NJ650.14C Drainage for Agricultural Structures

a) Introduction

NRCS in New Jersey provides assistance on agricultural structures including agrichemical handling facilities, heavy use areas, and waste storage facilities. These structures may be roofed or unroofed. Proper drainage or management of surface and subsurface water around agricultural structures helps to ensure that these facilities can be operated and maintained as intended. Depending on the site, this will generally include diversion of surface water, disposal of roof runoff, and the lowering or interception of ground water. Conditions that commonly cause problems include:

- The land is flat or slopes toward the facility, permitting surface water (rain and melting snow) to drain in or around the structure.
- Lack of gutters and downspouts to handle roof water from rain and snow. The free-falling water may blow into the facility or form puddles, or wet soil conditions around the structure.
- The ground water level is close to the underside of the floor slab. Water rises through the slab by capillarity, producing dampness.
- For below grade structures, high ground water levels may increase loads on walls and slabs, reduce available storage due to inflow, or be susceptible to contamination due to leakage of stored wastes or pollutants.

b) Site Selection

With proper site selection and planning, many adverse conditions due to poor drainage can be avoided. General information on soil conditions, seasonal high water tables and so forth may be found in the local soil survey report. This information must be verified with an on-site investigation to confirm conditions critical to the site plan and structural design.

An important consideration in selecting the site for a new agricultural structure is proper drainage. This includes not only drainage of surface, but also drainage of any subsurface or ground water that may be present or that may accumulate over a period of time and be blocked from its normal course of flow by the new construction.

High points on the landscape often provide the best building sites and the best surface conditions for drainage. An elevated site provides good surface drainage away from the structure in all directions.

On sloping ground, level foundation areas may be created by cutting into the slope, filling out from the slope, or by a combination of cutting and filling. Surface water should be intercepted upslope of the facility and safely conveyed and released in a down slope location. Deep cuts may expose perched or seasonal high ground water tables that will result in seepage. Surface or subsurface drains may be needed to intercept and divert the seepage flow from the facility.

If the site is flat, the ground must be built up or graded to drain surface water away from the foundation.

Ideal sites are those with well drained soils where the seasonal high ground water level will be several feet below the deepest structural footing or foundation; are outside of flood plains or paths of concentrated flows; and are readily accessible in terms of farm operation and management needs.

c) Surface drainage

Surface drainage around an agricultural structure generally consists of a diversion constructed upslope of the facility to intercept sheet or shallow concentrated flows. Diversions are sized to handle a specified 24-hour design storm frequency based on the type of structure being protected. All structures should be located outside of floodplains or areas of concentrated flow.

d) Subsurface drainage

When areas having a high water table cannot be

avoided, subsurface drainage may be required. It may be necessary to install a drain line or systematic pattern of drain lines in order to lower the ground water level and provide an adequate separation distance between the water table and the structure slab or foundation. Typically, the subsurface drain lines are installed with sand and gravel envelopes to improve interception and inflow into the drainage conduits. The systems should be conservatively designed with an adequate safety factor based on the knowledge and certainty of site conditions and the type or purpose of the structure.

Structural drains are often required around below grade structures such as storage tanks. On-site investigations and sampling will be necessary to properly design the structural drains and filter necessary to insure loading assumptions are met for pre-designed structures or to provide the geotechnical parameters needed for unique structural designs. Refer to the appropriate NRCS structural design and soil mechanics references when designing structural drainage systems.

e) Grading

Agricultural buildings typically include slabs constructed at or close to grade for ease of access by farm equipment or livestock. To maintain positive drainage away from buildings, floor slabs should be elevated a minimum of eight to twelve inches above the surrounding grade. Fill at access locations should be sloped away from the slab at a grade no steeper than fifteen percent. Other areas should be graded at 3H:1V or flatter depending on use and maintenance needs. The land slope in the vicinity of the structure should be a minimum of one percent, and preferable two percent, to avoid ponding during storm events or snow melt. Diversions or grassed waterways may be needed to intercept and convey runoff safety away from the facility.

Below grade structures such as standard waste storage tanks may have specific fill and grading requirements based on structural loading assumptions. These requirements must be met in the site grading plan.

f) Roof runoff

When roofs are installed as a component of an agrichemical handling facility, heavy use area, or waste storage structure, consideration needs to be given to management of roof runoff. Gutters and downspouts are recommended when blow-in of precipitation from the roof eaves is undesirable, or when roof runoff needs to be collected to avoid contamination, control erosion, improve site drainage, supplement water supplies, or to supplement infiltration. Collection systems may also consist of swales, troughs, or gravel filled trenches located along the drip line of the roof, especially where gutters may collect leaves or debris, or may not be easily adapted to the building eave. Gravel filled trenches may include perforated pipe, and non-perforated pipe to convey infiltrated runoff to an area of use or safe disposal. Likewise, downspouts may be connected to underground conduits for conveyance away from the structure. Surface disposal via a splash pad at the downspout may be acceptable where there are not water quality, storm water management, or erosion concerns. See figures C-1 and C-2 for typical installations.

Gutters, downspouts, and underground conduits are sized based on the peak discharge from a 10 year, 5 minute precipitation event except in manure management of concentrated livestock systems where the design storm is the 25 year, 5 minute event. Where collection tanks or infiltration structures are a part of the runoff management system, longer duration storms may need to be considered. Infiltration structures should be located at least 10 feet from building foundations, be accessible for monitoring, and be equipped with an overflow or by-pass pipe located at the structure or the downspout.

g) Dewatering

Dewatering is the temporary collection and disposal of ground water from an excavated area. The type of dewatering system needed depends on the site specific ground water and soil conditions; the depth

and duration of excavation; and the soil moisture conditions required for construction. A typical dewatering system consists of a section of perforated pipe installed vertically in a low area of the excavation, backfilled with gravel, and into which a small sump pump or suction line is placed. Although for most NRCS-assisted projects, the contractor is responsible for submitting a dewatering plan, a site investigation is needed for design so that ground water conditions and dewatering needs pertinent to the structure can be identified. Also, quality assurance personnel should be knowledgeable of ground water conditions for evaluation of the contractor's dewatering plan.

Figure C-1 Typical downspout-splash pad installation

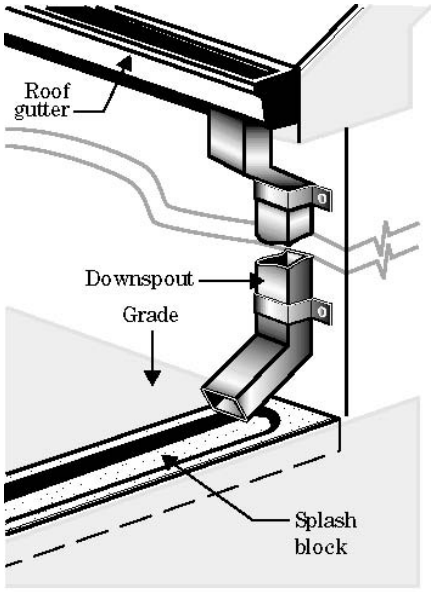
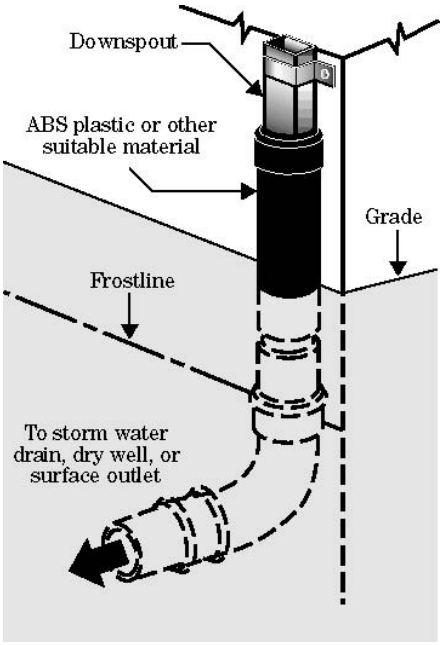


Figure C-2 Typical downspout-underground outlet pipe installation



h) Maintenance

Roof runoff structures and runoff management systems have estimated service lives of 15 years. Service life can be achieved and prolonged through proper maintenance. Standardized operation and maintenance plans have been developed for roof runoff structures and runoff management systems. These can be found in the NRCS New Jersey electronic Field Office Technical Guide.