Badger Army Ammunition Plant
Historical Overview
1941-2006

U.S. Army Joint Munitions Command
AMSJM-HI (History Office)
1 Rock Island Arsenal
Rock Island, IL 61299
Title Page Photo: You are looking east at the main production area of the Badger Ordnance Works. This photo shows:

- a housing area for single employees, and military personnel, the "H" shaped buildings in the foreground. The open area to the right was the future sight of the Badger Village to be built for family housing of plant employees.
- an expanded US Hwy 12 running across the photo above the "H" shaped buildings. This highway was expanded from two lanes to four.
- the two large buildings above the highway house the operating contractor's and Army offices.
- above these office buildings was the hospital (unbalanced "T" shape), the central maintenance area two large buildings with a group of smaller buildings.
- the road going into the Plant from the highway is the main entrance to the Plant, "North Service Road".
- the rows of identical buildings to the left of the main entrance are change houses where maintenance and production employees changed from their street clothes the special clothes required for their work areas.
- the building behind the change houses with the large windows was the main power house that furnished steam to the entire facility.
- to the left of these is the Nitrocotton Acid Area
- behind the above buildings the area with roads laid out and some buildings in place on both sides of the North Service Road going back to three larger buildings in a row make up the Nitrocotton and Smokeless Propellant Areas.
- other construction that does not show up well in this photo includes the Ether Stills, reservoirs
- the large body of water near the top center of the photo is Lake Wisconsin.
- scattered around the photo are farmsteads, many with the buildings still standing as the ammunition plant was constructed around them.
Badger Army Ammunition Plant

Touring the land of the former Badger Army Ammunition plant you have to imagine the sights and sounds, buildings, and employees that once occupied this Wisconsin area for over half a century. Imagine – simply because the plant is closed and being dismantled. All that remains are a skeleton staff and contractor environmentalists cleaning the land up for reuse by the local area. The story of Badger AAP begins in 1941 as the United States was building up military ordnance infrastructure to handle the demands of World War II. Badger was one of 77 Government-Owned Contractor-Operated (GOCO) industrial plants constructed by the U.S. Army for WWII, and one of 23 of these plants that produced explosives or propellants. Though several plants worked towards the mission of producing propellants, Badger became a unique element of the industrial base when Ball Powder production was produced at the plant in the 1950s.

Planning for an Ammo Plant - 1940s

In the months prior to the U.S. entry into WWII, the U.S. government began construction of several smokeless powder plants to meet the increasing needs of the U.S. and its allies fighting against Hitler and the Third Reich. Ideas to build upon or extend existing production capabilities at existing plants were discarded in favor of building additional plants at new locations which provided greater safety from enemy attacks or sabotage. Spreading the workload out at several plants would also provide employment opportunities throughout the country. The ability to mobilize reservoirs of the unemployed without moving masses of people to only a few locations was appeasing and the route that the ordnance department took.

Preliminary plans for construction of a powder plant in Wisconsin were evidently well underway in the summer of 1941. Information concerning the project was requested June 1941 by the Construction Division of the Army Quartermaster General in request to the Ordnance Department. In late October, an announcement concerning the project to be constructed near Merrimac, Wisconsin was issued to the newspapers by the Office of Rep. William H. Stevenson of Wisconsin’s Third Congressional District. A letter of intent dated 10 November 1941 to the Hercules Powder Company out of Wilmington Delaware, authorized that Company to proceed with preliminary surveys and to initiate design for the Plant. Hercules Powder Company was chosen as operating contractor because Badger was to be designed as a duplicate of the Radford Ordnance Work that the company had constructed and operated in Virginia.

Preliminary investigation of the proposed Wisconsin site ensued in mid-November. Commanding Officer, Major George F. Griffith of the Ordnance Department arrived in Baraboo on 8 January 1942. Mason and Hangar followed and set up their first field office by 14 January. By the end of the month work on the site of the Army’s future smokeless powder plant had begun.

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1 John Troyer. Memo to commanding General of APSA. *Chronology of Dates Leading to the Construction of Badger Ordnance Works*. 27 January 1971. Mr. Troyer included bits and pieces of evidence from 1941 memos in his letter. Memos talk about the planning for the plant. Memos also between Hercules and the ordnance department concerning contract negotiations.
Choosing a Site

Badger AAP was chosen for numerous reasons. The plant is located between Baraboo Sauk City, Prairie Du Sac, and Merrimac, WI cities on Highway 12 in the Townships of Sumpter, Merrimac, and Sauk County, WI. Badger was strategically located on fairly flat farmland, that is hilly or rolly enough to provide adequate drainage. The subsoil is gravelly in nature and presented opportunity for excellent load bearing qualities. The original acreage acquired by the government was in excess of 10,500. The plant was to be situated close to the Wisconsin River on the east and southeast for its water supply. It is bounded on the north by a range of hills known as the Baraboo Bluffs. The mean elevation of Badger is 870-900 feet above sea level. The geographical characteristics were appropriate for the requirements of an ammunition plant. Some of the land was occupied at this time. Several farmers were relocated off of the rich farmland known for being the heart of Wisconsin’s dairy, orchard, and farm belt.

Construction and a Town’s Reaction

Once plans and site investigations were concluded the ball began rolling and construction was soon underway. Contracts allowed just 12 months for the plant to be constructed and ready for production. Mason and Hanger the prime contractor subcontracted with numerous companies to complete this undertaking and the first operations began in the acid area in January 1943, less than a year from the date construction began. Construction proceeded throughout the war and new lines and facilities were left partially completed when construction was stopped in August 1945. The total cost of construction and equipment was $132,794,288 in the 1940s. Almost immediately after V-J day the Field Director of Ammunition Plants (FDAP) placed Badger in stand by status.

In 1995 a series of oral history interviews were conducted by Deborah Crown and the Corp of Engineers with residents of Baraboo and former employees of Badger AAP. They were interviewed on their recollections of the construction and operation of the plant. Mr. Floyd Allen was a resident of Sauk County and recalled when they began constructing the plant, “Construction workers come largely from other places. There just wasn’t enough [workers] available locally.” Suddenly he recalled the town became “swamped” with people. Workers worked around the clock seven days a week and received the eighth day off building what became a very large complex of buildings.

The town’s reaction to the news that an ammo plant would be rising in the community may have been one of confusion and mild fear about their futures. Mr. Allen states, “Well, of course, nobody knew what a powder plant was like. Nobody around here had ever seen one.

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And I had no idea. I had vision of one big, large factory type thing, instead of sprawled out the way it turned out.”

There were some fears about where all the influx of construction workers and eventually production employees would reside in and near Baraboo. Residents were mainly farmers and many lost their farms to sale of land for the plant. Residents were not happy about the loss but transitioned with the change. Dorothy Bohnsack remembered, “I knew that the farms had to be taken down and everybody was upset, but really, I don’t think it affected local (Sauk) people that much because most of the people were going into the service. And a lot of the people that didn’t stay in farming, they went to Madison to work at Oscar Mayer or Ray-O-Vac…I think probably the biggest was the shock of all the people coming up…”

At the same time of some of the perceived downsides, construction of the plant helped end the Depression for thousands of workers, and local residents benefited from retail sales and local construction projects. The construction crew for Badger peaked at 12,000 in August 1942. Construction and production workers poured in from near and far, finding housing in everything from homes, spare rooms, attics, on-site barracks and a nearby Civilian Conservation Corps (CCC) camp, to trailers and outbuildings. A Federal Housing Project community, Badger Village, was constructed nearby for workers, and the adjacent section of Hwy 12 became Wisconsin’s first rural 4-lane highway. Several local businesses and construction companies got their start during this time.

Most of the 1400+ buildings constructed at the plant were of wood-frame construction, which incorporated many design features related to specific production and safety requirements, including non-static concrete-graphite floors, break-out doors, escape chutes, blow-out roofs, concrete partitions, soil-filled timber barricades to direct explosions upward, high-capacity sprinkler systems, etc. To avoid sparks, some machines were powered by steam or compressed air, and some buildings were lit through windows from the outside. The spacing between specific buildings reflected the distance that explosions might carry.

Though I didn’t have a map showing original 1940 construction available for scanning into this report I have included a map showing the buildings and production areas that had been built up by 1992.

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5 Crown, 4.
6 Crown, 25.
This is a map showing Badger’s main production and magazine areas. Buildings are identified in red. Today some buildings still stand but most have been properly dismantled and disposed of. The land is slowly being turned back for local reuse.
The 1940s

Badger AAP was originally called Badger Ordnance Works (BOW). This following photo shows a guard shack and employee checkpoint with the BOW sign.

Badger’s mission as a Class II government owned contractor operated military industrial installation was to conduct the following:

- manufacture propellants, explosives and chemical materials as assigned

- operation and maintenance, as directed, of active facilities in support current operations. Maintenance and/or layaway in accordance with instructions, of standby facilities, including any machinery and packaged lines received from industry, in such condition as will permit rehabilitation and resumption of production

- receipt surveillance, maintenance renovation, demilitarization, salvage, storage and issue of assigned Field Service stocks and items of industrial stocks as required or directed

- procurement, receipt, storage and issue of necessary supplies, equipment, components and essential materials

- mobilization planning, including review and revision of plans as required

Though new production capabilities were added over the years such as ball powder production, operations and basic mission functions remained essentially the same across the century when the plant was operating.
Once the plant was completed it began operations immediately in 1943. Employment at the plant depended upon workload which took workers on a roller coaster of unemployment. Interviews indicated several employees expected that employment would not be long lasting and serve purpose towards war time work. When the plant opened people took the employment opportunities. A large portion of the workforce was women. The government and War Manpower Commission urgently recruited workers from all over the local region.

Badger was first operated by Hercules Powder. It produced acids and used these to treat cotton fibers and wood pulp to produce nitrocellulose. This was further processed into smokeless powder, ethyl centralite (E.C.) powder, and rocket powder. The latter product required nitroglycerin, which was also produced at the plant. These propellants were shipped elsewhere to be incorporated into ammunition for small arms, cannons, grenades and small rockets. A dynamite (TNT) production area was partially constructed but aborted. Electricity was provided by outside utilities. A large on-site power plant produced steam, which provided heat and some power through a network of some 200 miles of elevated pipe.

The workforce peaked at 6600, working round-the-clock in three shifts, and commuting by carpool and buses from as far as 80 miles. The workforce included production workers, safety and security forces, administrators, engineers, maintenance and crafts people, a small hospital staff, and others. Safety was also incorporated into operational procedures and functional uniforms, which varied among production areas. Smoking and matches were prohibited. Workers were often checked when arriving or leaving the plant, and were generally restricted to their work areas while on-site. A "plant culture" developed around the common experiences that related to production, safety issues, rationing and work on the "home front". This is reflected in the plant newspaper, recreation hall, and stories that have lasted nearly 60 years.

By 1945 the ordnance staff had been reduced to around 100 people. Reductions continued and after V-J day numerous employees voluntarily terminated employment after war tensions had ceased. By Dec 1945 the staff performing maintenance shut down operations were

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7 1945-1951 Badger Annual History. 5-6
released and bus services that had operated for the past 5 years were discontinued. Several construction projects were halted unfinished. The plant closed shortly after the war ended, but was maintained and preserved in stand-by status for the possibility of future wars.

The 1950s

When the Korean Conflict came about, that possibility of war may have come earlier than anyone would have liked. Badger was reactivated in February 1951. On 30 April 1951, the Liberty Powder Defense Corporation of East Alton, IL (a subsidiary of Olin Corporation) took over as operator of Badger from Hercules. Olin Corporation was a diversified company concentrated in chemicals, metals, and applied physics with emphasis on electronic materials and services, aerospace defense, and water quality management. Plans for rebuilding the workforce had already been underway in 1950. Actual production workers were not recruited until 1951. With the outbreak of the Korean conflict, about 5000 workers were called back and hired to produce smokeless and rocket powder. In February 1951 the first production order for manufacture of 16 million pounds of T6 M16 Rocket powder was received. The plant was back in business. The plant was rehabilitated and new construction activities commenced. Near the end of this war, a new section was built to produce ball powder. During this phase, the plant produced about 286 million pounds of propellant, including the new “Ball Powder.”

During 1954 and 1955 new facilities for the manufacture of ball powder propellant were constructed on a lump sum bid let by the Corp of Engineers. The architect engineer contractor was the HK Ferguson Company of Cleveland Ohio. The production of Ball powder was unique to the Badger plant, it was the only plant in the industrial ammo base with the capability. Production of ball powder started with a water slurry medium with other ingredients and solvents before it was turned into a lacquer form. Controlled agitation and adding protective colloid and dewatering salt dispersed the lacquer into droplets of suitable diameter. After the solvent was distilled off, round hard balls of nitrocellulose were left behind in a water suspension. After a few more steps in this process it is coated and glazed with substances to improve loading characteristics and static hazards before being tested and packed into containers.

Ball powder flowing into a circle buggy ➞ after salt coat and glazing operations

Wet Ball powder placed on trays for air drying ➔

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8 AMCCOM. FY84 Installation Profile Badger AAP. p 3.
Badger had a capacity to produce 3 million pounds of ball powder a month. A Blank fire ball powder area was also constructed that supported the production of 30,000 pounds a month.

Production during the Korean conflict also consisted of smokeless powder, double base rocket propellants, but excluded E.C. powder and ball powder. Total production, which included such items as .30 caliber ball powder, M6 for 75mm gun, M6 for 90mm gun, m-1 for the 155mm Howitzer, M-1 for the 8 in Howitzer, MK-18 JPN and M-16 Rocket powder all adding up to over 286 Million pounds. During this war time era employment peaked at 5,022 employees. Operations were ceased and the plant was placed on stand by status in 1958.

The 1960s and 70s

In 1963 Badger Ordnance Works was officially redesignated Badger Army Ammunition Plant. The plant was kept in stand-by mode again until 1966, when it began production for the Vietnam War. Reactivation notice was issued 3 Jan 1966 and the first powder was produced in May of ‘66. During the ensuing 10 years, the plant produced nearly as much propellant as it had for the first two wars combined. A total of around 446 million pounds of propellant was produced. Like other wartime periods, employment peaked at 5,390 employees. It was the focus of at least two antiwar protests during the Vietnam era and an unsuccessful bombing attempt by protester Karleton Armstrong, whose uncle had been killed by an accidental explosion at the plant in 1945. Armstrong eventually blew up Sterling Hall at University of Wisconsin-Madison, in protest of the war.

At the end of Vietnam era production, new facilities were built to produce acids and nitroglycerin. Other facilities were eventually constructed to clean groundwater contaminated by earlier, unsafe disposal practices, and polluted soil and other materials were treated or land-filled. A "buffer" area used for wildlife conservation eventually developed into a 1400-acre area for prairie and savanna restoration, managed with several partners. The USDA built a Dairy Forage Research Center on a corner of the property and began leasing several hundred acres for agricultural studies and production. A few warehouses, storage tanks, and an office building were leased to local businesses.

All production ceased at Badger in 1975 and the plant was designated as inactive. It was under the management of Olin Co. Other tenants of the site are Flambeau Plastic, CENEX, Dairy Forage Research Center, Orbitex, and others.

Understanding Badgers Production Operations 11

Throughout its existence, Badger may have been producing several types of powder and different variants within each family at a given time, but manufacturing operations were essentially integrated. The manufacturing process started with the manufacture of 98% nitric acid, using the ammonia oxidation process and the manufacture of 40% oleum (sulfuric acid).

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9 AMCCOM. FY84 Installation Profile Badger AAP, 3.
The acids are mixed to make nitrating compositions suitable for nitrating cellulose (of cotton linters or wood pulp origins) and natural or synthetic glycerin to make military graded nitrocellulose and nitroglycerin. These intermediates, after purification, constitute the energy components of the end product propellants. There were five nitrocellulose lines at Badger, with a total capacity of 15 million pounds a month and the nitroglycerin capacity was 2.25 million pounds a month. See the below figure for a picture of how the plant lines were integrated.

Operations included manufacture of several end items like single base smokeless powder for cannons and solventless double base rocket propellant and ball powder. Each production process is unique and I won’t discuss them all. In the production of solventless double base rocket propellant a paste is produced that is consolidated in roll mills to a rubbery sheet form. The sheet is tested for burning rate characteristics. The proved material is slit and rolled into carpet rolls suitable for charging into high pressure extrusion presses. The strand is then cut into an approximate finished length. Untrimmed rocket grains are machined in successive steps to exact final weight and dimensions. Ethyl cellulose inhibitors are cemented to the ends of the grains and spirally wrapped with a multi layer sleeve of ethyl cellulose tape. Acceptable grains are packed in protective tubes and bundled into pallet containers for shipment. Badger could produce 5 million pounds a month of MK43 rocket grains. See below photos for employees conducting parts of this process.

Sheets are slit and rolled into carpet rolls and transported to the final press operation

End inhibitors are applied to the MK 43 rocket grains after the final sawing operation
Plant Modernization

Before the plant was designated inactive in 1975 it was beginning to address the reality of modernization and advanced technologies. Badger’s parent command APSA (Army Procurement Supply Agency) began examining several different issues:

- assessment of the condition and capabilities of the Army Ammunition plants built during the WWII era and those still available in active or standby status

- stresses and problems arising from large scale production of ammo required to meet wartime needs and global commitments

- efforts to determine obsolescent plant and equipment supplying this ammo

- efforts to define, develop and implement a multi billion dollar modernization program designed to take advantage of technological progress in meeting present and future ammunition manufacturing requirements with greater efficiency and lower cost

- community relation problems created by the growth of residential areas near high pollution explosives and propellant plants with the efforts to control pollution at these plants.

During periods of standby status the plant was often not fully funded to conduct required maintenance. Many buildings and equipment deteriorated and decomposed. With each reactivation, rehabilitation was only applied to the areas that would be used. Rehabilitation was costly, especially for the smokeless and rocket areas. After the Korean War it had been decided that the rocket facilities would probably not be needed for future conflicts. The heat was shut off and the areas were cannibalized for equipment. It turned out that the rocket area was needed during Vietnam and had to be completely rehabilitated. So by the time Vietnam had arrived, extensive rehabilitation of the plant was needed. Badger was faced with the challenge of making deteriorated and obsolete operating equipment workable in new processing procedures. They faced the reality that many of the companies that made machinery simply no longer made replacement pieces for equipment so old. This increased the mobilization period. Technological advances also created problems that required reintegration of system design at high costs. The capability of Badger had drastically changed since it began operations in 1943.

Between 1964 and 1970 operational capability had been modified through operational improvements and addition of modern support facilities. By 1970 Badger had the capacity to produce 16 million pounds of single base propellant in four lines, 5 millions pounds per month of rocket propellant and the ball powder had remained in a ready state and its capacity of 3 million pounds a month remained.

Towards 1970 Badger was involved in creating modernization plans and addressing pollution issues. Badger produced a 12 Year Modernization Program by 1972 and several projects were initiated. The twelve year total for modernization was estimated at $503 Million, although Badger was never fully funded for all it had planned. A new acid complex was constructed west of the nitroglycerin area along with a new nitroglycerin plant. The old nitro
plant was a batch style production and the new provided continuous production processes. The objective was to increase automation, mechanization, and consolidate existing production operations. In June of 1974 the 12 year modernization program that had originated as a five year program, was stretched out to a 22 year program. Several projects that were planned for the plant never materialized. Those that did were aimed at doing more with less resources and labor.

Production during the 1970s gradually decreased. Schedules for FY74 called for increases in rocket powder but a decrease in ball powder and cessation of single based smokeless propellant. Contractor manpower decreased from 2,300 to 1,900. The Commander of the plant described Badger as a “pendulum of transition from production to modernization activities.” The close out of single base powder had cut total installation production by 60% and contributed to the growing unemployment in the area. In 1975 the decision had been made to place the whole installation in inactive status. The plant once again began to decontaminate and dismantle production lines. Naturally the local reaction was not positive, and employees talked to local newspapers about the challenge they would now face finding jobs. Reasons stated for placing the plant on standby included the end of the Vietnam War and competition with similar plants like Radford AAP in Virginia.

Closing Down a Plant

Badger celebrated its 50th anniversary in 1992. The 1992 plant manager James Mattei expressed his gratitude towards the workforce in a letter. He said, “each generation of workers has fully satisfied the expectations of our customer…the future is always difficult to foresee, particularly with the end of the Cold War and the rapidly changing European and Mid-East scene. However it is safe to expect that Badger will continue to be an important part of the mission to protect our people and our government.” In the mid 1990s badger was still on standby as the "backup" propellant facility in the Industrial Operations Command (IOC) industrial complex. Badger still had facilities to produce large quantities of propellants for artillery, tank cannons and naval guns; ball powder propellant for small and medium caliber ammunition; and grains for the 2.75' rocket system. Unfortunately, Badger would soon be slated for closure through a Base Realignment and Closure (BRAC) decision. Despite Badger’s unique capabilities, studies and Base Realignment and Closure (BRAC) As Badger prepared for closure, buildings were decontaminated and dismantled and numerous environmental remediation projects began.

In the late 1990s, Badger was removing 1,000,000 pounds of nitrocellulose left from the previous operations by conversion to fertilizer that is then land spread at Badger. The operating contractor, Olin Corporation, contracted with Bioremediation Services Inc., in Portland, Oregon, to remove and dispose of the nitrocellulose. This was the first time this technology has been used.

13 July 1972-June 1973 Badger Unit History, 36.
16 “Loss is Big Unknown.” Baraboo News Republic. 3 April 1975: np.
on this scale for the disposal of nitrocellulose. As the Army is faced with the need to deamil ammunition, this technology could be used for the disposal of nitrocellulose by conversion to a usable product.

In addition to standby activities, Badger was also involved in the remediation Badger Army Ammunition Plant of the facility for environmental problems from former periods of production. Eighty percent of funding for the plant was for remediation and the remainder was for standby and support activities. The former open burning site at Badger was closed with soil cover rather than by solidification in 1996, which resulted in significant reduction in remedial costs. Groundwater treatment facilities treating 3,400 gallons of water per minute are operating to handle the contamination. The treated water is being used at Badger for all water not suitable for drinking to save the cost of operating deep wells to supply the water. In 1997, a former landfill was closed with a cap and a soil vapor extraction system to remove soil solvent contamination at a former disposal site. Environmental clean up has been ongoing over the past 30 years. Studies have discovered numerous pollution issues that had to be addressed before any land was turned completely over for reuse. Some of the major problems were identified in a Badger Installation Action Plan published by the Operations Support Command in 2001.

The plant was kept on standby until the announcement of its impending excession in 1997. This was part of a larger decision to decommission ordnance plants no longer needed after the Cold War. In 1998 excess activities were brought under the oversight of GSA General Services Administration and have continued up until now. Thousands lined up to take a final tour of Badger in September 2000. Former employees to Vietnam veterans stopped in to see the plant on this day. Over the years employees of the plant felt pride in their positions at the plant. They were dedicated to serving the war effort and providing ammunition propellants of the highest caliber of quality. Many of the army’s installations that were built up in 1942 have been excessed and dismantled in exchange for increasing modern technology and modernizing the right size industrial base for today’s ammo production requirements. Today the organic or government owned number of installations has decreased to around 13 (to include depots and munitions centers).

I recently visited Badger for final document collection efforts in 2004 and toured the plant. Several buildings are hanging on by a thread and slated for disposal. Today the large industrial complex has turned back into the rolling prairie and farmland it once was. A local Badger History Group keeps the stories and history of the plant alive through their efforts. Additional information on Badger’s legacy can also be found at the Joint Munitions Command Headquarters History Office in Rock Island, IL. For further information a book by Michael Groc titled Powder, People and Place: Badger Ordnance Works and the Sauk Prairie is available on Amazon and through inter library loan programs. Videos of the plant and some operations are also located at the Joint Munitions Command.

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Badger 1970 Photos
Admin Area
Ammo Storage Area
Acid Area
Nitroglycerin and Rocket Powder Areas
Smokeless Powder Finishing Areas
Badger Ball Powder Area and Oleum (Sulphuric Acid) Plant
Badger AAP 2000s

View of Power Building in Badger Army Ammunition Plant

View of Process Building in Badger Army Ammunition Plant

Behind Shop Area with view of Power Building in Badger Army Ammunition Plant

Cemetary
Land Adjacent to Devils Lake State Park
in Badger Army Ammunition Plant

North Side of Badger Army Ammunition Plant
Groundwater Treatment Plant in Badger Army Ammunition Plant

General View of Badger Army Ammunition Plant