

significant unit, and control of all threats at each managed field location. Field locations are defined in the Makua Implementation Plan.

The goal of the Makua Implementation Plan is to stabilize species that otherwise would be jeopardized by military training in the Makua action area. Stability is not synonymous with recovery (i.e., delisting) (Makua Implementation Team 2003). Owing to limited knowledge of the life history requirements for short-term and long-term survival of endangered plants, Service recovery plans specify interim objectives to recovery that involve stabilization of all existing populations (Service 1999b, 1998 a). Sustaining a population unit at the minimum number of reproducing individuals for stability over the short-term can prevent extirpation by ensuring adequate regeneration. Recruitment of younger individuals into subsequent generations of mature, reproducing plants likely will improve a species' probability of survival. Stabilization alone, however, is inadequate over the long-term to achieve full recovery.

The Makua Implementation Plan incorporates the stabilization objectives outlined in Service recovery plans, and is based on conservation actions recommended for recovery. These actions include fencing all known occurrences; controlling non-native ungulates and plants; augmenting existing occurrences and establishing new ones; protecting occurrences from fire; investigating and implementing methods to control non-native slugs, snails, and insects; maintaining *ex situ* collections; and conducting research on pollinators. Numerical criteria for stabilizing a species are less stringent than those recovering (delisting) a species. Recovery criteria require eight to ten populations of 100 mature, reproducing individuals for long-lived perennials, 300 for short-lived perennials, and 500 for annuals (Service 1999a, 1998a, 1997). Stabilization approximates conditions necessary for survival of a species in the wild and is a prerequisite for recovery. Achieving stabilization, therefore, will enable the Army to comply with the Endangered Species Act jeopardy standard by avoiding or minimizing actions that will reduce appreciably a species' likelihood of both survival and recovery in the wild. Although recovery is the ideal, the Army is only expected to stabilize, not fully recover, species in order to avoid the likelihood of jeopardy resulting from military activities.

A population unit designated as "manage for stability" usually occurs in habitat that is relatively intact or restorable, and where threat control is expected to encourage natural regeneration. The Makua Implementation Plan designated, on average, six population units to be managed for stability for each target taxon, with the intent that at least three of the population units would be successful. Thus, monitoring to determine the response of target taxa to management is critical to achieving stability. If the number of individuals in a population unit declines, monitoring allows the Makua Implementation Team to adapt management actions to deal with the likely causes of decline through additional threat control actions and/or augmentation/reintroduction. Threat management includes control, as needed, of ungulates, weeds, rats, slugs, and insects. Ungulate control typically requires construction and maintenance of fenced exclosures. Within fenced population units, aggressive control of understory weeds is required within a 2-m (6.6-ft) radius of target taxon individuals. Long-term threat management goals include eradication of incipient invasive weeds at the population unit scale (within a 50-m (164-ft) radius of target plants). For other weeds, long-term weed control goals require eradication of up to 25 percent of existing weed cover in the proximity of population units and up to 50 percent total weed cover across the management unit or subunit.

A population unit designated as “manage for genetic storage collection” generally contains few individuals of the target taxon and poor conditions for regeneration or habitat rehabilitation. The purpose of genetic storage is to achieve adequate, appropriate *ex situ* storage of genetic material as insurance against loss of a population unit or reintroduced individuals. Options include seed storage, *in vitro* tissue storage through micropropagation, and living collections of cultivated plants in greenhouses and botanical gardens. For each population unit, at least 50 seeds will be collected from each of 50 individuals (but no more than 20 percent of all seeds produced each year), or three clones will be maintained in micropropagation, or three cultivated plants will be maintained in the greenhouse. For population units with fewer than 10 individuals, at least 20 percent of all seeds produced will be collected during the initial years, until sufficient material is collected for storage and augmentation/reintroduction needs. For species that can be propagated vegetatively, cuttings will be collected from non-fruiting plants. For very small population units of fewer than five individuals, each individual also will be represented as a living collection, typically as a potted plant in a greenhouse.

6.2 Makua Implementation Plan Addendum

For this consultation, the Army revised the Makua Implementation Plan to address the logistical difficulties of off-site conservation management and to reduce the cost of species stabilization actions. The Army’s proposed Makua Implementation Plan Addendum for Makua Military Reservation outlines actions to attain three stabilized, naturally reproducing population units for each target taxon (U.S. Army Garrison Hawaii 2005a). Instead of managing up to six population units per taxon to ensure that at least three eventually are stabilized, as recommended by the Makua Implementation Plan, the Makua Implementation Plan Addendum focuses management efforts on the three (or in a few cases, four) most viable prospects for success. Four population units will be managed for stability for species present in the action area of both Makua and Schofield Barracks Military Reservation, for certain species occurring in the high fire risk zone of the Makua action area, and for certain species for which stabilization will rely greatly on reintroduction. Accordingly, the Makua Implementation Plan Addendum addresses management for approximately 92 plant population units, instead of the 188 plant population units included for management in the Makua Implementation Plan. The purpose of additional population units in the Makua Implementation Plan was to provide future “back-ups” if any population units within the action area were extirpated before stabilization could be achieved; this option is no longer maintained under the Makua Implementation Plan Addendum. In addition, under the Makua Implementation Plan Addendum, the Army will focus the collection of genetic material primarily on those species that are most threatened by fire and that exist in very low numbers, with the purpose of supporting augmentation of population units and ensuring the availability of genetic material for future efforts. The Makua Implementation Plan provided for collection of genetic material from all *in situ* population units.

The projected time frame for the Makua Implementation Plan was 33 years; the projected time frame for the Addendum is 20 years. Like the Makua Implementation Plan, the Makua Implementation Plan Addendum includes population unit actions for each stabilization taxon and management unit actions to improve habitat on an ecosystem basis, as well as an implementation schedule and budget. The Army will provide an annual progress report that lists and describes the species specific management actions completed to date as they relate to the actions identified

in the Makua Implementation Plan. This report will be organized in a manner agreed upon by the Service to ensure that the progress meets the goals of the consultation. The Makua Implementation Team will conduct an annual assessment of management results by reviewing monitoring data to determine the Army's progress toward achieving stabilization of the target taxa within a reasonable time frame. The annual review also will allow for modification of stabilization strategies as needed, using an adaptive management approach.

6.3 Management Units

In addition to designating population units for stabilization management of target taxa, the Makua Implementation Plan also designated larger management units for ecosystem-level habitat management and threat control. The geographic scope of the Makua Implementation Plan included the entire action area (as then delineated) plus portions of the natural geographic ranges of the target taxa considered necessary to achieve their stability. Thirty-one management units were designated, based on the location of *in situ* population units and potential reintroduction areas for the target taxa. Together the management units covered 2,571 ha (6,353 ac) and were intended to define a large, contiguous landscape of habitat for the target taxa. In general, the management units encompassed most of the population units to be managed for stability or reintroduced for stability. Most management units would be fenced, and ungulates and other threats, such as non-native invasive plants, would be controlled. These actions also would benefit critical habitat for endangered plants and the Oahu elepaio within the management units.

The Makua Implementation Plan Addendum retains the basic implementation program of the Makua Implementation Plan while reducing the number of population units managed for stabilization, and the number and area of management units managed for ecosystem restoration. Six management units were eliminated and most of the remaining ones were reduced in area. The Makua Implementation Plan Addendum identifies 23 "priority management units" encompassing approximately 934 ha (2,307 ac) of "priority habitat." This area represents a 64 percent reduction from the area designated for the 31 management units in the Makua Implementation Plan. By reducing the number of population units managed for stability, and the number and area of management units to control ecosystem-level threats, the Army expects to reduce average annual costs to approximately \$3.3 million instead of \$8 million needed to implement the Makua Implementation Plan (U.S. Army Garrison 2005a). Chapter 2 of the Makua Implementation Plan Addendum describes the conservation actions the Army will implement within each management unit, and Chapter 3 describes the modified management units.

The 23 priority management units are located in the Waianae Mountains and Koolau Mountains of Oahu where the most important wild populations of the target taxa occur (see Figure 1). These management units are located on lands owned by the Army, State of Hawaii, City and County of Honolulu Board of Water Supply, and private entities. Cooperation through memoranda of agreement with landowners will be required before the Army can initiate management actions at non-Army sites. Eight management units are located on Army lands or within the Makua action area: Kahanahaiki, Kaluakauila, Lower Ohikilolo, and Ohikilolo are located on Makua Military Reservation; the Keauu and Makaha management unit is located on State lands within the action area; and the Pahole, Upper Kapuna, and West Makaleha

management units are located on State lands that are partially within the action area. Some of the management units on non-Army lands, such as Pahole (which is operated by the State of Hawaii as a Natural Area Reserve) and Ekahanui, Kaluaa and Waieli, and Palikea (which are operated by The Nature Conservancy of Hawaii as part of Honouliuli Preserve), are already being managed to varying degrees to protect sensitive species.

Table PD 6 lists the 23 priority management units identified in the Makua Implementation Plan Addendum and how they have been modified from those designated in the Makua Implementation Plan. Table PD 7 lists seven management units or subunits that are fenced, 22 management units or subunits that are planned to be fenced by 2015, and eight management units or subunits that will not be fenced. Dates of future construction are subject to change. Thus, about 32.8 percent of the total proposed management unit area is now fenced, 63.6 percent will be fenced over the next 10 years, and 3.6 percent will not be fenced. Ungulate control, where necessary, includes a combination of monitoring, fencing, hunting, and snaring. Weed control is conducted primarily in the most intact native habitats, for example within the seven management units with ecosystem-level fences and at five unfenced sites where ungulates are not a threat owing to the presence of topographical barriers. In general, weed control effort is prioritized to areas of high native plant cover, around target taxa individuals, and at potential augmentation/reintroduction sites. Over the last two years, Army Natural Resources Staff has established “weed control areas” in the management units and have begun to standardize weed monitoring and reporting (U.S. Army Garrison 2006c). Most of the weed control areas contain population units of target stabilization taxa and surrounding native habitat, and weeds within a 15-m (50-ft) radius around the population units are removed directly around the target plants (U.S. Army Garrison 2005c).

Other conservation management actions the Army is implementing to varying degrees in the management units include rat control, propagule collection, outplanting of target plant taxa, research on slug and insect control, and maintenance of two small fenced exclosures to protect Oahu tree snails. In addition, fire management plans for the management units have been completed. Actions including grass clearance from within 3 to 5 m (10 to 16 ft) of stabilization plants, and Army fire suppression assistance on fires threatening management units will be completed in order for the fire threat to be considered to be adequately controlled by the Army. Additional fuelbreaks, firebreaks, or other fire protection systems necessary to ensure that the habitat in the management units is not burned by a wildland fire, will be a necessary stabilization action. Army annual reports describe all ongoing actions implemented for conservation of target taxa within population units and management units (U.S. Army Garrison 2004a, 2005c, 2006c). Army actions within action area management units are briefly described below (M. Mansker, U.S. Army Garrison, pers. comm. 2006).

The Kahanahaiki, Kaluakauila, Lower Ohikilolo, and Ohikilolo management units are located on Makua that is generally considered goat-free, but pigs still have access to some areas. The Kahanahaiki Subunit I Management Unit is fenced, and both pigs and goats have been removed. Subunit II is not fenced but snaring reduces pig impacts on native communities in that subunit and on the subunit I fence. Management actions within the fenced Kahanahaiki subunit I include outplanting of target taxa, Oahu tree snail management, rat and weed control, monitoring of plants and tree snails, propagule collection, and research on slug damage and control measures.

Table PD 6. Priority Management Units in Makua Action Area (U.S. Army Garrison 2005a, Makua Implementation Team 2003).

Management Units (Addendum)	Acres	Management Units (Makua Implementation Plan)	Acres
1. East Makaleha	231	1. Central and East Makaleha	823
2. Ekahanui	203	2. Ekahanui	221
3. Haili to Kealia	30	3. Haili to Kawaihapai	161
		4. Huliwai (deleted)	118
		5. Kaahole to Paaiki (Kauai; deleted)	468
4. Kaena	52	6. Kaena and Keawaulu	103
5. Kahanahaiki	94	7. Kahanahaiki	97
6. Kaimuhole	100	8. Alaiheihe to Palikea Gulch	619
7. Kaluaa and Waieli	127	9. Kaluaa and Waieli	342
8. Kaluakauila	104	10. Kaluakauila	152
9. Kamaileunu	5	11. Kamaileunu	86
		12. Kauaopuu (deleted)	19
		13. Kaumoku Nui (deleted)	213
		14. Kawaiiki (Koolau; deleted)	44
10. Keaau and Makaha	5	15. Keaau and Makaha	5
11. Lower Kahana (Koolau; new)	3		
		16. Lower Kahanahaiki (deleted)	32
		17. Lower Kapuna (deleted)	266
12. Lower Ohikilolo	70	18. Lower Ohikilolo	70
13. Lower Opaepala (Koolau)	17	19. Lower Opaepala (Koolau)	65
14. Makaha	162	20. Makaha	172
15. Manuwai	166	21. Mt. Kaala Natural Area Reserve	166
		22. Mohiakea (deleted)	19
16. Ohikilolo	200	23. Ohikilolo	578
17. Pahole	215	24. Pahole	215
18. Palikea	45	25. Palikea	127
19. Puu Kumakalii	28	26. Puu Kumakalii	28
20. Upper Kapuna	182	27. Upper Kapuna	225
		28. Upper Keaau (deleted)	10
21. Waianae Kai	9	29. Waianae Kai	125
22. Waiawa (Koolau)	124	30. Waiawa (Koolau)	75
23. West Makaleha	93	31. West Makaleha	255
Total	2,307		6,353

Table PD 7. Fencing Status in Management Units, Makua Action Area (U.S. Army Garrison 2005b, 2005c).

Existing Fence	Acres	Fence Construction (target year)	Acres	No Plans to Fence	Acres
Ekahanui Subunit I	44	East Makaleha (2008)	231	Haili to Kealia Subunit I	20
Kahanahaiki Subunit I	63	Ekahanui Subunit II (2007)	159	Haili to Kealia Subunit II	10
Kaluaa and Waiele Subunit III	107	Kahanahaiki Subunit II (2008)	31	Kaena Subunit I	16
Kaluakauila (UA1)	104	Kaimuhole (2010)-not an option right now	100	Kaena Subunit II	36
Lower Ohikilolo (UA1)	70	Kaluaa and Waiele Subunit IIB (2015)	11	Palikea Subunit IV	9
Ohikilolo (Ridgeline)	162	Kamaileunu (2007 or 2008)	2	Palikea Subunit V	4
Pahole	215	Keaau and Makaha (2009)	5	Puu Kumakalii	28
Kaluaa and Waieli Subunits IIA + IIC	24	Lower Kahana (2014)	3		
		Lower Opaepala (2007)	17		
		Makaha Subunit I (2007)	96		
		Makaha Subunit II (2009)	66		
		Makaha Subunit III (2009)	1		
		Manuwai (2012)	166		
		Ohikilolo (Lower Makua) (2011)	38		
		Palikea Subunit IA (2009)	21		
		Palikea Subunit IB (2009)	11		
		Upper Kapuna Subunit I (2006-2007)	182		
		Upper Kapuna Subunits II, III, IV (2008-2009)	42		
		Waiana Kai (2011)	9		
		Waiawa (2013)	124		
		West Makaleha (2009 (estimated))	93		
Total	757		1467		83

The Kaluakauila Management Unit is fenced and ungulate-free. Management actions include weed control, alien grass control for fuels management, outplanting of native plants, and rare plant surveys.

The Lower Ohikilolo and Ohikilolo management units are bordered by the Ohikilolo perimeter ridgeline fence and are goat-free. The Lower Ohikilolo Management Unit contains a small strategic fence to protect an occurrence of *Melanthera tenuifolia*. Native plants predominate in this management unit owing to intensive control of alien grasses around occurrences of *Chamaesyce celastroides* var. *kaenana*, *Hibiscus brackenridgei* ssp. *mokuleianus*, and *Spermolepis hawaiiensis* (a listed species that is not being managed for stability). In the Ohikilolo Management Unit, actions include weed control, rat control around certain rare plants, propagule collection and outplanting of target taxa, Oahu tree snail management within a small fenced enclosure, and snail habitat restoration through outplanting of common, native host trees. This management unit also contains small fences around occurrences of *Neraudia angulata* and *Pritchardia kaalae*. Lower portions of the Ohikilolo Management Unit are inaccessible to Army Natural Resources staff due to the presence of unexploded ordnance.

The Pahole, Upper Kapuna, and West Makaleha management units are located on State lands that are partially within the action area; the Keaau and Makaha Management Unit is entirely within the action area. Most conservation actions in these management units are implemented by State personnel, with varying degrees of assistance from Army Natural Resources Staff. The Pahole Management Unit is fenced and ungulate-free; management actions include some weed control, outplanting, and propagule collection. In the Upper Kapuna Management Unit, the State is working on fencing subunit I and has built two small fences around reintroduced occurrences of *Phyllostegia kaalaensis*. The Army also assists with goat monitoring and removal and weed control, and will assist in future construction of fences around the three other Upper Kapuna subunits. The West Makaleha Management Unit is scheduled for fencing in 2006 or 2007 and already contains two small fences protecting occurrences of *Cyanea grimesiana* ssp. *obatae* and *Schiedea obovata*. The Army assists the State with goat monitoring and control, weed control, outplanting, and propagule collection. The Keaau and Makaha Management Unit is located on non-Federal lands within the State Keaau Game Management Area and will be fenced in 2009.

The Makaha Management Unit is located on city/county lands outside the action area and is critical for reintroduction of stabilization population units of several target taxa. Fence construction is currently being completed at Makaha subunit I and for the two other subunits in 2009. The Army currently assists the Board of Water Supply with rare plant surveys, intensive weed control, rat control in Oahu elepaio territories, and monitoring experiments for invasive plant control. The Army also funds a full-time field employee to assist The Nature Conservancy of Hawaii in conservation management of target taxa in the privately owned Honouliuli Preserve, which contains the Ekahanui, Kaluaa and Waieli, and Palikea management units.

6.4 Expedited Stabilization

The Makua Implementation Team recognized that full stabilization likely would not be achieved for the original 27 target plant taxa within the 33 years projected by the Makua Makua Implementation Plan. The Army's proposed Makua Implementation Plan Addendum covers a 20-year planning horizon that likewise does not guarantee target taxa will be stabilized within a specified timeframe. The Service originally intended to assess the success of stabilization in the short term by verifying the Army's implementation of management actions according to the schedule outlined in the Makua Implementation Plan. However, certain taxa at greatest risk from training impacts (i.e., those with very low numbers and/or those located within the high fire risk zone) were intended to receive all needed management during the first phase of implementation (years 1 to 13) (Makua Implementation Team 2003). The Army's proposed action for this Biological Opinion takes a similar approach by incorporating an expedited stabilization plan for 12 taxa identified as most at-risk from training-related wildfire in the action area. Stabilization plans for 11 of these at-risk taxa are already included in the Makua Implementation Plan and Makua Implementation Plan Addendum; *Gouania vitifolia* will be added due to its presence in the new action area for this consultation. In addition to expedited stabilization of these 12 at-risk taxa, the Army will continue to manage for full stabilization of all target taxa as outlined in the Makua Implementation Plan Addendum. The 12 target taxa identified for expedited stabilization include the following:

<i>Chamaesyce herbsti</i>	<i>Hibiscus brackenridgei</i> ssp. <i>mokuleianus</i>
<i>Cyanea grimesiana</i> ssp. <i>obatae</i>	<i>Neraudia angulata</i>
<i>Cyanea longiflora</i>	<i>Phyllostegia kaalaensis</i>
<i>Cyanea superba</i> ssp. <i>superba</i>	<i>Sanicula mariversa</i>
<i>Delissea subcordata</i>	<i>Schiedea nuttallii</i>
<i>Gouania vitifolia</i>	<i>Schiedea obovata</i>

Expedited implementation of a modified stabilization plan is intended to protect the 12 at-risk taxa from jeopardy over the next 10 years while actions toward full stabilization for all target taxa are being implemented. The purpose of expedited stabilization is to ensure that stabilized, or near-stabilized, population units are established both inside and outside the action area as quickly as possible. Stabilization of population units outside the action area where they will not be at risk of training-related wildfire is particularly critical. The expedited stabilization plan for the 12 at-risk taxa modifies certain priorities and numerical criteria for conservation actions outlined in the Makua Implementation Plan Addendum. Until these at-risk species have attained expedited, modified stabilization levels, the Army will not fire tracers, 2.75-caliber rockets, or Javelin missiles, or implement Column D weapons restrictions. In addition, other weapons systems and munitions will be used only in accordance with NFDRS and live fuel moisture conditions, and with the adequate fire suppression staffing specified in the Project Description evaluated for this opinion (see Table PD 2).

After attainment of expedited stabilization for the 12 at-risk taxa, the Army may begin training with the weapons systems and munitions cited above (note that full stabilization of all 12 at-risk taxa and all 16 stabilization target taxa are required before the Army may begin training with TOW missiles). However, certain restrictions will be imposed on continued use of those weapons systems and munitions if a fire is ignited outside the firebreak road or spreads outside

the firebreak road from an ignition within the training impact area. If such a fire occurs, the Army will immediately cease all live-fire training and focus on suppressing the fire. The Army will cease using the weaponry that caused the fire and will meet with the Service within 10 calendar days to discuss the incident. If the Service and Army agree that the fire ignition and suppression actions occurred as anticipated, training with that particular weapon or munition may resume.

Expedited implementation of a modified stabilization plan for the 12 at-risk taxa will be realized over the next 10 years through conservation measures summarized in Tables PD 8 and 9. The expedited actions are intended to increase the baselines of the 12 taxa inside and outside of the action area as rapidly as possible. In general, these expedited stabilization measures are based on continuing management of all *in situ* population units for all target taxa identified as “manage for stability” in the Makua Implementation Plan Addendum, with prioritization of activities to stabilize population units of at-risk taxa inside and outside the action area. For some at-risk taxa, this will require initiating establishment of new population units through reintroductions on State, city/county, or private lands on an accelerated schedule. Meanwhile, the Army will continue to implement activities intended to achieve full stabilization of all target taxa according to the schedule outlined in the Makua Implementation Plan Addendum. The Army and the Service will annually review monitoring data to assess the Army’s progress towards achieving full stabilization of all 29 target taxa (including 16 target plant taxa, 12 at-risk plant taxa, and the Oahu tree snail *Achatinella mustelina*). The annual review also will allow for modification of stabilization actions as needed, using an adaptive management approach.

For all stabilization population units of at-risk taxa (at least three per taxon), the Army will ensure that adequate numbers of individuals are outplanted and maintained to conform to modified numerical criteria for stability. For example, if a taxon’s numerical stabilization goal is 50 mature, reproducing individuals per population unit, the Army will establish and continue to maintain *in situ* at least 50 individuals of outplanting size per stabilization population unit, regardless of reproductive maturity. These numerical goals must be maintained or increased for at least two years before the designated weapons systems and munitions can be used. All outplanted plants will be of sufficient size and vigor to survive in the wild. The ability to maintain numerical criteria and protect plants in the wild will require fencing some of the management units encompassing the expedited population units as soon as possible. Expedited stabilization of certain species vulnerable to infestation by slugs and insects also will require investigation of appropriate pest control measures.

Expedited stabilization also will require measures be taken to better ensure that the stabilization population units are protected from the risk of training-related wildfire. Expedited stabilization population units not protected by intact vegetation (i.e., 200 m (656 ft) of shrub/forest), or strategically placed firebreaks or fuelbreaks will be protected with localized fuel treatments around individual plants. Three to five m (9.8 to 16.4 ft) of fuel clearance will be completed around individual expedited stabilization plants that are not otherwise protected by fire protection systems. Expedited stabilization plants occurring within the potential ignition areas of the Javelin or TOW will also receive this localized fuel treatment. Plant level fuel management may be waived on a case-by case basis for plants occurring on cliffs where fuels are discontinuous, with the approval of the Service. Management unit level fuelbreak and firebreak

completion is not an expedited stabilization measure, but will be completed in order to meet full stabilization implementation habitat protection goals. Once these fuels treatments are completed by the Army and expedited stabilization is completed for the 12 at-risk taxa, the Army may begin training with tracers and long-range weapons. Accordingly, an important component of the expedited, modified stabilization plan for the 12 at-risk taxa is annual monitoring to ensure survival of the minimum number of plants in the stabilization population units. Once all stabilization population units are established at expedited, modified goals for the 12 at-risk taxa, the Army will continue to implement standard conservation management of the population units and the management units in which they are located in order to attain full stabilization, as outlined in the Makua Implementation Plan Addendum.

The Army estimates that expedited stabilization can be achieved, with adequate funding, within 10 to 15 years for most of the 12 at-risk taxa. One species with periodic dormancy, *Sanicula maritima*, may require a longer timeline because preliminary monitoring must be conducted and evaluated to determine appropriate goals and techniques for stabilization. Successful achievement of expedited, modified stabilization for these species will not occur without full funding for the Makua Implementation Plan Addendum, the Wildland Fire Management Plan, and the wildland fire suppression and fuels management sections of this Project Description. The Service expects the Army will guarantee funding for these features to ensure expedited stabilization for the 12 at-risk taxa, so that training with the proposed weapons systems and munitions can take place at Makua.

Table PD 8. Conservation Activities in Management Units (U.S. Army Garrison 2005 a, b).

Management Unit	Area (acres)	Fence Schedule	Ungulate Control Status	Weed Control Areas (acres)
East Makaleha	231	Construct in 2008	Limited goat control in adjacent areas	None
Ekahanui	203	Subunit I (44 acres) fenced	Subunit I ungulate free	9.8 ac
		Subunit II (159 ac) construct in 2007		
		Small PU fences for <i>Delissea subcordata</i> , <i>Schiedea kaalae</i>		
Haili to Kealia	30	None	None	3.3 ac
Kaena	52	None	None	3.01 ac
Kahanahaiki	94	Subunit I (63 ac) fenced	Subunit I ungulate free	48.12 ac
		Subunit II (31 ac) construct in 2008		
Kaimuhole	100	Construct in 2010	None	None
Kaluaa and Waieli	127	Subunit IIA (9 ac) construct in 2006	Subunit III ungulate free	2.9 ac
		Subunit IIB (11 ac) construct 2015		
		Subunit IIC (8 ac) construct 2005		
		Subunit III (99 ac) fenced		
Kaluakauila	104	Fenced	Ungulate free	11.92 ac
Kamaileunu	5	None	None	None
Keaau and Makaha	5	Construct in 2009	None	None
Lower Kahana	3	Construct in 2014	None	None
Lower Ohikilolo	70	Fenced	Ungulate free	7.99
Lower Opaeula	17	Construct in 2007	None	None
Makaha	162	Subunit I (96 ac) construct in 2006	None	22.38 ac
		Subunit II (66 ac) construct in 2009		
		Subunit III (1 ac) construct in 2009		
Manuwai	166	Construct 2012	Goats controlled in adjacent areas	None
16. Ohikilolo	200	Majority (162 ac) fenced	Most goats removed	7.43 ac
		Lower Makua (38 ac) construct in 2011		
		Small PU fences for particular species		
17. Pahole	215	Fenced	Ungulate free	32.4 ac
18. Palikea	45	Subunit IA (21 ac) construct in 2009	Pigs controlled in subunits IA and IB	4.61 ac
		Subunit IB (11 ac) construct in 2009		
		Subunit IV (9 ac) none		
		Subunit V (4 ac) none		
		Small PU fences		
19. Puu Kumakalii	28	None	None	None
20. Upper Kapuna	182	Subunit I (182 ac) construct in 2006	None	6.33 ac
		Subunits II, III, IV (42 ac) construct in 2008-2009		
		Small PU fences for <i>Phyllostegia kaalaensis</i>		
21. Waianae Kai	9	Construct in 2011	None	None
		Small PU fences for particular species		
22. Waiawa	124	Construct in 2013	None	None
23. West Makaleha	93	Construct in 2006	Goats controlled in adjacent areas	3.3 ac
		Small PU fences for <i>Schiedea</i>		

Table PD 9. Conservation Measures for Expedited, Modified Stabilization of 12 At-Risk Taxa at Population Units (PUs) to be Managed for Expedited Stabilization and Management Units (MUs) in which They are Located. (Scientific names of taxa are abbreviated by combining the first three letters of the genus and species names.)

Conservation Measures	Chaher	Cyagri	Cyalon	Cyasup	Delsub	Gouvit	Hibbra	Nerang	Phykaa	Sanma	Schnut	Schobo
Manage 3-4 <i>in situ</i> PUs	3	3	3	4	4	3	4	4	3	3	3	3
Attain numerical stability at 1-3 PUs outside action area	2	2	1	3	3	2	3	3	2	1	1	1
Initiate reintroduction of PUs outside action area	2			2		1	1	1	2		1	1
Implement rat, slug, insect control as needed		X	X	X	X		X				X	X
Construct fence												
Upper Kapuna MU West Makaleha MU	X		X	X	X				X		X	
Makaha MU	X	X	X						X			
Other MUs	X			X				X	X		X	X
		X	X	X		X	X	X	X	X		
Control weeds	X	X	X	X	X	X	X	X	X	X	X	X
Implement additional fire management and	X	X	X	X	X	X	XXX	X	X	X	X	X
Obtain cooperative agreements	X	X	X	X	X		X	X	X	X	X	X
Conduct additional monitoring	X	X	X	X	X	X	X	X	X	X	X	X
Conduct population dynamics research										X		
Develop stabilization plan						X						

7. Conservation Measures

Funding:

- 1) The Makua Implementation Plan Addendum will be fully funded to ensure that all training activities at Makua are in conformance with the Biological Opinion. This funding shall be in place prior to any live-fire training activities occurring at Makua.
- 2) The Wildland Fire Management Plan will be updated to incorporate the requirements specified by this Biological Opinion, will be fully funded, and all precautions will be followed as outlined in this Opinion for any live-fire training to occur at Makua.

Training:

- 1) Range operations staff will be fully trained in WIMS and will have a thorough understanding of weapons restrictions based on fire danger, fuels project completion, and locations and status of endangered species at Makua.
- 2) The Army will not use Kaena Point trail for any training activities.
- 3) If any Army training-related fire ignites outside of the firebreak road (designated impact area), use of all weapons will cease and the Service will be notified within one hour. The Army will provide the Service with a briefing detailing the cause of the fire, forecasted and actual fire weather, forecasted and actual fire behavior, and predicted and actual helicopter productivity. The briefing will include video or other fire behavior and helicopter productivity data taken during the first hour of fire suppression. The range will be reopened for training only after the Service has determined that the Army actions that contributed to the fire and resulted in its suppression were conducted in accordance with the requirements of the Biological Opinion. If the Army is unable to identify and/or correct the problem, then further use of that weaponry will be prohibited until full stabilization, as outlined in the Makua Implementation Plan Addendum, is achieved.
- 4) If a prescribed burn or military training fire burns any portion of a management unit or designated critical habitat, the Army will meet with the Service to determine if there is a need to strengthen the fuelbreak and firebreak system, increase weapon restrictions, or augment fire suppression staffing to prevent a similar fire in the future.
- 5) Smoking is permitted only in the administrative bivouac site or near the Makua Range Control Building but no further than the gate into the actual valley.
- 6) All ordnance fired at Makua will be aimed to fall within the south firebreak road.
- 7) Targets will be placed to minimize the possibility of ammunition going outside the firebreak road.
- 8) No live-fire training (of any kind) will be allowed when fire danger is red (high).
- 9) C-Ridge will not be used for any training purpose.

- 10) No illumination rounds will be permitted at Makua.
- 11) All live-fire training will take place on existing training ranges (southern lobe impact area) and will not land outside of the surface danger zones.
- 12) Open fires are not allowed anywhere at Makua including bivouac sites.
- 13) There will be no off-road vehicular activity at Makua.
- 14) Before night training at Makua is conducted, helicopters must be authorized to be used for fighting night fire suppression.

Kuaokala Trail Conservation Measures:

- 1) Smoking will not be allowed during road or trail marches.
- 2) Soldiers would be restricted to the established trail or roads when on marches, and marching formation would conform to the width of the trail.
- 3) The trail will be surveyed before and after each march by a qualified Natural Resources Staff person capable of determining if there has been damage to the trail and the surrounding flora and fauna that would contribute to species and habitat deterioration. Any such deterioration will be reported to the Service within 48 hours and use of the trail will be suspended until the Army and Service can meet to discuss further conservation measures to prevent future damage.

8. Weapons Used at Makua

Small Arms

Blank Ammunition: There is the potential for hot shell casings to ignite fires close to the firing point during the firing of blank ammunition. Therefore, the range will be staffed by ground fire suppression forces including a NWCG-qualified Incident Commander, two engines, a water tender and standby helicopters. Unlike helicopter staffing requirements for all other weapons under most other conditions, none of the fire suppression helicopters need to be on-site at Makua when blank ammunition is being fired. They will all be assigned to the training, but with a one-hour response time to a fire occurring outside the firebreak road. Flash suppressors and blank adapters will always be used on weapons firing blanks at Makua, preventing hot residue from exiting the muzzle. Blanks will not be fired when live herbaceous fuel moisture is 49 percent or lower, or when the Fire Danger Rating is in the Red.

Ball Ammunition Training: All ball ammunition qualification and demolition training will take place within the current impact area, the southern lobe of the firebreak road. The qualification training involves using small arms (rifles, pistols, machine guns, or shot guns), with .308, .38, .45, or .50-caliber; 5.56, 7.62, or 9 mm; 12 gauge; or 40 mm target practice rounds shooting at either pop-up targets or fixed targets. The fixed firing points are elevated on a two-foot platform to decrease the chance of fire ignition from a muzzle flash or hot casings, and are located in a mowed area.

Small Arms Weapons Mounted on Helicopters: These weapons will not be discharged while the helicopter is outside the south lobe of the firebreak road to ensure that any fire ignited from a hot casing falling from the helicopter starts inside the firebreak road. Tracer fire from helicopters is prohibited.

Demolitions

Demolitions training at Makua will take place at the ordnance impact area and may include a range of activities such as: (1) use of low levels of explosives to destroy wood or steel structures, (2) gaining entry to buildings, (3) placement and detonation of shape charges at the ordnance impact area (shape charges are composed of C4 plastic and would be used as 6.8-kilogram (kg) (15-pound (lb)) charges (80 times a year) and 18-kg (40-lb) charges (36 times a year), and (4) detonation of cratering charges at the ordnance impact area following the detonation of the shape charge (the M039 cratering charge) filled with ammonium nitrate (placed within the hole created by the shape charge). The typical maximum amount of ammonium nitrate that would be used at any one time would be 68 kg (150 lbs) and possibly up to 136 kg (300 lbs). All demolitions training will be conducted in areas of bare ground or exploded within metal drums to reduce the risk of fire.

Special Demolitions and Demolition Munitions: These munitions will be used for specific purposes at Makua such as unexploded ordnance disposal or by Soldiers training to clear mines, breach doors or overcome obstacles. Demolition munitions contain ordnance capabilities and are used to assist the Soldier in battle situations. The only demolitions materials that will be used at Makua are C4, TNT, detonation cord, blasting caps, time fuses, cratering charges, shaped charges, and bangalore torpedoes. Procedures for the safe use of many of these weapons, including explosives such as TNT or composition C4, require use to be limited to excavated demolition pits surrounded by a sand bag barrier. No more than 136 kg (300 lb) net explosive weight will be detonated in any demolition at Makua. To minimize the chance of a fire igniting outside the firebreak road, demolitions will be oriented, when possible, in a way that directs hot gasses or blast fragments toward the interior of the south lobe of the firebreak road.

Unexploded Ordnance Disposal: Unexploded ordnance disposal activities may be conducted within the valley, outside the south lobe of the firebreak road, when live herbaceous fuel moisture, calculated in the WIMS for the Makua Range weather station (number 490301) is 100 percent or higher and the burning index is 20 or lower (fire danger rating Green/Low). Fire suppression ground and helicopter resources will be fully staffed in accordance with the fire suppression staffing guidelines used for live-fire training.

Restrictions

Unexploded ordnance may be detonated at locations 100 m (328 ft) or greater inside the south lobe of the firebreak road and within designated demolition training areas only when the burning index is 20 or lower and when live herbaceous fuel moisture is 60 percent or higher. This will only be allowed after grass has been removed from within 3 m (2 ft) of all *Hibiscus brackenridgei* ssp. *mokuleianus* and *Chamaesyce herbstii* plants within the Lower Ohikilolo Management Unit. Fire suppression helicopter staffing will be assigned to demolitions training

and unexploded ordinance activities in accordance with the helicopter staffing guidelines in Table PD 5.

M79 and M203 Grenade Launchers

Only M79 and M203 grenade launchers will be used at Makua. The maximum range for the M79 and M203 grenade launchers is 400 m (1,312 ft).

Restrictions

Use of these weapons will be restricted to mowed areas and Green fire danger rating conditions.

MK19 Grenade Launcher

The maximum range for blast fragments from the MK19 grenade launcher is 2.4 km (1.5 mi). It can fire 40 mm grenades, smoke grenades, and other grenades (Figure PD 15).

Restrictions

Only M385A1 inert rounds, with cartridge cases that detach from the projectile so that they land within 100 m (328 ft) of the firing point, will be used in Yellow fire danger rating conditions. Inert rounds that meet this specification may be fired when live herbaceous fuel moisture is 60 percent and higher. No other rounds will be fired from the MK19 grenade launcher until after the Kaluakauila, Kahanahaiki and Ohikilolo fuelbreaks and firebreaks are constructed and the expedited stabilization of three endangered plant species is completed (see Table PD 2). To minimize the areas where fires may be ignited by this weapon, the MK19 will not be fired east of the 580,900 m UTM line.

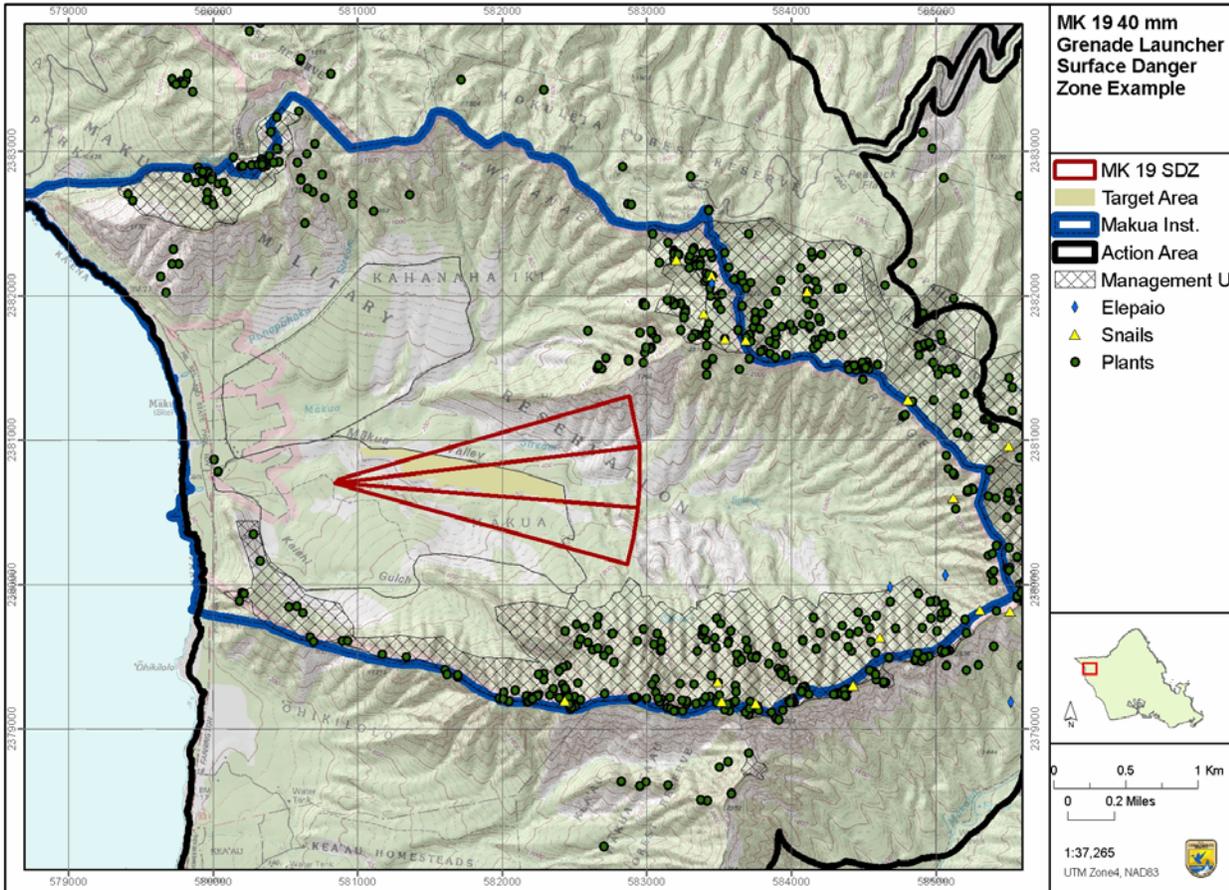


Figure PD 15. MK19 grenade launcher surface danger zone.

Simulators, Mines and Grenades

Explosive charges are used to simulate detonation of mines and incoming artillery projectiles, mortars, and bombs during training exercises. All use of these types of devices will be in accordance with Army Regulation 385-63, *Range Safety Manual*. Procedures for the safe use of many of these weapons, including explosives such as TNT or composition C4, require use to be limited to excavated demolition pits surrounded by a sand bag barrier. When Area F (which generally has a 30-m (98-ft) radius) is designated on the surface danger zone for the particular weapon, it will be cleared of flammable vegetation. To minimize the chance of a fire igniting outside the firebreak road, simulators, mines, and grenades will be oriented, when possible, in a way that directs hot gasses or blast fragments toward the interior of the south lobe of the firebreak road.

60 mm Mortars

Sixty mm mortars are used for indirect fire and support of troops. Mortar rounds are shot from a launch tube attached to a base plate, using 60 mm high explosives, 60 mm short-range training ammunition, or 60 mm inert ammunition. The 60 mm inert round has no explosion upon impact; the short-range training ammunition has a flash, bang, and smoke on impact, while the high explosive cartridge has a large explosion. The M720 and M888 high explosive cartridges have high fragmentation steel loaded with Composition B explosive that explodes on

81 mm Mortars

Similar to the 60 mm, this weapon consists of a launch tube mounted on a base plate. It is used for indirect fire support of troops. It fires 81 mm high explosive mortar and 81 mm target practice inert mortars. The 81 mm inert round has no explosion upon impact while the 81 mm high explosive has a large explosion. High explosive cartridges are designed for use against personnel, bunker and light materiel targets. The high fragmentation steel projectile is loaded with Composition B explosive. Maximum and sustained rates of fire are 15 to 30 rounds per minute. The rounds are propelled by doughnut charges. This 81 mm weapon has a maximum possible range of 5,900 m (19,357 ft). The number of charges and firing angles will be limited so that the weapon's maximum range or "Distance X" on the developed surface danger zone is 1,760 m (5,774 ft) or less at Makua. The maximum distance the 81 mm round can travel at Makua will be limited to 1,760 m (5,774 ft) or less by enforcing strict limits on the charge used and the angle that the weapon is fired (Figure PD 17).

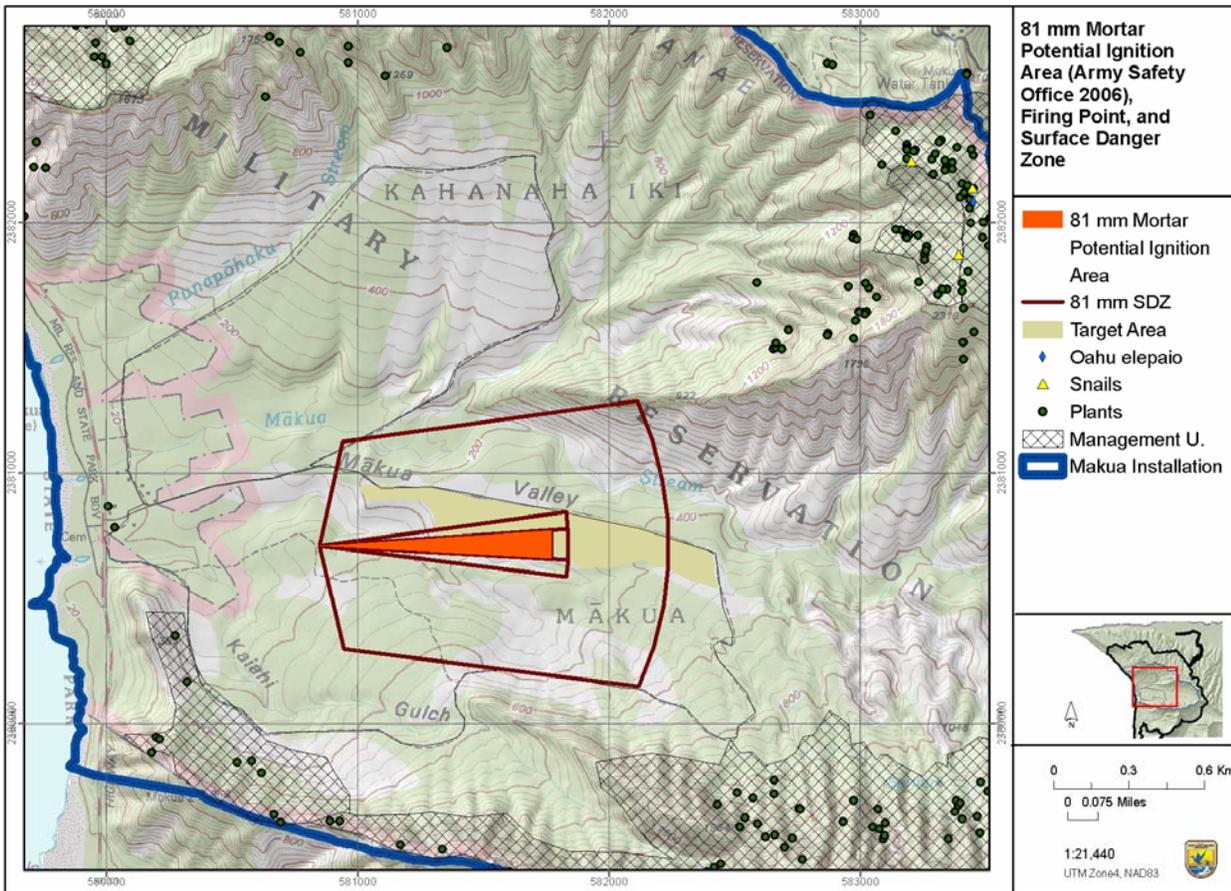


Figure PD 17. Potential ignition area and surface danger zone for 81 mm mortar.

120 mm Mortars

The 120 mm mortar consists of a tube mounted on a trailer or vehicle (Figure PD 18). It is used for indirect fire support of troops. It generally fires a fin-stabilized, 120 mm high explosive mortar from a smooth bore. It can also be fitted with a sleeve so that it can fire 81 mm projectiles. The M120 mortar system consists of the M298 cannon assembly, M190 bipod assembly, M9 baseplate, and M1100 trailer. The 120 mm high explosive has a large explosion. Only high explosive cartridges will be fired from the M120. The M933/934 high explosive cartridges are designed for use with the M120 and M121 120 mm mortar systems and are used against personnel, bunker and light materiel targets. The 1090 steel projectile is loaded with Composition B explosive. The M934 is equipped with the M734 multi-option fuse that can be set to function in the proximity, near surface burst, impact, or delay mode. The rounds are propelled by charge bags. This weapon has a maximum possible range of 7.2 km (4.5 mi). The number of charges and firing angles will be limited so that the weapon's maximum range or "Distance X" on the developed surface danger zone is less than 1.6 km (5,249 ft) at Makua. The maximum distance the 120 mm round can travel at Makua will be limited to 1.6 km (5,249 ft), enforcing strict limits on the charge used and the angle that the weapon is fired (Figure PD 19). The maximum and sustained rates of fire are 16 rounds/min for the first minute and 4 rounds/min thereafter.



Figure PD 18. The 120 mm mortar may be fired from Stryker or other vehicles or from the ground using a mortar plate (Photos: Global Security.org).

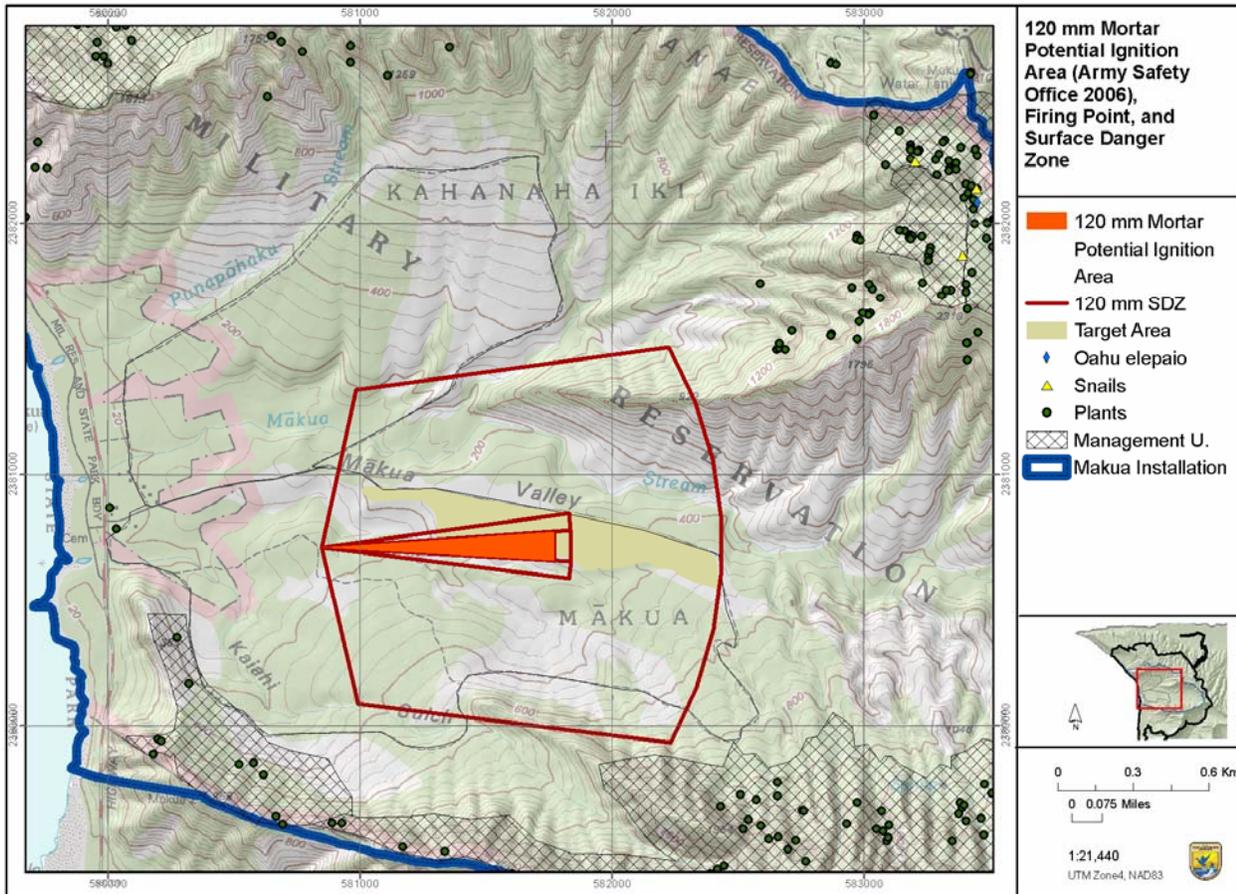


Figure PD 19. 120 mm mortar potential ignition area, firing point, and surface danger zone.

Restrictions for all Mortar Training

Mortars will only be fired from the designated spot in the mowed area (EJ 8085-8071) known as Coyote on the maps in this Project Description. Mortars will only be targeted at Objective Deer (EJ 8190-8070). Historically, the first round fired from a mortar would sometimes land outside the impact area because the force from this first shot is used to seat the mortar plate into its firing position. The number of charge bags used are closely controlled, counted out separately and inserted in the tube, and double checked prior to firing the weapon by at least four different personnel. At Makua, all mortar plates will be seated into place with a sledge hammer prior to firing the first round in order to better ensure accuracy of all mortar rounds fired.

No infrared, illumination or smoke cartridges will be used at Makua because of their increased fire risk.

105 mm Artillery

This weapon is a 1,814 kg (4,000 lb) cannon, generally towed by vehicles or airlifted into firing position, which is used for direct and indirect fire support of troops (Figure PD 20). The weapon has an average crew of seven Soldiers. It is capable of firing a wide range of standard NATO ammunition. At Makua, it will fire high explosive and inert rounds. The 105 mm inert round has no explosion upon impact, while the 105 mm high explosive has a large explosion. This 105 mm weapon has a range of 19.2 km (11.9 mi) when rocket assistance and eight charge bags are used. The number of charge bags and firing angles will be limited so that the weapon's maximum range or "Distance X" on the developed surface danger zone is 2,400 m (1.5 mi) or less at Makua. This maximum range will be limited by enforcing strict limits on the charge used and the angle that the weapon is fired (Figure PD 21). The amount of powder in each charge bag and the number of charge bags used is closely controlled. Charges are counted out separately and inserted in the tube, and double checked prior to firing the weapon by at least four different personnel. Artillery will only be fired from the designated spot in the irrigated green and mowed grass area in the north lobe of the firebreak road. Artillery will only be targeted at Objective Deer.



Figure PD 20. Photograph of 105 mm artillery.

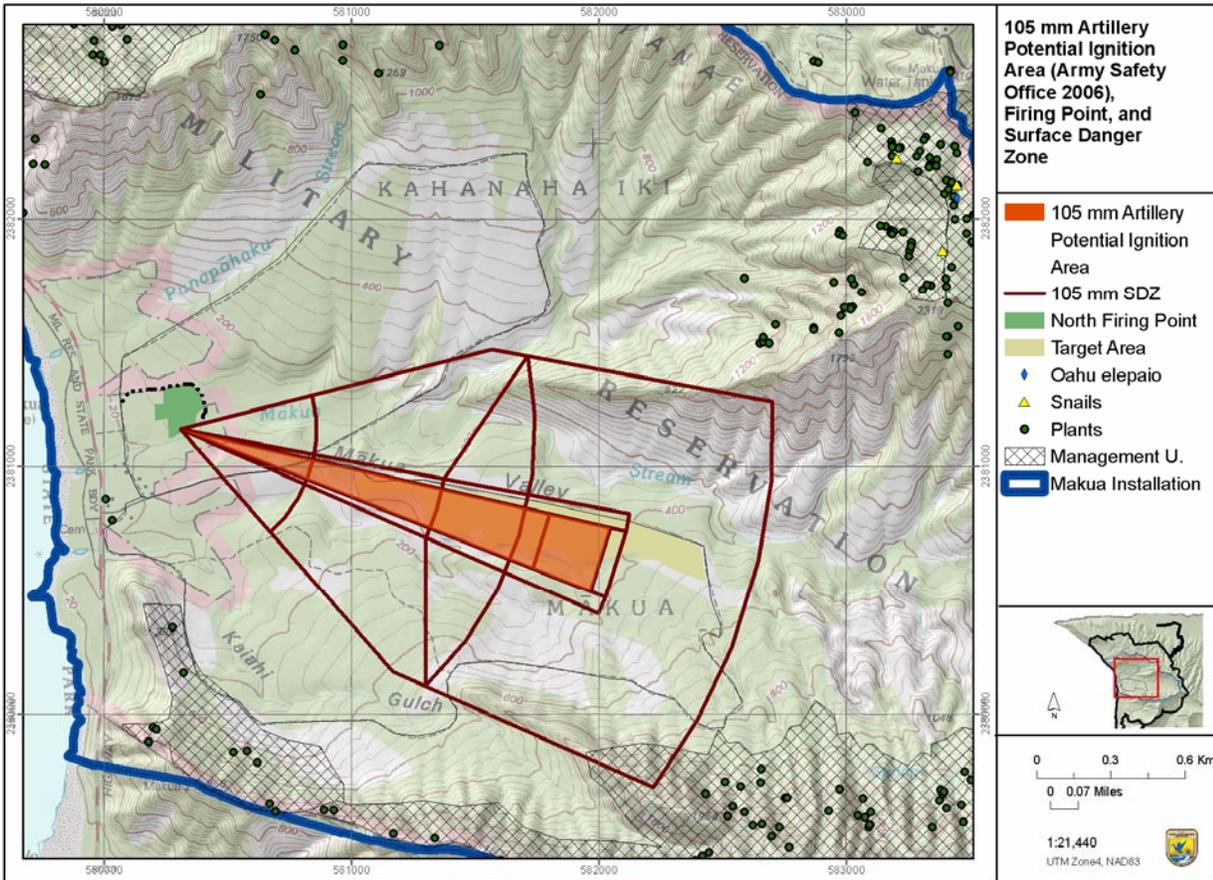


Figure PD 21. Surface danger zone and potential ignition area for 105 mm artillery.

155 mm Artillery

This weapon is a 7.1 kg (15,758 lb) cannon, generally towed by vehicles or airlifted into firing position, and used for direct and indirect fire support of troops (Figure PD 22). It is capable of firing a wide range of standard NATO ammunition. The 155 mm howitzer barrel can be fitted with a sleeve so that it fires 105 mm ammunition. At Makua, it will fire high explosive and inert rounds. The 155 mm inert round has no explosion upon impact, while the 155 mm high explosive has a large explosion with fragments and blast effects confined to the surface danger zone. The maximum effective range of this weapon is 22.4 km (13.9 mi) with conventional ammunition and 30 km (18.6 mi) using a rocket-assisted projectile. The maximum and sustained rates of fire are four and two rounds per minute, respectively. The howitzer is transported and operated by a crew of nine. The number of charge bags and firing angles will be limited so that the weapon’s maximum range or “Distance X” on the developed surface danger zone is 2,600 m (1.6 mi) or less at Makua (Figure PD 23). The maximum range for this weapon, given three bags of powder is 6,100 m (12.4 mi). To minimize the distance the 155 mm round can travel, the Army will enforce strict left and right limits, limit the angle that the weapon is fired, enforce use of the safety card (specifies the limitations of using at the range), and complete the firing solution (adjusting the direction of fire of the weapon) by two different methods, by hand and by computer, to ensure the two match up before firing. The amount of powder in each charge bag and the number of charge bags used is closely controlled. On Oahu, the charge bags are limited to no more than two to limit the distance the ammunition can

travel. Upon preparation for firing, the projectile and propellant are loaded into the howitzer in two separate operations. Separate loading ammunition propellants are issued as a separate unit of issue in sealed canisters to protect the propellant. The amount of propellant to be fired with artillery ammunition varies with the number of propellant increments. The charge selected is based on the range to the target and the tactical situation.

Restrictions

Illumination and white phosphorus (smoke) rounds will not be fired at Makua. Charges are counted out separately and inserted in the tube, and double-checked prior to firing the weapon by at least four different personnel. Artillery will only be fired from the designated spot in the irrigated green and mowed grass area in the north lobe of the firebreak road. Artillery will only be targeted at Objective Deer.



Figure PD 22. 155 mm artillery. (Photos: Department of Defense: www.defenselink.mil)

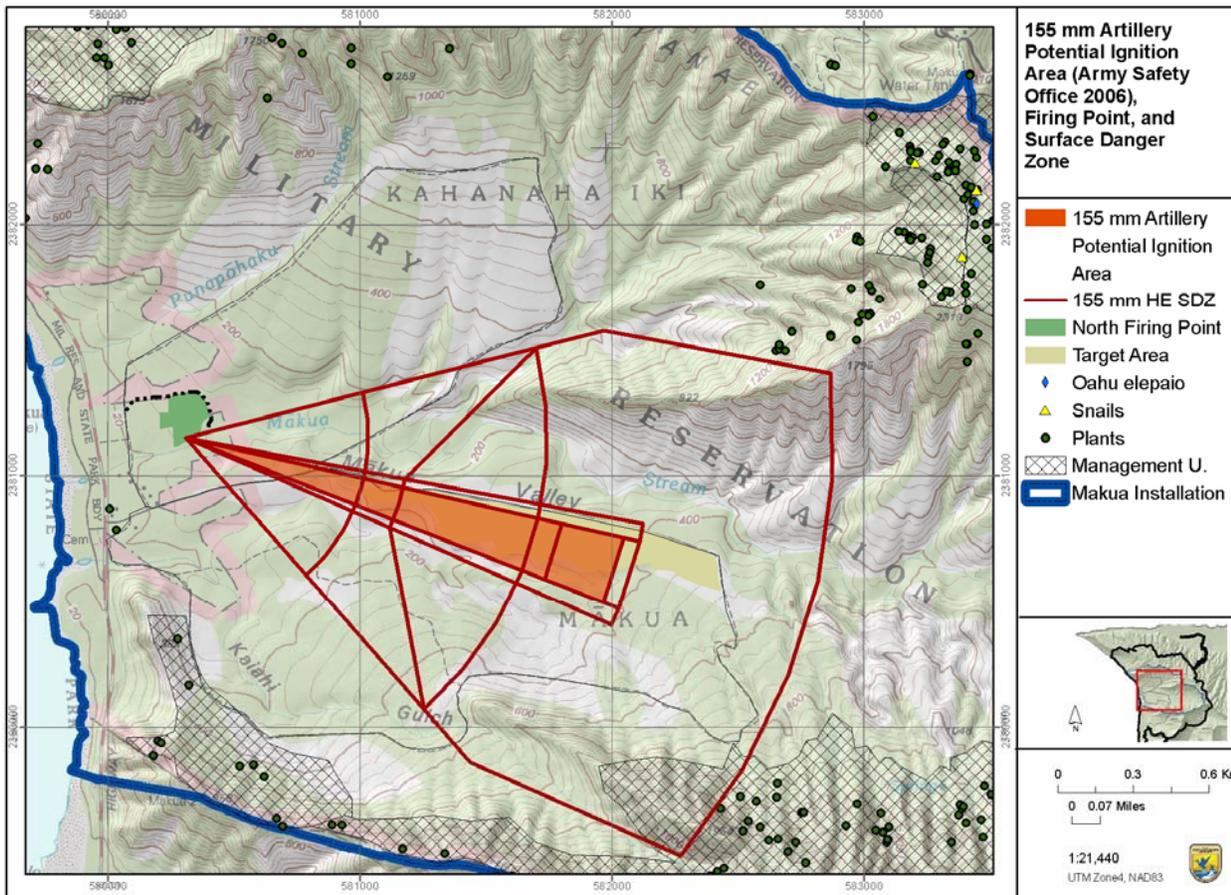


Figure PD 23. Potential ignition area, firing point, and surface danger zone for 155 mm artillery.

AT-4 Anti-Armor Weapon

The AT-4 is a lightweight, shoulder-fired, anti-armor weapon. Each AT-4 is pre-packaged and sealed with only one round of ammunition. It fires a rocket-type cartridge consisting of a fin-stabilizing assembly with a tracer element and a warhead consisting of an 84 mm, shaped, high-explosive warhead. Although the M136 AT-4 can be employed in limited visibility, the firer must be able to see and identify the target and estimate the range to it. The maximum range for the rocket is 2.1 km (1.3 mi). The AT-4 will be fired only from within the designated firing point in the north lobe of the firebreak road, a minimum of 50 m (164 ft) from the outer edge of the 7-ac (2.8-ha) mowed firing point with a minimum clearance of 95 m (311 ft) from any flammable vegetation. The designated firing point in the north lobe of the firebreak road will either be kept bare of vegetation or it will be mowed and irrigated, so that live herbaceous fuel moisture of the grass in all areas remains above 200 percent. The firing point will be bounded directly along its north and east edges by a new improved firebreak road, 469 m (1,539 ft) long and following the route of an area historically used as an access road, maintained with bare ground to a width not less than 6 m (19.7 ft) (Figure PD 24). The AT-4 will be targeted at Objective Deer (EJ 8190-8070). The AT-4 will not be fired until after the Kaluakauila, Kahanahaiki and Ohikilolo fuelbreaks and firebreaks are constructed and the expedited stabilization of three endangered plant species is completed (see Table PD 2).

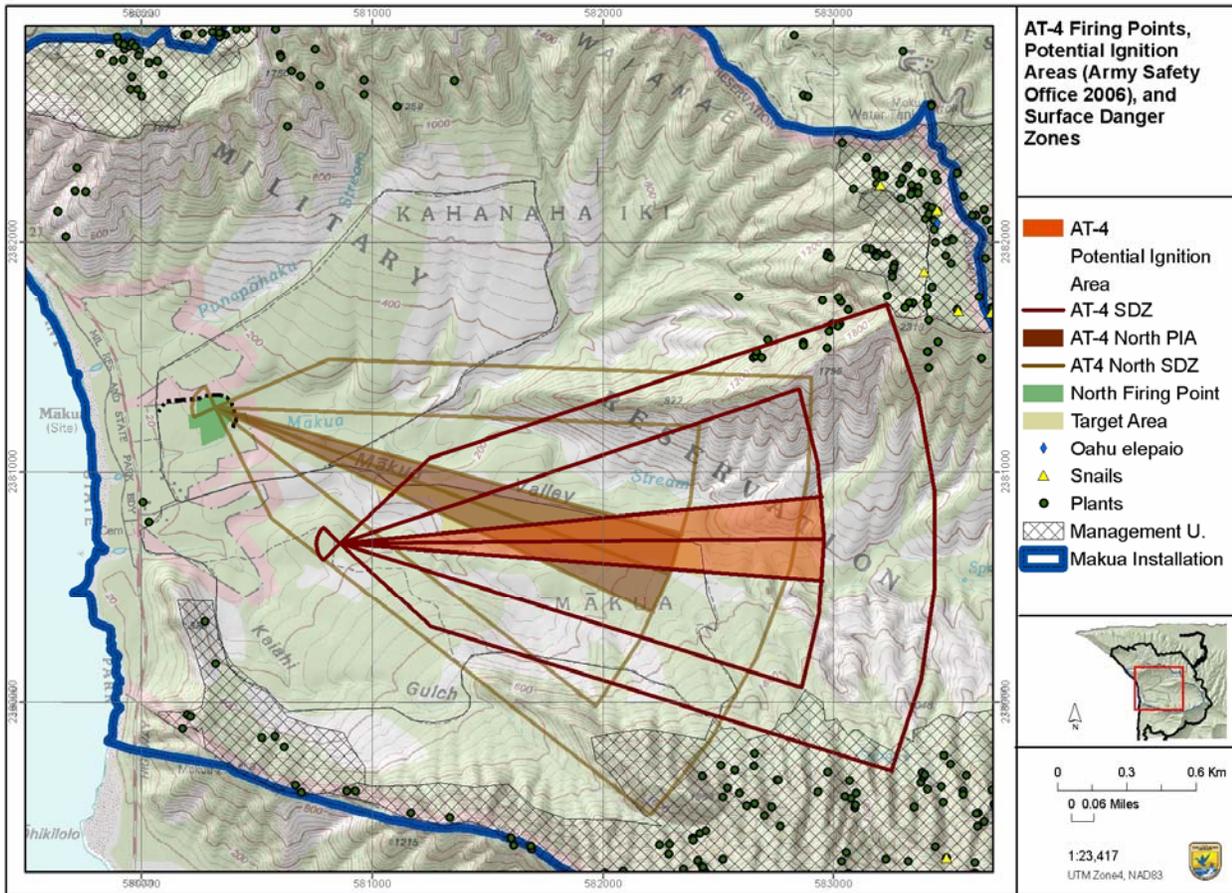


Figure PD 24. AT-4 surface danger zone, designated irrigated firing point, and maintained firebreak locations.

SMAW

The Launcher Assault Rocket 83 mm (SMAW) is a hand held fiberglass launch tube with a mounted sight and a maximum range of 2.0 km (1.2 mi). There is a 30-m (98-ft) back-blast area behind the firing point where hot flying debris could land, so this weapon will only be fired from the designated firing point in the north lobe of the firebreak road. The weapon will only be fired at a target in Objective Deer. This weapon is used at Makua by the Marine Corps. No surface danger zone is available for the SMAW, but its range and effects are similar to the AT-4. The SMAW will not be fired until after the Kaluakauila, Kahanahaiki and Ohikilolo fuelbreaks and firebreaks are constructed and the expedited stabilization of three endangered plant species is completed (see Table PD 2).

Tracers

Tracer ammunition is used to illuminate a shooter's line of fire at night or during the day, depending on the type of tracer used. A bright-burning pyrotechnic compound is added to a specially formed cup in the rear of the jacket of a given ammunition type. When the powder is ignited, it in turn ignites the tracing compound. This leaves a bright luminescent trail behind the bullet in flight, allowing the shooter to see the path of the projectile. Tracers are used primarily in machine gun and rifle applications, where every fourth or fifth round is a tracer. Only 5.56 mm, 7.62 mm, and .50 caliber M1 tracers will be fired from ground and Stryker-based locations and only 5.56 mm and 7.62 mm tracers will be fired from helicopters. Tracer burnout distances are as follows: 5.56 mm is 900 m (0.6 mi) (HQDA FM 23-14), 7.62 mm is 900 to 1,000 m (0.6 to 0.62 mi), and .50-caliber M1 is 1,800 m (1.1 mi) (HQDA FM 23-65) (Figure PD 25).

Restrictions

Use of all other tracers, including M17 tracers, is prohibited at Makua. Tracers will be fired by ground troops and from Strykers. Small arms tracers will be fired from various locations within the south lobe of the firebreak road, at various targets within the south lobe of the firebreak road. All firing points, including firing points for tracers fired from helicopters, will be within the south lobe of the firebreak road, east of UTM 581,400. M1 tracers will not be fired from any point farther east than the UTM 581,400 line within Objective Deer. Tracer ammunition will be used in accordance with the weapons restrictions specified in Table PD 2. Tracers will not be fired until after the Kaluakauila, Kahanahaiki and Ohikilolo fuelbreaks and firebreaks are constructed and expedited stabilization of three endangered plant species is completed. Prior to completion of expedited stabilization of 12 species, tracer ammunition will be used only when live herbaceous fuel moisture, calculated at the Makua Range WIMS weather station, is 120 percent or higher and when fire danger is low (Green). After expedited stabilization of 12 species is completed, tracers will only be fired when live herbaceous fuel moisture is 100 percent and higher when fire danger is low (Green). Fire suppression forces will be staffed pursuant to fire suppression staffing requirements described in Section 3 of the Project Description.

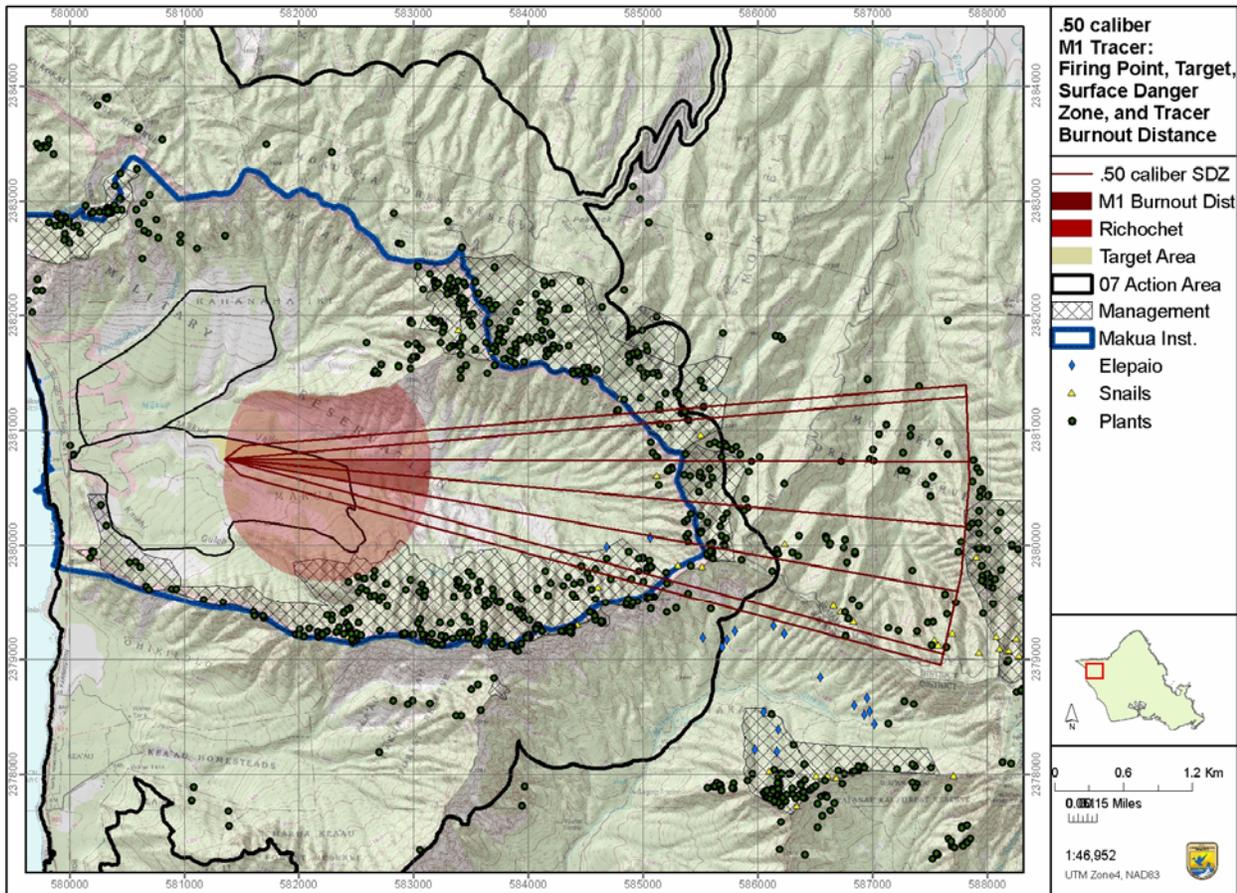


Figure PD 25. M1 tracer static firing point, target, surface danger zone and tracer burnout distance, and possible tracer ricochet dispersion area.

2.75-caliber Rocket

The 2.75-caliber (70 mm) Hydra-70 rocket system proposed for use at Makua consists of a seven-tube M260 launch tube, the MK66 MOD 4 rocket motor, and the blue spear WTU1B inert, ten pound steel training warhead (Figure PD 26). No other warhead or motor will be used at Makua. For use at Makua, the launch tube will be attached to an OH-58 Kiowa or similar helicopter. Only pilots with current qualifications in the use of 2.75-caliber rockets will fire these helicopter-mounted weapons in support of ground troops during CALFEX exercises. Makua will not be used for training, recertification, or qualification flights for 2.75-caliber rocket use. Rockets will be used by skilled, qualified pilots in order to provide realistic experience for personnel training on the ground. No more than 56 rockets will be fired during each CALFEX iteration. The rocket will be fired from approximately 1.0 km (0.6 mi) range at a target, which will be located in Objective Deer or Elk. The rocket will be fired from a Kiowa or similar helicopter flying below 134 m (440 ft) altitude, at a minimum of 60 knots airspeed, at a nose down dive, with a nose-down angle of at least 10 degrees. The rocket will never be fired from a helicopter that is not at a nose-down position of at least 10 degrees.



Figure PD 26. Example of 2.75-caliber rocket being fired from a helicopter and 2.75-caliber (70 mm) rocket pod mounted on the side of a helicopter. Unlike the rocket being fired in the photograph, rockets fired at Makua will only be fired from helicopters with nose-down angles of 10 degrees or more.

The Army currently uses a surface danger zone developed for a rocket fired from a level helicopter over flat terrain, in which the rocket has a maximum range of 3.0 km (1.9 mi). Topographic correction to the surface danger zone was completed by the Center for Environmental Management of Military Lands (Beavers 2006). Topographic correction is shown for a surface danger zone created for a rocket fired straight ahead (not nose down) at an altitude of 134 m (440 ft) (see Figure PD 26). At this time, surface danger zones when firing this weapon at a down angle have not been formally adopted by the Army. The maximum range (Distance X) of rockets fired from nose-down helicopters would be shorter than the range shown in Figure PD 27. The chance of a 2.75 rocket landing outside the Makua installation boundary is less than one in a million. An estimated 5,040 rounds will be fired in the next 30 years. Therefore, there is a 1:200 (1,000,000 divided by 5,040) chance of a round escaping from the installation boundary over the next 30 years.

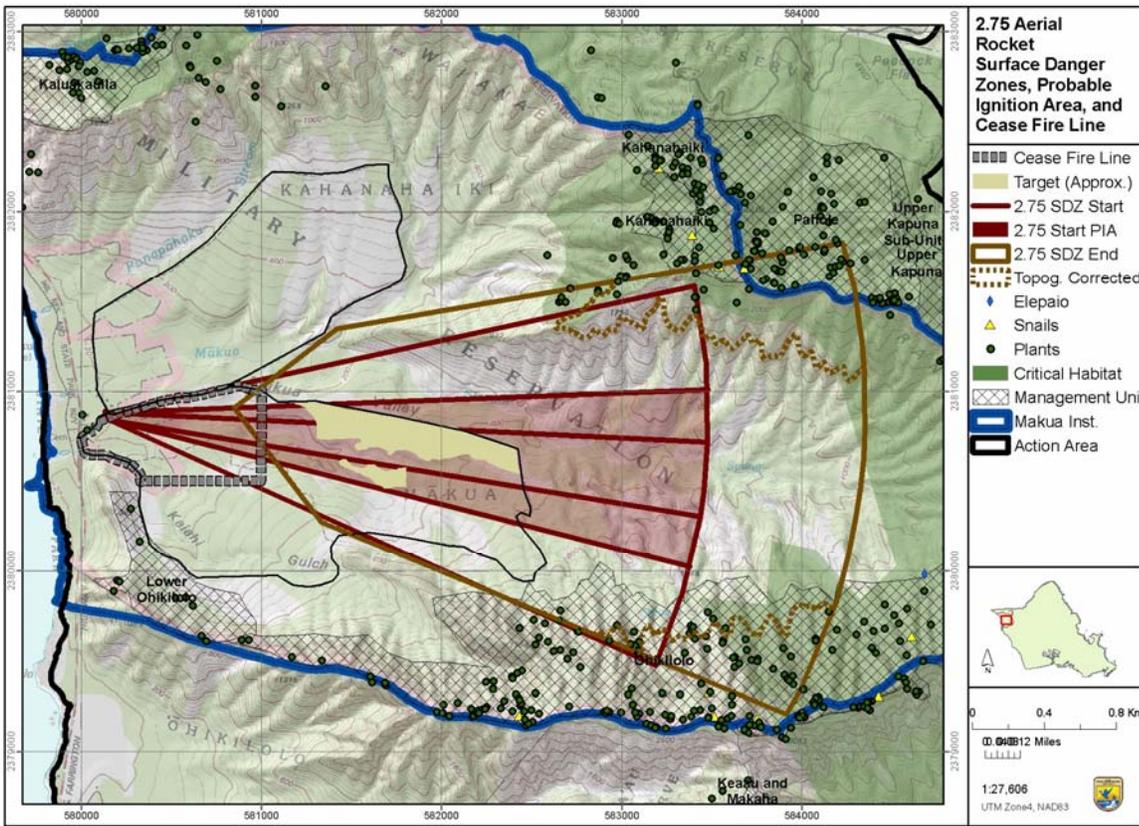


Figure PD 27. Surface danger zones (1: 1 million chance of escapement), an example of an associated probable ignition area, and the perimeter of the live-fire area cease fire lines (581,000 UTM line and roads) to be used for 2.75-caliber aerial gunnery rocket firing.

Restrictions

These rockets will not be fired until after the Kaluakauila, Kahanahaiki and Ohikilolo fuelbreaks and firebreaks are constructed and the expedited stabilization of 12 endangered plant species is completed (see Table PD 2). To ensure that hot residuals associated with the launch of the rocket do not fall outside the south lobe of the firebreak road or into Lower Ohikilolo Management Unit, rockets will not be fired south of 21° 31' 30'' North Latitude (the UTM NAD83 2380500 m line). To prevent the topographically corrected surface danger zone from overlapping with the management units on C-Ridge, rockets will not be fired above 122 m (400 ft) above ground level (AGL) and no further east than 158 ° 13' 10'' West Longitude (the UTM NAD83 581,000 m line). These cease fire lines will be visually marked on the ground with a minimum of 10 panels so that pilots can easily identify limits to live fire from the air. Ground markings will be visible to both the pilots and to an observer situated on the tower at the Makua Range office. A passing score for a 2.75 qualification exercise is one out of three, or three out of seven hits within a 100 by 100 m (328 by 328 ft) target box around a tank-sized object (Master Gunner S. Lodge, U.S. Army, pers. comm. 2006). The entire target box will lie inside the south lobe of the firebreak road. Although many rounds are expected to land outside the firebreak road, most of them will be within 800 m (2,624 ft) of the target. The rocket is propelled by burning propellant in a tube-shaped rocket motor. The motor burns out at approximately 450 m (1,476 ft), but the tube remains hot enough that it can ignite vegetation on impact 3.0 km (1.9 mi) down-range (S. Lodge, US Army, pers. comm. 2006).

Errors and malfunctions that have the potential to result in a rocket being fired outside the 3.0 km (1.9 mi) surface danger zone, can be minimized so that this weapon can be used safely at Makua. The maximum range for this weapon, if it were fired at a 45 degree positive angle, is 12.0 km (7.5 mi). To better ensure that rockets are only fired when the helicopter is in a dive, a second certified 2.75-caliber rocket pilot will be in the copilot seat and will arm the weapon only when the helicopter is at least 10 degrees nose down and below 134 m (440 ft altitude) (122 m (400 ft AGL)). Wind gusts affect rocket firing accuracy by affecting the helicopter's movement and by affecting the rocket's flight. Rockets tend to fly into the wind. Operations conducted in conjunction with aerial rocket firing will be suspended (per Army Regulation 385-63, *Range Safety Manual*) for one hour if wind gust is more than 30 knots (35 mph) as indicated by the maximum windspeed measured at the Makua Range weather station during the previous hour (available at <http://www.wrcc.dri.edu/cgi-bin/rawMAIN.pl?hiHMAR>). Skilled pilots will take wind into account when positioning their helicopter for firing to ensure that the landing skids running the length of the helicopter will be at a 10 degree front-down angle or greater whenever a rocket is fired at Makua.

Malfunctions of equipment resulting in a hang fire or a substantially misdirected rocket are rare. A hang fire, where the rocket is fired but does not leave the launch tube mounted to the helicopter, can result in a 10 degree "yaw" of the helicopter to the left or right. Our local 125th Battalion master gunners estimate that a hang fire occurs once for every 300,000 rockets fired. It is possible, but unlikely, for the pilot to be firing the trigger in ripple mode (which would enable deployment of 14 rockets in under six seconds), and, in a hang fire situation, a rocket could be fired 10 degrees off of the intended target. During these types of training exercises, pilots are likely to only fire two to four rockets during each pass at the target area so they are unlikely to employ ripple mode. Given a hang fire situation, the pilot may chose to jettison the launch tube assembly from the side of the helicopter. If the propellant in the rocket motor has been cracked, which could occur if it has been mishandled or dropped, the resulting uneven motor burn could potentially result in the rocket deploying at a 45 degree angle, regardless of the helicopter's nose-down position. However, the rocket's range would be reduced to 6.0 km (3.7 mi) (Yuma Proving Ground rocket specialist), and if the rocket contacted the helicopter's rotor blade, its range would be reduced even further. Recent changes in regulations regarding this weapon prohibit the use of any motor that has been dropped any distance. There is also the possibility of a malfunction of the rocket's side fins which could result in the rocket veering off course. However, the malfunction would also create a wobble in the rocket's flight and therefore the range of the malfunctioning rocket would be substantially reduced. A fin malfunction has not happened to any of the 300,000 2.75-caliber unguided rockets the 125th Battalion master gunner or the Yuma Proving Ground rocket specialist has observed. The 2.75-caliber rocket will be fired only when live herbaceous fuel moisture, calculated at the Makua Range WIMS weather station, is 100 percent or higher and when fire danger is low (Green). Fire suppression forces will be staffed pursuant to fire suppression staffing requirements.

Javelin Missile

The Javelin is a portable anti-tank weapon. It is shoulder-fired and can also be installed on tracked, wheeled or amphibious vehicles (Figure PD 28). The Javelin system consists of the Command Launch Unit and the round. The round consists of the Javelin missile and the ATK (Alliant Techsystems) Launch Tube Assembly. Javelin is a fire-and-forget missile with lock-on before launch and automatic self-guidance. The propulsion system is a two stage solid propellant design which provides a minimum smoke soft launch. At 1,000 m (0.6 mi), the flight motor is fully exhausted. Therefore, the surface danger zone, created for flat terrain, overestimates the maximum range of the weapon, given the terrain in the Makua valley. The tandem warhead is fitted with two shaped charges: a precursor warhead to initiate explosive reactive armor and a main warhead to penetrate base armor. At Makua the Javelin will be locked onto and fired at a heat source.

Restrictions

Tracers will not be fired until after the Kaluakauila, Kahanahaiki and Ohikilolo fuelbreaks and firebreaks are constructed and the expedited stabilization of 12 endangered plant species is completed (see Table PD 2). The weapon will be fired no closer than 25 m (82 ft) from the firebreak road to ensure that back blast resulting from activation of the flight motor pressure relief system does not ignite a fire outside the firebreak road. The blast will be contained by bunkers built around the targets. The vegetation within 10 m (32 ft) of the bunker will be maintained at stubble height. The maximum range of the missile is 4.0 km (2.5 mi) (Figure PD 29). The Javelin will be used only when live herbaceous fuel moisture, calculated at the Makua Range WIMS weather station is 100 percent or higher, and when fire danger is low (Green). Fire suppression forces will be staffed pursuant to fire suppression staffing requirements.



Figure PD 28. Javelin missile photographs from www.army-technology.com.