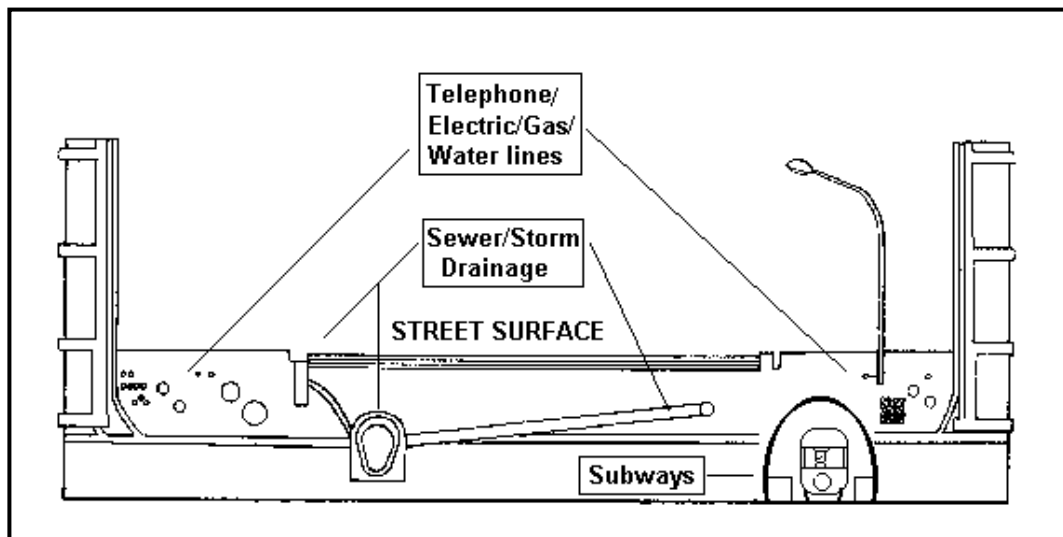


## APPENDIX J SUBTERRANEAN OPERATIONS

*Knowledge of the nature and location of underground facilities is of great value to both the urban attacker and defender. To exploit the advantages of underground facilities, a thorough reconnaissance is required. This appendix describes the techniques used to deny the enemy use of these features, the tactical value of subterranean passage techniques, and the psychological aspects of extended operations in subterranean passages.*

### J-1. PLANNING CONSIDERATIONS

In larger cities, subterranean features include underground garages, underground passages, subway lines, utility tunnels (Figure J-1), sewers, and storm drains. Most allow troop movement. Even in smaller European towns, sewers and storm drains permit soldiers to move beneath the fighting to surface behind the enemy.



**Figure J-1. Tunnels.**

a. **General.** Subterranean passages provide covered and concealed routes of movement throughout the urban areas. A detailed knowledge of the nature and location of underground facilities is potentially of great importance to both the attacker and the defender. Maximizing the use of these facilities could prove to be a decisive factor during UO. Units planning to conduct subterranean operations should:

- Conduct a thorough analysis of the reasons to place troops in a subterranean environment. Subterranean combat is physically and psychologically demanding and must be carefully thought out prior to committing troops.
- Determine whether the need to use subterranean avenues of approach or occupy subterranean areas will facilitate mission accomplishment.
- Plan for redundant communications (messengers, wire, radios).

- Plan for additional weapons and ammunition that may be required for subterranean operations (shotguns, pistols, distraction devices, early warning, and so forth).
- Plan for and provide support above ground for those elements that are deployed in subterranean areas. Insure that situational awareness is maintained both above, as well as below ground.
- Consider that it may be easier to seal off access routes to underground passages and use smoke to flush out anyone hiding in them. Smoke displaces oxygen in enclosed areas like tunnels; even protective masks are useless in these situations.

**DANGER**

LARGE AMOUNTS OF ANY TYPE OF GAS CAN DISPLACE THE OXYGEN IN AN ENCLOSED SPACE. THIS CONDITION RENDERS PROTECTIVE MASKS USELESS AND ENDANGERS THE LIVES OF ANYONE OPERATING IN THIS TYPE OF ENVIRONMENT. RESPIRATORS THAT HAVE THEIR OWN OXYGEN SUPPLY ARE THE ONLY ACCEPTABLE SOLUTION WHEN OPERATING IN THIS TYPE OF ENVIRONMENT. THE PRESENCE OF RODENTS AND OTHER PESTS IN A SUBTERRANEAN ENVIRONMENT INDICATE THAT THERE IS AN ADEQUATE AMOUNT OF OXYGEN. SMOKE GRENADES MAY DISPLACE OXYGEN IN CONFINED SPACES.

THE PRESENCE OF FLAMMABLE GASES CAN CAUSE A MAJOR EXPLOSION WITH THE SLIGHTEST SPARK. THE FIRING OF A WEAPON COULD CAUSE AN EXPLOSION.

SOME GASES CANNOT BE DETECTED BY SMELL. THE ONLY SURE WAY TO PROTECT SOLDIERS FROM HARMFUL GASES IS TO VENTILATE THE PASSAGEWAY BY FORCING FRESH AIR INTO THE SITE. REMOVING A MANHOLE COVER DOES NOT ADEQUATELY VENTILATE A SUBTERRANEAN PASSAGEWAY.

b. **Sewers.** Sewers are separated into sanitary, storm, or combined systems. Sanitary sewers carry wastes and are normally too small for troop movement or protection. Storm sewers, however, provide rainfall removal and are often large enough to permit troop and occasional vehicle movement and protection. Except for groundwater, these sewers are dry during periods of no precipitation. During rain-storms, however, sewers fill rapidly and, though normally drained by electrical pumps, may overflow. During winter, melting snow may preclude their use. Another hazard is poor ventilation and the resultant toxic fume build-up that occurs in sewer tunnels and subways. The conditions, in sewers, provide an excellent breeding ground for disease, which demands proper troop hygiene and immunization.

c. **Subways.** Subways tend to run under main roadways and have the potential hazard of having electrified rails and power leads. Passageways often extend outward from underground malls or storage areas, and catacombs are sometimes encountered in older sections of cities.

d. **Subterranean Characteristics.** Underground passageways provide tight fields of fire. They amplify the effect of munitions such as grenades. If the tunnels are to be blocked, early warning devices and obstacles should be employed and the entry points should be secured. If tunnels are not to be used, entry points should be sealed. Manhole covers can be blocked with heavy weights or can be tack-welded if the capability is available. The insides of tunnels provide little or no cover and concealment except for the darkness and any man-made barriers. Obstacles at intersections in the tunnels set up excellent ambush sites and turn the subterranean passages into a deadly maze. These obstacles can be quickly created using fencing, barbed or concertina wire, along with rubble, furniture, and parts of abandoned vehicles interspersed with command-detonated explosives or mines. A thorough reconnaissance of the subterranean or sewer system must be made first. As opposed to storm systems, sewers contain various types of contamination. Careful consideration should be given before entering such systems. To be effective, obstacles must be located at critical intersections in the passage network so that they trap attackers in a kill zone but allow defenders freedom of movement.

e. **Tactical Value.** The tactical values of underground facilities are:

(1) **Offensive Operations.** During offensive operations the use of subterranean routes could enable the attacker to use both surface and subterranean avenues of approach, thus being able to infiltrate a smaller force behind the enemy's defenses. The purpose of this maneuver is to disrupt his defense and obstruct avenues of withdrawal for his forward defense. Depending upon the strength and depth of the above ground defense, the attack along the subterranean avenue of approach could become the main attack. Even if the subterranean effort is not immediately successful, it forces the defender to fight on two levels and to extend his resources too more than just street-level fighting.

(2) **Defensive Operations.** The existence of subterranean passages forces the defender to cover the urban area above and below ground with observation and fire. Subterranean passages are more a disadvantage to the defender than the attacker. They do offer some advantages when thoroughly reconnoitered and controlled by the defender. Subterranean passages provide covered and concealed routes to move reinforcements or to launch counterattacks. They can be used as lines of communication, for the movement of supplies and evacuation of casualties. Tunnels can also be used to cache supplies for

forward companies. Subterranean passages also offer the defender a ready-made conduit for communications wire, protecting it from tracked vehicles and indirect fires.

f. **Use of Weapons.** The confined space amplifies the sound of weapons firing to a dangerous level. Hearing protection is critical to allow soldiers to continue to function. The overpressure from grenades, mines, and booby traps exploding in a sewer or tunnel can have an adverse effect on troops. Also, gases found in sewers can be flammable, making this a double-edged weapon for both attackers and defenders. For these reasons, small-arms weapons should be employed as the main weapon system in tunnels and sewers. Friendly personnel should be outside tunnels or out of range of the effects when mines or demolitions are detonated.

g. **Local Knowledge/Navigation.** Prior to conducting an urban operation and especially a tunnel patrol, it is imperative that up-to-date local town plans and sewer maps are acquired if at all possible. Any locals with knowledge of underground routes must be questioned in detail. Without this kind of information, you must map as you go. Once below ground, pacing must be used as a guide to location.

h. **Threat.** The following threats must be considered for both offensive and defensive operations in subterranean passageways:

(1) **Enemy Presence in Tunnels.** It is likely that the enemy will want to use tunnels and they may have the advantage of marked routes and detailed reconnaissance. They may have the element of surprise, being able to select ambush positions and withdrawal routes. A defended position in an underground facility could be very effective in countering enemy subterranean operations. It should be well protected, canalizing the enemy into a killing zone to inflict maximum casualties.

(2) **Booby Traps.** When moving through tunnels, great care must be taken to avoid booby traps. These will normally be deployed near junctions and will often be operated by trip wires. Standing water in tunnels provides excellent camouflage for AP mines and booby traps scattered on likely routes. If moving without light, the lead man should feel for wires using a tripwire feeler (Figure J-2). He should also avoid walking in water if possible.

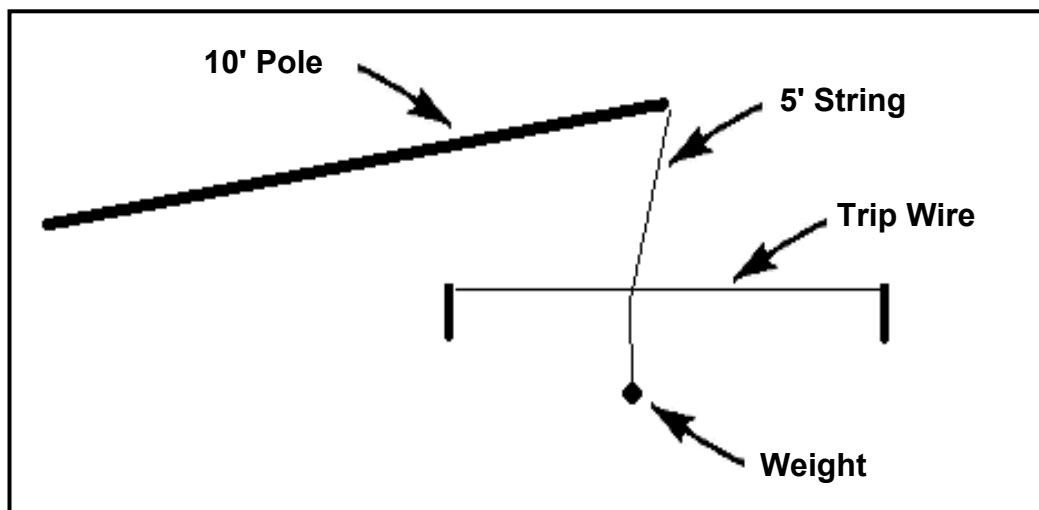


Figure J-2. Tripwire feeler.

(3) **Residual Dangers.** With the battle above continuing, and the possibility of artillery barrages and the use of demolitions, there is a strong possibility of flooding and a cave in. It is essential to identify escape routes.

(4) **Individual Protective Equipment.** To aid in the protection against small arms fire and fragmentation, it is advisable to wear all combat body armors available, as cover is limited inside tunnels. To avoid being stunned by blast and noise, all personnel that enter subterranean facilities must wear at least one set of hearing protection.

i. **Problems Involved with Tunnel Fighting.** There are several factors peculiar to tunnel fighting that restricts the soldier in his efforts to accomplish the mission. Some of those factors and solutions are:

(1) **Target Detection.** In the close confines of a tunnel, passive vision equipment such as NVGs, which require ambient light, are of little use. In order to quickly identify enemy personnel or other threats, an IR or white light should be used. The following equipment could be useful:

- NVG with IR source.
- IR filtered lights.
- White light flashlights.

(2) **Visual Aids When Defending.** When preparing defensive positions in the subterranean environment soldiers must be able to see what they are constructing. Battery-powered floodlights or bright flashlights can be used to do this. Because of the angles and lengths of tunnels, the ability to view around a corner without exposing oneself is extremely difficult. Mirrors can be used to look around corners and monitor major junctions for a defended position.

(3) **Use of Grenades.** Concussion and fragmentation grenades will produce a large shock wave and could, if used excessively, collapse the tunnel. The following alternatives should be considered:

(a) **WP Grenades.** Careful consideration must be given prior to the use of the white phosphorus grenade inside an enclosed space as the white phosphorus spreads, ignites, burns in the air, and causes extreme burns to the body. Any available oxygen in such an enclosed space will be rapidly consumed. These grenades should be used with care and extreme caution, as no immediate follow up with soldiers is possible.

(b) **Smoke Grenades.** Smoke will linger in a tunnel for a long period of time. It will certainly confuse the enemy and, in dense concentrations, it can displace oxygen to the point where it can constitute a danger. This is a double-edged weapon. Protective masks may be of little use against smoke grenades.

(c) **Stun Grenades.** M84 stun grenades may be used in confined spaces to produce a limited concussion and distraction effect without causing casualties to friendly forces.

(4) **Maneuverability.** The individual's ability to maneuver in subterranean areas is impeded initially by the confining characteristics of tunnel systems. Add to the confined space darkness, disorientation, uneven and slippery surfaces and you make movement almost impossible. Some techniques used to aid maneuver are:

(a) **Tag Lines.** Tag lines are a flexible handhold used to guide individuals along a route. Tag lines aid in navigation and movement when operating in confined spaces such as buildings, tunnel systems and caverns where visibility is limited and sense of direction can be lost. These lines can be made of rope, string, cable, wire and so forth. The most

effective item to be used as a tag line is WD-1A communications wire. Along with serving as a tag line it can be used as a primary means of communicating to elements above ground.

(b) *Safety Lines.* Ropes can be used not only as tag lines to ease movement through tunnels, but also to attach team members together to avoid breaks in contact. This safety line should be tied to team members leaving 5-meter intervals between them.

(c) *Wire Mesh.* Attaching wire mesh to the bottom of combat boots will enhance traction in some situations.

(5) *Degradation of Radio Communications.* Communications inside the tunnels will be severely degraded. Several methods to overcome this are:

- Land line and field telephone.
- Use of messengers.
- Increased power setting on radios.

(6) *Limitation of Firepower.* The limited use of available firepower will favor the defender. Prepared positions should be able to hold off a much larger force. Weapons best suited to the defender are:

- Automatic weapons.
- Shotguns or other scatter type munitions.
- Flame producing weapons.

**NOTE:** Any type of flame or incendiary weapon needs to be used in a well-vented area because of the smoke created and the oxygen used.

(7) *Chemical Hazard.* A constant concern for troops conducting subterranean operations is chemical defense. Enemy chemical warfare (CW) agents used in tunnels may be encountered in dense concentrations, with little chance of it dispersion (no wind). A chemical agent alarm system, carried by the point man, will provide instantaneous warning of the presence of CW agents. M8 and M9 detection papers should also be used to test for the presence of chemical agents. Noxious gases from decomposing sewage can also pose a threat because they displace oxygen and because they are not filtered by the soldier's protective mask. Unit leaders must be constantly alert for the physical presence and symptoms of gases on soldiers.

(8) *Psychological Considerations.* Combat operations in subterranean passages are much like night combat operations. The psychological factors of night operations reduce confidence, cause fear, and increase a sense of isolation. This is further magnified in the confines of the tunnels. As was discovered during tunnel operations in the Vietnam War, many personnel are unsuited for operations below ground. The layout of tunnels could require greater dispersion between positions, further enhancing the feeling of isolation.

(a) *Overcoming Fear and Anxiety.* Leaders must conduct reinforcement training to help suppress the fear and anxiety experienced when isolated in tunnels. These measures include leadership training, physical and mental fitness, sleep discipline, and stress management.

(b) *Communications.* Leaders maintain communication with soldiers manning positions in the tunnels either by personal visits or by field telephone. Communications inform leaders of the tactical situation as well as the mental state of their soldiers. Training during combat operations is limited; however, soldiers manning positions below

ground should be given as much information as possible on the organization of the tunnels and the importance of the mission. They should be briefed on contingency plans and alternate positions should their primary positions become untenable. All members, both above and below ground (Figure J-3), must know recognition signals.



**Figure J-3. Recognition signals.**

(c) *Stress.* Physical and mental fitness can be maintained by periodically rotating soldiers out of tunnels so they can stand and walk in fresh air and sunlight. Stress management is also a factor of operations in tunnels. Historically, combat in urban areas has been one of the most stressful forms of combat. Continuous darkness and restricted maneuver space cause more stress to soldiers than street fighting.

## **J-2. SUBTERRANEAN RECONNAISSANCE TECHNIQUES**

Local reconnaissance should be given to a squad-size element (seven to nine personnel). Enough soldiers are in a squad to gather the required data without getting in each other's way in the confines of the tunnel. Only in extremely large subterranean facilities should the size of a patrol be increased.

a. **Task Organization.** The squad leader organizes his squad for movement. One fire team leads with the rifleman as the point man, tasked with security to the front. The A-team leader moves directly behind the point man, controlling movement. Behind the team leader is the M249 gunner, ready to move forward and provide suppressive automatic fire if required. The squad leader moves directly behind the M249 gunner and records data. The team grenadier follows the squad leader and is the pace man during movement. Following the grenadier is the rifleman of the other team; he is responsible for rear security and rolling out the "tag line." The team leader, M249 gunner, and grenadier remain at the point of entry as a security post. They are responsible for detecting enemy and serving as the communications link between the squad leader and his higher headquarters.

b. **Special Equipment.** The squad leader should carry a map, compass, street plan, and notebook in which he has written the information he must gather for the platoon leader. The grenadier should carry tools needed to open manhole covers. If the patrol is to

move more than 200 to 300 meters or if the platoon leader directs, the rear team rifleman should also carry a sound-powered telephone (TA-1) and wire dispenser for communications because radios are unreliable in this environment. The point man should be equipped with night vision goggles (NVGs) and an IR source to maintain surveillance within the sewer.

c. **Specific Individual Equipment.** All soldiers entering the sewer should carry a sketch of the sewer system to include magnetic north, azimuths, distances, and manholes. They should also carry protective masks, flashlights, gloves, and chalk for marking features along the route. If available, all soldiers entering subterranean facilities should be equipped with night vision goggles.

d. **Initial Entry.** Once the squad is organized and equipped, it moves to the entrance of the tunnel, which is usually a manhole. With the manhole cover removed, the patrol waits 15 minutes before entry to allow any gases to dissipate. The point man descends into the tunnel (safety line attached), to determine if the air is safe to breathe and if movement is restricted. The point man should remain in the tunnel 10 minutes before the rest of the squad follows. If the point man becomes ill or is exposed to danger, he can be retrieved by use of the safety rope. (See Figure J-4.)

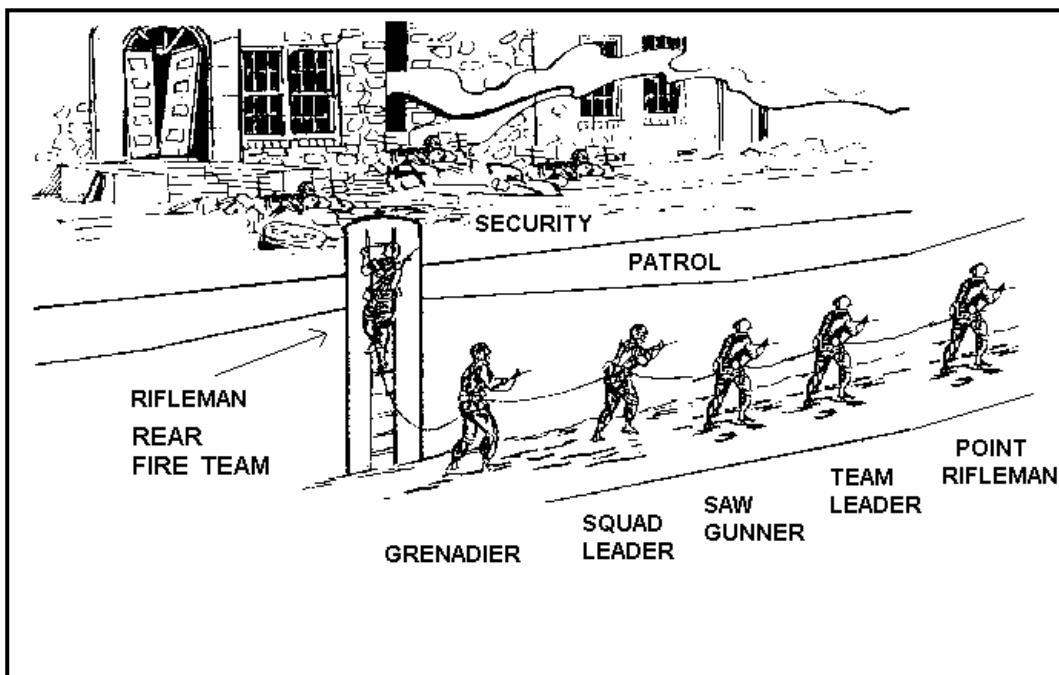


Figure J-4. Squad subterranean reconnaissance patrol.

e. **Movement Techniques.** When the squad is moving through the tunnel, the point man moves about 10 meters in front of the team leader. Other squad members maintain 5-meter intervals. If water in the tunnel is flowing faster than 2.5 meters per second or if the sewer contains slippery obstacles, those intervals should be increased to allow for squad members to react if one man slips. If using a safety rope, all squad members should remain tied in so that they can be retrieved from danger. The rear security man marks the route with the “tag line” so other troops can find the squad.



f. **Mapping.** The squad leader should note the azimuth and pace count of each turn he takes in the tunnel. When he encounters a manhole to the surface, the point man should open it and determine the location, which the squad leader then records. The use of recognition signals prevents friendly troops from accidentally shooting the point man as he appears at a manhole.

g. **Follow-on Tasks.** Once the squad has returned and submitted its report, the platoon leader must decide how to use the tunnel. In the offense, the tunnel could provide a covered route to move behind the enemy's defenses. In the defense, the tunnel could provide a covered passage between positions. In either mission, the squad members can serve as guides along the route.

### J-3. DENIAL TO THE ENEMY

Subterranean passages are useful to the defender only to the extent the attacker can be denied their use. The defender has an advantage, given the confining, dark environment of these passages; a small group of determined soldiers in a prepared defensive position can defeat a numerically superior force. Tunnels afford the attacker little cover and concealment except for the darkness and any man-made barriers. The passageways provide tight fields of fire and amplify the effect of grenades. Obstacles at intersections in the tunnels set up excellent ambush sites turning the subterranean passages into a deadly maze. These obstacles can be quickly created using fencing, barbed or concertina wire, along with rubble, furniture, and parts of abandoned vehicles interspersed with Claymore mines. A thorough reconnaissance of the subterranean passages or sewer system must be made first. Once the reconnaissance has been conducted, obstacles must be located at critical intersections in the tunnel network so they trap attackers in a kill zone but allow defenders freedom of movement (Figure J-5).

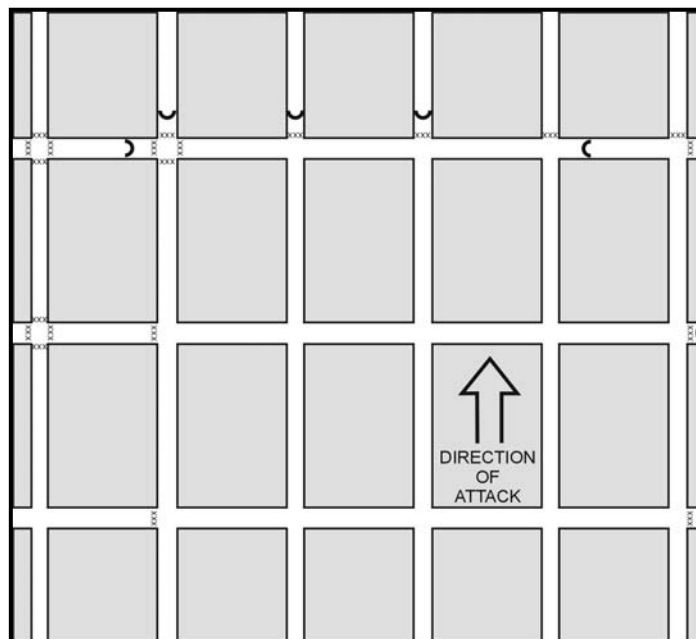


Figure J-5. Defense of a sewer system.