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Dedicated to the preservation and restoration
of the native biological diversity
of Whidbey Island and the Pacific Northwest

Nov. 13, 2003

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FROM: **Steve Erickson**
RE: **WA-WA-EIS-98-3-F (Cross-Base Highway)**

Please take these comments into consideration and make them part of the record.

WEAN urges rejection of the preferred alternative and selection of the No Build alternative. The preferred alternative will have unacceptably high environmental impacts and costs that are not adequately analyzed or mitigated. I submit these comments based on 20 years of professional experience in ecological restoration in the northwest, including of grassland ecosystems.

Comment-1. The no build alternative, as presented in the FEIS, is specious. Rather than use as the non-project alternative just that (not building the project), a straw man of other projects that theoretically might occur is used (i.e. relocation of the McChord AFB runway) for comparison.[1] If these other projects are not simply theoretical, those that are not replaced by the proposed alternative are in addition to it. Therefore, the cumulative impacts of the preferred alternative must be in <u>combination</u> with these

[1] "The extension of the runway may not occur for many years. Animal populations should be enhanced now and for the indefinite future, irregardless of what the distant future may bring." McChord AFB Staff Comments; Volume 3 - Comment Letter and Responses. This point is reiterated numerous times in different comments from McChord AFB.

other projects and should be analyzed as such. Instead, the FEIS evaluates the impacts of the highway in comparison with these projects. The FEIS also glosses over the non-linear (i.e. non-isolating) effects of these other possible projects when compared to the highway. Moreover, SEPA does not allow this evasion of proper evaluation of the actual environmental impacts of the proposal. By using as a baseline alternative an unreal non-project alternative, the true magnitude of the impacts of the project is masked.

Comment-2. The FEIS fails to properly recognize that Oak savannah and grassland in the Puget lowlands have already been reduced by over 90% of their pre-settlement extent and that these vegetation mosaics are some of the rarest and most endangered plant associations in the world. Any further reduction is significant in and of itself, regardless of comparison with the already reduced extent of these ecosystems. The result is a failure to properly recognize the significance of the projected losses from the preferred alternative.

Comment-3. The preferred alternative proposes to extirpate from a significant portion of its range one of the rarest mammals in Washington. This population of Western Gray Squirrel (WGS) has already undergone serious decline. It is doubtful that this population can withstand the proposed reduction in numbers, and the currently available habitat, even if not currently occupied, will certainly be needed for recovery. As discussed below, the preferred alternative proposes to permanently isolate from use by this rare mammal a large area of several thousand acres. The mitigation proposed is woefully inadequate considering the magnitude of the proposed impact.

Comment-4. We concur that the planned impacts to the Aster curtus populations would be regionally significant. (p. 4-141) However, this significance is not reflected by the preferred alternative. The planned mitigation is inadequate to mitigate these impacts for several reasons. The proposed mitigation strategy of translocating Aster curtus that will be directly impacted does not consider the impact to overall viability of this species in the area north of the proposed highway.[2] Before relying on this mitigation strategy, reliable techniques need to be developed and demonstrated showing that this species can successfully and reliably be translocated to the point of successful reproduction and persistence over time. There should also be modeling comparing the relative benefits to the species' persistence north of the new highway from increasing the population size of the remaining occurrences versus the increased vulnerability to stochastic events from reducing the number of occurrences.[3]

There are three reasons for this. First, generally speaking, translocation of rare plants has a poor record of success, especially when performed as mitigation for a construction project with typically limited budget, lack of attention to detail, and poor follow-through (i.e. in a mitigation context) and limited time frame. Second, even if the translocations are successful, the obvious result is that there will be fewer occurrences, though those remaining may be larger. Because there are fewer occurrences, the species will have less buffering from impacts due to stochastic events. Therefore, Aster curtus north of the new highway may have a higher probability of extirpation, despite the remaining occurrences being larger (assuming the translocation is successful). Third, over longer periods of time the new highway

[2] No genetic analysis has been performed on the Aster curtus in this area, so it is not known whether the individual occurrences are completely reproductively isolated over longer periods of time. (This seems unlikely.) Therefore, it is unknown whether these are isolated populations or occurrences that are part of a larger metapopulation. For this reason, I refer to the individual occurrences as just that - occurrences.

[3] The discussion on p. 4-134 recognizes the increased vulnerability to extirpation from reduction of individual population sizes, but fails to consider the increased vulnerability to the species north of the highway resulting from reduction in the number of occurrences.

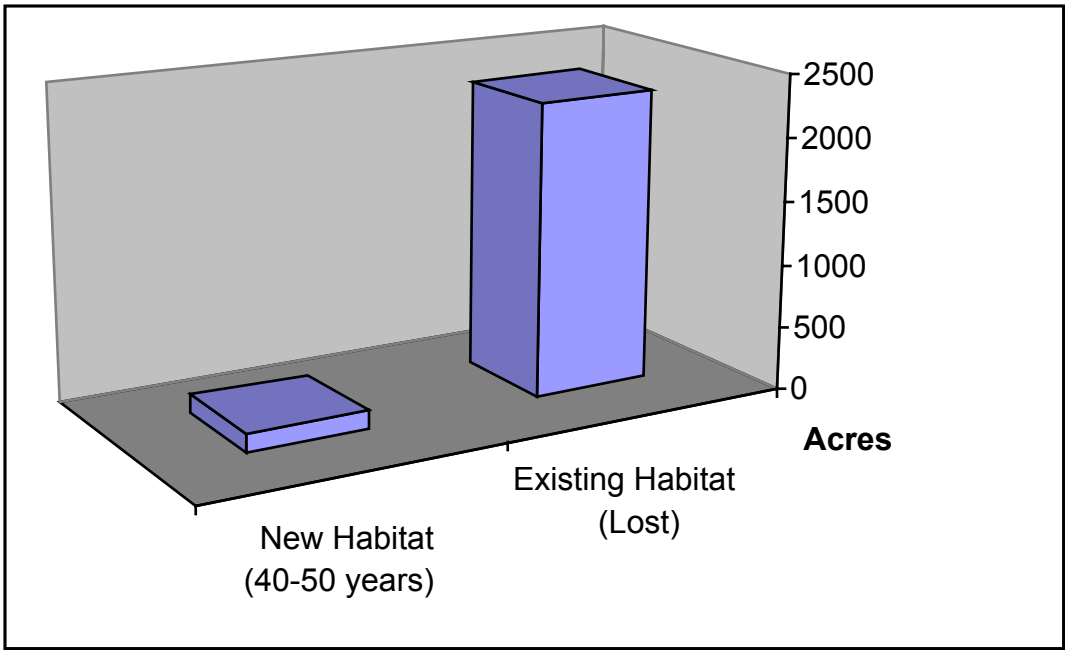
will act as a barrier to possible dispersal from the larger occurrences to the south, preventing genetic and demographic rescue effects or recolonization after localized extirpation. The net effect is to increase the probability of extirpation of the Aster curtus occurrences north of the new highway from stochastic and possibly genetic effects, create a barrier preventing movement of the populations south of the new highway, and thereby increase the probability that this extirpation will be permanent.

Comment-5. The justification for rejecting even a 1:1 mitigation ratio for lost WGS habitat is specious. The reason given is that mitigation ratios are not required by law and that there are no standard ratios for mitigating impacts to this species. However, this fails to address the rationale behind mitigation ratios: first, to account for the rarity and/or high value of the lost system or habitat; second, to assure that any inherent uncertainty of mitigation success is accounted for; and third, to account for temporal loss while the mitigation habitat develops sufficiently to replace that lost. I address these concerns below. However, it is important to realize that even the most optimistic assessment of the proposed mitigation still produces a negative mitigation ratio of about 1:6.5. That is, for every 6.5 acres of habitat lost, mitigation will provide only 1 acre of new habitat – and that after 40-50 years.

Comment-6. As bad as the above mitigation ratio is, it understates, and the FEIS actually overstates, the area of lost WGS habitat replaced by the Roy mitigation site, since portions of the Roy site are already functional habitat. (130 acres of possible habitat and 67 acres of possible travel corridors already exist on the site. p. 4-150) Under the proposed restoration scenario, the Roy mitigation site would ultimately provide 343 acres of possible WGS habitat (p. 4-153). Therefore, the actual provision of new WGS habitat is at best 146 acres, a negative mitigation ratio of 1:15.9, or 15.9 acres of existing habitat lost for each acre of new habitat provided in 40-50 years.

In 20 years I have never encountered or heard of such inadequate mitigation ratios under any circumstances. Were the proposed habitat losses of wetlands, the proposed mitigation would simply be laughed at. It is for one of the rarest mammals in Washington, and the sheer inadequacy is simply mind boggling.[4]

[4] While the screening criteria and prioritization of potential mitigation sites are good for selecting potential restoration sites, there are two major defects in terms of selecting potential mitigation sites (i.e. sites for restoration that will replace the lost habitat and function). First, the criteria fail to place site selection into a mitigation context, failing to account for habitat loss during the 40-50 years necessary for the mitigation acreage to become functional, as well as take into account the sheer quantity of lost habitat and the area necessary for reasonable mitigation of this loss. See comment-9. The FEIS fails to provide any targets or even discussion of this issue. Second, screening did not, apparently, include landscape level analysis in terms of improving landscape level connectivity. See comment-8. Because of the lack of any individual parcels that are large enough to provide adequate mitigation, an approach also (in addition to the Roy site) providing for the acquisition and restoration of many separated parcels or smaller clusters of parcels might be acceptable if the sheer area was large enough. This approach was not used. The second defect could be cured by the approach suggested in comment-12 and the analysis suggested in comment-13. At least then we would know the actual extent of increased connectivity of remaining existing squirrel habitat, so as to be able to make informed decisions. Instead, the FEIS appears written to justify the preferred alternative without providing the necessary information. Both of these approaches require the much more expensive acquisition, restoration, and perpetual conservation of much larger areas.



Comment-7. The project proponents may correctly argue that use of a simple mitigation ratio does not take into account habitat quality and function, such as connectivity. However, the proposed mitigation still fails to adequately replace the lost habitat and function. This is for several reasons:
i. The vast disparity in size between the WGS habitat proposed for loss (2,324 acres) and the new habitat to be created (146 acres). Even if the existing WGS habitat (an additional 197 acres) on the Roy mitigation site is included, the size disparity is still enormous;
ii. The very long time before the new habitat is at least semi-functional (40-50 years);
iii. The likely minimal function even after this time period; and
iv. The failure to demonstrate any (let alone major) increase in landscape level function (such as connectivity of currently unavailable habitat) due to the mitigation.

For the mitigation to outweigh these problems, the new habitat would have to be both extremely high quality and have very outstanding functional value, such as being essential to WGS survival or recovery, or providing connectivity to a very large area of formerly unavailable habitat. As pointed out by the Washington Dept. of Fish and Wildlife, major mast production cannot be expected from 40-50 year old oaks. Moreover, trees of this age are far too young to have developed important structural attributes such as cavities. (If creating snags from conifers is expected to fulfill this function, there should be modeling of the numbers and densities of snags that will be created, as well as careful attention to whether sufficiently large trees will be available to produce snags of sufficient size.) Therefore, even ignoring the experimental nature of the proposed mitigation due to its scale and the resulting high risk of failure, it simply will not produce truly high quality WGS habitat. There is no reason to believe that the proposed mitigation is essential to WGS persistence or recovery, or even sufficient to prevent an overall net loss of habitat and function, particularly in the context of the proposed habitat and functional loss of 2,324 acres of existing functional habitat. The failure to mitigate for lost connectivity is discussed below.

Comment-8. The Roy mitigation site does not make up for lost connectivity to the area north of the highway. The actual area of WGS habitat lost is acknowledged to be the entire area north of the new

highway. The FEIS acknowledges that squirrels will be extirpated from this entire area and that the highway will be an impassible barrier for this species, dooming to extirpation squirrels currently in this area and preventing all future use of 2,324 acres that are currently available (p. 4-134). The actual proposed mitigation is to ultimately create (in 40-50 years) 146 acres of habitat that currently does not exist (about 6.3% of that lost). While the restoration plan posits that the mitigation will eventually create travel corridors, the FEIS does not demonstrate how these corridors will provide connectivity to any existing habitat that is not already connected. At issue is not providing connectivity within or to the mitigation site, but within the larger landscape. While providing redundant connectivity and producing new areas of habitat may be desirable, the proposed mitigation must be judged against the proposed impact of completely and permanently isolating 2,324 acres of existing habitat now.

Nor does the FEIS quantify this posited newly connected habitat. Nowhere is the proposed mitigation site displayed on an aerial photo or other figure showing its relation to surrounding vegetation in the same area. Based on Fig. 7a (p. K-41) it appears that about 3-4 miles north of the mitigation site there may be a development barrier preventing or greatly inhibiting squirrel movement to the north. It also appears that there are areas of grasslands and development to the east of the mitigation site which are also likely dispersal and movement barriers. An "eyeball estimate" is that the Roy mitigation site, when functional, might connect less than 1500 acres of existing possibly isolated potential WGS habitat to the north of the mitigation site with that to the south. Showing the mitigation site on fig. 7a and 8a is necessary, as is quantifying how much currently isolated habitat would potentially eventually be connected by the proposed mitigation, thereby becoming newly available for use by the WGS. However, squirrels have previously been sighted both to the north and south of the mitigation site, so it is unclear if any of this area is currently isolated. If this area of habitat (apparently considerably less than that lost) is not currently isolated, there is no justification for any claims that the proposed mitigation will replace, or even mitigate, the proposed complete isolation and loss of the area north of the highway, particularly given the enormous disparity in size between the mitigation area and that lost.

Comment-9. The proposed mitigation for the WGS ignores temporal loss (p. 4-153 "40-50 years", even assuming that this is accurate). Loss of 2,324 acres of potential habitat now is proposed to be mitigated by experimental efforts to create 146 acres (p. 4-153) of new habitat in 40-50 years.

The FEIS states that a "cost/benefit evaluation is not appropriate for these mitigation measures because of the inherent difficulty and inaccuracy of placing a monetary value on habitat, wildlife, and species diversity." I agree. A pound of rare squirrel is not equatable to a pound of SUV saving a few minutes on a commute. However, it is simple to determine the relative value placed on the existing habitat proposed to be lost now in comparison to the value placed on the habitat presumed to be gained in the future. Common practices used for evaluating the return on investment in numerous fields (i.e. forestry, stocks and bonds, etc.) are applicable here. These allow a comparison of the value placed on the existing WGS habitat that will be lost now in comparison to the value of the habitat that is proposed to be created in the future. Acres of existing habitat lost now are treated as an investment made in the present, and habitat gained later is treated as a return on that investment in the future.

When making investments, people usually want to know if they are making the best investment and what return on their investment can be expected. The standard equation used for calculating expected returns on investment is:

$$F = P\,(1 + r)^n$$

Where:

F = Future amount of money (or acres of WGS habitat, in this case)
P = Amount of money invested now (or acres of WGS habitat, in this case)
r = Expected rate of return (interest rate)
n = length of investment (years)

For example, $1 invested at 10% interest is worth $13,780.61 after 100 years, while $1 invested at 5% interest is only worth $263.00 after 100 years.

Future Value	**Present Value**	**Interest Rate**	**Number of Years**
$13780.61	$1	0.10	100
$131.50	$1	0.05	100

Similarly, it can be determined how much investment is necessary now to generate a particular future return:

$$P = F/(1 + r)^n$$

As stated in the FEIS, it is extremely difficult to assign a monetary value to resources that have no obvious market value. In this case, the problem is avoided since we're not trying to establish a common currency between, say, squirrels and jets, but between WGS habitat now and in the future. Instead of attempting to assign an absolute value by placing a dollar value on WGS habitat, both the investment made now (loss of existing habitat) and the future return on that investment (habitat gained in the future through mitigation) have similar natural units of measurement (acres). Since the purpose is to compare the habitat lost now (the current investment) with the mitigation habitat to be provided in the future (the projected future return on investment) and vice-versa, this approach allows us to see what value the proposed Cross-Base Highway project places on WGS habitat. If WGS habitat is highly valued by the project proponents, they will presumably use a high rate of return. If WGS habitat is not valued highly, there will be a low rate of return.

A final note on this discussion. When investments are risky, people usually expect a high rate of return on their investment. The rate of return on junk bonds is higher than treasury bonds. As discussed elsewhere (see comments-7 and 10), both the efficacy and eventual success of the proposed mitigation are questionable. This argues for a high rate of return on "invested" (lost) WGS habitat to reflect the risk of failure. And of course, the biological risk of the "investment" (loss of habitat) now is that it pushes the WGS beyond a point where it can persist long enough or be able to take advantage of the new habitat in 40-50 years when it finally is available. These two factors, risk of mitigation failure and WGS extinction, combine to make the proposed "investment" (loss of habitat) inherently risky. However, the modeling shown below uses the interest rate commonly used in determining forestry investments, 5%. It does not reflect the obviously risky nature of the "investment."

Constants

Area of existing habitat proposed for loss (investment)	= 2,324 acres (p. 4-134)
Area of new habitat proposed for creation (return on investment)	= 146 acres (p. 4-150, 153)
Time for new habitat to become functional	= 40 or 50 years (p. K-132)

Present Value of Proposed Future Mitigation Habitat

With a 5% rate of return, the proposed future creation of 146 acres of WGS habitat is worth only approximately 20.7 or 12.7 acres of habitat existing now. In other words, with a 5% interest rate the proposed mitigation can only justify (at a 1:1 mitigation ratio) loss of 20.7 or 12.7 acres now.

Present Value (acres)	Future Value (acres)	Interest Rate	Number of Years
20.74	146	0.05	40
12.73	146	0.05	50

Proposed Rate of Return for Existing Habitat

Because the proposed mitigation habitat to be provided in the future (146 acres) is smaller than the existing habitat that will be lost now (2,324 acres), a negative rate of return of approximately -6.7% or -5.4% is proposed for the Cross-Base Highway. In other words, the investment is a losing proposition that cannot turn a "profit."

Future Value (acres)	Present Value (acres)	Interest Rate	Number of Years
145.61	2,324	-0.067	40
146.28	2,324	-0.054	50

Future Value of Existing Habitat

So how much is the existing habitat "worth" in the future? Using a 5% rate of return, the 2,324 acres of existing WGS habitat proposed for loss now is "worth" approximately 16,354 or 26,639 acres after 40 and 50 years respectively.

Future Value (acres)	Present Value (acres)	Interest Rate	Number of Years
16,353.89	2,323	0.05	40
26,638.77	2,323	0.05	50

Comment-10. As far as I am aware, the proposed mitigation near Roy would be the largest savannah and non-wetland grassland restoration ever attempted in the Puget lowlands. Techniques and their application for restoration on this scale are unknown or at best uncertain.[5] Practical difficulties include lack of proven techniques for elimination of the existing soil seed bank on the proposed mitigation site.[6]

[5] Even without the problems caused by the sheer scale of the proposed restoration, the FEIS simply assumes success at activities that are typically extremely difficult or highly problematic. For example, the FEIS blithely states that large patches of Reed Canary Grass will be selectively removed from wetlands (p. K F-34), without stating how this extremely difficult task will be accomplished. Typically, establishing (and maintaining) trees that will eventually shade out this invasive species is the most effective long-term technique for its control, though if it occurs upstream in the aquatic system continuing invasion may be a problem. However, in the situation presented, there will be open areas (i.e. without tree canopy) maintained in the wetland. This one short sentence in the FEIS is potentially representative of hundreds or thousands of hours of continuing work over many years.

[6] Of greater concern for long term restoration success than short-term removal of existing non-native vegetative cover is the presence of invasive exotic species present as viable seeds. Many common agricultural weeds have seeds which remain viable in the soil seed bank for decades and even hundreds of years. Scot's broom seed will likewise remain viable for (at least) decades. While these species may initially appear suppressed due to elimination of above ground plants, they will reappear from the seed bank following disturbance from mechanisms such as animal burrowing and digging, fire, etc. Such disturbances are not only predictable, but necessary for persistence of the plant communities targeted for creation. Yet, the proposed management of the Roy mitigation site ignores the presence, let alone the difficulty of controlling, the weedy seed bank, and even proposes to allow some presence of Scot's Broom (p. K-129). With the resources which should be available for mitigation of the proposed severe impacts of the project, eradication of Scot's Broom over an area of this size should be trivial. A flail mower and 10 person crew for a year should be adequate to eradicate all above ground plants of this noxious species, though this will not address the species presence in the soil seed bank.

This difficulty is completely glossed over with the assumption that in the existing degraded pasture (for example) simply disking and then seeding native herbaceous species will be successful at establishing the natives (p. K F-30). Another major operational barrier to successful restoration is the unavailability of necessary propagules (seeds) on the required scale.[7]

Additionally, in my experience, the typical agency method of having mitigation be a subordinate contract to an overall construction contract is also a significant operational barrier to successful mitigation. In these mitigation situations, low-bid methodologies and the short-term interest of prime and sub-contractors typically results in inadequate short-cutting and lack of continuity. In discussions I've been involved in regarding mitigation for possible impacts to prairie systems elsewhere in the Puget lowlands, WDOT personnel have been adamant that even a 10 year mitigation and monitoring period is beyond consideration by the agency. The FEIS suggests monitoring for 10 years "following substantial completion of construction" (p. K F-36).[8] I believe that fairly intensive restoration activities and monitoring will need to continue for considerably longer. The FEIS also proposes monitoring "at least once a year" (p. K F-36). Given the diversity of habitat types, and activities proposed, monitoring different habitat elements and activities will need to be conducted at various times of the year. Given the experimental nature of many of the proposed activities (i.e. introducing a shrub component under an existing tree overstory; large-scale planting of Garry Oak; enhancement and creation of herbaceous prairie) the lack of a section explicitly stating which activities are highly experimental is surprising and a serious deficiency, as is the lack of a clearly stated section discussing what responses the project proponents will take if the mitigation or particular mitigation activities fail. Will they simply repeat previously failed methods? The conceptual restoration plan needs considerable revision to deal with the experimental nature of much, if not most, of the proposed restoration. A 40-50 year mitigation period and maintenance in perpetuity, as projected for the Roy mitigation site, is clearly beyond the bounds of these agencies' existing culture and procedures.[9]

These barriers to successful restoration are not trivial or easily overcome and occur for even small scale restorations of these systems. In short, any restoration or recreation of these systems, especially on this scale, is experimental and success is uncertain. The sheer scale of the mitigation proposed for this project is such that the likelihood of failure is drastically increased. Finally, the FEIS does not explicitly commit the project proponents to actually fully funding even the minimal mitigation proposed (p. K F-31 Table 5: "Develop funding to insure implementation of restoration and management plan.") Full mitigation, including site acquisition, restoration, and long-term management and conservation must be funded by the project proponents.

Comment-11. Proposed management of the Roy mitigation site as presented in the FEIS suffers from several deficiencies. Proposed management of the grassland component includes "low impact grazing" to prevent invasion of trees and shrubs (p. K-129). It is unclear why this experimental technique was chosen as opposed to others, but in any event I do not believe this strategy would be successful. First, its

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[7] The statement that local sources of seed will be used is meaningless because of the caveat "to the extent possible." Local sources will not be available without a commitment by the project proponents matched by the necessary and substantial long-term funding and lead time to collect initial seed stock and perform growouts for seed production. The time-frame for such a program is realistically from 5 to 10 years and the cost is quite high (i.e. in the $1000s per acre of the area to be planted).

[8] This appears to be boilerplate language typically included in wetland mitigation specifications where earth moving is required.

[9] I've attached a copy of an outline I use in teaching workshops titled "How to Plan a Restoration Project." In the context of the proposed mitigation for the Cross-Base Highway, the cartoon on the front seems a very apropos comment.

likely that livestock will selectively eat Festuca idahoensis v. roemeri (i.e. the cows will treat it as an "ice cream" plant). Second, "low impact" grazing will likely not have the intended effect. Under light grazing pressure, it is unlikely that the livestock will graze or trample shrub and tree seedlings. They will, however, graze and trample the native herbaceous species which are desired in the understory, as well as transport and introduce undesirable non-native plant seeds ("weeds").

Also proposed is mowing. However, heavy reliance on mowing will tend to shift species composition and encourage rhizomatous non-native grasses.[10]. Burning is preferable, since it is the disturbance agent these prairie and savannah systems are adapted to, though it will not necessarily control alien rhizomatous grasses and will likely shift the species composition towards a more forb (instead of graminoid) rich composition.[11] [12] However, the proximity of the mitigation site to Roy may make frequent burning extremely difficult. As mentioned, mowing will not have the same effects and should not be counted on as the main management tool if the intent is long-term maintenance of the site as a savannah-prairie vegetation complex. This potential management limitation for the Roy mitigation site is not recognized or discussed, but has potentially far reaching effects on the viability of both existing habitat and the proposed restoration.

Also proposed is fencing riparian areas on the mitigation site to protect riparian areas from grazing. If the site is to be acquired for perpetual management as mitigation for impacts from the highway, I simply do not understand why livestock is simply not removed. Are the project proponents proposing less than fee simple acquisition of the mitigation site? If so, this must be disclosed now, along with the likely limitations on control and management.

Comment-12. The proposed mitigation explicitly includes actions reliant on voluntary land owner cooperation (i.e. conservation easements instead of fee simple acquisitions). These include actions to be taken on properties adjacent to the mitigation site and conservation easements on lands extending to the north. These actions are desirable; however, as presented they are just a "wish list," not a commitment to actual mitigation. If the project proponents are making a commitment to perform these actions (even if, for example, condemnation is required), they should say so, explicitly commit to a goal and the necessary funding to achieve the goal. For example, "Besides fee simple acquisition of the Roy mitigation site, conservation easements will be obtained to the north in an attempt to provide a continuous corridor and buffer adjacent to Fort Lewis averaging about 1/4-1/2 mile wide and extending far enough north to provide connectivity to the currently isolated or poorly connected WGS high quality habitat on Fort Lewis about 4-5 miles north of the mitigation site. Some portions of the corridor may be acquired through fee simple acquisition. Project proponents will execute legal instruments sand provide sufficient funding to assure ecological restoration of these areas and conservation and management in perpetuity."[13]

Otherwise, these actions should be explicitly presented as merely being desirable with no commitment on the part of the proponents to assure that they occur. In this case, the adequacy of the proposed mitigation is reduced, since portions of the mitigation site may then have incompatible

[10] Personal observations at Camp Rilea, Orgeon.

[11] See, e.g., Dunwiddie's work regarding burning on Yellow Island since the 1980's.

[12] It is somewhat surprising that the conceptual management plan nowhere discusses the variability over time of forb-grass dominance that would be expected to occur on the mitigation site.

[13] The justification for these widths (1/4-1/2 mile wide) is the shyness of the WGS and the need for buffering from disturbance and alien weed invasion.

adjacent activities (i.e. weed presence) permanently threatening the integrity of the mitigation and the proposed mitigation will not enhance landscape level connectivity (assuming it does at all; see comment-10).

Comment-13. The FEIS states that the mitigation "can increase the effective patch size of existing habitat on Fort Lewis" (p. K-131). However, the FEIS lacks any analysis of whether the proposed mitigation will, in fact, achieve this goal. There needs to be a quantitative analysis as to whether or not the mitigation will achieve this goal. The analysis must also compare the effective patch size for the entire Fort Lewis-McChord AFB area under current conditions, with loss of the area north of the proposed highway (mitigation failure scenario), and with the mitigation after 40-50 years (mitigation success scenario). This should include both number of patches, a metric of their connectivity, and their size (average, mean, and distribution).