NATURAL RESOURCES CONSERVATION SERVICE
ILLINOIS URBAN MANUAL
PRACTICE STANDARD

IMPOUNDMENT STRUCTURE - ROUTED

(no.)
CODE 842

(Source: Native Plant Guide for Streams and Stormwater Facilities in Northeastern Illinois)

DEFINITION

A dam or excavation which creates an impoundment to collect and store debris, sediment, or water.

PURPOSE

The purposes of this practice are to reduce sediment and/or debris in runoff waters or retard flooding, to prevent damage to downstream facilities; or to provide surface water for consumption, irrigation, wildlife habitat, recreation or fire protection.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where sediment or debris is expected to be contained in runoff waters and may impair the capacity of the watercourse or damage other structures or where a surface water supply is desirable; where storage for at least one inch of water from the contributing watershed is available and where any embankment does not exceed the limits for class III, small dams, as defined by the IDNR-OWR in "Rules for Construction and Maintenance of Dams" and the landowner or other responsible party has secured necessary permits, if required, for design and construction from IDNR-OWR and any local governmental authorities.

CRITERIA

Investigations - sufficient investigations shall be made of the impoundment site and borrow areas to determine the suitability of site and materials for construction, water holding ability and structure stability. A complete analysis of foundation and proposed fill materials shall be made when, in the opinion of the responsible engineer, it is necessary.

Hazard/safety - structures designed under criteria found in this practice shall fall within the class III, small dam category, defined by the IDNR-OWR as follows: "*class III. Dams located where failure has low probability for causing loss of life, where there are no permanent structures for human habitation, or minimum economic loss in*

excess of that which naturally would occur downstream of the dam if the dam had not failed. A dam has a low probability for causing loss of life or minimal economic loss if it is located where its failure may cause damage to agricultural fields, timber areas, township roads, or similar type areas where people seldom are present and where there are few structures. This corresponds to US Army Corps of Engineers Low Hazard Potential and USDA NRCS class a dams."

Small dams have a total impounding capacity of less than 1000 acre-feet and dam height of less than 40 feet, where dam height is defined as "*height of dam, in feet, as measured from the natural bed of the stream or watercourse at the downstream dam slope toe of the barrier to the top of the embankment or barrier*."

Owners of impoundment structures shall obtain all necessary permits. IDNR-OWR permits may be required for class III, small dams where:

1. The drainage area of the proposed dam is 6400 acres or more in a rural area or 640 acres or more in an urban area, or
2. The dam is 25 feet or more in height, provided that the impounding capacity is greater than 15 acre-feet, or
3. The dam has an impounding capacity of 50 acre-feet or more provided that the dam height is greater than 6 feet.

Pool capacities - structures for the impoundment of debris or sediment shall have a capacity equal to the volume of sediment or debris expected to be trapped at the site during the planned useful life of the structure. That capacity may be proportionally reduced, if periodic removal of sediment/debris is planned.

Structures that impound water for consumptive use shall have capacity as required by local consumptive use standards.

Structures that impound water for irrigation, wildlife habitat or recreation shall have capacity and depth adequate for the intended use.

Structures that impound water for fire protection shall have a capacity of at least 4000 cubic feet per residence. That capacity shall exist between the inlet to hydrant and an elevation three feet below the permanent pool elevation.

Runoff computation - total runoff amounts and peak discharges may be computed using procedures found in NRCS Engineering Field Handbook, NRCS Engineering Handbook, SCS TR-55 and TR-20, US Army Corps of Engineers HEC-1 or other procedures designated by the appropriate regulatory authorities.

Principal spillways - non-permit, IDNR-OWR class III dams shall have a principal spillway structure capable of passing the peak discharge from the routed hydrograph from a 24-hour duration storm event of frequency specified in Table 1 with stage at or below emergency spillway crest.

IDNR-OWR class III, permit size dams shall have a principal spillway structure capable of passing the peak discharge from the routed hydrograph from a 24-hour, 25 year storm event with stage at or below the emergency spillway crest.

Acceptable procedures for flood routing include those in Chapter 11, NRCS Engineering Field Handbook, SCS TR-20, SCS TR-48, US Army Corps of Engineers HEC-1 or other procedures designated by the appropriate regulatory authorities.

For structures with flood retarding as a purpose capacity of the principal spillway shall be adequate to discharge, in 10 days or less, the floodwater storage needed to provide the desired level of protection to the downstream benefited area. Storage provided primarily for the purpose of reducing the frequency of use of the emergency spillway need not be included in this 10-day drawdown limitation. The determination of capacity must be based on consideration of the benefits that accrue to the reduction in the discharge rate, damages that may result from prolonged storage in the retarding pool, damages that may result from prolonged outflow, and limitations in water rights or other legal requirements. Longer release times may be used if warranted by downstream conditions. The discharge through gated outlets shall not be considered in determining the emptying time of the retarding pool.

The elevation of the crest of the lowest stage of the principal spillway shall be set at the elevation of the sediment pool. For dry dams, the riser shall be designed to permit design discharge at the sediment pool elevation with provisions for discharging water at lower elevations to satisfy the functional requirements of the structure.

All parts of the principal spillway, except attached gates and trash racks, shall have an expected service life equal to or greater than the design life of the structure or provisions made for replacement.

The minimum diameter of the conduit used as a principal spillway shall be 10 inches.

The storage volume shall not be less than the expected sediment accumulation during a period equal to the design life.

The retarding storage requirements shall be contain the runoff expected to occur at a frequency consistent with the level of protection to be provided to the downstream benefited area, with proper allowance for discharge through the principal spillway. The retarding storage capacity shall be sufficient to limit the use of the emergency spillway to a permissible frequency and duration based upon consideration of the erosion resistance of the spillway material and vegetative protection to be provided.

Principal spillway structures may be conduits, weir-type straight drops, or chutes.

Principal spillway pipe conduits and fittings may be metal, as per NRCS material specifications 551 through 554 or non-metal, as per NRCS material specifications 541, 542, 544, or 547. Conduits of other materials may be used at the discretion of the appropriate regulatory authorities.

Pipe conduits should meet the following requirements:

The pipe should be capable of withstanding external loading without yielding, buckling, or cracking. Pipe strength should not be less than that of the types indicated in Table 2 for plastic

pipe and in Table 3 for corrugated aluminum and galvanized steel pipe. Flexible pipe strength shall not be less than that necessary to support the design load with maximum 5 percent deflection. The inlets and outlets should be structurally sound and made of materials compatible with that of the pipe. All pipe joints should be made watertight by the use of couplings or gaskets or by welding or caulking.

Acceptable pipe materials are cast-iron, steel, corrugated steel, or aluminum, concrete, plastic, vitrified clay with rubber gaskets, and cast-in-place reinforced concrete. Aluminum pipe will not be used in soils with pH values outside the range of 4-9. Concrete and vitrified clay pipe should be laid in a concrete bedding. Plastic pipe that will be exposed to direct sunlight should be made of ultraviolet-resistant materials and protected by coating or shielding, or provisions for replacement should be specified. Connections of plastic pipe to less flexible pipe or structures must be designed to avoid stress concentrations that could rupture the plastic. Cantilever outlet sections, if used, should be designed to withstand the cantilever load. Pipe supports should be provided when needed. Other suitable outlet protection structure devices may also be used to provide a safe outlet.

Anti-seep collars should be installed around the pipe conduit in the normal saturation zone if any of the following conditions exist:

1. The settled dam height exceeds 15 feet.
2. The conduit is of smooth exterior pipe larger than eight inches in diameter.
3. The conduit is of corrugated exterior pipe larger than 12 inches in diameter.

Anti-seep collars and their connections to the pipe should be watertight. The collar material should be compatible with pipe materials. The maximum spacing should be approximately 14 times the minimum projection of the collar measured perpendicular to the pipe. A minimum of one anti-seep collar should be used on all conduits.

Closed conduit spillways designed for pressure flow must have adequate anti-vortex devices at their inlets.

If needed to prevent clogging of the conduit, an appropriate trash guard should be installed at the inlet or riser.

For safety reasons, all vertical drop inlets should be constructed to prevent accidental injury. This may be accomplished by using a horizontal anti-vortex baffle, trash rack or guardrail.

Procedures for designing, dimensioning, and detailing pipe conduit spillways may be found in the Engineering Field handbook, the NRCS National Engineering Handbook and the Illinois Procedures and Standards for Urban Soil Erosion and Sedimentation Control or other references specified by local regulatory authorities.

Weir-type straight drops or box inlets and chutes shall be designed according to procedures in the NRCS Engineering Field Handbook, the NRCS National Engineering Handbook, and the USDA Agricultural handbook No. 301, or as specified by the local regulatory authorities.

NRCS toe wall drop structures can be used if the vertical drop is 4 feet or less, flows are intermittent, downstream grades are stable, and tailwater depth at design flow is equal to or greater than one-third of the height of the overfall.

The ratio of the capacity of drop boxes to road culverts shall be as required by the responsible road authority. The drop box capacity attached to a new or existing culvert must equal or exceed the culvert capacity at the design flow.

Emergency spillways - An emergency spillway must be provided for each dam, unless the principal spillway is large enough to pass peak discharge from the routed design hydrograph and the trash that comes to it without overtopping the dam. The following are minimum criteria for acceptable use of pipe conduit principal spillway without an emergency spillway: a conduit with a cross-sectional area of 3 feet or more, an inlet that will not clog, and an elbow designed to facilitate the passage of trash.

The minimum capacity of a natural or constructed emergency spillway shall be that required to pass the peak flow expected from the routed hydrograph from a design storm of the frequency and duration shown in Table 1. IDNR-OWR class III permit dams shall have an emergency spillway capable of passing the peak discharge from the routed hydrograph from a 100-year, 24-hour storm event less principal spillway discharge.

Emergency spillways shall provide for passing the design flow at a safe velocity to a point downstream where the dam will not be endangered.

Constructed emergency spillways are open channels that usually consist of an inlet channel, a control section, and an exit channel. They shall be stable for the material in which the spillway is to be constructed. The emergency spillway shall have a bottom width of not less than 10 feet.

Upstream from the control section, the inlet channel shall be level for the distance needed to protect and maintain the crest elevation of the spillway. The inlet channel may be curved to fit existing topography. The grade of the exit channel of a constructed emergency spillway shall fall within the range established by discharge requirements and permissible velocities. Design procedures and details for vegetated earth emergency spillways may be found in the NRCS Engineering Field Handbook, the NRCS National Engineering Handbook, and SCS Technical Release 52, or other references specified by the local regulatory authorities.

Foundation cutoff - A cutoff of relatively impervious material shall be provided under the dam if necessary. The cutoff shall be located at or upstream from the centerline of the dam. It shall extend up the abutments as required and be deep enough to extend into a relatively impervious layer or provide for a stable dam when combined with seepage control. The cutoff trench shall have a bottom width adequate to accommodate the equipment used for excavation, backfill, and compaction operations. Side slopes shall not be steeper than one horizontal to one vertical.

Seepage control - Seepage control is to be included if:

1. Pervious layers are not intercepted by the cutoff,
2. Seepage creates swamping downstream,
3. Such control is needed to insure a stable embankment,
4. Special problems require drainage for a stable dam.

Seepage may be controlled by:

1. Foundation, abutment, or embankment drains,
2. Reservoir blanketing,
3. A combination of these measures.

Earth embankment - The minimum top width for a dam is shown in Table 4. If the embankment top is to be used as a public road, the minimum width shall be 16 feet for one-way traffic and 26 feet for two-way traffic. Guardrails or other safety measures shall be used where necessary and shall meet the requirements of the responsible road authority.

The combined upstream and downstream side slopes of the settled embankments shall not be less than five horizontal to one vertical, and neither slope shall be steeper than two horizontal to one vertical. All slopes must be designed to be stable, even if flatter side slopes are required.

If needed to protect the slopes of the dam, special measures, such as berms, rock riprap, sand-gravel, soil cement, or special vegetation, shall be provided.

The minimum elevation of the top of the settled embankment shall be 1 foot above the water surface in the reservoir with the emergency spillway flowing at design depth. The minimum difference in elevation between the crest of the emergency spillway and the settled top of the dam shall be 2 feet for all dams having more than 20 acres drainage area or more than 20 feet in effective height.

The design height of the dam shall be increased by the amount needed to insure that after settlement the height of the dam equals or exceeds the design height. This increase shall not be less than 5 percent, except where detailed soil testing and laboratory analysis show that a lesser amount is adequate.

Excavated impoundments:

Runoff - Provisions shall be made for a pipe and emergency spillway if necessary. Runoff flow patterns shall be considered when locating the pit and placing the spoil.

Side slopes - Side slopes of excavated ponds shall be stable and shall not be steeper than one horizontal to one vertical.

Perimeter form - If the structures are to be used for recreation or are highly visible to the public, the perimeter or edge should be curvilinear.

Inlet protection - If surface water enters the pond in a natural or excavated channel, the side slope of the impoundment shall be protected against erosion.

Excavated material - The material excavated from the pond shall be placed so that its weight will not endanger the stability of the pond side slopes and so that it will not be washed back into the pond by rainfall. It shall be disposed of in one of the following ways:

1. Uniformly spread to a height that does not exceed 3 feet, with the top graded to a continuous slope away from the impoundment.
2. Uniformly placed or shaped reasonably well, with side slopes assuming a natural angle of repose. The excavated material will be placed at a distance equal to the depth of the impoundment but not less than 12 feet from the edge of the impoundment.
3. Shaped to a designed form that blends visually with the landscape
4. Used for low embankment and leveling.
5. Hauled away.

Vegetation - Disturbed areas that are not to be cultivated shall be established as soon as practicable after construction. Seedbed preparation, seeding, fertilizing and mulching shall comply with practice standards PERMANENT VEGETATION 880 or TEMPORARY SEEDING 965.

CONSIDERATIONS

Site safety - Impoundments are potential attractive nuisances and safety aspects must be considered in their design and layout. If the area is used or may be used for recreation, it is recommended that warning signs be erected, that lifesaving equipment be available on site and that emergency instructions be posted in a conspicuous location.

Visual resource design - The visual design of impoundments shall be carefully considered in areas of high public visibility and those associated with recreation. The underlying criterion for all visual design is appropriateness. The shape and form of ponds, excavated material, and plantings are to relate visually to their surroundings and to their function.

The embankment may be shaped to blend with the natural topography. The edge of the impoundment may be shaped so that it is generally curvilinear rather than rectangular. Excavated material can be shaped so that the final form is smooth, flowing, and fitting to the adjacent landscape rather than angular geometric mounds. If feasible, islands may be added for visual interest and to attract wildlife.

Impoundments for water supply should have adequate drainage area to fill at least yearly. As a minimum, drainage area, in acres, where water supply is a primary purpose, shall equal permanent storage in acre-feet.

PLANS AND SPECIFICATIONS

Plans and specifications for installing full flow impoundment structures shall be in keeping with this standard and shall describe the requirements for installing the practice to achieve its intended purpose. Items that specifications should address, if applicable, and appropriate construction/material specifications, standard drawings and other standards are as follows:

Site and foundation preparation - All site and foundation areas shall be prepared and maintained in such a manner that earthfill placement or other specified treatments allow the practice to achieve its intended purpose. Applicable construction specifications may include: 1 CLEARING, 2 CLEARING AND GRUBBING, 8 MOBILIZATION, 10 WATER FOR CONSTRUCTION, and 11 REMOVAL OF WATER.

Applicable material specifications may include: 521 AGGREGATES FOR DRAINFILL FILTERS, and 592 GEOTEXTILES.

Applicable standard drawings may include drawing number IL-515 DIVERSION PLAN, IL-585 EARTH DAM STRUCTURE PLAN, IL-630 STABILIZED CONSTRUCTION ENTRANCE, IL-650 SUMP PIT PLAN, and IL-670 TEMPORARY SLOPE DRAIN PLAN.

Other applicable standards may include: DIVERSION 815, SUMP PIT 950, TEMPORARY SLOPE DRAIN 970, and TEMPORARY STREAM CROSSING 975.

Excavations and earthfill - All specified excavation shall be preformed and earthfills shall be placed in such a manner that allows the practice to achieve its intended purpose. Applicable construction specifications may include: 10 WATER FOR CONSTRUCTION, 21 EXCAVATION, 23 EARTHFILL, 24 DRAINFILL, 25 ROCKFILL, 26 SALVAGING AND SPREADING TOPSOIL, 61 LOOSE ROCK RIPRAP, 62 GROUTED ROCK RIPRAP, and 95 GEOTEXTILE.

Applicable material specifications may include: 521 AGGREGATES FOR DRAINFILL AND FILTERS, 523 ROCK FOR RIPRAP, and 592 GEOTEXTILE.

Applicable standard drawings may include: IL-585 EARTH DAM STRUCTURE PLAN.

Spillway structures - All spillways including inlet and outlet structures shall be constructed or installed in a manner that allows the practice to achieve its intended purpose. Materials and construction techniques specified shall be appropriate for the intended life and hazard classification of the practice. Where available, manufacturer's installation recommendations may be included in specifications. Applicable construction specifications may include: 24 DRAINFILL, 25 ROCKFILL, 32 CONCRETE FOR MINOR STRUCTURES, 34 STEEL REINFORCEMENT, 41 REINFORCED CONCRETE PRESSURE PIPE PRINCIPAL SPILLWAY CONDUITS, 42 CONCRETE PIPE CONDUITS AND DRAINS, 43 CLAY PIPE CONDUITS, 51 CORRUGATED METAL PIPE CONDUITS, 52 STEEL PIPE CONDUITS, 53 DUCTILE-IRON PIPE CONDUITS, 61 LOOSE ROCK RIPRAP, 62 GROUTED ROCK RIPRAP, 64 WIRE MESH GABIONS, 71 WATER CONTROL GATES, 81 METAL FABRICATION AND INSTALLATION, 83 TIMBER FABRICATION & INSTALLATION, and 95 GEOTEXTILES.

Applicable material specifications may include: 521 AGGREGATES FOR DRAINFILL and FILTERS, 522 AGGREGATES FOR CONCRETE, 523 ROCK FOR RIPRAP, 531 PORTLAND CEMENT, 532 AIR ENTRAINING ADMIXTURES, 534 CURING COMPOUND, 535 PREFORMED EXPANSION JOINT FILLER, 536 SEALING COMPOUND, 537 NON-METALLIC WATERSTOPS, 538 METAL WATERSTOPS, 539 STEEL REINFORCEMENT, 541 REINFORCED CONCRETE PRESSURE PIPE, 542 CONCRETE CULVERT PIPE, 544 CLAY PIPE AND CLAY DRAIN TILE, 547 PLASTIC (PVC, PE, ABS) PIPE, 551 METALLIC COATED CORRUGATED STEEL PIPE, 552

ALUMINUM CORRUGATED PIPE, 554 STEEL PIPE & FITTINGS, 581 METAL, 582 GALVANIZING, 584 STRUCTURAL TIMBER AND LUMBER, 585 WOOD PRESERVATIVES AND TREATMENT, and 592 GEOTEXTILE.

Applicable standard drawings may include: IL-543 INLET FOR UNDERGROUND OUTLET METAL, IL-545 CULVERT FLARED END SECTION, IL-576 HEADWALL SAFETY GUARD FOR PIPE RISERS, IL-577 HOOD INLET WITH BAFFLE FOR CMP, IL-578 CMP DROP INLET & BAFFLE, IL-579 CMP PIPE DIAPHRAGM, IL-580 COUPLING BAND FOR CMP, IL-581 TIMBER PROP FOR 10" - 30" DIAMETER CMP, IL-582 TIMBER PROP FOR 36" - 48" DIAMETER CMP, IL-583 DROP INLET STRUCTURE PLAN, IL-584 HOOD INLET STRUCTURE PLAN, IL-585 EARTH DAM STRUCTURE PLAN, IL-586 CMP SUPPORT, IL-590 TRASH RACKS FOR PIPE DROP INLET, IL-591 TRASH RACKS FOR HOODED INLET, IL-592 DETAIL FOR PVC CANOPY INLET, IL-593 FLEXIBLE ANTISEEP COLLAR, and IL-610 PIPE OUTLET TO FLAT AREA.

Site physical protection plan - Adequate measure shall be specified to control, on site, additional runoff and/or contaminants expected as a result of construction activities; to provide for the safety of the general public; and to provide a maintainable system of erosion protection for the constructed practice. Applicable construction specifications may include: 6 SEEDING, SPRIGGING, & MULCHING FOR PROTECTIVE COVER, 26 SALVAGING & SPREADING TOPSOIL, 27 DIVERSIONS AND WATERWAYS, 46 TILE DRAINS, 61 LOOSE ROCK RIPRAP, 62 GROUTED ROCK RIPRAP, 64 WIRE MESH GABIONS, 91 CHAIN LINK FENCE, and 95 GEOTEXTILES.

Applicable material specifications may include: 523 ROCK FOR RIPRAP and 592 GEOTEXTILES.

Applicable standard drawings may include: IL-515 DIVERSION PLAN, IL-540 WATERWAY PLAN, IL-541 ROCK CHECKS FOR WATERWAYS, IL-543 INLET FOR UNDERGROUND OUTLET, IL-595 PORTABLE SEDIMENT TANK PLAN, IL-615 SEDIMENT BASIN DEWATERING PLAN, IL-620 SILT FENCE PLAN, IL-630 STABILIZED CONSTRUCTION ENTRANCE PLAN, IL-635 STRAW BALE BARRIER PLAN, and IL-660 TEMPORARY SEDIMENT TRAP.

Other applicable standards may include: DIVERSION 815, DIVERSION DIKE 820, DUST CONTROL 825, EROSION BLANKET 830, FILTER STRIP 835, LAND GRADING 865, MULCHING 875, PERMANENT SEEDING 880, PORTABLE SEDIMENT TANK 895, ROCK OUTLET PROTECTION 910, SILT FENCE 920, SODDING 925, STRAW BALE BARRIER 935, SUBSURFACE DRAIN 945, TEMPORARY DIVERSION 955, TEMPORARY SEDIMENT TRAP 960, TEMPORARY SEEDING 965, TEMPORARY SWALE 980, and TOPSOILING 981.

OPERATION AND MAINTENANCE

An operation and maintenance plan should be developed and concurred in by the owners/operators of the impoundment structure. The operation plan shall establish a schedule for

testing all operable facilities to ensure that they function as intended, or that necessary repairs are made. The maintenance plan shall specify responsible parties for maintaining or replacing, as necessary: all vegetative components of the structure, riprap for wave protection or outlet protection, inlet and outlet works, safety features including fences and signs, and on-site erosion/water control facilities.

Procedures and responsible parties for removing and disposing of accumulated debris and/or sediment as necessary to ensure the function of the structure shall be specified. Procedures and responsible parties for repairing damage to embankment, spillway structures and other appurtenances shall be specified. The structure shall be inspected at least yearly and after every storm event causing flows through vegetated spillways or over top of embankment.

If required by the IDNR-OWR, an emergency action plan shall be filed for permit structures.

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TABLE 1

SPILLWAY REQUIREMENTS FOR NON-PERMIT DAMS

Drainage Area (Acres)	Principal Spillway Minimum Design Storm Frequency (Years)	Emergency Spillway Minimum Design Storm Frequency (Years)
0 –100	5	25
100 – 250	10	50
> 250	25	100

TABLE 2

PRINCIPAL SPILLWAY
PVC PIPE FOR USE IN EARTH DAMS

Nominal Pipe Size	Schedule or Standard Dimension Ratio (SDR)	Maximum Depth of Fill (ft.)
4” or smaller	Schedule 40	15
	Schedule 80	20
	SDR 26	10
6”, 8”, 10”, 12”	Schedule 40	10
	Schedule 80	15
	SDR 26	10

TABLE 3

PRINCIPAL SPILLWAY
MINIMUM GAUGES FOR CORRUGATED METAL PIPE

	Pipe Diameter (in.)						Pipe Diameter (in.)			
	12 & less	24	30	36	42	48	12 & less	24	30	36
Fill Over Pipe (ft.)	Steel Minimum Gauge						Aluminum[1] Minimum Thickness (in.)			
1 – 15	16	16	16	14	12	10	.06	.06	.075	.075
15 – 20	16	16	16	14	12	10	.06	.06	.105	.105

[1] Riveted or helical fabrication.

TABLE 4

MINIMUM TOP WIDTH FOR DAMS

Total Height of Embankment (ft.)	Top Width (ft.)
10 or less	6
10 – 15	8
15 – 20	10
20 – 25	12
25 – 35	14
35 or more	15