The

SWEAT/IR Book

Version 2.1 (6OCT05)

Infrastructure Reconnaissance

United States Army Engineer School

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FOREWARD.

Similar to the Red Book and Sand Book, the SWEAT Book is the Soldier's reference for Infrastructure Reconnaissance. While the Red and Sand Books focus on different regions, the SWEAT Book focuses on the subject regardless of the part of the world the Soldier may be located. The SWEAT Book is the continuation of the hard work of many organizations to include the National Training Center (*the Sidewinders*), countless MTOE units, the U.S. Army Engineer School, the Engineer Research and Development Center - (CERL), the U.S. Military Academy, etc. The efforts of all those involved has led to the continued progress towards solving this gap in our capabilities. Future work to be expected includes continued feedback from units supporting missions in OEF/OIF, and U.S.M.A.'s research on an infrastructure assessment methodology. The SWEAT Book will be updated accordingly.

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Part 1 – Introduction to SWEAT/IR.

What does SWEAT/IR stand for?

S=Sewer, W=Water, E=Electricity, A=Academics, T=Trash
IR=Infrastructure Reconnaissance (the eventual doctrinal term for SWEAT)

Why the terms SWEAT and Infrastructure Reconnaissance?

Bottom line is that the term 'sweat' was 'invented' first… and has caught on throughout the force. Infrastructure Reconnaissance (IR) however, is the more appropriate term and will be used more often in this book.

Why change SWEAT to IR?

SWEAT is a great acronym. It has caught on and is in widespread use. Those infrastructure categories that make up the acronym SWEAT, however, do not always provide the infrastructure solution that the commander needs. See Part 2 of the SWEAT Book to see all categories of IR and the proposed 'hierarchy' of which areas to focus on first, and which may be secondary efforts. As with any mission, a prioritization of tasks must be made and using SWEAT alone cannot be relied upon in every scenario.

Which is it… Academics or Schools?

Since this 'doctrine' is still evolving, a final solution is not set. It will take continued feedback from the field to determine which terms will be the true answer. Regardless, for the Soldier without the time to wait for doctrine to be finalized, note the following terms that mean the same for IR:

Academics = Schools

Electricity = Power

TIM = Chemicals / Hazardous Materials

SWEAT/IR and Assured Mobility.

Assured mobility encompasses those actions that give the commander the ability to deploy, move, and maneuver where and when he desires, without interruption or delay, to achieve the mission. Assured mobility enables friendly forces to exploit superior situational understanding, and therefore gain unsurpassed freedom of movement. The graphic below displays how a unit integrates the fundamentals and imperatives of assured mobility into the Urban Operational Framework. Since our current and future conflicts will most likely take place in urban and complex terrain, the engineer must understand this linkage.

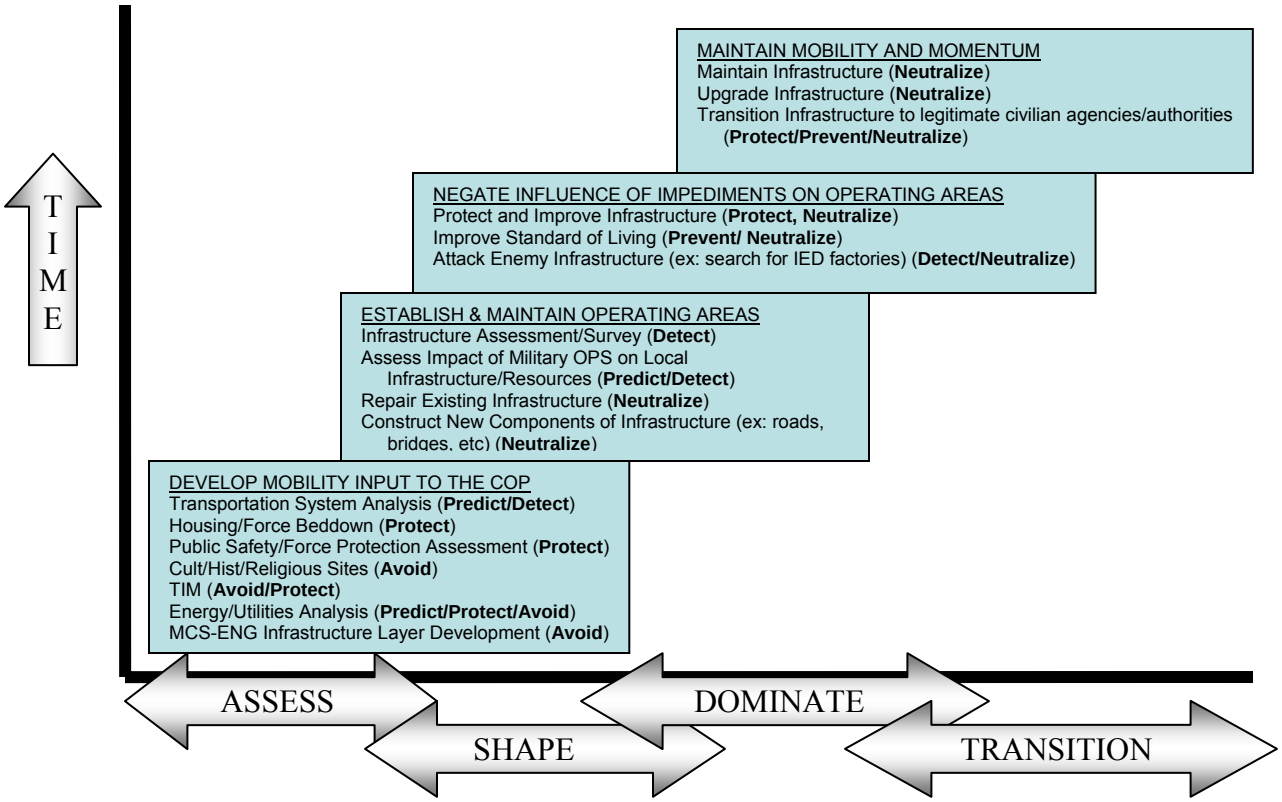


Figure 1 – Assured Mobility Imperatives and Fundamentals Integrated with the Urban Operational Framework (FM 3-06)

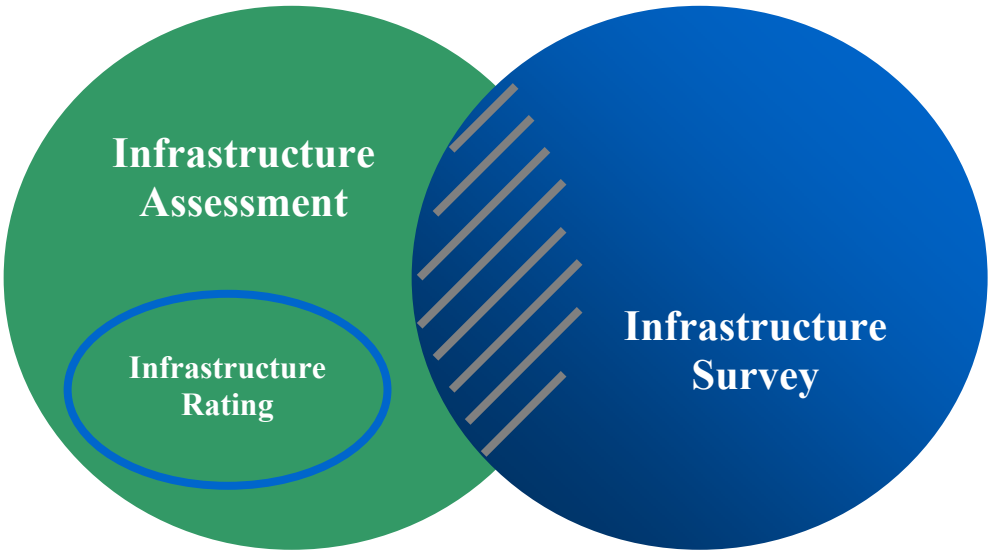


Figure 2 – Assessment Overlapping with Survey

Part 2 – Future/Current Operations Usage

SWEAT/IR will be accomplished in stages. Initially, especially during an offensive mission, combat engineer units will be on site first. Accordingly, it would be expected that those same units will have an extremely limited number of personnel with the training and experience to do a thorough analysis of the infrastructure (ie – infrastructure survey). Therefore a series of smartcards (see Part 3 of the SWEAT Book) are being developed to assist the combat engineer, whoever they may be (SGT, 2LT, CPT, etc). They must provide the initial infrastructure rating and assessment to be forwarded to those more qualified personnel who follow in later stages of the mission.

As operations continue, personnel arrive who are more qualified for infrastructure survey (Facility Engineer Team, Forward Engineer Support Team, construction units, etc). These more qualified engineers will take those initial infrastructure assessments from the combat engineers in order to prioritize parts of the infrastructure to be re-assessed in more detail (via an infrastructure survey).

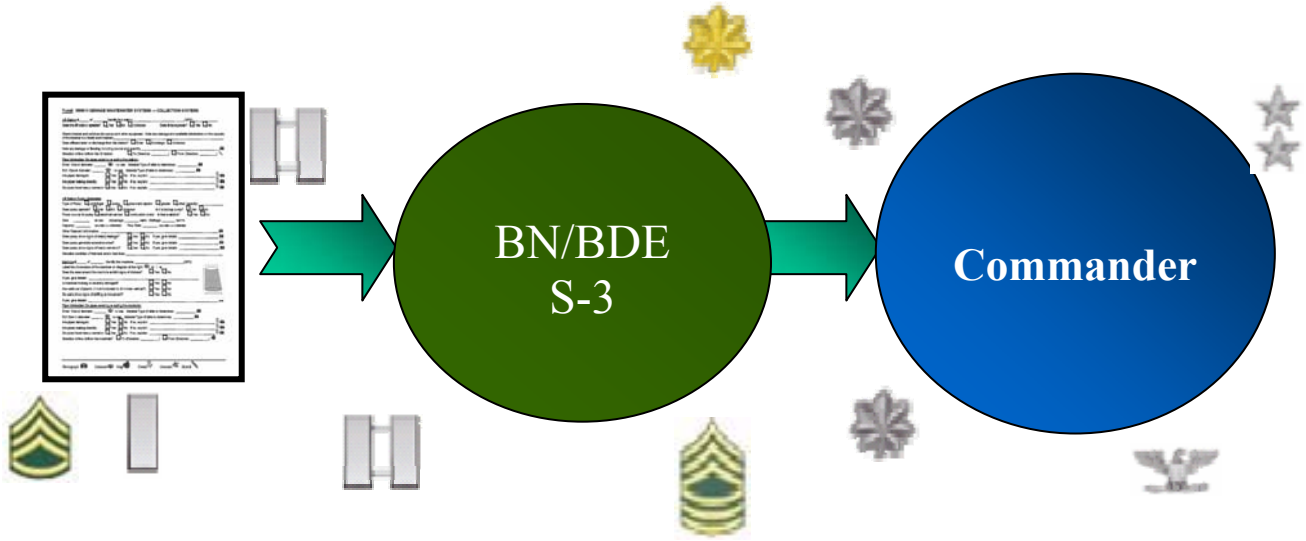


Figure 3 – The IR Process

Data Processing.

Once on the ground Soldiers begin conducting the initial infrastructure assessment utilizing the smartcards in Part 3 of this book to conduct/document the assessment. This begins a standardized reporting system that can be shared among all engineers.

Those Soldiers will turn in the initial reports to their headquarters… most likely a battalion or brigade headquarters. These battalion or brigade S-3's will compile those smartcards/reports for the entire infrastructure they are assessing in their area of operations. The next step is to receive some commander's guidance (from either a maneuver commander or engineer commander depending upon the task organization).

As forces build, more and more general engineering specialists arrive in theater. Theses specialists can assist the commander in determining the priority for a thorough survey of key pieces of infrastructure. Once the infrastructure survey(s) has been completed, the commander will have to make another decision on priorities for repair/replacement. During the infrastructure survey, teams ideally will use the same smartcards as the combat engineer, but they may use a form of their own design depending upon their level of training/experience.

Infrastructure Categories.

Based upon analysis of civil affairs doctrine and other research, the following categories of infrastructure have been identified (see Figure 4). All will have a smartcard/form developed by the U.S. Army Engineer School.

The challenge with many of these categories of IR is that it is not an engineer unique mission. While the engineer has a part of recommending a solution to these categories, many other branches need to be involved, or be in charge of the entire assessment (ie – Public Safety should probably have a military police Soldier in the lead for its assessment/survey).

Category	Status
Food Supply Chain	Draft due 1JAN06
Water	Complete
Health Services	Draft Form
Public Safety	Draft Form
Housing	Draft Form
Socio-Economic	Draft due 1JAN06
Power	Complete
Sewer	Complete
Trash	Complete
Trans	Draft due 1DEC05
Commo	Draft due 1DEC05
Academics	Draft Form
TIM	Draft due 1JAN06
Cult/Historical/Religious	Draft Form
Attitude	No form to be developed

Figure 4 – IR Categories

Multiple Forms. Some categories of IR may require the use of more than one form due to their complexity/components. Figure 5 identifies the linkages between forms among the various categories.

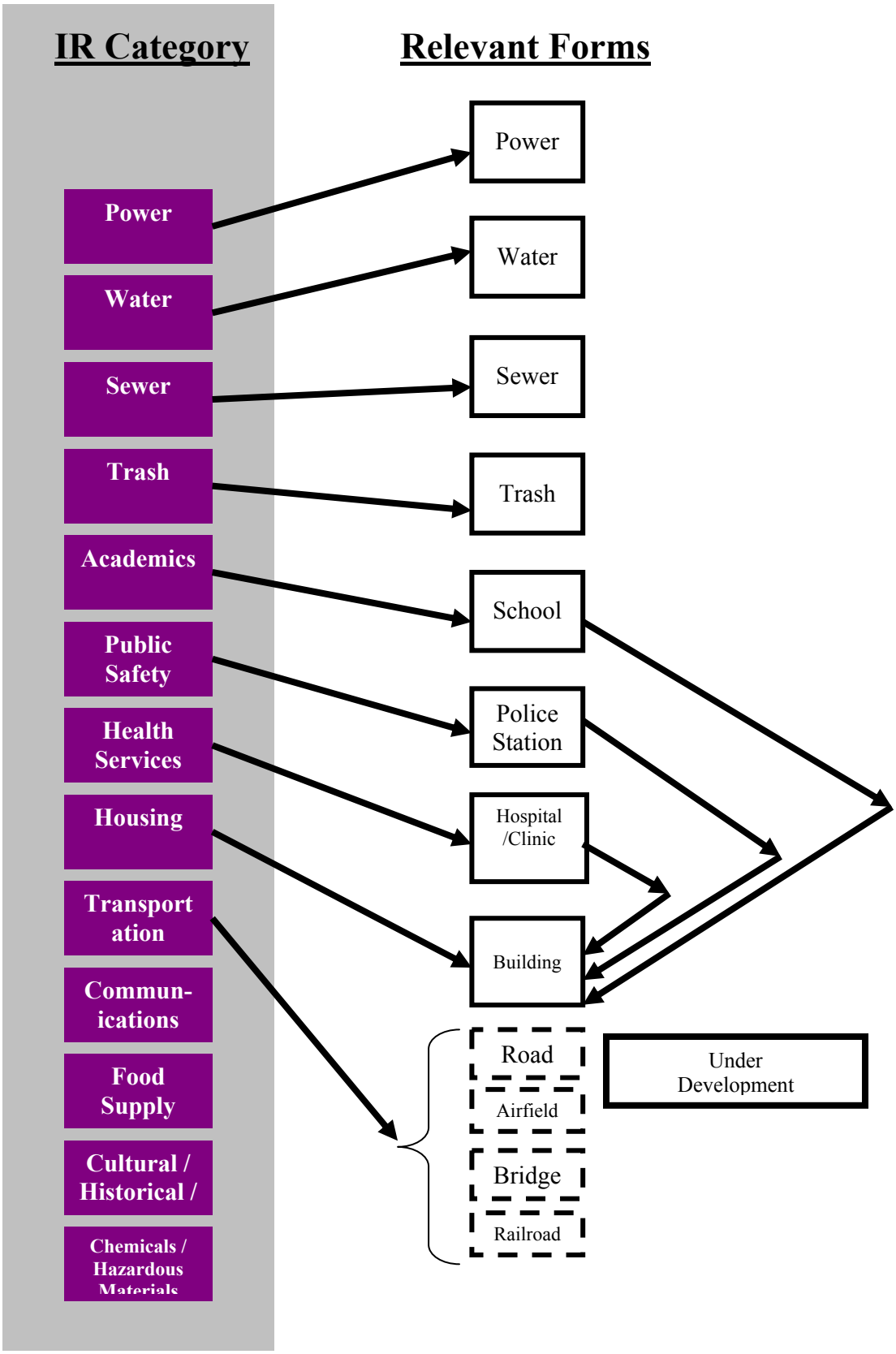
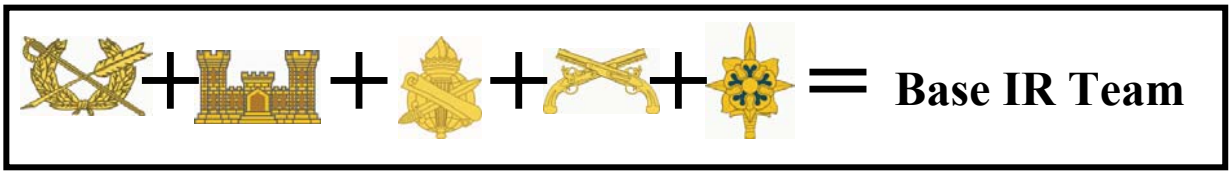


Figure 5 – Forms for the IR Categories



IR Category

- Power
- Water
- Sewer
- Trash
- Academics
- Public Safety
- Health Services
- Housing
- Transport ation
- Commun- ications
- Food Supply
- Cultural / Historical / Religious
- Chemical Hazardous Materials

'The IR Team.' There is some debate concerning who should own SWEAT/IR… Is it an engineer commander or the maneuver commander? Should the engineer be responsible for every component of infrastructure or should a variety of branches help depending on the category. Regardless, the engineer will likely be the OIC of this mission and thus should be prepared for it, however, an effort should be made to include other branches to take advantage of their unique skills.

The branches at the top of this page (JAG, EN, CA, MP, MI) will be involved in almost all categories. This page displays the IR categories and the additional branches that one should consider integrating into the IR team that inspects specific parts of the local infrastructure.

Infrastructure Prioritization.

Ideally, an IR plan is developed prior to the start of an operation. This planning must be supported by a considerable amount of intelligence. Numerous questions of IR planners may lead to PIR for the commander:

1) Has the infrastructure been maintained?
2) Who built that component of the infrastructure?
3) Are there repair parts/equipment available?
4) Will the infrastructure be targeted by the host nation?
5) Will host nation employees return to the site after hostilities?

A systematic way of prioritizing IR is needed to support this part of the maneuver commander's planning. Until a system is developed, an initial hierarchy is shown in Figure 5.

To begin a solid foundation, basic human needs must be addressed by the commander. A familiar approach is to use Maslow's Hierarchy of Needs. The commander must ensure that the local population has the basics (food, water, health care, safety, etc). Without them, the local populace may be forced to take extreme measures to see that their needs are met (ie – steal, riot, demonstrate, terrorist acts, etc). Without meeting these needs, work on the other IR categories may be compromised.

Once those basic human needs are met, the categories of power, water, trash, and sewer should be assessed (thus the original SWEAT acronym). As time progresses and success is found on basic human needs, units should move on to the upper tiers of IR.

Attitude. While no smartcard for attitude is being developed it is a critical aspect of IR. Attitude can be considered the foundation of the local population's willingness to accept the U.S. Soldiers' efforts within their community. If the U.S./coalition's efforts cause their standard of living to rise, then the host nation's attitude should be positive. If no progress is made, or a drop in the standard of living is experienced, then the host nation's attitude will be negative towards our Soldiers.

Western/Eastern Culture. While Figure 6 displays a typical 'hierarchy' of systems, understand that it is not a solution for every situation. For example, in many regions of the world that have a predominantly eastern culture, the cultural/historical/religious category may be of much higher importance and may be of equal standing as water, food supply and health services. It is up to the commander and his staff to determine the unique hierarchy for their AO.

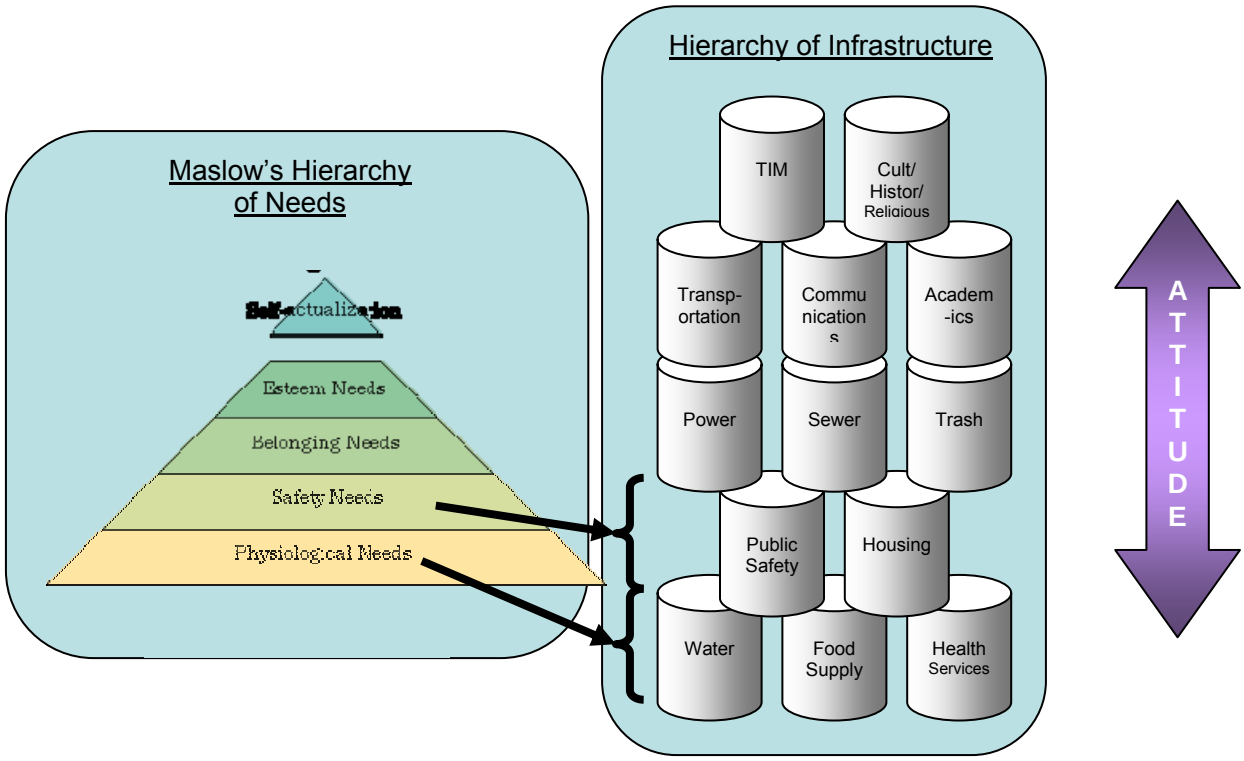


Figure 6 – Hierarchy of IR Categories

Prioritization Criteria.

The United States Military Academy has developed criteria to assist the commander in determining the prioritization of infrastructure within his AO. The following are general criteria to assist the commander and his staff.

1. Effort – The amount of expertise required to repair or replace a facility or operation; or the availability and transportation required for repair or replacement of specialty equipment.
2. Health and Safety – The magnitude of impact a task has on the health and safety of a population.
3. Cost – The monetary cost to repair or replace a particular type of facility or operation.
4. Local Perception – Perceived importance by the local population.
5. Self-governance – The level of impact that the loss of function by a facility or operation has on the continued or resumption of self-governance in an area.
6. Interdependence – The interdependence of this item with the completion of other tasks, subcategories, or categories of infrastructure activities.

Infrastructure Category Links.

As a unit develops their AO's IR plan, it will become obvious that many IR categories are linked. None are a closed system that can be altered without affecting another. For instance, a lack of power in an AO will cause home refrigerators to cease to work. This will stress the food supply chain to deliver more goods as the local population's ability to store food for more than a few days is diminished. Additionally as the food supply chain's requirements increase, the transportation system is stressed due to the increased traffic flow.

Figure 6 displays the potential links between the various IR categories. A staff/commander must be aware of these links before altering them in a significant manner.

Under Development

	Food Supply	Water	Health Services	Public Safety	Housing	Socio-Economic	Power	Sewer	Trash	Transportation	Communications	Academics	TIM	Cult/His/Religi.
Food Supply		X		X	X	X	X			X		X		
Water	X		X	X	X		X	X				X		
Health Services		X		X			X		X		X			
Public Safety	X	X	X		X	X	X	X		X	X	X	X	X
Housing	X	X		X		X	X	X	X	X		X	X	X
Socio- Economic	X			X	X		X			X	X	X	X	
Power	X	X	X	X	X	X		X		X	X	X	X	
Sewer		X		X	X		X			X		X		
Trash			X		X					X		X		
Transportation	X			X	X	X	X	X	X			X	X	X
Communications			X	X		X	X							
Academics	X	X		X	X	X	X	X	X	X				
TIM				X	X	X	X			X				
Cult/Hist/Relig.				X	X					X				

Figure 7 –IR Category Links

Part 3 – Smartcards for IR (+ Safety)

The assessment guidance provided is for soldiers who do not have significant knowledge of the systems being inspected. The results will have significant gaps but should be adequate to help prioritize and plan further work.

The smartcards in this section provide guidance for collecting inventory and inspection information on major components of infrastructure systems. They have the following objectives:

1. Assist the inspector in identifying and inventorying the primary components of the system
2. Indicate what types of damage the inspector should be looking for and reporting
3. Provide guidance for collecting the information visually or from operators and locals workers

Approach

The target user has neither the subject matter education nor the relevant experience for more technical material. There are numerous reference materials available that provide the technical details that the user can obtain if they want to obtain more information. This document includes very brief overviews of the specified infrastructure systems and suggests what inventory and inspection information an inspector might want to collect on the infrastructure. It is important to consider that specific situations may not require inspection and inventory of all the components covered in this document. That decision must be made at that time. The needs and scope should be considered carefully based on the objective and available resources.

This guidance is to assist soldiers in quickly and objectively collecting inventory and inspection information on major components of infrastructure. This information is of paramount importance in the planning of stability and reconstruction operations.

In general, the first part of the smartcards gives a brief overview of the infrastructure area, how they work, and some of the major components in the system. The second part is the form that the inspector can use to collect inventory and inspection information. The forms will be then forwarded to ‘collectors’… aka battalions or brigades who will subsequently give the data to subject matter experts to perform the a thorough infrastructure survey and determine maintenance and repair plans.

Inspection Tools.

An inspection is more than observing and recording problems. It also involves discussing conditions with the local people and users. Some problems may not be immediately obvious or they may be intermittent. A discussion with the people who work or live in the area can bring these issues to the forefront.

Some components are very difficult, if not impossible, to inspect. These may include water piping and electrical wiring. When the condition cannot be observed or directly determined, look for subtle clues to ascertain condition. These can include discoloration from overheating, unusual noises, saturated dirt or caved in soil above a potential water line, etc. If inspection reveals little information, annotate that and move on.

If available, an excellent source of information to review will be the equipment logs often kept in the mechanical rooms (or elsewhere). They can provide insight to problems and a record of work performed.

The inspector should assemble any tools that will help. Such tools include:

- copies of the required forms
- 'Gerber' knife
- flashlight
- hammer
- GPS receiver
- digital camera
- safety equipment

Other tools that expedite the work include:

- tape measure
- measuring wheel
- binoculars

Inspection Safety

Inspection of these infrastructure categories/systems introduces many possible hazards. With awareness of the surroundings and appropriate care, the risks present can be minimized.

Disease – Some systems carry many pathogens but they pose little of no risk unless ingested. Washing hands is very important after completing the inspection, especially for wastewater systems.

Electrical – Adequate grounding, circuit breakers, and ground-fault protection may not be present. Do not touch downed lines and damaged electrical equipment. The presence of electricity and water in treatment plants and pumping stations is a dangerous mix.

Confined spaces – Confined spaces include manholes, pipes, tanks, and chlorination buildings. Locals may not follow appropriate safety protocols and one should always be aware of the risks present in any confined space. Methane gas from the wastewater and hydrogen sulfide are potential hazards in manholes. If the inspector has to enter the confined space, a second Soldier should be present.

Chemicals – Numerous hazardous chemicals are used in treatment plants. Chlorine gas is one of the most common and is very dangerous if not properly managed. Other hazardous chemicals include acids and ammonia. Other less immediate threats to safety include PCBs and lead.

Poles, Towers, and Antennas – Taller metallic structures are susceptible to damage, structural failure, rust, and corrosion and present fall hazards. *Do not* climb any towers under any circumstance.

Equipment – Moving equipment such as pumps, grinders, mixing paddles, and other mechanical devices present hazards when appropriate care is not taken. Inspectors should be aware of automatic mechanical start and maintain appropriate distance.

Communications equipment - Base station controllers, RF antennas, and other communication devices present multiple hazards. *Do not* come into contact with antenna faces or transmitters under any circumstance.

Roads – Component inspection of the different systems that are in or around roads, may place an inspector in roads with traffic. This is a very real hazard even in secure areas.

The following charts give a description of how to 'label' an infrastructure category utilizing a red-amber-green-black system.

Area	Green	Amber	Red	Black
Water	water distribution works 100% of buildings	water distribution works 50% strength, leaks	water distribution does not work	no water distribution left, destroyed
	Tested as clean or told by locals clean	Appears clean, no smell	Does not appear clean	Contaminated water, smells
	public facilities have running water 100%	public facilities running water at least 50% buildings	public facilities running water less then 50% buildings	public facilities no running water
Sewer	sewage system works, consistent	sewage system runs but can't determine where/if treated	No treatment seen- something exists but broken	no sewege system left, destroyed
	No sewage seen, or smelt	No sewage seen, can be smelt-damaged system	Sewage seen and smelt-system broken	Raw sewage and smell would be a health issue
	public facilities work 100% of buildings	public facilities work at least 50% building	public facilities work less then 50% building	public facilities no working sewer
Power	power system works; only black outs are planned	power system works; black outs unplanned	power system not reliable, broken	power system destroyed
	electric lines are up 100%, no damage, no energy loss	electric lines are up at least 50%, some damage, some line deterioration, can't determine pwr loss	Some electric lines down greater then 50%; majority of lines deteriorated; power loss seen	Electric lines are all down; hot wires; power loss
	Power grid station intact; secureable	Power grid station working; not securable	power grid station not working; not securable; looted	power grid station stripped; destroyed
Trash	trash collection system exists; works	trash collection exists but limited	no formal trash collection	no trash collection; trash stays
	trash put in an area that is not a health issue	not known where trash is dumped	trash is consolidated in a place that could be a health issue	trash is consolidated in a place that is a health issue
	public facilities do not have a trash problem	public facilities do have trash; but it is cleaned-limited	public facilities have no means to remove trash	public facilities have trash; not removed
Housing	residences are structural sound and offer protection from the environment	residences are damaged, need eval for structural; limited protection from environment	residences are damaged; not structural sound; should not be occupied	residences destroyed; not habitable
	utilites are working; reliable	utilities work over 50% of time; not reliable	utilities work under 50% of time; broken	utilities destroyed
Roads and Railroads	minimum of a Class C road; road can be upgraded; no damage	minimum of a Class D road; damage or upgrade requirements will effect flow of traffic	minimum of a Class E road; upgrade to support is extensive; material not readily available	road is not trafficable
	working railroad system	railroad is damaged but resources to repair are available; jacks are available	railroad damage is extensive; resources not readily available	railroad system did exist but the damage is extensive to both the track and the train
Bridges and Waterways	Bridge is trafficable; no visble damage	Bridge is trafficable; damage to spans not supports	Bridge is not trafficable to military; risky for civilians; damage both spans and supports	bridge is not trafficable; not passable
	MLC was verified through ERDC	MLC has been calculated but cannot be not verified due to damage	MLC is not effective due to damage	re-build required before MLC can be done
	inspection/evaluation shows original strength assessment valid	inspection/evaluation determines issue of strength support	inspection/evaluation shows not supportable strength of support	inspection/evaluation shows remains of bridge can not support weight
Airports	Airport capable of supporting military traffic; no damage	Airport not capable of supporting all military traffic, only C130; no damage	Airport damaged; utilities, structures not reliable or safe	No working airport
	Airfield runway serviceable with no damage; MOG	Runway serviceable but contains some areas that will limit taxiway; MOG	Runway is not serviceable; can repair with available resourses, extensive damage	Runway is not serviceable and dimensions are too small to support any military aircraft

Area	Green	Amber	Red	Black
Communication	telephone works, equipment is available, reliable in all public facilities	telephone hookups are in public facilities; equipment is over 50%; fairly reliable	telephone hookups are in facilities; equipment is in less then 50%; not reliable	no telephone hookups in facilities; no idea if system works
	postal system exists, works, reliable	postal system exists, slow, over 50% of mail gets through	postal system appears to exist, very slow with over 50% not getting through	no postal system works
	all three forms of media: radio, TV, newspaper exist and are running	one form of media exist and is running	one form of media exists but is not running	no forms of media exists
Schools	building is useable; securable; utilities	building useable; not securable; utilities work at over 50%	building useable; not securable; utilities work at under 50%	building not useable; utilities don't work
	equipment in building enough for all students	equipment in building enough for over 50% of students	equipment in building enough for less then 50% of students	no equipment to support students
Health Services	medical buiding intact; back up generator; no support issues	medical building useable; no back up generator; minimal basic support items	medical building health issue; utilities not reliable; support items missing	medical building not useable from damage or desrepair; no working utilities; looted
	emergency service running and efficient; more then one vehicle; designated personnel	emergency service exists; one vehicle; personnel man the truck may or may not be trained	emergency service is not in place; vehicle exists; no trained personnel	no emergency service; no vehicle; no personnel
	animal services exist; securable place to keep animals; ability to put animals down	animal services exist; area could secure animals; homemade way to put animals down	animal services do not exist; area could secure animals; supplies available to put animals down	animal services do not exist; no place to secure animals; no method to put animals down
Public Safety	Police working; building securable and intact; equipment available and useable	Police working at least 50%; building securable but damaged; equipment at least 50% avail and useable	Police working at under 50% strength; building damaged; equipment over 50% not useable	Police are not useable; building not useable; no useable equipment
	Fire system is in place, working; building securable and intact; equipment available and useable	Fire system is talked; building securable but damaged; equipment at least 50% available and useable	Fire system is not organized, not formal; no set building; less then 50% equipment available	no fire system built; no building; no equipment
	Crime in area is not issue; Jail exists, clean and useable; locals listen and obey authority	Crime occurs; police are proactive; jail is useable; majority of locals obey authority	Crime occurs; police are reactive; jail is substandard; locals disgruntled	Crime great problem; no jail; locals do not follow authority
	UXO are not an issue; area swept not UXOs	UXOs have been found; marked/removed; no continous threat	UXOs can still be found; continous swepts required; threat	UXOs are a continous occurance; will effect mission due to threat
Attitude	Community leaders not hostile; religious centers are intact; support EN fixing	Community leaders are neutral; religious centers are damaged but secureable; support EN fixing	Community leaders are negative; religious centers are damaged, not securable; skeptic of EN support	Community leaders hostile; religious centers destroyed; don't trust US and don't want help
	NO Ethnic Tension, all one community	Distinct ethnic groups within AO; will support if improving or fixing will be equal to all groups	Distinct ethnic groups within AO; one group is dominant; improving area can not be equal to all groups	Ethnic violence occurs; one group rules; to improve area would increase ethnic tension
	Employment is over 50%	Employment is under 50%; able to work for EN	Employment is under 50%; not able to work for EN	Employment an issue; won't work for EN
	no formal paramilitary threat	paramilitary threat briefed at brigade level	paramilitary threat briefed and concerned at brigade level	paramilitary threat briefed and concern at division level

Food Supply Chain,
Cultural/Historical/Religious,
Chemical, Hazardous Materials…

Under
Development

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SEWER

Sewage systems – Information

• Sewage is divided into four classifications: **Domestic** sewage comes from residences, institutions, and business buildings and is a priority due to its sanitation threat. **Industrial** waste is the liquid resulting from manufacturing or industrial processes - treatment of these wastes is usually collocated with the plant from which they originate. **Storm** sewage is the runoff during or immediately after storms. **Combined** sewage systems carry any combination of domestic, industrial, and/or storm sewage. Sewage systems consist of two major types of facilities: **collection** and **treatment**.

• The major components of collection are **pipes**, **lift stations**, and **manholes**. Pipes can vary in size, of course, and include collectors, trunk lines, and interceptors. Lift stations pump waste to a higher point for continued gravity flow or initiate forced flow when gravity flow isn't adequate. A lift station is comprised of a pump with vertical piping that is usually located in a small building. Manholes provide access into the Sewage system for inspection, preventive maintenance and repair; they are also the likely site of **junction boxes** and **cleanouts**, which marry systems and provide access to stoppages.

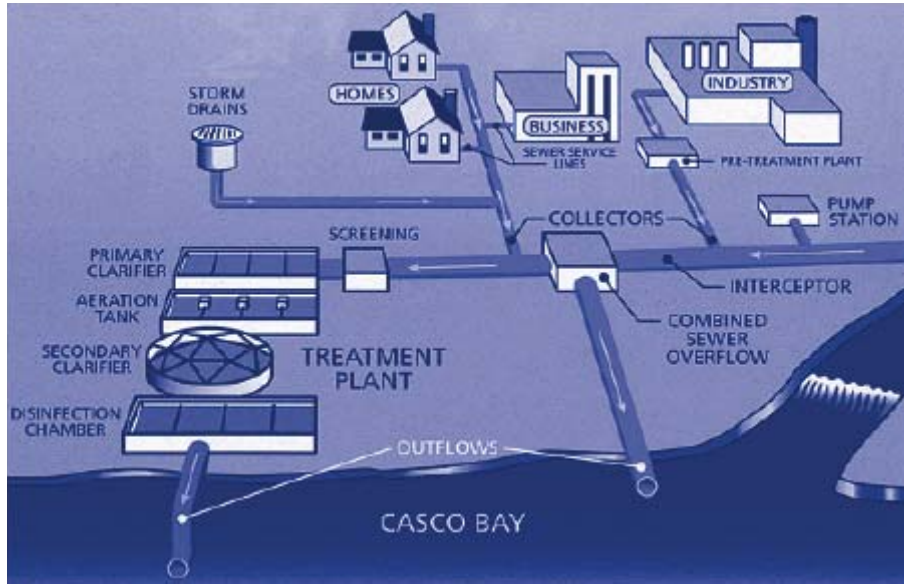
• There are three stages of treatment that may be present in a wastewater treatment plant: **primary**, **secondary** and **tertiary**. Wastewater may be completely untreated or treated up to the first, second, or all three levels.

The primary treatment method is the physical process (screening and sedimentation) that separates solids from liquids. **Racks** and **screens** are used to remove the largest solids and then **sedimentation tanks and clarifiers** are used to settle and remove smaller solids. The solids are sent to a **sludge digester** to stabilize the waste and subsequently dry in the **drying bed.** The solid waste should be disposed of off site. If the plant does no more than primary treatment, then the water is sent to a **final clarifier**, then **chlorinated (disinfected)** and finally **discharged**.

The secondary treatment method is additional to the primary. Typical layout is waste is combined with micro-organisms that break down the waste organic material in large **aerated tanks**. The wastewater then flows to settling tanks called **secondary clarifiers** where the bacteria settle out. A-typical layout has a **trickling filter** used instead, which contains granular media and bacteria that break down the organic material as it flows through the filter. Also, before discharge, a **sand filter** may be used.

The tertiary treatment method is where nutrients are removed from wastewater. Very little tertiary treatment is done.

Sewage system diagram



Sewage systems – Measurements

▪ It is obvious when a sewage collection system is failing, but a treatment plant might not show direct signs of malfunction. The following metrics are used to measure discharge in order of severity top to bottom:

Coliform bacteria count – this is the measure of fecal bacteria remaining in the water. Ideally this number would be zero. Note that the water in the environment is not totally free of fecal bacteria – wildlife do introduce some.

Chlorine – the chlorine used to kill harmful bacteria needs to be removed so it does not kill beneficial bacteria in the environment. Ideally, chlorine should not be detectable.

BOD (**B**iological **O**xygen **D**emand) – is a measure of how much oxygen in the water will be required to finish digesting the organic material. It should be zero, because organic material should not be discharged.

Dissolved oxygen – is the amount of oxygen in the water as it leaves the plant. If the water contains no oxygen, it will kill any aquatic life that comes into contact with it, therefore, dissolved oxygen should be as high as possible and needs to at least cover the BOD, if there is any.

pH – this is the measure if the water's acidity once it leaves the plant. The water's pH should match the pH of the receiving body of water.

Suspended solids – this is the measure of the solids remaining in the water after treatment. Ideally, suspended solids would be zero.

Phosphorus and **nitrogen** – is the measure of the nutrients remaining in the water. This should be close to zero.

Sewage systems-Collection systems

Lift station

Junction box and cleanout

Sewage systems - Emergency situations

▪ Stoppages caused by debris being blown and washed into sewers can be expected. Deliberate demolition by the enemy is usually limited to junction manholes or large mains. The enemy may destroy pumping stations deliberately because they are key points, are more accessible, and are most difficult to repair.

▪ Highly populated urban areas (such as apartment and house districts) depend almost entirely on waterborne sewage disposal systems, smaller communities can use temporary latrines.

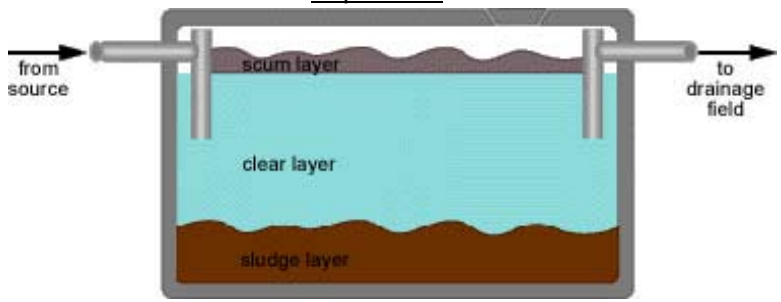
▪ Sewers are the most essential item in a sewage disposal system. Service can be restored temporarily by pumping from an upstream manhole, around the damaged section, and into a downstream manhole. If the sewer is completely stopped or badly damaged, an open channel can be built. Where storm and sanitary sewers are separate, it may be possible to divert sanitary sewage through a storm sewer to a suitable outlet.

▪ Portable, skid-mounted, centrifugal, gasoline engine pumps are the most suitable type for use in the hasty rehabilitation of Sewage systems. They must be of non-clog (open impeller) design and capable of handling unscreened sewage. Pumps with four inch intake and discharge are the most adaptable, since they can be used for draining craters, pumping around blocked sections of sewers, and temporarily replacing damaged pumping stations. Pipe less than four inches in diameter should never be used for sewage. Army system only has six inch diameter, closed impeller pumps that were originally designed for oil. Can work but not the good solution.

Septic systems – Information

• The primary components of a septic system are its **tank** and its **drainage field**. A tank is simply a big concrete or steel tank that is buried. A drainage field is made of perforated pipes buried in trenches filled with gravel. Wastewater moves through the tank and then flows into the drain field, where it is slowly absorbed and filtered by the ground.

Septic tank



A septic tank is: wastewater flows into the tank at one end and leaves the tank on the other. There are three layers in a tank. Anything that floats rises to the top and forms a layer called a **scum layer**. Anything heavier than water sinks to the bottom and forms the **sludge layer**. In the middle is fairly **clear layer** of water, which contains bacteria and chemicals like nitrogen and phosphorus that act as fertilizers. As new water enters the tank, it displaces the water that is already there. Larger systems are more likely to have multiple tanks that separate solids and/or a sand filter between the tank and drainage field.

Drainage Field

Septic systems - Measurement

• The primary metric for assessing septic tanks is their ability to accept additional wastewater. Scum must be periodically removed from the tank to avoid leaching into the drainage field and clogging the soil. Solids visible above the water level would also indicate impending problems. If possible, use a long pole to assess the thickness of the scum layer, liquid layer, and sediment.

Sewage systems treatment – Primary with a typical secondary layout

Coarse solids removal
rack/screen

Primary sedimentation tank and clarifiers

Aerated tanks

Drying bed

off site

Sludge digester

Secondary sedimentation tank and clarifiers

active solid liquid Secondary process

Body of water

discharge

Chlorination

Final clarifier

Sewage systems treatment – Primary with an Atypical secondary layout

Coarse solids removal
rack/screen

Primary sedimentation tank and clarifiers

Trickling filter

Secondary sedimentation tank and clarifiers

Sludge digester

Drying bed

off site

active solid liquid Secondary process

Final clarifier

Sand filter

Chlorination

discharge

Form#: WW000 SEWAGE WASTEWATER SYSTEMS OVERVIEW

Population serviced: _____Approximate area serviced: _____

Map network to include lines, manholes, and lift stations. Circle unit of measure: **FT / M**

What is the approximate distance between manholes? _____

Random survey of local users:

- Note buildings and areas serviced and not serviced by the collection system.
- Does the wastewater backup into buildings? ☐ Yes ☐ No
- How often do backup problems occur?

☐ regularly ☐ irregularly ☐ during power outages ☐ when it rains

☐ other (specify): _____

Note any reports of strong smells from wastewater collection system originating indoors or outdoors. Describe conditions and location.

_____

_____

Form#: **WW011 SEWAGE WASTEWATER SYSTEMS --- COLLECTION SYSTEMS**

Lift Station #_____ of _____ Identify this station:_____ _____(GPS)_____

Does the lift station operate? ☐ Yes ☐ No ☐ Unknown Does it have power? ☐ Yes ☐ No

Check breaker and switches for pumps and other equipment. Note any damage and available information on the capacity of the breaker box feeds and breakers_____

Does effluent enter or discharge from the station? ☐ Enter ☐ Discharge ☐ Unknown

Note any leakage or flooding including source and quantity _____

Direction of flow to/from the lift station: ☐ To (Direction: _____) ☐ From (Direction: _____)

Pipe Information (for pipes entering or exiting the station):

Enter: Size in diameter: _____ : **IN / MM** Material Type (if able to determine): _____

Exit: Size in diameter: _____ : **IN / MM** Material Type (if able to determine): _____

Are pipes damaged: ☐ Yes ☐ No If so, explain: _____

Are pipes leaking steadily: ☐ Yes ☐ No If so, explain: _____

Do pipes have heavy corrosion: ☐ Yes ☐ No If so, explain: _____

Lift Station Pump Information:

Type of Pump: ☐ centrifugal ☐ screw ☐ pneumatic ejector ☐ grinder ☐ other (specify): _____

Does pump operate? ☐ Yes ☐ No ☐ Unknown Is it a backup pump? ☐ Yes ☐ No

Power source for pump: ☐ electrical service ☐ combustion motor Is fuel available? ☐ Yes ☐ No

Size: _____ **IN / MM** Amperage:_____ **AMPS** Wattage: _____ **WATTS**

Capacity: _____ **GAL/SEC or LITER/SEC** Flow Rate: _____ **GAL/SEC or LITER/SEC**

Other Relevant Information: _____

Does pump show signs of steady leakage? ☐ Yes ☐ No If yes, give details: _____

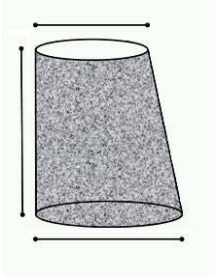
Does pump generate excessive noise? ☐ Yes ☐ No If yes, give details: _____

Does pump show signs of heavy corrosion? ☐ Yes ☐ No If yes, give details: _____

Describe condition of fuel tank and/or fuel lines _____

Manhole #_____ of _____ Identify this manhole: _____(GPS)

Label the dimensions of the manhole on diagram at the right. **FT / M**



Does the area around the manhole exhibit signs of distress? ☐ Yes ☐ No

If yes, give details: _____

Is manhole missing or severely damaged? ☐ Yes ☐ No

Are walls out of plumb (1 inch horizontal to 24 inches vertical?) ☐ Yes ☐ No

Do walls show signs of shifting or movement? ☐ Yes ☐ No

If yes, give details: _____

Pipe Information (for pipes entering or exiting the manhole):

Enter: Size in diameter: _____ **IN / MM** Material Type (if able to determine): _____

Exit Size in diameter: _____ **IN / MM** Material Type (if able to determine): _____

Are pipes damaged: ☐ Yes ☐ No If so, explain: _____

Are pipes leaking steadily: ☐ Yes ☐ No If so, explain: _____

Do pipes have heavy corrosion: ☐ Yes ☐ No If so, explain: _____

Direction of flow to/from the manhole? ☐ To (Direction: _____) ☐ From (Direction: _____)

Form#: WW020 SEWAGE WASTEWATER SYSTEMS TREATMENT PLANT

Using the guide, identify major plant components

Identify this plant:_____ (GPS)_____Approx. area serviced:_____

Population serviced: _____Capacity of plant: _____ **Million gallons/day / million liters/day**

Does the system appear to be operating? ☐ Yes ☐ No If not, is there power at the site? ☐ Yes ☐ No

Check breaker and switches for pumps and other equipment. Note any damage and available information on the capacity of the breaker box feeds and breakers

_____

Are open containers overflowing? ☐ Yes ☐ No If yes, identify: _____ 📷

Are racks operational? ☐ Yes ☐ No ☐ Unknown Clogged? ☐ Yes ☐ No Damaged? ☐ Yes ☐ No

Are the screens operational? ☐ Yes ☐ No ☐ Unknown Clogged? ☐ Yes ☐ No Damaged? ☐ Yes ☐ No

Describe any damage and other problems _____

tanks _____ for each tank, fill out a tank detail. # pumps _____for each pump, fill out a pump detail.

Is the water disinfected before discharge? ☐ Yes ☐ No. Form of disinfection used: Chlorine gas ☐

Sodium hypochlorite ☐ Calcium hypochlorite ☐ Ozonation ☐ Ultraviolet ☐ Other: _____

Pipe Information (for pipes entering or exiting the source):

Enter: Size in diameter: _____ 👁 **IN / MM** Material Type (if able to determine): _____ 📷

Exit: Size in diameter: _____ 👁 **IN / MM** Material Type (if able to determine): _____ 📷

Are pipes damaged: ☐ Yes ☐ No If so, explain: _____ 📝 📷

Are pipes leaking steadily: ☐ Yes ☐ No If so, explain: _____ 📝 📷

Do pipes have heavy corrosion: ☐ Yes ☐ No If so, explain: _____ 📝 📷

Direction of flow to/from the station? ☐ To (Direction: _____) ☐ From (Direction: _____) 🌐

Plant Tank Detail Information for Tank #_____ of _____

Description: _____ Location: _____

Shape: _____ Component type: _____

Height: _____**FT / M** Width: _____ **FT / M**

Length: _____**FT / M** Capacity: _____ **GALLONS / LITERS**

Is the aerator working? ☐ Yes ☐ No ☐ Unknown

Is the water entering the sand or trickling filter clear? ☐ Yes ☐ No

Is scum removing equipment operating on clarifying tank surface? ☐ Yes ☐ No

Does the sludge move from the clarifier? ☐ Yes ☐ No To the sludge digester? ☐ Yes ☐ No

To the drying bed? ☐ Yes ☐ No Is the sludge removed at the last processing stage? ☐ Yes ☐ No How?

Describe any problems with the above listed equipment here _____

Plant Pump Detail: Information for Pump#___ of ____Description: _____Location: _____

Type of Pump: centrifugal ☐ screw ☐ pneumatic ejector ☐ grinder ☐ other /Unknown:_____

Does the pump operate? ☐ Yes ☐ No ☐ Unknown Is there a backup pump? ☐ Yes ☐ No

Check breakers and switches for pumps and other equipment. Record any relevant information on capacity of breaker box feeds:_____

Power source for pump: ☐ electrical service ☐ combustion motor Size:_____**IN / MM** Wattage: _____ **WATTS**

Amperage:_____ **AMPS** Flow Rate: _____ **GALLONS/SEC or LITERS/SEC** Other Relevant Information:

_____

Does pump show signs of steady leakage? ☐ Yes ☐ No 📷 If so, explain: _____

Does pump generate excessive noise? ☐ Yes ☐ No 📷 If so, explain: _____

Does pump show signs of heavy corrosion? ☐ Yes ☐ No 📷 If so, explain: _____

Form#: SP000 SEPTIC SYSTEM OVERVIEW

Identify this system_____ GPS_____

List and Map Buildings serviced: _____

Random survey of local users:

- Note buildings and areas serviced and not serviced by the collection system.
- Does the system backup into buildings? ☐ Yes ☐ No
- How often do backup problems occur? ☐ regularly ☐ irregularly ☐ during power outages ☐ when it rains ☐ other (specify): _____

Septic Drainage Field Information

Approx. size of septic field:_____ by _____Unit of Measure: _____Note any surface water or wetness in this area

Septic Tank Information

Size of tank: ☐ Round or Cylindrical Height: _____ Diameter: _____Unit of measure: _____

☐ Rectangular Height: _____ Width: _____ Length: _____ Unit of measure: _____

☐ Other Shape Specify: _____

Height: _____ Width: _____ Length: _____ Unit of measure: _____

What is the tank capacity? _____ Unit of measure: _____

Describe openings to tank: _____

Approximate size in diameter of openings: _____ Unit of measure: _____

Baffles? ☐ Yes ☐ No If so, detail _____ Multiple tanks? ☐ Yes ☐ No number: _____

Thickness of the scum layer _____ Unit of measure: _____Thickness of the water layer _____ Unit of measure: _____Thickness of the sediment layer _____ Unit of measure: _____

Of what material is the tank constructed? ☐ Concrete ☐ Steel ☐ Wood ☐ other (specify): _____

Does the tank show signs of: ☐ Leakage? ☐ Corrosion? ☐ Distress in outer finish or coating?

☐ Other (specify): _____

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WATER

Water systems – Overview/ Production facility

• A typical water system can be broken down into three major parts that function in the following order: the **production facility**, the **storage facility**, and the **distribution system**.

• The production facility has two components: the **water source** and the **treatment plant**. A water source can either be a **surface water source** or a **ground water source**.

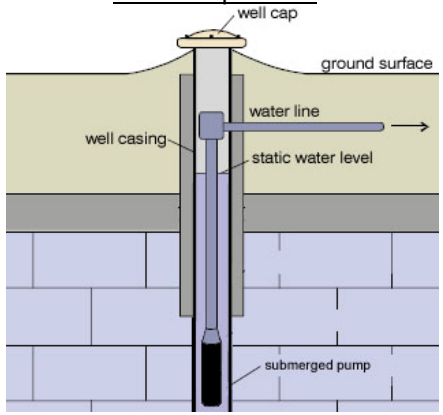
• A surface water source is a river, stream, or a lake of a suitable size and its pump. A surface water source is simple: water is drawn into a pumphouse via a vertical or horizontal pipe, with a **trash screen** of some sort to prevent any solids that might be ingested.

• A ground water source, which taps into the **water table**, typically requires less treatment and is one of three types of well: a **dug well**, a **driven well** or a **drilled well**. Dug wells are literally dug into the ground by hand or by small equipment. These wells are easily identifiable because they are lined with stones or bricks to prevent them from collapsing. Most dug wells are shallow, and therefore affected by drought and seasonal declines in the water table. They are most subject to contamination from nearby surface sources, sabotage, or poor sanitation. Although some dug wells still use a bucket, they are increasingly paired with small **well pumps**. They typically serve a very small population.

Driven wells operate on the same principles, but are built by driving a small-diameter pipe into soft earth, such as sand or gravel. A screen is usually attached to the bottom of the pipe to filter out sand and other particles. Driven wells are similar to dug wells in that they are so close to the surface, but their small profile eliminates some of the exposure issues. Driven wells always will be paired with some sort of well pump.

Drilled wells also operate similarly, but on a massive scale. They can be drilled up to 300 meters deep, and have methodological placement. This is the method most common in cities and towns. Municipal water systems will generally have several wells feeding the system, and drilled wells are generally safe from the hazards of their shallower brethren.

Well components



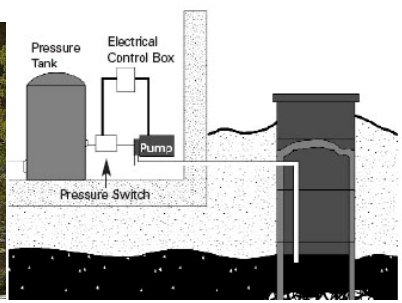
Since wells are dug, driven, or drilled into the ground, a quick visual inspection is limited to a few components. The scale of dug and driven wells makes their assessment intuitive and simple. However, a typical drilled well will have the following components: the **casing**, **well cap** or **well seal**, a **pump**, and the associated **piping**. The casing is a steel or plastic pipe which is inserted into the well to prevent the collapse of the hole and the entrance of contaminants from lateral seepage. The well cap is a device used to cover the top of the casing and prevents the entry of surface runoff; these caps may have a conduit box for electrical wires going to a **submerged pump** within the well. A well seal is a similar device, but differs from a well cap in that it has a gasket and truly *seals* the well; a well seal should include an elevated, screened vent pipe that passes through the gasket to allow pressure equilibration, prevent contamination, and make flooding impossible.

There are two major groups of pumps used with wells. These are **submerged** and **surface** well pumps. A submerged pump is actually in the well while a surface pump may be located over the well, in a pump house near the well or in an underground vault located near the well. Piping may be through the well cap or well seal, or inside the well itself. Some underground pipes can be inspected through a hatch or access port.

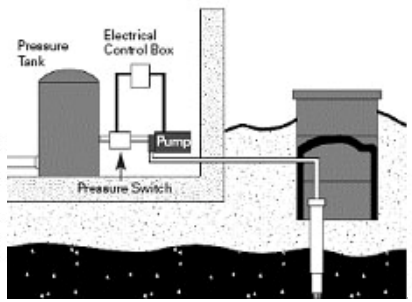
• Pumps, whatever role they serve in a water system, can often be identified through the **nameplate**. It should have the pump's capacity and power requirements as well as manufacture's name, pump model number and serial number on it. This information is indispensable and should be recorded even in functioning systems.

Surface water source

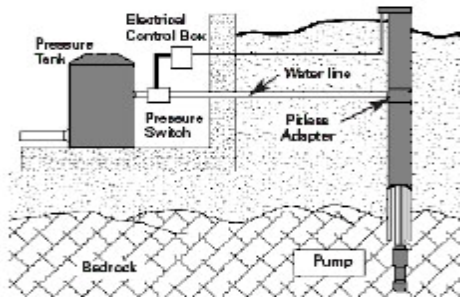
Dug well



Driven well



Drilled well



Well pump

Water systems – Production Facility/ Treatment

• Some water sources are pure enough that no treatment other than disinfection is necessary before it is used, but most water production facilities will have a water treatment plant. Upon reaching the treatment plant the raw water flows through a series of steps designed to treat the water to a level that is pure enough for human consumption.

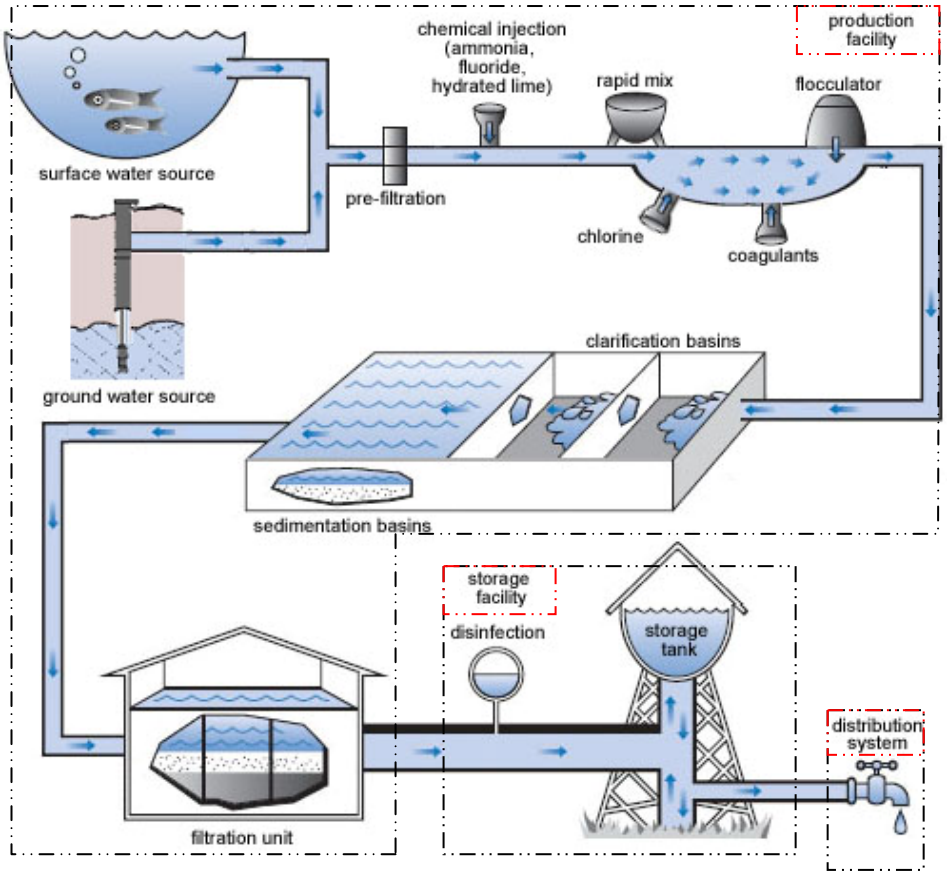
• First, raw water is drawn from the water source. The treatment plant begins when the raw water is processed through **pre-filtration units**, which remove small quantities of suspended solids that passed through the trash screen. A **chemical injector** then introduces one or all of the following chemicals into the water flow: **ammonia**, which helps to produce a more stable disinfecting residual **fluoride**, which reduces dental issues in the population, and **hydrated lime**, which softens water from the diffused calcium and magnesium that is inherent in ground water sources due to rock.

The water will then enter into a **rapid mixer**. Rapid mixers look like huge outboard motors that lay in pools with tanks of chemicals close by. This is where **chlorine**, which kills harmful organisms, and **coagulants** (like aluminum salts or *alum*, ferric salts, and polymers) are added. Coagulants aid in the process of **flocculation**, which is shorthand for the gathering of like sized, suspended particles to facilitate speedy sedimentation. The process of flocculation is carried out by a **flocculator**, which is easily identifiable by its steamboat-like paddles. A flocculator provides gentle agitation of the water that has been coagulated to promote particle contact and formation of larger particles.

From the flocculator the water will then enter into **clarification basins** and **sedimentation basins** where the particles will settle out. Gravity and a deep layer of conditioned solids cause the incoming water to settle. This accumulation of solids or sludge is siphoned off and usually discharged into the sewage system. Although they serve similar functions, a sedimentation basin contains a finer process and is usually under cover.

Next, the **filtration unit** is employed to remove the *very* fine solids that did not settle out in the sedimentation basin. Water enters the filtration unit by way of the **wash troughs**, which act as a spillover device much like a underwater fountain. The wash troughs agitate and keep the water flowing through gravity and pressure. The filtration unit employs sand, gravel, coal, and other media in a network of layers, culminating in a final screen that holds the media up, called a **perforated lateral**. Usually, the water is filtered via ever decreasing aggregates, but it can consist of only one type of media in simple plants. No matter what, a filtration unit is always under cover. After water passes through the filtration unit, it could still be on the treatment plant site in a **clear well**, which can vary in type from covered pools to tanks. The most widespread employment of a clear well is in a very large underground reservoir that resembles a shallow swimming pool. Clear wells allow for further disinfection through rest and provide water pressure to the storage facility. Clear wells are not a storage facility and are different because of their co-location in the treatment plant.

Water system overview



A final note about production facilities: throughout the treatment plant, there are tanks of chemicals. Chlorine is *the* crucial chemical, above all other chemicals, to the treatment plant's processes. Liquid chlorine tanks are commonly referred to as "**salt cells**" and have a simple metric – they are filled and injecting properly, or they are not. It is important to note that chlorine is created (through electrical current) using **sodium hydroxide,** which is also known as **caustic soda** or **lye**. Not all lye is sodium hydroxide, however, so this must be clarified: the *term* is interchangeable but the *chemical* is not. In a treatment plant, it is not uncommon to see the double walled tanks of sodium hydroxide instead of salt cells, or even in some other form like gas, but chlorine *will* be there. Sodium hydroxide is extremely corrosive, and chlorine fumes are so toxic that they have been weaponized in the past.

Treatment sequence

Source with trash screen (pre-filtration)

Chemical Injection

Rapid Mixers

Coagulants

Chlorine

Injection Pumps

Flocculator

Clarification Basin

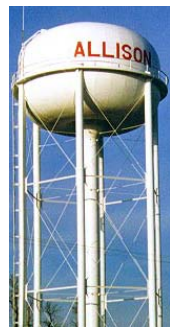
Sedimentation Basin

Filtration Unit

Clear Well

Disinfection (Chlorine)

Storage Facility



Distribution

Water systems – Storage

Some water systems do not have storage facilities and the water goes straight from production to distribution, but it is common to store water for a myriad of reasons, the most important being the accommodation of demand fluctuation through pressure. Also, storing water allows for more incorporation of chemicals before they are distributed. The most prevalent pre-storage chemical is injection of additional chlorine. Other chemicals may also be injected at this time to control acidity and corrosiveness.

Storages tanks can be divided into two categories: **at grade** and **elevated**. At grade storage tanks, to include underground storage tanks, operate by pumping water to the distribution system after the water has been stored. Elevated storage tanks pump water *into* the storage tank, then let gravity and pressure do the work of pushing water to the distribution system.

There are many kinds of tanks, but the most frequent types found are **underground** or **surface reservoirs** (they both resemble enclosed swimming pools), **standpipes**, **ground level tanks**, and **elevated storage tanks**. Elevated storage tanks are the most efficient type of storage tank, as they ensure a relatively uniform pressure in the distribution system with sufficient reserve storage for high demand periods and an adequate supply of water for emergencies. With all storage tanks, a pressure pump takes the water from the water production facility: if the pump is producing more water than the demand, then the excess is stored in the tank, but if the community is demanding more than the pump can produce, then water flows out of the tank. Many buildings and hospitals will also have their own tanks to ensure adequate pressure at the tap.

Ground level tank

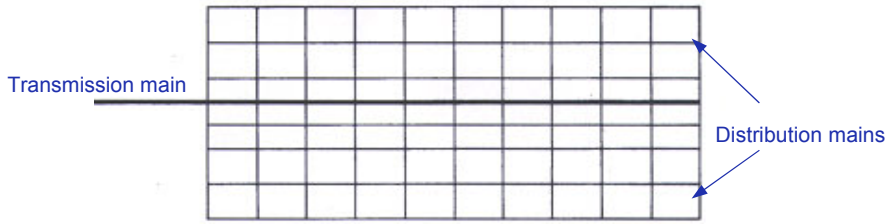
Water systems – Distribution system

• The distribution system delivers the water to the local population for use in residential, commercial, and industrial areas. A network of **pipes**, **valves**, and **booster pumping stations** make up the water distribution system, which may also contain **fire hydrants**. Some communities do not have distribution systems, which results in either public access to water or private holding tanks.

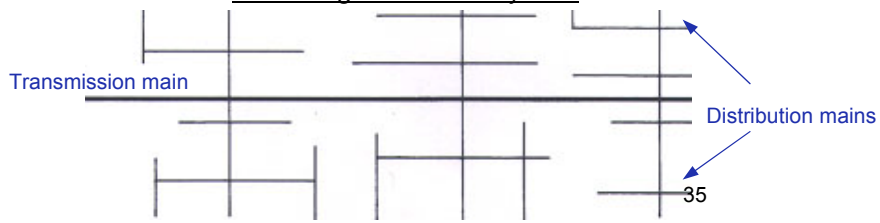
• There are two basic types of distribution systems: **grid** and **branching**. Many systems are a combination. The distribution system in a city may have a grid configuration, while dead-end branches serve remote areas. Grid systems feature looped and interconnected distribution piping that allows free water circulation. A heavy discharge from one main allows drawing water from other pipes. Branching systems are single direction, include several dead ends, and are subject to loss of pressure as water gets tapped down the line.

• Different pipes carry water from the production facility to the end user. **Mains** make up the network of pipes in a distribution system and are commonly made from cast iron, steel, cement-lined ductile iron, asbestos-cement, or PVC. Very old mains may use lead, wood, or clay tile. The diameter of mains varies widely depending on the size of the system and number of consumers served. There are two types of mains: **transmission mains** and **distribution mains**. Transmission mains are used for movement of water from the production facility, through the storage facility, and on to the distribution system. Distribution mains make up the network of pipelines that provide service to all users and are frequently six inches or twelve inches in diameter. The pipes that join distribution mains to the end user are called **service lines**.

Grid distribution system



Branching distribution system



Valve box

Booster pump

• Valves are mechanical devices that are used to regulate water flow. All systems have valves that can be used to isolate sections of distribution mains. Locating these types of valves is an immediate concern, as emergencies can be swiftly dealt with in this fashion. The majority of systems also have **service valves** that can be used to shut off service lines. Valves also come in a transmission mains variety: **altitude valves** that control water levels in storage tanks, and **pressure reducing valves** that normalize the effects of elevation on a distribution system. Valves are typically located in underground **valve boxes**, close to the surface and usually on roads or sidewalks in an urban area. Valve boxes are also referred to as **gate pots** or **road boxes**. Critical valves may be located aboveground or in vaults with manholes so that they are readily accessible by water system operators.
• Booster pump stations maintain required pipeline service pressure, either from the friction of pipes over distance or in order to maintain required service pressure along long pipelines. Booster pumps can take *many* shapes and sometimes are placed after the service line by the end user. Booster pumps will always have some sort of access for maintenance and identification and are generally large enough to warrant their own access rooms or buildings.
• Fire hydrants provide fire protection throughout a community and are located throughout the water distribution system. A valve is usually located near the hydrant, which is used to stop the water supply to a damaged hydrant. Fire hydrants can be color coded to indicate if the hydrant is a municipal, private, or special purpose hydrant. Occasionally, non-potable water will be used for fire hydrants; they will run separate and parallel to the drinking water system.

Water systems – Metrics
• Beyond water reaching its destination, the scientific metrics for a water system are quite simple: **disinfectants**, **inorganic chemicals**, **organic chemicals**, **disinfection byproducts**, **microorganisms**, and **radionuclides** should be kept to an absolute minimum. Without testing equipment, a quick visual and odor check can be enough to tell there is a problem with the water system. Most likely, a local will be available to advise on the situation.

Water systems – Emergency Situations
• Damaged water systems produce conditions favorable to the outbreak and spread of disease. Water mains are subject to contamination, and lack of water for cooking and hygienic purposes results in the use of untreated sources out of desperation. For small communities or towns, a supply of potable water for drinking and cooking is usually all that must be provided. For large communities and cities, water must also be supplied for personal hygiene and waterborne sewage disposal.
• Minimum requirements to meet these needs are as follows for every civilian per day: one-third gallon for drinking only, and four gallons without a sewage system. Employment of a sewage system is an additional 14 to 20 gallons. Water for temporary civilian use must be treated to prevent the spread of waterborne diseases. Hasty disinfection starts with moderately clear water with a pH of 7 or less, and then adding enough chlorine to produce a residual slightly greater than 2 parts per million after a 30-minute contact period.
•If water is available in certain portions of the damaged system, hydrants on the edge of the damaged area may be used to fill tank trucks, which carry the water to residents of the damaged area. Can draw water directly from the trucks or from tanks set up at convenient points.
• Surface water source damage is usually confined to the collection pipe, but expect wells to be filled with debris and have casing damage. Elevated tanks are generally damaged beyond repair if toppled from high supports, and other storage tanks may be punctured or somehow disabled. Most likely, damage to distribution systems is normally confined to pumps, valves, aqueducts, and mains and *not* service lines. The enemy may deliberately contaminate water supply systems by placing bone oil, refuse, bodies, lubrication oils, or other materials in the system. Especially vulnerable are locations in which water mains and sewers are close together. Mines detectors can be used to locate mains and valves.
• Standard engineer construction equipment and materials, such as power excavators and ditchers, compressors with accessories, pumps, dozers and shovels, pipe-cutting and pipe-joining equipment, and shoring and sheathing are usually adequate for most main repairs. Steel pipe with mechanical couplings should be used for making repairs. Cast-iron pipe can be used as well but is harder to work with. Fire hose may also be used for temporary bypasses. Repaired lines should be tested for leaks under slightly more than working pressure before they are covered. The importance of disinfecting water systems before returning them to service cannot be overemphasized. During disasters when the system is most likely to become contaminated, there may be a tendency to overlook disinfection and that is unacceptable.
• Civilian populace may become desperate or merely inconvenienced by the lack of adequate water. This may lead to scavenging or rigging improvised service lines. This situation is unacceptable due to the sanitation risk, especially in branch systems.

Form#: **PW011 POTABLE WATER - PRODUCTION FACILITIES – WATER SOURCES SURFACE**

Surface Water Source #_____ of _____Production capacity per year: _____ **GAL** / **LIT**

Location of this source: _____(GPS)_____

Water level sufficient at the intake? ☐ Yes ☐ No If no, explain:_____

Obvious contamination risks in the area? ☐ Yes ☐ No If yes,explain:_____

Inspect the intake screens: Are there signs of blockage or damage? ☐ Yes ☐ No

If yes, explain: _____

Pipe Information: Size in diameter(IN): _____ **IN / MM** Material Type: _____

Size in diameter(OUT): _____ **IN / MM** Material Type : _____

Are pipes damaged: ☐ Yes ☐ No If so, explain: _____

Are pipes leaking steadily: ☐ Yes ☐ No If so, explain: _____

Do pipes have heavy corrosion: ☐ Yes ☐ No If so, explain: _____

Direction of flow to/from the station? ☐ To (Direction: _____) ☐ From (Direction: _____)

Pump Information: Are there pumps located at this water source? ☐ Yes ☐ No

Information for Pump#_____ of _____Description: _____Location: _____

Power source for pump: ☐ electrical service ☐ combustion motor Does the pump operate? ☐ Yes ☐ No ☐ **UNK**

Is there a backup pump? ☐ Yes ☐ No If **NO** or **UNKNOWN CHECK:** Is the power switch on? ☐ Yes ☐ No Is the safety switch on? ☐ Yes ☐ No Check breakers and switches for pumps and other equipment. Record any relevant information on capacity of breaker box feeds:_____

Pipe Diameter (in): _____ **IN** / **MM** Pipe Diameter (out): _____ **IN** / **MM** Pump Wattage: _____ **WATTS**

Pump Amperage: _____ **AMPS** Capacity: _____ **GALLONS/SEC / LITERS/SEC**

Is the pump leaking steadily? ☐ Yes ☐ No If yes, what is leaking out? ☐ Water ☐ Lubricant

Does pump generate excessive noise? ☐ Yes ☐ No If yes, explain: _____

Does pump show signs of heavy corrosion? ☐ Yes ☐ No If yes, explain: _____

Form#: PW011 POTABLE WATER - PRODUCTION FACILITIES – WATER SOURCES WELL

Well #_____ of _____ Production capacity per year: _____ GAL / LIT

Location of this well: _____ (GPS)_____

Indicate type of well: ☐ Dug ☐ Driven ☐ Drilled ☐ Unknown _____

What is the depth of the well? _____ **FEET / METERS**

Are there multiple well heads at the source? ☐ Yes ☐ No If yes, how many? _____

Well casing diameter? Size in diameter: _____ **IN / MM**

Pipe access from well to surface: ☐ Through well head ☐ Underground ☐ In vault or tunnel ☐ Unknown ☐ other (specify):_____

Type of well cover: ☐ Cap ☐ Seal Is it damaged? ☐ Yes ☐ No If yes, detail:_____

Is there a vent in the well head? ☐ Yes ☐ No Is the well operating? ☐ Yes ☐ No ☐ Unknown

If answer is **NO** or **UNKNOWN for operating**, then check to see if power switch is on.

Is the power switch on? ☐ Yes ☐ No Is the safety switch on? ☐ Yes ☐ No

Are wires properly connected? ☐ Yes ☐ No Is there power at this site? ☐ Yes ☐ No

Pump Information: Information for Pump#_____ of _____

Is there a pump on this well? ☐ Yes ☐ No ☐ Unknown If **UNKNOWN**, is there a conduit box or electrical wires indicating the existence of a submerged pump? ☐ Yes ☐ No If yes, is the pump operating? ☐ Yes ☐ No ☐ Unknown ☐ No pump indicated. Type of pump: ☐ Submerged ☐ Surface ☐ Unknown

If Surface pump, where is it located? ☐ Above the Well Head ☐ In a separate pump house ☐ In an underground vault

Is there any flooding in the area of the well head or does the well head appear to be submerged? ☐ Yes ☐ No

If yes, explain:__ _____

Does the well head appear to be leaking heavily? ☐ Yes ☐ No If yes, explain:_____

Has the exposed well casing shifted or moved? ☐ Yes ☐ No If yes, explain:_____

Can you hear water running down the well casing? ☐ Yes ☐ No

Pipe Diameter (in): _____ **IN / MM** Pipe Diameter (out): _____ **IN / MM** Pump Wattage: _____ **WATTS**

Pump Amperage: _____ **AMPS** Capacity: _____ **GALLONS/SEC / LITERS/SEC**

Is the pump leaking steadily? ☐ Yes ☐ No If yes, what is leaking out? ☐ Water ☐ Lubricant

Does pump generate excessive noise? ☐ Yes ☐ No If yes, explain: _____

Does pump show signs of heavy corrosion? ☐ Yes ☐ No If yes, explain: _____

Pipe Information: Size in diameter(IN): _____ **IN / MM** Material Type : _____

Size in diameter(OUT): _____ **IN / MM** Material Type _____

Are pipes damaged: ☐ Yes ☐ No If so, explain: _____

Are pipes leaking steadily: ☐ Yes ☐ No If so, explain: _____

Do pipes have heavy corrosion: ☐ Yes ☐ No If so, explain: _____

Direction of flow to/from the station? ☐ To (Direction: _____) ☐ From (Direction: _____)

Photograph Estimate Map Detail Measure Sketch

Form#: PW021 POTABLE WATER – PRODUCTION FACILITIES -TREATMENT

Identify this plant: _____ (GPS)_____Approx area serviced: _____

Population serviced: _____Capacity of plant: _____ **MGD** / **MLD**

Are there known problems or issues at this site? If yes, give details : _____

_____

Does the plant appear to be operating? ☐ Yes ☐ No ☐ Unk If not, is there power at the site? ☐ Yes ☐ No

Check breaker and switches for pumps and other equipment. Note any damage and available information on the capacity of the breaker box feeds and breakers_____

Which types of equipment are in use at the plant? (Identify them on your plant diagram.)

☐ **Raw Water Storage** How many? _____ Where is water stored? ☐ Tank ☐ Reservoir ☐ other _____

☐ **Pre-Filtration Units** How many? _____

☐ **Rapid Mixer** How many? _____ Is it working? ☐ Yes ☐ No ☐ Unknown

What chemicals are being added? _____

☐ **Flocculators** How many? _____ Inspect agitators, paddle wheels and impellers.

Note problems: _____ 

☐ **Clarification Basins** How many? _____ Inspect agitators, paddle wheels and impellers.

Note problems: _____ 

Is sludge being siphoned off of the basin? ☐ Yes ☐ No Where is sludge being discharged to? _____ How is sludge treated or disposed? _____ 

☐ **Sedimentation Basins** How many? _____

☐ **Filters** How many? _____ Is there flow through it? ☐ Yes ☐ No ☐ **UNK** filter capacity: _____

☐ **Tanks** How many? _____ Do tanks show cracks or distresses? ☐ Yes ☐ No

Note any leakage, wetness, puddles, flow, unexpected water levels: _____ 

☐ Pumps How many? _____

Information for Pump#_____ of _____Description: _____Location: _____

Power source for pump: ☐ electrical service ☐ combustion motor

Does the pump operate? ☐ Yes ☐ No ☐ **UNKNOWN** Is there a backup pump? ☐ Yes ☐ No

If **NO** or **UNKNOWN CHECK:** Is the power switch on? ☐ Yes ☐ No Is the safety switch on? ☐ Yes ☐ No

Check breakers and switches for pumps and other equipment. Record any relevant information on capacity of breaker box feeds:_____

Pipe Diameter (in): _____ **IN** / **MM** Pipe Diameter (out): _____ **IN** / **MM** Pump Wattage: _____ **WATTS**

Pump Amperage: _____ **AMPS** Capacity: _____ **GALLONS/SEC / LITERS/SEC**

Is the pump leaking steadily? ☐ Yes ☐ No If yes, what is leaking out? ☐ Water ☐ Lubricant

Does pump generate excessive noise? ☐ Yes ☐ No If yes, explain: _____ 

Does pump show signs of heavy corrosion? ☐ Yes ☐ No If yes, explain: _____ 

Pipe Information: Size in diameter(IN): _____  **IN / MM** Material Type : _____ 

Size in diameter(OUT): _____  **IN / MM** Material Type : _____ 

Are pipes damaged: ☐ Yes ☐ No If so, explain: _____ 

Are pipes leaking steadily: ☐ Yes ☐ No If so, explain: _____ 

Do pipes have heavy corrosion: ☐ Yes ☐ No If so, explain: _____ 

Direction of flow to/from the station? ☐ To (Direction: _____) ☐ From (Direction: _____) 

Form#: PW031 POTABLE WATER - STORAGE FACILITIES

Tank #_____ of _____Location of tank: _____ (GPS)_____

Type of tank: ☐ Elevated ☐ At Grade ☐ Below Ground ☐ other (specify): _____

Shape of tank: ☐ Round or Cylindrical Height: _____ Diameter: _____ Circle unit of measure: **FT** / **M**

☐ Rectangular Height: _____ Width: _____ Length: _____ **FT** / **M**

☐ Other Shape Specify: _____Height: _____ Width: _____Length: _____**FT** / **M**

Is the tank: ☐ Open to Air ☐ Sealed/Closed to Air. What is the capacity? _____ **GALLON** / **LITER**

Material is the tank constructed: ☐ Concrete ☐ Steel ☐ Wood ☐ other (specify): _____

Does the tank show signs of: ☐ Steady Leakage ☐ Heavy Corrosion ☐ Distress in outer finish or coating

☐ Other (specify): _____

Pump Information: Are there pumps located on this tank? ☐ Yes ☐ No

Information for Pump#_____ of _____Description: _____Location: _____

Power source for pump: ☐ electrical service ☐ combustion motor

Does the pump operate? ☐ Yes ☐ No ☐ **UNKNOWN** Is there a backup pump? ☐ Yes ☐ No

If **NO** or **UNKNOWN CHECK:** Is the power switch on? ☐ Yes ☐ No Is the safety switch on? ☐ Yes ☐ No

Check breakers and switches for pumps and other equipment. Record any relevant information on capacity of breaker box feeds:_____

Pipe Diameter (in): _____ **IN** / **MM** Pipe Diameter (out): _____ **IN** / **MM** Pump Wattage: _____ **WATTS**

Pump Amperage: _____ **AMPS** Capacity: _____ **GALLONS/SEC / LITERS/SEC**

Is the pump leaking steadily? ☐ Yes ☐ No If yes, what is leaking out? ☐ Water ☐ Lubricant

Does pump generate excessive noise? ☐ Yes ☐ No If yes, explain: _____

Does pump show signs of heavy corrosion? ☐ Yes ☐ No If yes, explain: _____

Pipe Information: Size in diameter(IN): _____ **IN / MM** Material Type : _____

Size in diameter(OUT): _____ **IN / MM** Material Type : _____

Are pipes damaged: ☐ Yes ☐ No If so, explain: _____

Are pipes leaking steadily: ☐ Yes ☐ No If so, explain: _____

Do pipes have heavy corrosion: ☐ Yes ☐ No If so, explain: _____

Direction of flow to/from the station? ☐ To (Direction: _____) ☐ From (Direction: _____)

For Elevated Tanks, additional: What is the elevation of the tank? _____ **FT** / **M**

Where is the pump housed? ☐ In a separate pump house ☐ Within the lower base

Observe any access doors or inspection ports to the lift and supply pipes. Do they show signs of leakage or distress?

☐ Yes ☐ No If yes, explain: _____

Do legs and supports show signs of damage or distress? ☐ Yes ☐ No If yes, explain: _____

Any cross braces: ☐ Missing ☐ Damaged ☐ Broken If yes to any, explain: _____

Any base supports sinking? ☐ Yes ☐ No If yes, explain: _____

Note any damage or distress to ladders, railings and cat walks: _____

Photograph Estimate Map Detail Measure Sketch

Form#: **PW040 POTABLE WATER - DISTRIBUTION SYSTEM**

- Locate major elements on map. Sketch layout. This may be based solely on location of fire hydrants and pump stations. However, at the minimum note the location of possible problem areas and unique or unusual components
- Estimate the locations of transmission, and distribution mains on map.
- If possible, identify the type of the distribution system: ☐ Grid System ☐ Branch System ☐ Dead-end System
- Visually check source pipes and shut-off valves for damage, leaks or corrosions. Note severity and location of any leaks or damage: _____
_____

- What is the approximate distance between pump stations? _____ **FT** / **M**

Pump Information:

Information for Pump#_____ of _____Description: _____Location: _____

Power source for pump: ☐ electrical service ☐ combustion motor

Does the pump operate? ☐ Yes ☐ No ☐ **UNKNOWN** Is there a backup pump? ☐ Yes ☐ No

If **NO** or **UNKNOWN CHECK:** Is the power switch on? ☐ Yes ☐ No Is the safety switch on? ☐ Yes ☐ No

Check breakers and switches for pumps and other equipment. Record any relevant information on capacity of breaker box feeds:_____

Pipe Diameter (in): _____ **IN** / **MM** Pipe Diameter (out): _____ **IN** / **MM** Pump Wattage: _____ **WATTS**

Pump Amperage: _____ **AMPS** Capacity: _____ **GALLONS/SEC / LITERS/SEC**

Is the pump leaking steadily? ☐ Yes ☐ No If yes, what is leaking out? ☐ Water ☐ Lubricant

Does pump generate excessive noise? ☐ Yes ☐ No If yes, explain: _____

Does pump show signs of heavy corrosion? ☐ Yes ☐ No If yes, explain: _____

Pipe Information: Size in diameter(IN): _____ **IN / MM** Material Type : _____

Size in diameter(OUT): _____ **IN / MM** Material Type : _____

Are pipes damaged: ☐ Yes ☐ No If so, explain: _____

Are pipes leaking steadily: ☐ Yes ☐ No If so, explain: _____

Do pipes have heavy corrosion: ☐ Yes ☐ No If so, explain: _____

Direction of flow to/from the station? ☐ To (Direction: _____) ☐ From (Direction: _____)

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POWER

Electricity systems – Information

• There are four major types of facilities: power **generation plants**, **substations**, **transmission lines**, and **distribution systems**. The system starts at the generation plant at several thousand volts. After exiting the generation plant, the electricity goes to a step-up substation that uses transformers to boost voltage and deliver through extra-high voltage transmission lines – this is done to overcome the resistance of wires over distance. These transmission lines deliver the electricity to substations in the destination region where the voltage is stepped down to a distribution voltage level. Distribution systems further reduce and deliver to the end user.

• The generation plant consists of electrical **generators**. Generators are essentially large quantities of copper wire spinning at high speeds inside large magnets: when magnets and wires are rotated close together, an electrical current is generated in that wire. Rotating **turbines** attached to generators enable this process, and turbines may be driven by using steam, water, wind or other fluids as an intermediate energy carrier. The most common usage is by steam in fossil fuel power plants or nuclear power plants, and by water in hydroelectric dams.

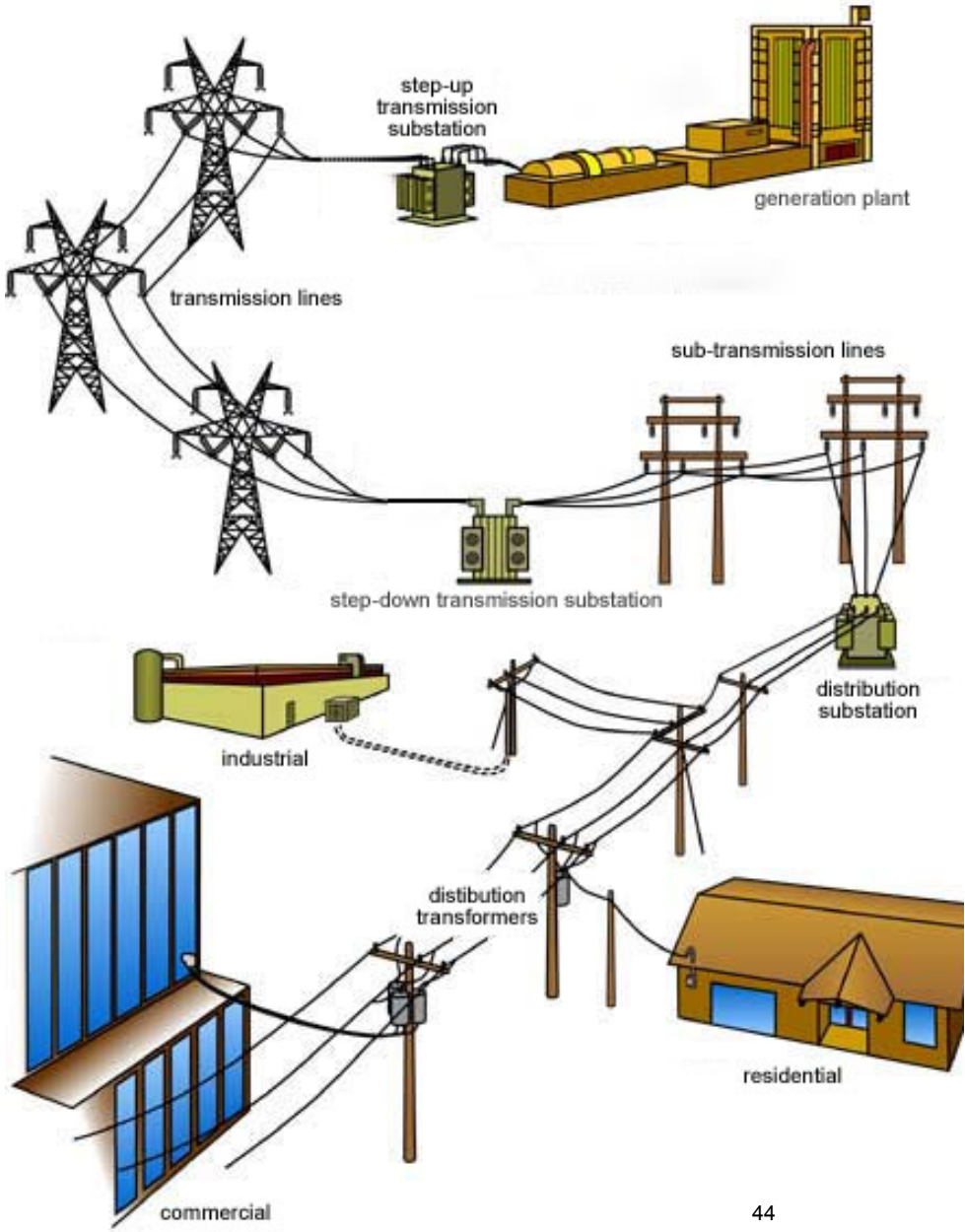
• Substations can do one or a combination of the following things: change voltage from one level to another, regulate voltage drops as the power travels through the lines, measure power qualities, provide protection from lightning and other surges, connect generation plants to the system, make interconnections between the systems of more than one generation plant, or provide automatic disconnection of **circuits** experiencing faults. A substation can also have breakers for emergencies requiring shut-down or redirection.

All substations are primarily composed of **transformers**. A transformer consists of two primary components: a **core** made of magnetically permeable material, and a **conductor** made of a low resistance material such as copper or aluminum. The conductor is wound around the core at differing ratios, transforming current from one voltage to another. This process requires a liquid insulation material (or air for smaller transformers) to cool and insulate.

There are three major types of substations: the **step-up transmission substation**, the **step-down transmission substation**, and the **distribution substation**. A step-up transmission substation receives power from a nearby power generation plant and uses a large power transformer to increase the voltage for transmission to distant locations. Most likely, a **transmission bus** is used to distribute power to one or more transmission lines within a step-up transmission substation.

A step-down transmission substation is located at **switching points** in an grid. They connect different parts of a grid and are a source for distribution substations. Sometimes, power is tapped for use in an industrial facility along the way. Otherwise, the power goes straight to a distribution substation.

Electricity system diagram



Step-down transmission substation

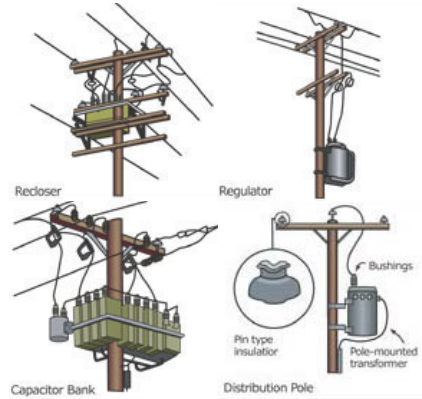
Distribution substation

A distribution substation makes power useful in a homes or businesses. This may happen in several phases, but it is typified with transformers that convert to domestic voltages. Distribution substations incorporate a **distribution bus** that splits the power off in multiple directions with breakers and switches, so that problems can be localized.

• There are three types of transmission lines. **Overhead transmission lines** are primary lines (trans-regional) that carry current from 69kV to 765kV for distances up to 300 miles. **Overhead sub-transmission lines** are secondary lines (regional) that carry 34.5kV to 69kV. **Underground transmission lines** are more common in populated areas where they are buried bare, placed in conduit, trenches, or tunnels. All transmission lines are based on either **alternating** (three phase/three wire) or **direct** (two phase/two wire) currents, with alternating being far more common due to its easy conversion from generation to high voltage.

Industrial substation

Distribution poles and mounted hardware



A distribution system originates at a distribution substation, where a number of circuits emanate in various directions. The most common ways to distribute electricity are the **radial system**, where each circuit is terminated at the farthest customer, and the **looped system**, where each circuit goes out and returns to the same substation. Radial systems are used more often because they are easier to protect and electricity flow is in one direction on the line. Also, radial lines can be interconnected, which allows for temporary service if needed.

Along the distribution line, connections are made to service individual customers. A **distribution transformer** is needed to step down the voltage from distribution level to the customer's required voltage. In addition to **customer service connections** and **pole mounted transformers**, there are several other pieces of equipment which may be encountered along a distribution line, especially lines extending significant miles from the distribution substation. Some of the components include automatic **reclosers**, **voltage regulators**, and **capacitors**.

Customers along the distribution line can be classified as **industrial**, **commercial**, or **residential**. Industrial customers typically need their own substation to reduce the voltage from the transmission line. Commercial customers are usually served at distribution voltages through a **service drop line**, which leads from a transformer on or near the distribution pole to the customer's end use structure. For the residential customer, the distribution electricity is reduced to the end use voltage via a pole mounted or pad-mounted transformer. Power is delivered to the residential customer through a service drop line, which leads from the distribution pole transformer to the structure. For a pole-mounted system, which is most common, a typical configuration consists of a transformer, guy wire, and ground. The two from the transformer are insulated, and the third one is bare. The bare wire is the ground wire.

Electricity systems – Measurements and emergency situations

• Short of a completely destroyed generation plant, the worst-case scenario would be that transformers or switchgear are battle damaged along the electrical pathway. In theater, this could mean that the grid is out of commission until BOM is manufactured 3 to 6 months.

• Most likely, when a grid is failing, the circuit breakers are tripped or overhead lines are down (or underground lines cut). All down or cut lines will correct themselves in one of two ways: if the line comes in contact with objects, it will hold current until that circuit is opened by the breaker, or it will continue to draw current until it fries the sub-station.

• Overhead lines that are hanging low, but do not make contact with any object, need to be avoided with as much space as possible! Underground lines with the insulation cut away and wiring exposed must also be avoided, but can be safely buried (or bermed) and marked.

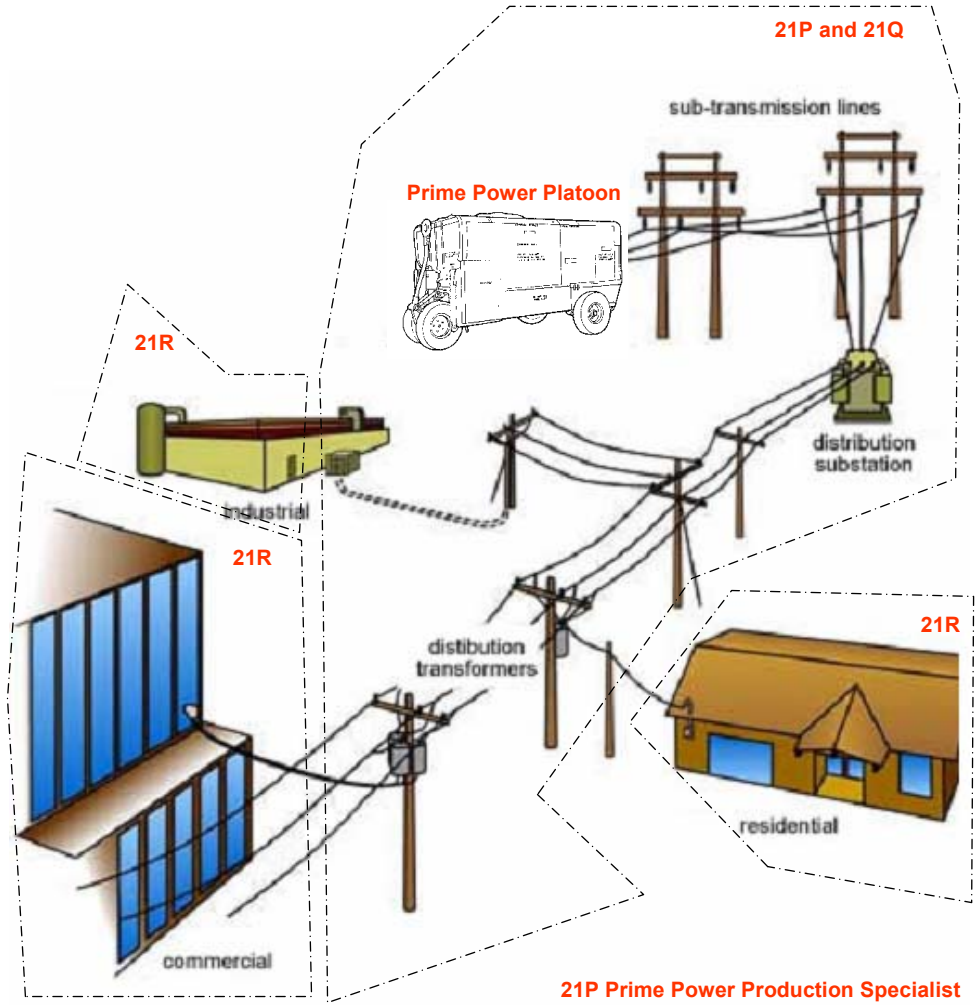
• The true danger is the distribution line, as these voltages can be in single conductors and become exposed easily. They will stay energized until contacted. In this situation, only tripping breakers on interior boxes will help the situation.

• Electrical systems are extremely dangerous to the layman, so it is advised that no untrained personnel attempt any repair or hasty solution. The army has the 249th Engineer Battalion (Prime Power) for this.

• Prime Power units provide continuity between tactical generators and commercial sources. They provide technical assistance and staff planning to support development of electrical solutions for the full range of military operations. Not only does the Prime Power soldier determine required electrical supplies and translate technical requirements to contracting strategies, but they also handle generation. This generation acts as a stopgap when transmission lines or local plants are inoperable. When existing civilian generation plants are repaired, Prime Power personnel can support and supervise day to day operations, if need be.

• There are three critical army personnel to consider when assessing. First, the 21P is the production specialist, who actually works the generators. Second, the is the 21Q, who fixes the sub transmission and distribution lines. Finally, the 21R (who belongs to a construction battalion, and not Prime Power) repairs any consumer-level damage inside the structure. Recognize that the army competency plugs into the equivalent of a step-down transmission substation. Any electrical failure that occurs in larger capacity, closer to the generation plant, requires contracting.

• The Prime Power platoon (the unit of employment) consists of eighteen personnel that comprise two sections. Prime Power elements need security and lighting (light sets) and will occupy at least a thousand square feet, which must be flat and stable for their equipment. When in operation, Prime Power platoons will use 5400 gallons of JP8 a day.



21P Prime Power Production Specialist
21Q Power Lineman
21R Interior Electrician

Form#: EPS010 ELECTRICAL POWER SYSTEMS – POWER PLANT

Identify this plant:_____#____of____ GPS_____Type of power production:_____
Number of Generator Units: _____ Capacity of plant (MW or MVA): _____
Number of overhead circuits (lines) leaving power plant:_____Overall Plant Appearance (Age)_____
Describe overall conditions of plant (age, maintenance, appearance, etc.):

_____

Generator Nameplate & Info

1. Mfg/Brand/Model _____#____of___ Capacity (kW/kVA)_____ Output voltage:_____
   Other Nameplate Info_____
   Generator Age:_____ Prime Mover: (circle) - engine, gas turbine, steam turbine, other_____
   Fuel: (circle) – Diesel, Natural Gas, Steam from coal boiler, Steam from nuclear, other_____
2. Mfg/Brand/Model _____#____of___ Capacity (kW/kVA)_____ Output voltage:_____
   Other Nameplate Info_____
   Generator Age:_____ Prime Mover: (circle) - engine, gas turbine, steam turbine, other_____
   Fuel: (circle) – Diesel, Natural Gas, Steam from coal boiler, Steam from nuclear, other_____
3. Mfg/Brand/Model _____#____of___ Capacity (kW/kVA)_____ Output voltage:_____
   Other Nameplate Info_____
   Generator Age:_____ Prime Mover: (circle) - engine, gas turbine, steam turbine, other_____
   Fuel: (circle) – Diesel, Natural Gas, Steam from coal boiler, Steam from nuclear, other_____
4. Mfg/Brand/Model _____#____of___ Capacity (kW/kVA)_____ Output voltage:_____
   Other Nameplate Info_____
   Generator Age:_____ Prime Mover: (circle) - engine, gas turbine, steam turbine, other_____
   Fuel: (circle) – Diesel, Natural Gas, Steam from coal boiler, Steam from nuclear, other_____

Non -Generator Equipment

1. Equipment Type_____ Description:_____
Condition: _____
2. Equipment Type_____ Description:_____
Condition: _____

Questions for Power Plant Operator/Engineer

1. Is plant able to output rated capacity?_____
2. Are all generators functional? If not, explain._____
3. What is typical kW load of plant peak ? _____ off-peak?_____
4. Controls: Automated synchronization? _____Remotely controlled?_____
5. Major causes for downtime?_____

Photograph Estimate Map Detail Measure Sketch

Form#: EPS011 ELECTRICAL POWER SYSTEMS – SUBSTATIONS

Transmission/Distribution Substations: number:_____
Identify this substation: _____#____of_____GPS _____
Transformer Capacity (MVA) _____ Incoming Lines (qty)_____ Voltage In (kV): _____
Outgoing Lines (qty)_____ Voltage Out (kV):_____
Substation Type: ❑ step up transmission station ❑ step down transmission station ❑ sistribution substation

Structures: Note the overall stability of the structures: (Any loose bolts, discoloration from fire or chemicals, bending, etc.)_____

Transformers: Number of transformers:_____#____of ____
Name plate information:_____Describe any damage to the transformers: (oil leaking, fire damage,etc) _____

Transmission / Distribution Towers and lines: Number of total circuits:_____

Define your starting location: #___of ____ Point A:_____ GPS _____
your ending location: Point B:_____ GPS_____ number of poles_____ distance_____ mile/km

Structure Type: ❑ transmission ❑ sub transmission Structure Height:_____
Structure Material: _____ If wood, describe condition: (Note any deterioration, leaning, etc.)
_____

Is there any damage to the towers and lines at the points defined? ❑ Yes ❑ No If yes, describe (look for structural stability, discoloration, obstructions or downed lines, damaged transformers and components, etc.)
_____

Sketch Layout: (show transmission lines connecting substations, indicate voltage levels, indicate qty. of circuits going out of distribution substations)

TRASH

Trash Management

EPA530-R-95-023 *Decision Maker's Guide to Solid Waste Management – Volume II* provides guidance on building trash management from scratch.

• There are two steps to trash management: **collection** and **disposal**. Collection is the physical collection of trash from the source, and its transportation to the disposal facility. Disposal is the act of reducing trash's risk to the environment through **burning**, **composting**, **incinerating**, or **landfill**. The obstacle to this relatively simple process is **hazardous material**, which cannot be handled in the same manner as other trash.

• The metric for collection is straightforward because it is most common breakdown, and it is identifiable by the trash piles being in places where they should not be. While the standard of trash management in the United States seems unreasonably high, in comparison to some locations, it provides a good measure of acceptable levels of trash in "the streets". Unfortunately, collection can be interrupted very easily by taking away or damaging the collecting vehicles, but most likely it is the operators who are failing in their duties, for.

Collection Failure

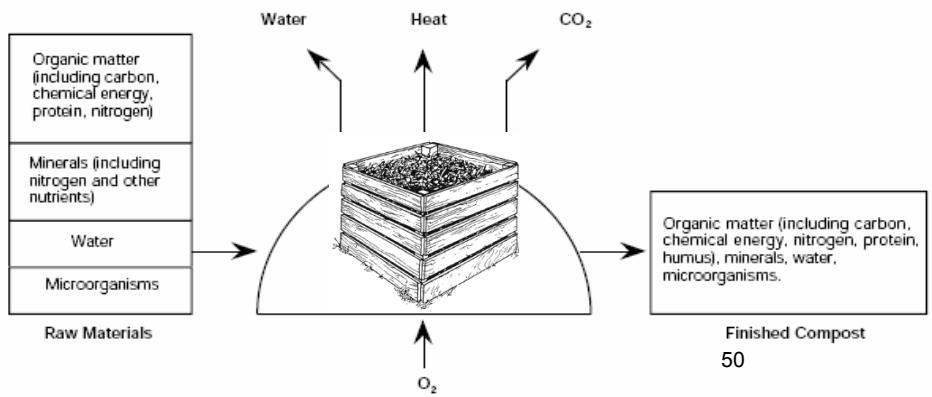
• Upon arrival to a site with collection failure, all available transportation must be inventoried and allocated, but new equipment should not be requisitioned until volume is determined. Usually a contract with locals is arranged, but if not, a unit can expect to use its earthmoving equipment to facilitate trash collection. Key in this area is hygiene, as operators should be prepared to button up if possible, or at least wear some sort of breathing mask. Both the equipment and the personnel must be washed thoroughly after dealing with any trash collection. Collection is limited only to the director's imagination. Contractors can use horse-drawn vehicles if enough motor vehicles are not available. Collection day can become a community event with vehicle tools.

• Until collection is working again, householders must burn or compost their own refuse. No matter the method, locals must be educated on the separation of trash for handling, or at least what it *should* look like. Glass should be crushed and used in applications that involve sand. Metal should be collected and turned over to a scrap metal dealer. Rubber can be incorporated with erosion control. Plastics should be *buried* in a designated collection pit and *never* burned. Paper, wood, cloth and other organic materials should be composted.

• Most will elect to burn their trash due to its perceived ease, but *burning trash should be a last resort*! The smoke from burning trash is more than just an irritating nuisance. It also contains many harmful pollutants that can cause immediate and long-term damage to the lungs, nervous system, kidneys, or liver. Some of the most toxic chemicals produced by open burning of household waste are **dioxins**. Dioxins are a group of long-lasting organic compounds that form when products containing carbon and small amounts of chlorine are burned. Dioxins are toxic at extremely low levels and are linked to several health problems, including cancer, developmental problems, and reproductive disorders. Dioxins have a nasty habit of accumulating in the food chain. These dioxins accumulate in the fats of animals, and then in humans when we consume meat, fish, and dairy products. Ash from dioxins is likely to contain toxic pollutants, which can contaminate vegetables if scattered in gardens.

• Composting is a natural way to deal with organic trash that involves weed seed and time. Organic material breaks down into its elemental solids, carbon dioxide, and heat. **Windrows** (piles), no more than one meter, are left to decay until they stop producing heat, then flipped or stirred. At that point, the composts are dark in color, peat-like, have a crumbly texture, an earthy odor, and resemble rich topsoil. The final product has no resemblance in physical form to the original waste from which the compost was made. It is important to view compost as usable, *not* as waste requiring disposal. When developing and promoting a composting program and when marketing the resulting compost, directors should stress that the composting process is an environmentally sound and beneficial means of recycling organic materials, *not* a means of disposal.

Composting



The carbon, chemical energy, protein, and water in the finished compost is less than that in the raw materials. The finished compost has more humus. The volume of the finished compost is 50% or less of the volume of raw material.

Trash Management

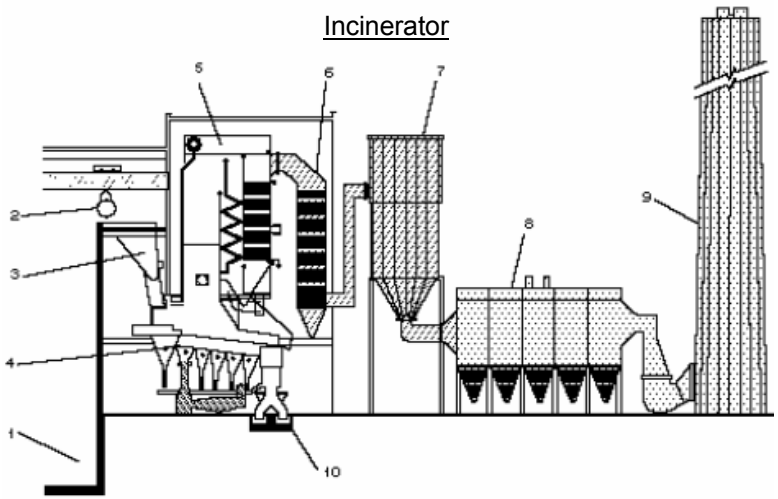
• An incinerator's defining equipment is the **combustor**. Combustors make carbon, hydrogen, and other elements in the waste combine with oxygen in combustion air, a controlled burn that sets specific conditions between1,800° F to 2,000° F. This temperature is selected to ensure good combustion, complete elimination of odors, and protection of the facility itself. A minimum of 1,500° F is required to eliminate odor. Combustors turn waste into exhaust (sometimes referred to as flue gas) and ash, usually through in-line furnaces with a grate system.

• Some incinerators generate steam that can be harnessed for applications like producing electricity or processing steam for heating. If this is the case (there are some incinerators lack the equipment to channel steam), then the **steam generator** generally consists of water/wall systems, in which tubes absorb the heat from combustion and then exploit it.

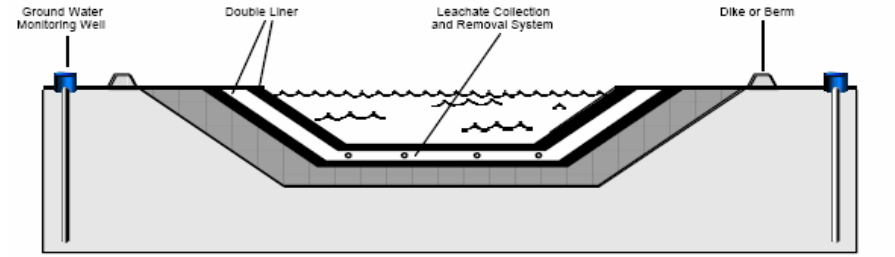
• Flue gas is harmless after the acid gas portion is eliminated. This process is called **scrubbing** and is usually accomplished by incorporating lime slurry (lime and water). The leftover material from scrubbing can be recovered either as a dry powder residue or as a liquid, but is a hazardous material.

• Ash is captured using fabric filters inside of baghouses, which are used for **particulate collection**. A series of tubular fabric filter bags are set together in an array through which particulates are directed then trapped. The collected particulates are removed from the bag by various mechanical methods, including reversing the exhaust flow or by physically shaking them out periodically.

Incinerator



• Landfills and **surface impoundments** for trash are very similar in that both units are a natural topographic depression, manmade excavation, or dike. A landfill is simply a surface impoundment that is covered; the remaining criteria are simple enough. The most important feature is a **double liner system**, which consists of a top liner to prevent migration of waste, and a composite bottom liner consisting of a synthetic geomembrane with three feet of compacted soil. Functional landfills can be very simple to infinitely complex, but the most important factor is preventing contamination of groundwater.



Hazardous Materials

• Hazardous wastes come in many shapes and forms. They can be liquids, solids, contained gases, or sludge. They can be the byproducts of manufacturing processes or simply discarded commercial products, like cleaning fluids or pesticides. Whatever their form, proper management and disposal are essential to protect human health and the environment.

• **Treatment facilities** use various processes to alter the character or composition of a hazardous waste. Some treatment processes enable waste to be recovered and reused in manufacturing settings, while other treatment processes reduce the volume or hazard of waste to facilitate further storage or disposal. **Storage facilities** hold hazardous waste temporarily until it is treated or disposed of. Treatment and storage activities take place in various units such as tanks, incinerators, and containment areas.

• A waste is hazardous if it exhibits one or more of these characteristics:

Ignitability. Ignitable wastes can create fires under certain conditions or are spontaneously combustible. Examples include waste oils and used solvents.

Corrosively. Corrosive wastes are acids or bases that are capable of corroding metal, such as storage tanks, containers, drums, and barrels. Battery acid is a good example.

Reactivity. Reactive wastes are unstable under "normal" conditions. They can cause explosions; toxic fumes, gases, or vapors when mixed with water. Examples include lithium-sulfur batteries and explosives.

Toxicity. Toxic wastes are harmful or fatal when ingested or absorbed. When toxic wastes are disposed of on land, contaminated liquid may drain (leach) from the waste and pollute ground water. Certain chemical wastes and heavy metals are examples of potential toxic wastes.

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PAGE

BUILDINGS/ HOUSING

Building Inspection (Target ID #_____)

Inspector ID_____ Inspection date/time _____
List information on building's name and address and additional location information (including GPS). Note accessibility by

Roads: _____ Locate major

_____ elements on local map

These forms should be filled out as completely as possible by the inspector(s). Do not leave blank spaces; use "UNK" for "Unknown", "NA" for "Not Applicable", or "None" when appropriate. Talk with the owner to obtain as much information as possible. Assure him/her that detailed name and address information will not be released to the public. Photos should be taken of each exterior building elevation, and of any locations where significant damage is visible.

General Information

Approximate footprint (estimate dimensions and attach sketch): _____

# of stories: _____ Stories above ground _____ Stories below ground_____

Year of construction or approximate age: _____

Is the building occupied? ☐ Yes ☐ No _____

Does the building appear habitable? ☐ Yes ☐ No

Are building administrators available? ☐ Yes ☐ No Names/ Position _____

_____

Type of occupancy: ☐ Residential ☐ School ☐ Hospital ☐ Police ☐ Fire ☐ Medical

☐ Other public _____

No. of Units / Beds / Classrooms _____

Is this building historic? ☐ Yes ☐ No

Describe Building Contents:

_____

_____

_____

Security - Has the building been vandalized? ☐ Yes ☐ No

Does the building have armed conflict damage ☐ Yes ☐ No

Can the building be locked and secured? ☐ Yes ☐ No

Are there personnel guarding the building? ☐ Yes ☐ No

Describe existing setbacks from roads and any barricades or how that might be accomplished: _____

_____

_____

Building Damage

Note any apparent hazards from loose materials and other overhead dangers _____

_____

Describe observed structural damage to building. Indicate where damage is to local members, an area, or throughout. Types of damage common to many materials: Missing, failed, & bent members; Missing & failed connectors; Settlement;

_____

_____

_____

Photograph Estimate Map Detail Measure Sketch

Damage common to steel: Distortion; Cracks; Corrosion
Damage common to wood: Rot; Insect damage; Checking; Crushing;
Damage common to concrete and masonry: Cracking; Differential movement; Crushing;

_____
_____
_____

Exterior

Wall Assembly Type: ☐ Stacked Unit ☐ Monolithic ☐ Framed ☐ Curtain Grid ☐ Curtain Panel ☐ Other
Describe the observed damage to the wall. Be sure to specify quantity (SF area) of damage. If damage is a potential safety hazard, indicate and explain why.  _____
_____
_____
_____

What is the predominate roofing surface:: ☐ Asphalt Shingle; ☐ Wood Shingle; ☐ Slate Shingle; ☐ Metal Shingle; ☐ Clay/Concrete Tile; ☐ Standing Seam Metal; ☐ Nailed Metal Sheet; ☐ Pre-formed Panels; ☐ Thatched Roofs.
While walking through the interior space, denote locations of water leakage from above. Describe location and nature of any roof leaks:_____
_____
_____

Electrical

Transformers – Note any obvious damage such as rust, heavy blackness, leaking oil, etc. Also note any excessive humming, although some humming should be heard._____

_____

Main Breaker – Note any damage. _____ 

Backup Generator Yes ☐ No ☐, Document the type of generator (e.g. diesel) and the size (in kW). Note damage.
_____ 

Lighting – Note the adequacy of the lighting. Note if the lights dim when other electrical equipment starts up (may need to ask a building operator):_____

Switchgear – Describe overall condition. Note and document any physical differences in the fuses (e.g. obvious blown wires, blackness). _____
_____

Panel Boards – CIRCUIT BREAKERS AND FUSES: Document any physical differences (e.g. obvious blown wires, blackness). _____
_____
_____

Receptacles – Describe the availability of the receptacles (extension cords necessary, receptacles overloaded). Note the availability of receptacles that accept three-prong plugs. Create a drawing with locations noted if necessary.
_____

Plumbing

According to locals is the water drinkable? ☐ Yes ☐ No
Does the water exhibit an unusual taste, color or odor? ☐ Yes ☐ No
If yes, give details:_____

- Does the water pressure ever drop? ☐ Yes ☐ No If yes, how often? ☐ Regularly ☐ Sporadically ☐ Rarely
- Does the water temperature fluctuate? ☐ Yes ☐ No If yes, how often? ☐ Regularly ☐ Sporadically ☐ Rarely

Give Details: _____
_____

- Are there any known issues with the plumbing pipes or fixtures in the building? ☐ Yes ☐ No if yes, explain
_____

Hot Water Supply: ☐ Boiler ☐ Water heater ☐ None ☐ Other (specify): _____
Is there a fire suppression system? ☐ No ☐ Yes, _____ % of Building Protected: _____

Note any distresses in pipes such as broken pipes, leaks, corrosion, damages insulation etc.

_____

_____

_____

HVAC

Cooling System Type: ❑ Central Plant ❑ Central Air Conditioner ❑ Room Air Conditioners ❑ Chiller ❑ Heat Pump ❑ Evaporative Cooling ❑ Thermal Storage ❑ Other (specify): _____

Heating System Type: ❑ Central Plant ❑ Boiler ❑ Electric Resistance Heat ❑ Forced Air Furnace ❑ Heat Pump ❑ Passive Solar ❑ Radiant ❑ Other (specify): _____

Heat source location ❑ Central ❑ Distributed to local units

If central plant, identify plant location or ID number: _____

Fuel Type(s): ❑ Coal ❑ Natural Gas ❑ Fuel Oil ❑ Crude Oil ❑ Wood ❑ Electric ❑ Propane ❑ Other (specify): _____

Fuel Storage: ❑ No ❑ Yes Capacity: _____ Location: _____

If possible, provide fuel specifications, i.e. grade, heating value, delivery means, etc.) : _____

_____

Communications

What type of communications system does the building have. Radio, phone, internet, etc:_____

_____

_____

Other

Are there any critical issues with the building that must be addressed immediately: _____

_____

_____

Does the building owner/ operator seem trustworthy? ❑ Yes ❑ No if no, explain: _____

_____

List any additional comments or impressions not otherwise noted above:

Sketch overall facility to include buildings, barriers, and utility locations. If building is multiple stories then a sketch of each should be included. Rooms and areas should be numbered and following table completed. Use following table to identify contents, dimensions, and damage. Sketch should include approximate dimensions: 

Room/ Area #	Dimensions	Description	Contents	Damage

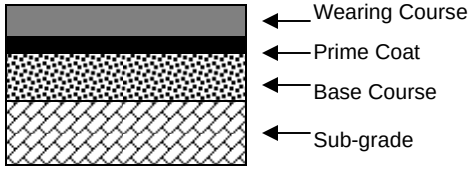
Photograph Estimate Map Detail Measure Sketch

ROADS

Transportation-Roadways and Parking Lots

Overview Roadways- Surfaced roadways are primarily constructed of asphalt, concrete, stone, or brick. Improved roads are surfaced with a hard material that has better load-bearing characteristics and provides superior all-weather performance. Unsurfaced roads are primarily constructed of stabilized earth or gravel. Unimproved roads are either earth or gravel and are less expensive to build and maintain, but create more problems in weather extremes.

Roadway construction consists of preparing 3 primary layers of material. The first, or bottom-most, layer is called the **sub-grade**. The middle layer is the **base course**. The base course is typically constructed from aggregate or asphalt. In some cases, a **prime coat** (also called tack coat), may be sprayed between the top two layers to ensure good adhesion between the surface course and the base course. The topmost layer is called the surface, or **wearing course**.



Required Roadway Data:
- Surface Type
- Surface Thickness- materials of each layer
- Route Width
- Route Type
- Overhead clearance
- Route Length- annotate landmarks

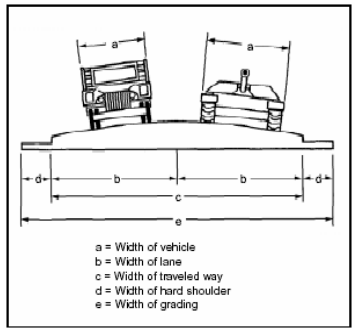


Figure 3 - Route widths (FM 5-170)

The **route width** is the narrowest width of traveled way on a route. This narrow width may be the width of a bridge, a tunnel, a road, an underpass, or other constriction. Lane width normally required for wheeled vehicles is 3.5 meters; for tracked vehicles it is 4.0 meters.

Route Classification by number of lanes:
- Single lane—Permits use in only one direction at any one time. Passing or movement in the opposite direction is impossible.
  - oSingle flow—Permits the passage of a column of vehicles and allows isolated vehicles to pass or travel in the opposite direction at predetermined points. It is preferable that such a route be at least 1.5 lanes wide.
  - oDouble flow—Permits two columns of vehicles to proceed simultaneously. Such a route must be at least two lanes wide.

Roadway Route Type-

Type X	All Weather	Waterproof surfaces	No weather closures	
Type Y	Passable all the year w/ maintenance	No Waterproof surfaces	Weather closures of up to one day	Heavy use and weather could cause road failure
Type Z	Passable in fair weather	No Waterproof surfaces	Long closures due to weather	Improvement only through construction

Surface Types:
Asphalt Concrete (A/C) – Commonly referred to as asphalt, these pavements are constructed from asphalt bitumen and aggregate. They are typically black or dark gray in color.
Portland cement Concrete –Constructed from. Portland cement and aggregate. They are typically a light gray in color and cut with saws to form slabs.
Cobblestone or Brick –Either bricks or some type of stone that have been placed tightly together to form a hard surface.
Surface treatment (blacktop)–A mixture of oil, aggregate, or rubber chips
Stabilized Earth (dirt roads)– Can have compacted soil or clay as a base. Chemicals can be added to the surface to maintain the surface integrity and limit the creation of dust.
Compacted Gravel (aggregate) –A mix of stone, sand and fine-sized particles.

Parking Lots:

Overview- Parking lots are constructed from the same materials and with the same layers as is used for roadways. Surfaced parking lots are constructed from the same materials as surfaced roadways. Concrete is used for long-term storage because asphalt will quickly degrade from oil and fuel spillage or leaks.

Inspection:
Surface type
Dimensions
Function- The facility the parking lot serves, or the function it supports. Examples of functions include motorpools, open storage areas, wash racks, and fueling points .

Distresses:

A/C:
•**Blowups** – Joints in concrete expand to allow for changes in temperature. Pressure from debris can cause the concrete to buckle or shatter. Severe blowups can make roads unsuitable for traffic.
•**Shattered Slabs** –A concrete slab divided into pieces by cracks from overloading or a failure of the base. Slabs divided by large cracks into 6 or more pieces will deteriorate rapidly and be unable to support heavy loads.
•**Spalling** – The breakdown of the slab edges or corners within .6 m (2 feet) of the side of the slab. In severe cases, the edges or corners of concrete slabs are broken into pieces or fragmented with pieces loose or absent.


SHATTERED SLAB


BLOWUPS


SPALLING

Asphalt:
•**Slippage Cracking** – Crescent or half-moon shaped cracks. Occur in areas of aircraft turning or heavy braking when the top layer of asphalt pavement does not bond to the layers below. May cause the pavement to break up.
•**Alligator Cracking** –The most severe forms of this look like a series of interconnected cracks, similar in appearance to alligator skin. It occurs in wheel paths and areas that receive the heaviest loads.


POTHOLES


SLIPPAGE


DEPRESSION

A/C and Asphalt:
•**Depressions** – Localized areas in the pavement surface with a lower elevation than the surrounding pavement.
•**Patching** – A weakness in the pavement structure. Locates where repairs or maintenance may have been performed before.
•Potholes – Potholes are small (usually less than 30 inches in diameter) bowl-shaped depressions in the pavement surface.
•Ruts – A rut is a surface depression in the wheel path parallel to the road centerline.
Other- UXO, Craters, Foreign Object Debris


ALLIGATOR CRACKING


RUTTING


SHOVING


PATCHING

Unsurfaced:
•**Corrugation** – A series of closely spaced ripples in the runway surface at regular intervals of less than 10 feet. They run perpendicular to the direction of traffic and create a 'washboard' effect.
•**Dust** – Wear and tear of traffic on unsurfaced roads will eventually loosen the larger particles from the soil binder. As traffic passes, dust clouds are generated. The dust clouds may cause 'brown-out' conditions that severely limit visibility and the general area and severity should be noted.
•**Deformation** –This includes erosion, rutting, depressions, or manmade damage of the runway surface. Depressions are sunken portions of the road surface that can be of varying sizes and depths.


CORRUGATION


DEFORMATION / RUTS

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PAGE

AIRFIELDS

Transportation-Airfields
Overview- Airfield systems consist of a network of surfaced or unsurfaced pathways designed explicitly for the movement and/or storage of private, commercial, or military vehicles. This also includes the lighting and control structures to manage aircraft and vehicle traffic. The evaluation is broken into airfield surfaces, airfield tower control, and airfield lighting signs and marking.

It is important to establish an inventory of the airfield surface systems into three basic components: Runways Taxiways and Aprons.

Runways:
Permanent runway construction consists of preparing three or more layers of material. If any one of the three layers fails, then problems will result. Temporary, or unimproved, runway construction may consist of one or more layers. These runways may consist of a prepared soil base and aggregate, or just the aggregate layer. Matting may also be used in constructing temporary airfields.
There are two simple to label runways on a sketch. They could be labeled starting with R1, R2, etc. or labeled with the azimuth of their direction. For example, R24 indicates that it is the runway along the 240 degree azimuth. In cases where there are two parallel runways, refer to them as R24L (left) and R24R (right).

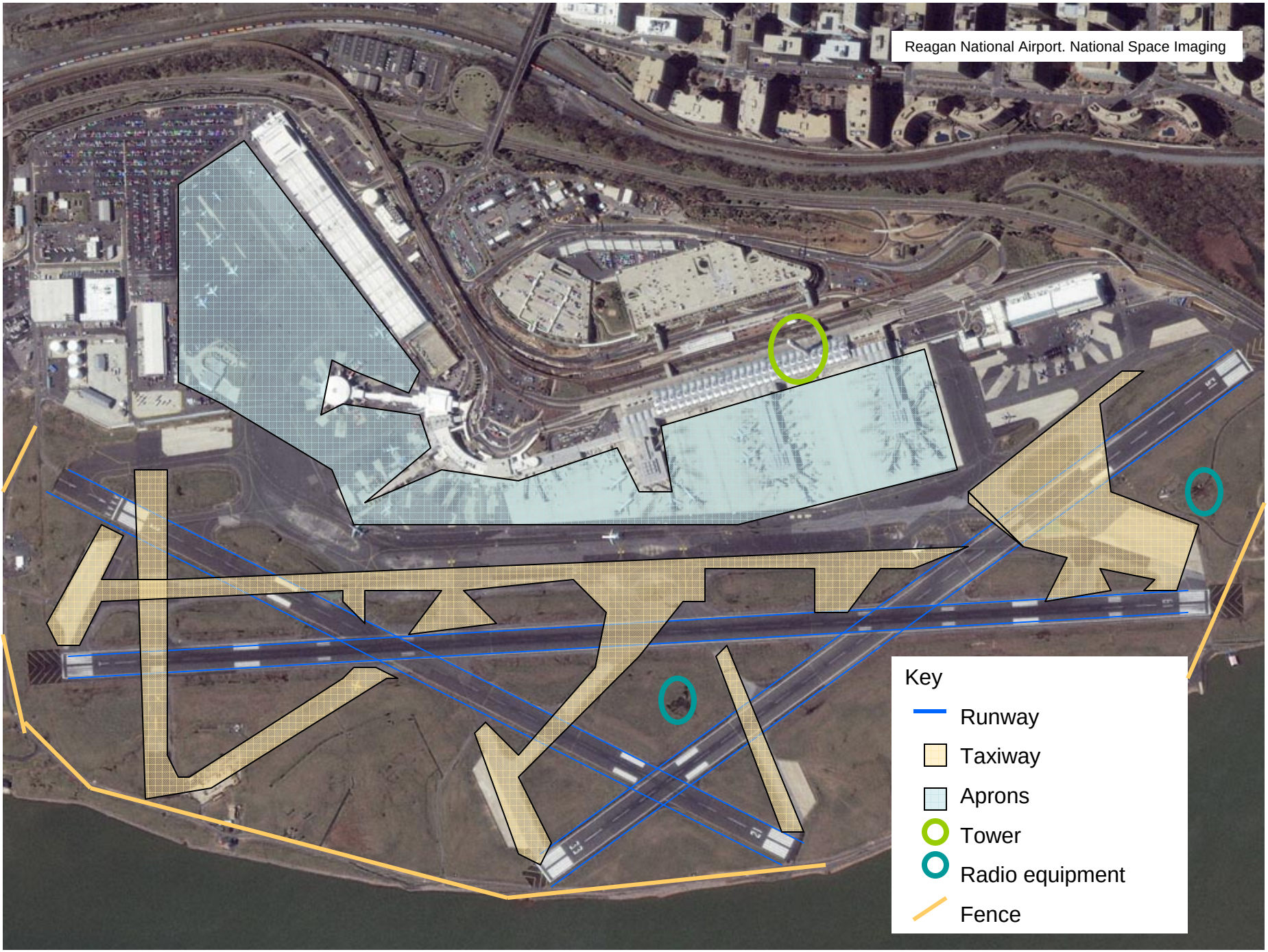
Aprons:
Aprons are prepared surfaces designed for the storage and temporary parking of aircraft. Aprons are also used as areas for refueling and arming aircraft. Aprons may also be used as areas for the takeoff/landing of rotary wing aircraft. Aprons may be labeled as A1, A2, etc.

Taxiways: Taxiways are pathways designed for aircraft to move to different parts of the airfield. Each taxiway should be inspected separately and annotated to show what other features it connects. Taxiways can be labeled as T1, T2, etc. Posted signs may refer to the taxiways in some other convention. If this convention is easily understood and the signs are all in place, then this may be used. Lastly, the taxiways could be labeled based on letters of the alphabet i.e. Taxiway Alpha (A), Taxiway Bravo (B), etc.

Surface Types:
Asphalt Concrete (A/C) – Commonly referred to as asphalt, these pavements are constructed from asphalt bitumen and aggregate. They are typically black or dark gray in color.
Portland cement Concrete –These pavements are constructed from. Portland cement and aggregate. They are typically a light gray in color and cut with saws to form slabs. They are also referred to as 'rigid' pavement.
Tactical matting –Hasty airfield construction or repair may utilize a heavy metal or composite matting to provide a landing surface for aircraft.
Stabilized Earth – Sometimes appearing simply as 'dirt' roads, these pathways can have compacted soil or clay as a base. Chemicals can be added to the surface to maintain the surface integrity and limit the creation of dust.
Compacted Gravel –A mix of stone, sand and fine-sized particles. Also called aggregate

Verify the dimensions of airfield pavements and accuracy of existing drawings. Existing information on the airfield is helpful, such as: soil boring data; geological, topographical, and agricultural maps; and aerial photographs. Check these sources:
•AFCESA/CESC, Pavements Laboratory, DSN 523-6084,
•commercial (850) 283-6084.
•AMC Global Decision Support System (GDSS) or Airfield Suitability and Restrictions Report (ASRR), HQ AMC DOVS, DSN 779-2677/3112,
•commercial (618) 229-2677/3112, https://www.afd.scott.af.mil
•Assault Zone Survey Repository, HQ AMC DOK, DSN 779-3148/3727, commercial (618) 229-3148/3727.
•DOD Flight Information Publications (FLIP), National Geospatial Intellegence Agency (NGA), DSN 693-4864, commercial 1-800-455-0899, http://www.nga..mil.
•Host nation data, if available.

Required Measurements:
•Runway width – Measure the average width of the runway over the length to be inspected. If the width changes significantly (±40%), for a distance greater than ¼ mile, then inspect as separate segments. Note areas (such as intersections, bridges, underpasses) where runway width may briefly change significantly, or other obstructions are present.
•Runway length – Measure the length of the runway segment that is being inspected. In addition, it is advisable to annotate any landmarks that would help identify the beginning and end of the runway segment being inspected. The landmarks (bridges, intersections, buildings, rivers, etc.) should be things that cannot be easily removed and have a clear location.
•Orientation – All runways are oriented along degrees of a compass direction.
•Thickness – If possible, measure or estimate the thickness of the apron surface
•Turnarounds. For C-17 LZs without parallel taxiways, turnarounds must be provided at both ends of the runway. In other cases, turnarounds may be located on overruns or taxiways, depending upon mission or terrain requirements.
•Separation Distances Between Permanent Runways/Helipads and LZ Runways for Simultaneous Operations.


Reagan National Airport. National Space Imaging
Key
Runway
Taxiway
Aprons
Tower
Radio equipment
Fence

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POTHOLES


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CORRUGATION


DEFORMATION / RUTS

Airfield Tower Control

The control tower serves as a base of operations for management of traffic on the runways and taxiways. The control tower may also include air traffic controllers who provide and monitor flight plans over a much larger geographical area. Radios and radar monitors and are located off of the observation deck. Electrical requirements, including backup generators and voltage regulators, also have more importance.

The communications equipment is arguably the most critical. There is likely to be a built-in unit providing a control panel to access the standard frequencies. This unit should have a battery backup. Communication equipment at a remote location such as the emergency service building is also needed in the case of destruction of the control tower. Navigation stations also need backup power that is often provided by a relatively large battery bank. Some equipment may have its own dedicated backup power.

Radar equipment is usually remote from the control tower with a feed to radar monitors in the control tower. Except for the transmitter dish, other components usually include redundant systems. Radar transceivers are usually located some distance from the control tower. They should have diesel backup.

Backup power is an important type of equipment often located outside the control tower. The control tower and lighting system will also have backup generators. Automatic switching should be present. FAA requires backup power to be available in 15 seconds in many situations

Pictures of all of these system will indicate the airports capabilities.

•**Nondirectional Radio Beacon (NDB) -** A low or medium frequency radio beacon transmits nondirectional signals whereby the pilot of an aircraft properly equipped can determine bearings and “home” on the station.

•**Very High Frequency (VHF) Omnidirectional Range (VOR)** - This device is a radio transmitting ground station broadcasting azimuth information. More accurate than NRB

•**Automated Surface Observing System (ASOS)/Automated Weather Observing System (AWOS) -** At uncontrolled airports that are equipped with ASOS/AWOS with ground-to-air broadcast capability, the one-minute updated airport weather should be available.

•**Lighting Controls** – Airfield lighting can often be controlled from a number of different points including the control tower. The matchbox sized vehicles on the console are used elsewhere to indicate when vehicle are on or near a runway.

•**Location ID** – A plane’s three character code can be entered to retrieve further information on the plane and also its location.

•**Flight Progress** – The flight plan for a plane is available through the flight progress system.

NDB

Tower

VOR

ASOS / AWOS

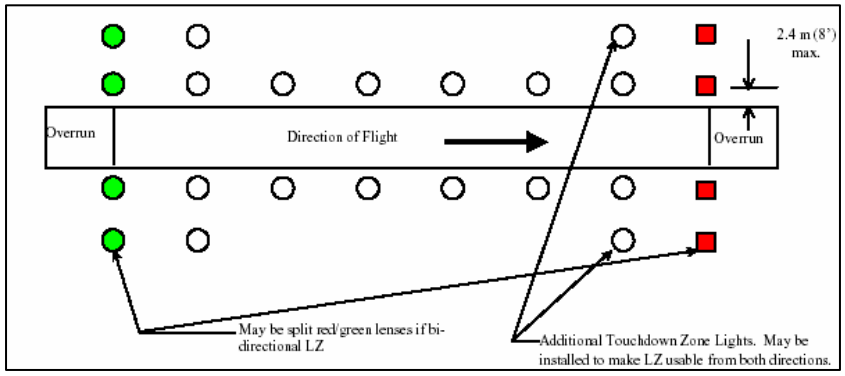
Airfield Lighting, Signs and Markings

Airfield lighting, markings and signs and markings are important for safe operation of airfields. Military and general aviation airfields may have minimal lighting, signs and markings but these features are important for safe operation of commercial airports.

Sign, lighting, and marking locations can be noted on an airfield map with additional information such as their conditions and operational status.

Lighting: Lights for airfields usually have a dedicated power supply infrastructure that includes circuit breakers, voltage regulators, backup generators and switching gear as previously discussed, and additional controls. Typically, runway lights can be controlled in the power vault, the control tower, and remotely from incoming planes if the airport is unmanned. Lighting systems are used during nighttime operations to provide visual cues to pilots about the location and dimensions of the LZ runway. Lights may be NVG capable.

Taxiway and turnaround lenses are blue. If the LZ runway is used for bi-directional operations, lights at the thresholds should have green/red split lenses. Include colors of lights and spacing from surface edge on airfield drawing.



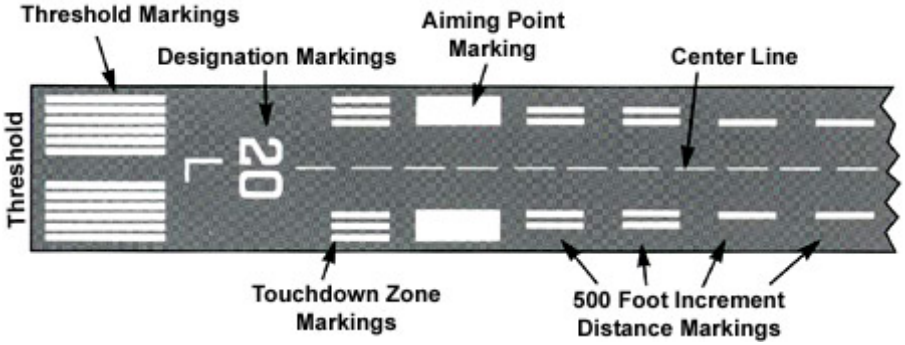
Example Lighting Configuration-Airfield Lighting Layout. Fig 9 Att1 ETL 04-7

Green Light, 2 m (6')± 0.3 m (1') apart when used in pairs

White Light, 2 m (6')± 0.3 m (1') apart when used in pairs

Red Light, 2 m (6')± 0.3 m (1') apart when used in pairs

Airfield signs and markings are not required but will assist with airfield operations. Annotate and measure markings on airfield sketch. Note location of any signs.



Example runway markings

Other Requirements:

Airfield security fencing: Not required but reduces the amount of FOD (foreign object debris) and civilians on the airfield. Note location and status of airfield fencing, i.e., holes.

Crash Fire Rescue: Air force planes must have fire crash rescue support to use an LZ. The air force has internal assets but hardstand facilities should be noted on the airfield sketch.

BRIDGES

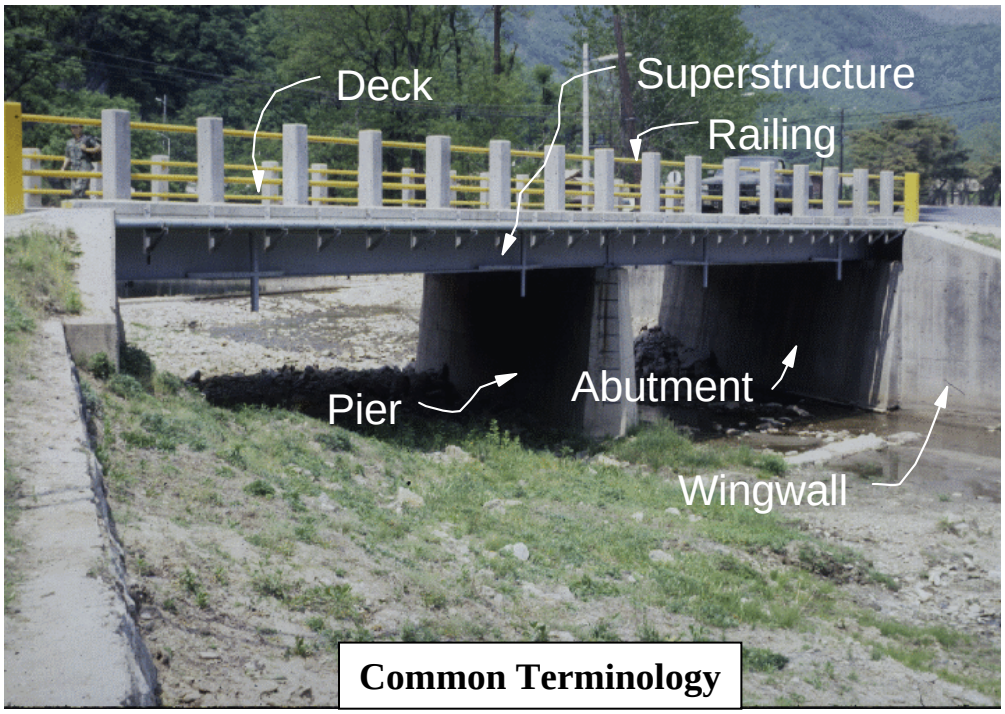
Bridge Reconnaissance Requirements

For TeleEngineering

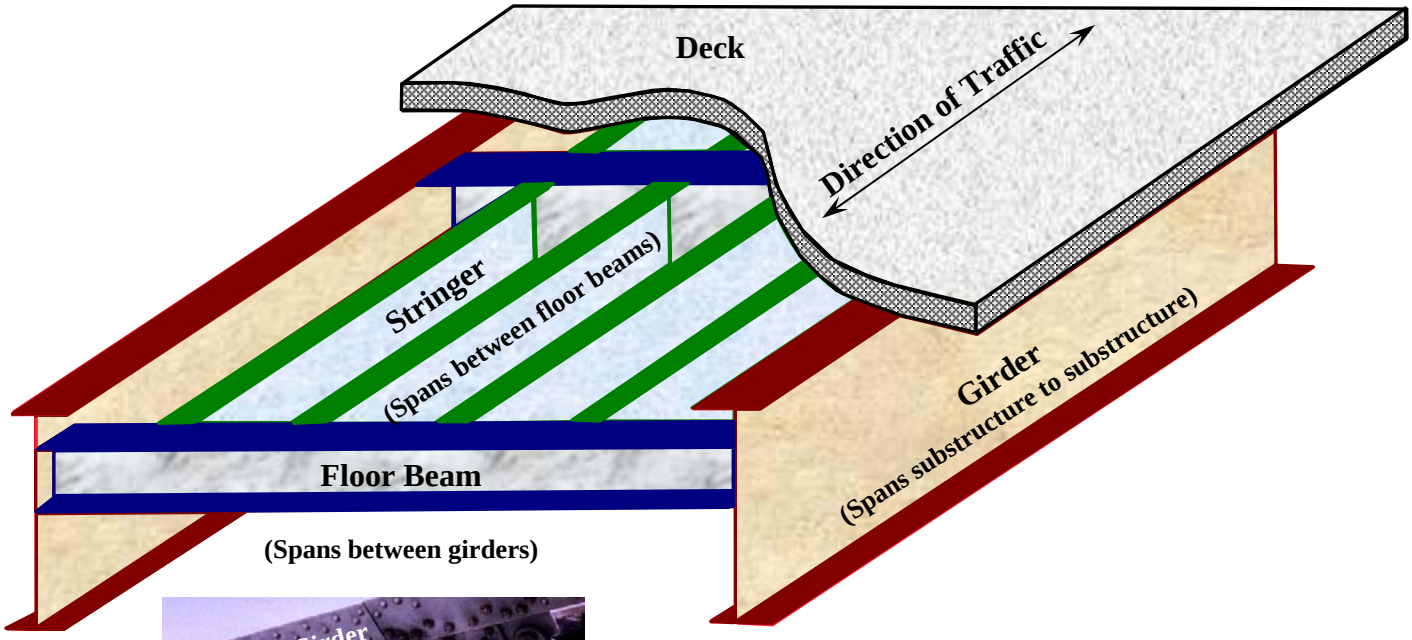
TEOC@usace.army.mil

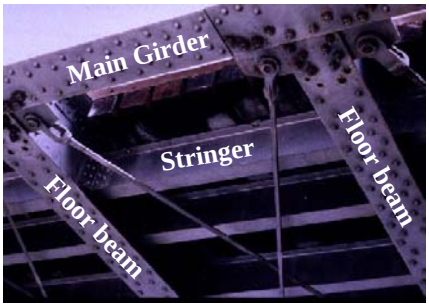
This field guide is provided to facilitate adequate data exchange for bridge assessment support through TeleEngineering. It's purpose is not to replace, but to supplement the field reconnaissance guidelines of FM5-36 "Route Reconnaissance and Classification" and the analytical guidelines of FM5-446 "Military Nonstandard Fixed Bridging".

Provide reconnaissance data as requested.

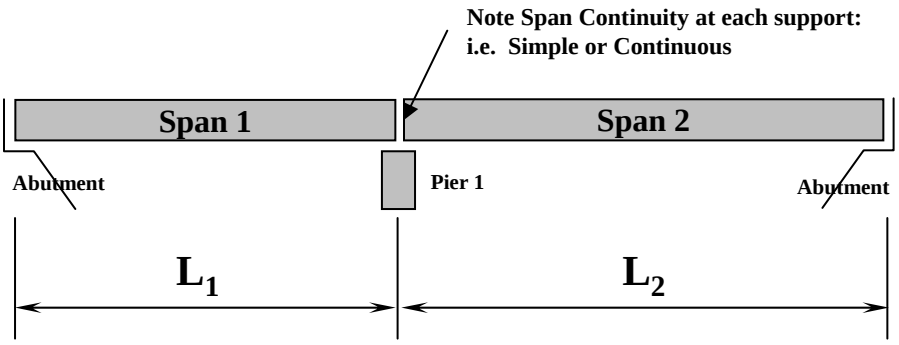


Common Terminology





Common Superstructure Terminology



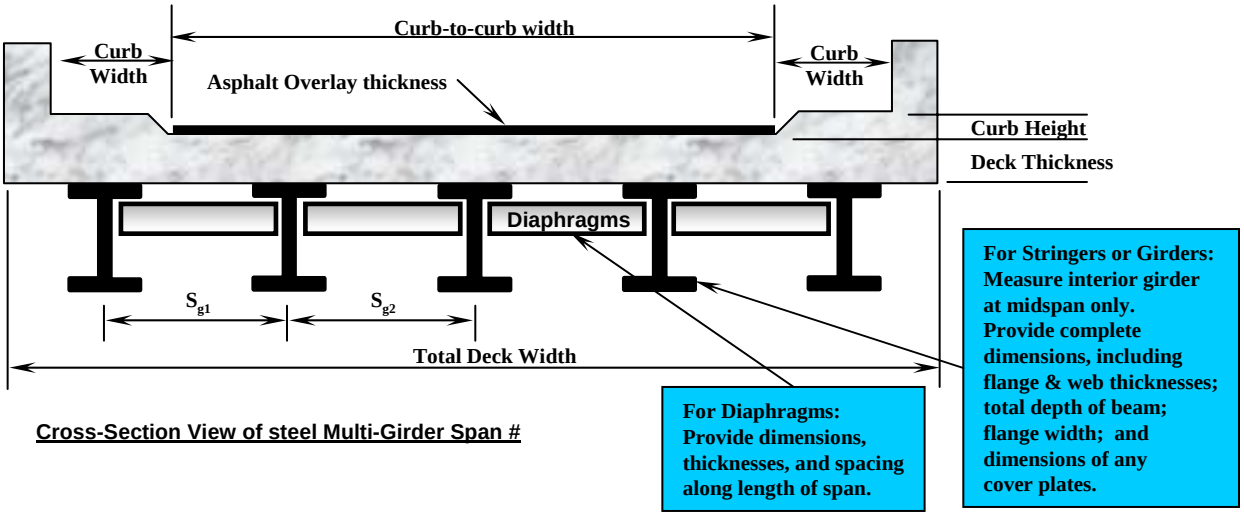
- **For each bridge, provide a side view sketch of all spans as shown above, along with a good photo if possible.**
- **Then provide a sketch of each span's cross-section as shown on the following pages.**

Side View of all Bridges

Steel Multi-Girder Bridges

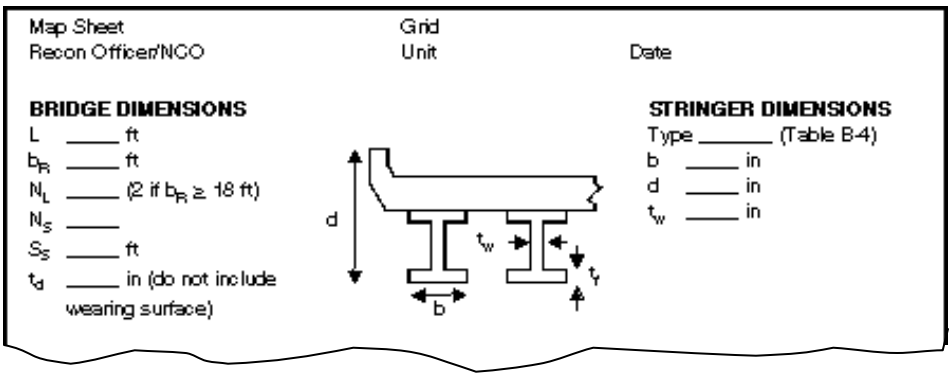
Side View

Underside View



Cross-Section View of steel Multi-Girder Span #

- **Provide cross-sectional details of each span as shown above.**
- **Take all measurements at midspan only.**

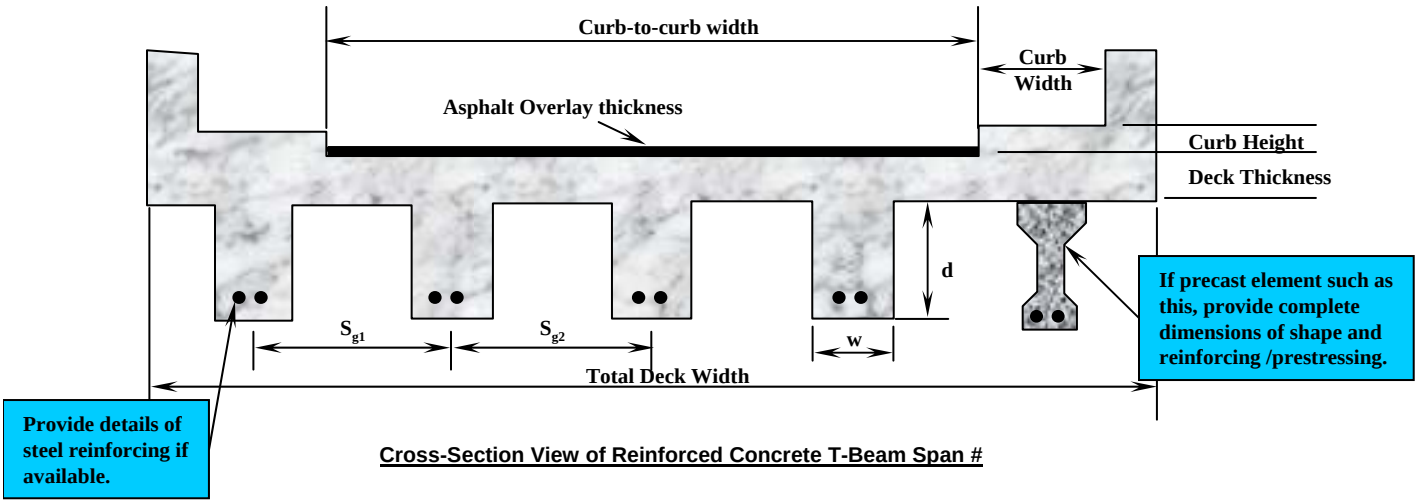


Reinforced Concrete or Prestressed Bridges

Side View

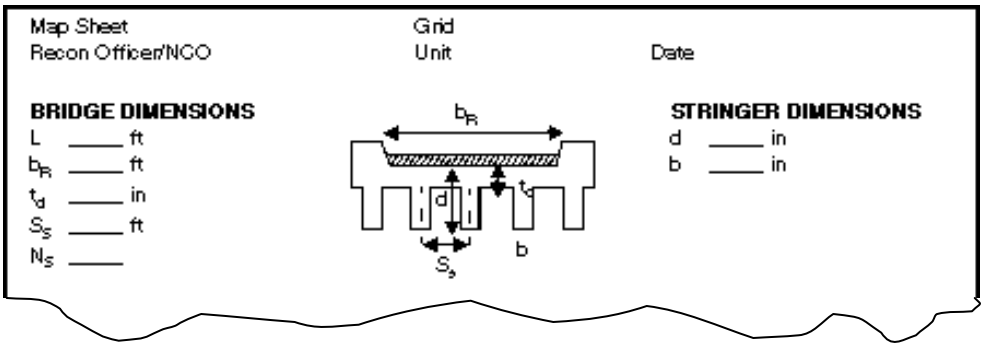
Girder Close-up

Underside View



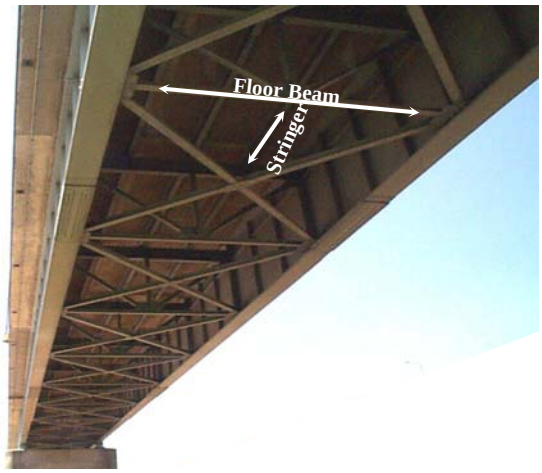
Cross-Section View of Reinforced Concrete T-Beam Span #

- Provide cross-sectional details of each span as shown above.
- Take all measurements at midspan only.

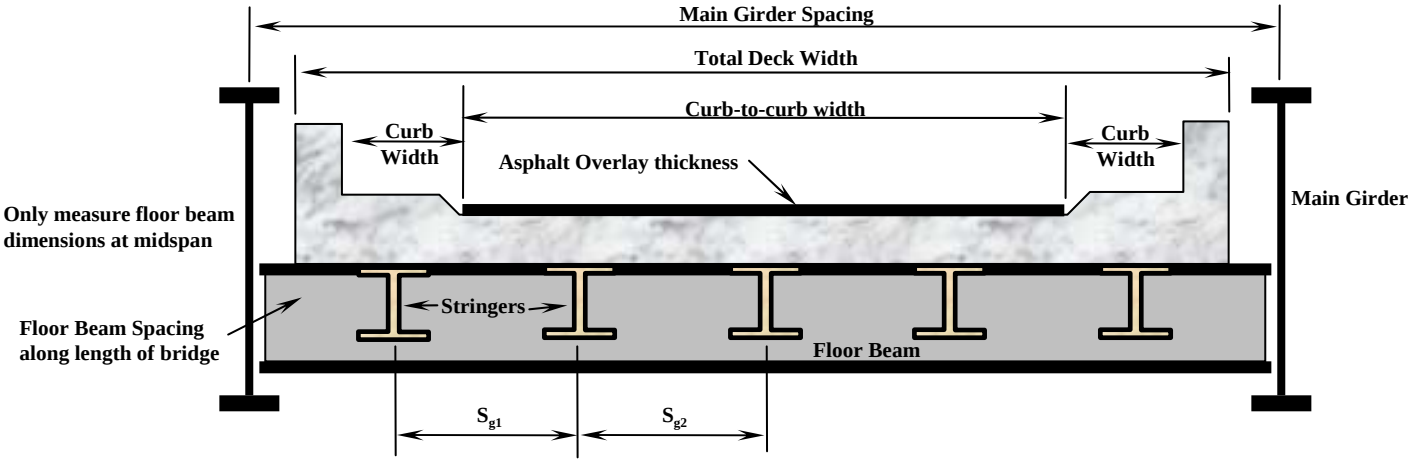


Two-Girder Bridges with Floor System

Side View



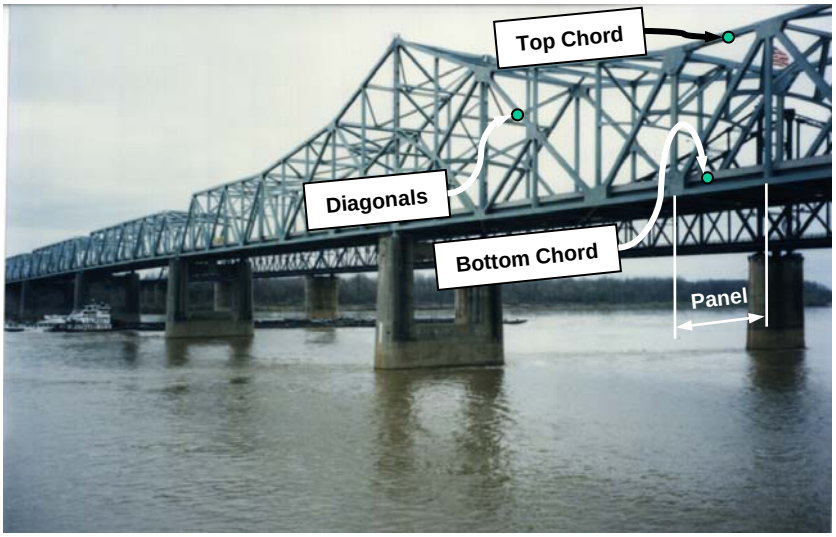
Underside View



Cross-Section View of Two-Girder Span #

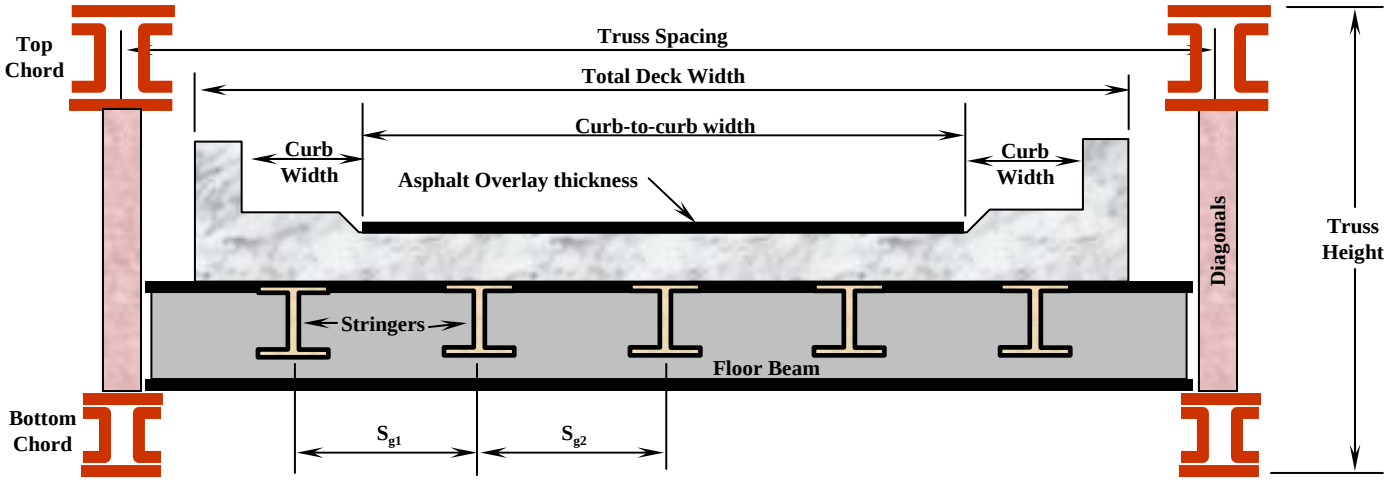
Provide complete dimensions and spacings of girders, stringers, floorbeams, and deck as shown above.

Truss Bridges



Side View

Underside View



Cross-Section View of Truss Span #

In addition to truss chord dimensions at midspan, provide complete dimensions of stringers, floorbeams, and deck as shown above.

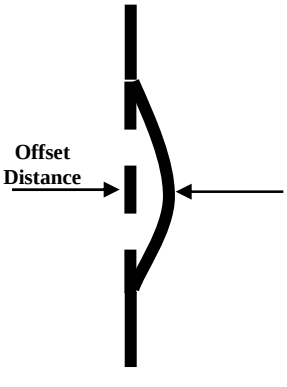
Damaged Bridges

Provide as many close-ups as possible

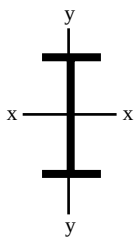
If possible, provide details of reinforcing/prestressing; i.e. number, spacing, and diameter.

Define damage to bridge as follows:

a. Cause of Damage (Air-to-surface weapon, hand-emplaced explosives, vehicle impact, etc.)
b. Span number and location along length of span (ft or meters) of damage
c. Member(s) that are damaged (girder # 4, x-feet from North edge of bridge)
d. Type of damage (i.e. bent or severed members, cratered concrete, etc.)
e. Dimensions of damage (see examples next page):



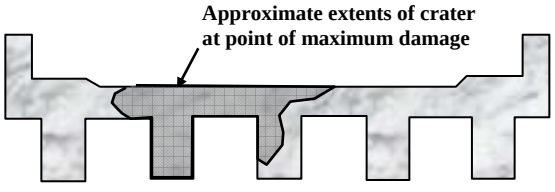
Side View



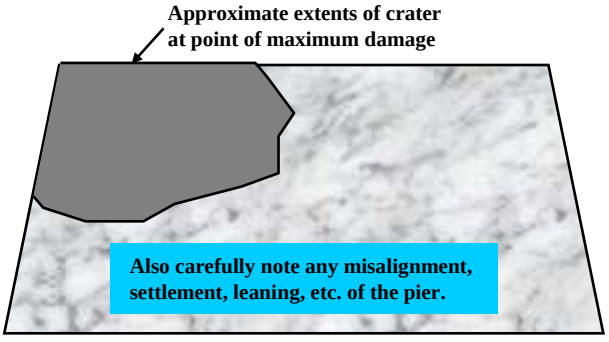
Indicate Axis about which member is bent:

Top View

Bent Steel Member



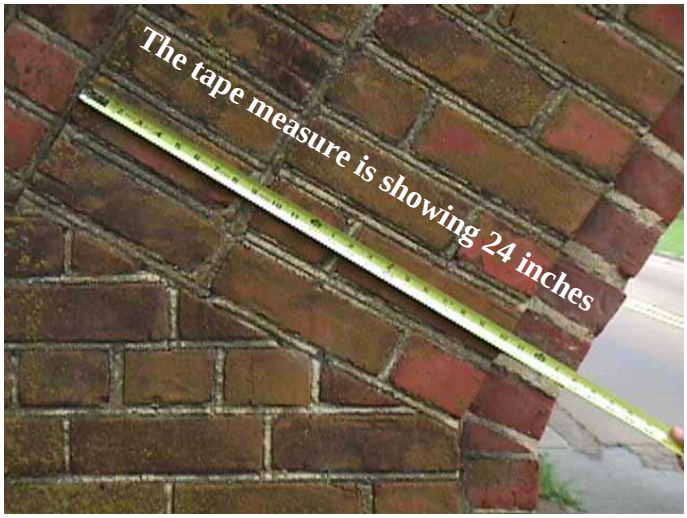
Cross-sectional view of bridge superstructure



End View of Bridge Pier

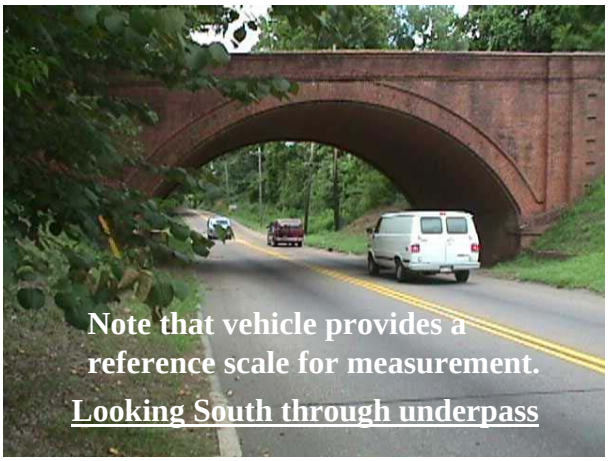
Photo Reconnaissance Tips

Whenever possible, provide a reference scale for measurement in all photos.



Provide as many "close-ups" of main structural members as possible.

Top view along length of bridge is helpful, but least useful of all photos



A good overall side view of the bridge is very helpful; showing all spans.

Get as close to the bridge as possible. This is too far away.

Be careful of shadows. They make the photo useless.

BLANK

PAGE

HEALTH SERVICES

Hospital/ Clinic Assessment (Target ID #_____)

Inspector ID_____ Inspection date/time _____
List information on building's name and address and additional location information (including GPS). Note accessibility by
Roads: _____ Locate major
_____ elements on local map
These forms should be filled out as completely as possible by the inspector(s). Do not leave blank spaces; use "UNK" for "Unknown", "NA" for "Not Applicable", or "None" when appropriate. Talk with the owner to obtain as much information as possible. Assure him/her that detailed name and address information will not be released to the public. Photos should be taken of each exterior building elevation, and of any locations where significant damage is visible.

General Information

Name of facility: _____
Chief facility administrator: _____
Is the facility a hospital or clinic? _____
What type of service does the facility provide: ☐ Inpatient ☐ Outpatient ☐ Emergency/Trauma Care ☐ Minor Surgery ☐ Major Surgery ☐ Intensive Care ☐ Other: _____
What is normal day-to-day bed capacity? _____ Emergency Capacity? _____
Average number of patients on a daily basis: _____
How many people does the facility service (population): _____
Is the facility public or private? _____
Facility hours: _____ through _____
What is the facility's annual budget in local currency? _____
Is the facility currently receiving funding? ☐ Yes ☐ No if no, explain: _____
_____
Where does facility receive its funding from? _____
How do patients pay for their care? _____
Does the facility have security personnel? ☐ Yes ☐ No
Can the facility be secured via doors or gates? ☐ Yes ☐ No
Describe the surrounding area. What type of neighborhood is it, upper or lower class etc. Are there any nearby facilities that are of interest. Is there anything in the area that could pose a threat? _____
_____
_____

Personnel/ Specialists

How many doctors are there? _____
How many nurses are there? _____
How many administration personnel are there? _____
How many non-medical personnel are there? _____
What types of specialists are there? ☐ Anesthesiologist ☐ General practice ☐ OBGYN ☐ Ophthalmologist ☐ Pediatrician ☐ Pathologist ☐ Psychiatrist ☐ Radiologist ☐ Surgeon ☐ Other: _____
_____
Is the facility currently short of doctors or nurses? ☐ Yes ☐ No if yes, explain: _____
_____

Emergency Services

Does the facility have a crisis management plan for: ❑ Fire ❑ Natural Disaster ❑ Medical Emergencies ❑ Terrorist Acts ❑ Other: _____

Does the facility have ambulances ❑ Yes ❑ No if yes, how many: _____

What are the ambulances used for? _____

Who operates the ambulances? ❑ EMT ❑ Medical students ❑ Non-medical Personnel ❑ Other:_____

What equipment and services are provided by the ambulance? _____

_____

Services

What services is the facility able to provide? _____

_____

_____

Does the facility have a pharmacy? ❑ Yes ❑ No if yes, attach a copy of pharmacy's stock inventory (BDE Surgeon or BN PA can assess to determine care that they can provide)

Are there any drugs the facility is critically short of? ❑ Yes ❑ No if yes, list:_____

_____

Does the facility have capability to sterilize equipment? ❑ Yes ❑ No if yes explain: _____

_____

When facility is unable to provide required level of care where are patients sent? Include name and location of facility:

Name: _____ Location/ travel time: _____

Does the facility have the ability to take X-rays? ❑ Yes ❑ No

Does the facility have a lab where blood tests and cultures can be processed? ❑ Yes ❑ No

What level of technology does the facility have (computer, internet, telephone, etc)? Explain: _____

_____

_____

What level is the facility currently operating at _____% If not 100% what is needed to increase to 100%? Explain:

_____

_____

_____

Are there any smaller facilities the facility is responsible for? ❑ Yes ❑ No if yes, provide name and location:

_____

_____

Where does the facility receive its supplies from? _____

_____

How does the facility dispose of medical waste? _____

_____

Is the facility short of any supplies?

Drugs: _____

_____

Medical Supplies (syringes, bandages, etc): _____

_____

Medical Equipment (x-ray machine, etc): _____

_____

Non-medical equipment (beds, tables, chairs, etc): _____

_____

Is there any equipment that has been damage and is in need of immediate repair of replacement?  _____

_____

Does the facility have an isolation ward? ☐ Yes ☐ No

Are there any NGOs working with the facility? ☐ Yes ☐ No if yes, include POC, services provided, and frequency of support. _____

_____

_____

Hospital Organizational Structure.

Sketch a flow chart to detail how the facility is organized and which department provides what service.

Public Sentiment

Do doctors and nurses feel safe? ☐ Yes ☐ No if no, explain:_____

_____

What is public sentiment about the facility (positive or negative) and explain: _____

_____

Does the facility appear to be adequate in size? ☐ Yes ☐ No if no, explain: _____

_____

Does the facility appear to be well maintained? ☐ Yes ☐ No if no, explain: _____

_____

Does the facility appear to be sanitary? ☐ Yes ☐ No if no, explain: _____

_____

List any additional comments or impressions not otherwise noted above:

PUBLIC SAFETY

Police Station Assessment (Target ID #_____)

Inspector ID_____ Inspection date/time _____
List information on building's name and address and additional location information (including GPS). Note accessibility by
Roads: _____ Locate major
_____ elements on local map
These forms should be filled out as completely as possible by the inspector(s). Do not leave blank spaces; use "UNK" for "Unknown", "NA" for "Not Applicable", or "None" when appropriate. Talk with the owner to obtain as much information as possible. Assure him/her that detailed name and address information will not be released to the public. Photos should be taken of each exterior building elevation, and of any locations where significant damage is visible.

General Information

Name of facility: _____
Chief of Police: _____
Is the facility a hospital or clinic? _____
What type of service does the facility provide: ☐ Administration ☐ Patrol ☐ Other: _____
How many people does the facility service (population): _____
Facility hours: _____ through _____
What is the facility's annual budget in local currency? _____
Is the facility currently receiving funding? ☐ Yes ☐ No if no, explain: _____
_____
Where does facility receive its funding from? _____
Describe the surrounding area. What type of neighborhood is it, upper or lower class etc. Are there any nearby facilities that are of interest. Is there anything in the area that could pose a threat? _____
_____
_____
What is the total area the department is responsible for? Should be marked on a map _____

Personnel/ Specialists

How many officers are there? _____
How many patrolmen are there? _____
How many administration personnel are there? _____
How many non-medical personnel are there? _____
How many reserve policemen? _____
Are there any other security organizations operating in the area? _____
Who do they report to? _____
Is the facility currently short of policemen? ☐ Yes ☐ No if yes, explain: _____
_____
Have senior personnel been vetted? ☐ Yes ☐ No

Services

Does the facility have a crisis management plan for: ☐ Fire ☐ Natural Disaster ☐ Medical Emergencies ☐ Terrorist Acts ☐ Other: _____
Does the facility have vehicles ☐ Yes ☐ No if yes, how many: _____
How are vehicles marked? _____
What services are provided by the vehicles? Patrol, admin, personal use, etc _____

_____

What services is the facility able to provide? _____

Percentage of officers with uniforms? _____% describe uniforms: _____

_____

_____

Do the police have photo IDs? ☐ Yes ☐ No if yes, attach a copy of ID

How are police armed? (note: in most place handguns are a status symbol, whereas criminals have AK-47's pistols handguns aren't enough) ☐ Yes ☐ No if yes, list type and quantities _____

_____

Do the police have enough ammunition? ☐ Yes ☐ No if no, list quantity and type needed

_____

Do the police have enough equipment (handcuffs, flashlights, etc) _____

Dos the station have radios? ☐ Yes ☐ No if yes, include number and type _____

Does the station have a jail? ☐ Yes ☐ No if yes, explain _____

Does the station have a secure arms room? ☐ Yes ☐ No if yes, describe and include capacity_____

What percentage of the police force is trained in policing? _____% Where did they receive their training? _____

_____

What is the background of different policemen? (army, air force, national guard, etc) _____

_____

_____

_____

Are there any crime concerns for the local area? _____

_____

_____

What is the crime fighting strategy / (in some countries police do not patrol, they merely react to reports of crime) _____

_____

_____

_____

Who does the department answer to? (mayor, city council, province, government, etc) _____

_____

Does the department maintain criminal records? ☐ Yes ☐ No if yes, how far back do they go (years) _____

What level of technology does the facility have? (computer, internet, telephone, etc) Explain: _____

_____

_____

What level is the facility currently operating at _____% If not 100% what is needed to increase to 100%? Explain:

_____

_____

_____

Are there any smaller facilities the facility is responsible for? ☐ Yes ☐ No if yes, provide name and location:

_____

_____

Where does the facility receive its supplies from? _____

_____

Is the deportment short of any equipment (beds, tables, chairs, etc): _____

_____

_____

Is there any equipment that has been damage and is in need of immediate repair of replacement?  _____

_____

_____

Are there any NGOs working with the facility? ☐ Yes ☐ No of yes, include POC, services provided, and frequency of support. _____

_____

_____

Police Department Organizational Structure.

Sketch a flow chart to detail how the facility is organized and which department provides what service.

Public Sentiment

Do policemen feel safe? ☐ Yes ☐ No if no, explain:_____

_____

What is public sentiment about the police department (positive or negative) and explain: _____

_____

Does the department appear to be adequate in size? ☐ Yes ☐ No if no, explain: _____

_____

Does the facility appear to be well maintained? ☐ Yes ☐ No if no, explain: _____

_____

Does the facility appear to be sanitary? ☐ Yes ☐ No if no, explain: _____

_____

Do you feel the police force is effective? ☐ Yes ☐ No if no, explain: _____

_____

Do you feel that the answers provided by the police are truthful? ☐ Yes ☐ No if no, explain: _____

_____

Do you feel the police are trustworthy? ☐ Yes ☐ No if no, explain: _____

_____

List any additional comments or impressions not otherwise noted above:

ACADEMICS/ SCHOOLS

School Assessment (Target ID #_____)

Inspector ID_____ Inspection date/time _____
List information on building's name and address and additional location information (including GPS). Note accessibility by

Roads: _____ Locate major

_____ elements on local map

These forms should be filled out as completely as possible by the inspector(s). Do not leave blank spaces; use "UNK" for "Unknown", "NA" for "Not Applicable", or "None" when appropriate. Talk with the owner to obtain as much information as possible. Assure him/her that detailed name and address information will not be released to the public. Photos should be taken of each exterior building elevation, and of any locations where significant damage is visible.

General Information

Name of school: _____

Chief school administrator: _____

Is the school public or private? _____

Is school currently in session? ☐ Yes ☐ No

School hours: _____ through _____

What is the normal school year? _____ through _____

Can the school currently operate as is? ☐ Yes ☐ No if no, what is required to bring into operation? _____

_____

_____

How many students is the school responsible for? If unknown, note geographical area: _____

% of students enrolled in the area the school is responsible for? _____

What is the capacity of the school: _____

What is daily average attendance: _____%

How many grades are provided or ages of students who attend? _____ thru _____

How many teachers are there? _____

How many teachers' aides or assistants are there? _____

How many administration personnel are there? _____

Is there a school nurse? ☐ Yes ☐ No

Is the school currently short of teachers? ☐ Yes ☐ No if yes, explain: _____

_____

What is the schools annual budget in local currency? _____

Where does school receive its funding? _____

Do citizens pay so their children can attend? ☐ Yes ☐ No

Who does the school report too? _____

Is there mandatory testing? ☐ Yes ☐ No if yes, how often: _____

Is the school a specialty school? ☐ Yes ☐ No if yes, what type: _____

Are there male and female students in the same classroom? ☐ Yes ☐ No

Is the school segregated? ☐ Yes ☐ No if yes, explain: _____

_____

Is the school religiously affiliated? ☐ Yes ☐ No if yes, explain: _____

Does the school have security personnel? ☐ Yes ☐ No

Can the school be secured via doors or gates? ☐ Yes ☐ No

Describe the surrounding area. What type of neighborhood is it, upper or lower class etc. Are there any nearby facilities that are of interest. Is there anything in the area that could pose a threat? _____

_____

_____

Are there any NGOs working with the facility? ☐ Yes ☐ No of yes, include POC, services provided, and frequency of support. _____

_____

_____

Curriculum and Facilities

Who sets the curriculum (the school, province, government)? _____

What subjects are taught?

Mathematics: Grades/Ages taught: _____ textbook to student ratio: ____ : ____
textbook copyright: _____

Science: Grades/Ages taught: _____ textbook to student ratio: ____ : ____
textbook copyright: _____

Language Arts: Grades/Ages taught: _____ textbook to student ratio: ____ : ____
textbook copyright: _____
Is English taught? ☐ Yes ☐ No if yes, to what extent? _____

Social Studies: Grades/Ages taught: _____ textbook to student ratio: ____ : ____
average textbook age: _____

Health Education: Grades/Ages taught: _____ textbook to student ratio: ____ : ____
average textbook age: _____

Government Education: Grades/Ages taught: _____ textbook to student ratio: ____ : ____
average textbook age: _____

Religion: Grades/Ages taught: _____ textbook to student ratio: ____ : ____
average textbook age: _____

Vocational Education: Grades/Ages taught: _____ textbook to student ratio: ____ : ____
average textbook age: _____

Physical Education: Grades/Ages taught: _____ textbook to student ratio: ____ : ____
average textbook age: _____

List any additional subjects taught: _____

_____

Does the school provide extracurricular activities? ☐ Yes ☐ No if yes, list: _____

_____

Does the school provide education for special needs children? ☐ Yes ☐ No if yes, list: _____

_____

Is the school teaching any propaganda? ☐ Yes ☐ No if yes, explain: _____

_____

_____

What level of technology does the school have (computer, internet, telephone, etc)? Explain: _____

_____

Does the school have a library? ☐ Yes ☐ No If yes, how many books or size: _____

Does the school provide lunch for students? ☐ Yes ☐ No

if yes, does cafeteria and kitchen appear adequate and sanitary? ☐ Yes ☐ No if no, explain: _____

_____

Are there adequate supplies for teachers and students (paper, pencils, chalk boards, etc) ☐ Yes ☐ No

If no list needed supplies: _____

_____

_____

Is there adequate equipment for the school (desks, tables, chairs, copiers, etc)? ☐ Yes ☐ No

If no, list needed equipment: _____

_____

_____

Is there any equipment that has been damage and is in need of immediate repair of replacement?  _____

_____

_____

Safety and Public Sentiment

Does the school have a crisis management plan for: ☐ Fire ☐ Natural Disaster ☐ Medical Emergencies ☐ Intruders ☐ Terrorist Acts ☐ Other: _____

Do teachers feel safe? ☐ Yes ☐ No if no, explain:_____

_____

Do students feel safe? ☐ Yes ☐ No if no, explain: _____

_____

Do parents feel school is safe? ☐ Yes ☐ No if no, explain: _____

_____

What is public sentiment about the school (positive or negative) and explain: _____

_____

Does school appear to be a healthy environment? ☐ Yes ☐ No if no, explain: _____

_____

Does the school appear to be adequate in size? ☐ Yes ☐ No if no, explain: _____

_____

Does the school appear to be well maintained? ☐ Yes ☐ No if no, explain: _____

_____

Does the building owner/ operator seem trustworthy? ☐ Yes ☐ No if no, explain: _____

_____

List any additional comments or impressions not otherwise noted above:

FOOD SUPPLY CHAIN

Under Development

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PAGE

CULTURAL/ HISTORICAL /RELIGIOUS

Under Development

Appendix _ – Historical, Cultural, Religious Inspection Forms

Form#: HCR010 HISTORICAL, CULTURAL, RELIGIOUS

Photograph problem areas.

Identify problem areas and important components on the map.

- Current DTG: _____
- What are the grid coordinates of the site?

_____

- Local climate/topography:

☐ Mountains, ☐ Plains, ☐ Rainforest, ☐ Beach, ☐ Lakes,
☐ Rivers, ☐ Desert, ☐ Arctic, ☐ Other (specify) _____

Describe briefly:

_____
_____

- How large is the site? Acreage, Square Miles or Kilometers

_____

- Is there a visitor's guide, tour, or local map or flyer available? ☐ Yes ☐ No If yes, please include all literature available

- Who are the leaders/decision makers in the area? ie. Tribal, Religious, Civil, Administrative

NAME POSITION TIME IN POSITION

_____
_____
_____
_____
_____

- List the top religions/sects/ethnicities/factions/tribes in the region and annotate the majority/most powerful:

_____
_____
_____
_____

- Are there other important groups, leaders, or officials (government or non-government) to be noted with respect to this site? ☐ Yes ☐ No If yes, give details:

_____
_____

- Does this site hold the same meaning/symbolism to all religions/sects/ethnicities/factions/tribes involved?

❑ Yes ❑ No

If No, give details and annotate key differences that are potential points or sources of conflict

_____

_____

- Are the religions/sects/ethnicities/factions/tribes themselves in conflict currently ❑ Yes ❑ No

If yes, give details and annotate if it is related to the site in particular:

_____

_____

- Is this site a source or point of special or extreme tension or conflict? ❑ Yes ❑ No If yes, give details:

_____ 

_____

- Who controls this site? What agency, government or non-government, tribe, religious sect/faction?

_____

_____

- Is this site protected by an agency, government or non-government, local law, tribe, religious sect/faction?

❑ Yes ❑ No give details:

_____ 

_____

- Is this site more Cultural, Historical or Religious in Nature?

❑ Cultural, ❑ Historical, ❑ Religious, Check all that apply, give details (ie. Birth place of local leader)

_____ 

_____

- Is this site very well defined or well marked? ❑ Yes ❑ No give details:

_____ 

_____

- Is this site easily maintainable and securable with respect to current OPTEMPO? ❑ Yes ❑ No give details:

_____ 

_____

- What size element is necessary to adequately secure the site?

_____

- Will the local populace demand access to this site? ❑ Yes ❑ No give details:

_____

_____

- Does the local populace, leaders, or decision makers have an agenda or plans for this site and what they want done?

❑ Yes ❑ No give details: if possible, obtain copies of plans

_____

_____

- This area is ❑ Urban ❑ Rural ❑ Suburban ❑ Other specify: _____

- Include brief description of surroundings; ie. Farmland, what type, # of buildings, etc.

_____

_____

- Take some photographs of key areas of interest at this site. (i.e. damage, signs, buildings, etc.) describe briefly:

_____

_____

- Is the site damaged? ❑ Yes ❑ No

If yes, to what extent is the damage? ❑ Mild ❑ Some ❑ A Lot ❑ Destroyed describe briefly:

_____

_____

- What was the cause of damage? ❑ Bombing ❑ Looting ❑ Vandalism

❑ Natural Disaster ❑ Accident ❑ Other Describe briefly:

_____

_____

- Is the site salvageable? ❑ Yes ❑ No give details:

_____

_____

- If possible interview multiple local populace and record viewpoints, ideas, concerns about this site.

NAME GROUP AFFILIATION POSITION CONCERN, VIEW, IDEAS

_____

_____

_____

_____

CHEMICALS/ HAZARDOUS MATERIALS (TIM)

Under Development

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SOCIO-ECONOMIC

Under Development

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PAGE

TELECOM

Telecommunication Systems

Overview- Telecommunication systems connect people throughout countries by transmitting data over copper wire, fiber optic cable, radio frequency channels. Telecommunication systems include hardware, cellular and combined systems. All components of these systems must operate in order for the system to function properly. Cellular systems are less expensive to operate/maintain and easier to establish than land based systems.

Narrowband Network (Land based): Forms TC000,TC010, TC011, TC020

Overview: This network consists of a series of copper twisted pairs that feed into a larger bandwidth cables to the telephone exchange or central office.

Customer level box- Wires running to the box are usually buried. Red wires are negative, green positive. Dimensions: 1' x 1' x 3'
Cable collector box- Fed by customer level box. Typically located on street corners or easily accessible locations. Dimensions 3' x 5' x 2'.
Main cable interface box- Central hub through which all network cables are fed. Dimensions: 6' x 4' x 8'.
Central office- Fed by main cable interface box. Handles telephone data traffic across the network to switches or satellites. Housed in a hardstand building with a knowledgeable staff. Must have a constant voltage, backup generators are necessary

Base Station Substation

Network Subsystem

Customer level boxes

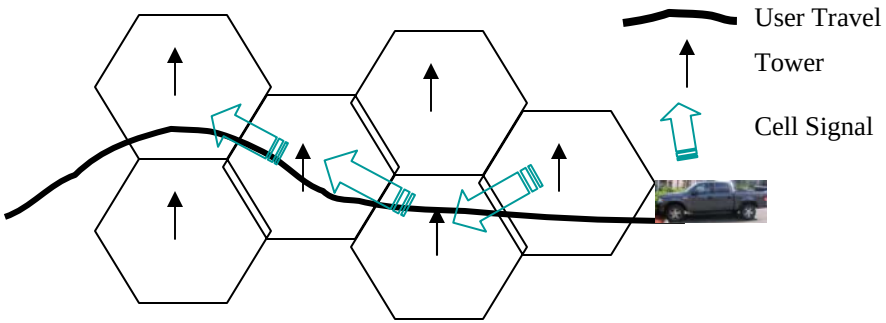
Cable collector boxes

Main cable interface box

Central Office

Wide Are Network (Cellular): Forms TC000, TC021, TC022

Overview WAN: The cellular network divides the city into small cells. This ensures that millions of people can use cell phones simultaneously. Each cell is about 10 square miles arranged in a grid. When a user is traveling. one tower carries a call until the signal fades. When the signal fades from one tower, the next tower picks up the call. Cellular networks require a large number of base stations.

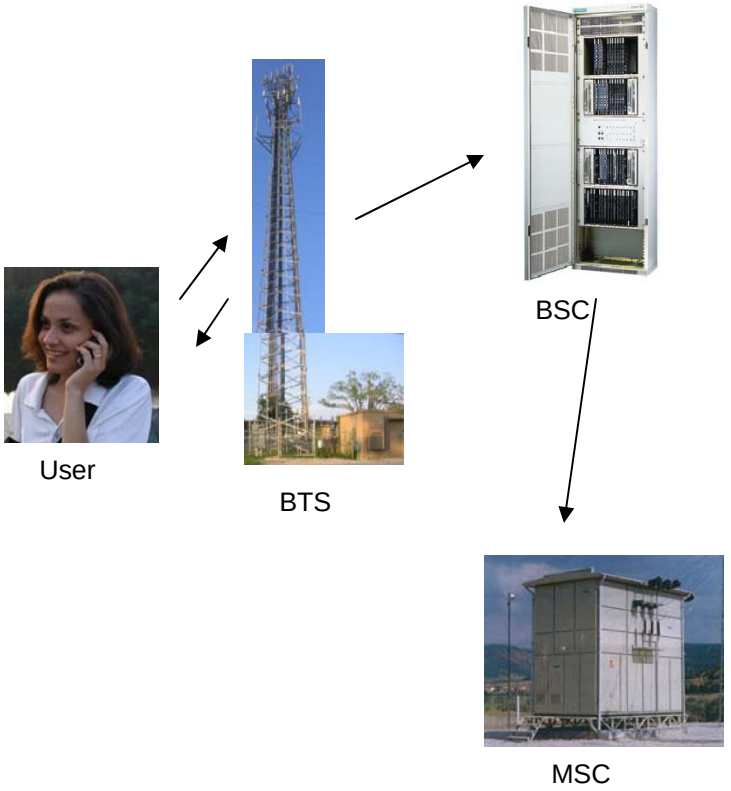


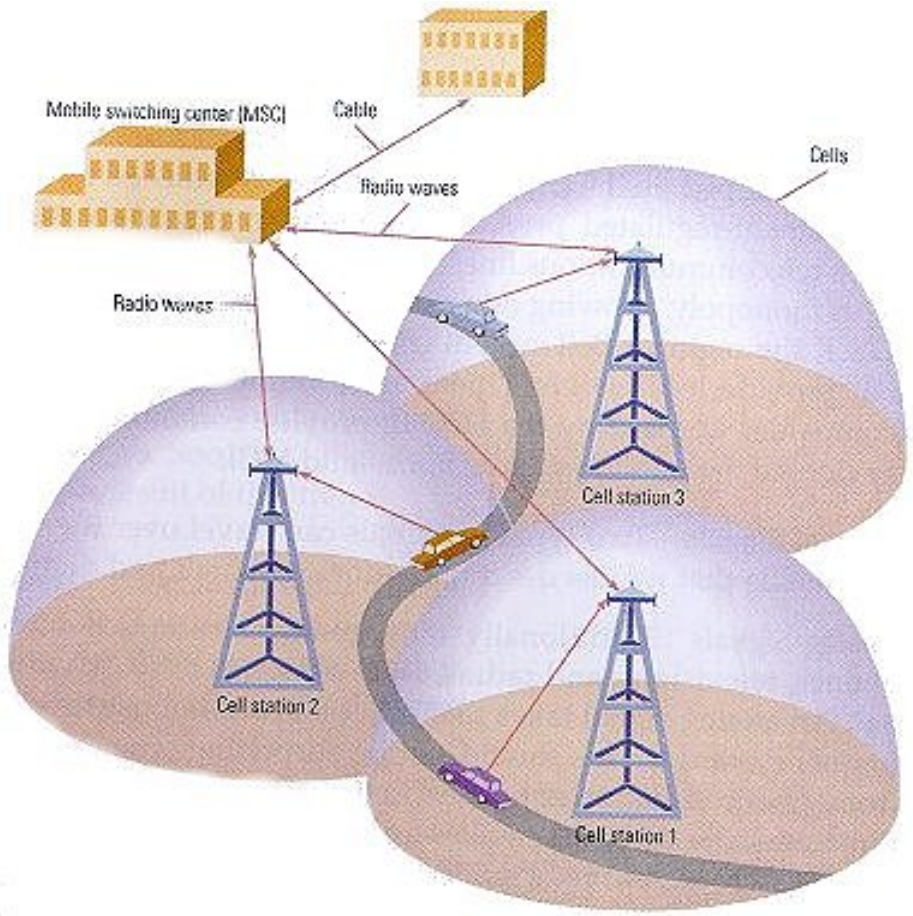
The cellular network can be divided into 4 broad parts.
•The Mobile Station i.e. the cellular phone
•The Base Station Subsystem controls the radio link with the Mobile Station.
•The Network Subsystem, the main part of which is the Mobile services Switching Center (MSC), performs the switching of calls between the mobile users, and between mobile and fixed network users.
•The Operations and Maintenance Center, oversees the proper operation and setup of the network

Base Station Subsystem (BSS)- Consists of a base transceiver station (BTS) and a base station controller (BSC). The base station controller (BSC) gathers the calls from many base stations (BTS) and passes them on to a mobile telephone switch. The BTS consists of a tower and a small building containing the radio equipment. It is responsible for the transmission of all mobile telephone data traffic and user identification authentication. This data is regulated by base station controllers at various cellular tower sites. It houses the radio transceivers which connect it to the mobile station. Required cellular tower hardware components include power sources, interface equipment, radio frequency transmitters and receivers, backup generator units, and antenna systems. The Base Station Controller (BSC) is the central network for the (BSS) manages the radio resources for one or more BTS. It is the connection between the mobile service and the MSC.

Network Subsystem- Central component is the Mobile services Switching Center (MSC). It provides the handovers for all the base stations. Receives data packets from the Base Station Subsystem. Each carrier will also run a central office called a mobile switch. This office also handles all normal land based phone system calls.

MSC: Critical to the Network subsystem is the Mobile Services Switching System. From that switch come and go the calls from the regular telephone network. Signaling between all components in the network subsystem can be accomplished with a mobile switch. MSC is an enclosed metal Mobile switches go by many names: mobile switch (MS), mobile switching center (MSC), or mobile telecommunications switching office (MTSO). They all process mobile telephone calls.




Mobile switching center (MSC)
Cable
Cells
Radio waves
Radio waves
Cell station 3
Cell station 2
Cell station 1

RAILROADS

Transportation-Railroads

Overview

Railroad infrastructure plays a vital role in the transportation and mobilization of people, equipment, supplies, and other materials They can also serve as a measure of the economy, the ability to transfer goods.

To help identify track structure attributes, track components, and defects, it is important to have an understanding of the track layout. The track network layout should include any **mainline, branches, spurs, and siding tracks**. Stationing (distance) and naming of the tracks are also required.

Glossary

Track configuration is generally denoted as tangent or curved track. Tangent track is the straight portion of the track line. Curved track changes the horizontal direction of the track.

Rail crossings provide a means for two tracks to cross at the same grade.

Turnouts (fig 25) are the portion of track where two track lines converge or diverge. The major components of a turnout are the **switch**, the **frog**, and the **guard rail**.

The **switch** (fig 26) is the moveable part of the turnout which consists of switch point rails that move from side to side depending on the path of the train through the turnout.

The **frog** (fig 27) is the part of the turnout where the wheel flanges from the train cross through the rail from the diverging track.

The **guard rail** protects the frog point from the potential impact from the wheel flanges.

Railroad track structure consists of **subgrade**, **ballast**, **cross ties**, **fastenings and other track material** (F&OTM), and **rail**.

The **subgrade** serves as the foundation for the track and supports the load from the track superstructure above.

The **ballast** section consists of angular aggregate or crushed stone that carries the load from the individual ties and distributes it evenly to the subgrade below, restricts longitudinal movement, and provides drainage.

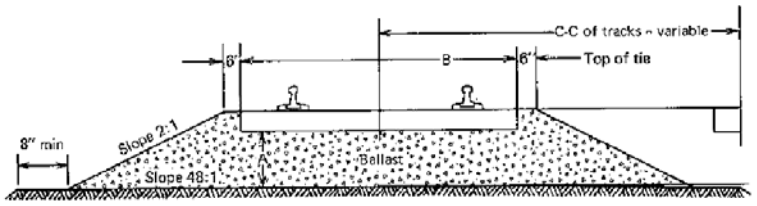
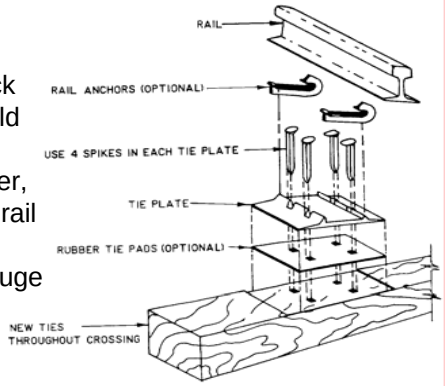
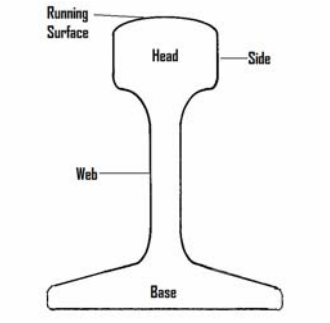


Figure 28 - Typical ballast cross section

The **cross ties** serve three purposes: 1) to provide lateral stability for the rail 2) to provide bearing support for the rail, and 3) to maintain the gauge between the rails. Ties should be installed perpendicular to the rail, and tamped with the top of the tie in full contact with the tie plate and rail, and the bottom of the tie in full contact with the ballast.

Fastenings and other track material encompasses the hardware of the track structure. These include tie plates, hold down devices, joint bars and bolt assemblies which connect rails together, rail anchors (Figure 30) which hold the rail in place longitudinally, gauge rods, typically used in curves, to hold the gauge between rails.

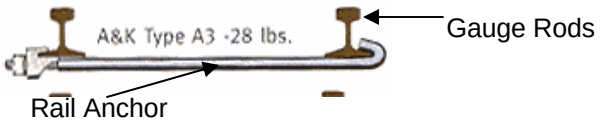




The **rail** provides the running surface for the train. Information about the rail weight and rail section is forged into the web of each piece of rail. The side of the rail facing the inside of the track is called the gage side, and the side facing the outside is termed the field side.

Drainage is important to maintain the load carrying capacity of the subgrade of the track structure. It also allows for ditches and streams to pass across the track.

Grade Crossings provide an intersection for highway traffic and train traffic at the same elevation. The approach on either sides of the rail, and the section in between rails can be constructed of asphalt, concrete, wood timbers or ties, steel, rubber, aggregate, or other material.



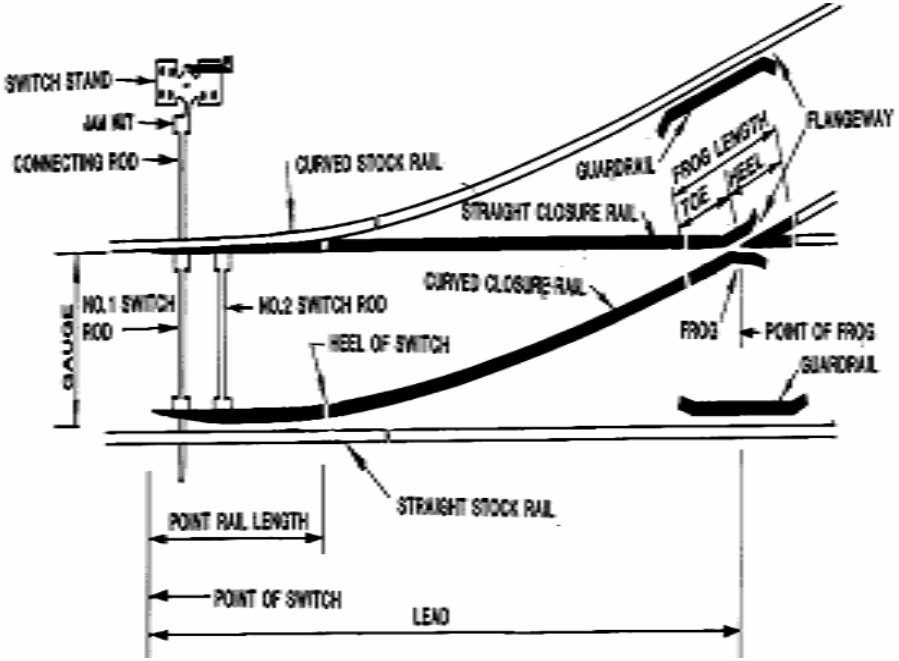


Figure 25 - Turnout components (Army Track Standards Handbook)

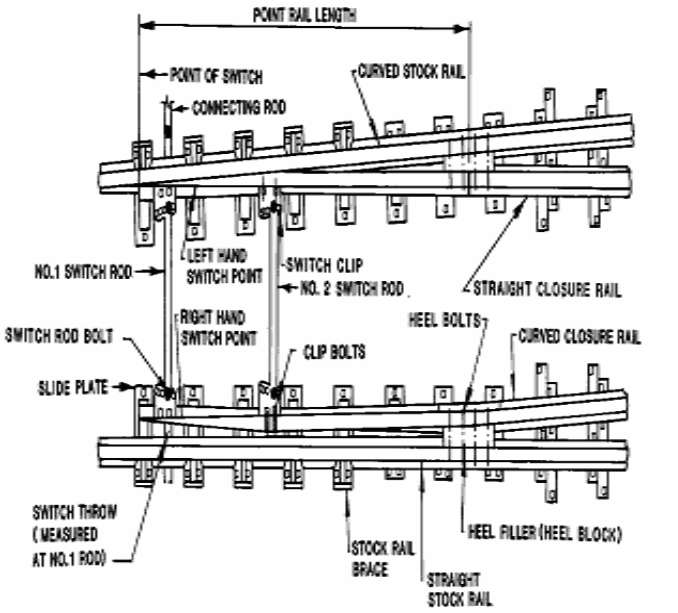


Figure 26 - Turnout switch components (Army Track Standards Handbook)

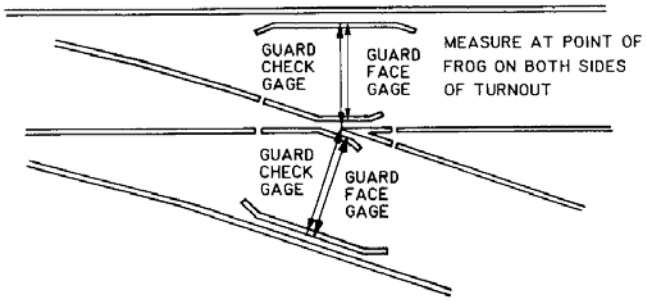


Figure 27 - Frog and Guard Rail Components (Army Track Standards Handbook)

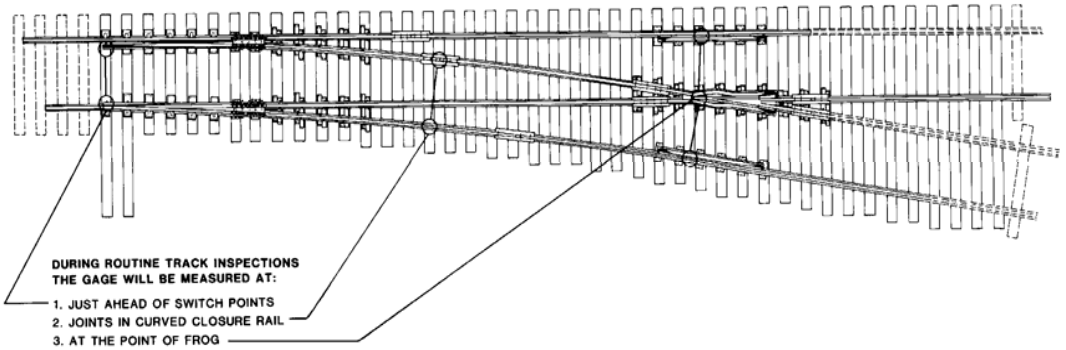


Figure 86 - Required gauge measurements in turnouts (Army Track Standards Handbook)

Deficiencies:

Track Defects and Deficiencies:

General problems to look for in the ballast and roadway include:

•Erosion of embankments affecting the slope or stability of the track can be a potential safety issue.

•Track washouts, caused by water flowing over the track, and eroding ballast and subgrade materials.

•Pumping ties, seen as mud build up in the ballast around the ties, caused by infiltration of Subgrade materials into the ballast section.

•Vegetation that interferes with train or vehicle visibility at grade crossings, or interferes with train operations.

Problems specific to ballast include:

•Ballast filled with soil, mud, sand, or other foreign materials that may impede drainage

•Inadequate crib or shoulder ballast, which affects the lateral stability of the track. Shoulder ballast should extend 6" past the end of the tie

•Improperly distributed ballast which interferes with moveable track parts, such as switches

Tie Defects:

A concrete tie is defective if it is:

•Broken

•Showing deterioration such as exposed prestressing wires, crumbling, etc.

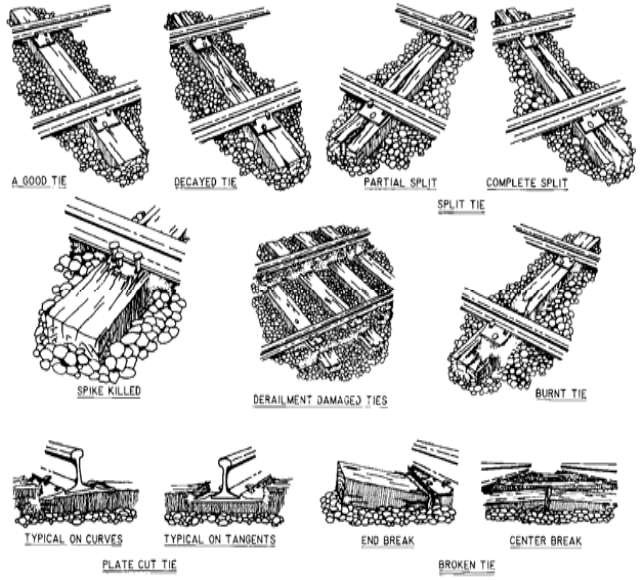
•Tie is damaged by derailment, dragging equipment, etc.

Additional ties related problems are:

•Missing ties

•Skewed ties

•Excessive ties spacing



Fastenings and Other Track Material

Defects include:

•Missing tie plates

•Missing or improperly driven spikes or other fasteners

•Cracked or broken joint bars

•Loose or missing bolts or broken washers. Bolts should be of proper size and type with at least two bolts per rail end. Figure 33 shows proper bolts assembly installation.

•Missing rail anchors can allow rail movement longitudinally, creating potential rail buckling problems. A minimum of 8 rail anchors per 39' is recommended.

•Excessive rail end mismatch occurs when the two ends of the rail are laterally or horizontally displaced. A mismatch of greater than 3/16" should be recorded and is a potential safety problem.

•A joint gap occurs when an excessive spacing exists between the two rails at the joint. A joint gap of greater than 1.25" should be recorded as a potential safety defect.

Rail Defects:

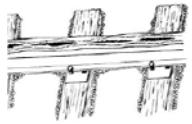
Bolt hole crack: A progressive fracture originating at a bolt hole. Bolt hole cracks are not visible until a bolt or joint bar has been removed unless the defect has progressed beyond the bar. They may be recognized by a hairline crack extending from the bolt hole.

Broken base: Any break in the base of the rail.

Complete break: A complete transverse separation of the head, web, and base of the rail.

Corrosion: The decaying or corroding of the metal in the web or base of the rail.

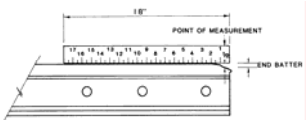
Corrugation: A repeated wavelike pattern on the running surface of the rail.



Crushed head: the flattening of several inches of the rail head generally caused by a soft spot in the steel. It generally appears as a flattening and widening of the head with small cracks in a depression in the running surface.

•*Defective Weld*: A progressive transverse separation within an area where two rails have been joined by a weld.

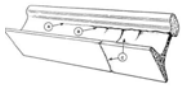
End Batter: Damage caused by wheels striking the rail end. It appears as damage to or a depression in the top surface of the rail head at the ends of the rail.



Engine Burns: Rail that has been scarred on the running surface by the friction of slipping locomotive wheels.

Flowed Rail: A rolling out of the tread metal beyond the field or gage corner with no breaking down of the underside of the head.

Head/web separation: A progressive fracture separating the head and the web of the rail at the head fillet area. It appears as wavy lines or small cracks running along the fillet between the head and the web



Horizontal split head: A progressive longitudinal fracture in the rail head parallel to the running surface.

Mill Defects: Deformations, cavities, seams, or foreign material found in the head, web, or base of rail.

Piped rail: A progressive longitudinal fracture in the web of the rail with a vertical separation or seam, forming a cavity in the advanced stages of development. It appears as a bulging of the web on either or both sides.

Rail wear: The loss of material from the running surface and side of the rail head due to the passage of wheels over the rail. Rail wear appears as a rounding of the running surface of the rail head, particularly on the gage side.

Shelling: A progressive horizontal separation which may crack out any level on the gage side but generally at the gage corner. It extends longitudinally not as a true horizontal or vertical crack, but at an angle related to the amount of rail wear.

Slivers: the separation of a thin tapered mass of metal from the surface of the head, web, or base of a rail. It appears as thin slivers on the surface of the rail head and parallel to the rail surface.

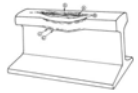
Split web: A progressive fracture through the web in a longitudinal or transverse direction.

Surface bent rail: The permanent downward bending of the rail ends due to long-term passage of traffic over the track with loose or poorly supported joints.

Surface damage: Any damage to the surface of the rail, both the running surface and external surfaces, caused by deep engine burns or by striking the rail. It appears as deep engine burns, dents, nicks, cuts, or other abnormalities on the surface of the rail.

Torch cut rail: Any rail that is cut or otherwise modified (including bolt holes) using an acetylene torch or other open flame. It appears as irregular or rough rail ends or bolt holes.

Vertical split head: A progressive longitudinal fracture in the head of the rail perpendicular to the running surface. It appears as cracks or sagging in the running head of the rail.



Grade Crossing Defects:

Crossing Surface

The Crossing Surface material should be maintained in good shape to allow for smooth crossing of vehicle traffic. Any conditions that might lead to a deteriorated surface should be recorded including: cracked, damaged, faulted, settled, or displaced surfaces.

Flangeway

The flangeway in a grade crossing provides a pathway between the rail and the crossing surface material for the wheel flanges to travel. The flangeways in a road crossing should kept clear of debris, and have adequate width and depth for safe train movement. Any flangeway width less than 1.75” or flangeway depth less than 1.5” should be noted and recorded.

Crossing Protection Devices (Signs, Signals and Gates)

Note the condition and functionality of signs, signals, and gates at the grade crossing. Signs should be clearly visible, and missing or deteriorated signs should be recorded. Signals and gates should be tested for proper working condition.

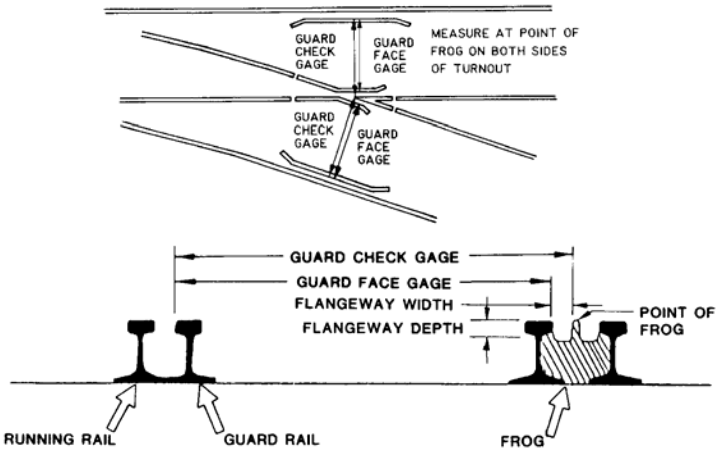
The **switch rails** are the moveable parts of the **turnout** that slide between the stock rails. Problems common with the switch include:

•Gap between the switch point and the stock rail on each side.
•Point of switch higher than stock rail.
•Point rail beyond taper lower than stock rail.
•Damaged or missing switch stand lever latches or switch point lock.
•Loose, damaged, or improperly installed switch stand.
•Loose, damaged, or missing jam nut at the end of the connecting rod.
•Bent, damaged, loose, binding, or improperly installed connecting rod, switch rods, or switch clips.
•Loose, damaged, or missing switch clip, switch rod, or connecting rod bolts.
•Loose, damaged, or missing heel bolts; cracked or improper heel joint bars or heel filler.
•Loose, damaged, or missing rail braces.
•Loose, damaged, or missing slide plates; dirt and debris buildup on slide plates under the point rails.
•Missing cotter keys on switch rod and switch clip bolts.
•Debris obstructing switch rods and connecting rod from proper movement

Turnout frogs- The point and surface of the frog should be observed for any wear, and all bolts securing the frog to the rails should be present and tight.

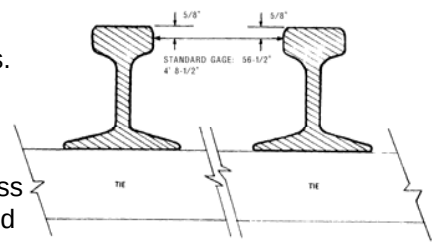
Guard rails- The guardrails should be adequately positioned and securely fastened to the stock rails across from the frog point.

Measurements Required:



Track Geometry Measurements

During an inspection, track geometry measurements should be taken wherever visual indications of geometry deviations exist.

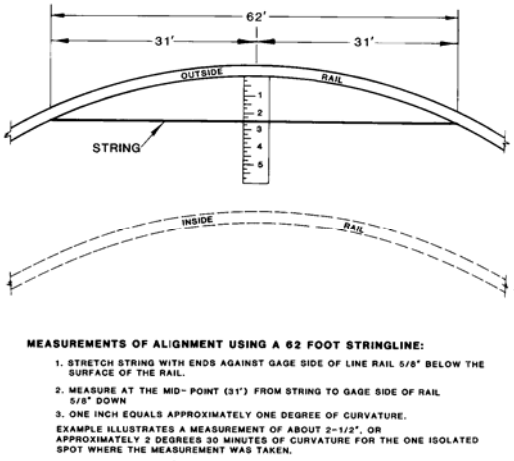


Gauge is the distance between the two rails, measured at right angles to the rails. Standard gauge is 56.5” for most track networks. Significant deviation in gauge from this value can cause a potential derailment risk. Gauge measurements less than 56.125” or greater than 57.75” should be noted during the inspection.

Crosslevel is the difference in elevation between the top surface of the two rails, measured at right angles on the track. Any superelevation should be subtracted from crosslevel measurements in curves. If the outside rail is lower than the inside rail in a curve (negative superelevation) this condition should be noted as a safety hazard. In addition, any crosslevel measurement greater than 2” should be noted and recorded during the inspection. In the absence of such tool, severe cross level problems should be noted based on visual observation, including the track and stationing location of the defect.

Profile is the relative longitudinal elevation of a rail. Profile deviation is the deviation from uniform profile on either rail at the midpoint of a 62’ chord. Profile deviations of greater than 2.75” should be recorded during the inspection.

Alignment is the relative position of the rails in a horizontal plane. Any obvious alignment deviations should be observed and noted. Alignment deviations in tangent track are seen as waviness from the straight rail. Any alignment deviations greater than 3” should be recorded during the inspection.



Miscellaneous Appliance Defects

Bonded and grounded track

Track used for loading and unloading of fuel and ordinances may be bonded or grounded to reduce explosive potential. Any bond and ground connections should be observed. Loose, broken, missing, or corrosive connections, should be noted and recorded.

Derails, Car bumpers, wheel stops

These track appliances should be maintained in good working order, be adequately visible, and be securely fastened. Any loose or damaged track appliances should be recorded.

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PAGE

Part 4 – Language Smartcards

Feedback from the field has shown a need for language smartcards. When Soldiers are required to conduct an inspection they almost always require a translator. Finding a translator who is also an engineer by degree is even more challenging. To assist the Soldier and translator, lists of 'common' engineering / infrastructure terms have been assembled along with their Arabic translation.

Under Development

Translation of Technical Terms (focus sewer, power, water, telecommunications)

English	العربية
Aerator	جهاز التهوية
Aerobic, Anaerobic	هوائي او غير هوائي
Air Circuit Breaker	الداؤة الفاصلة الهوائية
Asbestos	صخر حريري
Automatic Reclosers	اعادة الفصل الذاتي
Axial Flow	تدفق محوري
Baffles	المعيق اوالمعترض
Base Station Controller	محطة السيطرة
Bases Transceiver Station	محطة المرسل المستقبل
Blackwater (From Toilets)	الماء السوداء (من المرحاض)
Booster Pump	المضخة المعززة
Branching System	منضومة متفرعة
Bus Support Insulators	حافلة استناد العوازل
Cable Interface Box	صندوق الكبل السطحي
Hypochlorite	تحت كلوريت
Capacitor Bank	مخزن الادخار
Cellular	خليوي
Centrifugal Pump	مضخة بالنبذ
Circuit Breakers	فواصل الدارة
Circuit Switchers	مفاتيح الدارة
Circuit	الدارة
Clarifiers	المروق او المصفي
Clay Tile	الطابوق الطيني
Cleanouts	التنظيف
Coagulants	المخثر
Coaxial Cable	كبل متحد المحور
Collectors	المجمعات
Comminuters	الجواريش
Conductor	ناقل
Conduits	مجرى الاسلاك
Control Panels	لوحة مراقبة
Control Wires	اسلاك السيطرة
Converter Stations	محطات تحويل
Coupling Capacitors	مدخرات الوصل
Current Transformers	محولات التيار
Dechlorination	نزع الكلور
Density	الكثافة
Discharge Nozzle	صنبور التفريغ
Disconnect Switches	الفواصل المتقطعة
Disinfectant	المطهر
Distribution Bus	الحافلة الموزعة

Translation of Technical Terms

English	العربية
Distribution System	منظومة التوزتع
Duct Runs	خط المجرى
Electrical load	الحمل الكهربائي
Feeder	المغذي
Fiber Optic Network	شبكة ليف بصري
Fire Hydrant	ماخذ اطفاء الحرائق
Flocculator	اندماج الدقائق المترسبة
Forced Flow	جريان بالقوة
Frequency Changers	مشحن الذبذبة
Frequency	ذبذبة
Gravity Flow,	جريان بالجاذبية الارضية
Greywater (From Showers And Sinks)	الماء الرمادي (من الدوش اوالمغسلة)
Grid System	منضومة شبكية
Grinder Pump	مضخة الطحن
Grit	رواسب حصى ورمل
Ground	الارضي
Grounding Resistors	المقاومات الارضية
Grounding Transformers	المحولات الارضية
High-Voltage Fuses	صمامات التوتر العالي
High-Voltage	توتر عال
Impeller	العنفة او المروحية
Interceptors	موقف او المعترض
Junction Boxes	صندوف توصيل او علبة توزيع
Land-Based Network	الشبكة الارضية
Lift Station,	مضخة رفع
Light-Emitting Diodes	صمام الارسال الخفيف
Lightning Arresters	كابح البرق
Lime,	كلس
Looped	حلقي
Magnetically Permeable Material	مواد نافذة مغناطيسيا
Mains,	الموصلات الرئيسية
Manhole	فتحة دخول الى مجرور
Mechanical load	الحمل الميكانيي
Metal-Clad Switchgear	مجموعة مفاتيح الكهرباء محاط بمعدن مؤرض
Meters	عدادات
Microwave	أمواج دقيقة
Narrowband	نطاق ضيق من الموجات
Oil Circuit Breakers	فواصل الدارات الزيتية
Pneumatic Ejector	قاذف ضغطي
Potential Transformers	المحوالات الكامنة

Translation of Technical Terms

English	العربية
Potheads	رأس مرجلي
Power Transformer	المحول الكهربائي
Power-Line Carrier	حامل خط الكهرباء
Primary Treatment,	العلاج الاساسي
Purification Facilities	منشأة التصفية
Radial Flow Pumps	مضخة التدفق قطري
Radial System	منظومة قطرية
Raw Water	الماء الخام
Rectifiers	المقوم
Relays	مرحل
Sanitary Sewer	المجاري الصحية
Screen Racks	منصب الشاشة
Screw Pump	مضخة لولبية
Scum Layer	طبقة لازبدة او الرغوة
Seal Gland	صمام الاحكام
Secondary Treatment,	العلاج الثانوي
Sedimentation,	رواسب
Septic Tank,	الحفرة الفنية (خزان التعفين)
Sewer –	المجاري
Shunt Reactors	المفاعلات المتوازية
Single Suction (pump type)	احادي السحب (نوع مضخة)
Skimmer	مقشدة او كشاطة
Sludge Layer	طفقة الوحل
Sludge	وحل
Steel Superstructures	انشاء علوي حديدي
Storm Sewer,	مجاري مياه المطر
Submersible	قابل للغطس
Supervisory Control	السيطرة الاشرافية
Suspension Insulators	عوازل معلقة
Switch	مفتاح
Switchgear	مجموعة المفاتيح الكهربائية
Synchronous Condensers	المكثفات الزمنية
Telecommunication	الاتصالات
Terminals	طرف نهائي
Tertiary Treatment,	العلاج الثلاثي
Transformer	المحول المحول
Transmission Bus	حافلة الارسال
Transmission	نقل او ارسال
Trickling Filter,	جهاز ترشيح النض
Trunk Lines,	الخطوط(الخراطيم) الرئيسية
Underground Cables	كبلات تحت الارض

Translation of Technical Term

English	العربية
Vacuum Circuit Breakers فواصل	الدارات المفرغة
Valves	الصمامات
Voltage Regulator	منظم الفولت
Well cap or seal	غطاء البئر
Wireless	لاسلكي

Translation of Technical Terms (focus on buildings, etc)

English	العربية
Adapters	المحولات
Aggregate Displacement	تفتت الحصى
Air Mixing	خلط الهواء
Backup Generator:	مولد احتياطي
Bearing Walls	جدار التحمل
Blisters And Ridges	تّبثروانحدار
Boiler	مرجل
Braced Frame	اطار مثبت او مقوى
Built-Up Roofing Membrane	غشاء مركب للسطوح
Capillary Tube	انبوب شعري
Chillers	مبردات
Circuit Switchgear:	مجموعة مفاتيح الكهرباء للدارة
Circulation Pump	مضخة التوزيع (الدوران)
Clay Tile	بلاط طيني
Coils	ملفات
Commercial And Industrial	تجاري و صناعي
Compressor	الظاغط
Contingency Operation	احداث الطوارئ
Cooling Towers	برج التبريد
Cracking	تشقق
Crushing	مسحوق
Curtain Wall	جدار حاجب
Damper	المخمد
Debris	ركام
Decks	سطح
Defective Seams:	فشل الاصق
Diagonals	قطري مائل
Diaphragms	غشاء
Differential Movement	حركة متباينة
Digital Subscriber Line	مودوم رقمي لخط المشتركين
Distorted Beam	جسر مشوه
Drain Pipes	انابيب التصريف
Drainage	تصريف الماء
Ducts	المجرى
Electric Resistance Heat	المقاوم الحراري
Evaporative Cooling	مبرد بخاري
Exhaust Air	الهواء المنفلت(المطروح)
Exterior Facing	الوجه الخارجي
Ethylene Propylene Diene Monomer (EPDM)	مونمر دين بروبلين اثلين
Falling Hazards	خطر السقوط
Fans	المروحة

Translation of Technical Terms

English	العربية
Faucets	الحنفيات
Filters	مصافي الترشيح
Fire Hydrants	ماخذ اطفاء الحرائق
Fire Sprinklers	مرشات الحريق
Flashing	حشوة
Flexible Diaphragm	غشاء لين
Forced Air Furnaces	افران تعمل في ضغط الهواء
Fountains	النوافير
Heat Pumps	مضخات حرارية
Hot Water Heater	مرجل الماء الساخن
Hubs	صرة في الشبكة تنظم الاشارات
Heating, Ventilation, and Air Conditioning (HVAC)	تدفئة و تهوية وتبريد
Hybrids	هجيني
Infrastructure	البنية التحتية
Insulation	العازل
Integrated Services Digital Network (ISDN)	شبكة الخدمات الرقمية المتكاملة
Light Frame	اطار خفيف
Liquid Applied Membranes	غشاء من سائل مطلي
Low Slope Roofing	سقف ذو ميل خفيف
Low-side float valve.	صمام طوفان الجانب المنخض
Main Switchgear:	مجموعة مفاتيح الكهرباء الرئيسية
Make-Up Air –	الهواء المعوض.
Metal Deck Diaphragms	غشاء من سطح معدني
Mixed Air –	الهواء المخلوط
Modem	مودوم جهاز وصل الكمبيوتر في الانترنت
Moment Frame	اطار عزمي
Monolithic	من قطعة واحدة
Node	القطب
Outdoor Air	الهواء الخارجي
PVC (Poly vinyl chloride)	بولي فاينل كلورايد
Panel Boards	الواح الجدارية
Passive Solar Heat	حرارة شمسية غير فعالة
Patching	ترقيع
Piles	خوازيق داعمة
Plumbing	تمديدات صحية
Ponding	تجمع المياه على شكل بركة
Precast Concrete	خرسانة مسبق الصنع
Pre-Formed Panels	جدار مسبق الصنع
Pressure Tanks	خزانات الظغط
Pumps	المضخة

Translation of Technical Terms

English	العربية
Radiant Heat	حرارة اشعاعية
Recool	اعادة التبريد
Reheat	اعادة التدفئة
Reinforced Masonry	طابوق مسلح
Repeaters	المردد
Residential Buildings	مباني السكن
Return Air	الهواء العائد
Rot	بال
Seamed Metal Sheets	الواح معدنية مدروزة
Shear Walls	جدار مقاوم القص
Shingles (asphalt or three tab)	الواح (عادة من ثلاث وريقات اسفلتية)
Showers	المرشات
Shut Off Valves	صمام الاغلاق
Sinks	احواض الغسيل
Slab On Grade	بلاطة على مستوى الارض
Slippage	زلق
Splits	تفسخ
Spread Footings	اساسات منتشرة
Stacked Unit	وحدة متكدسة
Steel Frame With Infill Shear Walls	اطار حديدي محشو في جدران الطابوق
Steel Girder	عارضة حديدية
Steep Roofing	سقف ذو ميل حاد
Storage Tanks	خزانات التخزين
Strip Foundation	اساس شريحي
Supply Air –	الهواء المجهز
Supply Pipes	انابيب التجهيز
Surface Deterioration	تاكل السطح
Switches	المفاتيح
Thermal Storage Systems	منظومات تخزين حرارية
Thermostatic Expansion Valve	صمام امتداد حراري ساكن (ثرموستاتك)
Toilets	المراحيض
Transfer Air	الهواء المنقول
Transfer Switch	مفتاح المحول
Transformer And Metering:	محولات وعدادات
Traps	مصيدة المواد الصلبة
Tubs	احواض
Urinals	المباول
UV Damage	الضرر من الاشعة فوق البنفسجية
Valves	صمامات
Variable Air Volume (Vav)	الحجم الهوائي المختلف
Vent Pipes	انابيب التهوية
Water Softener	ملطف المياه
Wythes	طبقات

Translation of Technical Terms (focus on airfields, etc)

English	العربية
Aircraft Hangars	حظائر الطائرات
Aircraft	طائرة
Alligator Cracking	تشقق على شكل جلد التمساح
Air Traffic Control Tower (ATCT)	برج المراقبة
Ash Handlers	ناقل الرماد
Automated Surface Observing System (ASOS)	منطومة مراقبة السطح الذاتية
Automated Weather Observing System (AWOS)	منطومة مراقبة الطقس الذاتية
Base Station Controllers	محطة الضبط الرئيسية
Biological Activity	النشاطات الحيوية
Biological Treatment	المعالجة الحوية
Blowups	تفتت
Boiler Feed Pumps	مضخات تغذية المرجل
Broken Base	اساس مكسور (في السكة الحديدية)
Brown-Out	تعتيم بني اللون
Bulky Waste:	فضلات في الجملة
Carbon Adsorption	الاستجذاب الكربوني
Cathodic Protection	حماية مهبطية
Chemical Additives	اضافات كيماوية
Chevrons	اشارة المنطقة الغير صالحة للعبور
Circuit Breakers	فاصل كهربائي
Clearance Bars	حواجز الحيزات
Compactor Collection Vehicle	ناقلة مصغرة لجمع النفايات
Complete Break	شق كامل
Condenser Water Pump	مضخة تركيز الماء
Confined Spaces	اماكن محددة او ضيقة
Construction And Demolition Waste	ركام هدم انشائي
Control Tower	برج مراقبة
Corrosion Control	ضبط التاكل
Corrosion	تاكل من الصد أ
Corrugation	تموجات
Cover Material	مواد تغطية
Craters	حفر نتيجة متفجرات
Crushed Head	محطم الرأس
Daily Cover:	غطاء يومي
Defective Weld:	لحام ردئ
Deformation	تشويه
Demarcation Bar	حاجز التحديد

Translation of Technical Terms

English	العربية
Depressions	اماكن منخفضة نتيجة ظغط
Disease	أمراض
Dissolved Minerals	معادن منحلة
Distillation	التقطير
End Batter	منحدر نهائي
Engine Burns	حروق احتكاك بواسطة المحرك
Evaporation	التبخر
Exit Sign	قارمة المخرج
Federal Aviation Administration (FAA)	ادارة الطيران الفيدرالية
Flaking	تقشر
Flight Progress	تقدم الرحلة
Flowed Rail	منساب عاى شكل لسان
Food Waste	فضلات الاطعمة
Foreign Objects	اجسام غريبة
Fuel Spillage	اندلاق الوقود
Grounding	أرضي
Hardness	صلابة او الصلادة
Head/Web Separation:	انفصال تين الوترة والراس
Heat Exchangers	المبادل الحراري
Heat Treatment	المعالجة الحرارية
Holding Position Markings On Runways	اشارة اماكن و قوف في المدرج حين الزحمة
Holding Position	مكان وقوف
Holding Position Sign For Runway Approach	حاملة الاشارة في مدرج الاقلاع
Horizontal Split Head	شق طولاني في الراس
Inbound Destination Sign	اشارة داخل حد المكان المقصود
Instrument Landing System (ILS)	منظومة اجهزة الهبوط
Ion Exchange	تبادل شوارد
Iron Rust	صدأ فولاذي
Land Hold Short Lighting Systems	منظومة اضاءة المكان المؤفت
Lighting Controls	ظوابط الاضائة
Lime Stabilization	التوازن الجصي
Location ID	شفرة تحديد المكان
Manhole	فتحة دخول الى مجرور
Medium-Intensity Approach Lighting System MALS	منظومة اضاءة للاقتراب متوسطة القوة
Microwave Landing System (MLS)	منظومة الهبوط بالذبذبات الدقيقة
Mill Defects	اضرار حشوية
Neutralization	التعديل (الكيماوي)
No Entry Sign	اشارة ممنوع الدخول

Translation of Technical Terms

English	العربية
Nondirectional Radio Beacon (NDB)	اشارة راديولاسلكية غير محددة الاتجاه
Open Burning	حرق فضلات في الهواء الطلق
Outbound Destination Sign	اشارة خارج حد المكان المقصود
Parking Lots	مواقب سيارات
Pathogens	كائن ممرض
Piped Rail	سكة على شكل ماسورة
PH	خفيف الحموضة
Portable Radio Unit	جهاز راديو قابل للحمل
Potholes	حفرة على شكل قدر
Precision Approach Path Indicators (PAPI)	مؤشرات الطريق للاقتراب المحكم
Precision Obstacle Free Zone (POFZ)	منطقة خالية من العوائق باحكام
Pumped Drainage From Sump Basin	ضخ مياه التصريف من المجمع
Physical Treatment of Corrosion	معالجة فيزيائية للتاكل
Radio Control Interface	الظابط السطحي للراديو
Rail Wear	هريان او انمحاح السكة
Railroad Crossings	تقاطع سكة حديدية
Runway End Identifier Lights (REIL)	اضواء تحديد نهاية المدرج
Resin Adsorption	امتصاص راتنجي
Receiver Checkpoint Markings (Visions of Reality, VOR)	اشارات ارسال حواجزفي دليل الاتجاه (رؤية واقعية)
Rotating Beacons	اشارات التغيير
Runway Aiming Point Marking	اشارات نقطة الهبوط للمدرج
Runway Centerline Markings	اشارات الخط المركزي للمدرج
Runway Designation Marking	اشارة تدل على المكان المقصود
Runway Distance Remaining Sign	اشارة المسافة المتبقية في المدرج
Runway Edge Lighting System	منطومة اضاءة حافة مدرج الاقلاع
Runway Guard Lights (RGL)	خطوط حراسة مدرج الاقلاع
Runway Shoulder Markings	اشارة كتف المدرج
Runway Side Stripe Marking	اشارة الحد الجانبي للمدرج
Runway Threshold Bar	حاجز بداية المدرج
Runway Threshold Marking	اشارات بدايةاو عتبة المدرج
Runway Touchdown Zone Marking	منطقة الهبوط على المدرج
Rut	بال
Sanitary Landfill	المزابل الصحية
Shattered Slabs	بلاطة متحطمة
Shelling	يصبح على شكل قبة
Shelters	الملاجئ
Slippage Cracking	شقوق انزلاقية
Slivers	تشظي
Sludge	وحل
Split Web	انشقاق الوترة

Translation of Technical Terms

English	العربية
Splashblock	حاجز الرش
Stationary Compactor	مركز رص
Stop Bars	حواجز الوقوف
Surface Bent Rail	سكة ملتوية السطح
Surface Damage	ضرر سطحي
Surface Painted Gate Identification Signs	اشارة تعريف المدخل مدهونة الوجه
Surge Tanks	صهريج التمور
Taxiway Edge Lighting Systems	منطومة اضاءة حافة مدرج التدرج
Taxiway Edge Marking	اشارة حد القيادة الارضية
Taxiway Ending Marker	نهاية حد التدرج
Taxiway Shoulder Markings	اشارات كتف القتادة الارضية
Threshold/Runway End Lights	العتبة \ اضاءة نهاية مدرج التدرج
Torch Cut Rail	سكة مقطوعة بمشعل الاكسجين
Touchdown Lighting Systems	منطومة اضاءة خط النهاية
Transfer Station	مركز نقل
Transmitter	المرسل
Treatment Plants	منشات المعالجة
Unexploded Ordnance (UXO) –	متفجرات غير مفجرة
Vector	ناقل جراثيم
Vehicle Roadway Markings	اشارات طريق السيارات
Vertical Split Head	شق عامودي بالراس
Very High Frequency (VHF)	ذبذبة عالية
Wind Cones	كم او مخروط الريح

Part 5 – References

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