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WATERDOG  
(NRDU-V PROJECT 104-68) - PO-0004

U. S. NAVY RESEARCH AND DEVELOPMENT UNIT - VIETNAM

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From: Chief, U. S. Navy Research and Development Unit, Vietnam  
To: Commander U. S. Naval Forces, Vietnam

Subj: Final Report on Project 104-68, WATERDOG

Ref: (a) NRDU-V (C) ltr ser 031-68 of 18 Dec 1968  
(b) NRDU-V (C) msg 090102Z DEC 69  
(c) NRDU-V (C) msg 160757Z MAY 70

1. (U) The formal report of Project 104-68, entitled WATERDOG is forwarded for information and retention.
2. (U) References (a) and (b) established the project and concurred in the in-country evaluation. An interim report was submitted by reference (c).
3. (U) Unless otherwise directed, this report is considered to complete evaluation of this project.
4. (U) Findings, conclusions and recommendations are based on observations made throughout the evaluation and are solely attributable to the U. S. Navy Research and Development Unit, Vietnam.

  
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## TABLE OF CONTENTS

	<u>PAGE</u>
ACKNOWLEDGEMENTS	iii
ABSTRACT	vi
DEFINITION OF TERMS	vii
1. REFERENCES	1
2. PURPOSE	1
3. BACKGROUND	1
4. OBJECTIVES	3
5. DESCRIPTION OF MATERIAL	4
6. DISCUSSION OF RESULTS	6
a. SETTING AND METHODOLOGY	6
b. RESULTS	13
c. LIMITATIONS	15
d. SUPPORT	19
e. TRAINING REQUIREMENTS	21
7. CONCLUSIONS	22
8. RECOMMENDATIONS	23
9. OPINIONS	25
APPENDIX A: OPERATIONAL PROCEDURES	26
<u>LIST OF FIGURES</u>	
1. WATERDOG Patrol Team	5
2. WATERDOG Kennel and Berthing Ammi-barge	8
3. Pontoon Bridge and Temporary Kennel at ATSB Go Dau Ha	9

## TABLE OF CONTENTS

	<u>PAGE</u>
4. Obstructed Shoreline Where Swimmer Might Try to Evade Patrol	16
5. Buildings Over Water Where Swimmer Might Enter the Water and Attempt to Avoid Detection by Patrols	17
A-1. Idealized Swimmer Approach Sectors for a Point Target (approach angle and distance as a function of current assuming a 1 knot swimmer capability)	29
A-2. Quartering Area	30
A-3. Open Water Problem With Wind Direction at an Angle to Current (ship at anchor in a bay)	31
A-4. Diagram of Open Water Problem With Clearing Pattern (open water, no current situation)	32
A-5. Diagram of Patrol of an Inhabited Target in Opposing Wind and Current Situation	33

## ABSTRACT

An evaluation of the use of a WATERDOG team as a mobile water-borne patrol was conducted to investigate the effectiveness of the team in detecting enemy swimmer/sappers in the operational environment of the Republic of Vietnam (RVN). The patrol team consists of a specially trained German Shepherd dog and handler positioned aboard an outboard powered small craft.

The evaluation was conducted from March through June 1970 at four sites within RVN. These were Nha Be, Go Dau Ha and Ben Keo on the Vam Co Dong River and Cam Ranh Bay.

During the period of the evaluation no hostile swimmers were detected. However, based on performance during demonstrations and a limited number of detection problems utilizing friendly swimmers, the use of the WATERDOG concept is considered to be a highly effective and a relatively inexpensive swimmer/sapper countermeasure. During the period of the evaluation, the dogs did detect eight indigenous personnel in the water or near the water on the river banks. During the demonstrations and detection problems the Water Dogs were able to readily detect surface, snorkeling or open circuit scuba equipped swimmers. The Water Dogs are able to work effectively except in conditions of hard rain or rough water.

As a result of this evaluation it was recommended that:

- (1) The existing WATERDOG teams should be used as an operational unit in RVN.
- (2) A complete set of lesson plans and instructional support materials be written to cover the special training required for the training of WATERDOG teams. These lesson plans should be written so that they could be easily understood by experienced dog trainers and implemented without outside assistance. All available experience, including the retraining of the replacement Water Dogs at Cam Ranh Bay should be incorporated into these lesson plans.
- (3) As part of the Vietnamization plan, consideration should be given to initiation of a pilot WATERDOG training program under the auspices of the ARVN Dog Training Center.
- (4) Sufficient additional testing and evaluation be conducted in CONUS to obtain an adequate data base of statistically meaningful data on which estimates of system performance under various situations could be based.
- (5) An investigation should be made of the use of other dog breeds for training in a swimmer detection role.

#### DEFINITION OF TERMS

1. WATERDOG used when referring to the concept or a "system".
2. Water Dog used when referring to the trained animal.
3. Patrol and Scout Dogs used when referring to the trained animal as opposed to the role (patrolling, scouting, etc.).

1. (U) References.

- a. NRDU-V (S) ltr ser 0031-68 of 18 December 1968; Subj: Dogs for Swimmer Defense; request for laboratory assistance
- b. NAVSHIPRANDELAB PANFLA (S) msg 252140Z NOV 69
- c. NRDU-V (C) msg 090102Z DEC 69
- d. NAVSHIPRANDELAB PANFLA (C) msg 102115Z FEB 70
- e. NAVSHIPRANDELAB PANFLA (C) msg 271340Z FEB 70
- f. NRDU-V (C) msg 180105Z FEB 70
- g. NAVSHIPRANDELAB PANFLA (C) ltr of transmittal ser 0130 of 6 March 1970
- h. CTG 194.9 (C) msg 030410Z APR 70
- i. NRDU-V (C) msg 050747Z APR 70
- j. COMNAVFORV (C) msg 281218Z APR 70
- k. NRDU-V (C) msg 160757Z MAY 70
- l. COMNAVFORV (C) msg 081010Z JUL 70
- m. ACTIV Final Report of Project No. ACG-71F "Sentry Dog Utilization in Military Police Operations", dtd 21 May 1970
- n. Department of the Army Field Manual FM 20-20 "Military Dog Training and Employment", Headquarters, Department of the Army
- o. Department of the Air Force, AF Manual 125-5, "USAF Sentry Dog Program", Air Training Command, 15 April 1968
- p. NAVSHIPRANDELAB PANFLA (Code P743) (S) ltr of transmittal ser 0077 of 30 March 1970

2. (:) Purpose. To conduct an in-country evaluation of the effectiveness of the performance of WATERDOG teams in detecting enemy swimmer/sappers in the operational environment of the Republic of Vietnam (RVN).

3. (C) Background.

a. Experience accumulated during the course of the conflict in the RVN has demonstrated the imposing threat to military assets, bridges and commercial shipping of attack by the trained, simply equipped "loincloth" swimmer/sapper. This threat is expected to rank high in any insurgency or limited war situation, as well as any major conflict, because of the potential destruction that can be inflicted when compared to the minimal resources involved. The immediate swimmer/sapper threat encountered in the RVN required that the research community find more effective swimmer/sapper countermeasures.

b. The concept of using trained dogs for swimmer detection was conceived in an attempt to use swimmer "signatures" other than the acoustic effects that are normally employed for swimmer detection. Dogs had been and are presently used extensively by the military in support of combat operations. Although dogs had been trained for sentry, patrol, scout and mine/tunnel/booby trap detection roles on

land, no investigation had been conducted concerning the feasibility of employing dogs for waterborne sentry duty, particularly the detection of surface and subsurface swimmers. Since the desired mission of a swimmer detection dog was similar to that of a Sentry or Patrol Dog, it was considered that with proper training and conditioning a dog might provide a considerable capability for swimmer detection. If feasible, such a swimmer detection system would provide an extremely low cost and relatively unsophisticated swimmer countermeasures which could be easily deployed to meet an existing threat.

c. Based on Naval Ship Research and Development Laboratory, Panama City (NSRDL/PC) proposal, reference (a) requested assistance under the Vietnamese Laboratory Assistance Program (VLAP) for the conduct of controlled field tests in CONUS to determine the feasibility of using dogs to detect swimmers in river and bay environments.

d. Results of initial CONUS feasibility tests were reported by reference (b). These tests were conducted during October and November 1969 in the vicinity of Panama City, Florida. German Shepherd Patrol Dogs and dog handlers were obtained from the Patrol Dog Training School, Lackland Air Force Base, Texas to support the exploratory program. Results of the tests indicated that the dogs could detect and provide an alert on a surface, snorkeling or open circuit scuba equipped swimmer at upwind ranges in excess of 500 yards under optimum conditions employing scent as the detection sense. The dogs provided a positive alert on a swimmer by barking and showing aggressiveness towards the source of the human scent detected. Tactical procedures and the effects of some potential disturbance factors were also determined. It was established that the dog and handler team could be most effectively used by employing the team as mobile patrol in a skimmer-type craft. This maneuverability was found to be required to keep the potential swimmer approach sector upwind; to permit defensive coverage of a larger area; and to provide a capability to immediately counter any detected swimmer in order to prevent him from carrying out his primary or alternate mission or his escape. Success was found to be critically dependent on conditioning of the dogs, high standards of training, and motivation of the dogs and handlers.

e. Based on the results of the initial feasibility tests, reference (b) recommended consideration of an in-country evaluation of the WATERDOG concept subject to completion of additional training and the following:

- (1) Final technical evaluation of the configured WATERDOG system after development of modifications for the boat and associated equipment.

- (2) Agreement by the U. S. Air Force to provide the specially

trained dogs and their handlers under Navy funding.

(3) Preparation of operating instructions.

f. COMNAVFORV and NRDU-V concurred with the proposed in-country evaluation by reference (c).

g. Additional CONUS evaluation tests were conducted at Key West, Florida in January and February 1970. In addition to refresher training of the dogs and handlers in preparation for an in-country evaluation, these tests were to determine the effects of disturbance factors (e.g., noise, odors, inhabited targets and harbor activity) on dogs, false alarm rates, and to refine operational tactics for use by a WATERDOG team.

h. Reference (d) advised that the WATERDOG teams and supporting personnel would be ready to depart for RVN about the first week of March. Reference (e) later advised of a delay of arrival in-country until 16 March 1970 for approximately a two month evaluation. This time frame for the evaluation was based on the availability of experienced replacement dog handlers from in-country assets for WATERDOG training. This training was to be conducted concurrently with the evaluation so that the replacement handlers could take over the dogs at the end of the evaluation. A three week transition period was indicated for turnover of the dogs to the replacement handlers.

i. Reference (f) proposed Nha Be as the site for initial in-country shakedown/refresher training and ATSB Go Dau Ha as the follow-on site for evaluation of performance in a riverine operational environment.

j. Reference (g) provided a proposed test plan for the in-country evaluation.

k. The dogs and handlers arrived in-country on 19 March 1970.

4. (C) Objectives:

a. To determine the effectiveness of a WATERDOG system in protecting various assets against attack by swimmers in the operational riverine environment of the RVN.

b. To evaluate and refine proposed operational tactics to be used by a WATERDOG team in defending various assets under various operational and geographical situations.

c. To determine potential weaknesses and/or limitations of the technique and tactics in order to overcome them through further training and/or developments.

d. To determine the watch section patrol duration for which the dogs are able to perform effectively.

e. To determine training requirements for replacement handlers and patrol boat operators.

f. To determine support requirements for operational employment of WATERDOG teams.

#### 5. (C) Description of Material.

a. The basic component of the WATERDOG antiswimmer patrol team is a specially trained German Shepherd dog. The training principle used to condition the prototype Water Dogs was to develop a condition to near overaggressiveness towards humans in water. This was done by exposing the dogs to human agitators positioned in the water. After initial agitation to motivate the dogs to detect humans in the water, various detection problems were run to develop the dog's ability to detect swimmers by their emitted scents. By placing the dog and handler aboard a 16½ foot Boston Whaler (Figure 1) and patrolling downwind in the potential swimmer approach area, the dog can detect intruders in the water and the swimmer approach area can be maintained under continuous surveillance. In order for a dog to be most effective in the swimmer detection role, it is necessary for the dog to be positioned close to the water surface as possible. Positioning the dog and handler on an elevated position, i.e. a bridge, would tend to negate scent detection. Being close to the water surface enhances the dog's ability to differentiate scents originating at the water surface from the various background scents which may be present. There was some basis during the CONUS tests to indicate that the air emitted from scuba equipment might have a characteristic odor which may enhance detection ranges. When the dog alerts, i.e. gives an indication to his handler that he detects an intruder, the direction to the source of the alert can be ascertained by the handler from the dog's reactions. The distance to the alert source can then be closed to permit further visual investigation and countermeasures as necessary. The dog does not physically attack the intruder. Concussion grenades, rifle fire or any other appropriate means can be used for this purpose.

b. When operating in situations where a coordinated land and swimmer attack could occur, it is considered necessary to have three persons in the patrol craft; the dog handler, a boat operator and a "gunner". Duties of the dog handler are twofold: "reading" his dog for its peculiar indications of alerts and general attentiveness and keeping his dog under control at all times to protect both the dog and other occupants of the boat from injury. The boat operator has the responsibility to maneuver the boat in the area where the dog can detect an attacking swimmer. Of necessity, this involves being constantly



Figure 1

Waterdog Patrol Team

aware of the wind and current conditions. He must also be acquainted with the capabilities of a swimmer so he can maneuver the patrol boat most effectively. If a swimmer is detected, the boat operator must follow the dog's alert indications and handler's directions to localize and defeat the swimmer. The dog handler is in charge of the patrol. If an attack by land forces occurs while on patrol, the boat operator must clear the combat area as soon as possible to minimize the chances of injury to the team and/or disablement to the craft. The gunner performs various incidental tasks as needed. He continuously monitors the local operations command center radio frequency and keeps the command center informed of any unusual events that may occur. The gunner is equipped with a M-16 and a M-79 grenade launcher with which he delivers defensive return fire on adjacent land areas or fires upon any floating surface object that could be a possible threat; i.e., a floating mine or camouflaged surface swimmer. Other ordnance available for his use are concussion grenades, handheld parachute illumination flares and a handheld spotlight to illuminate suspicious floating surface objects and areas of alert.

## 6. Discussion of Results.

### a. Setting and Methodology.

(1) The four Water Dogs, their handlers, a boat operator and the project coordinator arrived in the RVN by 19 March 1970. The WATERDOG system initially remained in the Saigon-Nha Be area for acclimatization of the dogs, assembly and checkout of equipment, refresher training of the teams, and pre-evaluation proficiency trials. The Nha Be area was selected as the location for preparation for the evaluation on the basis of providing a convenient point to assemble the required support items and the most suitable area in which to conduct the required refresher training and swimmer detection proficiency trials, particularly at night. Also, the area has a history of attempted and successful swimmer attacks in the vicinity of the POL facilities north of the Naval Logistics Support Base at Nha Be.

(2) The first phase of the evaluation consisted of refresher training for the dogs and limited swimmer detection performance trials at Nha Be. Following basic agitation training of the dogs, initial swimmer detection proficiency/refresher training was conducted using scuba equipped swimmers during the early morning hours while it was relatively cool. The trials were conducted in the vicinity of the Nha Be POL facilities using Vietnamese surface swimmers. These swimmers were Vietnamese EOD personnel and were provided through the cooperation of the Commander of the Nha Be District Sensitive Zone and his

U. S. Army advisor. Operations in the Nha Be area were coordinated through the Rung Sat Special Zone (RSSZ) Tactical Operations Center (TOC) or the Nha Be District Sensitive Zone TOC. The WATERDOG system was supported by the Naval Support Activity Detachment (NSAD) at Nha Be.

(3) The second phase was the evaluation of the performance of the WATERDOG concept in the riverine environment. The Advanced Tactical Support Bases (ATSBs) at Go Dau Ha and Ben Keo were proposed as sites for the second phase. The ATSB at Go Dau Ha is located on a narrow strip of land adjacent to the western approach ramp to the bridge at the city of Go Dau Ha. ATSB Ben Keo consists of an assemblage of ammi-barges moored to the river bank at the village of Ben Keo. These ATSBs are located on the Vam Co Dong River and had been subjected to attacks by swimmer/sappers on several occasions. These bases provide support for various river patrol craft used to interdict VC movement across and on the river and adjacent waterways as part of the former Operation Giant Slingshot, now called Tran Hung Dao Two.

(4) During a preliminary visit to the proposed ATSB operational evaluation sites it was confirmed that there was a lack of adequate land area on which a satisfactory temporary kennel facility could be established. The lack of space was particularly acute at ATSB Ben Keo. Reference (h) advised of the desire to conduct the operational evaluation at ATSB Ben Keo at the earliest time because the swimmer threat was considered high. On this basis it was decided to construct a kennel and berthing facility aboard an ammi-barge to provide a transportable support base for the WATERDOG system. This platform could be located wherever the swimmer defense system was needed and would be especially suited for operations in the Mekong Delta area. Accordingly, modification of a fuel ammi-barge was initiated by NSAD Nha Be for use in the evaluation and for follow on operational use as necessary. Two standard "hootches" (16 feet by 32 feet) were constructed on a standard fuel ammi-barge as shown in Figure 2. The kennel "hootch" was modified to have a concrete slab floor and screened-in sides to facilitate cleaning and to allow sufficient air circulation.

(5) While the floating kennel was being completed at Nha Be, the necessary support was requested by reference (i) to transport the WATERDOG system by vehicle to ATSB Go Dau Ha for commencement of operational evaluation. The system was transported to Go Dau Ha on 7 April 1970 and a makeshift kennel was set up to commence the second phase. The dogs were staked to the perimeter fence and canvas shades erected as shown in Figure 3. Since November 1969 there had been three swimmer attacks in the immediate area of the ATSB. The last attack resulted in dropping two spans of the bridge crossing the Song Vam Co Dong on highway QL-1 leading to Cambodia. While

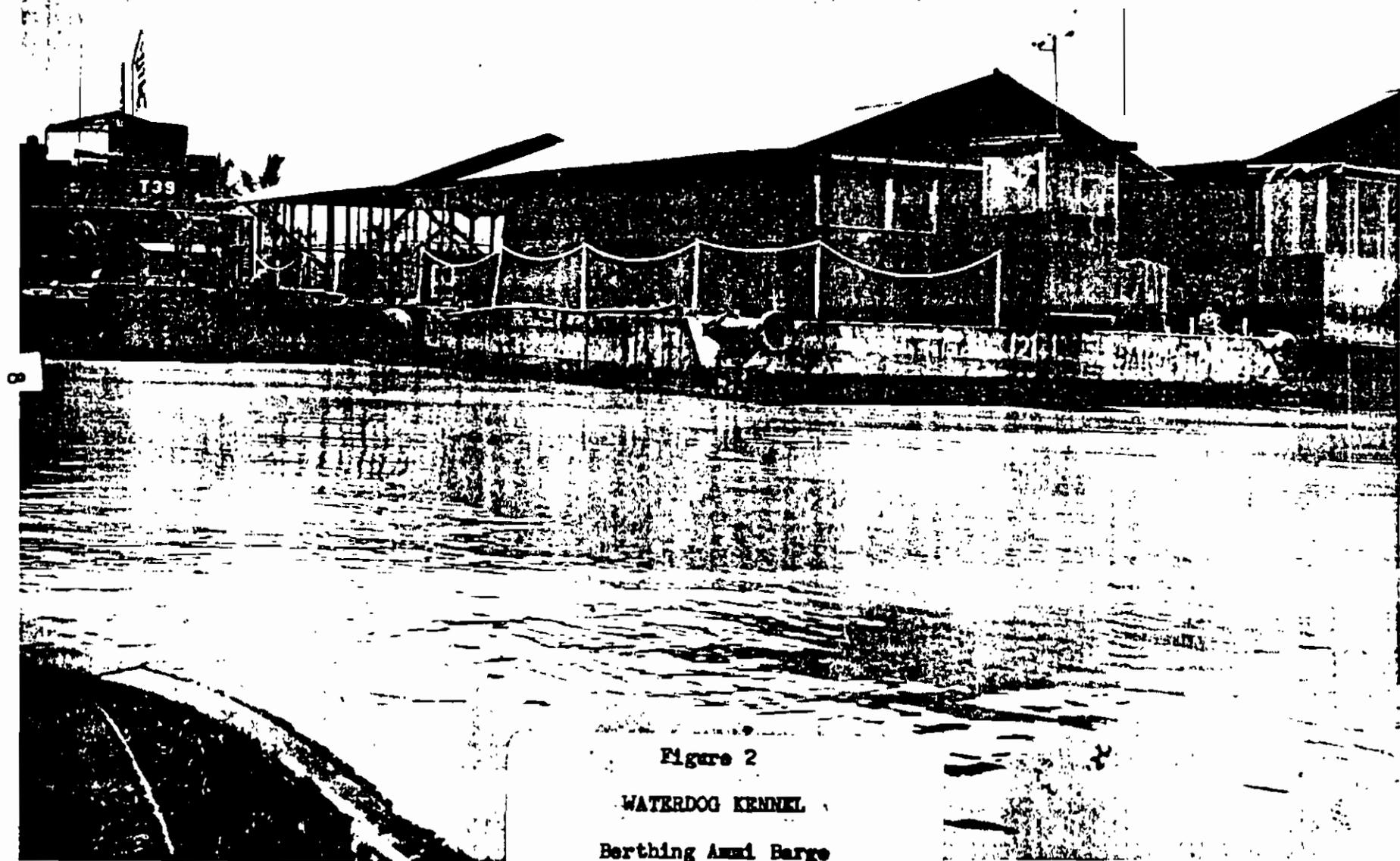


Figure 2

WATERDOG KENNEL  
Berthing Ammi Barge

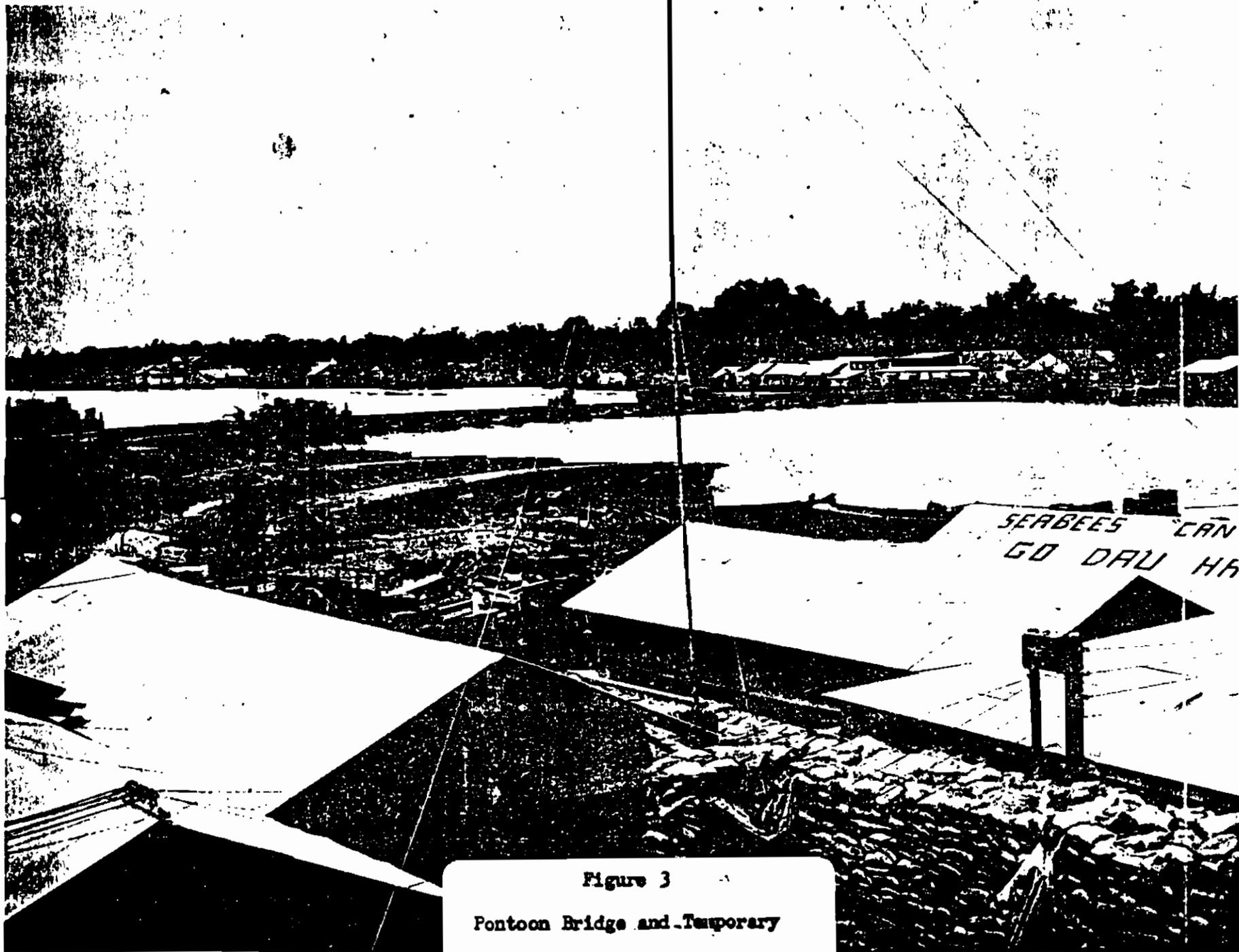


Figure 3  
Pontoon Bridge and Temporary  
Kennel at ATSB Go Dau Ha

the main bridge was being repaired a pontoon bridge was constructed upriver to carry vehicular traffic prior to and during the Cambodian offensive. This bridge was considered critical and a very likely target for an enemy swimmer attack. The WATERDOG team patrolled to protect this installation.

(6) Patrol operations were conducted commencing on 8 April 1970 for four nights from 1930 to 0530 under extremely trying conditions. Eventually, the local situation deteriorated to the point where it was becoming unsafe to be on the river at night due to "friendly" small arms fire in the immediate vicinity and the patrols were stopped. As soon as the floating kennel arrived at Go Dau Ha the system was loaded aboard and moved to ATSB Ben Keo arriving on 16 April 1970.

(7) ATSB Ben Keo consisted of an assembly of six small-barges (including the WATERDOG barge) and a very limited water-front area to which the barges were anchored. These barges extended 180 feet in length and their combined width was 90 feet. Generally, there were river patrol craft (PRRs, ATCs, ASPBs) tied up alongside. The width of the Vam Co Dong River at this point was 125 to 150 yards.

(8) One month before the WATERDOG teams arrived, the ATSB was attacked by three snorkel equipped swimmers each carrying a 50 pound charge of C-4. They were fortuitously discovered and directly countered before they could plant their explosives.

(9) WATERDOG patrols were maintained on a 1930 to 0530 basis for six consecutive nights starting 16 April before taking a night off to rest. The teams remained on site until 5 May and operated a total of 16 nights. Average time on patrol per dog each night was 2½ hours. Until the four replacement U. S. Navy dog handlers arrived on 21 April 1970 the original four dog handlers alternated duties with the boat operator and served as gunner when not handling their dogs. During the day the handlers had to feed, exercise, and care for their dogs.

(10) On the third night of operations the base was hit by a 107mm rocket fired from a range of about 500 meters. The rocket passed between the hootches on the kennel barge. It narrowly missed causing injury to the WATERDOG personnel and dogs. Shrapnel and blast effects slightly damaged the WATERDOG barge. The next night the base again assumed General Quarters after ten rockets were launched towards the base and impacted in the Vietnamese Army Training Center less than 1 km away.

(11) In accordance with reference (j) the WATERDOG system began movement to Cam Ranh Bay on 5 May 1970 to complete the final phase of the in-country evaluation. This phase consisted of the turnover of the dogs to the U. S. Navy handlers and the training of

two boat operators. Reference (j) also advised of the intent to assign the WATERDOG system to AYSB SEAFLOAT (near Nam Can on the Cau Ma Peninsula) upon completion of the training at Cam Ranh Bay. This plan was later revised as indicated in reference (k) to retain the teams at Cam Ranh Bay for four to six weeks of nightly operations under the supervision of one of the Air Force instructor/handlers. The turnover of the dogs to the Navy handlers was considered nearly completed when one of the original four Water Dogs (Topper) died on 19 May. The exact cause of death is still unknown, but was considered to probably have been the result of heat exhaustion.

(12) In order to maintain the WATERDOG system at four teams, which was considered to be the minimum feasible number for post-evaluation employment as an operational unit, it was proposed to obtain the Sentry Dog formerly assigned to the respective Navy handler and retrain the dog at Cam Ranh Bay. This retraining was expected to provide additional information and experience with which to refine the preliminary lesson plans and training schedule. While awaiting receipt of the Sentry Dog for training, the transition/turnover training of the other three dogs and handlers was completed. The turnover training of the three remaining teams was considered completed within two weeks and the three teams began patrol operations in the vicinity of the U. S. Army Ammunition Piers. The patrol sector assigned consisted of the ammunition piers and the adjacent land and water areas out to a 500 yard radius. Patrol operations were coordinated through the Harbor Entrance Control Point operated by the Inshore Undersea Warfare Group WESTPAC Detachment Unit Two at Cam Ranh Bay. During these night patrols it was noted that the Navy handlers were having some difficulty in correctly interpreting their dog's various alert indications. When the replacement Sentry Dog was received from the Sentry Dog Unit of Naval Support Activity (NSA), Danang, the three teams were taken off patrol for additional detection problem training.

(13) The retraining of Fritz (brand number 79X3) to perform duties as a Water Dog involved only three weeks of training and was done in five phases. The primary reason for this relatively short time was that the dog was considered to be an outstanding Sentry Dog. The first phase of five days dealt with the dog becoming accustomed to the new working surroundings and included walking and obedience training on the beach and daily rides in the skimmer. The second phase consisted of agitation sessions on the beach and in shallow water. The third phase was conducted by patrolling on the beach with a swimmer in the water and upwind. This is the basic part of detection training for a Water Dog to train him to detect and alert on swimmers in the water. The fourth phase was conducted by placing a swimmer in open water and patrolling downwind with the

dog riding on the bow of the skimmer to permit the dog to use the available wind to maximum advantage. The fifth phase was conducted in the same manner as the fourth, with the exception being that the swimmer was equipped with open-circuit scuba gear. During the three weeks of retraining of Fritz, the three original dogs were also put through the basic training cycle and showed an improvement in general alertness, aggressiveness and performance. It was felt that the reason for this improvement was the previous lack of refresher training opportunity during the riverine environment phase of the in-country evaluation. It was also determined during the retraining of Fritz that extensive use of snorkel equipped swimmer during swimmer detection problems will enhance the dogs' ability to detect scuba swimmers. While working the Water Dogs in Cam Ranh Bay, high winds and rough water sometimes prevented the dog teams from going out on patrol. This occurred because the dogs would be unable to remain on the bow of the skimmer.

(14) The future plans for the WATERDOG system at this point in time were for it to remain operational until the Navy handlers were detached from duty in the RVN and work wherever they were needed and could be the most effective. Because of the possibility that the dogs could be carriers of an incurable blood disease, they cannot presently be returned to CONUS after duty in RVN.

(15) On 1 July 1970, another of the original Water Dogs (Pete) died. The cause of the death has not been determined. There was some great concern initially that the second death was somehow related to the first. However, information received informally from the Navy handlers revealed that the dog had been operated on the day before his death in an attempt to determine the cause of reoccurring bloating of the stomach and possibly related loss of appetite and weakness of the hind quarters. Consideration was given to acquiring the Sentry Dog previously assigned to the respective Navy handler when at NSA Danang and retraining this dog for Water Dog duties through use of the preliminary lesson plans provided by the Air Force and the recent personal experiences of the U. S. Navy Water Dog handlers. However, on the basis of the immediate swimmer/sapper threat at SEAFLOAT, reference (1) directed the transfer of the remaining three Water Dog teams to that location for about three months.

(16) The mobility of the WATERDOG system was demonstrated by the subsequent movement. The dogs and handlers arrived at SEAFLOAT on 12 July 1970 via fixed wing and helicopter transportation from Cam Ranh Bay. The biggest problem in the move was the expeditious transfer of the team's patrol boat. A kennel was built at Solid Anchor by the Navy SeaBee Detachment on the river bank opposite the midstream barge complex comprising ATSB SEAFLOAT. The dogs were

slightly upset by the helicopter ride and were also initially quite "gun shy" in the presence of 3"/50 caliber fire delivered nightly by the USN PG moored near ATSB SEAFLOAT. The latter was mostly overcome in a matter of a few days. Although there were three confirmed swimmer/sapper incidents in the vicinity of ATSB SEAFLOAT during the period of 12 July through 1 September while the WATERDOG system was assigned, in none of these cases was a WATERDOG patrol on station in a position where they could have detected the intruders under the environmental conditions present at the time. Two of the attacks were detected and countered by alert sentries and the third resulted in the sinking of a VNN LSSL. Opportunity to use friendly swimmers to run detection problems and provide refresher training for the WATERDOG teams was again limited. Nighttime detection problems were considered completely out of question and the tropical heat of day and/or high river currents imposed limitations during the day. However, utilizing the presence of scuba equipped divers who were inspecting the sunken LSSL as a target of opportunity, the dogs provided strong alerts at approximately 600 yards on the first pass through the scent cone. Wind conditions were optimum at the time, i.e. in the same direction as river current and moderate in strength. During subsequent limited demonstrations during the daytime, similar results were reported obtained with surface or snorkeling swimmers.

b. Results.

(1) Over two hundred hours of patrol time were logged during the operational evaluation in typical riverine combat environments. Two types of assets were patrolled; a pontoon bridge and an afloat ATSB. Although no enemy swimmers were detected and friendly swimmers were used only in a limited way, the working ability and usefulness of the WATERDOG team in the field was demonstrated. During the time spent at both ATSB Go Dau Ha and ATSB Ben Keo it was generally impossible to use friendly swimmers to simulate an attack situation during the hours of darkness, since there was no way to assure the safety of the swimmers. This prohibited making an assessment of the effectiveness of the system in terms of probability of detection, but a positive intuitive judgement can be made based on performance during detection problem trials and on the detections of indigenous bathers and other personnel near the water's edge. A total of eight indigenous personnel were detected in or very near the water during patrols. Two were bathing, one was swimming and the other five were found while they were checking fish traps, defecating or urinating, performing sentry duty, or moving along the banks after dark. Ranges at which these detections were made varied from an estimated 25 to 150 yards in areas heavily congested with people. Six were detected by scent and two by sight, the latter occurring under more favorable lighting conditions. The riverine base setting of the evaluation areas also limited the ranges at

which detections could be made. Friendly surface swimmers were used to simulate one nighttime attack apiece for three of four dogs while at ATSB Ben Keo to test the dogs efficiency after 14 days of patrols and to reinforce their skills of scent detection. An attempt to determine the maximum range of detection was not made. All three dogs alerted on scent on the first pass at an estimated range of 100 yards under very light wind conditions. During the initial daytime scuba detection refresher training runs conducted at Nha Be, the dogs alerted at estimated ranges between 175 and 200 yards in similar wind conditions. In both cases the wind was blowing cross-river.

(2) An average of one alert per night was made by the dogs on sources that could not be positively located or identified. The source of these alerts always originated from the land surrounding the base. Theoretically there should have been no people in these areas after dark unless they were the enemy. The dog's alert to a person on land is different from an alert on a waterborne source and the handler can usually tell the type of alert and react accordingly. When an alert on an apparent source on land was made, the local Naval Operations Center (NOC) was informed by radio so that the area could be observed for enemy activity. Normal patrol was resumed quickly because of the possibility that the enemy could use such a deception as a diversionary technique to counter the WATERDOG team.

(3) All three senses of the dog, scent, sight, and hearing, are used at all times, but the main detection sense in the WATERDOG roll is scent. A properly trained dog will observe any visible floating objects but not alert on them unless there is a human scent associated with a particular object. Therefore, the patrol boat must pass downwind of any suspicious floating objects so this check can be made. The dog handler can visually check the object when it is illuminated. As long as the number of suspicious floating objects is not excessive (2 to 4 per hour) the WATERDOG patrol can perform these duties in addition to patrol operations against swimmers.

(4) The effects of distractions occurring while on patrol were minimal. The dogs adjusted well to events that were recurring. The first time that something happened with which a dog was not familiar the dog was distracted by it, but once identified it was accepted as normal.

(5) The standard technique for swimmer defense prior to the arrival of the WATERDOG team at ATSB Ben Keo was randomized use of concussion grenades. The effectiveness of this technique is based solely on fear on the part of an attacking swimmer of not knowing when a grenade will be used. For the personnel living aboard the

ATSB barges and boats alongside it was almost impossible to get a good night's sleep. With the arrival of the WATERDOG teams and the subsequent reduction in the number of grenades utilized, rest conditions improved considerably.

(6) The weekly usage rate of concussion grenades at ATSB Ben Keo was compared before and after the arrival of the WATERDOG project. Pre-WATERDOG average usage rate was 900 grenades per week. During the evaluation it dropped to approximately 200. Most of these were expended by river division personnel who used them away from the ATSB area. Project WATERDOG personnel used four per night on the average.

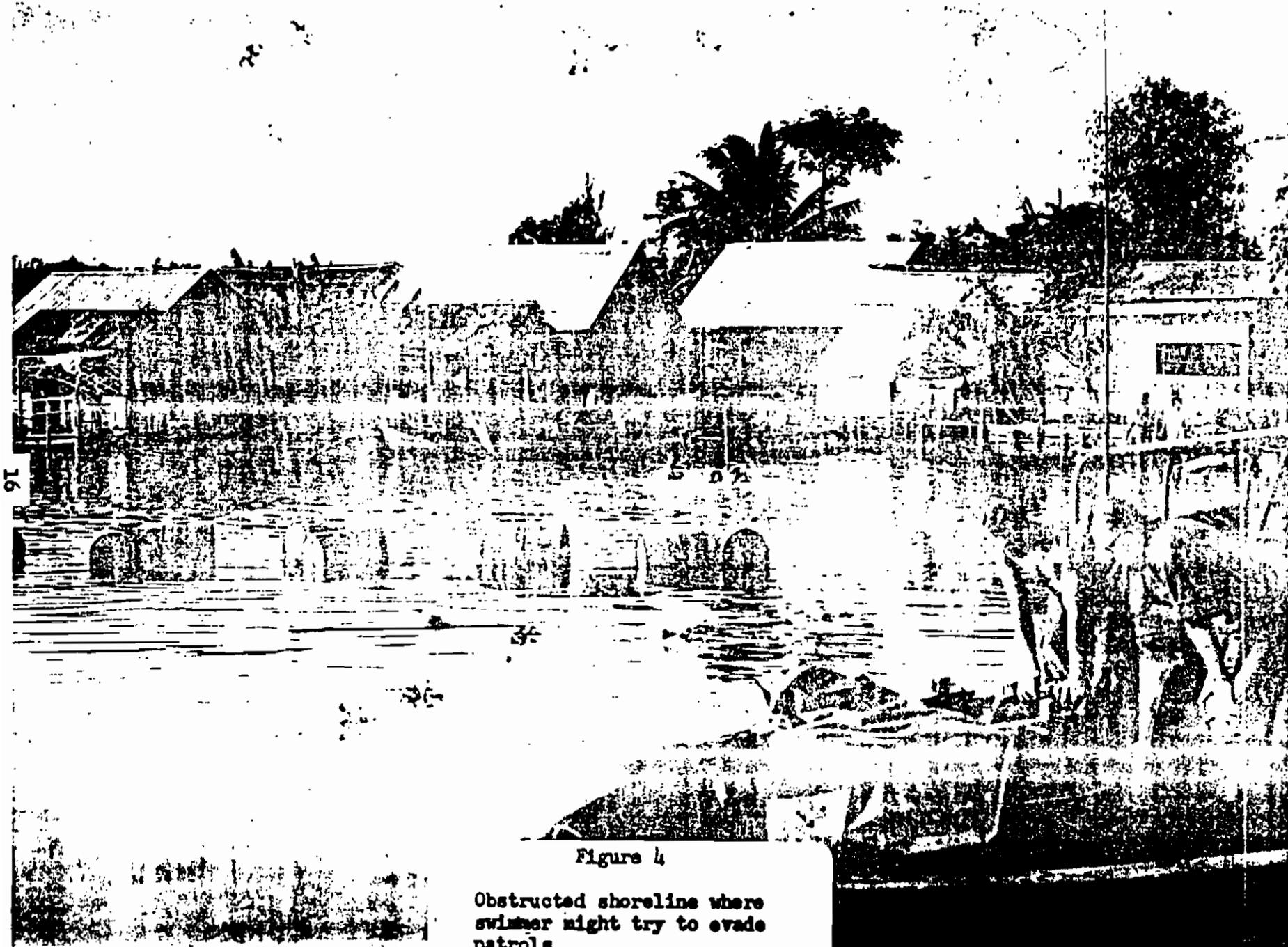
(7) The general temperament and disposition of the four dogs throughout the evaluation period and to date has been good. No problems with control or obedience occurred. All the dogs appeared to have become well adjusted to working from a boat.

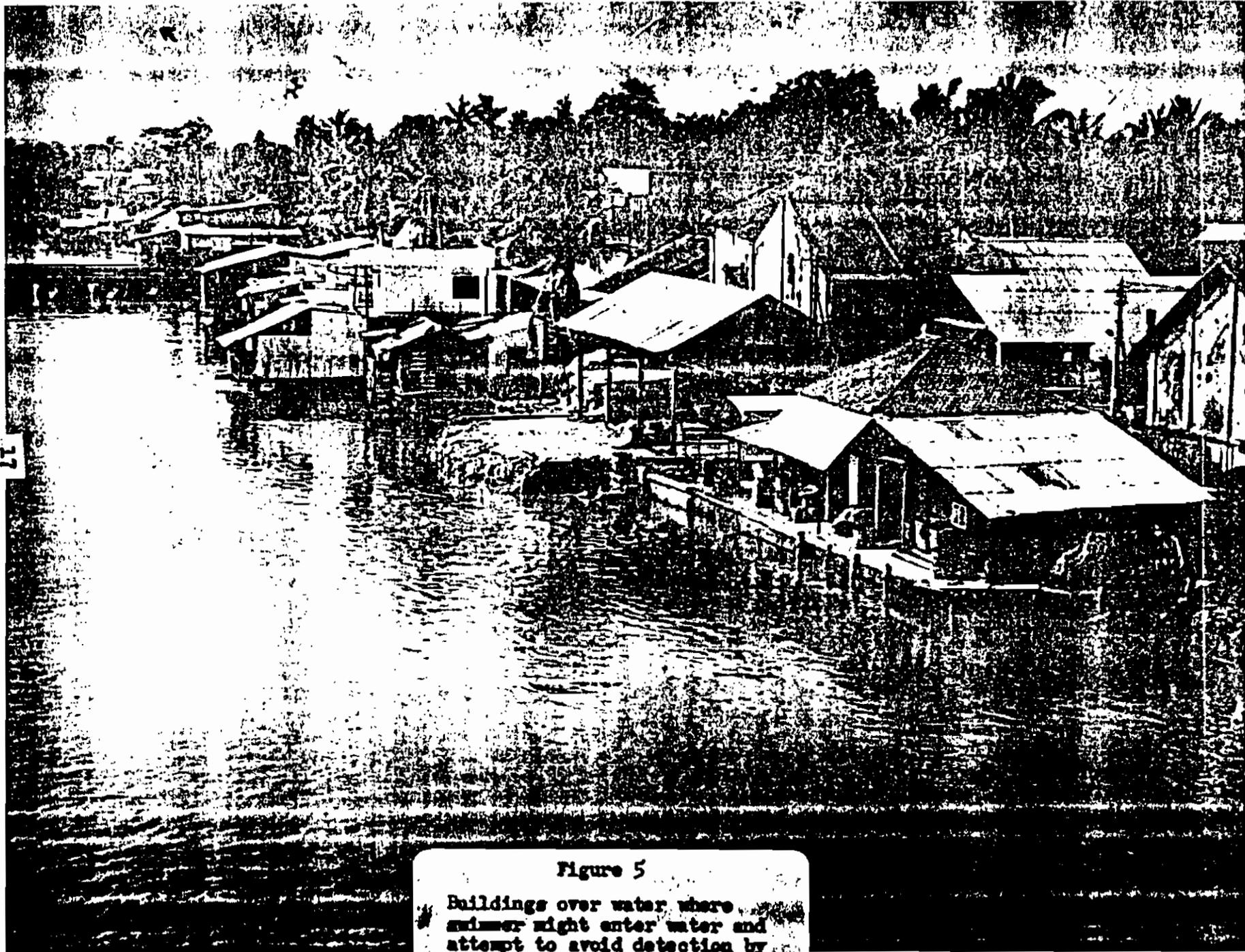
c. Limitations.

(1) Practical limitations on the use of a WATERDOG system fall into three categories: size of the area that can be effectively secured, effects of certain weather conditions and necessary support requirements. These limitations must be considered in determining the application and use of WATERDOG teams.

(2) Primary factors affecting the size of the area that can be secured are the number of WATERDOG patrol teams and support equipment available, type of protected asset, location of the asset and the environmental conditions. Assuming that adequate WATERDOG teams, equipment and logistics support are available to maintain one WATERDOG team on patrol throughout the desired patrol period, the maximum linear frontal area that can be secured by one WATERDOG patrol under ideal conditions is approximately 250 yards. A situational example would be a ship anchored in a bay or protected harbor and at least 500 to 1000 yards away from an uncontrolled land area from which a swimmer could enter the water. The patrol team must have unrestricted access to all sides of the ship at all times.

(3) Whenever the enemy swimmer has an area close to the target to enter the water, the WATERDOG patrol team is restricted in freedom of patrol movement. In this situation and if unfavorable wind and current conditions prevail the area that can be secured is reduced accordingly. Figures 4 and 5 illustrate two riverine shoreline situations in which a swimmer could possibly enter the water from adjacent land areas to make his attack. Appendix A presents a summary of the factors that affect the performance of a WATERDOG patrol and the attacking swimmer. An understanding of swimmer capabilities and limitations is necessary for deploying and





17

Figure 5

Buildings over water where  
swimmer might enter water and  
attempt to avoid detection by  
patrols

maintaining an effective antiswimmer program of any type. This Appendix also contains guidelines for determining the techniques, areas and methods of patrol under various conditions that might confront a WATERDOG team.

(4) Limitations of the WATERDOG patrols due to adverse environmental conditions are varied. Sea states that make the 16 foot skimmer craft uncomfortable or unsafe for a human affect the dog similarly. When a dog must concentrate on remaining upright and inside the boat, his effectiveness as a swimmer detector is diminished. Calm wind conditions make an area more difficult to secure, since the scent detection range is reduced. A hard rain will distract the dog somewhat, make him uncomfortable and shorten the scent detection range. A dog can, however, still work in a moderate rain and may be more effective against a surface swimmer under this condition than most other antiswimmer systems developed to date. Because patrols are usually maintained at night, the tropical heat does not affect the dog's performance unless it prevents him from resting properly during the day. It was found that it is best not to work the the dogs excessively between about 0900 and 1700 because of the high ambient temperature in RVN. Since dogs are very susceptible to overheating (heat strokes, heat cramps, or heat exhaustion), care must be taken in their use during the heat of the day.

(5) When a dog is used in the Boston Whaler, freedom of movement and opportunity for exercise are very limited in comparison to operations on land. The dog's alertness and effectiveness is reduced after about three hours on patrol. If exercised for a brief period and then given a two hour rest, each dog could possibly be rescheduled for another three hour patrol for a total daily working time of six hours per night. Practically speaking, if this schedule were maintained continuously day after day, it would be very exhausting, especially for the handlers. Nine to twelve hour work days would be required. Because the opportunity for exercise in the patrol boat is limited, each Water Dog should be exercised at least one hour daily. This should be done on an established obstacle course during the early morning or early evening hours to prevent overheating in a tropical environment.

(6) The long-term effects of employing dogs continuously in a boat have not been determined, but it was observed that they did become physically weaker after four weeks of boat work without the opportunity for adequate off duty exercise. The instructors from the USAF Patrol Dog School who were the original Water Dog handlers believed that it may be advisable to periodically rotate the Water Dogs to land type Sentry or Patrol Dog duties if exercise as described in subparagraph (5) above is not possible. This would give the dogs

a chance to physically rebuild and may stimulate their interest by providing a change in surroundings and work. Minor retraining would probably be necessary before making the change. A result of this rotation may be to increase the dogs working efficiency. It was considered that the frequency of this rotation should be about once every three months.

(7) Experience acquired during this evaluation demonstrated that four dogs, four handlers and two boat operators cannot maintain a pace of continuous night operations seven days per week for an extended period of time. Since the men will require periodic breaks to rest and to take care of their personal needs, the patrol team element size must be expanded to a level to compensate for these requirements. Considering the situation where it is desired to maintain one patrol on station continuously during the hours of darkness seven days per week, a WATERDOG element of a minimum of five or six dogs and handlers, two boat operators and possibly two gunners would be required. Two such elements would be required to adequately secure larger anchorage or pier areas.

d. Support.

(1) Basic support requirements to maintain a WATERDOG system fall into the following categories: dogs and handlers, kennel facilities and space, dog handling and care equipment, veterinarian services, food for the dogs, swimmer support services and logistics support for the patrol boat.

(2) There are some situations where it may not be necessary to have a gunner aboard the boat. In situations where a gunner is required, it is desirable to select personnel from the local command's watch sections to fill this need. This would relieve the dog handlers of this responsibility and enable each WATERDOG team member to take a night off at least once per week.

(3) The kennel and berthing semi-barge makes it possible to employ dogs at many locations where it would not otherwise be feasible. The kennel barge should be positioned as far as possible from personnel and any boat traffic. All boats should be prohibited from tying up to the barge. All friendly swimmers and/or bathers must be kept out of sight of the dogs. The Water Dogs are agitated by activities of this nature and cannot rest properly. It is also desirable to have a fenced-in area containing an obstacle course where the dogs can be exercised and run off-leash. This area can also be used for daily obedience training.

(4) Veterinarian services are required for routine check-ups at least once a month. To aid in disease control, blood and fecal samples must be taken and analyzed each month for heart worms and "bleeding disease". The most common afflictions/diseases which affect

military working dogs in the RVN are internal parasites, the "bleeding disease" (idiopathic hemorrhagic syndrome, IHSD) and leptospirosis. Reference (m) provides some background on diseases among U. S. Army Sentry Dogs in the RVN. Procedures for control of internal parasites are detailed in references (n) and (o).

(a) The "bleeding disease" results in internal and external hemorrhaging and is normally fatal, once contracted. The disease is considered communicable among dogs, and animals suspected of having the disease are isolated. Present policy precludes transfer of any dogs from RVN because of the possibility of having contracted the "bleeding disease", even though no manifestation exists. For early detection and control of this disease, the temperature of each dog should be taken daily, preferably just before the dogs goes to work. This data should be recorded and charted. A gradual rise may indicate the presence of the disease. It is presently believed that the disease may be transmitted by parasites such as ticks, lice, and/or fleas. Therefore, a program of insect control involving general kennel cleanliness and regular dipping is necessary.

(b) Leptospirosis is a disease of the kidneys caused by water-borne bacteria. Incapacitation and possible death result. Immunization is reportedly not effective against all strains of the bacteria.

(c) Veterinarian services are also required on an emergency basis in the event of illness or injury to a dog. Provisions for rapid medical evacuation of a dog to an animal hospital or clinic should also be arranged in the event of serious injury or illness.

(5) A proper diet is necessary to keep the dogs in a state of good health. A commercially prepared dog food designed to satisfy all the dietary needs of the dog is sufficient. Adequate supplies of whatever type is selected should be maintained. About three pounds per dog per day is required. It is not desirable to change the diet often. The amount that is fed depends upon the dog, his condition, the type of work the dog is doing and the climate. Adequate supplies of fresh potable water must be available at all times. Several quarts per dog per day are usually required.

(6) The Boston Whaler was selected because it has adequate stability, width and maneuverability to give the dog a good working base. Indoor/outdoor carpeting was installed to cover the inside portion of the bow area to provide the dog a nonskid footing over the fiberglass. An 85 hp outboard was fitted to the boat used in the evaluation. Ninety percent of the hours logged were at idling speed and every two to three weeks it was necessary to change spark plugs because they had fouled badly. Operationally, it is advisable to

have two patrol craft available in case one boat fails or if it is desired to put two WATERDOG teams on patrol during slack tide. Also, the second team can be available on call to assist in localizing a swimmer after a sighting or to counter a threat in another area as might occur in a large anchorage area.

(7) In the riverine combat environment situation it would be desirable to have two 40 hp engines on the patrol craft so that if one failed or was knocked out, the boat would not be disabled and helpless. During patrols, one engine would be used more efficiently. This would probably minimize the fouled spark plug problem.

(8) Swimmer support services are required on at least a weekly basis to conduct refresher detection problem training of the dogs. When possible it would be best to conduct this training on a daily basis to maintain peak performance and interest. Local operating environment conditions or lack of swimmer support due to other operational commitments prevented the desired frequency of refresher training during the in-country evaluation.

e. Training Requirements.

(1) Periodic refresher training and agitation of the dogs is necessary to keep them alert, aggressive and motivated at a high level. The original four dogs showed very little loss of their willingness and ability to seek out swimmers after a month of inactivity before coming in-country. After beginning the period of nightly patrols, it appeared that each dog should be exposed to a swimmer of the type the dog is weakest in detecting at least once a week. A minimum of two detection problems is desirable. A dog with a relatively weaker sense of smell should be exposed to a surface or snorkel swimmer rather than a scuba swimmer. The dog handlers should maintain vigilance of their dogs' state of alertness and arrange for agitation training whenever it is apparent that a dog is losing interest. The frequency of both of the above forms of training depends upon the individual dog. If possible, the training should be conducted under actual working conditions approximately one half hour after the patrol begins. The dog must remain confident of his ability to find a swimmer after three hours of fruitless effort. Swimmer support services must be available for this periodic refresher training.

(2) Since the first four dogs were trained on a trial-and-error basis, the exact time required for a training course is not known. Tentatively, it appears that a trained Sentry Dog could be trained as a Water Dog in a four week period. The preliminary lesson plans and training schedule were tested when a former Sentry Dog was trained as a Water Dog at Cam Ranh Bay to replace the Water Dog which died. The training was completed in three weeks as a result of

the outstanding ability of the dog and the seven day work week. It is understood the results of this training experience will be used to update the previously-prepared lesson plans and training schedule.

(3) Based on the observations made during the in-country evaluation, it appears that two modifications should be made to the training plan:

(a) During the training and tests conducted in CONUS, a small firecracker (M-80) was used to signal the scuba or snorkel equipped swimmer to surface and agitate the dog. During in-country evaluation, it was apparent that this was an error. Initially, everytime a concussion grenade detonated in the vicinity of the patrol, the dog expected that a swimmer would surface and was agitated by this expectance. This tended to make the dog less alert after numerous occurrences because a swimmer did not appear.

(b) The Water Dog should be trained to lie down in the boat when the craft's speed is increased. This will make it safer for both the dog and his handler. Several times a dog fell overboard, causing unnecessary delay in clearing the area. This delay could have been catastrophic in an attack by hostile fire situation.

(4) Assuming that prospective new or replacement Water Dog handlers have had basic dog handling training and practical experience with dogs, the time required for training a handler in the WATERDOG concept is estimated to be four to six weeks. This is most easily done when a system is already operational. The dog builds up a close relationship with the assigned handler and the minimum duration of this working relationship is suggested to be one year. The dog strives to satisfy his master and the handler's affection is his only reward. There have been indications that if a dog's handler is changed too often, the dog tends to become confused and becomes less effective as a military working dog.

(5) Training of a patrol boat coxswain is also easiest when a system is operational. A period of about two weeks is necessary. It is also advisable that at least one boat operator on a team be experienced in the repair and maintenance of outboard engines and that at least one boat operator be a scuba qualified swimmer in order to have swimmer services readily available for refresher training of the dogs.

## 7. (C) Conclusions.

a. The use of a trained dog aboard a skimmer patrol craft is

considered to be an effective countermeasure for detecting enemy swimmers in the riverine and bay environments of RVN. When properly used, a WATERDOG team can provide effective defense for afloat military assets, bridges, docks, piers and waterfront areas from attacks by surface, snorkeling, or open-circuit scuba equipped swimmers under most conditions that might be encountered.

b. The WATERDOG kennel and berthing semi-barge is suitable for supporting a WATERDOG element and can be moved to most locations where WATERDOG operations would otherwise be impossible. Other temporary kennel facilities may be acceptable for short periods of time. However, standard dog kennel facilities should be utilized whenever possible.

c. Operating procedures and tactics as originally proposed appear to be adequate for most situations that might be encountered.

d. The four dogs and handler teams comprising the prototype WATERDOG system were insufficient in numbers to continuously maintain a single patrol post or to secure larger areas where two patrol teams must be maintained on station to provide adequate security.

e. The maximum effective length of patrol for a Water Dog in a 16 foot Boston Whaler is about three hours. With exercise and about two hours of rest between patrols it is anticipated that each dog could be worked for a total of six hours per day.

f. Replacement dog handlers can be trained and assume full responsibilities in about four to six weeks, provided that the new handlers have had previous military dog handler training and qualified knowledgeable instructors are available. Handlers should not be changed more often than once a year.

g. Replacement boat operators can be trained in a two to three week period. Previous experience with outboard motor operation, maintenance and repair is advisable.

h. Support requirements have been determined and are within the capability of countries seeking a relatively inexpensive, simple, effective swimmer countermeasure technique.

#### 8. (C) Recommendations.

a. The existing WATERDOG teams should be utilized as an operational unit in the RVN. They should be assigned to a harbor or anchorage defense command and used in conjunction with other normal security patrols. These teams can also demonstrate their capabilities and usefulness to other friendly forces who may be interested in developing

a program of their own.

b. It is recommended that a standard dog kennel facility as specified by current U. S. Army and Air Force directives be utilized whenever possible. The kennel and berthing ammi-barge can extend employment to certain areas where space is limited, or be used in a new operational area until a regular kennel facility can be built. The afloat kennel adds to the number and type of assets that can be secured.

c. A complete set of lesson plans and instructional support materials should be written to cover the special training required for WATERDOG teams. These lesson plans should be easily understood by experienced instructors and implemented without outside assistance. All available experience, including the retraining of the replacement Water Dog at Cam Ranh Bay, should be incorporated into these lesson plans.

d. As part of the Vietnamization plan, consideration should be given to initiation of a pilot WATERDOG team training program under the auspices of the ARVN Dog Training Center. The progress and results of such a program would require close monitoring to determine the degree of success. It is recommended that such a program include an effective incentive award program to attract the most capable personnel.

e. An investigation should be made to determine the feasibility/adaptability of other dog breeds for training in the swimmer detection role.

f. Although reference (p) provided some data of a statistical nature which was gathered during the initial CONUS evaluation period, there is a lack of an adequate data base from which the performance of a WATERDOG element could be predicted under various environmental conditions. Qualitative performance of the teams in the RVN during those limited opportunities when the dogs could be exposed to friendly swimmers under somewhat controlled conditions was very impressive. However, ranges of detection had to be visually estimated. In most cases the handlers were aware that there was or would be a swimmer in the water. In view of the above, additional CONUS testing and evaluation is recommended to provide a better data base, which would include variations of the most important variables of wind, current, and swimmer type and include totally unalerted conditions, on which estimates of system performance under various situations could be based.

g. The minimum size of a WATERDOG unit should be two elements, each with five or six dogs and handlers and two boat operators, with a senior Petty Officer in charge.

h. A minimum of three Boston Whaler type patrol craft outfitted with

two 40 hp outboard engines should be provided for a WATERDOG unit of ten teams (two elements). The use of commercially available electric powered outboard drive units should also be considered where relatively covert patrol operations may be required.

1. Neither M-80 firecrackers nor other explosive type devices should be used during WATERDOG training to signal swimmers to surface.

j. At least one boat coxswain in each patrol element should be experienced in the repair and maintenance of outboard engines and at least one boat operator should be a scuba qualified swimmer. The number of boat coxswains qualified in these areas may be decreased somewhat as the number of patrol elements increases.

## 9. (C) Opinions.

a. On the basis of the somewhat limited information concerning and description of actual swimmer detections contained in this report, there may be some doubt as to the effectiveness of the WATERDOG concept in an operational situation. Most individuals were or appeared to be quite skeptical when first having the concept presented to them. This included the U. S. Navy replacement dog handlers.

b. Observation of a Water Dog patrol in action, particularly during a swimmer detection problem, was sufficient in all cases to easily convince the most reserved "Doubting Thomas". The ability of a Water Dog to differentiate a swimmer scent in the presence of various other human and non-human scents was totally impressive.

c. The performance of the Water Dog is entirely dependent on the degree of conditioning of the dog, an understanding on the part of the handler and boat operator of the measures necessary to counter an attacking swimmer and proper patrol procedures.

d. In view of all of the many practical variables involved, it may not be feasible to achieve a meaningful statistical estimate of predicted performance. This opinion is based on the difficulty in establishing the degree of the dog's motivation, ability, or interest at a particular time as opposed to measuring the operating parameters of an electronic detection device.

e. On the basis of observations during the in-country evaluation and formal and informal information received concerning performance and tests during the CGNUS evaluation, the WATERDOG concept appears to be the singularly most cost effective and least expensive counter-measures developed to date to counter the surface, unpowered or open-circuit scuba swimmer/sapper under various operational situations.

## APPENDIX A

### OPERATIONAL PROCEDURES

1. (C) The WATERDOG patrol team has only one principal function. This function is to protect an assigned asset from attack by surface, snorkeling, and/or scuba equipped swimmers. However, the patrol boat's presence in the upcurrent area in the riverine situation places the patrol where it can also intercept, identify and destroy floating objects which might be drifting mines.
  
2. (C) Several factors must be taken into consideration when determining the area and method of patrolling. Since scent is the primary mode of detection, the relative wind speed and direction must be noted at all times and the patrol area adjusted to place the dog downwind in the area from which a swimmer could approach. Wind speed affects the width of the scent cone and strength of the scent as it is carried with the air currents. Although higher wind speeds produce very narrow and strong scent cones and the range of detection may be increased accordingly, a dog passing across the cone at a right angle could miss the scent altogether if the patrol boat was travelling too fast. In the case of light winds, the reasoning is the opposite; the scent cone is diffused and the scent strength weakened and the patrol craft can travel at somewhat faster speeds to increase the area searched and the probability of detection, but at somewhat shorter ranges.
  
3. (C) Swimmer capability to effect an attack is dependent upon the physical setting, the amount of ordnance the swimmer is transporting, his swimming expertise and endurance, the type of equipment he has and the environment. For example, a scuba equipped swimmer in muddy river water must surface periodically to re-establish his position and take a new compass bearing to reach his target. Also, a swimmer towing a 100 lb. charge could not swim rapidly against a current and remain covert. Practically speaking, the attacking swimmer will usually swim and drift with the current and use it to his advantage. By drifting with the current he can concentrate on moving cross current to intercept the target. Theoretical maximum swimmer approach sectors for a point target assuming a 1 knot swimmer speed and 0 to 5 knot current speeds are presented in Figure A-1. A current of 1 knot will move a drifting object at a speed of about 1.7 feet per second. In a five minute period this object will travel 510 feet. The most effective patrol pattern must take into consideration all environmental factors to maximize the opportunity for detection.
  
4. (C) In areas where water currents are influenced by tidal action, the time near slack current is a high threat period and the WATERDOG patrols must take this into account. Nearly slack water makes it

theoretically possible for a swimmer to attack from any direction and therefore the swimmer approach area to be patrolled is increased significantly. For most assets the patrol pattern can be randomized or the patrol speed increased to compensate for the slack current period. During a very high threat period in a given tactical situation, a second WATERDOG patrol team may be required to adequately cover the increased swimmer approach sector area.

5. (U) Three hypothetical situations that depict different combinations of wind and current about an anchored vessel in open waters are presented in Figures A-2 through A-5. These figures will aid in understanding the reasoning that must be followed in establishing the proper patrol techniques.

6. (C) Normal speed of the patrol craft is relatively slow, about three knots or less. A regular schedule for the length of patrols and the time of relief should not be established. Team changes should be coordinated by radio on an as needed basis or on a randomized schedule. The relieving team should depart immediately when the on duty team comes in to minimize the time off-station.

7. (C) To secure an area or point target with the WATERDOG team, it is necessary to establish a patrol pattern such that the scent from a swimmer would be intercepted. At the beginning of each patrol watch period, it is necessary that the target area be initially cleared. To clear an area, the patrol craft should circle the defended asset to ensure that it is secure, and then broaden the patrol pattern from this point. The target area may be cleared many times during a watch, and the patrol thereafter broadened to include as wide an area as necessary.

8. (C) Figure A-5 shows a target being defended by a patrol with wind and current in opposite directions. After circling the target to clear it, the patrol quarters the approximate swimmer approach sector and is able to pick up a swimmer as soon as he is past the patrol boat (upwind). The dog will alert on a swimmer rather than the target since the dog is relatively used to the target scent(s), the swimmer would be closer and therefore have a stronger scent and the swimmer's scent, especially his output of breathed compressed air if scuba is used, is different than that of the target and will usually be more concentrated near the water surface.

9. (U) The capability exists to follow up on alerts obtained to the point of localization of the source and to use several methods (concussion grenades, small arms, capture, etc.) to deal with a localized intruder.

10. (U) References 1 and 2 provide general information on training techniques for and utilization of other military dogs presently in use.

**REFERENCES:**

1. Department of the Army, FM 20-20 Military Dog Training and Employment, May 1967
2. Department of the Air Force, AF Manual 125-5 USAF Sentry Dog Program, 15 April 1968

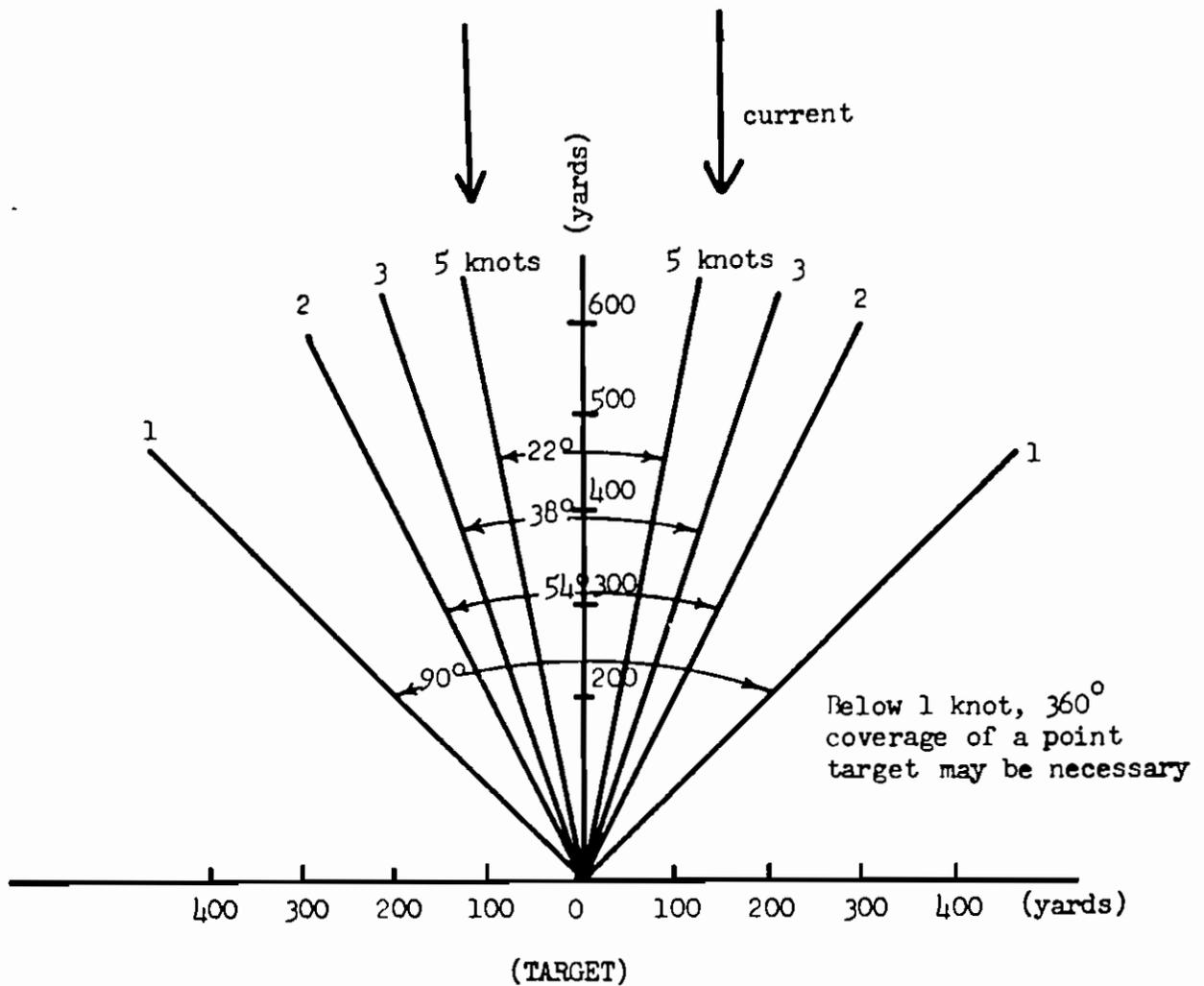


FIGURE A-1

Idealized Swimmer Approach Sectors for point target (current vs distance assuming 1 knot swimmer capability)

An area with a square or rectangular shape can be "cleared" by running the patrol as much as possible perpendicular to the wind, cutting or "quartering" the area into segments which lend themselves well to possible target presentation as regards scent cone. At point "A" the dog smells the edge of the scent cone but loses it on the way in. By "crossing the 'T' from point "B" to point "C," he can pick up the scent again with the 'T' relocation search pattern.

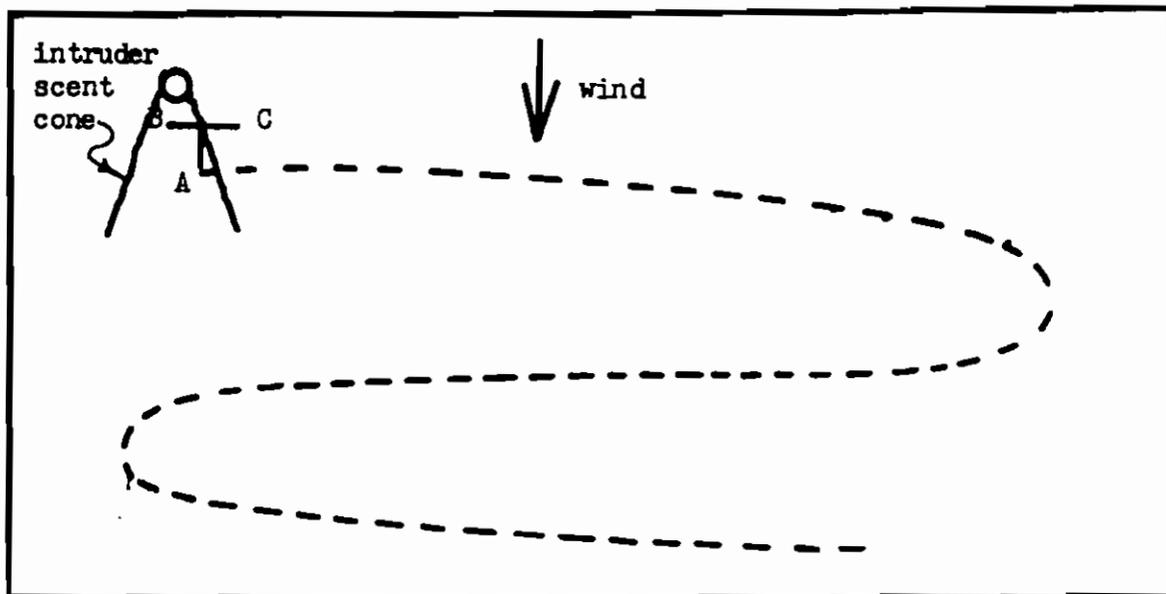
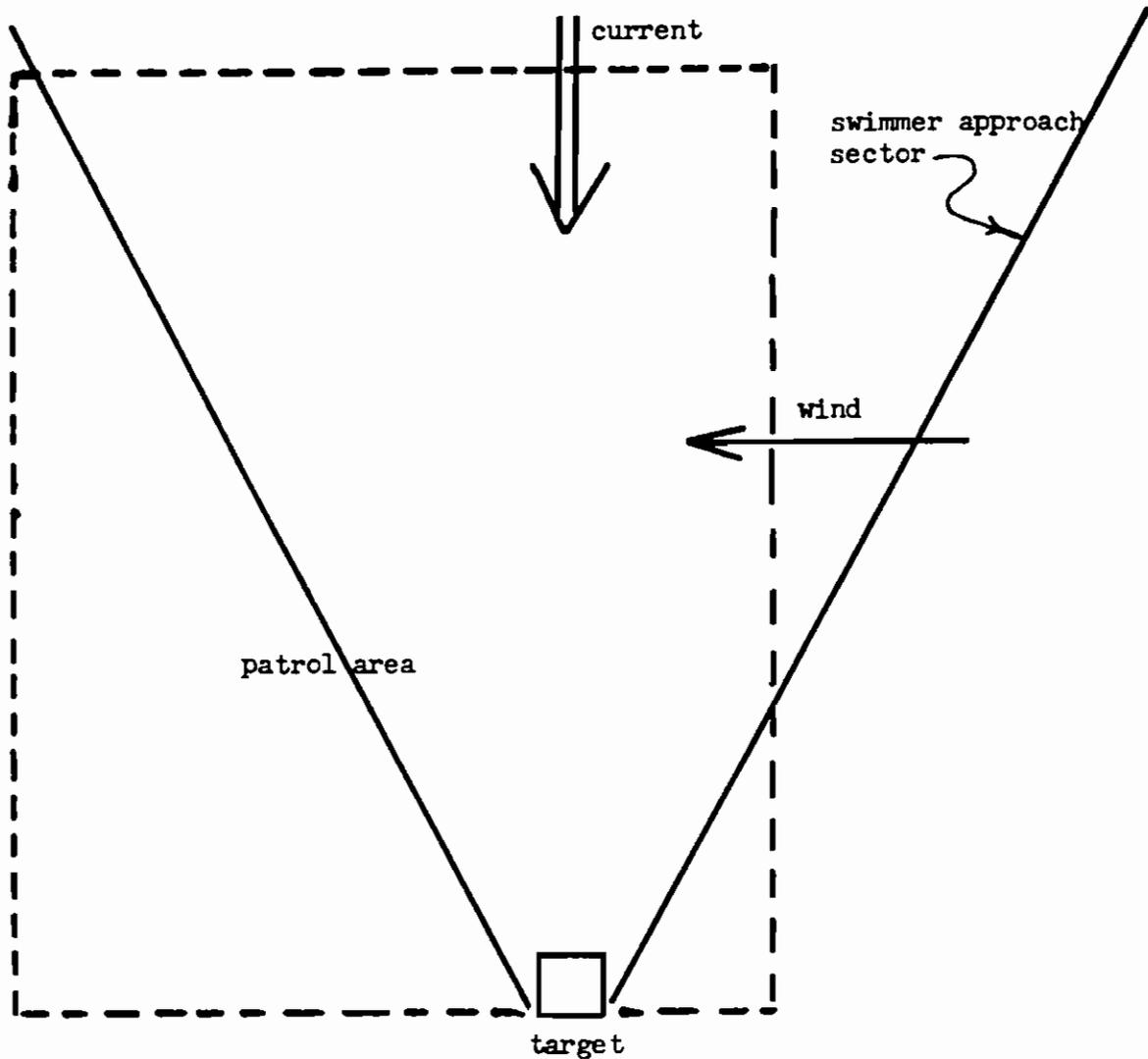


FIGURE A-2

Quartering Area



since the swimmer making an attack is constrained to a sector approach, the patrol area is superimposed on this sector in order to secure and "quarter" it. The patrol area shown will remain constant in size but the approach area must be secured. Only the quartering patrol in relation to the wind, whether E, W, N, or S, will change aspect in relation to wind direction.

FIGURE A-3

Open Water (Bay) Problem with Current at Angle to Wind Direction  
(Ship at Anchor)

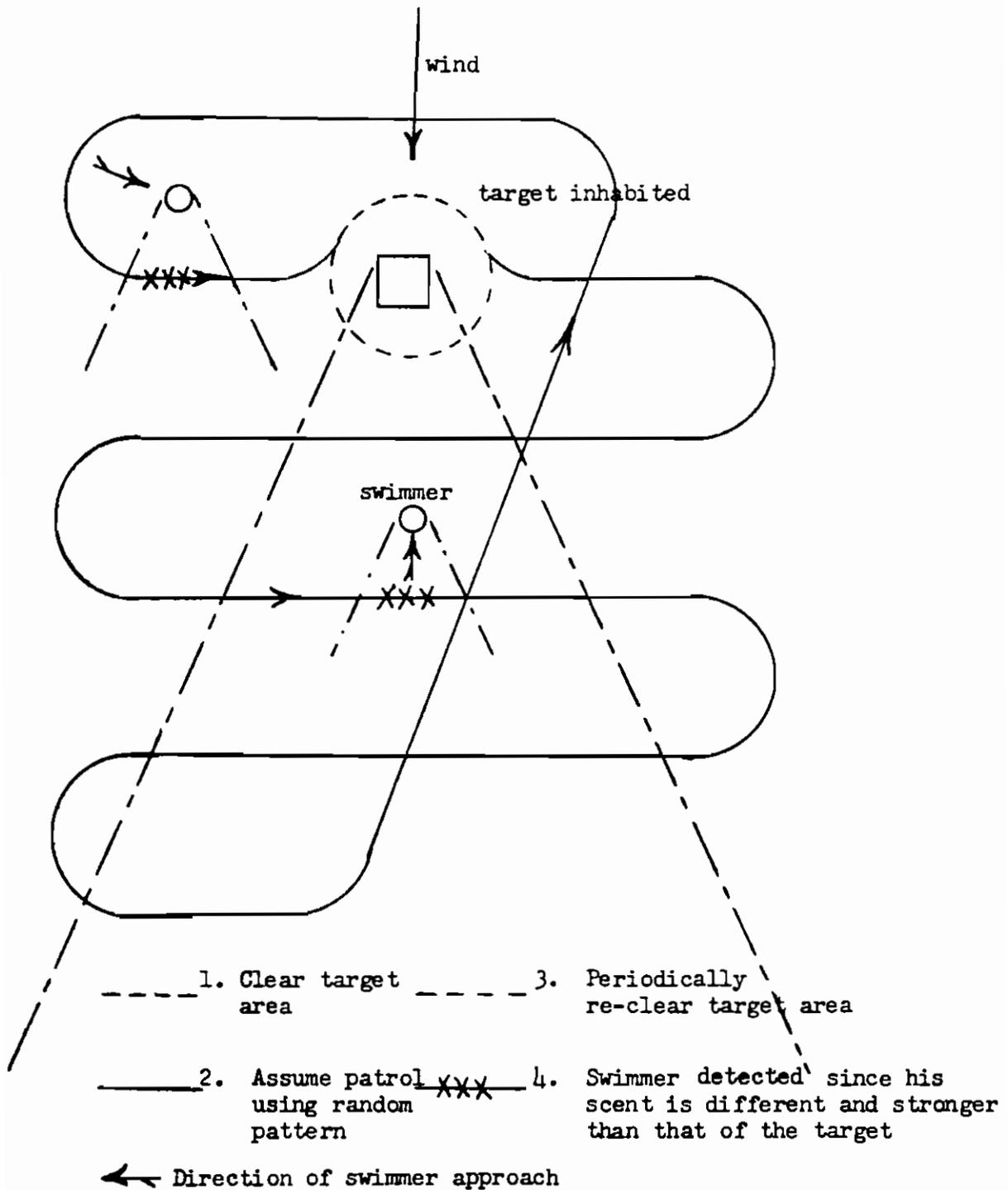
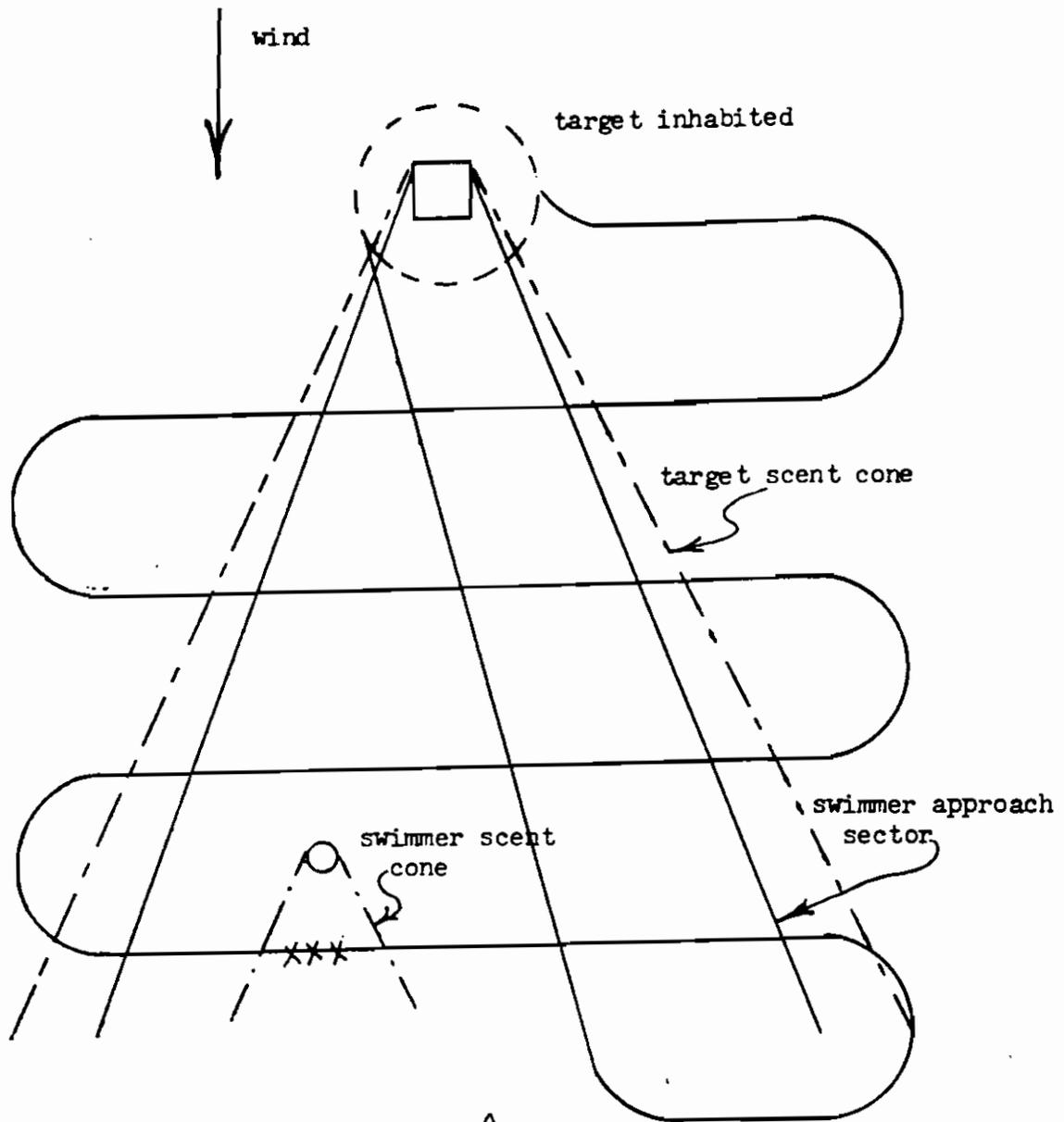


FIGURE A-4

Diagram of Open Water Problem with Clearing Pattern  
(open water, no current)



1. Clear target - - - -

2. Start pattern at target ————

3. Swimmer is detected when boat and dog are downwind. Since the swimmer scent is different from and stronger than those from the target the dog can differentiate the swimmer from the target. ~~XXX~~

FIGURE A-5

Diagram of Patrol Run with Inhabited Target  
in Opposing Wind and Current Situation