceous plant) invades disturbed forests, streambanks and other sites throughout New Jersey (and now being found in dry areas, versus its original habitat of wet, shaded land), outcompeting native plants at high levels of infestation and thereby eliminating wildlife food. It could harm forestry through competition with tree seedlings. Purple loosestrife (perennial herb) occupies open freshwater wetlands throughout New Jersey, affecting 5-10% of the state (but particularly in the north and the inner coastal plain), displacing native plants and wildlife, including several endangered and threatened species. Its growth in drainage channels can damage agricultural fields and crops; it decreases quality of waterfowl habitat, harming recreation. Norway maple (tree) is one of the most commonly planted street trees in NJ, outshading wildflowers and other woody seedlings. It is an exception among these invasives in being able to invade undisturbed habitats, as well as disturbed lands (forest edges, vacant lots, abandoned farmland, open woods, etc.). Very prevalent throughout north and central NJ, and in southern NJ urban areas, less common or absent in Pine Barrens and southern coastal plains. Directly competes with native sugar maple; risks to species that feed off replaced plants may be substantial. Japanese stilt grass (grass) forms dense mats, particularly on floodplains, that outcompete native plants, alter soil environments, and often are accompanied by exotic earthworms; it is most common in NJ along streams, ditches and canals. It is probably in all NJ counties (Ecological estimate is 5-10% of NJ is affected, growing at exponential rate), although not yet reported in Sussex and Cape May Counties. Japanese barberry is sold as an ornamental shrub. It invades forested areas, particularly in central and northern New Jersey (but also in Burlington, Cape May, Camden, Gloucester and Monmouth counties), and can survive under closed-canopy forests as well as in more open or edge environments. It forms dense clumps that out-compete native plants and alter soil chemistry, making regeneration of native plants after hand removal of barberry slow and difficult. Its attraction as an ornamental shrub is likely to continue to increase its presence in NJ forests and its undesired impacts.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Property Values; Employment; Costs Incurred; Aesthetic Levels; Psychological Impacts
Key impacts selected (critical socio-economic effects)	Property Values: no significant impacts; it is assumed that most property purchasers are unlikely to notice the presence of such plants, and to the extent they do notice are unlikely to deem them a threat; indeed, residential users apparently see several of them as beneficial (e.g., visually pleasing); for resource extractors, such as farmers, huge infestations of plants might well depress land prices, but it is assumed that farmland will have undergone eradication efforts prior to the sale in order to make the land usable anyway, so such price-depressing infestations are unlikely on current farmland. Employment: forestry; agriculture; fisheries; recreation. Costs Incurred: damages assumed to occur to activities listed under "Employment" (e.g., feed for horses whose pasture is overrun). Aesthetic Levels: no significant impacts; visual was considered the only route for aesthetic impact; assumed to be a tossup—unvarying landscape ["monotypic," or one-species only, stands] is uninteresting, but is still green vegetation that might be a relief from built landscapes, and in some cases [e.g., multiflora rose, purple loosestrife] many people find these plants attractive. Psychological Impacts: no significant impacts: average NJ citizen assumed to be little worried by either ecological or consequent socio-

	economic impacts on family or community; worry among a few ecologists and others (e.g., hikers) about the concept of native plants being reduced in incidence (exclusive of other socioeconomic impacts) probably offset by far more common lack of worry, as well as pleasure among those who find (some of) these plants visually attractive.
Exposure Assessment	
Socio-economic entities: exposure routes and pathways considered	Forestry: Although forestry industries were cited as potentially at risk in the Ecological analyses, Edelman (2000) knew of no evidence of such impacts for the terrestrial plants involved, and believed that any such impacts of these early-successional plants (pioneers of disturbed lands) would be temporary or the result of absent or inadequate management of such lands. A U.S. Forest Service forester (Reardon, 2000) noted that tree regeneration, through these plants outcompeting native plants for open space, might be the primary plausible impact. He also reported that the Forest Service had some complaints about recreational impact, such as difficult access to desired sites. However, he noted that in a study of the mile-a-minute weed, even when he called several different timber and paper companies, only two of 15 reported any problem with this weed at all. It needed to be removed from about 10-15 acres (out of thousands of acres planted in trees for these companies) in order to prepare the land for regeneration of trees, at a cost of between $50-200 an acre. Agriculture: Chianese (2000) noted that purple loosestrife could be very damaging to cranberry farmers if it invaded their bogs. Although it has been found in drainage areas near such bogs, it has not been found in the bogs themselves, the farmers spray herbicides in their bogs regularly (aimed at other plants) which also might limit loosestrife infestation, and the farmers were not concerned about the nearby loosestrife when informed of it. NJDAg is keeping a close eye on these neighboring infestations. Chianese also noted the potential for purple loosestrife to interfere with pasture feeding in wet meadows in northern New Jersey, but so far little impact has been observed and farmers are unworried. Fisheries: Phragmites has been hypothesized by the Ecological TWG to reduce fish populations by physically preventing passage of breeding fish (e.g., killifish) into a fully infested marsh, or fry out of the marsh; Freeman (2000) also mentioned that for a phragmites removal project marginal benefits to fish from the plant were assumed, in contrast to the ability of Spartina marshes to provide food for bay anchovies, a primary food in turn for such species as striped bass or weakfish. However, Weinstein et al. (2000) reports that Phragmites does indeed contribute to the nutrient flux, at least in upper Delaware Bay estuary populations, of such species as bay anchovy and white perch. Windham (2000) reported phragmites providing more nutrients than expected to estuarine fish, including some species that do not spend any part of their lives in marshes. Windham's findings suggest that overall, Phragmites and Spartina might provide the same nutrient loading to the environment, making it unlikely that differences on nutrients between these species offer different impacts on the environment (which might, if it exists, be mediated more through shading or physical obstruction—such as juvenile fish finding less opportunity to hide from predators in Phragmites, due to the steep banks it produces reducing shallow-water habitat at marsh edges). Recreation: With 95 acres of Phragmites at Cape May Point, some 700,000 visitors come to the park each year. Although Zappile (2000) thought that replacement of the reed with Spartina might have ecological benefits, he wondered whether many more visitors could be accommodated even if the park thereby became more attractive. Hikers might be unable to reach certain spots due to infestation by thick mats of vegetation (Salmons, 2000; Ehrenfeld, 2000). Chianese (2000) said that NJDEP had reported to him that they observed impacts of purple loosestrife on waterfowl populations, but had no quantitative data. Fruit- and seed-eating birds can lose food supplies from the spread of tree-of-heaven; fruit-eating birds and rodents, however, can benefit from the spread of multiflora rose. Pimentel et al. (1999) note that purple loosestrife has reduced biomass of 44 native plants and of several duck species dependent on these plants; presumably this could affect birding and hunting activities. Biodiversity Preferences: Westbrooks (1998) cites experts to the effect that "Nonnative species are now considered by some experts to be the second most important threat to biodiversity, after habitat destruction." About 50% of beetles released in an experiment to control purple loosestrife in NJ were aimed at bog turtle habitat in wet meadows in northern NJ. Schmidt and Whelan (1999) observed greater predation of robins and thrushes nesting in honeysuckle than in native arrowwood in a Chicago-area woodland (the honeysuckle species was L. maackii, not the L. Japonica discussed here), due to (they speculate) sturdier branches of the honeysuckle allowing predators to get higher and birds to nest lower. Honeysuckle seems an attractive nesting site for robins, perhaps because it leafs out before native shrubs: robins nesting in honeysuckle increased six-fold to more than 30% during the study, but they could not quantify the population impacts (Whelan, 2000). Ehrenfeld (2000)

	reported that in central New Jersey Japanese barberry appears to be as good or better a resource for songbirds as native plants.
Quantification of exposure levels statewide	Spatial: As noted above, these plants—certainly in the aggregate, and for most plants individually—are found in large numbers on disturbed lands throughout the state except in the central Pine Barrens. The Japanese honeysuckle and tree-of-heaven are said to be somewhat more common in north than in south New Jersey. A rough NJDAg estimate (Chianese, 2000) was that some 51,000 acres were infested with purple loosestrife in 1996 out of an estimated potentially susceptible total of 114,000 acres of freshwater wetlands in the state. Zampella (2000a, b), however, noted only one spot in the Mullica River basin where this plant was found, and noted that it was unknown to what degree elevated pH, elevated nutrients, soft substrate (probably from siltation), heavily altered landscapes, and large seedbanks might explain the distribution of non-indigenous plants. Cartica (2000) stressed that the location and magnitude of NJ infestations are unknown for multiflora rose, tree-of-heaven, Asiatic bittersweet, garlic mustard and Japanese honeysuckle, although he agreed with the TWG ecologists that they were found throughout the state. Temporal: Once established in the wild, these plant populations tend to endure and spread, and are highly resistant to control methods (many of which, as in herbicide applications or fire, can have their own negative consequences or must be continued for several years to exhaust seed banks). Thus exposure, once established, should be considered nearly permanent in the absence of systematic and sustained control efforts. Controllability is still being explored, outside of the current NJ experiment with purple loosestrife control. A project in Rock Creek Park (Washington, D.C.) was able to reduce the incidence of Asiatic bittersweet by 92%, Japanese barberry by 98%, multiflora rose by 88%, and Japanese honeysuckle to a much lower degree over a three-year period. However, maintenance treatment might still be needed every year in the most vulnerable areas and every 3-5 years elsewhere, so control will be an ongoing need even in successful cases. Targeted spraying of certain pesticides (particularly glyphosate, marketed as Roundup and Rodeo) seemed much more effective than mechanical methods such as vine-cutting (Salmons, 2000). Another estimate is that "it is practicable to control about ¾ of them, but at about ten times the present effort" (Imlay, 2000). These analyses both mention problems with other invasive plants as control efforts remove their invasive competitors, so management of the invasive "complex" (rather than focusing on a single plant) seems vital. Hand uprooting is the main permanent solution, although pesticides can help.
Specific socio-economic entities at increased risk	Farmers, anglers, birders, hikers, and loggers are all potentially at risk, although the degree of that risk is very difficult to quantify. Preferences among a small proportion of humans for biodiversity are threatened by these plants' success.
Quantification of exposure levels to entities at increased risk	Ecological TWG analyses of these plants note that little quantitative data exist even on the incidence of these plants, much less data (for example) on the degree to which native plants or fish populations are suffering from their incursions. This makes quantification of potential socio-economic impacts impossible except by judicious use of assumptions.
Dose/Impact-Response Assessment	
Quantitative/Qualitative impact-assessment employed	Three approaches are possible given the lack of data on direct socio-economic impacts: (1) "equivalent" estimates from estimates of reduction in environmental resources (e.g., if invasive plants reduce tree, fish, or bird production by X%, then plausibly employment, etc. might be reduced by up to X%--perhaps less, given substitution and other offsetting factors); (2) use of control costs as a willingness-to-pay surrogate for consumer surplus (i.e., people would not spend more money on controls than the value they receive from avoiding undesired impacts of invasive species; thus control costs provide a plausible minimum estimate of socio-economic impacts; (3) estimating the degree of impact that would be needed to move from one category to another (e.g., a minimum of 20,000 jobs lost in relevant economic sectors to shift from a Severity score of 1 to 2), and then determining whether that degree of impact on ecosystem resources is plausible. Unfortunately, the first option is not feasible; no one has done the studies needed to quantify ecological impacts. The second option is somewhat practical, since one can either extrapolate from estimates of national loss/control costs (e.g., Pimentel et al., 1999) to New Jersey (e.g., loss and control costs for agriculture nationally, extrapolated as the percentage of national agricultural production contributed by New Jersey), or use site-specific costs per acre to extrapolate to the total number of acres affected in New Jersey (if latter figures are available). Conceptually, however, this approach has problems: economists' assumption that expenditures signal a lower limit to consumers' surplus

	depends upon assumption of a market with many sellers and buyers; since most control decisions are currently being made by government agencies and activist groups and scientists, it is unclear whether their preferences represent those of the larger population. The sensitivity analysis approach (estimating the value needed to switch from one category to another), is far more feasible, but still requires certain assumptions (e.g., the proportion of jobs in an economic sector that might be related to issue-relevant impacts), and depends very heavily on the plausibility of the divisions between categories.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values—no significant impacts	Severity	*0.1*
	Irreversibility	1
	Scale	3
	Uncertainty	1
Employment	Severity: A threshold of 20,000 jobs is needed to assign a medium (2) score. The 1997 statewide total of jobs likely to be affected were 29,000 (agriculture--includes production of livestock and crops, services, forestry, and fishing/ trapping/hunting), 3,800 (lumber and wood products), 74,000 (hotel and other lodging), and 38,000 (amusement and recreation services). I assumed that jobs could be affected statewide, given the geographic scope of the plants. If all of these jobs were related to resources affected by invasive plants, the minimum impact on those resources of the plants would have to be 14% to yield 20,000 jobs. However, less than all hotel/lodging and amusement/recreation should be affected (e.g., business trips, beach trips, etc. won't be relevant). Assuming 10% of these latter two job categories are relevant (e.g., to use of these sectors by birders or non-resident anglers), then that minimum impact level is 45%. This seems implausible on current evidence. A 1979 estimate (cited in Westbrooks, 1998) was "that 10-15% of the total market value of farm and forest products in the United States was lost to weeds." Even if we assume that twice as high a proportion of jobs is lost in New Jersey for an equivalent market value decline in the state for these particular kinds of jobs, this is less than the estimated minimum value needed to assign a Medium score.	*1*
	Irreversibility: Although the potential for substitution of jobs is high in a booming economy, its persistence is uncertain, and many of these potentially affected jobs are in natural resource use sectors that (like farming or fishing) could be already operating with marginal profits, making even small impacts more consequential than otherwise (since control of these plants, much less reversal of their ecological impacts, is likely to take years). Thus I am rating the irreversibility as Medium.	2
	Scale—statewide, given wide dispersal of these plants	3
	Uncertainty—very poor, since even ecological impacts are poorly documented	3

Costs Incurred	Severity: Data for direct cost estimates are not available. For example, Pimentel et al. (1999) report an estimate from the literature of 40 cents spent per bird observed by bird watchers, but estimates of bird population reductions due to invasive plants are lacking (e.g., see Schmidt and Whelan, 1999). Pimentel (2000) reported that "as with purple loosestrife, when we assessed the damages from this invasive plant, all that we could find were the control costs. The damages are surely much greater than just the control costs but there were no available data that we could find. We do not have any data for the other plants that you listed." Westbrooks (1998) cited a 1994 estimate of $20 billion in costs (loss and control) inflicted by weeds on the U.S. economy as a whole: $15 billion for agriculture, $5 billion for highway rights-of-way, industrial sites, forestry, turf and ornamentals, golf courses, aquatic sites, and other non-crop sectors. The NJ agricultural sector yields about 0.4% of U.S. agriculture (estimated from its proportion of net farm income, 0.3%; final agricultural sector output, 0.4%; assets, 0.6%; and debt, 0.4%, from 1997 data in the 1999 Statistical Abstract of the United States). Applying this percentage to the national agricultural loss/control figure for weeds would yield a NJ loss/control figure of $60 million. In 1997 NJ contained 0.9% of the highway miles in the nation (Federal Highway Administration, 1999). If we apply this percentage to the U.S. non-crop loss/control figure (crudely extrapolating from highway rights-of-way as an invasive plant reservoir), the NJ non-crop impacts would be nearly $46 million. Strictly speaking control costs are not supposed to be included in NJCRP impact estimates; if we assume that at most half of these costs are related to impacts proper, that yields a total NJ impact (crop and non-crop) of $53 million. If we use control costs as a guideline to inferred impacts (people must value avoided impacts at least as much as what they spend to avoid or reduce them), then we can get another set of numbers. NJDAg estimates of 51,000 acres affected by loosestrife in 1996 (and presumably more in 2000), with $100 an acre per year for three years as a possible underestimate of the true costs for use of beetle controls (Chianese 2000), would suggest a minimum control cost of over $15 million. An invasive-plant control project in Rock Creek Park, Washington, D.C. (Salmons, 2000) included four of the plants discussed here (Asiatic bittersweet, Japanese honeysuckle, Japanese barberry, multiflora rose) among the 13 it sought to reduce. Costs per acre declined over the 3-year project, from $464 to $235. If we assume the $344 (2d year) figure, and apply that to the length of highway miles in NJ (35,920 in 1997) multiplied by a conservative 4 feet (2 feet on each side) of right-of-way susceptible to invasive plants (thus 17,416 acres), the result is almost $6 million, or $18 million for a 3-year eradication program. If we assume that the total of disturbed land in NJ is five times this acreage, which seems plausible, than again at $90 million we are firmly into a Medium score. Finally, if we take the range of Ecological estimates of NJ infestation for Japanese stilt grass (5-10%), and apply it for all invasives to the state's roughly 5 million acres overall at $300 per acre control cost, this results in estimates of $75-150 million for a single year.	*2*
	Irreversibility—unlikely to have more than negligible effect on an individual's standard of living	1

	Scale—	3
	Uncertainty	3
Aesthetic Levels—no significant impacts	Severity	*0.1*
	Irreversibility	1
	Scale	3
	Uncertainty	1
Psychological Impacts—no significant impacts	Severity	*0.1*
	Irreversibility	1
	Scale	3
	Uncertainty	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description (data gaps; highlight significant data needs)	H: Data on incidence of these plants or their impact on natural populations (see "Quantification of exposure levels to entities at increased risk," above) would provide by far the greatest value for revising socio-economic impact estimates, and have the additional value of targeting management efforts. Better data on impact costs and employment effects would be helpful also, but nowhere near as much as the incidence and ecological impact data.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, ---, where + is improvement) and brief description	-: Ecological analyses of these plants diverged on this judgment, even for a single plant species. On the positive side, analysts mentioned tests being conducted on biocontrols for purple loosestrife (currently being done in NJ) and garlic mustard (in U.S. and Europe, to be completed in 3 years) that might limit the spread and extent of these plants. The effectiveness of targeted and sustained eradication efforts (Salmons, 2000; Imlay, 2000) has been touted recently. Bans on the sale, <u>if</u> enacted, of Japanese honeysuckle, purple loosestrife, Japanese barberry and Asiatic bittersweet also are mentioned as potentially positive, although this step would not affect established populations of these plants. On the negative side, analysts noted that the attributes of these plants discussed under "Description of Stressor" make very likely their persistence (even in the face of short-term eradication efforts) and geographic expansion. Given these assessments, it is likely that the socio-economic impacts will be negative for some time to come. This is due to (1) these plants' great ability to invade new locations; (2) continuing human activities (plus natural events) that disturb lands and create new habitats for these plants; (3) no current systematic management or regulation of these plants; (4) the years' wait to demonstrate that biological controls work on two of these plants (and, eventually, perhaps more—but, for example, known pests and diseases of tree-of-heaven were judged by the Ecological TWG to have low impact, and for stilt grass non-specific, costly and ineffective) and then to get those controls widely implemented in the state; and (5) the current low likelihood of a ban on their sale as ornamentals (where applicable).	
Potential for catastrophic impacts (H,M,L) and brief description	Low: Although Ecological analyses characterized these plants as having potentially catastrophic impacts on endangered species, it is likely that any socio-economic impacts will have Low catastrophic potential: they will occur gradually in step with possible alterations of ecosystem function and biodiversity. If particular ecosystems reach a catastrophic "tipping point" (e.g., where a threatened plant becomes too few in number to survive, and rapidly decreases to extinction), the consequent socio-economic impacts are likely to be small enough and restricted enough in geographic extent to not count as catastrophic.	
Incidence of impacts (affected sub-groups, variability, equity issues)	With the exception of the central Pine Barrens, these plants occur in lands disturbed by human or natural alteration of the landscape throughout New Jersey, although somewhat more common in the northern part of the state. Owners and managers of these disturbed lands, and users of resources stemming from wetlands (e.g., birders, hikers, possibly anglers), are the most affected populations. Evidence is absent, and there is no logical rationale, for assuming differing impacts across demographic groups.	
Relative Contributions of Sources to Risk (H,M,L):		

include any information/details on sources	
NJ Primary Sources	
Large business/industry	M: unmanaged lands/wetlands or where development activities cause disturbance of habitat
Small business/industry	M: Asiatic bittersweet, purple loosestrife, Japanese barberry and Japanese honeysuckle are still sold for residential landscaping, in addition to contribution of habitat disturbance and lack of management; possible transport of stilt grass seeds in plant containers or soil by landscapers, plant nurseries, and plant wholesalers
Transportation	M: Road creation, mowing, maintenance, and ditches, and railroad rights-of-way, favor invasion; canals offer dispersal for loosestrife and stilt grass; loosestrife also has been used for "roadside beautification" on Atlantic City Expressway
Residential	M: home gardeners, using these plants as ornamentals (see "Small business," above) or for wildlife cover and food (multiflora rose) or for winter decorations (bittersweet); building sites and normal landscaping practices also disturb habitat; residences are not a source of Phragmites
Agriculture	M: disturbance due to normal farm operations; permanent woodland edges (honeysuckle, bittersweet); old fields, unmanaged field boundaries, old "living fences" and wildlife plantings (multiflora rose, tree-of-heaven); unmanaged wetlands (loosestrife); salt hay farming, with its ditching and tide restriction, and upland farming near streams (phragmites)
Recreation	M: unmanaged lands, edges of recreation fields, disturbance from off-road vehicles and heavy foot traffic; duck hunters using stolons as blind material (phragmites)
Resource extraction	M: disturbance by logging and mining
Government	M: unmanaged open space (also see Atlantic City Expressway under "Transportation," above); ditching for mosquito control promotes spread of phragmites
Natural resources	H: established plant populations will continue to colonize disturbed sites; hurricanes spread rhizome fragments (phragmites)
Orphan contaminated sites	M: disturbance from original or remediation activities can provide opportunities; unmanaged wetlands sites (phragmites, loosestrife)
Diffuse Sources	
Sediment sinks	NA
Soil sinks	H: seed banks or buried rhizome fragments; although seed bank dynamics are "unknown" for Japanese honeysuckle or with low long-term viability for Asiatic bittersweet
Non-local air sources incl. deposition	L: large hurricanes and tides have potential to raft in phragmites rhizomes
Biota sinks	NA
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Current Policy and Regulatory Framework	
Federal	No current regulation. In 1999 President Clinton established by Executive Order the Interagency Invasive Species Council to produce a plan within 18 months for federal action to defend against invasive species, and a Federal Interagency Weed Committee has been formed to deal with invasive plants. Then-Secretary of the Interior Babbitt established an Invasive Weed Awareness Coalition to help.
State & Local	No current systematic policy or regulation; New Jersey is one of only 11 states with no noxious weed laws or regulations (Westbrooks, 1998). NJ Dept. of Agriculture, which has established a laboratory for rearing insects that can control plant or insect pests, is collaborating with NJDEP on a test program to control purple loosestrife with a leaf-feeding beetle on state lands, particularly in bog turtle habitat (free) and private lands (at $100 per 1,000 beetles, minimum 3,000 beetles per acre if heavily infested, does not necessarily cover NJDA costs). In its first year beetle populations were established at release sites (400,000 beetles released) and produced leaf damage. Releases will be continued for three years, when ultimate results should be seen; outside New Jersey plant density seems clearly reduced from beetle attacks, and in at least one case in Quebec purple loosestrife was nearly eliminated. This laboratory (also rearing beetles that attack the woolly adelgid, also on the NJCRP issue list) could provide a resource for controlling other invasive plant species for which biological controls have been found, if state and other agencies take advantage of it.

Issue: Invasive Plants
Author: Branden Johnson and Clint Andrews
Version: 05/09/01
Socio-economic Impact Evaluation of Environmental Issue

"Invasive plants": specifically including (1) multiflora rose, (2) tree-of-heaven, (3) Asiatic bittersweet, (4) phragmites, (5) Japanese honeysuckle, (6) garlic mustard, (7) purple loosestrife, (8) Norway maple, (9) Japanese stilt grass, and (10) Japanese barberry [latter not yet incorporated]. NOTE: Due to time constraints and judged similarity of socioeconomic impacts, this assessment combines issues treated separately by the Ecological TWG (and not at all by Health TWG).

Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	1	2	0.1	0.1
Irreversibility	1	2	1	1	1
Scale	3	3	3	3	3
Subtotal Risk	0.3	6	6	0.3	0.3

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
2.58	**2.58**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty	1	3	3	1	1	1.8

Trend: -

Catastrophic Potential: L

Issue: Land Use Change
Author: Susan Scibilia
Version: 08/01

NJ Comparative Risk Project.
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Land Use Change**
Description of stressor	Changes in land use and land cover, including agricultural land to suburban, forested land to suburban, and wetlands to suburban. Generally, this is a result of high land values in New Jersey and low agricultural profits.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Transformation of land to developed suburban areas can result in an increase in air and water pollution, which can increase potential for illness. Reduced physical activity found in auto-dependent lifestyles in the suburbs can also create numerous weight related health effects. Increased impervious cover can create a greater potential for flooding, increasing potential for illness and death. In addition, transformation of land from open space to suburban areas can increase stress levels. High stress levels in suburban areas can be attributed to increased vehicle miles traveled, increased financial pressure, and less family/community time.
Stressor-specific impacts considered	Transformation of land has numerous impacts, both positive and negative. Major negative impacts evaluated include property values, employment, costs incurred, aesthetic levels, and psychological impacts.
Key impacts selected (critical socio-economic effects)	From a statewide perspective, employment and property values have only increased as suburbanization has progressed. A majority of New Jersey residents are voting with their feet and saying that they prefer suburban to urban living. There is growing evidence that this vast dispersal of population has also been costly. Some costs are simple transfers, as suburban areas attract housing and commercial investment and jobs, while cities suffer from declining property tax bases and a spatial mismatch between housing and jobs. Although there is no associated statewide loss in property values, these transfers diminish the overall level of social capital within the state, by pitting new winners and losers against one another, and by weakening long-established social networks. There are also direct costs associated with sprawling land use patterns relative to centralized development patterns, most significantly the higher cost to provide transportation, utilities, schools, and other public services. Increased costs are also important because they serve as a multiplier for psychological impacts, such as stress. There is a lack of data and research needed to effectively evaluate all of the stressor-specific impacts, especially aesthetic effects. Both opinion polls and public support for open space preservation indicate that New Jersey residents perceive significant social costs associated with long commute times, traffic congestion, reduced housing choices, unwalkable neighborhoods, and less varied scenery.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Transformation of agricultural land, forested land, and wetlands can have different impacts on various subgroups. Loss of large amounts of agricultural land can affect the viability of the industry in a state or a region. Many crops (grains, vegetables) need large contiguous amounts of land to produce reasonable yields and profits for farmers. As agricultural land diminishes and becomes increasingly expensive to own, economies of scale no longer work in the farmer's favor. The cumulative impacts of this progression lead to the loss of the farming family, a traditional way of life, and damage the industry as a whole. Unless farmers can develop a unique niche, they are forced off of the land and into other professions. Loss of forested land has different implications. Foresters, who actively manage much of New Jersey's forested land, lose clients and income. Environmentalists, who appreciate the ecological benefits of forested land as the best land use for protecting water quality, can become increasingly hostile and angry. Birders and hunters can lose valuable open space where they can participate in their hobby. As more and more

	forested land is subdivided and developed, wildlife problems (deer) can be exacerbated. Problems can include deer-car accidents, landscape damage, and deforestation of woodlands. Control of these wildlife populations becomes more difficult as land previously available to hunters is developed and thus unavailable to hunters. Loss of wetlands can also have impacts on birders and environmentalists. More importantly, wetlands serve as critical filters for water, especially suburban runoff polluted with nonpoint source pollution. Wetlands can filter contaminants out of runoff prior their reaching a stream, lake, or estuary. In addition, wetlands can mitigate the impact of floods and large rainfalls. Loss of wetlands can dramatically increase costs related to water quality and property damage during storms.
Quantification of exposure levels statewide	The latest Natural Resources Conservation Service National Resources Inventory reports that New Jersey's total rural land declined from 836,300 acres in 1982 to 630,800 in 1997. Clearly, the 1980s and 1990s were at time of dramatic development and loss of open space (USDA NRCS, 1999). After analyzing two-thirds of the state from 1985 to 1995, an NJDEP study found more than 100,000 acres of open land was lost to development in the north and central parts of the state. The land included almost 70,000 acres of farmland, 29,000 acres of woodlands, and 13,764 acres of wetlands (McNichol, 2000). A 1992 Rutgers University Center for Urban Policy Research study found that New Jersey lost 25% of its tidal marshes between 1953 and 1973. (Speck-Bartynski, 2000) Transformation of land affects residents across New Jersey, especially those at the suburban/rural fringe (Sussex, Warren, Hunterdon, Morris, and Mercer counties, as well as most southern counties). While the trend for suburbanization began in force after World War II, New Jersey's most intense suburbanization has occurred in the last 30 years. In the last 20 years, suburbanization has progressed southward, into New Jersey's central region (Middlesex, Monmouth, Mercer, Somerset, and Hunterdon counties) and even to southern counties surrounding Philadelphia. Data from the Delaware Valley Regional Planning Commission indicates dramatic increases in housing units from 1970 to 1980 (a 37% increase in Burlington County, a 33% increase in Gloucester County, and a 16% increase in Mercer County). Much of this housing was built on farmland and woodland. Since 1950 New Jersey has lost more than half of its farmland, nearly 1 million acres. In addition, this development was clearly suburban in nature, consuming 30% of the metropolitan area's land between 1970 and 1995, while population only increased by 2% (Speck-Bartynski, 2000). Statistics from the Regional Planning Partnership reveal that more than 48,000 acres of undeveloped land was developed from 1976 to 1996 in the Middlesex-Somerset-Mercer region. This represents a 61% increase in developed land in the twenty-year period, with more than 38% of the region now developed (Speck-Bartynski, 2000). This region, commonly known as the "wealth-belt" of New Jersey, is known as a rapidly developing region of significant affluence.
Specific socio-economic entities at increased risk	Entities at increased risk include rural residents and existing suburban dwellers in counties along the suburban/rural fringe. Also at risk are city dwellers who feel the economic and social impact of the flight from the cities. High growth counties are especially vulnerable to the impacts of land transformation.
Quantification of exposure levels to entities at increased risk	This issue is a statewide issue.
Dose/Impact-Response Assessment	
Quantitative/Qualitative impact-assessment employed	Literature search.
Risk Characterization	

Issue: Land Use Change
Author: Susan Scibilia
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Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: Although large increases in property values are seen in developing suburban areas, these gains are partially offset by losses in urbanized areas. As former city dwellers leave the city for new suburban developments, they take with them their resources and incomes, transferring their wealth to newly developing areas. Left behind are less fortunate, less mobile residents. This creates a downward spiral as more and more people leave and fewer business remain open or locate in the city. The overall effect is an increase in inner city deterioration, characterized by decreasing residential and nonresidential property values, that is difficult at best to reverse. Although this deterioration is related to many factors, it depends most significantly on the amount of housing built outside the central city. (Transportation Research Board, 1998, p. 109) However, compared with the large property value gains from new suburban developments, the severity related to property value loss in urban areas is fairly low on a statewide basis. An analysis of the Minneapolis- St. Paul region in the late 1980s found that many poverty-stricken neighborhoods lost one-tenth to one-fifth of their assessed residential value. In contrast, developing suburbs in the region experience an increase in residential property value ranging from 18 to 33%. (Orfield, 1997). Applying a 10-20% loss in assessed 1998 property value to several of NJ's central cities (Asbury Park, Atlantic City, Camden City, East Orange, Elizabeth, Jersey City, Linden, New Brunswick, Newark, Paterson, Perth Amboy, Rahway, Trenton, Union City) yields losses of $3.5-7.1 billion, a medium impact because it is greater than the cutpoint of $2.2 billion.	*2*
	Duration/irreversibility: Loss in property values in urbanized areas lasts more than five years.	3
	Scale: The impact affects numerous neighborhoods and more than one county.	2
	Uncertainty: impact estimate is extrapolated and may not apply to the NJ context	3
Employment	Severity: Loss of employment would be seen in the agricultural and forestry sectors. The impact to the forestry sector would be minor, as there are few loggers in New Jersey and also relatively few consulting foresters in the state. The agricultural sector would suffer larger impacts, due to loss of land and decreasing farmland productivity. However, in New Jersey many farmers have been able to find new market niches and continue farming while supplementing their income with other jobs. "Hobby farms" (1-50 acre farms where farming is not the main or only source of income) have flourished. Although the number of acres in farmland has decreased from 916,000 in 1982 to 832,000 in 1997, the number of farms has increased from 8,277 to 9,101. In 1997, the median size of farms was 23 acres, with over 6,000 farms in the 1 to 49 acre category. (USDA, 1997). Loss of employment in cities may also be tied to sprawl. Although employment rates depend on many factors, suburbanization can foster a spatial mismatch between jobs and housing. Low-income city residents cannot travel to suburban jobs located out of the reach of mass transit, creating a blue collar labor shortage in the suburbs. (TRB, 1998, p. 106)	*1*
	Duration/irreversibility: Once developed, agricultural land cannot be recovered, nor can the associated jobs.	3
	Scale: Impacts affect a number of counties on the rural-suburban fringe.	2
	Confidence: The small number of people involved in the agricultural and forestry professions support the conclusions of the assessment. However, the impact of spatial mismatch is less easily assessed.	2

Costs Incurred	a) Severity: Increased suburban development on previously vacant land can produce higher infrastructure costs, higher public operating costs, more expensive development costs, higher property taxes, and higher land costs. In sprawling areas, roads, sewer, water, and school costs are higher than in mixed or high density developments. A compilation of three studies has found that the costs of roads in compact developments was 75% of what costs were for sprawling developments, the costs of schools were 95% and utilities were 80% of what costs were for sprawling developments. Burchell found that the combined municipal and school district operational costs could be reduced by 2% annually by compact developments. In addition, new suburban developments "steal" high quality land uses from central cities, creating more adverse public fiscal impacts in cities. In New Jersey, the State Plan (which attempts to contain population and growth in already developed areas) offers an annual $112 million fiscal advantage to municipalities. Public schools will find a $286 million annual fiscal advantage under the State Plan. (TRB, 1998, p. 57) Because of these increasing public costs, residents in suburbs are commonly faced with increasing private costs. A number of studies have demonstrated the long-term link between residential development and increasing property taxes. A Burlington County study of one township found that for every $1.00 in taxes that a new residential unit generates, it requires $1.48 for services. Farmland costs $.27 in services for every $1.00 in taxes it generates. (Speck-Bartynski, 1999). Transformation of open land to suburban developments can also increase transportation and travel costs. Sprawl clearly generates increased vehicle miles traveled (VMTs). Holtzclaw found that a doubling of residential densities was associated with 16% fewer VMTS, while a New Jersey group concluded that greater land use mixes decrease trip distances and auto mode shares. (TRB, 1998, p. 63) Sprawling suburban developments are more likely to make more automobile trips, while at the same time the nature of sprawl development makes transit less efficient and effective. Increase automobile travel also produces higher social cost, such as an increase in air and water pollution, more impervious parking lots, and more accidents. Social costs make up 16 to 17% of the costs per passenger mile for single occupancy vehicles compared to 1 to 7% for transit and a negligible amount for walking and biking. (TRB, 1998, p. 68) Increasing dependence on automobiles and suburbs that are designed for cars, not people, are creating increased health risks and costs. Sprawling communities, with few sidewalks, wide busy streets, large parking lots, and a general focus on cars, are the most dangerous places for pedestrians. In New Jersey for 1997 to 1998, 20% of traffic deaths are pedestrian, compared with 13% nationwide (McCann, 2000, p. 20). As a result, people are walking less, which may lead to health problems associated with sedentary lifestyles. Poor diet and lack of physical activity are the second leading actual causes of death in the United States, accounting for over 300,000 deaths per year (McGinnis, 1990). Lack of physical activity can lead to numerous health problems, including obesity, cancer, cardiovascular disease, and coronary heart disease, all of which can cost hundreds of billions of dollars a year. Although there are many factors affecting this cost, the prevalence of suburban developments is part of the problem. Cars are used for 80% of trips less than one mile, the average adult walks 1.5 miles per week, and 20% of children walk to school (compared to 80% when their parents were school aged). (RWJF, 2000). Students are three times as likely to get bused if they attend a school built after 1971 (McCann, 2000, p. 16).	*3*

	b) Duration/irreversibility: Costs incurred significantly reduce standard of living in the short run	3
	c) Scale: impacts are statewide	3
	d) Confidence: Some documentation exists.	2
Aesthetic Levels	Severity: Although it is often stated that the suburbs are aesthetically displeasing, there is little evidence in the literature that the majority of Americans find sprawl less attractive. Aesthetics can vary widely from development to development and high-density urban developments can also be aesthetically displeasing. As Duany states "…the problem with suburbia is not that it is ugly. The problem with suburbia is that, in spite of all its regulatory controls, it is not functional: it simply does not efficiently serve society or preserve the environment." (Duany et al., 2000) However, certain characteristics of sprawl are often cited as being generally unappealing, including visual uniformity, strip malls, absence of quality public spaces, and a lack of community cohesiveness. (TRB, 1998, p. 84) There is some indication that increased suburban development can lessen historic preservation efforts. As sprawl encourages people to leave urban areas, the base supporting historic structures diminishes. In addition, flight from the cities leaves these areas with increased concentrations of poor that cannot revitalize historic structures. (TRB, 1998, p. 92) Sprawl can greatly diminish the natural beauty of rural and wooded areas. Scenic vistas, wooded hillsides, water views, and rolling farm fields are lost once development arrives. New Jerseyans preferences for protection of these open spaces and their associated aesthetic benefits is clearly indicated by support of open space taxes, shade tree commissions, environmental commissions, watershed groups, and increased interest in the work of planning boards. As of December 1999, 17 counties and 119 municipalities are authorized to dedicate a portion of their property taxes or sell bonds to fund open space and farmland preservation. In November, 1998, New Jersey voters supported (by a 2 to 1 margin) a constitutional amendment that allows New Jersey to set aside $98 million per year for ten years and to set aside up to $1.0 billion in bond proceeds to preserve open space and historic resources (New Jersey Green Acres Program, 1999). Over 300 of New Jersey's 566 municipalities have environmental commissions (ANJEC, 2000).	*2*
	Duration/irreversibility: can only be reversed with great effort	3
	Scale: occurs frequently and affects more than 60% of the state	3
	Confidence:	2
Psychological Impacts	***a)*** Severity: Suburbanization can create a number of psychological or quality of life impacts, including a weakened sense of community and greater stress. Although it's difficult to measure, there is some evidence that the lack of public spaces in suburban areas weakens community structure. In dense urban areas, residents are more likely to walk and interact and have more places to go to interact. (Putnam, 2000) Sprawl can also lead to segregation by income, often denying suburban residents intergenerational and interracial interactions. Increased VMTs and car trips can also reduce time spent with family members. (TRB, 1998, p. 89) The dependence on automobiles and longer commuting times required by suburban living can greatly increase stress levels of commuters. Studies have indicated a lower tolerance for frustration, negative moods, and lower overall life satisfaction as indicators of increased stress levels. (TRB, 1998, p. 89) Suburbs can also concentrate low-income residents in certain city neighborhoods, which exacerbates education, crime and drug problems there. In addition, many suburban jobs are unavailable to city residents due to lack of mass transit. As more and more residents leave the cities for the suburbs, these problems only become worse and add to the deterioration of the city. These problems can increase stress and worry levels among urban dwellers. (TRB, 1998, p. 104)	*2*
	Duration/irreversibility: worry endures	3
	Scale: worry is ubiquitous in the state and occurs often	3
	Confidence: arbitrary scores that could be off by more than one number	3

Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description.	High potential for more data to change this assessment. Data is needed to better quantify aesthetic and psychological impacts. Although visual preference surveys seem to indicate preferences for compact development, there is some disagreement about what these surveys actually measure (are they measuring consumers' preference for the type of development or just their preference for high quality architecture, for instance?). More information is needed about consumers' preference for suburbs. Do they choose to live there because there are no other decent options? An evaluation of various "town center" projects in New Jersey (i.e.) Washington Township, Mercer County) may be helpful in providing insight into consumer preferences and choices in terms of aesthetic characteristics. Psychological impacts need additional documentation, especially with regards to sprawl's impacts on suburban families and children.
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	--- The trend in New Jersey is towards more development, even though land preservation has accelerated in recent years. New Jersey's land area totals 5 million acres: 2 million are developed, 1 million are preserved, and 1 million are expected to be preserved, leaving 1 million left for development. (NJ Future, 2000). The number of building permits authorized in the 1990s increased nearly every year. In 1990, local governments issued 17,524 building permits, in 1995 21,521 were issued, and in 1999, 31,976 permits were issued. During the ten year period, over 239,000 permits were issued, with over 83% of those for single family homes. (US Census, 1999) Within the next 5 years, more development is likely to cause additional impacts and risk. Many municipalities in New Jersey report that most of their open space is already vested with development approvals. Popular opinion in the planning field report that New Jersey is in a ten year race to preserve as much land as possible; after that most land will be developed, vested, or preserved. The most developed New Jersey counties (Union, Bergen, Essex, and Hudson) were, on average, 66% developed as of 1995. At the 1986 – 1995 development rate, the entire state will be as developed as these four counties in 100 years (NJ Future, 2000). New planning trends, however, have the potential to reduce the risk from the stressor, including cluster development, transfer of development rights, redevelopment in urban areas, and traditional neighborhood developments.
Potential for catastrophic impacts (H,M,L) and brief description	The potential for catastrophic impacts is medium. As more land is developed and covered with impervious surfaces, the ability of that land to absorb water is reduced, possibly causing devastating floods during large storms. Some environmentalists estimate that every cleared tree is one less 500-gallon sponge (Coughlin, 2000). Many central New Jersey areas experienced this destructive flooding during Hurricane Floyd in 1999. Increased impervious cover also allows runoff to accumulate more nonpoint source pollutants, creating water quality problems. Water treatment plants can be dramatically affected by floods and source water pollution. Flooding and water quality/quantity problems will only be exacerbated with increased development.
Incidence of impacts (affected sub-groups, variability, equity issues)	Suburbanization depletes resources from older sections of cities, areas that are most in need of these resources. Much of the cost of suburban growth is financed through federal, state, and local taxes. These taxes often redistribute resources from cities to suburbs, creating suburban growth that is partially subsidized by older urban areas (Duany, 2000). Suburban exclusion, a spatial mismatch between jobs and housing, and increased city fiscal stress all impact low-income city residents at a rate much larger than any other subgroup. Suburban exclusion concentrates low-income residents in certain city neighborhoods, exacerbating education, crime and drug problems there. Increased suburban jobs may play a role in low city employment rates. Compounding these problems, cities must provide costly services to large number of poor residents while these same households generate low per capita tax revenues. (TRB, 1998, p. 108). New Jersey's most affected areas include Trenton (Mercer County), Camden (Camden County), and Newark (Essex County).
Extent to which threat is currently regulated	The threat is currently regulated by the NJ Municipal Land Use Law. This law focuses extensively on procedures and processes for development, not on controlling or limited growth. Along with the NJ State Plan, which details a voluntary plan to direct and manage growth, these documents are largely viewed as weak and ineffective. A number of municipalities have ordinances that provide mechanisms to control and limit suburban growth, such as large lot zoning, preservation of wooded areas and steep slopes, limits on sewer service areas, and the creation of agricultural

	development areas.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	M
Small business industry	M
Transportation	H
Residential	H
Agriculture	L
Recreation	L
Resource extraction	L
Government	H
Natural sources/processes	L
Orphan contaminated sites	M
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. Deposition	L
Biota sinks	L
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Current Policy and Regulatory Framework	
Federal	Federal government involvement in this issue includes substantial highway subsidies and home mortgage guarantees that encourage sprawl development, and minor mass transit and urban revitalization subsidies that discourage it. The federal government is very wary of getting involved with local/state land use decisions. However, a number of government agencies have developed guidance for local governments on techniques to avoid sprawl.
State & Local	Local governments largely control the development of land in New Jersey, and some municipalities actively encourage compact development

	while others do not. The New Jersey State Plan details a voluntary approach for managing growth, and the Governor's Smart Growth Coordinating Council is attempting to coordinate the efforts of state agencies in this regard.

Physical transformation of the environment through land use changes. The dramatic physical transformation of open, wooded, agricultural, and wetland areas to suburban development in recent decades has had significant impacts. Most obvious are ecological insults including habitat loss and fragmentation, and increased impervious surface cover that worsens flooding hazards and pollutant runoff into surface waters. There are also important distributional socioeconomic impacts, as urban and rural areas lose jobs, tax revenues, and social capital to suburban areas. Statewide, suburbanization appears to provide net gains in employment and property values, and net losses in aesthetic and psychological terms. Sprawl imposes large direct costs due to increased commuting distances, congestion, and inefficient infrastructure investment.

Socio-economic Impact Evaluation of Environmental Issue:

Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).

Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	2	1	3	2	2
Duration/ Irreversibility	3	3	3	3	3
Scale (spatial, population)	2	2	3	3	3
Subtotal Risk	12	6	27	18	18

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
16.2	**16.2**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Confidence**
Uncertainty Level	3	2	2	2	3	2.4

Trend: ---

Catastrophic Potential: M