505 West Northern Lights, Suite 205
Anchorage, Alaska 99503
Phone (907) 222-7714; Fax (907) 222-7715
www.akaction.org; info@akaction.net

Bud Rice
Environmental Protection Specialist
Alaska Regional Office
240 West 5th Ave.
Anchorage, AK 99501

October 30, 2008

Dear Mr. Rice:

With this letter, we provide the comments of Alaska Community Action on Toxics regarding the Alaska Region Invasive Plant Management Plan Environmental Assessment which would permit the use of herbicides within the National Park system of Alaska.

Alaska Community Action on Toxics ("ACAT") is a statewide non-profit public interest environmental health research and advocacy organization dedicated to protecting environmental health and achieving environmental justice. Alaska Community Action on Toxics mission: *to assure justice by advocating for environmental and community health. We believe that everyone has a right to clean air, clean water and toxic-free food*. We work to stop the production, proliferation, and release of toxic chemicals that may harm human health or the environment.

Alaska Community Action on Toxics firmly opposes the use of herbicides and associated chemicals for vegetation management purposes by the National Park Service. We assert that there are viable, economical alternatives that preclude the need for chemical treatments. Our comments provide justification for our opposition on the basis that herbicide use poses an unacceptable threat to water quality, fish, wildlife, habitat, and public health.

Environmental and Human Health Effects of the Proposed Herbicides

The following sections provide a review of some of the peer-reviewed literature concerning the environmental and health effects associated with the individual herbicides. Although not intended as an exhaustive review of the literature, the summaries presented here clearly demonstrate that the individual herbicides proposed for use by the National Park Service are unacceptable for use because they will likely harm the health and well-being of fish, wildlife and

communities in close proximity to the National Parks, park visitors, employees, and individuals who use adjacent lands and waters for subsistence uses, including berry-picking, fishing, and hunting.

Persistence and Potential for Leaching into Wetlands, Streams, and Groundwaters, Environmental and Health Effects—Glyphosate

Glyphosate is an active ingredient in several herbicide formulations. Glyphosate is persistent in soils after application, especially in northern regions. In a Finnish study, the measured half-life of glyphosate was 249 days.[i] In Ontario, Canada, glyphosate had a half-life in forest soils of 24 days with detectable residues persisting for 335 days.[ii] On 3 British Columbia forestry sites, glyphosate persisted 360 days.[iii] In a Swedish study, glyphosate persisted from one to three years on eleven forestry sites.[iv] Another peer-reviewed study reported that glyphosate has a half-life of 3 days to 25 weeks in soil and 1 day to 25 weeks in water with a pH of 7.[v]

The herbicide has the potential of eliminating a wide variety of plants including desirable as well as "undesirable" vegetation, grasses and many broad leaf species. The main breakdown products of glyphosate are aminomethylphosphonic acid (AMPA).[vi] Another reported degradation product of glyphosate is formaldehyde,[vii] a known carcinogen. In a study of glyphosate degradation in Willapa Bay in Washington State, glyphosate concentrations in the estuarine mudflats took 119 days to decline to 72%, while AMPA did not degrade during that period.[viii] Other studies show that the half-life for glyphosate in water ranges from 35-65 days. "In British Columbia, following application of glyphosate using a no-spray buffer and very low concentrations of glyphosate, the breakdown product AMPA was sometimes observed in water and sediment of streams after the first heavy rain following application.[ix] Another study of agricultural watersheds shows similar results, with the highest concentrations in runoff one to ten days, and detection up to 4 months after application.[x] Higher peak concentrations were observed in water following heavy rain events up to three weeks after application and "sediment peaks were observed later and persisted in stream sediments for more than one year."[xi] A fact sheet about glyphosate from the Oregon State University Environmental Toxicology and Chemistry Program does not recommend berry or mushroom consumption from newly-treated areas.

Herbicides cause "trophic cascades" including direct and indirect harmful effects on many species, including aquatic invertebrates that are food sources for salmonids and other fish.xii In general, herbicides and other pesticides have long residence times in soils and waters at northern latitudes. Product formulations of active ingredients and proprietary, undisclosed additives such as solvents and surfactants can cause enhanced adverse effects to the environment and human health. Interactive and low-level effects at concentrations below EPA allowable levels have been found to cause profound impacts on neurological, endocrine, immune, and developmental processes including the development and function of the brain, as well as reproductive health.

Glyphosate, the active ingredient in Razor Pro, is toxic to a variety of aquatic insects and tadpoles. Species richness of aquatic biota (copepods, *Daphnia*, snails, arthropods, amphibians) was reduced 22% in this 2005 study. Toad tadpole survival was reduced from 97 % to 0%.[xiii] In a study published in 2000, Giesey and other researchers found toxicity of glyphosate can be quite high to some invertebrates.[xiv] Glyphosate also causes serious sublethal effects in fish at low concentrations, including erratic swimming, gill damage and liver structure changes.[xvxvi] Fry and fingerlings are more vulnerable to the toxic effects of glyphosate than adult fish, with harmful toxicological effects on developing rainbow trout at 2-3 ppm.[xvii]

In comments from the U.S. Fish and Wildlife Service on a proposed aerial application of glyphosate for forestry purposes in SE Alaska (letter to ADEC dated October 28, 2005), agency biologists stated: "We are concerned that these application restrictions for Accord [active ingredient is glyphosate] will not be adequate to protect aquatic resources, based on recent glyphosate toxicity data. Accord [active ingredient glyphosate] does not appear to be an acceptable product due to its potential for aquatic toxicity."

Toxicity of glyphosate is affected by such environmental factors as water hardness, temperature, and pH. Toxicity increases at lower pH levels and higher temperatures.[xviii] Surfactants may exhibit increased toxicity in alkaline waters.[xix] In addition, glyphosate has an antagonistic effect on the toxic action of a surfactant.[xx] High pH (7.5) "increased the toxic effects of the herbicide" [glyphosate] on survival, reproduction, and development time in zooplankton and amphibian species (frog species *Rana pipiens* and zooplankton species *Simocephalus vetulus*).[xxi]

Glyphosate sub-lethal effects in fish and wildlife have not been well-studied, although available science indicates cause for concern. Chronic exposure to glyphosate for 14 days resulted in histopathological changes in gill and liver structure, as well as adverse effects to liver, heart, kidney and serum enzyme activity. Threshold gill and liver histopathological responses were observed at concentrations equal to 0.8% (5 ppm) and 1.6% (10 ppm), respectively, of the 96 LC50 for that species (620 ppm). Researchers surmised that the gill histopathological response was reparable if the fish were relocated to clean water, however the liver fibrosis was considered indicative of serious liver damage. Statistically significant changes in enzyme activity were observed at 0.4% of the 96 hr. LC50, the lowest exposure concentration, in liver (alkaline phosphatase, P less than 0.01; and glutamic-pyruvic transaminase, P less than 0.05) and kidneys (glutamic-oxaloacetic transaminase, P less than 0.05 and glutamic-pyruvic transaminase, P less than 0.05. Responses to chemical exposure vary by species, but equivalent exposure concentrations (0.4%, 0.8%, and 1.6% of the 96 hour LC50) for salmonids would be 4.4 ppm, 8.8 ppm, and 17.6 ppm.[xxii], [xxiii] Rainbow trout fry were the most sensitive life stage followed by emergent fry.[xxiv] After treatment with Roundup, aquatic macroinvertebrate density declined by 42% for a 1.5 year period.[xxv]

Studies show adverse effects on the following categories of beneficial insects: pollinators, soil aerators, predators, and soil producers. Glyphosate reduces the growth and survival of

earthworms.[xxvi] It is acutely toxic (at concentrations ranging from 2-55 ppm) and causes sub-lethal effects on fish.[xxvii] One herbicide formulation with glyphosate, Roundup (with associated proprietary surfactants and other additives), is 20-70 times more toxic than glyphosate alone.[xxviii] Toxicity increases with water temperature.[xxix]

Glyphosate causes an increase in water temperature for years following application through the destruction of shading vegetation—this increase is particularly dangerous to fish such as juvenile salmon, which depend on cooler water temperatures for survival.[xxx] In Nova Scotia, studies of treated forests revealed that songbird densities (white-throated sparrows and common yellowthroat) were reduced for two years after the glyphosate application.[xxxi] A three-year study of treated forests in Maine demonstrated a decline in the abundance of songbirds.[xxxii] Declines in small mammal populations and adverse effects on moose, elk, and deer browse have also been documented.[xxxiii] Glyphosate can adversely affect the health of soils and nutrient cycling by: 1) inhibiting nitrogen fixation[xxxiv], 2) causing a decline of beneficial mycorhizal fungi[xxxv], and 3) increasing the disease susceptibility of plants.[xxxvi]

Contrary to claims of safety, research demonstrates serious harmful effects to human health associated with exposures to the herbicides. A study by Garry, et.al. found that glyphosate showed a significant correlation with excess adverse birth and neuro-developmental effects. The authors also note: "Regarding the herbicide glyphosate, our present study shows a tentative association between ADD/ADHD and use of this herbicide."[xxxvii] Another study concluded: "Preconception exposure to the pesticide active ingredients glyphosate, atrazine, carbaryl, and 2,4-D was associated with a 20-40% relative increase in risk…The herbicide glyphosate was associated with increased risks of late abortion, regardless of when exposure occurred."[xxxviii] "The genotoxicity of glyphosate has been positive in *in vitro* cultures of bovine and human lymphocytes and weakly mutagenic in a *Salmonella* assay."[xxxix] One study observed the onset of parkinsonian syndrome following an accidental exposure to glyphosate. "A 54-year old man accidentally sprayed himself with the chemical agent glyphosate, an herbicide derived from the amino acid glycine. He developed disseminated skin lesions 6 hours after the accident. One month later, he developed symmetrical parkinsonian syndrome."[xl]

Exposure to glyphosate is also associated with elevated risk of a rare form of non-Hodgkins's lymphoma (NHL), hairy cell leukemia: "The more recent study described two case-control studies, one on NHL alone and one specifically on hairy-cell leukemia, a rare form of NHL, with respect to pesticide exposure (with many different pesticides and exposure levels tested). A pooled analysis (done in order to increase numbers) revealed elevated ORs with statistical significance for herbicides in general, phenoxyacetic acids, glyphosate, and MCPA. Also, there were dose-response effects in these pesticide groups, most with statistical significance."[xli], [xlii] A 2003 study confirmed the association of glyphosate exposure with increased incidence of non-Hodgkin's lymphoma.[xliii]

Many currently used pesticides have the capacity to disrupt reproductive function in animals. Walsh and colleagues conducted a study concerning the underlying cause of reproductive endocrine disorders because "the possibility these compounds can affect the reproductive health of humans and wildlife in their natural habitats is of great concern. Little information is available regarding the effects of pesticides…on endocrine system function, despite their widespread use." The authors conclude: "Roundup [active ingredient glyphosate] disrupted steroidogenesis in Leydig cells through a post-transcriptional reduction in StAR (**St**eroidogenic **A**cute **R**egulatory) protein expression. Not only does StAR play an important role in steroid (hormone) production in gonads, but it is also indispensable for steroidogenesis in the adrenal glands. As a result, a disruption in StAR protein expression may impair more than just fertility. The adrenal glands synthesize glucocorticoids and mineralocorticoids, and a reduction in StAR expression in the adrenal glands may affect carbohydrate metabolism, immune system function, and balance. Because many toxicants that reduce StAR expression and steroidogenesis in the adrenal gland, a disruption in StAR protein expression may underlie many of the toxic effects of environmental pollutants."[xliv]

Finnish researchers showed that Roundup's active ingredient, glyphosate, decreases the defenses of enzymes of the liver and intestines.[xlv] Roundup, as a mixture of all its ingredients, has been shown to shut down a powerful antioxidant in the liver that detoxifies harmful compounds so they can be excreted through bile. Glyphosate also alters gene expression and inhibits necessary steroid production by disrupting a particular protein expression. In 2002, a paper shows that glyphosate can also affect early cell division processes in embryos."[xlvi]

In a systematic review of the peer-reviewed scientific literature concerning health effects of pesticides, a team of physicians from the Ontario College of Family Physicians concluded: "The literature does not support the concept that some pesticides are safer than others; it simply points to different health effects with different latency periods for the different classes…Some more surprising positive associations were found for pesticides that are considered less toxic in acute poisoning settings…The herbicides glyphosate and glufosinate had associations with congenital malformations [birth defects]. Parental preconception exposure to glyphosate was associated with late abortion."[xlvii] A growing body of evidence implicates glyphosate and its formulations with health problems thus far ignored by the National Park Service.

Persistence and Potential for Leaching into Wetlands, Streams, and Groundwaters, Environmental and Health Effects—2,4-D

EPA includes 2,4-D among the list of compounds that are likely to leach from soil. In oxygenated waters, the half-life of 2,4-D is one week to several weeks. Despite its relatively short half-life in soil and aquatic environments, the chemical has been measured in groundwater supplies of at least 5 states and in Canada.[xlviii]

2,4-D has a soil half life of one to two weeks. However, persistence and accumulation of 2,4-D residues from normal use is possible in cold northern environments according to a review of the chemical by the World Health Organization.[xlix] Also, when tracked indoors and not exposed to direct sunlight, 2,4-D can persist in carpets for up to one year after a single application at a concentration of approximately 0.5 µg/g.l

The Material Safety Data Sheet (MSDS) provided by a manufacturer of the chemical states that this product is "toxic to aquatic invertebrates. Drift or runoff may adversely affect aquatic invertebrates and non-target plants." The MSDS warns: "do not apply directly to water, or to areas where surface water is present…" The MSDS also states: "Do not enter or allow workers entry into treated areas during the Restricted-Entry interval of 48-hours." The U.S. EPA requires manufacturers of 2,4-D to label the product with a warning about toxicity to fish. Toxic effects to fish occur at minute concentrations and adversely affect reproduction and development.[li]

2,4-D has been linked to cancer, endocrine disruption, reproductive toxicity, neurotoxicity, kidney and liver damage, and toxicity to fish and wildlife. In a review of nearly 120 studies, the Lymphoma Foundation of America states that the pesticides "more frequently associated with increased lymphoma incidence and/or deaths" include the herbicides 2,4-D and the triazines.[lii] Studies in Canada and Sweden of members of the general public found a 30-50% higher odds of 2,4-D exposure among people with non-Hodgkin's lymphoma.[liii],[liv] The Ontario College of Family Physicians review of health effects of pesticide concluded: "Previous studies have pointed to certain pesticides, such as 2,4-D. as possible precipitants of non-Hodgkin's lymphoma, and the findings of this review are clearly consistent with this."[lv] In another study, "herbicide use (mainly 2,4-D) both during pregnancy and childhood showed a consistent interaction with poor metabolizer genes and was associated with a 2-fold increase in leukemia incidence.[lvi] "Six pesticides, including 2,4-D and dicamba, were associated with increased time to pregnancy."[lvii]

2,4-D causes significant suppression of thyroid function.[lviii] Thyroid function plays a critical role in the development of the brain and metabolism. Slight thyroid suppression adversely affects neurological development in developing children, resulting in lasting effects on learning and behavior. 2,4-D is associated with reproductive disorders and abnormalities.[lix] The chemical also interferes with the neurotransmitters dopamine and serotonin. In young organisms, exposure to 2,4-D results in delays in brain development and abnormal behavior patterns.[lx] This herbicide specifically impairs normal deposition of myelin in the developing brain.[lxi] Another neurotoxic effect was recently elucidated by scientists studying the effects of 2,4-D on the dopaminergic system. They found that 2,4-D may "increase the brain's vulnerability to drug seeking behavior."[lxii] The neurotoxic and anti-thyroid effects of 2,4-D make it highly likely that developing children will be more susceptible to long-term adverse health effects from exposure to this chemical. Recent research has revealed that 2,4-D accumulates and is transferred to the developing baby in breast milk.[lxiii] Dioxin, a highly toxic compound known as carcinogenic and mutagenic at minute levels, contaminates 2,4-D as byproducts during the manufacturing

process.[lxiv] It has also been found that 2,4-D moderate doses may severely impair honeybee brood production[lxv], a serious consideration given the recent dramatic declines in bee and other pollinator species.

Persistence and Potential for Leaching into Wetlands, Streams, and Groundwaters, Environmental and Health Effects—Imazapyr

Acute effects of imazapyr have been found in laboratory tests of rabbits, including bleeding and congested lungs. Laboratory tests also showed congestion of the kidney, liver, and intestine. Exposure to imazapyr can cause irritation and irreversible eye damage. Rabbits exposed to imazapyr in laboratory tests suffered reddening; scaling and crusting of the skin at all dose levels. Female rabbits experienced stomach ulcers and intestinal lesions after oral administration over a 12-day period at most dose levels. Chronic effects in laboratory mice after exposure over a 2-year period included: fluid accumulation in lungs, increased incidence of kidney cysts in males, and an increase in the incidence of brain congestion in females. Evidence of carcinogenicity is inconclusive. The EPA hazards assessment for Arsenal is based mostly on tests of imazapyr as the active ingredient and not formulations including the other chemical ingredients. One of the breakdown products of imazapyr, quinolinic acid, is a neurotoxin, causes symptoms similar to Huntington's disease, as well as irritation of the eyes, respiratory tract, and skin.

Persistence and Potential for Leaching into Wetlands, Streams, and Groundwaters, Environmental and Health Effects—Chlorsulfuron

Chlorsulfuron was recognized by the State of California as a developmental and reproductive toxicant and is regulated under Proposition 65.[lxvi]

Environmental and Human Health Effects of "Inert" Ingredients

The EA discusses the potential impacts of the active ingredients in herbicide preparations, but fails to describe the impacts of so called inert ingredients. On August 1, 2006 the Attorney General of Alaska announced that Alaska "joined with 13 other states and the U.S. Virgin Islands to petition the Environmental Protection Agency (EPA) to require pesticide manufacturers to disclose on the label of their product all hazardous ingredients…The EPA currently requires that pesticide labels disclose only the product's "active" ingredients that contain toxic materials intended to kill insects, weeds, or other target organisms. Pesticide products also contain many other "inert" ingredients, which are intended to preserve or improve the effectiveness of the pesticides' active ingredients. These "inert" ingredients may be toxic themselves…" The news release further states that "people who use or who are impacted by the use of a pesticide should have notice of all that product's potential health risks." For the environmental impact statement to be accurate, the potential impact of inert ingredients in herbicide solutions must be considered.

Dr. Warren Porter, Professor of Environmental Toxicology at the University of Wisconsin, Madison, recently completed a review of the literature concerning the environmental health effects of low-dose chemical mixtures of pesticides.[lxvii] He concluded:

- Pesticides have interactive effects and ultra low-level effects that are below EPA allowable levels. These effects include adverse neurological, endocrine, immune, reproductive and developmental health outcomes.
- EPA assessments of biological risk can be off by a factor of 10,000 at ultra low doses. Scientists call for a new type of risk assessment in the open literature because of the inadequacies of the current EPA pesticide registration system.
- Pesticides have broad biological effects that are unintended and often unpredictable because of physicochemical properties engineered into their molecules.
- Pesticides of different classes can have similar impacts on endocrine disruption and sexual development. Chemicals affect development at levels in the tenths of a part per billion range.

In a recent issue of the preeminent peer-reviewed environmental health journal published by the National Institute for Environmental Health Sciences, *Environmental Health Perspectives*,[lxviii] the authors warn: "Inert ingredients may be biologically or chemically active and are labeled inert only because of their function in the formulated product…Inert ingredients can increase the ability of pesticide formulations to affect significant toxicological endpoints, including developmental neurotoxicity, genotoxicity, and disruption of hormone function. They can also increase exposure by increasing dermal absorption, decreasing the efficacy of protective clothing, and increasing environmental mobility and persistence. Inert ingredients can increase the phytotoxicity of pesticide formulations, as well as toxicity to fish, amphibians, and microorganisms."

Persistence of Herbicides in the Sub-Arctic

Another factor that must be considered is that there have been few studies on the fate of herbicides in the arctic and sub-arctic environments after they have been applied[lxix]. At the Sixth International Conference on Contaminants in Freezing Ground, David Barnes from the University of Alaska Fairbanks, presented original research on herbicides. He studied the way that 2,4-D and triclopyr attenuates in Northern soil and wrote this about his findings.

Results from two different climatic zones in Alaska indicate that the fraction of each

herbicide that is not taken up by susceptible and non-susceptible vegetation is retained to a certain extent in the organic rich surface soils. Loss from this layer is first order during the thawed season. Herbicide is detected in the subsurface as rain events leach the herbicide into the subsurface. No loss of the herbicide is detected through the winter, however during spring thaw an increase in herbicide concentration is measured in the soil. In some cases this increase is substantial[lxx].

It has been shown that the biodegradation of other toxic substances is slow to non-existent in sub-arctic environments[lxxi]. An aquifer polluted with chlorinated solvents in Six Mile Village near Fairbanks was studied in the late 1990's by scientists affiliated with the UAF. They determined that the microbial activity was so low that the attenuation that was caused by dilution[lxxii]. The persistence in the soil of herbicides listed in Appendix G of the EA is based on studies done in temperate climates and does not consider the differences in microbial activity in cold climates.

Alternatives to Herbicides/Chemical Mixtures for Vegetation Management

After carefully reviewing the Invasive Plant Management Plan, we feel as if the committee should take more time evaluating whether applications of such chemical based products are actually beneficial over all. It was stated on page 1 of the Plan that"…the overall goal of the National Park Service is to manage invasive plants in a manner to prevent adverse impacts to park resources and values while minimizing the adverse impacts of the management effort." With the amount of research that has been conducted on the toxicity and persistence of these chemicals, our organization feels that there is a high probability of environmental damage to areas that are sprayed with herbicides.

With the above stated, there are a multitude of alternatives that should be considered when managing invasive plant populations other than the proposed application of herbicides. Wildlife Biologist for the Bureau of Land Management Ruth Gronquist has been an advocate for the removal of white leaf clover on the Dalton Highway by the use of pesticide free alternatives since 2005. Gronquist, a key speaker at the October 2008 Alaska Invasive Species Conference, gave several different methods of eradicating species of noxious plants without the use of chemicals. She has been coordinating volunteer weed pulls through the Spring and Summer seasons since 2006. This year, Gronquist and a dedicated 19 individuals successfully removed invasive species of plants from Coldfoot to the Yukon Crossing without the use of any chemicals. Perhaps, the National Park Service could focus on coordinating such community outreach events instead of relying on chemical treatment to solve the problem.

Another simple yet effective non-toxic alternative can be found right on the shelves of local grocery stores. Instead of filling up backpack sprayers with chemicals such as 2,4-D, and glyphosate, vinegar and hot water can be used as a replacement for these chemicals[lxxiii].

Researchers from the USDA tested on Canadian Thistle, an invasive plant mentioned in the EA. They found that a combination of 5% vinegar with water killed 100% of the top perennial growth of these plants[lxxiv]. With the above stated, there should be more research going into finding other alternatives.

We urge the National Park Service to adopt a least-toxic pest management policy in Alaska and in all of its parks. To protect the human health and the environment, a pest management strategy should be:

- ☐☐☐ Least disruptive of natural controls.
- ☐☐☐ Least hazardous to human health.
- ☐☐☐ Minimize negative impacts to non-target organisms.
- ☐☐☐ Least damaging to the school and natural environment.
- ☐☐☐ Most likely to produce long-term reductions in pest control requirements

The pest management program should provide regular monitoring to determine if and when treatments are needed to prevent damage or health problems. Educational, physical, mechanical, and biological measures of prevention and control must be given priority over chemical measures. Pesticides will be used as a last resort only if pests present a health and safety hazard, not for aesthetic or nuisance purposes. If pesticides are used, the Park Service should use the smallest amount of the least toxic formulation with the least potential for human exposure. Further, no chemical is permitted for use if it is acutely toxic, or has been proven to cause cancer, hormone disruption, reproductive damage, immune system damage or nervous system toxicity. The NPS should apply the precautionary approach in all pest management decisions to prevent harm to human health and the environment from the use of toxic pesticides that have not been fully tested.

Conclusion

The use of herbicides to manage non-native plants would be contrary to the National Park Services mission to preserve "…unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations.[lxxv]" Herbicides in your proposal such as Glyphosate, 2,4-D, and Imazapyr have been linked to deleterious effects on the health of humans and animals. The effects of inert ingredients have not been considered by the National Park Service, but they may increase the toxicity and environmental impact of the proposed herbicides. Also, the persistence and low attenuation rate of herbicides in cold climates should be considered in the environmental impact statement.

We urge the National Park Service to adopt a least-toxic pest management policy to preserve and protect our National Parks. We also ask the NPS to take these comments into full review and consideration and realign its environmental assessment accordingly. We are confident that once full exposure and risks are accounted for, it will be clear that the risks to human health and the environment from herbicides listed in the EA are unacceptable.

Please ensure that these comments are entered into the public record and confirm receipt. Thank you for your careful consideration of our comments.

Pam Miller Sara Hannon Ryan Gallman

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