18.0 MISCELLANEOUS MAIN CANAL STRUCTURES

18.1 General

Miscellaneous structures include the minor structures that are typically provided within the main canal to deliver water, manage surface runoff that is intercepted by the main canal, or maintain vehicle access. Typical structures include turnouts, drainage control structures, and culverts.

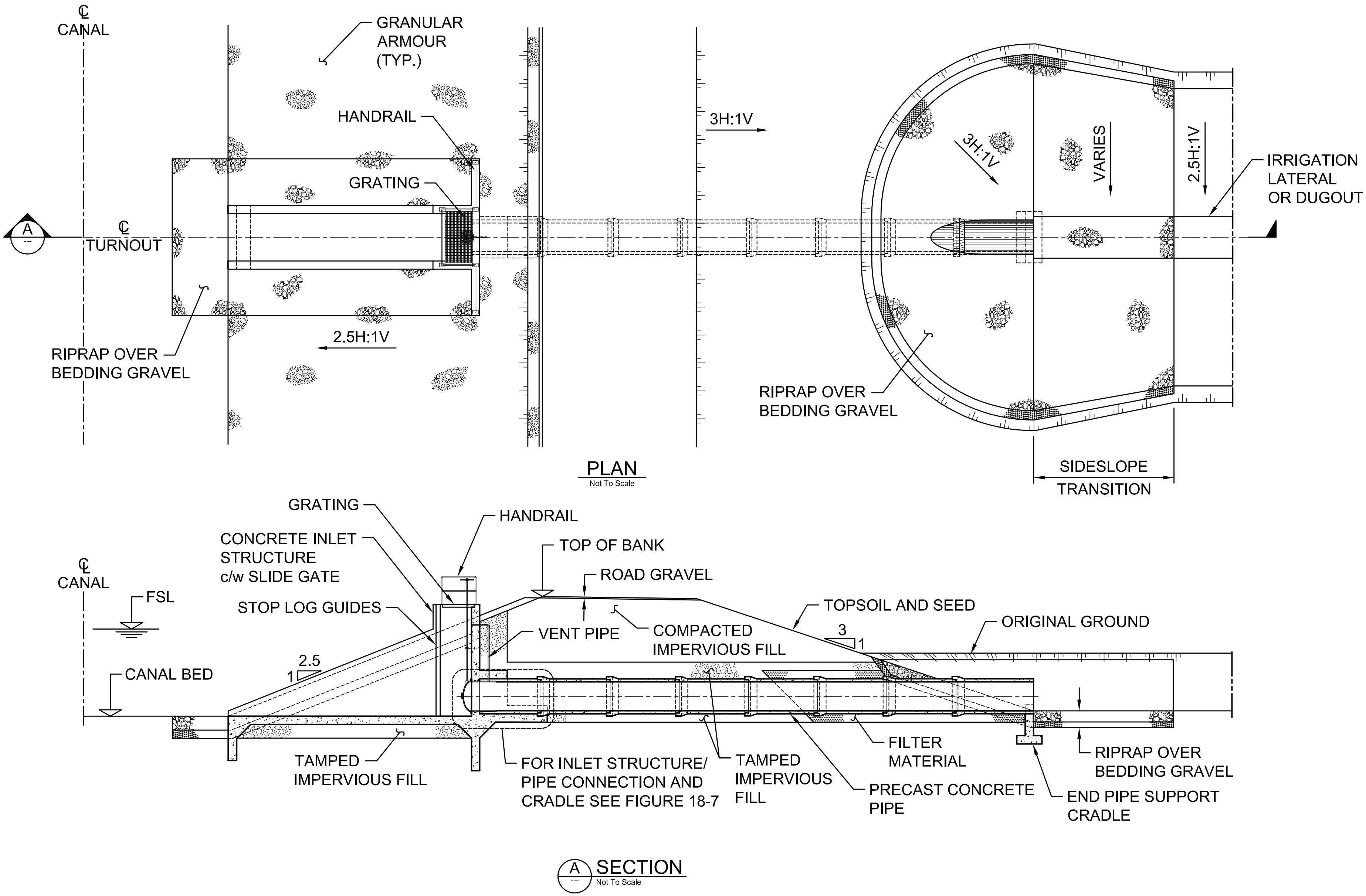
18.2 Turnout Structures

Turnout structures are provided to deliver water from the main canal to the water user via a lateral canal, pipeline, or pumpwell. The type of turnout structure and its design requirements are primarily dependent on its location and therefore the consequence of its failure on the integrity of the canal bank, and its required discharge capacity as described in Table 18-1.

Table 18-1
Description of Turnout Structures

Turnout	Location	Description
Type I	Embankment or downslope side of the canal.	Gravity turnout comprised of gated cast-in-place concrete inlet with precast concrete pipe as illustrated on Figure 18-1. Normally used for a design capacity greater than 0.5 m^3/s.
Type II	Embankment or downslope side of the canal.	Gravity turnout comprised of cast-in-place concrete gatewell with precast concrete pipe as illustrated on Figure 18-2. Normally used for a design capacity equal to or less than 0.5 m^3/s. A minimum pipe diameter of 0.5 m is preferred.
Type III	Embankment or downslope side of the canal.	Pumped turnout comprised of cast-in-place concrete gatewell and pumpwell, and precast concrete pipe as illustrated on Figure 18-3. A minimum pipe diameter of 0.5 m is preferred.
Type IV	Embankment or downslope side of the canal.	Syphon turnout consisting of a steel pipe, valves, and CSP priming and valve wells as illustrated on Figure 18-4. Normally used for low discharge capacities. Maximum pipe diameter of 0.5 m has been used.
Type V	Cut slope or upslope side of the canal.	Pumped turnout comprised of CSP intake pipe and pumpwell as illustrated on Figure 18-5. A minimum pipe diameter of 0.5 m is preferred.
Type VI	Either side of the canal.	At locations where access to pump water for domestic or stock watering purposes is required, a small diameter CSP culvert (maximum 0.3 m diameter) can be provided as illustrated on Figure 18-6. This arrangement facilitates the installation of intake pipes without affecting vehicle access along the top of the canal bank.

Turnout structures located within a canal bank constructed of fill (embankment), where the



ALBERTA TRANSPORTATION
CIVIL PROJECTS BRANCH

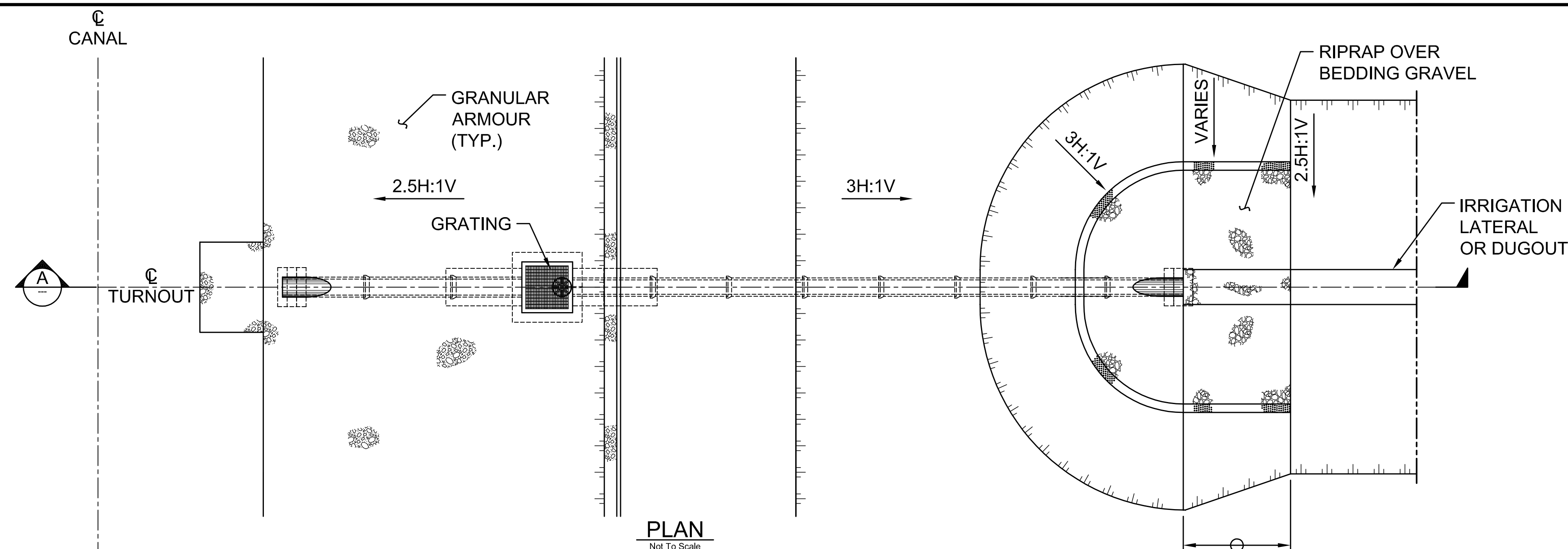
ALBERTA ENVIRONMENT
WATER MANAGEMENT OPERATIONS

WATER CONTROL STRUCTURES - SELECTED DESIGN GUIDELINES

TURNOUT TYPE I - PRECAST CONCRETE PIPE WITH CONCRETE INLET STRUCTURE

DATE:	CAD FILE:	FIGURE No.:
November 2004	99008A18-1.dwg	18-1

18-1 Jan 07'2005 - 11:00am Jesse Llorca



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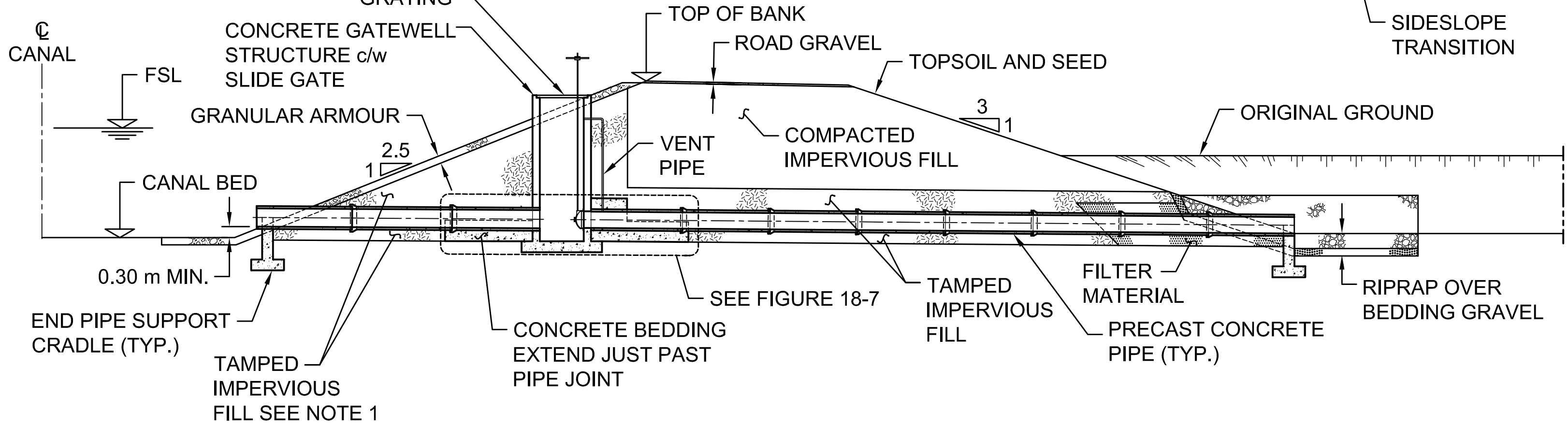

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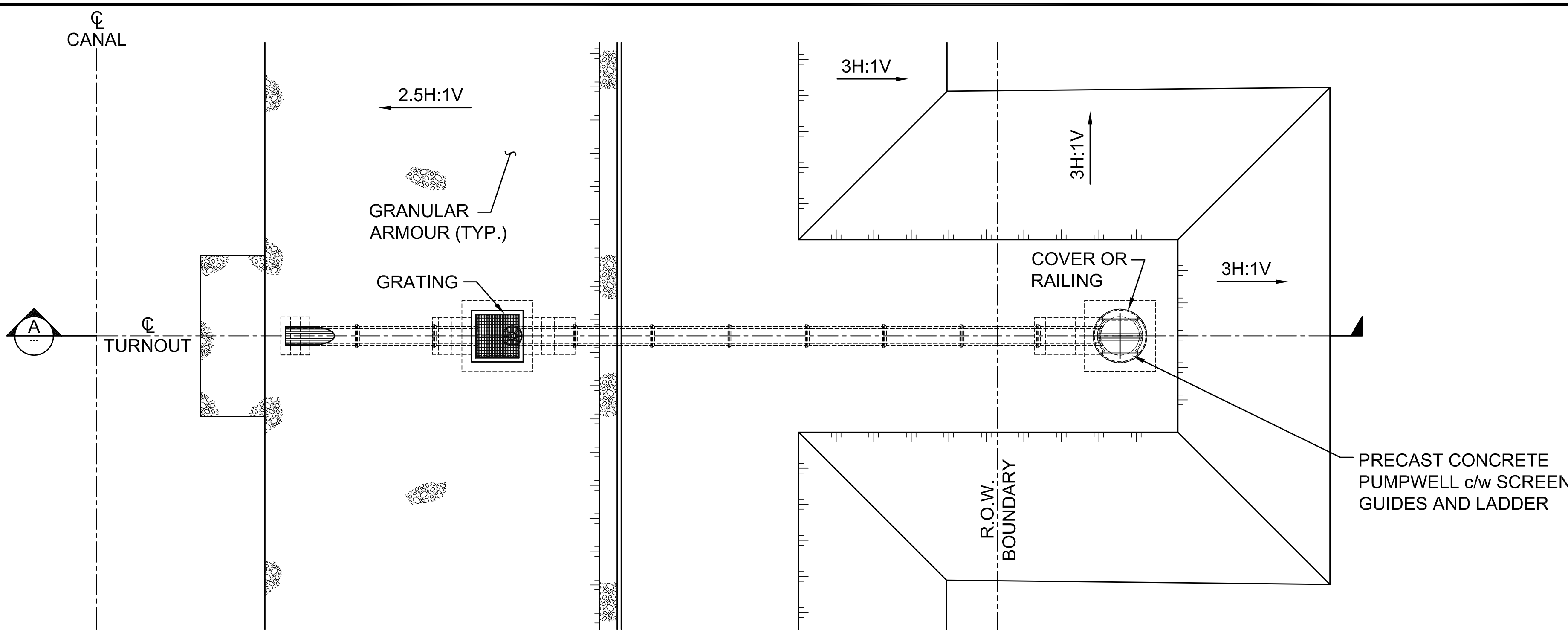
NOTE:

1. FOR SHORT DISTANCES, CONSIDER EXTENDING CONCRETE BEDDING RATHER THAN PLACING IMPERVIOUS FILL.

ALBERTA TRANSPORTATION CIVIL PROJECTS BRANCH **ALBERTA ENVIRONMENT** WATER MANAGEMENT OPERATIONS	**WATER CONTROL STRUCTURES - SELECTED DESIGN GUIDELINES** **TURNOUT TYPE II - PRECAST CONCRETE PIPE WITH CONCRETE GATEWELL** DATE: November 2004 — CAD FILE: 99008A18-2.dwg — FIGURE No.: 18-2

18-2 Jan 07'2005 - 11:02am Jesse Llorca



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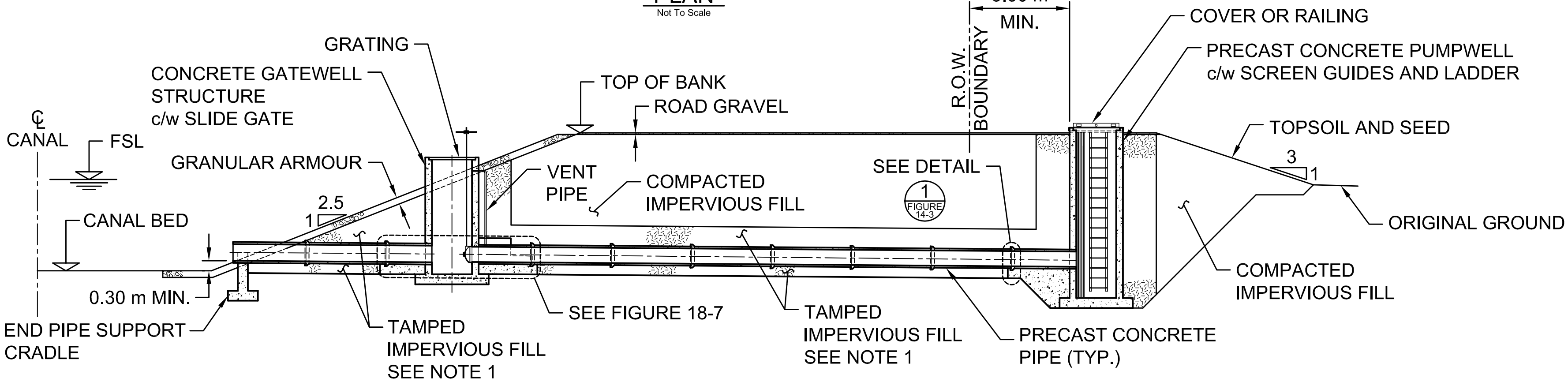

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NOTE:

1. FOR SHORT DISTANCES, CONSIDER EXTENDING CONCRETE BEDDING RATHER THAN PLACING IMPERVIOUS FILL.

ALBERTA TRANSPORTATION
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ALBERTA ENVIRONMENT
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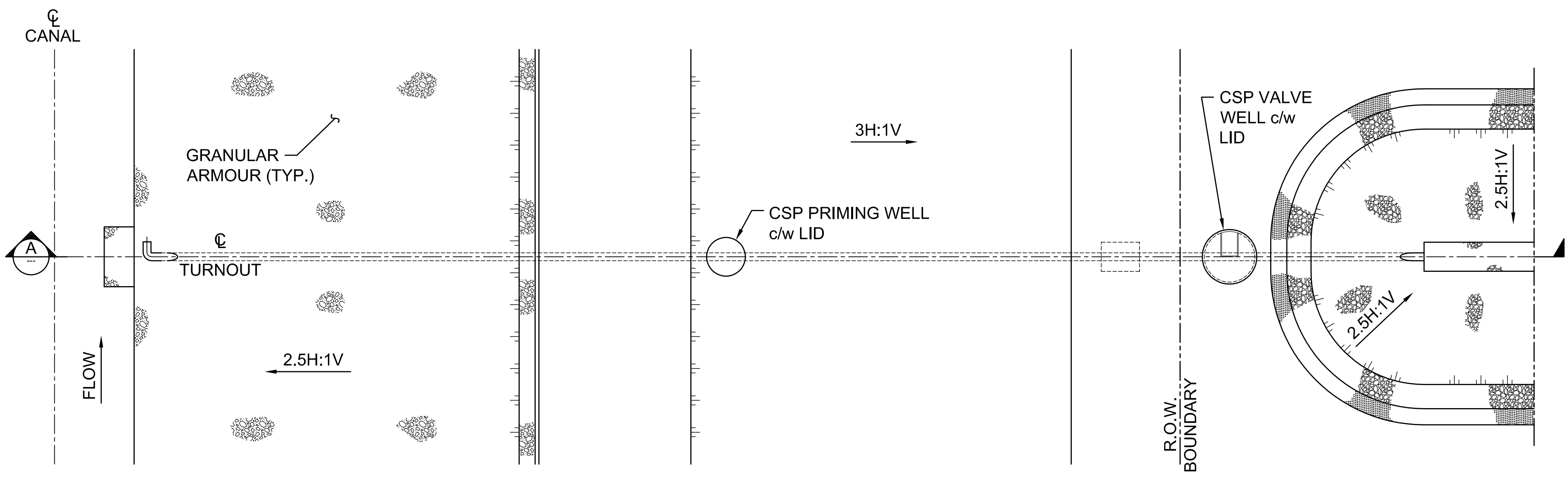
WATER CONTROL STRUCTURES - SELECTED DESIGN GUIDELINES

TURNOUT TYPE III - PRECAST CONCRETE PIPE WITH CONCRETE GATEWELL AND PUMPWELL

DATE:	CAD FILE:	FIGURE No.:
November 2004	99008A18-3.dwg	18-3

18-3 Jan 07'2005 - 11:06am Jesse Llorca



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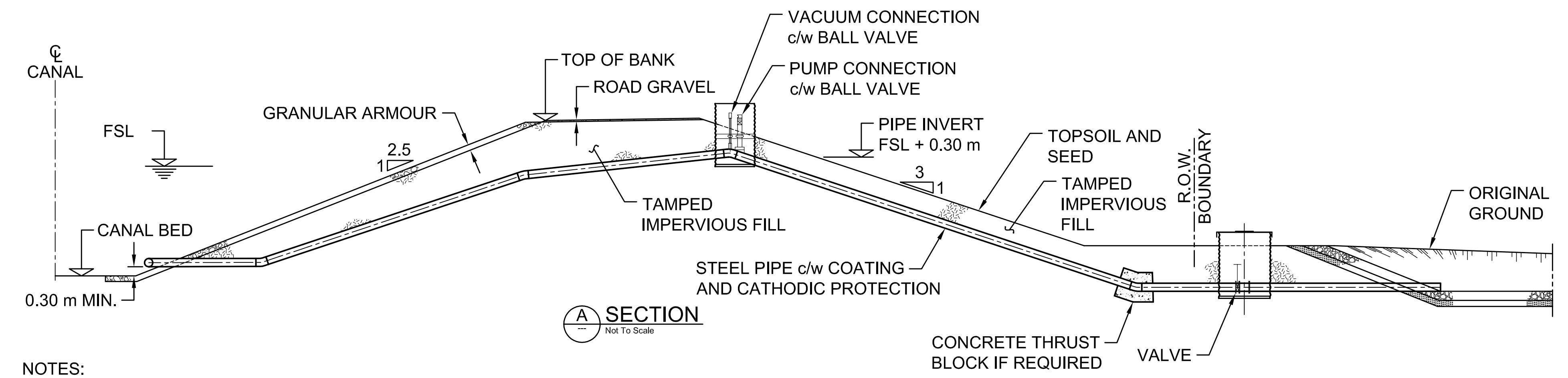

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NOTES:

1. OUTLET END OF SYPHON PIPE MAY ALSO BE CONNECTED TO USER'S DELIVERY SYSTEM. REVIEW NEED TO ISOLATE USER'S FACILITIES FROM CATHODICALLY PROTECTED SYPHON.

2. AT THE INLET END, CONSIDER NEED FOR A VORTEX BREAKER.

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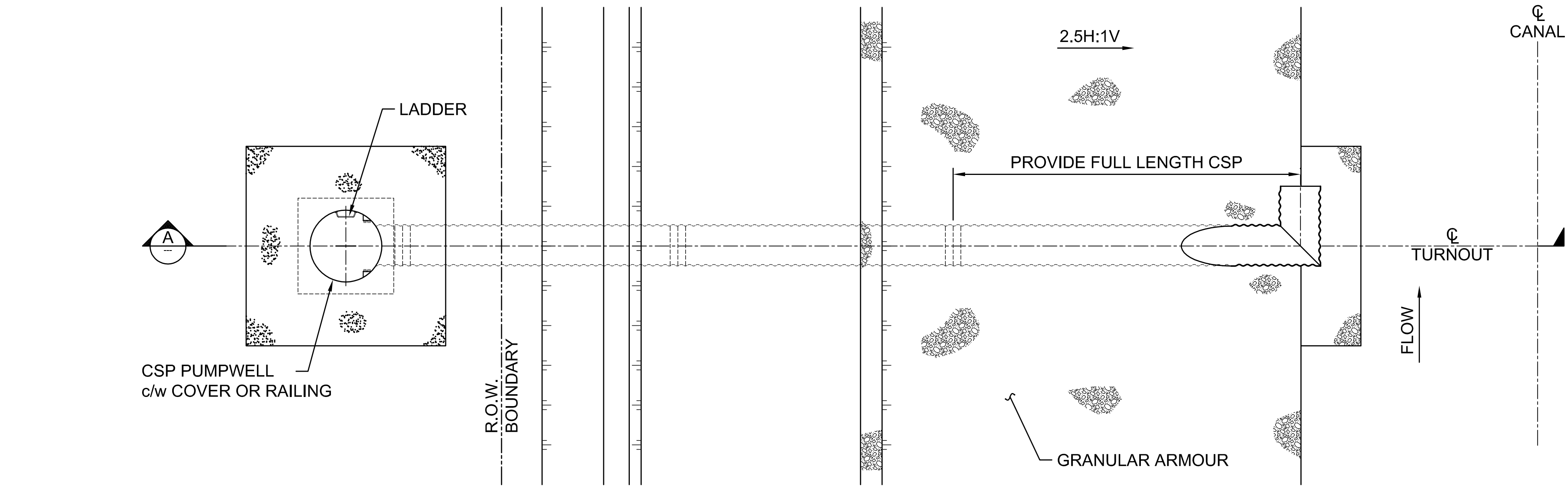
TURNOUT TYPE IV - STEEL SYPHON

DATE:	CAD FILE:	FIGURE No.:
November 2004	99008A18-4.dwg	18-4



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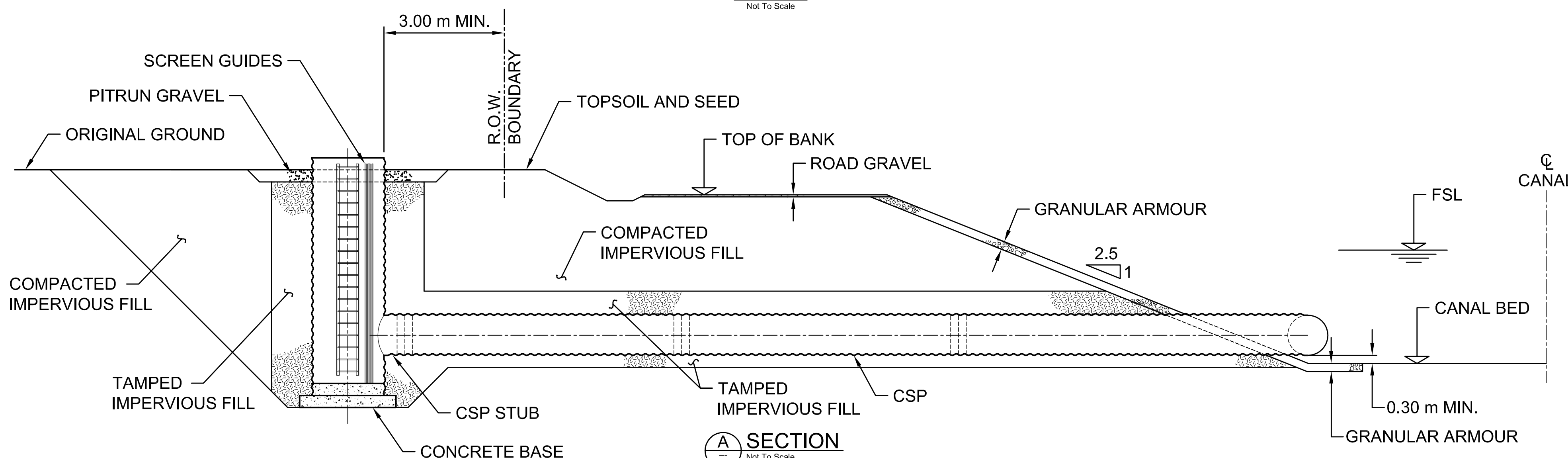

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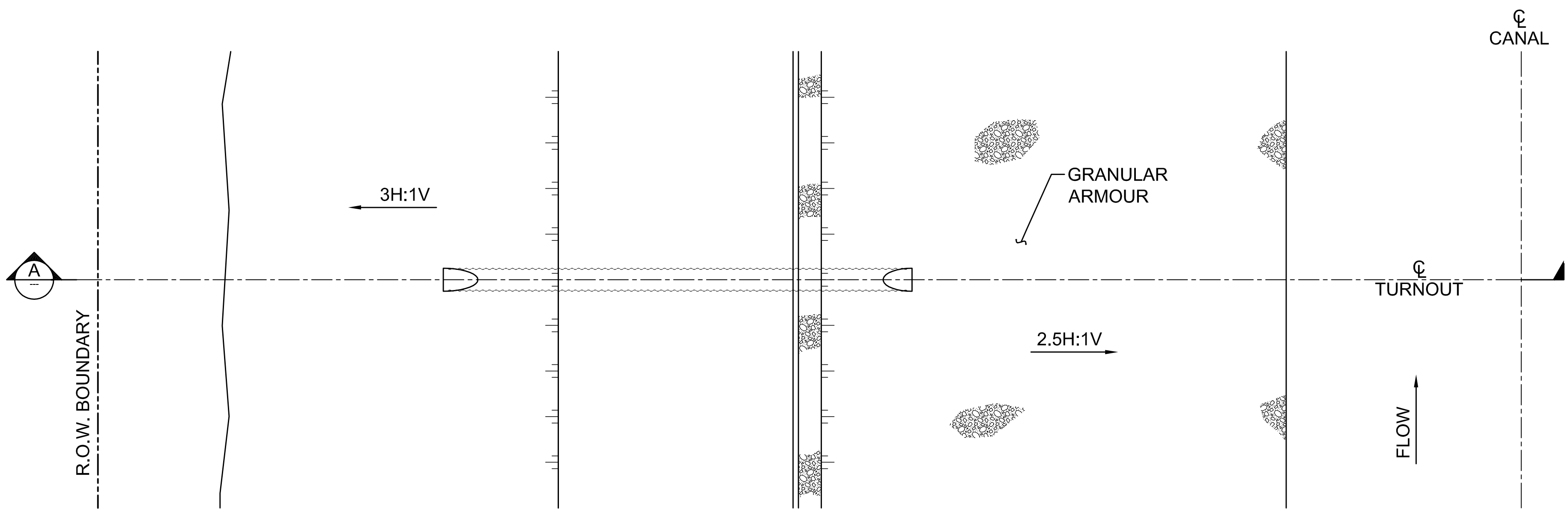
ALBERTA TRANSPORTATION CIVIL PROJECTS BRANCH ALBERTA ENVIRONMENT WATER MANAGEMENT OPERATIONS	WATER CONTROL STRUCTURES - SELECTED DESIGN GUIDELINES TURNOUT TYPE V - CSP PUMPWELL STRUCTURE		
	DATE: November 2004	CAD FILE: 99008A18-5.dwg	FIGURE No.: 18-5

18-5 Jan 07'2005 - 11:07am Jesse Llorca



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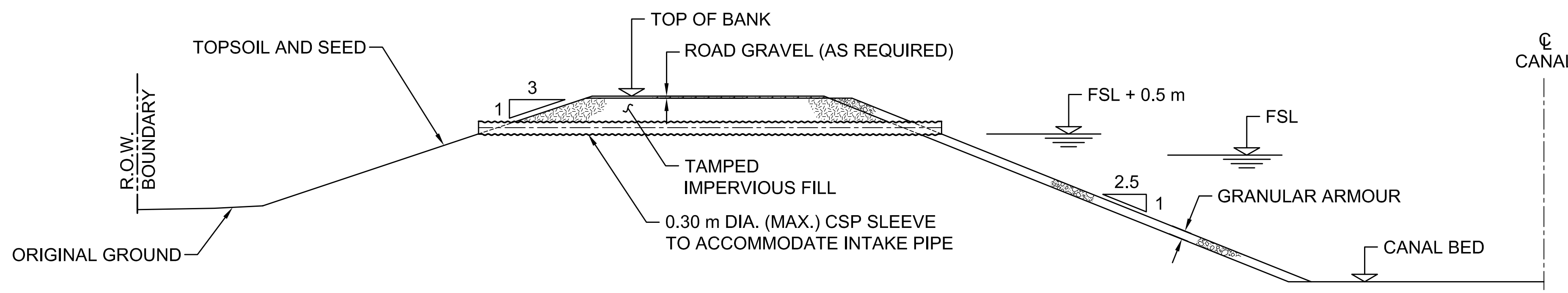

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ALBERTA TRANSPORTATION CIVIL PROJECTS BRANCH **ALBERTA ENVIRONMENT** WATER MANAGEMENT OPERATIONS	**WATER CONTROL STRUCTURES - SELECTED DESIGN GUIDELINES** **TURNOUT TYPE VI - CSP SLEEVE** DATE: November 2004 — CAD FILE: 99008A18-6.dwg — FIGURE No.: 18-6

consequence of a canal breach would be significant, normally consist of cast-in-place concrete structure components (inlet structure, gatewell, pumpwell) and low pressure, precast concrete pipes. The design should also include measures to accommodate differential settlements between the structures and the pipes, and prevent piping, since failure of the embankment would result in loss of the canal and flood damage. Connection details between the precast concrete pipe and the cast-in-place concrete structure are shown on Figure 18-7.

Depending on the required design capacity and delivery requirements, a Type I, II or III turnout may be used as noted in Table 18-1. For small discharges, a Type IV syphon turnout constructed of steel pipe may be used. Operational problems commonly encountered with syphons include vortex formation at the inlet end particularly at low canal water levels, and loss of prime, therefore these issues should be carefully reviewed. Corrosion protection of the steel pipe should ordinarily include an external coating, and cathodic protection measures. Care is required when choosing an internal coating since flaking of the coating has caused plugging of sprinkler heads; however, if a coating is not provided, rust particles can also cause plugging.

Where the turnout is located within a canal bank constructed in cut (upslope side of the canal), a Type V turnout structure comprised of CSP elements may be used (pipe and pumpwells). Where the insitu soil and groundwater conditions are corrosive, the use of PVC or precast or cast-in-place concrete elements instead of CSP should be considered. The use of precast concrete inlets and gatewells in cut areas may be permissible, but should be technically and economically justified.

Normally, gates are installed on turnouts located within embankments, and are not provided on turnouts within a cut slope. Typically, cast-iron medium duty slide gates or fabricated stainless steel slide gates, as discussed in Section 19.1.5, are used.

18.3 Drainage Control Structures

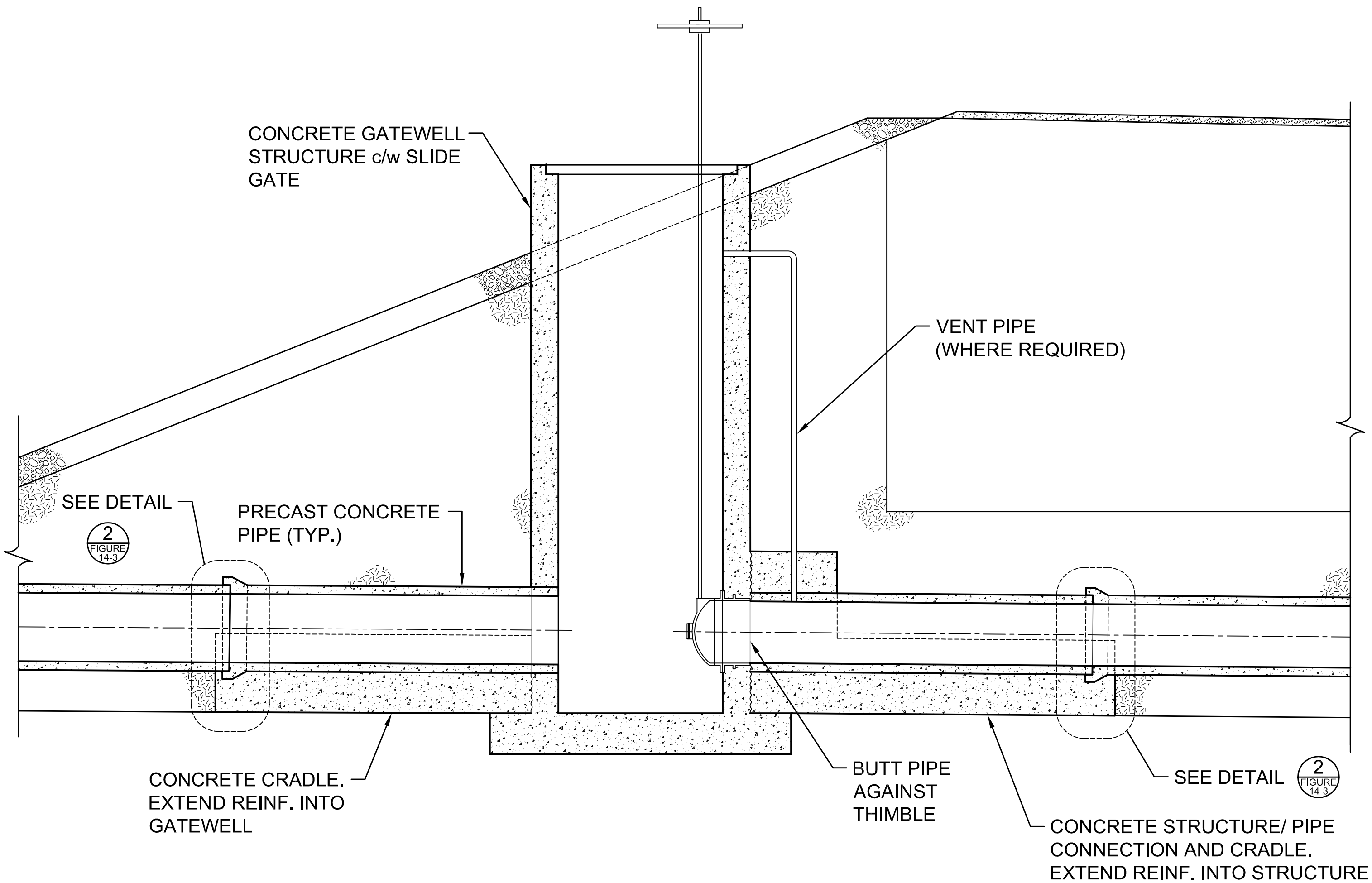
18.3.1 General

Drainage control structures are provided to control flooding by allowing excess water to be released from the canal at strategic locations (e.g. existing drainage courses), permit surface runoff water that is intercepted by the canal to safely enter or bypass the canal without causing erosion, and reduce or control ponding adjacent to the canal.

The type and design requirements of a particular drainage control structure are dependent on its location (i.e. above or below FSL), function, and discharge capacity.

18.3.2 Drainage Inlet Structures

Drain inlet structures are provided to permit surface runoff water that is intercepted by the canal to safely enter the canal without causing erosion. The drain inlets are normally sized to accommodate the peak flows due to the 1:25 year annual flood. However, at locations where the drainage area is large and/or significant ponding would occur upstream of the drain inlet, flood routing simulations



ALBERTA TRANSPORTATION CIVIL PROJECTS BRANCH **ALBERTA ENVIRONMENT** WATER MANAGEMENT OPERATIONS	WATER CONTROL STRUCTURES - SELECTED DESIGN GUIDELINES **MISCELLANEOUS CANAL STRUCTURES PRECAST CONCRETE PIPE/ STRUCTURE CONNECTION** DATE: November 2004 | CAD FILE: 99008A18-7.dwg | FIGURE No.: 18-7

should be undertaken to determine the appropriate routed peak discharge that should be used in the design.

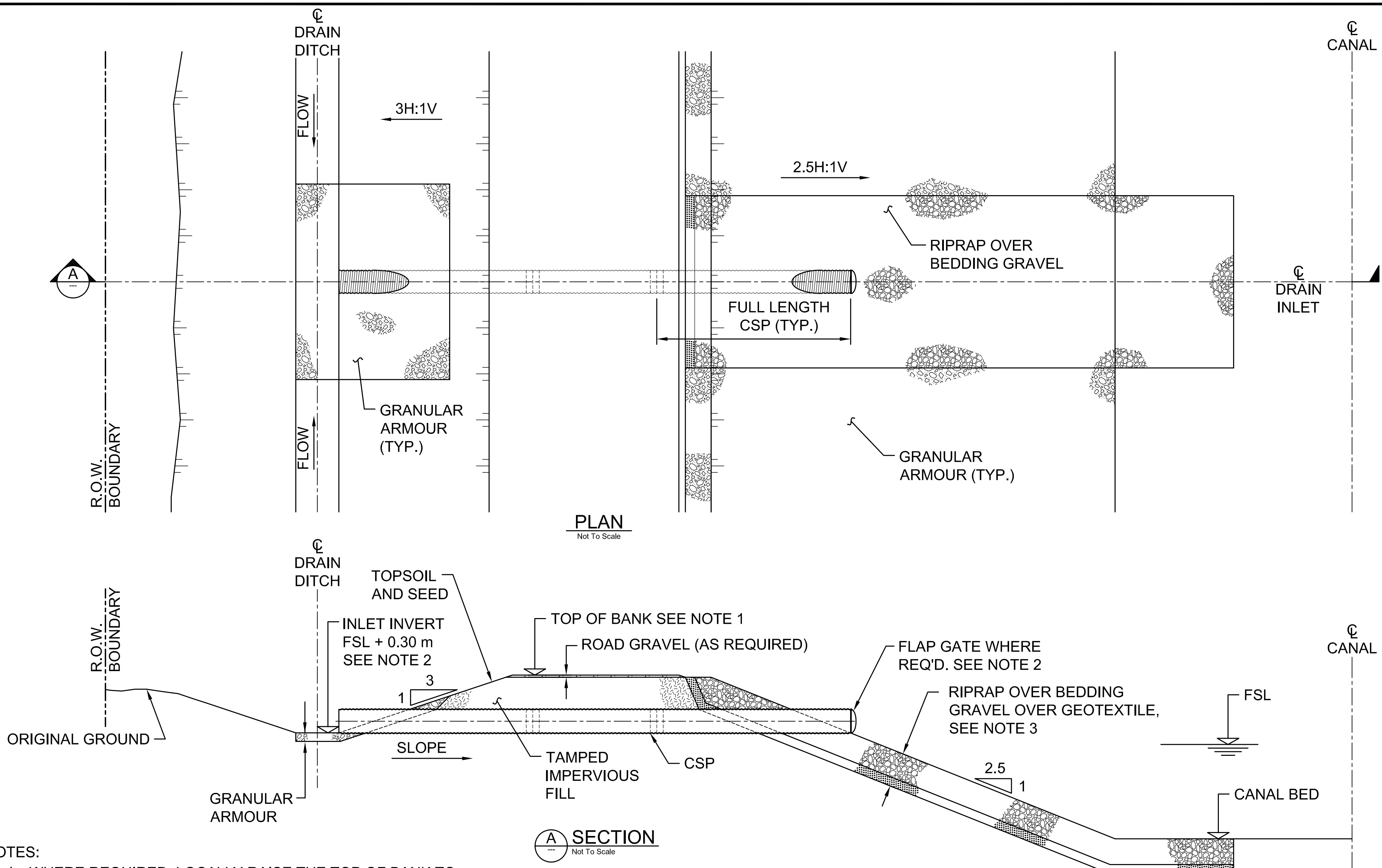
Depending on the site topography, the design inverts for these structures may be above or below the canal FSL, and will therefore require a specific type of structure as outlined in Table 18-2.

Table 18-2
Description of Drain Inlet Structures

Drain Inlet	Design Inlet Invert/Crest Location	Description
Type I	Above canal FSL.	Ungated CSP with the invert on the inlet set at least 0.3 m above FSL as shown on Figure 18-8. Typically used for small inflows. A minimum pipe diameter of 0.5 m is preferred.
Type II	Below canal FSL.	Overflow drop inlet (gated) and discharge pipe constructed of CSP as shown on Figure 18-9. The drop inlet crest is set above FSL and allows runoff to enter the canal when the canal is in operation. A minimum pipe diameter of 0.5 m is preferred.
Type III	Above canal FSL.	Cast-in-place overflow drop inlet (gated) with precast concrete pipe constructed as shown on Figure 18-10. The crests of the side weirs at the drop inlet are set above FSL and allow runoff to enter the canal when the canal is in operation. The gate can be used to release flow into or to drain ponded areas. A minimum pipe diameter of 0.5 m is preferred.
Type IV	Above canal FSL.	Cast-in-place concrete chute drop with an uncontrolled weir set at least 0.3 m above FSL as shown on Figure 18-11. A cast-in-place or precast concrete bridge deck is ordinarily provided to maintain access along the canal bank.
Type V	Below canal FSL.	Precast concrete pumpwell and intake pipe. The pumpwell is normally equipped with a submersible pump that is used to pump water into the canal as illustrated on Figure 18-12.

For drain inlet structures with design invert elevations above the canal FSL, a Type I drain inlet may be used for small inflows. Where large inflows are expected, a Type IV cast-in-place concrete structure may be provided. Consideration should also be given to providing a silt trap at locations where the drainage course upstream of the chute may transport a large amount of silt.

For drain inlet structures with design invert elevations below the canal FSL, cast-in-place concrete structures (gatewell, pumpwell) and precast concrete pipes are normally used particularly where failure of the embankment could result in loss of the canal or flood large areas. At locations where the drainage area is localized and therefore the loss of the canal or extensive flooding would not occur, a Type II drain inlet with galvanized CSP elements (gatewell and pipe) may be used. Where the insitu soil and groundwater conditions are corrosive, the use of PVC or precast concrete



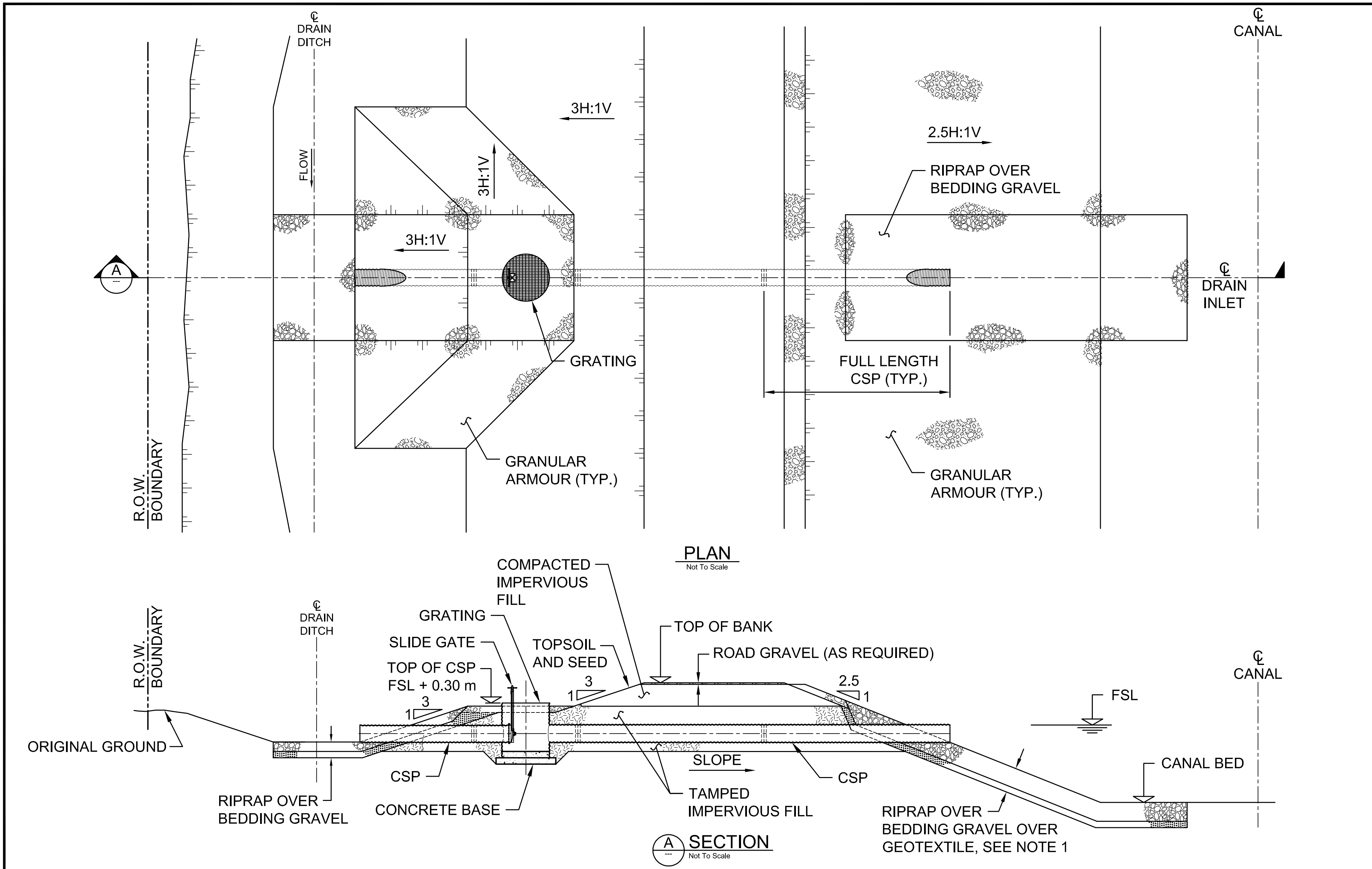
NOTES:

1. WHERE REQUIRED, LOCALLY RAISE THE TOP OF BANK TO PROVIDE SUFFICIENT COVER OVER THE CSP.

2. INLET INVERT SET AT OR ABOVE FSL; HOWEVER, PROVIDE FLAP GATE WHERE THE INLET INVERT IS LESS THAN 0.30 m ABOVE FSL.

3. WHERE LARGE INFLOWS ARE EXPECTED, THE USE OF LARGER SIZED RIPRAP OR GABIONS SHOULD BE CONSIDERED.

ALBERTA TRANSPORTATION CIVIL PROJECTS BRANCH **ALBERTA ENVIRONMENT** WATER MANAGEMENT OPERATIONS	**WATER CONTROL STRUCTURES - SELECTED DESIGN GUIDELINES** **DRAIN INLET TYPE I - CSP CULVERT** DATE: November 2004 / CAD FILE: 99008A18-8.dwg / FIGURE No.: 18-8



NOTE:

1. WHERE LARGE INFLOWS ARE EXPECTED, THE USE OF LARGER SIZED RIPRAP OR GABIONS SHOULD BE CONSIDERED.

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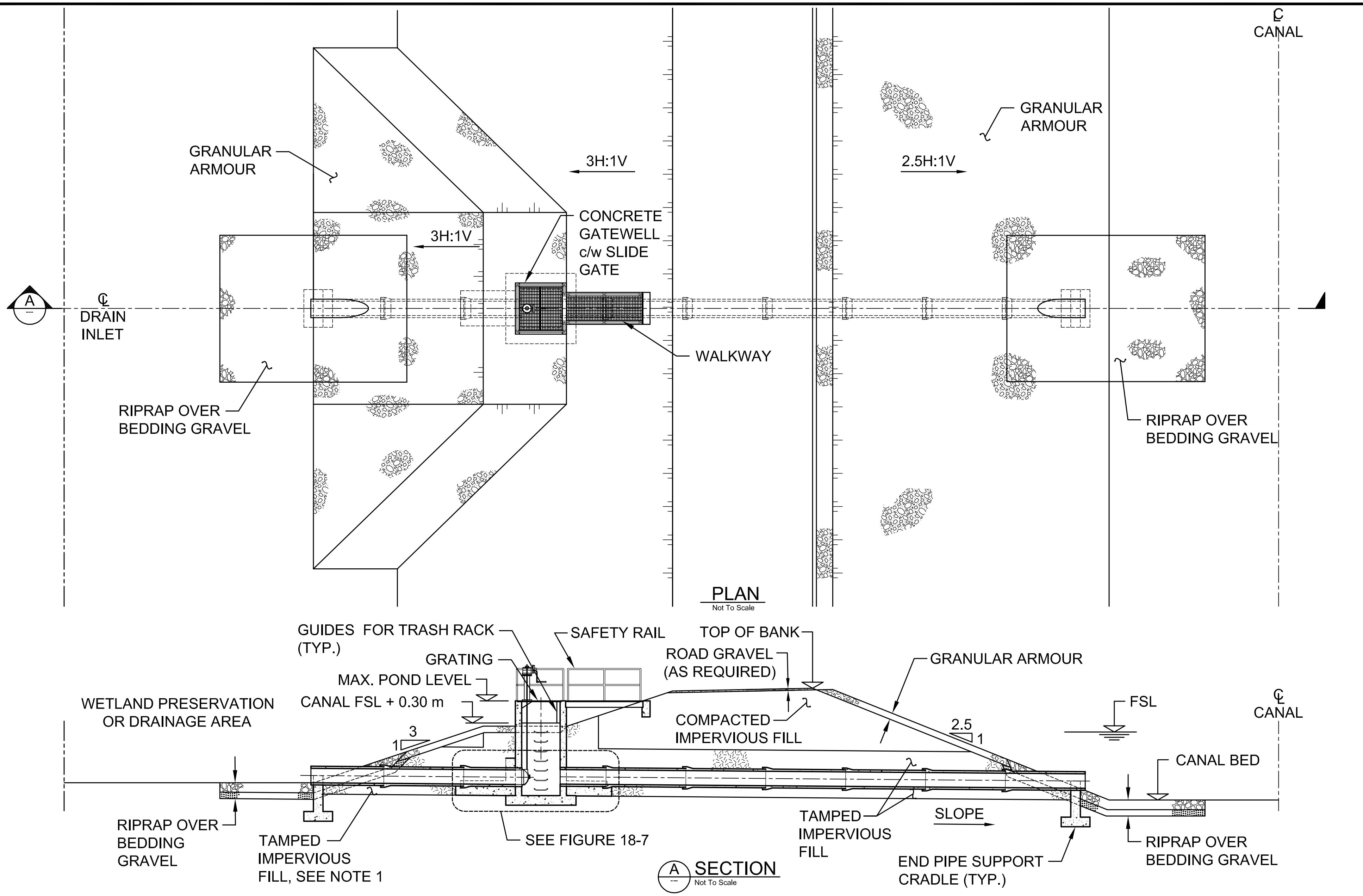
WATER CONTROL STRUCTURES - SELECTED DESIGN GUIDELINES

DRAIN INLET TYPE II - CSP DROP INLET

DATE:	CAD FILE:	FIGURE No.:
November 2004	99008A18-9.dwg	18-9



NOTES:

1. FOR SHORT DISTANCES, CONSIDER EXTENDING CONCRETE BEDDING RATHER THAN PLACING IMPERVIOUS FILL.

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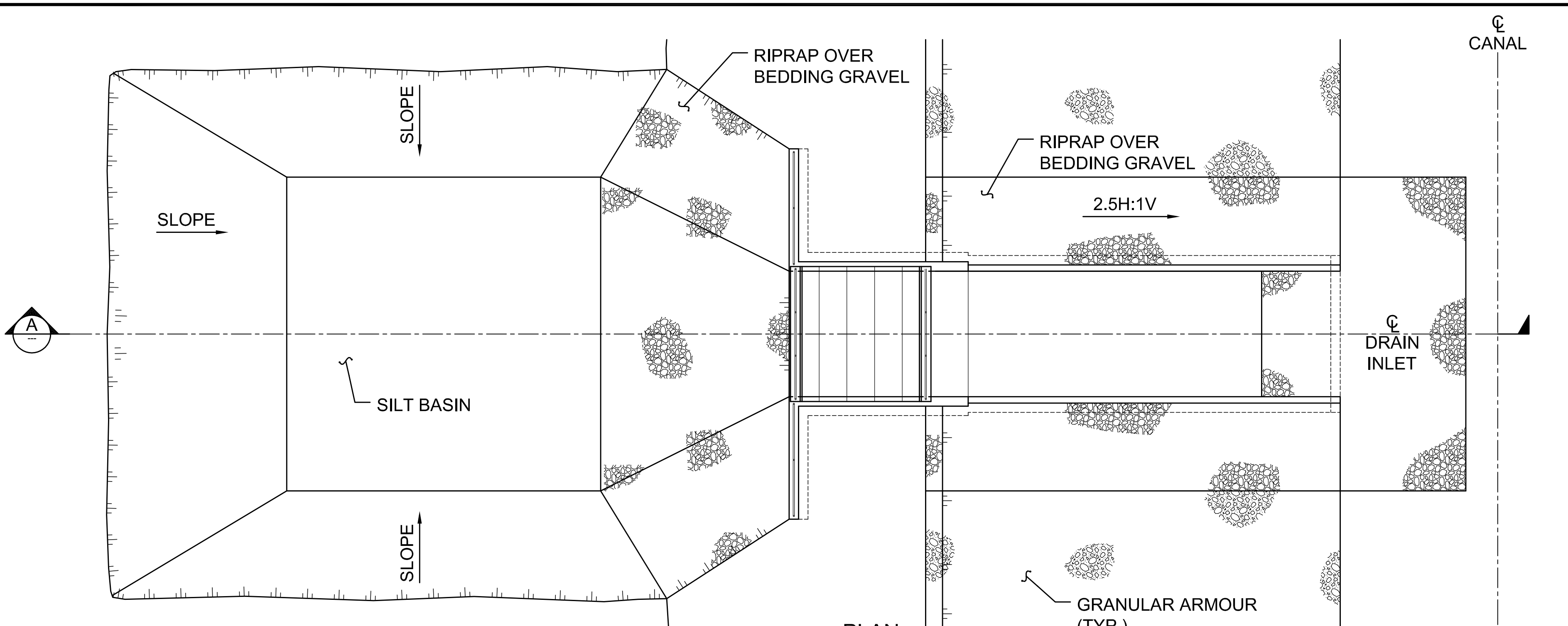
DRAIN INLET TYPE III - PRECAST CONCRETE PIPE WITH CONCRETE GATEWELL

DATE:	CAD FILE:	FIGURE No.:
November 2004	99008A18-10.dwg	18-10



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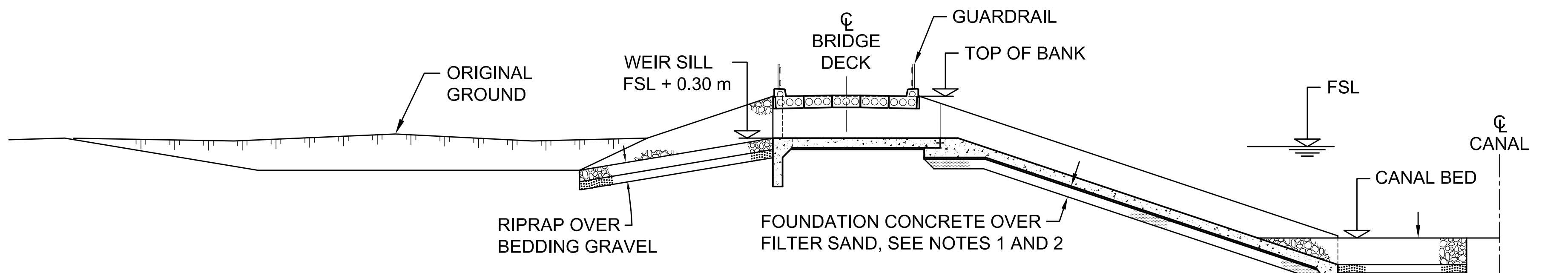

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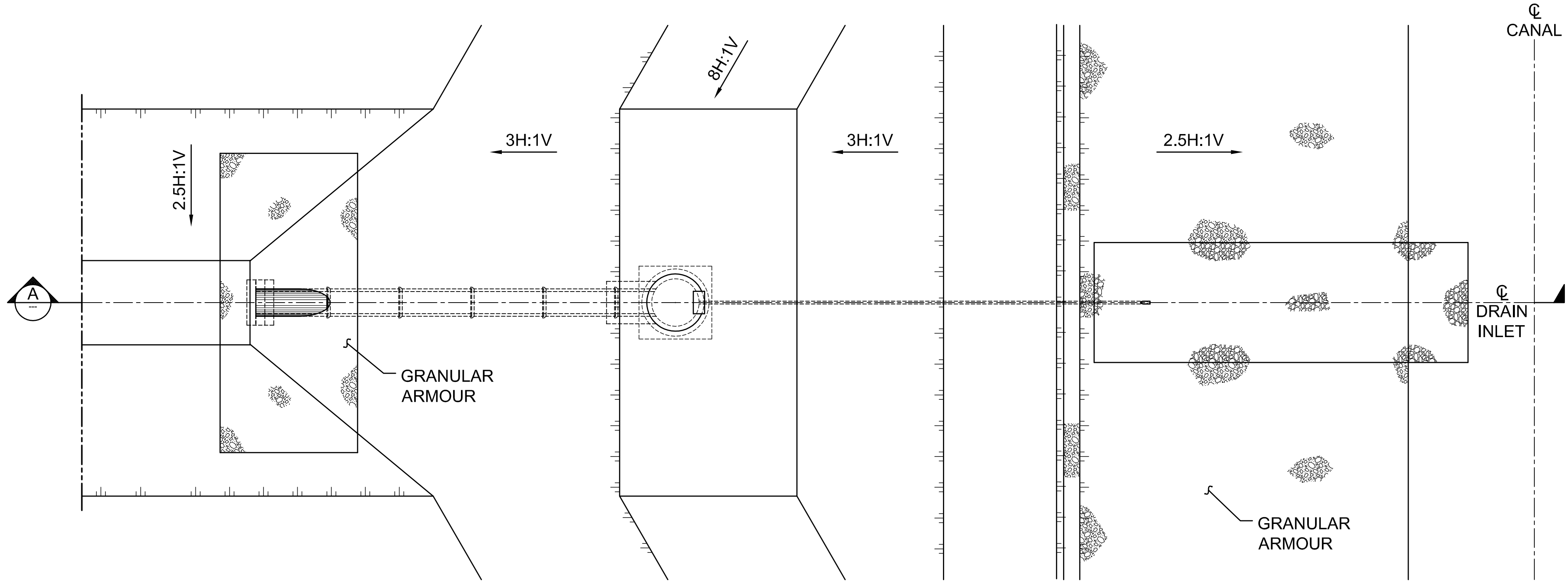
NOTES:

1. IN CASES WHERE INCREASED UNDERSLAB DRAINAGE CAPACITY IS NEEDED, ADD A DRAINAGE GRAVEL LAYER.
2. EXTEND UNDERSLAB FILTER/DRAINAGE MATERIALS OUT PAST SLAB AND PROPERLY TIE-IN WITH THOSE ADJACENT THE WALLS AND WITH THE BEDDING GRAVEL.
3. ON THE BED, PROVIDE LARGE-SIZED RIPRAP OR GABIONS.

ALBERTA TRANSPORTATION CIVIL PROJECTS BRANCH **ALBERTA ENVIRONMENT** WATER MANAGEMENT OPERATIONS	**WATER CONTROL STRUCTURES - SELECTED DESIGN GUIDELINES** **DRAIN INLET TYPE IV - CONCRETE CHUTE DROP** DATE: November 2004 — CAD FILE: 99008A18-11.dwg — FIGURE No.: 18-11



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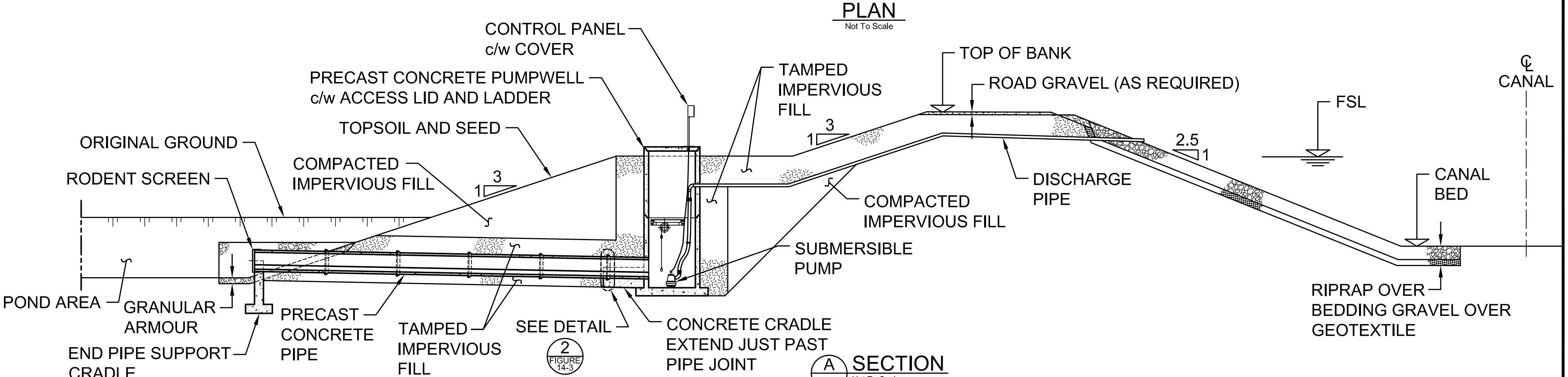

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ALBERTA TRANSPORTATION
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ALBERTA ENVIRONMENT
WATER MANAGEMENT OPERATIONS

WATER CONTROL STRUCTURES - SELECTED DESIGN GUIDELINES

DRAIN INLET TYPE V - PRECAST CONCRETE PIPE AND PUMPWELL

DATE:	CAD FILE:	FIGURE No.:
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18-12 Jan 072005 - 11:10am Jesse Llorca

elements instead of CSP should be considered.

Typically, cast-iron medium duty slide gates as discussed in Section 19.1.5 are used.

18.3.3 Cross Drains

A cross drain structure may be used to convey surface runoff water under the canal. Cast-in-place concrete (inlet and outlet/terminal structure) and a precast concrete or cast-in-place conduit are normally required.

The cross drain structure is usually sized to handle peak flows during the 1:25 year annual flood. However, its performance during the 1:100 year annual flood is normally also assessed to verify that the integrity of the canal embankment and structure are not compromised, and that excessive backwater effects are not occurring. A minimum inside pipe diameter of 1.05 m is preferred as discussed in Section 13.6.

In addition, measures to prevent seepage and piping should be provided since failure of the embankment would result in loss of the canal and flood damage. Where the pipe crosses below the canal bed, a minimum cover of 0.6 m of impervious backfill is preferred, and the use of a membrane liner and gravel armour within the canal should be considered to reduce seepage and scour. Furthermore, the pipe joints should be wrapped with geotextile fabric as an added measure against piping. A typical arrangement is shown on Figure 18-13.

Downstream of the outlet/terminal structure, erosion protection will normally be required. In addition, the potential impacts of flood discharges within the natural drainage course (erosion, flooding) should be considered.

18.3.4 Wasteways

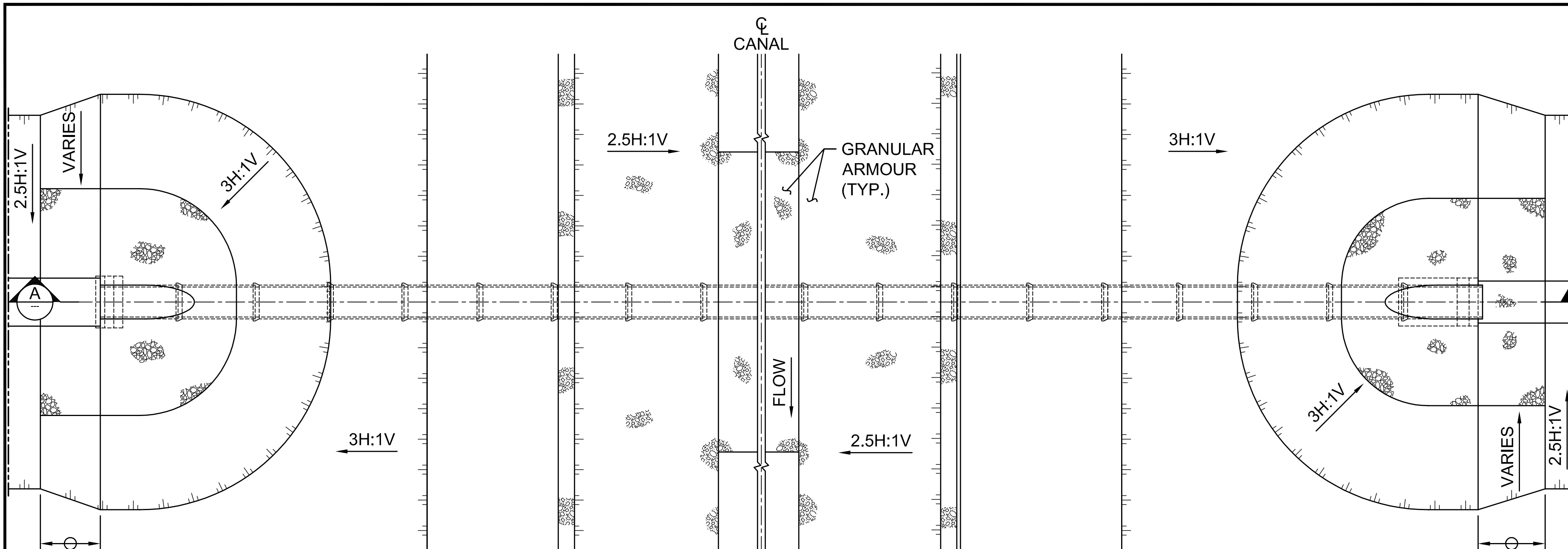
Wasteway structures are usually provided to permit excess floodwater within the canal to be safely released into natural drainage courses, and allow the canal to be drained. Typically, a wasteway structure consists of a chute drop structure as described in Section 17.6; however, baffled chute drops, as discussed in Section 13.7.4, may also be considered. For flow control, radial gates are typically used as described in Section 19.1.2.

The potential impacts of flood discharges within the natural drainage course (erosion, flooding) should be considered.

18.4 Miscellaneous Structures

18.4.1 Culverts

Culverts are typically provided at road or farm crossings. Galvanized corrugated steel materials are typically used; however, the use of precast concrete elements should be considered where corrosive conditions exist.



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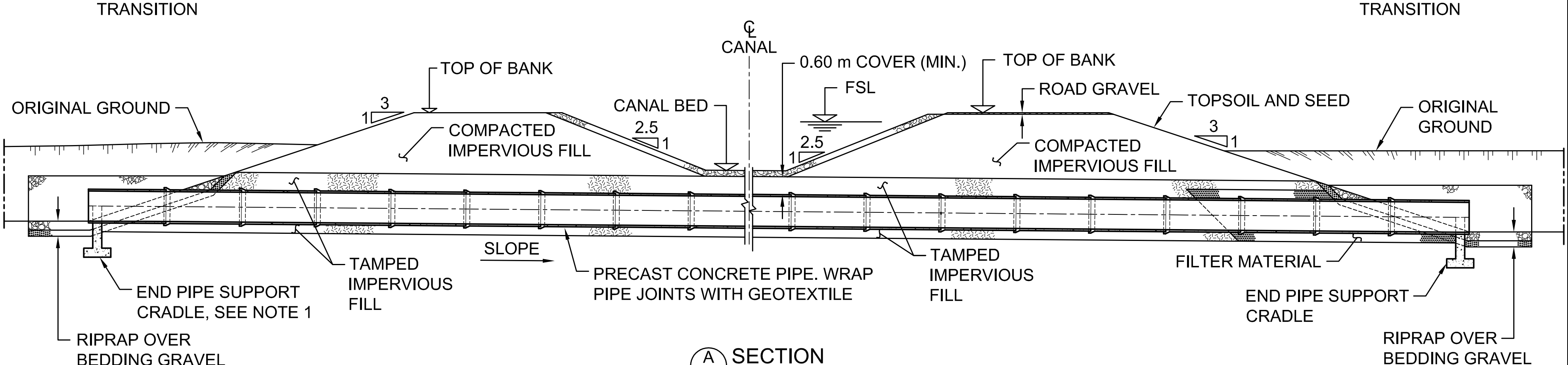

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NOTE:
1. AN INLET STRUCTURE CAN BE PROVIDED TO ACCOMMODATE A CHANGE IN ELEVATION (I.E. DROP) BETWEEN CHANNEL AND PIPE INVERT, STOP LOGS OR TRASHRACK.

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WATER CONTROL STRUCTURES - SELECTED DESIGN GUIDELINES

CROSS DRAIN STRUCTURE

DATE:	CAD FILE:	FIGURE No.:
November 2004	99008A18-13.dwg	18-13

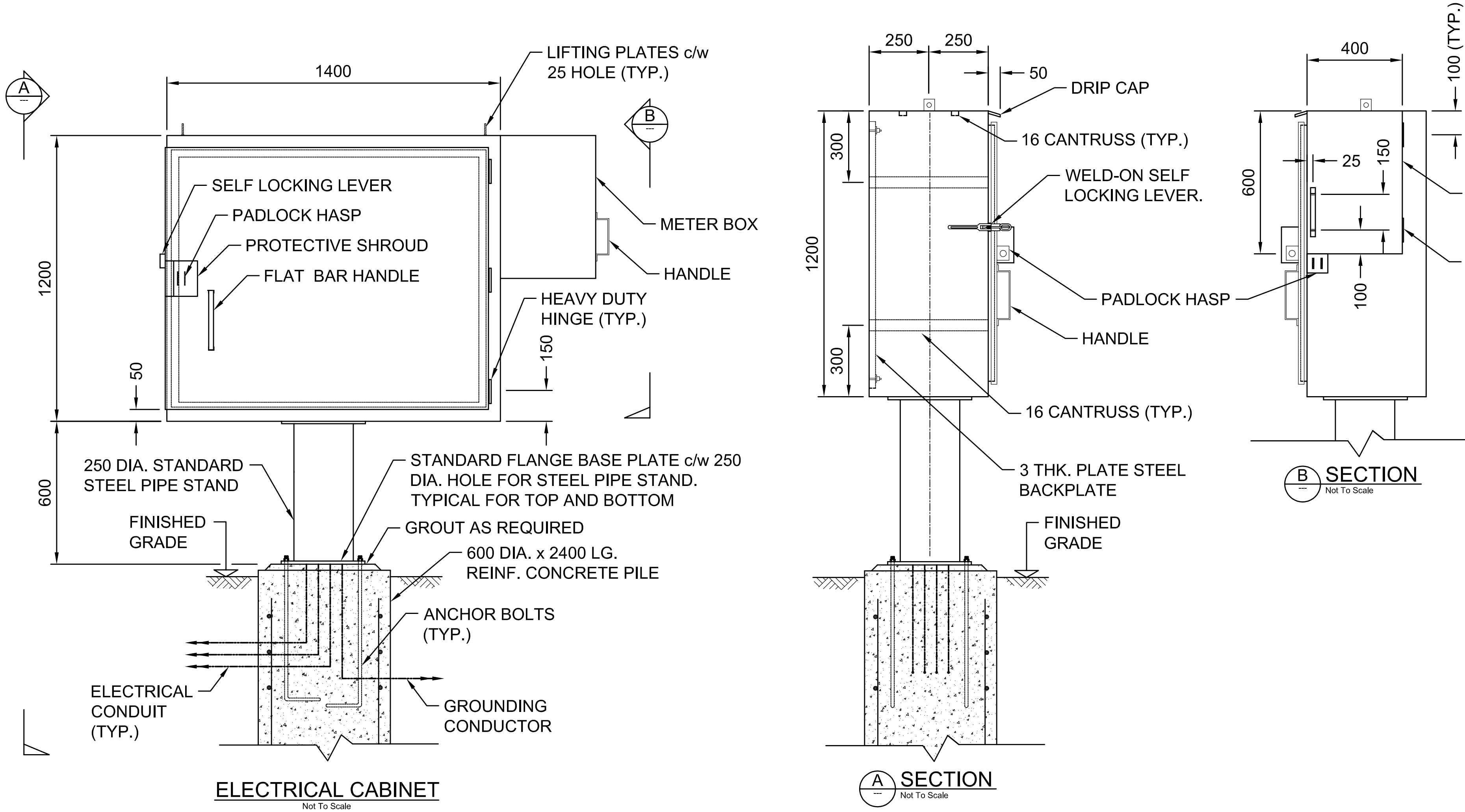
For corrugated steel, pipe and pipe arch shapes are typically used. For pipe arch culverts, the backfill material and compaction density should be carefully chosen since high corner pressures will occur. In addition, the upstream end of the culverts may be subjected to significant uplift pressure (due to the differential head inside versus outside of the culvert). Consequently, a concrete collar or head wall may be required to provide added resistance with large culverts. Where CSP is used, the first joint should be located as far downstream as possible from the upstream end (i.e. a full length pipe is provided at the upstream end).

Culvert crossing installations should conform to the requirements specified in TRANS (1995 and 2000); however, the riprap requirements (i.e. gradation and extent) may be determined on a site-specific basis.

18.4.2 Control Buildings

Control buildings are provided to house electrical and control equipment and panels for gated water control structures where a pedestal-mounted electrical cabinet, as shown on Figure 18-14, is not large enough or appropriate for a particular site.

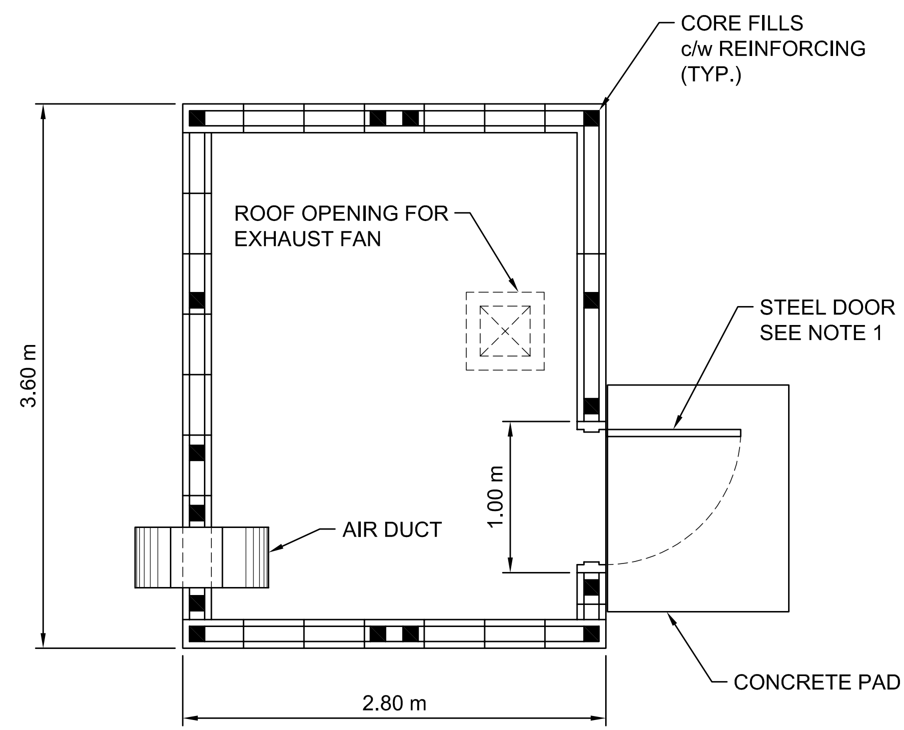
Two types of buildings including: a) cast-in-place concrete floor slab, concrete block walls, and metal roof and gable ends as shown on Figure 18-15; and b) precast concrete floor slab, walls, and flat roof, have been used. It is preferred that a concrete block building be used at all locations where aesthetics is a consideration. The building may also be enlarged to house the standby generator, where required.



NOTES:

1. CABINET FABRICATED FROM 6 mm THK. PAINTED STEEL PLATE (i.e. BULLET PROOF).

ALBERTA TRANSPORTATION CIVIL PROJECTS BRANCH ALBERTA ENVIRONMENT WATER MANAGEMENT DIVISION	PROJECT: WATER CONTROL STRUCTURES - SELECTED DESIGN GUIDELINES		
	TITLE: TYPICAL PEDESTAL-MOUNTED ELECTRICAL CABINET		
	DATE: November 2004	CAD FILE: 99008A18-14.dwg	FIGURE No.: 18-14



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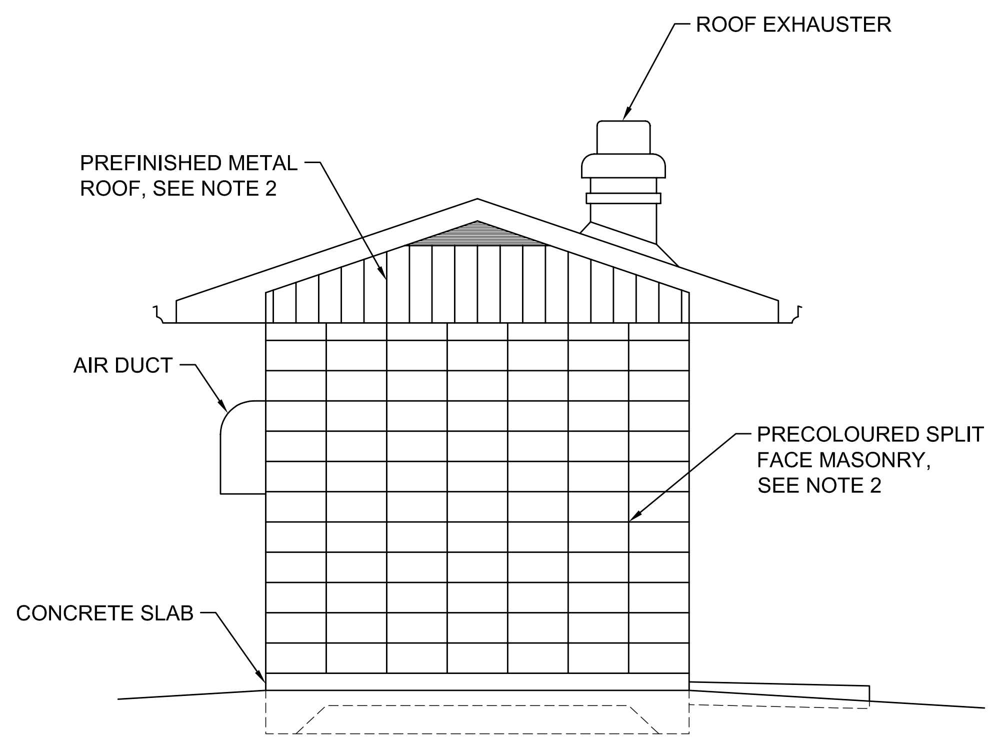

END ELEVATION
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NOTES:

1. PROVIDE INDUSTRIAL HEAVY DUTY INTERNALLY STIFFENED INSULATED STEEL DOOR c/w WELDED STEEL FRAME. CONSIDER PREDOMINANT WIND DIRECTION WHEN LOCATING AND ORIENTING DOOR.

2. ALTERNATIVELY WHERE AESTHETICS IS LESS IMPORTANT, A PRECAST CONCRETE BUILDING WITH EXPOSED AGGREGATE FINISH ON EXTERIOR WALLS MAY BE USED .

ALBERTA TRANSPORTATION CIVIL PROJECTS BRANCH **ALBERTA ENVIRONMENT** WATER MANAGEMENT OPERATIONS	**WATER CONTROL STRUCTURES - SELECTED DESIGN GUIDELINES** **TYPICAL CONCRETE BLOCK CONTROL BUILDING** DATE: November 2004 — CAD FILE: 99008A18-15.dwg — FIGURE No.: 18-15