DESIGN AND CONSTRUCTION GUIDELINES AND PLAN PREPARATION MANUAL

FOR

SUBDIVISIONS

IN THE

COMMONWEALTH OF THE BAHAMAS

2004

MINISTRY OF WORKS & UTILITIES

DEPARTMENT OF PUBLIC WORKS
CIVIL DESIGN SECTION

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Preface

The guidelines were developed in an effort to provide detailed and comprehensive standards for design of subdivisions to include all types of roadways including public or private.
Guidelines were developed from the existing *'Standard Specifications for the Construction of New Roads in Subdivisions on New Providence'* and references from standards developed by various agencies from the United States of America and United Kingdom. These guidelines represent part of the '*Private Roads and Subdivisions Act', Chapter 256 and 257, 'Town Planning Act', Chapter 236*. The guidelines are the 'Design and Construction Guidelines and Plan Preparation manual for Subdivisions in The Commonwealth of The Bahamas, 2004'

The guidelines consist of two sections; Section I-Design and Construction Guidelines, outline of various design practices for roadway geometrics and drainage for the subdivisions, and construction methods for the design.
Section II-Plan Preparation Manual, outlines the required information for each phase of the design in the drawing set.
Appendices have been included with examples for clarification. The drawings presented in the appendices represent only a few of the typical details possible.

The guidelines supersede the previous standards, mentioned above, and will be continuously updated to provide the most effective design and construction practices.

Part I – Design and Construction Guidelines for Subdivisions in the Commonwealth of the Bahamas

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Section I - Design and Construction Guidelines for Subdivisions in the Commonwealth of the Bahamas

General

The guidelines for the design of subdivisions roadways public or private are detailed in this section. The policy is to provide guidance for the designer with recommended ranges of values. Values used outside the range to be justified on request to Civil Design Section of The Ministry of Works and Utilities (MOW&U).

References were made to the following standards:

A policy on Geometric Design of Highways and Streets-The American Association of State Highway and Transportation Officials (AASHTO)

Standard Specifications for Road and Bridge Construction-Florida Department of Transportation (FDOT)

Design Manual for Roads and Bridges-Highways Agency, Scottish Office Development Department (DMRB)

The Traffic Signs Regulations and General Directions 1994-Her Majesty's Stationary Office.

The Traffic Signs Manuals Chapters 1-8- Her Majesty's Stationary Office.

American Society for Testing and Materials (ASTM) 2002-2003

Standards are available from the addresses listed in the Reference section.

Chapter 1-Roadway Layout

1.1 Roadway Layout

Classification of subdivision roads is as follows:

Main Road 'A' is defined as a road capable of carrying Average Daily Traffic (ADT) of 25,000 vehicles maximum acceptable capacity.

Main Road 'B' is defined as a road capable of carrying an ADT of 22,000 vehicles maximum acceptable capacity

Major subdivision road is defined as a road capable of carrying an ADT of 14,000 vehicles maximum acceptable capacity.

Minor Subdivision road is defined as a road capable of carrying an ADT of 5,000 vehicles maximum acceptable capacity.

Local Street is defined as a road capable of carrying an ADT of 3,500 vehicles maximum acceptable capacity.

Table 1 summarizes the design details of the road classification:

Table 1: Roadway Design Details

Roadway Type	Design Speed (mph)	ROW Width (ft)	Lanes	Pavement Width (ft)	Total Verge Width (ft)	Sidewalk Width (ft)
Main Road 'A' (Arterial)	70	100	4 2	48 24	40 20	6 6
Main Road 'B' (Arterial)	70	80	4 2	48 24	26 20	6 6
Major Subdivision Road (Collector)	45	50	2	24	20	6
Minor Subdivision Road	35	40	2	20	20	6
Local Street	30	36	2	20	8	5

Local streets with cul-de-sacs to have a verge width of 6-ft around the cul-de-sac.

Sidewalks are optional, and can be constructed on one side or both sides depending on pedestrian traffic patterns. Verge width to decrease to accommodate width of sidewalk.

Exhibit of typical roadway cross-sections are included in Appendix I.

Chapter 2-Horizontal Alignment

2.1 General

Horizontal alignment of the carriageway shall provide a safe and comfortable ride quality for motorists. Critical for safety is design speed as compared to sight-distance, and super-elevation.

Transition from one alignment to another shall be with a tangent-spiral-curve-spiral-tangent, to the alignment connected.

Curves with normal cross-falls shall have a minimum radius as stated in Table 2.

Table 2: Minimum Radius for Normal Cross-Fall

Design Speed (mph)	Minimum Radius (ft)
20	**1,475**
25	**2,625**
30	**3,650**
35	**5,000**
40	**6,600**
45	**8,140**
70	**9,500**

Smaller radii can be used with the use of super-elevation, and removal of adverse crown.

2.2 Super-elevation

Super-elevation shall be used when the horizontal curve radius used is smaller than that in Table 2. Consideration shall be given when providing super-elevation, rotating either the edge of pavement or centerline of roadway, for drainage, and minimizing cut and fill quantities.

Curves for low speed urban streets (Local Streets) super-elevation may/be impractical, due to drainage, lot grading, and cross-streets. Curves with normal cross-fall may have a minimum radius as stated in Table 3.

Table 3: Minimum Radius for Low Speed Urban Streets

Design Speed (mph)	Minimum Radius (ft)
20	**70**
25	**164**
30	**280**
35	**440**

Tables are provided in AASHTO as a guide for required radius as a function of super-elevation, design speed, and length of runoff. Maximum rate of super-elevation not to exceed 6.0%.

2.2.1 Transition Curves (Spirals)

Transition curves or spirals shall be provided to increase and decrease centrifugal forces to motorists when traversing a super-elevated curve.

Spiral curves shall be defined using the Shortt equation as follows:

$$L = \frac{0.0702V^3}{RC}$$

Where: L=minimum length of spiral, ft
V=speed, mph
R=curve radius, ft
C=rate of increase of centripetal acceleration, m/s^3
Value of C can be between 1 and 3.

2.2.2 Super-elevation Runoff

Super-elevation runoff shall be provided to change from a normal crown to an adverse crown or cross-fall, and back.

Runoff shall be defined as follows:

$$L = \frac{2.72fV}{C}$$

Where: L=minimum length of runoff, ft
F=side friction factor
V=design speed, mph
R=curve radius, ft
C=rate of change of f, m/s^3
Value of C can be between 1.2 for 20 mph, and 1.05 for 30 mph

Tables are provided in AASHTO as a guide for required runoff as a function of super-elevation, minimum radius, and design speed.

Refer to Part II-Plan Preparation Manual, Chapter 4-Roadway Plan and Roadway Plan-Profile, for the presentation of the required data on the drawing set.

Chapter 3 - Vertical Alignment

3.1 General

Vertical alignment of the carriageway shall provide a safe and comfortable ride quality for motorists, and adequate drainage. Critical for safety is adequate stopping sight-distance, which should be more liberal than using the minimum criteria.

Transition from one grade to another in excess of a 2% algebraic difference shall be with a symmetrical parabolic curve tangent to the grades connected. Unsymmetrical curves may be required in special circumstances. Vertical curves shall be designed as per Section 3.3.

3.2 Design of Grades

Vertical grades to have a 0.5% minimum slope not to exceed a maximum slope of 8.3%. Circumstances due to terrain may require exceeding the maximum slope, in which case justification is required. The minimum roadway slope may/be waived provided there is sufficient ROW to grade swales to 0.5% minimum slope for drainage. Drainage swale profiles and cross-sections at minimum and maximum depths to be provided.

Percent Slope is defined as the difference in grade divided by the horizontal length of change in grade, multiplied by 100.

Refer to Part II-Plan Preparation Manual, Chapter 7-Lateral Ditch/Outfalls, Retention/Detention and Mitigation Areas, for the presentation of the required data on the drawing set.

3.3 Vertical Curves

Vertical curves are required for change in grades. Parabolic curves are determined by sight-distance. Vertical curves are defined as either a Crest curve or Sag curve, and to be described using the following:

K= rate of curvature, ft per % of A
A= algebraic difference in grade changes, percent
L=length of curve, ft
R=radius of curve, ft
VPI=vertical point of intersection
VPC=vertical point of curvature
Design Speed, mph

3.3.1 Crest Vertical Curves

Crest vertical curves are defined as follows:

When S is less than L

$$L = \frac{AS^2}{100\,(\sqrt{2h_1} + \sqrt{2h_2})^2}$$

When S is greater than L

$$L = 2S - \frac{200(\sqrt{h_1} + \sqrt{h_2})^2}{A}$$

Where: L=length of vertical curve, ft
S=sight-distance, ft
A=algebraic difference in grades, percent
h_1=height of eye above roadway surface, ft
h_2=height object above roadway surface, ft

Minimum K value of 25 is required. K value will increase with increase in design speed.

Tables are provided in AASHTO as a guide for required K value with design speed.

3.3.2 Sag Vertical Curves

Sag vertical curves are defined as follows:

When S is less than L

$$L = \frac{AS^2}{120+3.5S}$$

When S is greater than L

$$L = 2S - \frac{(120+3.5S)}{A}$$

Where: L=length of vertical curve, ft
S=light beam distance, ft
A=algebraic difference in grades, percent

Minimum K value of 40 is required. K value will increase with increase in design speed.

Tables are provided in AASHTO as a guide for required K value with design speed.

Refer to Part II-Plan Preparation Manual, Chapter 4-Roadway Plan and Roadway Plan-Profile, for the presentation of the required data on the drawing set.

Chapter 4 - Drainage

4.1 General

While it is recognized that there is a great demand for residential/commercial developments and such investments stimulate the economy, it is recognized that land located in low lying areas is unsuitable for subdivision development due to the land serving as a natural drainage basin i.e. wetlands. Observation has shown land in New Providence below 5-ft above Mean Sea Level (aMSL) is subject to flooding during heavy rain periods (e.g. sections of Pinewood, South Beach Est., Bel Air, Coconut Grove). Due to the high water table in these areas percolation of water into the ground is very slow resulting in long periods of water settlement which may result in serious health risks and high financial losses. Storm drainage wells are very ineffective in relieving flooding in low areas due to inadequate hydraulic head. Storm drainage wells in areas below 5-ft aMSL back flow onto streets and into properties during high tide events. Therefore, the minimum elevation for developable land to be 5-ft aMSL. It is preferred that this be the natural elevation of the proposed subdivision site, however if filling in of portions or all of the site is required to achieve 5-ft aMSL then this shall be achieved without detriment to surrounding properties.

All storm water runoff generated on site is to be retained or disposed of on the subdivision's property using natural or structured drainage systems. Runoff into adjourning properties above the levels existing before the development is prohibited. The designer should as much as possible use the natural terrain when creating a drainage design. Low areas and valleys that naturally serve as drainage basins or collection areas for storm runoff should be used for location of drainage facilities (e.g. wells, retention or detention ponds) or left as open areas for parks or green space. Generally the designer is encouraged to be innovative in the design of the system.

The plan is to clearly delineate the individual drainage areas within the subdivision by outlining the boundary areas on plan and labeling the area. The area and peak flow rate to be provided. Locations of all storm water management facilities/structures i.e. wells, swales, culverts, detention ponds are to be indicated on plan. The direction of water flow is to be shown on plan. The elevation of the top of catch basin and the invert levels (where necessary) is to be provided on plan. Provide proposed centerline elevations and stations at 100-foot intervals of the road on the plan. Contours are to be shown.

Refer to Part II-Plan Preparation Manual, Chapter 6-Drainage Structures, and Chapter 7-Lateral Ditch/Outfalls, Retention/Detention and Mitigation Areas, for the presentation of the required data on the drawing set.

4.2 Topographic Map

A topographic Map is to be prepared by a registered surveyor of the subdivision and adjacent lands (upstream and downstream) that may affect drainage of the subdivision. The map is to have existing contours at 2-ft intervals that extend to a minimum of 100-ft beyond the property boundary (MOW&U may request additional contour information after review of the initial submittal). All elevations must be referenced to Mean Sea Level. The Topographic Map is to show any bodies of water (sea, lake, pond, canals, ocean holes), the high water shoreline and wetlands.

In the event a Lands & Survey Bench Mark cannot be located within reasonable vicinity of the property the MOW&U may grant permission to use information from the 1967 1:1200 contour maps if it can be proved that the land elevation has not been altered by filling or excavation. The contours on the 1:1200 maps require a Shattuck correction of -3.67-ft to equate them to Mean Sea Level. A physical survey of the land will still have to be done to ensure that the contour information on the 1:1200 maps is accurate. Alternatively the ground water levels on site will have to be monitored to determine the average High Water Level. MOW&U to approve ground watering monitoring method. Design levels 2-ft above the High Water Level will be accepted for development.

4.3 Stormwater Runoff

Storm drainage design shall be produced for the entire subdivision that can accommodate a 1 in 5 year storm of 6-hour duration and intensity of 0.8 in./hr (equivalent to 4.8 inches of rain) without water ponding on the road, with supporting calculations to be provided. The designer can use any acceptable conventional method to evaluate the watershed area. The preferred method shall be the Rational Method for determining of runoff for developments up to 200 acres (see Appendix VII for sample calculations).

The peak flow rate as per the Rational Method shall be defined as follows:

$$Q = CIA$$

Where: Q = peak flow rate,
C = runoff coefficient
I = average intensity, inches/hour
A = tributary drainage area, acres
Values of C are defined in Table 3

Table 3: Runoff Coefficients*

Surface	Runoff Coefficient (C)
Asphalt, Roofs & Concrete	0.95
Swales	0.30
Single Family Lots	0.35
Multi-Family Lots	0.50
Commercial & Industrial Lots	0.70

*Additional runoff coefficients are listed in Appendix VII.

4.4 Lot Grading

Lot-grading plan shall be provided, showing the existing and final proposed grades at the lot boundaries. The lots are to be graded to provide positive drainage towards the roads. The roadways shall be designed to accommodate runoff via swales, curbs or gutters. The minimum longitudinal grade for lots is 0.5%.

4.5 Drainage Structures

Drainage structures details shall be provided on a separate sheet. The details are to clearly show all specifications, grades, elevations, dimensions, construction materials and supporting information required to properly construct the drainage structures.

4.5.1 Drainage Wells and Catchpits

The MOW&U standard well set-up is the catchpits in the left and right swale connected to a well within the roadway at the edge of pavement via 12-inch diameter culvert. The well is to be a minimum 10-inch diameter and have a casing length of 40-ft. This is the minimum standard and the maximum discharge rate accepted by the MOW&U for such a well is 1.36-cfs. A designer using a discharge value higher than this value will be required to conduct a pump test of the well to validate the value.

4.5.2 Outfalls

All out falls to natural bodies of waters such as lakes, ponds and the sea will be reviewed by the Bahamas Environmental Science Technology Commission (BEST) to determine environmental impacts if any. Provisions for sediment control and oil separators will be required.

4.5.3 Detention Ponds

Whenever possible the open/green space or park/recreational areas should be utilized as dry detention areas. Natural grades should be utilized when they lend themselves to a depressed area for the detention of storm runoff. Dry detention areas should have side slopes no greater than 3 to 1 and the bottom is to be no lower than 2-ft below the lowest point on the paved road. If the elevation of the pond bottom is 5-ft aMSL or more, a storm drainage well can be placed in the bottom of the pond or if the bottom is less the 5-ft aMSL the well can be placed at a higher elevation along the perimeter of the pond.

Ponds designed to remain wet to have a minimum pond bottom elevation of –3-ft below low water mark, for movement of water, be lined if appropriate by an approved geo-textile material, and have slope protect where required. Side slopes to be 3:1 and no flatter than 20:1. Mechanical aeration may/be required if water becomes stagnant, due to lack of tidal movement.

4.6 Stability Control

The maximum side slope for filled areas is 3:1. Slopes steeper than the maximum stated will require a structural retaining wall, or alternative approved method by MOW&U, to prevent erosion.

Cut in lime rock the maximum side slope is 1:6 horizontal to vertical.

4.7 Fire wells

Fire Wells shall be installed in all subdivisions within 600 to 1000-ft of all structures

Chapter 5 - Intersections

5.1 General

Where two roadways intersect, and conflicting traffic movements are present, an intersection design shall be required, detailing traffic control, geometrics, drainage, landscaping, signage and pavement markings as outlined by this Section. Intersection design to accommodate safe traffic movements with minimum delays on the designated major and minor roadways, within the subdivision. Intersections or junctions created by subdivision roads connecting to the existing road network, shall be deemed the minor roadway.

Uncontrolled intersections of this type will be deemed a priority junction with the major roadway having the right of way over the minor roadway. Controlled junctions are defined in Sections 5.4 and 5.5.

Subdivisions with a minimum of 200 lots, or projected density of 20 lots per acre, are required to perform a Traffic Impact Study to identify effects on the existing road network.

Intersections shall be required to incorporate pedestrian facilities for safe operations.

Refer to Part II-Plan Preparation Manual, Chapter 5 - Intersection Details/Layouts, for the presentation of the required data on the drawing set.

5.2 Alignment of Intersections

Intersecting roadways to be perpendicular at the point of intersection where possible. Where right angles are not possible the intersecting angle shall be within the ranges of 70 to 120 degrees, with the requisite islands to separate turning movements.

Roadways shall be connected with radii tangent to each roadway. Table 3 summarizes the minimum radii for the various types of intersecting roadways. **Note radii stated are for edge of pavement and not road reservation.** ROWs at intersections may have radii or chamfers to provide the required verge width for drainage facilities, sidewalks, etc…

Staggered junctions of the right/left configuration shall be acceptable provided there is adequate spacing between the junctions. Table 3 summarizes the minimum spacing between the various types of roadways.

5.3 Sight-Distance

Sight-distance provided on the minor roadway to be applicable for the design speed of the major roadway.

Table 3 summarizes the minimum sight triangles for the various types of intersecting roadways.

Obstacles within the sight triangle are to be below 2.5-ft or above 6-ft in height, as not to impeded sightlines of motorists.

Table 3: Intersection Spacing, Radii, and Sight-Triangle Details

Designated Major roadway	Designated Minor Roadway	Junction Spacing (ft)	Junction Pavement Radii (ft)	Sight-Triangles*	
				X (ft)	Y (ft)
Main Road	All other Roads	230	35	30	300
Major Subdivision Road	Minor Subdivision Road	130	35	15	200
Major Subdivision Road	Local Street	130	35	15	200
Minor Subdivision Road	Minor Subdivision Road	130	35	15	200
Minor Subdivision Road	Local Street	80	25	15	130
Local Street	Local Street	80	25	10	130

*Exhibit of sight triangles are included in Appendix II.

5.4 Roundabouts

Evaluation of intersections for the provision of a roundabout will be as per the Design Manual for Roads and Bridges Volume 6, Section 2, Geometric Design of Roundabouts, Highways Agency, Scottish Office Development Department, United Kingdom, 1993.

Signage and pavement marking for roundabouts will be as per the Design Manual for Roads and Bridges, Volume 6, Section 2, Design of road markings at roundabouts, Highways Agency, Scottish Office Development, United Kingdom, 1997.

5.5 Signalized Intersections

Evaluation of intersections for the provision of signal control will be as per the 'Traffic Signal Warrants' from the Manual on Uniform Traffic Control Devices (MUTCD), United States Department of Transportation, Federal Highway Administration, 2000.

Intersections for signal installation to be identified from a Traffic Impact Study or as directed by the Ministry of Works & Utilities.

5.6 Drainage

Drainage for intersections to be provided as outlined by Chapter 4 - Drainage, of these Specifications.

5.7 Signage and Pavement Markings

Signage and pavement markings for intersections to be designed and installed as outlined by Chapter 7 - Signage and Pavement Markings, of these Specifications.

Chapter 6 - Turning Facilities

6.1 General

Tuning facilities shall be provided where a roadway terminates at the end of a property boundary, and does not join or intersect into another roadway.

6.2 Cul-de-sacs

Cul-de-sacs shall have a minimum 36-ft road reservation radius, and minimum 30-ft paved road radius.

6.3 Hammerheads

Hammerheads shall have a minimum road reservation dimensions of 72-ft length, 36-ft width, and 35-ft radius, and a minimum paved road dimensions of 62-ft length, 20-ft width, and 30-ft radius.

Exhibit of a typical cul-de-sac and hammerhead are included in Appendix III.

Chapter 7 - Signage and Pavement Markings

7.1 General

Signage and pavement markings to be designed and installed as per the 'Road Traffic Act' of The Commonwealth of the Bahamas, 'Traffic Signs Manuals' of the Department of Transportation, Scottish Development Department, Welsh Office, United Kingdom, and 'The Traffic Signs Regulations and General Directions 1994' United Kingdom, or as directed by The Ministry of Works & Utilities.

7.2 Signage

Signs to be designed and installed as per the Chapters 3, and 4 of the Traffic Signs Manual.

Signs to be retro-reflective.

Signs to have a minimum clearance of 2-ft from the edge of pavement to edge of sign, and minimum height of 6-ft from finished road level to bottom of sign.

Signage details to be dimensioned for adequate construction.

Exhibits of typical signs are included in Appendix IV.

7.3 Pavement Markings

Pavement markings to be designed and installed as per Chapter 5 of the Traffic Signs Manual.

Pavement Markings to be retro-reflective.

Pavement markings detail to be dimensioned for adequate construction.

Exhibit of typical pavement markings are included in Appendix IV.

Chapter 8 - Utility Services

8.1 General

Services may be installed overhead or underground, however, underground installation is preferred for increased safety, and aesthetics.

Underground utilities to be installed within the swale. Electrical, telephone, and cable services, to be located separately from potable water service. All services to be installed to a minimum depth of 2-ft 6-inches below the finished road level.
When underground services are used, a connection on each alternate property boundary extending a minimum of 1-ft 6-inches in the property will be provided by the developer.
Special requirements of the Utility Services regarding layout, installation, and protection must be adhered to by the developer.

Utility poles carrying services ONLY to be located to the edge of the road reservation, but in no case less than 3-ft from the edge of the road reservation, without obstructing sight-distance at intersections, driveways, etc…

Poles used separately for street lighting to be installed with a minimum clearance of 5-ft from edge of pavement, without obstructing sight-distance at intersections, driveways, etc…

Chapter 9 - Material and Construction Standards

Construction standards and methods with stated tolerances are to be in accordance with FDOT - Standard Specifications for Road and Bridge Construction, or unless otherwise stated in the following sections.

9.1 Clearing

The natural ground over which filling is to be place shall be cleared of all loose boulders, grass, productive soil, bushes, trees, roots and other vegetation. No filling material shall be placed until all watercourses have been diverted or drained. All potholes or cavities discovered shall be opened up, filled and compacted before any filling takes place.
Approval from Department of Physical Planning required prior to clearing.

9.2 Excavation

Vegetation and topsoil shall be completely removed from the entire road reservation width, and ground excavated for the full width of the formation level or to a depth as may be required to eliminate depressions, or soft-compacted areas. Trees, of minimum clear-trunk of 5-ft with clearance outside the edge of the shoulders, to be saved for beautification.
Approval from Department of Physical Planning required prior to removing any protected tree species.

9.3 Sub base

At sections to be reconstructed or where cutting is required, the existing formation shall be scarified to a depth of 6" below formation level.

The scarified material shall then be shaped and rough graded, watered and compacted after hard planning to achieve the required cross-fall a further rolling of any loose material shall be carried out until a smooth surface layer is achieved, except for verges. They shall be left with a rough surface to receive the subsequent base layer.

9.4 Base

Base to be of clean well graded limerock material passing a 2-inch mesh, applied in two layers of 4-inches, to achieve a minimum base thickness of 8-inches after compaction.

Moisture content of material will be manipulated with the required amount of wetting or drying of the full width and depth of the course to obtain compaction, to be ± 3% of optimum moisture content.

Layers to be compacted on obtaining proper conditions of moisture to a minimum density of 100% of maximum density as determined by AASHTO T180, ASTM D1557. Areas located outside the travel lanes to be compacted to a minimum density of 98%, i.e. intersections, cul-de-sacs, hammerheads, etc…

9.4.1 Density Testing

Minimum of three density tests shall be performed on each section of final compaction or as determined by the Engineer for the development.
Density shall be determined using the Nuclear Density Method, or Sand-Cone Method, and shall conform to ASTM standards or approved equivalent. Moisture density curves shall conform to ASTM D1557; sieve analyses to ASTM C136; and field densities to ASTM D2167 or to ASTM D2922.

A copy of the density test results to be forwarded to MOW&U for review.

9.5 Prime Coat

Prime coat used shall be a cutback asphalt or emulsified asphalt. Base course to be free of all organics, and shaped to the design cross-fall before the application of the prime coat.

Prime coat shall be applied uniformly over the full width of the carriageway to be paved.

9.6 Tack Coat

Tack coat to be used when an overlay is required.

The tack coat shall be undiluted asphalt grades RS-1 or RS-2 heated to a temperature of 140 to 180 degrees Fahrenheit.

Application shall be with an approved pressure distributor at the rate of 10-square yards per gallon of residual bitumen, over the width of the carriageway to be paved. **Care should be taken to prevent pooling of the emulsions, when used.**

Tack coat shall be applied in advance of the bituminous mix to permit sufficient drying but not to lose adhesive properties.

Tack coat shall be free of traffic until bituminous layer has been laid.

9.7 Bituminous Surfacing

The surface of the carriageway to be hot rolled asphalt as specified by Florida Department of Transportation Standard Specifications for Road and Bridge Construction 2001, Section 331.

Bituminous surfacing shall be Type S-I or S-III asphaltic concrete, applied with approved plant in a single layer of 1 ½-inches when compacted.

Temperature during spreading of mix shall be within 25 degrees Fahrenheit of the established mix temperature.

Surfacing operation will cease during rainfall, or water is covering carriageway to be surfaced.

Bituminous surfacing of Type S-I or S-III shall be applied to all newly constructed roads in New Providence.

Roads in the Family Islands to be surfaced using a double seal treatment of primecoat, pea-rock and sandseal surface, or other suitable material subject to the approval by MOW&U. Double seal treatment to be placed as per Section 9.8. Family Islands with asphalt plants have the option of surfacing roads with bituminous surfacing Type S-I or S-III. Surfacing roads with concrete is acceptable with concrete mix design submitted to and approved by MOW&U.

9.7.1 Compaction

Compaction will be carried out using a vibratory or static roller of 5 to 12 tons for seal rolling, with final rolling completed before pavement temperature is below 175 degrees Fahrenheit, to achieve required density.

Final rolling to be with an 8 to 12 ton steel roller after the seal rolling, with rolling completed before pavement temperature is below 175 degrees Fahrenheit.

Rolling to be longitudinally, with the center joint pinched prior to rolling the remainder of the lane. Rolling to proceed across entire mat with 6-inches of overlap on each adjacent pass. Rolling speed to be slow enough to avoid displacement of the mix, and until all roller marks are eliminated.

Bituminous surface to have a minimum density of 98% of maximum density as determined by AASHTO T180.

9.7.2 Density Testing

Density of the in-place asphalt shall be determined using either the Nuclear Density Method-use a nuclear density machine at ten random locations within the full width of the paved carriageway or intervals as determined by the Engineer of the development; or by determining the density of the cores.

Coring shall be carried out at random locations on the full width of the surfaced carriageway to determine thickness of bituminous surface, as determined by the Engineer of the development.

A copy of the density test results to be forwarded to MOW&U for review.

9.8 Double Seal Treatment

Double seal treatment is for application on Family Island roads ONLY.

Each of the following surface treatment layers shall be distributed by means of an approved mechanical spreader and drag broomed to achieve an even distribution. The surfaces shall be rolled with at least four passes of a 7 to 10 ton pneumatic tyred roller

No surfacing shall commence until the finish base has been approved by the Engineer

9.8.1 Prime Coat

Prime coat-basecourse shall be power broomed to sweep the surface clean of all dust and deleterious material. The RC-250 prime coat shall be applied to the base when it is dry or slightly damp.

Prime coat- RC-250 diluted 25% by volume with light (grade 1) diesel fuel shall be applied at a rate of 0.2 gallons per square yard, at a temperature between 140 degrees F and 180 degrees F, and at a spray bar pressure of at least 40-pounds per square inch. It should then be allowed to dry for not less than 48 hours without being disturbed by traffic.

9.8.2 Pea-Rock Surface (1st Coat)

RC-250 shall applied at a rate of 0.3 gallons per square yard, at a temperature between 140 degrees F and 180 degrees F, and at a spray bar pressure of at least 40- pounds per square inch, **blinded with 3/8 inch pea-gravel aggregate**, at an application rate of 35 pounds per square yard, and rolled as stipulated above.

9.8.3 Sandseal Surface (2nd Coat)

Second coat – After a period of not less than 48 hours, during which the first coat has been kept free of traffic, the surface will be swept by a power broom to remove all loose chippings and deleterious material. RC-250 shall applied at a rate of 0.3 gallons per square yard, at a temperature between 140 degrees F and 180 degrees F, and at a spray bar pressure of at least 40- pounds per square inch, **blinded with coarse, sharp sand**, at an application rate of 35 lb per square yard, or at a rate stipulated by the S.O., and rolled as stipulated above.

9.8.4 Sweeping

After a period of not less than 48 hours, during which the second coat has been kept free of traffic, the surface will be swept by a power broom to remove all loose chippings and deleterious material.

9.9 Drainage Wells and Catchpits

Drainage wells to be constructed using an approved drilling contractor, with adequate measures to retain spill water on site.
Well to have a minimum diameter of 10-inches and be drilled to a minimum depth of 150-ft, and verified by Engineer of development and approved by MOW&U prior to installation of well casing.

Casings to be installed and grouted to a minimum depth of 40-ft or as approved by MOW&U to ensure protection of the fresh water table, with an upstand of 4-inches and covered with a mesh basket.

Catchpits for the well head to be constructed with concrete of strength 3,000 psi., poured in place, with minimum dimensions of 2-ft width, 3-ft length, 2-ft depth. Frame and covers for catchpit and wellheads to have a minimum load rating of H-20, and to be of Neenah Foundry, U.S. Foundry or equivalent approved by MOW&U.

Exhibit of typical drainage well and catchpit details are included in Appendix VI.

9.10 Culverts

Culverts shall be provided to connect catchpits, ponds or natural bodies of water, when construction of roadway impedes flow. Culverts to be sized to provided adequate flow, with a minimum diameter of 18-inches or equivalent surface area

Exhibit of typical culvert details are included in Appendix VI.

9.11 Sidewalks

Sidewalks may be provided on all roads, including cul-de-sacs.

Sidewalks to be constructed using asphalt concrete with concrete kerb or Portland concrete cement, having a minimum width of 6-ft and kerb height of 6-inches.

Sidewalks to be recessed at accesses to provide a transition from edge of access to sidewalk.

Transition from sidewalk to recessed sidewalk shall be with a disabled ramp of minimum length 3-ft.

9.11.1 Asphalt Type Sidewalk

Asphalt sidewalks to be constructed as per Section 9.7-Bituminous Surfacing, with the construction of a concrete kerb as per Section 9.13-Kerb.

9.11.2 Concrete Type Sidewalk

Concrete sidewalks to be constructed by cast-in-place or slip form method. Cast-in-place includes, preparation of sub-grade, supply and placing of fill materials, supply of materials and cast-in-place sidewalk and kerb, finishing, curing, and backfilling.

Concrete shall be to the following:
Type B Concrete proportion normal density concrete to American Concrete Institute (ACI)-318, Chapter 4 to give the following mix:
Cement type 1 with a strength of 3,000 pounds per square inch at 28 days for one cylinder, using nominal coarse aggregate size ¾ inch, with a water/cement ratio max 0.55, and slump discharge of 4 inches, min 2 inches

Reinforcing bars- new billet steel, grade 60, deformed bars to ASTM A153 or suitable fiber reinforcement approved by MOW&U.
Curing compound to ASTM-C309 Type 1-D Class B.

Exhibit of a typical sidewalk details are included in Appendix V.

9.11.2.1 Testing

Minimum quality control test frequencies specified as follows are the minimum number required.
Cast 3 concrete cylinders for each compressive strength test, one cylinder for the 7 day test and two cylinders for the 28 day test.

One test for each section 0 to 600 linear feet of sidewalk and kerb.

Air content test one test per load or batch of concrete

Perform slump test at the discretion of Engineer.

9.11.2.2 Method of Construction

Remove all deleterious substances at the sub-grade level and replace with approved fill material to 98% maximum density as per the Standard Proctor Compaction Test.

Haul excavated material unsuitable for use as fill and place in area for grass seeding as shown on the drawings.

Use straight, smooth, and clean metal or timber forms oiled with Parvelube #30 or approved alternative.

Place forms to line and elevation, and brace and stake firmly in place.

Forms to be wooden or approved equivalent for curved surfaces with radii less than 150-ft.

Place concrete in forms and consolidate in forms using mechanical vibrators.

Vibrate all kerb with a poker type vibrator not exceeding 2-inches in diameter.

Place contraction joints ¼ inch wide and 2 inches deep every 10-ft.

Finish to be broom finish to provide even surface, avoiding excessive toweling.

Sidewalk and Kerb edges to be rounded.

Protect work until concrete is set.

Remove forms and apply curing compound immediately and uniformly using an approved pressurized sprayer.

Backfill to 2 inches below the top of kerb to allow for topsoil.

9.12 Kerb

Kerb to be used at intersections, traffic islands, or asphalt and concrete sidewalks for delineation of edge of paved carriageway from unpaved areas, or transition from one elevated area to another, or for drainage as approved by Engineer for development.

Kerb to be cast-in-place, pre-cast, or slip-formed to provide a minimum height of 6-inches from the edge of paved carriageway.

Kerb construction and testing as per Section 9.11.2.

Exhibit of a typical sidewalk details are included in Appendix V.

9.13 Landscaping

Landscaping to include indigenous trees to the Bahamas as much as possible. No invasive species shall be permitted. Any existing invasive species shall be removed and destroyed.

Tree list is provided in Appendix VIII.

All plants and trees shall be completely free of diseases and/or insect infestations. Tree guys shall be taut and all accessories in good condition as specified. All planting beds and tree saucers shall be freshly cultivated and free of all weeds and debris.

Imported topsoil: natural, fertile, friable, agricultural soil containing no less than of 6% organic material with pH value ranging from 5.9 to 7.0.
Fertilizing shall be with approved mechanical equipment. Spread to be 50% of fertilizer in one direction, then 50% at right angles. Apply 50/50 mix of 6.6.6 fertilizer/Milogomite mix at the combined rate Of 1.0 lb/square yard, or as directed by the Engineer.

Grassing can be by seeding using an approved seed spreader after ground preparation and fertilizing. Fertilizer to be spread uniformly over the area to be seeded at a spread rate of 800 to 1000 pounds per acre, and mixed into the soil to a depth of 4-inches. Seed to be scattered uniformly over the area to be grassed, using Pensacola bahia seed or equivalent. Water seeded area to proceed to after germination, to sustain growth until established.

Grassing by sodding using ground preparation and fertilizing as in this section. Sod to be placed on the entire area to be grassed, unless in drainage swales or ditches where sod is to be staggered. Water sodded area until established.

9.14 As-Built Survey

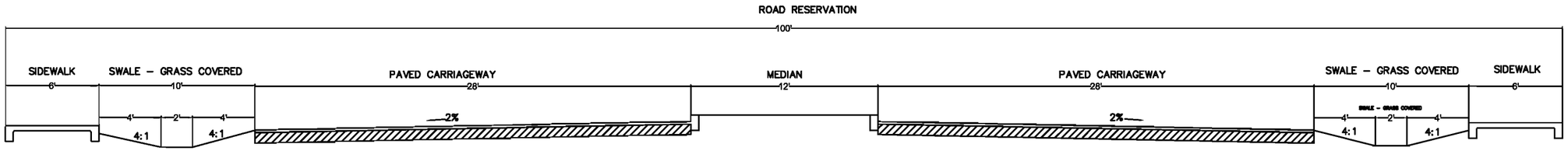
A topographic survey to be conducted on completion of construction for the subdivision, to include the following:

- Roadway centerline bearing and distance
- Roadway centerline elevations at 100-ft stations (Profile Plan to be included)
- Swale (drainage ditch) centerline elevations at 100-ft stations
- Drainage wells, catchpits, and culvert locations with elevations
- Lot boundary elevations

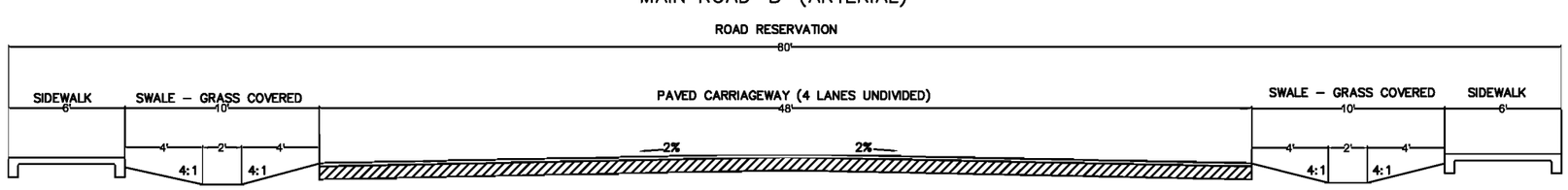
Appendix I

Typical Right-of-Way Configurations

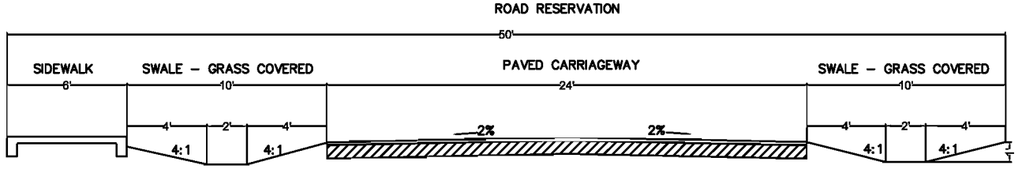
MAIN ROAD 'A' (ARTERIAL)



MAIN ROAD 'B' (ARTERIAL)



MAJOR SUBDIVISION ROADWAY



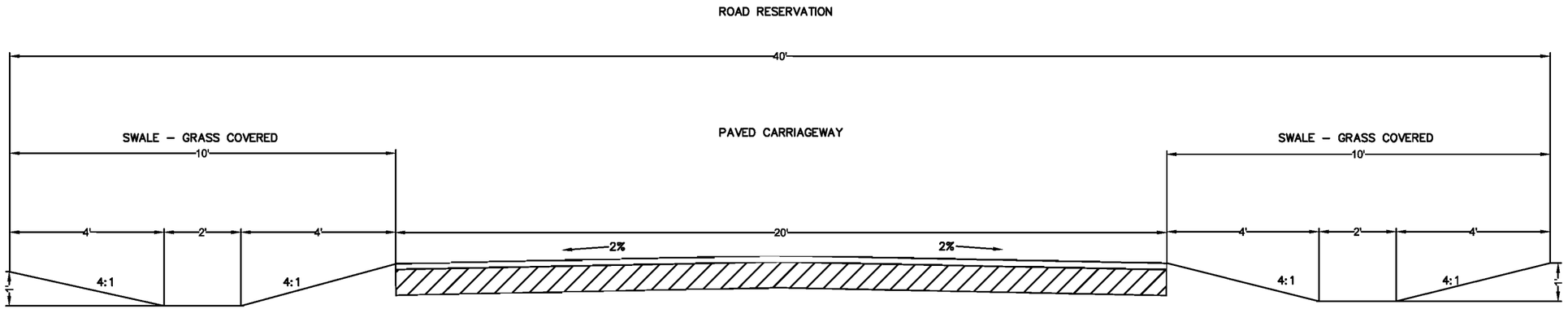
No.	REVISION	DATE

THE COMMONWEALTH OF THE BAHAMAS
MINISTRY OF WORKS & UTILITIES

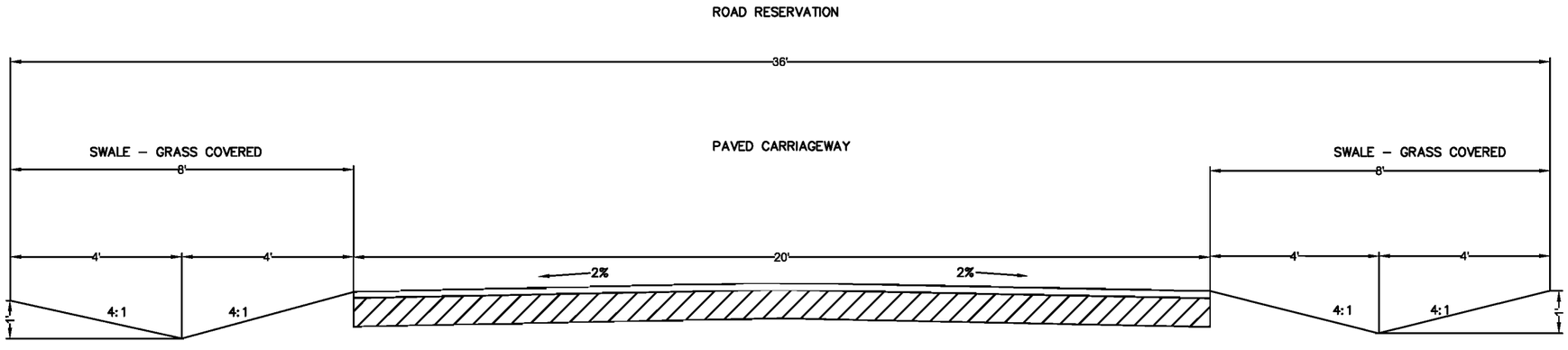
TYPICAL CROSS-SECTIONS
100-FT ROW
80-FT ROW
50-FT ROW

DESIGNED	R. GARRAWAY		FILE No.
DRAWN	R. GARRAWAY		
CHECKED			SHEET No. A-11
APPROVED			SCALE: NOT TO SCALE
DIRECTOR			DATE APRIL 2003

MINOR SUBDIVISION ROADWAY



LOCAL STREET

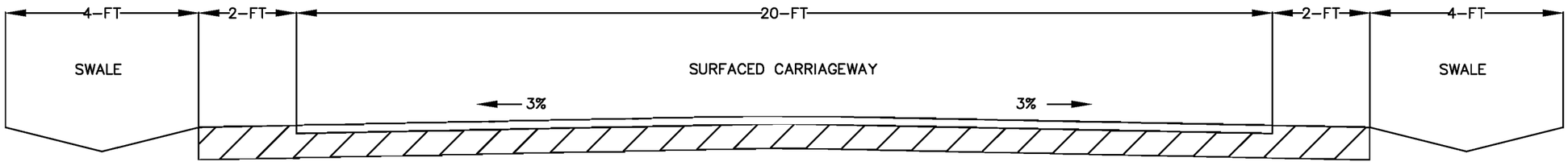


No.	REVISION	DATE

THE COMMONWEALTH OF THE BAHAMAS
MINISTRY OF WORKS & UTILITIES
TYPICAL CROSS–SECTIONS
40–FT ROW
36–FT ROW

DESIGNED	R. GARRAWAY		FILE No.
DRAWN	R. GARRAWAY		
CHECKED			SHEET No. A-1 2
APPROVED			SCALE: NOT TO SCALE
DIRECTOR			DATE APRIL 2003

FAMILY ISLAND



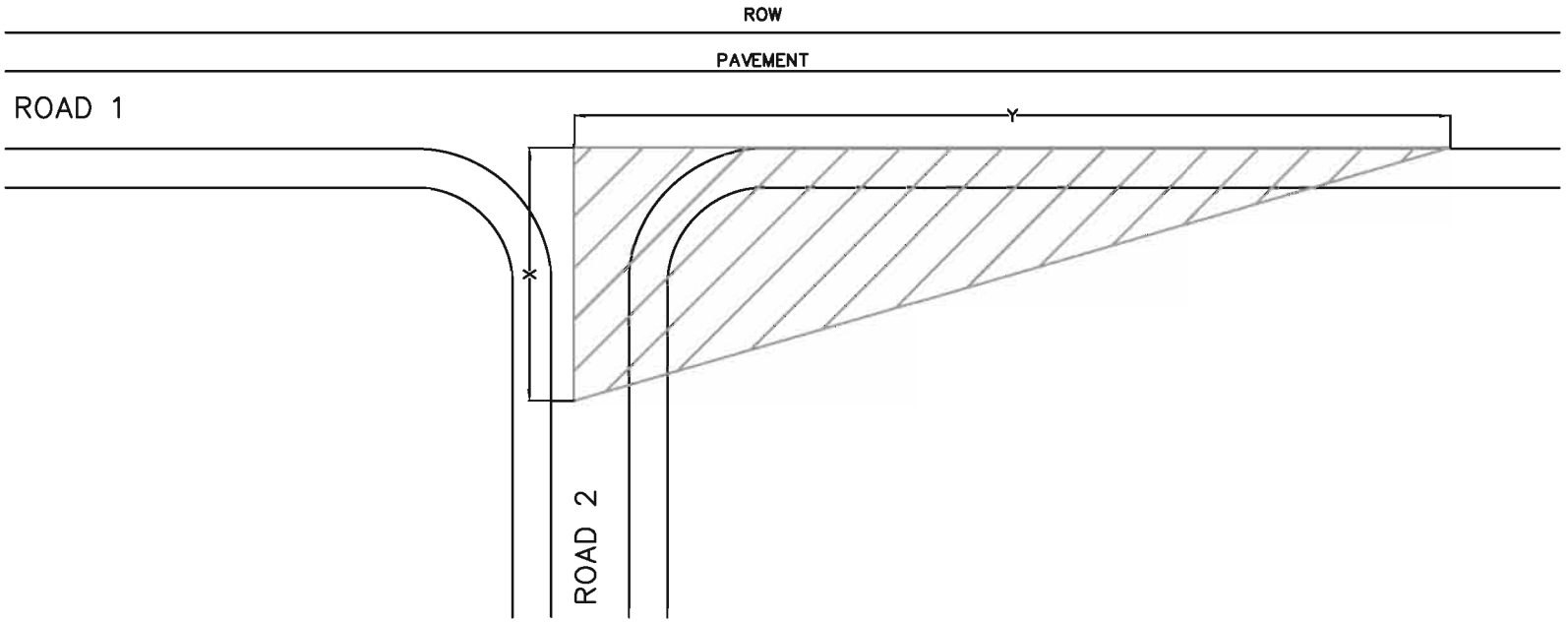
No.	REVISION	DATE

THE COMMONWEALTH OF THE BAHAMAS
MINISTRY OF WORKS & UTILITIES
TYPICAL CROSS–SECTIONS
FAMILY ISLAND

DESIGNED	R. GARRAWAY		FILE No.
DRAWN	R. GARRAWAY		
CHECKED			SHEET No. A-I 3
APPROVED			SCALE: NOT TO SCALE
DIRECTOR			DATE APRIL 2003

Appendix II

Sight Triangle



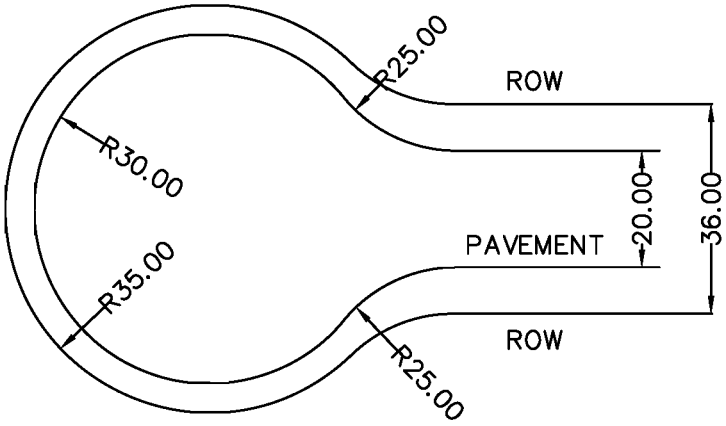
No.	REVISION	DATE

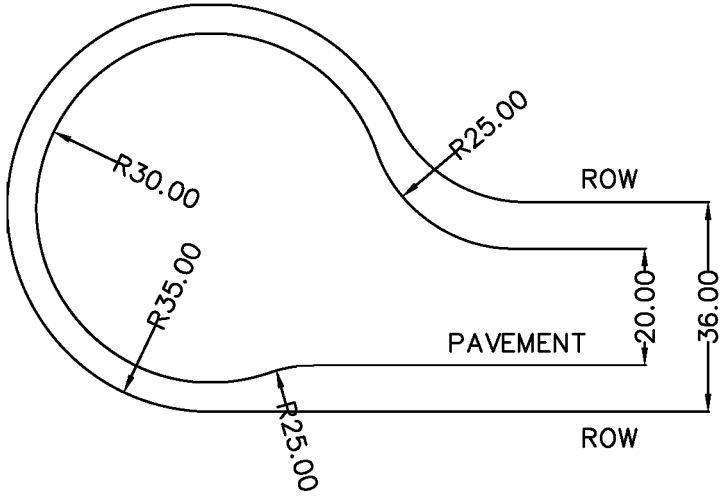
THE COMMONWEALTH OF THE BAHAMAS
MINISTRY OF WORKS & UTILITIES

TYPICAL SIGHT TRIANGLE

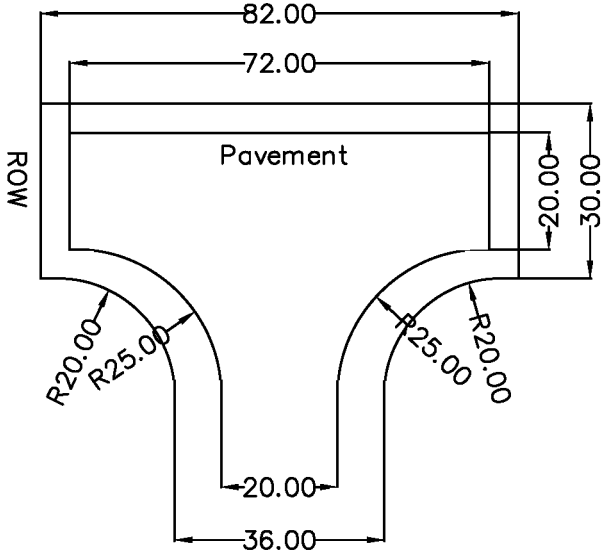
DESIGNED	E. CHERRY		JOB No.
DRAWN	E.CHERRY		
CHECKED			SHEET No. AB-1
APPROVED			SCALE N. T. S.
DIRECTOR			DATE: MAY 2013

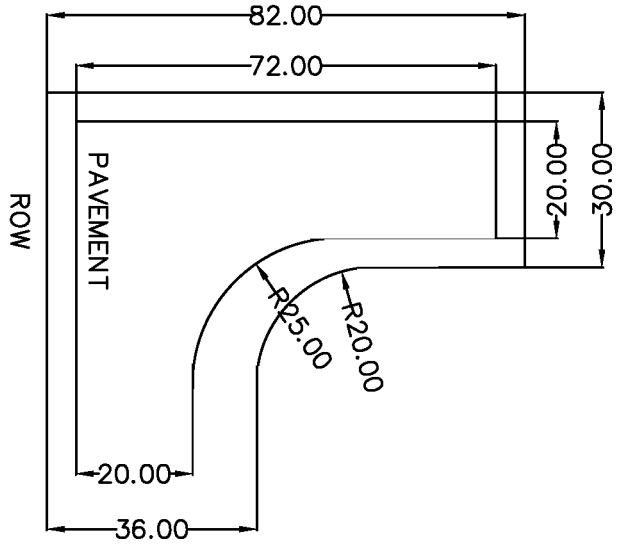
Appendix III
Typical Turning Facilities





CUL–DE–SAC FORMATIONS





HAMMERHEAD FORMATIONS

No.	REVISION	DATE

THE COMMONWEALTH OF THE BAHAMAS
MINISTRY OF WORKS & UTILITIES

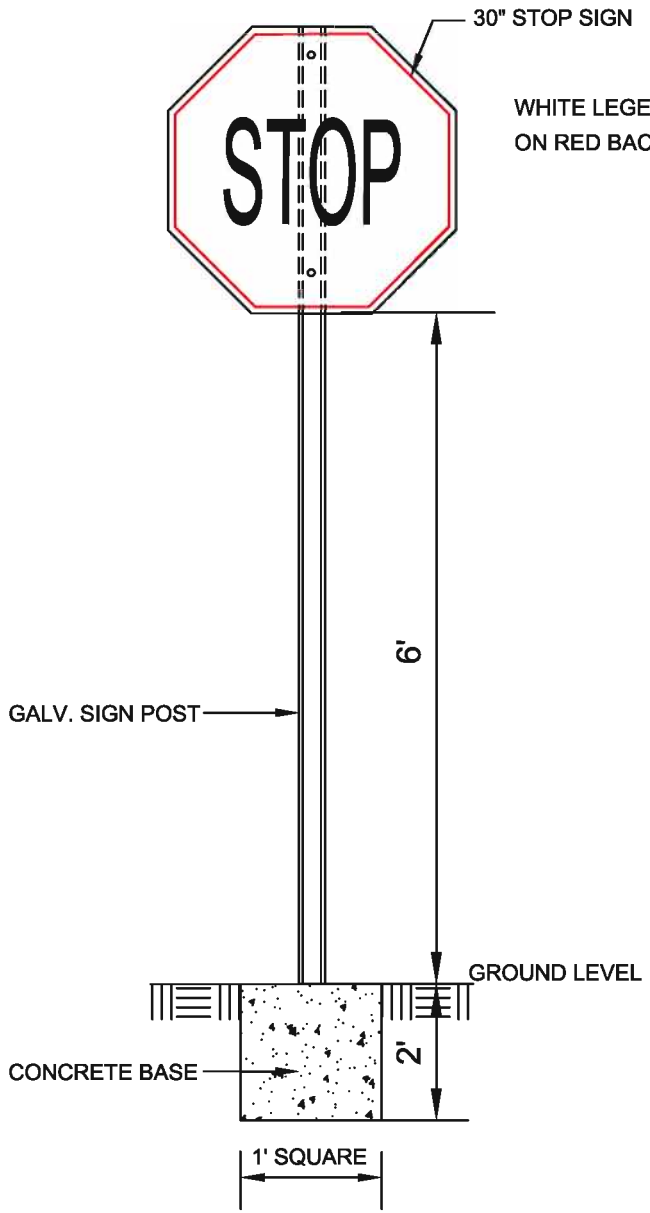
TYPICAL DRAINAGE WELL, CATCHPIT
CUL–DE–SACS
HAMMERHEADS

DESIGNED	R. GIBBONS		JOB No.
DRAWN	R.GIBBONS		
CHECKED			SHEET No. A&E–1
APPROVED			SCALE: N. T. S.
DIRECTOR			DATE: MAY 2005

Appendix IV

Typical Signage and Pavement Markings

STOP SIGN INSTALLATION

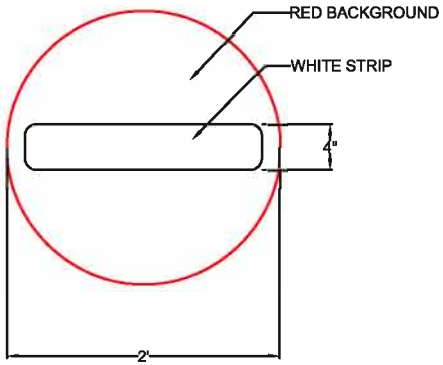


No.	REVISION	DATE

THE COMMONWEALTH OF THE BAHAMAS
MINISTRY OF WORKS & UTILITIES

STOP SIGN INSTALLATION

DESIGNED	R. GARRAWAY		JOB No.
DRAWN	R.GARRAWAY		
CHECKED			SHEET No. A/V-0
APPROVED			SCALE: N.T.S.
DIRECTOR			DATE: MAY 2008



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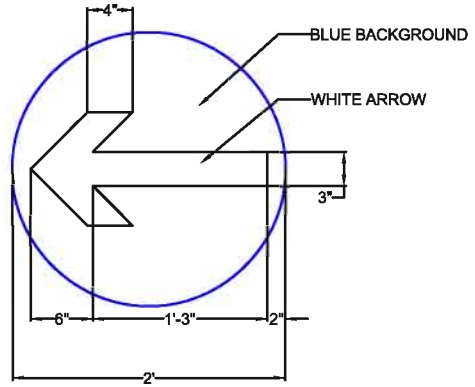
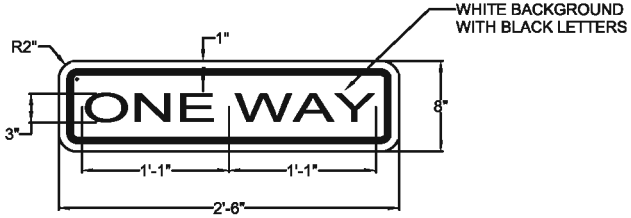
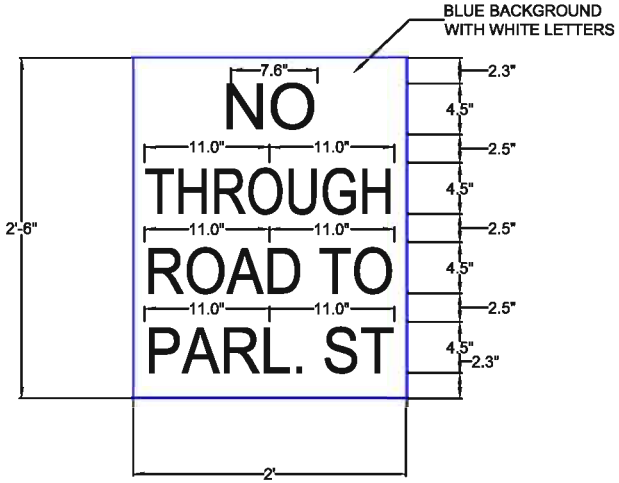
SIGN PLATE





ONE WAY
SIGN PLATE

STREET NAME
SIGN PLATE



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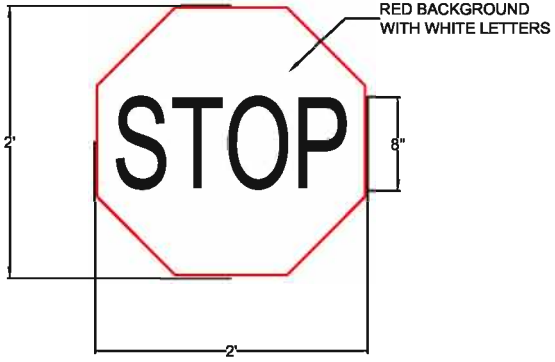


STOP
SIGN PLATE

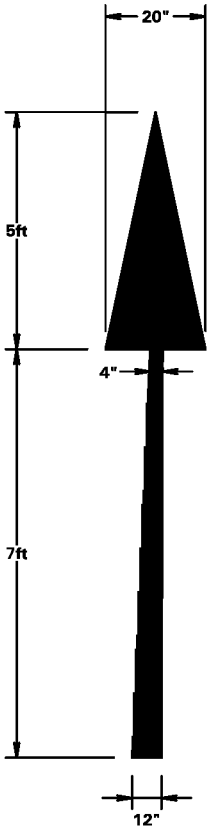
No.	REVISION	DATE

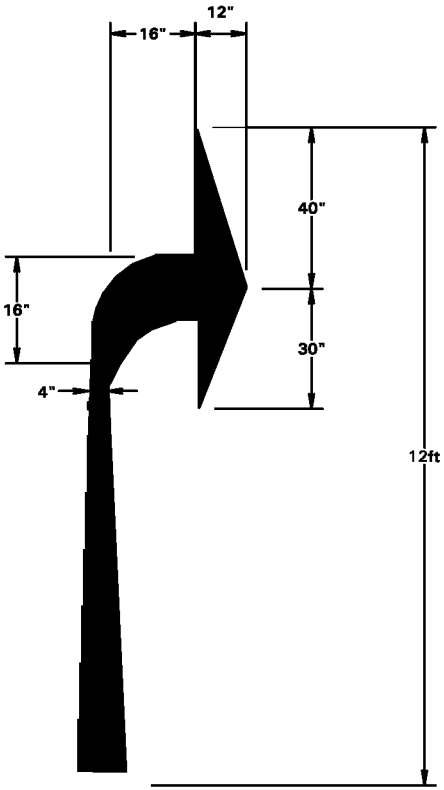
THE COMMONWEALTH OF THE BAHAMAS
MINISTRY OF WORKS & UTILITIES

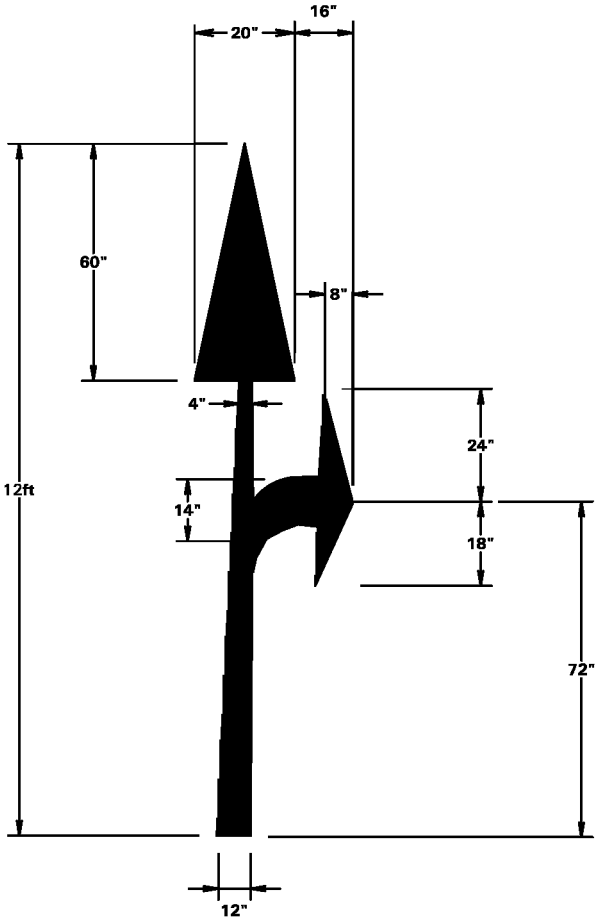
TYPICAL PAVEMENT MARKINGS
STOP SIGNAGE

DESIGNED	E. CHERRY		JOB No.
DRAWN	E. CHERRY		
CHECKED			SHEET No. AM-1
APPROVED			SCALE N. T. S.
DIRECTOR			DATE MAY 2013

TRAFFIC LANE MARKINGS







No.	REVISION	DATE

THE COMMONWEALTH OF THE BAHAMAS
MINISTRY OF WORKS & UTILITIES

TYPICAL PAVEMENT MARKINGS
TURNING ARROWS

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DRAWN	R.GARRAWAY		
CHECKED			SHEET No. AIV-2
APPROVED			SCALE: N.T.S.
DIRECTOR			DATE: MAY 2003

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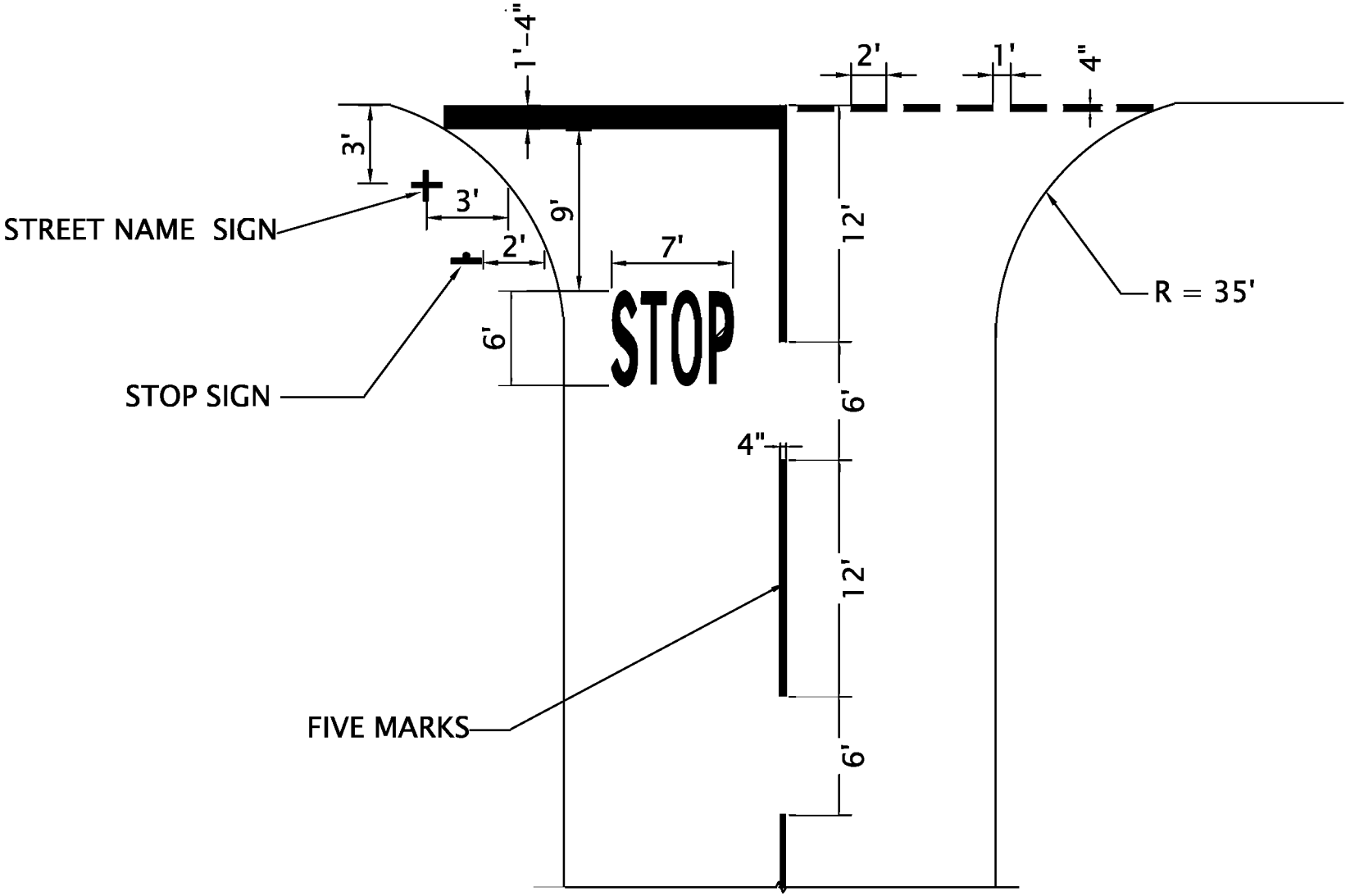


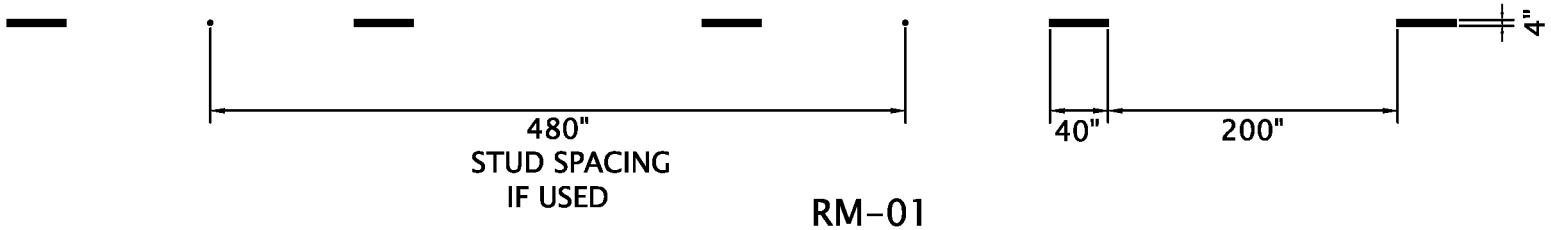
No.	REVISION	DATE

THE COMMONWEALTH OF THE BAHAMAS
MINISTRY OF WORKS & UTILITIES

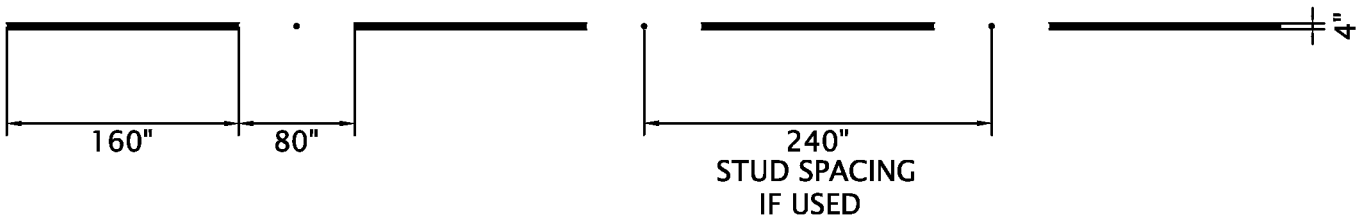
TYPICAL PAVEMENT MARKINGS
STOP MARKING

DESIGNED	R. GARRAWAY		JOB No.
DRAWN	R.GARRAWAY		
CHECKED			SHEET No. AIV-3
APPROVED			SCALE: N.T.S.
DIRECTOR			DATE: MAY 2003

WARNING MARKINGS



RM-01
LANE MARKINGS
NOT TO SCALE



No.	REVISION	DATE

THE COMMONWEALTH OF THE BAHAMAS
MINISTRY OF WORKS & UTILITIES

TYPICAL PAVEMENT MARKINGS
LANE MARKINGS

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DRAWN	R.GARRAWAY		
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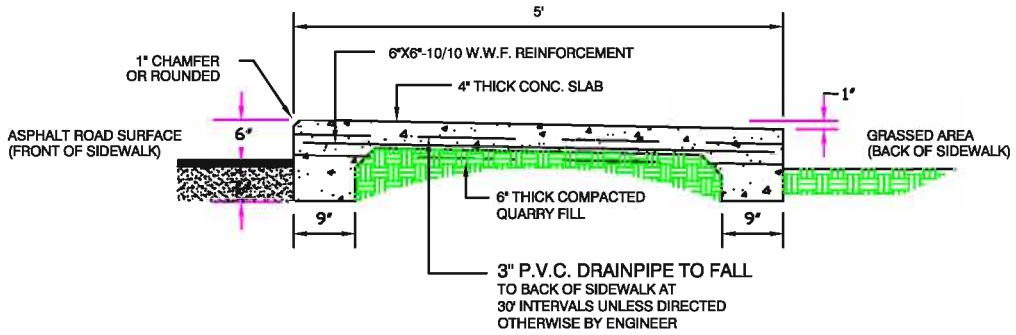
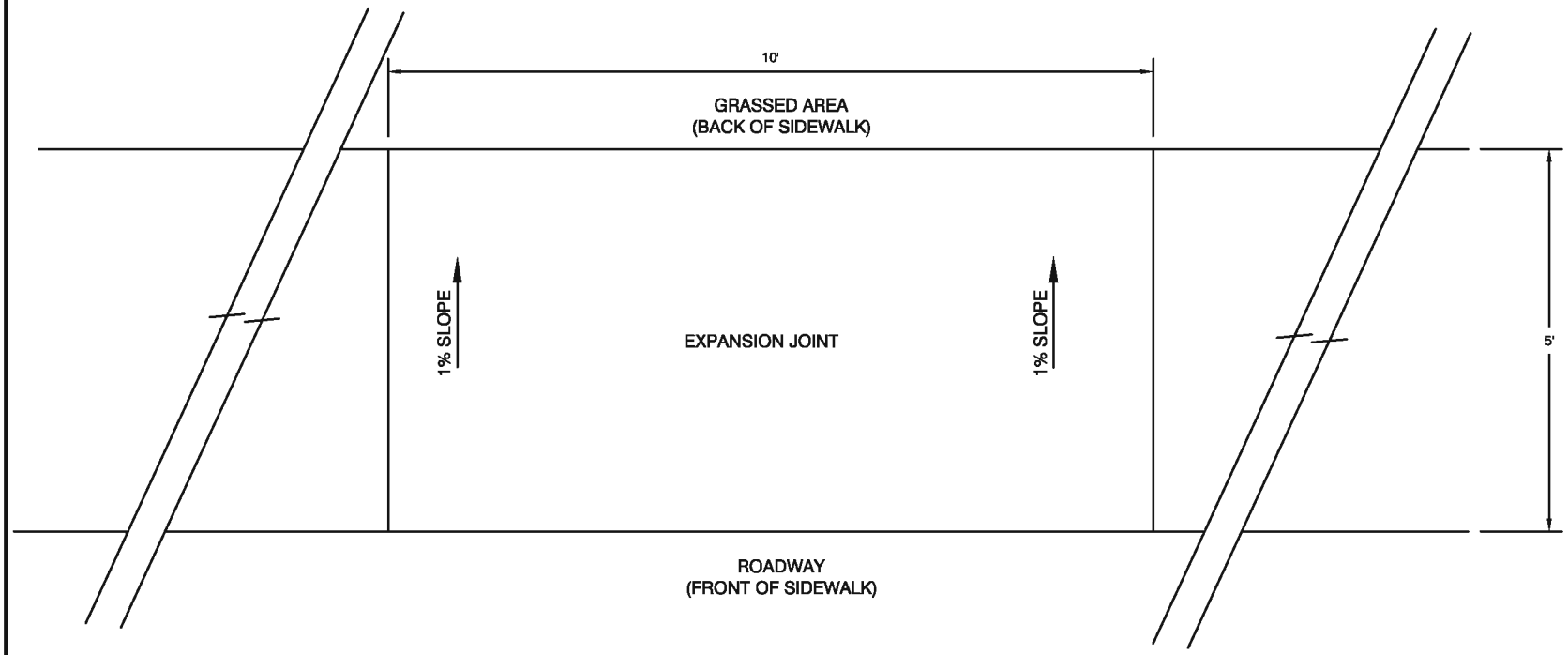
APPROVED			SCALE: N.T.S.
DIRECTOR			DATE: MAY 2003

Appendix V

Typical Sidewalk Details



SECTION THRU CONCRETE SIDEWALK



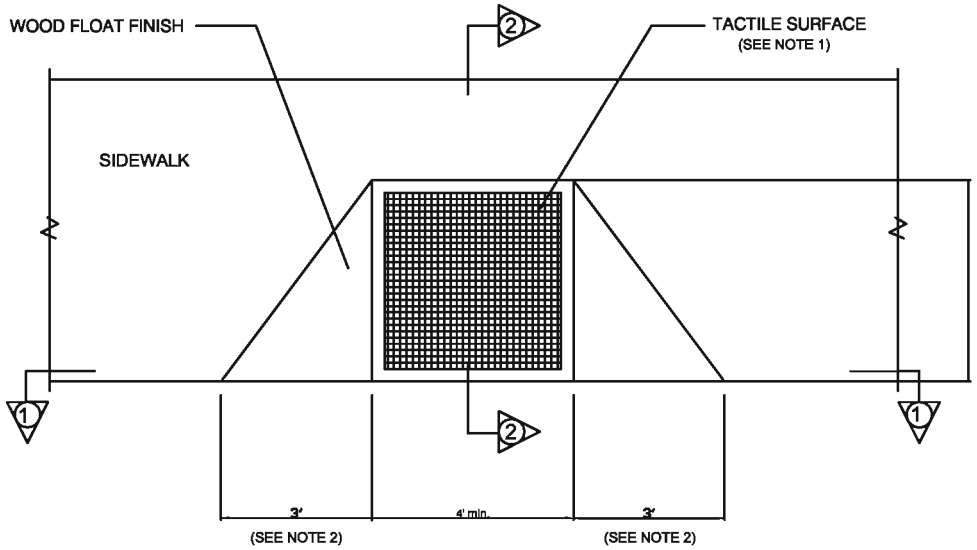
TOP VIEW OF CONCRETE SIDEWALK

No.	REVISION	DATE

THE COMMONWEALTH OF THE BAHAMAS
MINISTRY OF WORKS & UTILITIES

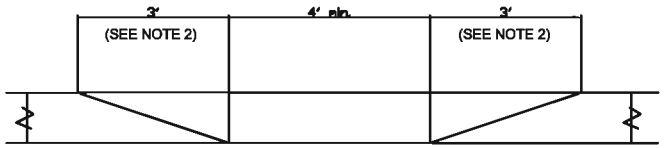
TYPICAL SIDEWALK DETAIL

DESIGNED	E. CHERRY		JOB No.
DRAWN	E.CHERRY		
CHECKED			SHEET No. A/-1
APPROVED			SCALE N. T. S.
DIRECTOR			DATE MAY 2003

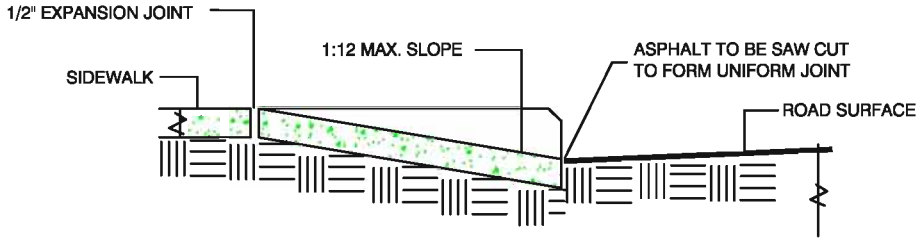


PLAN VIEW OF CONCRETE RAMP

NOT TO SCALE



SECTION 1-1



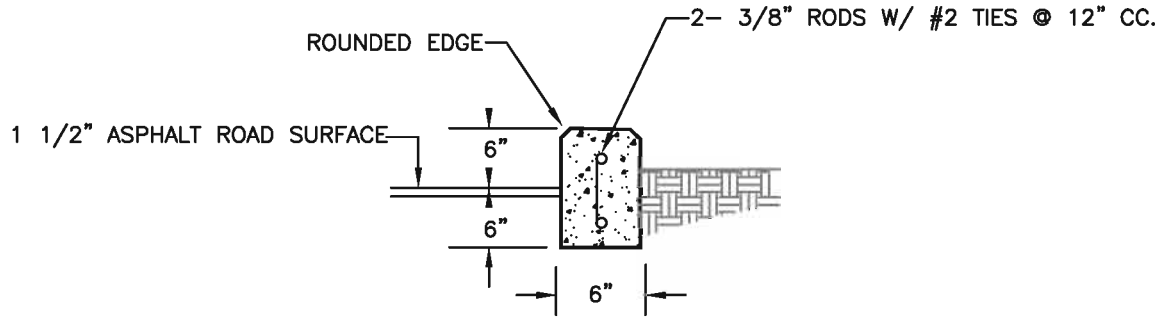
SECTION 2-2

No.	REVISION	DATE

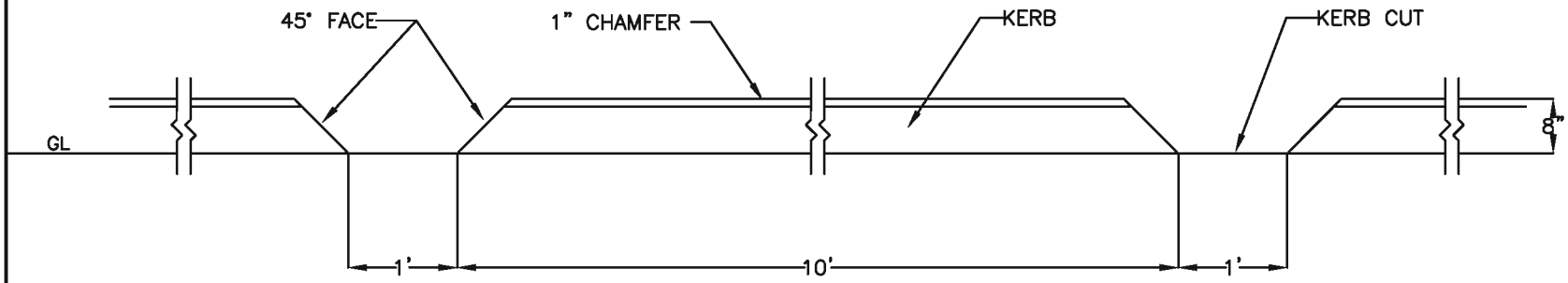
THE COMMONWEALTH OF THE BAHAMAS
MINISTRY OF WORKS & UTILITIES

TYPICAL SIDEWALK RAMP DETAIL

DESIGNED	E. CHERRY		JOB No.
DRAWN	E.CHERRY		
CHECKED			SHEET No. AV-2
APPROVED			SCALE N. T. S.
DIRECTOR			DATE: MAY 2003



SECTION THRU CONCRETE KERB



PLAN VIEW OF CONCRETE KERB

No.	REVISION	DATE

THE COMMONWEALTH OF THE BAHAMAS
MINISTRY OF WORKS & UTILITIES

TYPICAL KERB DETAIL

DESIGNED	[illegible]		JOB No.
DRAWN	[illegible]		
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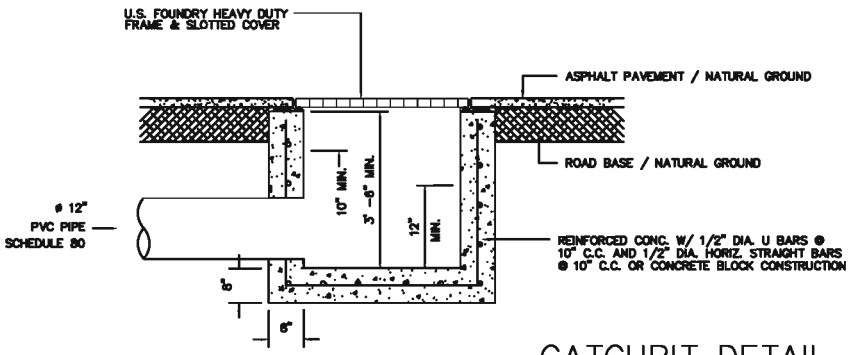
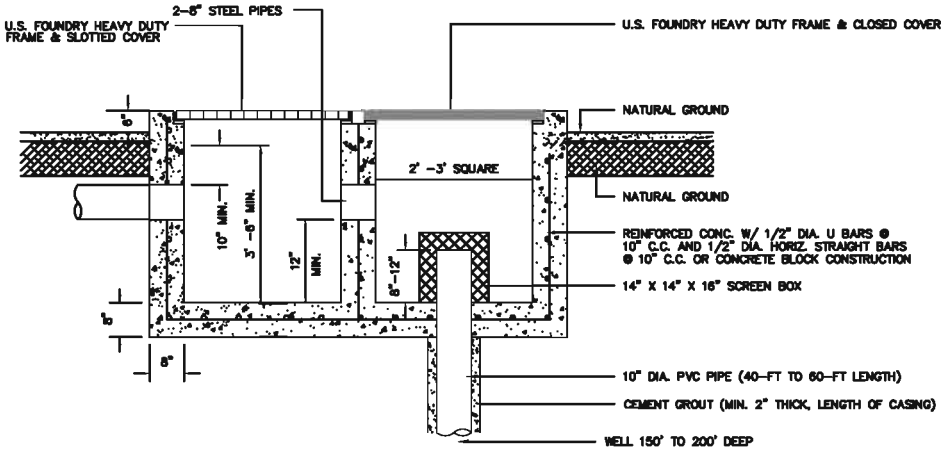
APPROVED			SCALE: N. T. S.
DIRECTOR			DATE: MAY 2003

Appendix VI

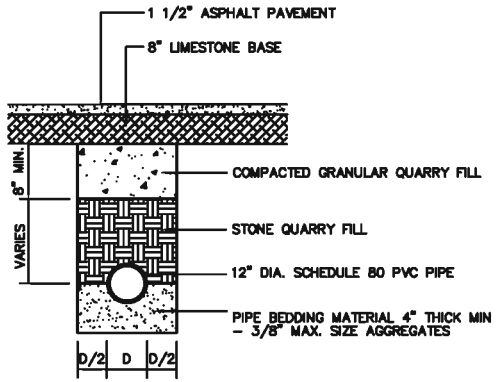
Typical Drainage Well, Catchpit, Culvert Details



CATCHPIT DETAIL



DRAINAGE WELL DETAIL



CULVERT DETAIL

No.	REVISION	DATE

THE COMMONWEALTH OF THE BAHAMAS
MINISTRY OF WORKS & UTILITIES

TYPICAL DRAINAGE WELL, CATCHPIT AND CULVERT DETAILS

DESIGNED	E. CHERRY		JOB No.
DRAWN	E.CHERRY		
CHECKED			SHEET No. AM-1
APPROVED			SCALE N. T. S.
DIRECTOR			DATE: MAY 2013

Appendix VII

Sample Drainage Calculations

Sample Drainage Calculations

Drainage calculations based on Rational Method, using the following criteria:

Q=CIA where Q= total flow, cubic feet per second (cfs)
C= runoff coefficient
I= rainfall intensity, inches per hour (in/hr)
A= total drainage area, acres

Total Drainage Area, A is as follows:

Surface	Area (sq. ft.)	Area (acres)	Percentage
Residential Lots	351,028.39	8.058	79.56
Paved Area	75,758.30	1.739	17.17
Swale Area	14,450.23	0.332	3.27
Total	441,236.92	10.129	100.00

A=441,236.92 sq. ft. or 10.129 acres

Runoff Coefficient (Cw) to be weighted as follows:
Residential lots: 0.4
Paved area: 0.95
Swales: 0.4

$$Cw=\frac{0.4(351,028.39)+0.95(75,758.30)+0.4(14,450.23)}{441,236.92}$$

Cw=0.494

Rainfall intensity: 1 in 5 year storm (4.75 inches in 6 hours)

I=0.79 in/hr

Total Flow =0.494 (0.79) (10.129)

Q=3.953 cfs

Assuming a well draw capacity of 1.35 cfs

$$\text{Required Drainage wells} = \frac{3.953}{1.35}$$

2.92 Wells **use 3 Drainage Wells**

Appendix VIII

Tree List

References

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London WC1V 6HB
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Federal Highway Administration
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Part II - Plan Preparation Manual
for
Subdivisions
in the
Commonwealth of the Bahamas

Part II - Plan Preparation Manual for Subdivisions in the Commonwealth of the Bahamas

Table of Contents

Chapter 1-Plans Production

1.1 Displaying Information and Data

The following rules apply for displaying information and data in the plan:

1. Dimensioning Requirements:

   a. Typical Section Elements, including lane widths and shoulder widths-in feet, generally as a whole number.

   b. Horizontal control points on plans, including survey centerline, baseline, intersections and alignment-in feet to 2 decimal places.

   c. Vertical alignment control points, (PVC, PVI, PVT) and profile grade elevations-in feet to 2 decimal place.

   d. Profile Grade-in percent to 3 decimal place.

   e. Proposed flow lines-in feet to 1 decimal place.

   f. Manhole tops and grate elevations-in feet to 2 decimal places.

   g. Ditch elevations-in feet to 1 decimal place (to nearest 0.5 when controlled by percent of grade).

   h. Box Culvert Spans and Heights-(Show feet as a whole number using the span by height format: e.g., 10x6 means the spans is 10 feet and the height is 6 feet): In feet as a whole number for new construction; in feet to 2 decimal places for extensions of existing box culverts.

2. Display alignment bearings, degree of curve and delta angles for curve data in degrees, minutes and seconds, rounded to the nearest second.

3. Express slope ratios in vertical to horizontal (V:H) format. For example, show roadside slope as 1:6, 1:4, etc.

1.1.1 Converting from Metric to English

2. When converting metric values related to surveys, right of way and other geometric alignment use the U.S. Survey Foot taken to a minimum of 8 decimal places:

$$1 \text{ foot} = \frac{12 \text{ inches/foot}}{39.37 \text{ inches/meter}} = 0.\ 304\ 800\ 61 \text{ meters}$$

For other direct mathematical conversions use the Sl definition: 1 foot = 0.3048 meters

3. Display direct mathematical (soft converted values to 2 decimal places.

4. On resurfacing projects where the original construction was done in metric, hard convert typical section dimensions (lane widths, shoulder widths, etc.) where existing conditions permit.

   Use direct mathematical (soft) conversion for existing pavement widths in curbed sections, existing right way widths, and existing median widths.

Chapter 2-Sequence of Plans Preparation

2.1 General

The set of plans depicting in detail the desired construction work is known as the Design Plans Set". This set consists of all sheets pertaining to subdivision design and component plans. The component plans are comprised of:

1. Subdivision layout plan
2. Survey plan
3. Road plan and profile
4. Typical cross-section
5. Drainage plan
6. Drainage detail
7. Road Marking plan
8. Road marking details

Utility Joint Participation Agreement Plans are placed in the back of the plan set.

The Subdivision set should be prepared systematically, undergoing phases of review and revision to ensure technically correct and clear plans.

2.2 Presentation of Existing Data

CADD files generated from the field survey will contain existing topography and other characteristics of the project site, these also include the existing utilities and drainage structure within the limits of the project.

All data pertaining to topography, horizontal location of existing utilities and drainage structures shall be shown on the plan portion of the appropriate sheets (whether they are plan view only, or plan-profile).

2.3 Proposed Typical Section

Typical section shows the cross section design elements of a roadway. In addition to the Typical Section Sheet, certain elements of the typical section are shown on various other plan sheets, such as the Plan-Profile Sheets and Cross Sections. The various chapters for individual plan sheet address the specific requirements for displaying data (including typical section elements) on those sheets.

2.4 Geometrics

The Engineer of Record (EOR) sets the horizontal and vertical geometrics for a project and develops of supervises development of the CADD files used in the production of various plan sheets.

Horizontal geometrics include the baseline survey/centerline construction with bearings, curve data, angles or bearings at street intersections, pavement widths, taper lengths, turn lanes, and other geometric elements. These elements are plotted on the plan portion of the plan-profile sheets, as well as other appropriate plan sheets.

Vertical geometrics show the vertical curves and grades of the roadway along the profile grade line.

On all projects which include the development of a vertical alignment the existing ground line along the baseline of survey and the proposed profile grade line shall be plotted on the profile portion of appropriate sheets in the roadway or structures plan.

2.5 Phase Submittals

2.5.1 General

The remainder of this chapter outlines, in detail, the sequence for subdivision plans preparation and assembly, as well as the information required to be presented on the various plan sheets which are included in design phase submittals.

Standard submittal phases are as follows:

SUBMITTAL PHASE
- **Phase I**
- **Phase II**
- **Phase III**
- **Phase IV**

Figure 2.1 summarize the plans sheet status for each submittal. No phase complete until all review comments have been resolved and documented.

The technical accuracy required for the design is the responsibility of the Engineer of Record. Prior to submitting the plans for a formal Ministry of Works & Utilities Phase review, the design organization (in-house or consultant) shall conduct a review to ensure technically correct and complete plans. Any revisions or correction noted during the review shall be incorporated into the plans before submittal for the formal Phase review.

When deemed necessary by the Engineer of Record, or as requested by the Ministry of Works & Utilities, phase submittals may include an additional plan sheet titled

"Notes for Reviewers." This sheet is placed as the second sheet in the submittal package. It contains information pertinent to design criteria and special project requirements, as well as other details or notes which call the reviewer's attention to issues and features unique to the project design. The sheet is to be used only in the review process and is not included in the final plans.

Figure 2.1 Summaries of Phase Submittals

Item	Phase I	Phase* II	Phase III	Phase IV
Key Sheet	P	P	C	F
Summary of Pay Items		P	C	F
Drainage Map	P	P	C	F
Typical Section	P	P	C	F
Box Culvert Data			C	F
Summary of Drainage Structures			C	F
Project Layout	P	C	C	F
Roadway Plan-Profile	P	P	C	F
Social Profile	P	P	C	F
Back-of-sidewalk Profile	P	C	C	F
Intersection Layout/Detail	P	P	C	F
Lateral Ditch Plan-Profile		P	C	F
Lateral Ditch Cross Section		P	C	F
Retention/Detention ponds		P	C	F
Cross Section Pattern	P	P	C	F
Cross Sections	P	P	C	F
Traffic Control Plans	P	P	C	F
Miscellaneous Structure Plans	P	P	C	F
Signing and Pavement Marking Plans		P	C	F
Signalization Plans		P	C	F
Landscape Plans	P	P	C	F
Mitigation Plans		P	C	F

Status Key:

P - Preliminary
C - Complete but subject to change
F - Final

*Project which have a structures plans component are required to submit the latest set of structures plans with the Phase II roadway submittal.

2.5.2 Requirements for Phase I Submittal

Unless otherwise directed by the Ministry of Works & Utilities, the following elements are required for a Phase I set of plans.

Key Sheet
Location Map w/location of project on map
existing
Exception & Equations
Project Name
Roadway Name if applicable
exception
City, and/or Island Name
North arrow and scale
Approval signature lines
Date of Drawings Set of submittal
Revision box
Governing Standards & Specifications dates

Project Manager's Name
Begin & end project station and begin milepost
Begin & end bridge stations
Points
Consultant's name, address, contract number, email address

Drainage Map – Plan View
North arrow and scale
Drainage divides and ground elevations

Drainage areas and flow direction arrows
Equations
High water information as required
Preliminary horizontal alignment
Street name
Begin & station of project, bridge, bridge
Culvert & exceptions as required
Existing structures & pipes with relevant Information

Plan and Profile – Plan View
North arrow and scale
Baseline of survey, equations
Curve data (including superelevation)
Existing topography including utilities
Preliminary horizontal geometrics/dimensions
Existing & proposed R/W lines (if available)
Centerline of construction (if different from the Baseline of survey)

Drainage Map – Profile View
Preliminary profile grade &

ground line Horizontal & vertical
scale Begin & end station of project
bridges bridge culvert &

Equations

Typical Sections
Mainline and crossroad typical
R/W lines. Special detail
(bifurcated) sections, high fills, etc.)
Traffic data

Project Layout/Reference

Plan profile sheet sequence
(mainline and crossroads)
Reference points (if layout sheet is required)

Intersection Layout

North arrow and scale
Existing topography
(if applicable)
Proposed R/W limits
Length of turn lane
Taper lengths
Existing Utilities
Geometric dimensions
(radii, offsets, widths)

Cross Sections
Scale
Existing ground line
Existing survey baseline
elevations
Station numbers
Baseline of survey labeled
Existing utilities
Proposed template with

Begin and end stations for the project, bridges,
Bridge culverts and exceptions
Reference points (if project layout sheet not

Include in plans set)

Plan and Profile – Profile View

Scale
Appropriate existing utilities

Bench mark information
Preliminary profile grade line
Equations
Existing ground line with elevations at each
End of sheet
Begin and End Station for the project,
Bridges, bridge culvert and exceptions.

Special Profile
Scale
Ramp profile worksheet including nose sections
Existing ground line of intersections
Preliminary grade line of intersections
Preliminary curb return profile, if applicable

profile grade elevations
along mainline and cross-
streets as necessary

Traffic Control Plans

Project specific
other worksheets as

Necessary to convey concept
and scope

Landscape Plans
Conceptual landscape plan

2.5.3 Requirements for Phase II Submittal

Unless otherwise directed by the Ministry of works & Utilities, the following elements are required for a Phase II set of plans.

Key Sheet
Index of sheets
Component plans list

Drainage Map – Plan View
Proposed structures with structure numbers
Flow arrows along proposed ditches
and area size
Cross drains with pipe sized and structure Numbers
Bridge/bridge culvert with begin and end Stations
Flood data (if applicable)

Drainage Map – Profile
Ditch gradients including DPls
Final roadway profile grade line
Mainline flow line elevations
General
Mainline structures with structure numbers and pipes
Bridge, Bridge Culvert
Cross drains with pipe size, structure numbers and flow line elevation

Plan And Profile-Profile View
Final profile grades and vertical curve data
Final profile grades and vertical curve data
Proposed special ditches
Ditch gradients with DPI station and elevation
Non-standard and superelevation transition details
High water elevations
Existing utilities
Mainline drainage structures with structure numbers

Typical Sections
Pavement Design

Project Layout
Complete

Plan and Profile-Plan view
Curb return numbers, station ties and elevations

Proposed drainage structures with structures no. proposed R/W lines
Proposed side drain pipe requirements (including size) for access and intersections. Final geometrics and dimensions
Including radii, station pluses, offset, widths, taper/transition lengths, curve data.

notes (if project layout sheet not included). Flood data if not shown elsewhere

Drainage Structures
Vertical and horizontal scale
Roadway template with profile grade
Underground utilities
Special sections at conflict points
R/W lines (at critical locations)
Flow arrows
Structure number and location
station along right side of sheet
station along right side of sheet number
Drainage structures with numbers
Numerical other, type, size, location

Special Profile
Final intersection profile grades
Final curb return profiles (if applicable)
Superelevation diagrams as required
Final ramp profile grades including nose
Sections. Preliminary access and frontage
Road profiles (may contain one or more types
Of special profiles.)

Intersection Layout
Application notes
Cross drains with structure number
And pipe sizes
Final geometrics including dimensions,
Radii, offsets, station pluses and
Taper/transition lengths

Outfall/Lateral Ditch System
Profile View
Bench mark information
Scale
Existing ground line
Proposed ditch with grades
Begin and end ditch stations
High water elevations
Existing utilities
Overland flow or overtopping elevations
Proposed drainage structure numbers
Typical section can be placed in either
Plan or profile

Lateral Ditch Cross-Sections
Horizontal and vertical scale
Existing ground line
Station numbers
Survey centerline and elevation
R/W
Begin and end ditch stations
Begin and end excavation stations
Existing utilities
Total earthwork quantity in cubic yards

Cross Section Pattern
North arrow and scale
Interchange layout
Access and frontage roads
Mainline stationing
and flow-line elevations

Outfall/Lateral Ditch System-Plan
North arrow and scale
Roadway centerline
Existing and/or survey ditch
centerline
Proposed ditch centerline with
stationing
Begin and end ditch stations
Equations
Ditch centerline intersection
station
R/W lines
bearings of ditch and mainline
centerlines
Proposed storm sewer pipes
Ditch PI stations with deflection
angle left or right
Proposed drainage structure with
numbers
Existing topography, drainage
Structures, utilities

Cross Sections
R/W
Special ditch bottom elevation
Mainline equation stations
Soil borings
Water table
Extent of unsuitable material
Proposed template with profile grade
elevation
Earthwork
Begin and end stationing for project
construction and earthwork, bridge
and bridge culvert
Existing utilities affected by the
Template and where unsuitable
materials are present

Traffic Control Plans
Preliminary traffic control plan
Detour plan
Phasing plan
R/W-existing and additional if
required
Existing Utilities

Begin and end bridge stations
Cross section location lines

Signing and Pavement Marking Plans-Tabulation of
Key sheet
Begin and end stations & exceptions
Station Equations (if location map is shown)
Governing Standards & Specifications Date
Engineer on Record
Consultants name & address if applicable

Signing and Pavement Marking Plans
Plan Sheets
North arrow and scale
Basic roadway Geometrics
Begin/end Stations & exceptions
Station Equations
Conflicting utilities, lighting or drainage
Pavement markings
Sign locations
Begin/End Stations and Exceptions
Schedule
Station equations
Conflicting utilities, lighting or drainage
Pavement markings
Sign locations

Signing and Pavement Marking Plans
Interconnect/
Sign Detail Sheet
Guide Sign Work Sheet
Project specific

Signalization Plans- Key Sheet
Station equations (if location map is shown)
Governing Standards & Specifications Date
Sheet
Engineer of Record
Consultants name & address, if applicable

Landscape Plan – Tabulation of
Specifications **Quantities**
Project Specific
Applicable standard details

Signalization Plans –

Quantities
Project Specific

Signalization Plans – Plan Sheet
North arrow and scale
Basic Roadway Geometrics
Begin/End Station and Exceptions
Station Equations
Conflicting utilities, lighting or drainage
Signal Pole Location of loops
Type and location of signal heads
Pedestrian Signal
Location of Pedestrian Crosswalks
Sheet Title

Signalization Plans – Pole

Pole location, number, type
Pole dimensions
Joint use pole details, if applicable
Foundation design

Signalization Plans –

Communication Cable Plan
Placement of interconnect/
Communication cable conflicting
Utilities, lighting or drainage
Other project specific details

Landscape Plan-Key

Begin/end stations & exceptions
Station Equations (if location map is shown)
Governing Standard
Data
Engineer of Record
Consultants name & address, if applicable

Landscape Plans – Standard Detail Sheet

Roadway and sidewalk plan
Component plans features (signing, signalization, lighting etc.)
Plan placement by symbol
Limits of clear sight
Canopy limits/location of existing vegetation

Landscape Plan – Plan sheets

(if applicable)
Type of system
location and size of heads

Landscape Plans – Specifications

Plans Sheet
Project specific

Mitigation Plans

Project Specific

2.5.4 Phase III Plans Submittal

Ordinarily, the only other remaining work to be done will be to comply with comments received as a result of the review.

All plan sheets are complete and updated. Final drainage tabulations shall also be furnished for review.

A"marked up" set of the plans and review comments shall be returned to the EOR for incorporation of the comments into the plan. When the review comments have been resolved and documented by the designer, the plans are ready to proceed to completion.

2.5.5 Phase IV Plans Submittal

After all corrections noted in the Phase III submittal are complete and the cost estimate is complete, the plans are considered final.

Chapter 3 - Typical Sections

3.1 General

Typical sections are detailed cross section depictions of the roadways principal elements that are standard between certain station or milepost limits. These sections are the basis for construction details and information shown on the various plan sheets throughout the plans package.

Typical sections should show typical conditions only. Non-standard conditions that prevail for short distances only should not be shown. Existing elements that are to be incorporated into roadway's final section are depicted in conjunction with the proposed elements.

When more than one typical section is necessary for a project, the station limits of each section shall be shown below the typical section title. Typical section stationing shall cover the entire project. Transitions form one typical to another shall be included in the stationing of one or the other typical section. Sheets that feature more than one typical section should read from the top down, with the sections in the order in which they occur within the project.

The hierarchy for the typical shall be as follow:

1. Project mainline
2. Intersection (Roundabout)
3. Crossing side roads
4. Minor side streets

Half sections and details which supplement or support various typical section should be placed on the same sheet as the typical section to which they apply. In the event that this is not possible, additional sheets for details should be placed behind the typical section sheet(s).

Half section are necessary when changes occur that effect several typical section elements such as number of lanes, width, ditch/drainage features, clearing and grubbing, R/W width, etc.

Details and partial sections are necessary for the clarification construction techniques or sequence, and to show alternates, such as the placement of shoulder gutter in high fill areas, changes in sidewalk location, etc. Judgment will be necessary in making decisions about when and where details should be shown.

3.2 Mandatory Information

Typical sections for all projects shall include the following data:

1. Design speed for each typical section

2. Cross Slopes

   a. Cross slope of roadway pavement, shoulder surface, sidewalks and bridge decks shall be expressed as a percentage of a foot vertical per foot horizontal. These cross slope shall be rounded to one decimal places, i.e., 1.5%, 2.0%.

   b. Median and outer slopes shall be shown by ratio, horizontal to vertical, i.e., 4:1, 2:1.

3. Profile grade point shall be flagged.

4. Pavement construction shall be described in a clear, precise manner by indicating the LBR requirement and the thickness of the subgrade stabilization, subbase or base, as well as spread rates for structural course, friction course and shoulder base, as well as spread rates for structural course, friction course and shoulder pavement. Use 4 inches for both base extensions on rural sections and for stabilization extension on curbed sections.

   Pavement structure information shall be obtained from the approved pavement design and shall be described in the order of construction, i.e. starting with bottom.

Layer and ending with friction course. Show pavement spread rate descriptions for leveling, overbuild, structural course and friction course in pound per square yard (lbs/sv).

5. Sidewalk location grassing.

6. Sidewalk location and width.

7. Curb and gutter location and type (show Type “E” or “F”, not the dimension).

   On new construction curb and gutter projects which include Asphalt Base, Type B-12.5 only, the asphalt curb pad shall be indicated on the typical section and a detail provided.

8. Limits of clearing and grubbing, where application.

9. R/W, where applicable.

10. Template dimensions:

    For widening projects, the existing pavement width shall be shown as a +/- dimension, and the base widening shall be shown with an asterisk.

NOTE: For typical sections with varying dimensions, the dimensions shall be clearly indicated on the plan-profiles sheets.

Exhibit 3-1 Standard Notes for Typical Section Sheets

Below are standard notes that shall be shown on typical section sheets as applicable.

Chapter 4- Roadway Plan and Roadway Plan-Profile

4.1 General

The roadway plan sheet shows the project's complete horizontal alignment. The plan profile sheet shows the project's complete horizontal and vertical alignments. Various roadway elements such as pavement width, medians, paved shoulders, curbs, drainage elements, tapers, turn provisions, and intersecting roadways, are also shown on these sheets.

Plotting should typical be done at a horizontal scale of 1" = 40' or 1" = 50' for urban jobs.

For rural jobs, the scale should typically be from 1" = 100' or 1" = 200' horizontally, depending on the project specific details.

If a project layout sheet is not included in the plan set, provision shall be made on the first plan-profile sheet to show applicable general note.

4.2 Roadway Plan Portion

4.2.1 Centerline

The baseline survey and /or centerline of construction be centered in the plan portion of the sheet. When alignment includes in horizontal curves, the centerline should be positioned on the sheet to avoid breaks or match lines (except at the beginning or end of the sheet).

A "tick" mark shall be placed on the centerline at every station.

Station numbers should be placed close to tick marks for scales up to and including 1" =50' and outside the R/W lines for smaller scales.

In cases where the construction centerline does not coincide with the survey baseline, the construction centerline shall be identified with complete alignment data and ties to the survey baseline. However, the construction centerline need not be shown when it is uniformly offset from the survey baseline for the entire length of the project, and is shown on the typical sections. All section equations shall be included. These include equations occurring on the survey baseline and those equating the survey baseline and construction centerline.

A north arrow and scale shall be shown at a point of maximum visibility, preferably in the upper left portion of the plan view.

4.2.1 Horizontal Curves

PC and PT points of horizontal curves shall be indicated by small circle short radial lines shall be drawn from these points and identified. PL's shall be noted by the use of a small triangle with a short section of tangent on either side. Care must be taken in the clipping of plan sheets to properly orient the horizontal curves within the plan view. In cases where the curve extends over more than one sheet, the curve data shall be repeated on each sheet showing the curve.

Complete curve data shall be shown for each horizontal curve using the following format:

Curve Data

PI (station)

A (Delta Angle with Direction)

D (Degree of Curve)

T (Tangent Length)

L (Length of Curve)

R (Radius Length)

PC (Station)

PT (Station)

E (Superelevation)

4.2.2 Existing Topography

All existing topography shall be shown. Existing roads, streets, drives building, underground and overhead utilities, wall, curbs, pavements, fences, railroads, bridges, drainage structures and similar items shall be plotted and labeled. Streams, ponds, lakes, wooded areas, ditches and all other physical features shall also be shown.

All existing utilities shall be shown on the plan and noted by an appropriate symbol. If the type of utilities is unknown it shall be labeled as such. Existing gasoline storage tanks within limits of topographical survey shall be located and illustrated.

4.2.3 Reference Data

Bearings, in the direction of stationing, shall be shown for all tangent sections.

Station equivalencies, angles with mainline centerline and/or bearings in the direction of stationing of the crossroad shall be shown for all roads and street s intersecting or crossing the project.

All section survey reference points shall be shown (if layout sheet is not included in plan set locations removed from the centerline.

4.2.4 Construction and Project Limits

Proposed construction and project limits shall be indicated it the plans. The limits to be flagged and stationed are:

1. Begin and end of project, and begin and end of construction where construction limits are other than project limits. If plans cover more than one project, the limits of each shall be clearly identified by station. Limits identification shall be shown both in plan and in profile.

   It is the responsibility of the Engineer of Record (EOR) to set the project and construction limits. It the plans cover more than one project or are part of a corridor improvement, the project limits should be at the beginning of the full typical sections, with any construction (transition, etc.) outside these limits being within the construction limits. Examples of type of works that may fall within construction limits but outside project limits are featuring, friction course, guardrail, drainage work and signing and marking work.

2. The limits of each type of construction classification where more than one type is involved, such a, new construction, resurfacing, bridgework, widening, and milling.

3. The begin and end of exceptions and equations.

4.2.5 Drainage structures and Bridges

Proposed cross drain pipes and culverts shall be indicated in the plan by a symbol and identified by a drainage structure number. Cross drain pipe sizes and lengths shall be shown. (Box culvert lengths shall be shown on the drainage structure sheets).

Box culverts (single or multiple) of 30 feet total or more between inside faces of end supports, measured along the center of the roadway, shall be designated as bridge Culverts and shall be identified by both a bridge number and a drainage structure number. The beginning and ending stations (outside wall) shall be flagged.

Proposed bridge and approach slab shall be shown by simple outline. Bridges shall be identified by bridge number and their beginning and ending stations noted by station flags. The beginning and ending stations of approach slabs shall be noted.

A short section of lateral ditch/outfall centerline shall be shown, when appropriate, on the roadway plan-profile sheet, together with a note referring to lateral ditch/outfall sheets for details.

The proposed drainage system is indicated by showing storm sewer pipes with a single line, and the outline of inlets, manholes and junction boxes. The outline of structure bottom may be shown at the designer's discretion. The pipe size and length between structure shall be given. Structure numbers shall be provided for inlets, manholes, junction boxes and special structures.

4.2.6 Plan Layout

1. Right of way lines shall be shown. Right of way shall be dimensioned only if the applicable typical section shows a varying dimension from the baseline or centerline. Dimensions of the R/W line shall be from the centerline or baseline, if survey and construction lines are parallel; otherwise it shall be dimensioned from the construction centerline.

2. The showing of detailed information regarding median openings or intersections should be avoided when they are of a type that can be detailed and grouped on a separate sheet. When this is the case, median openings and intersections shall be identified by section location.

3. At locations along the alignment where traveled way dimensions charge, or begin to change, the station and dimensions of the traveled way shall be shown.

4. Curb, curb and gutter, traffic separators, sidewalks, curb ramp, retaining wall, etc. should be shown.

5. Stations of return points shall be shown in tabular form or shown on the plan, unless shown on an intersection detail sheet. Offsets shall be shown, if not governed by a typical.

6. Station of radius points of traffic separator or median curb at median opening shall be shown in plan. Elevation of these points shall also be shown if not shown in the intersection details sheet or unobtainable in plans.

7. Control radii for traffic turns that set median nose location shall be indicated, unless shown on the intersection detail sheet.

8. Station of end of curb and gutter as side street intersections (when end is not at a return point) shall be shown with proposed gutter grade elevation of these points.

9. Limits of pavement and grading at side street intersections shall be indicated.

10. When incidental construction extends beyond the right of way lines, construction easements or license agreements may be required and should be shown on the plan sheets.

11. Limits of wetland shall be shown based on permit or regulatory requirements.

4.3 Roadway Profile Portion

4.3.1 General Data

The horizontal scale for the profile portion of the sheet shall be the same as that used for the plan portion. Station limits of the profile shall correspond to those of the plan portion of each sheet. Station numbers shall be placed across the bottom of the sheet just above the title block. Intervals for profile stations shall be the same as those in the plan view.

Vertical elevation datum selected shall be such that the profile will not crowd either the upper or lower limits of the profile format. A general guideline is the vertical scale should be 10% of the horizontal grip. Elevation datum shall be shown on both the left and right sides of the sheet in the space provide adjacent to the grip.

The existing ground line profile shall be shown and labeled. Existing ground line elevations shall be noted vertically, just above the station numbers at each end of the sheet only.

All high water elevations affecting base clearance or roadway grades shall be shown and labeled.

Benmark data should normally be given just below the upper margin of the profile portion. However, if space permits, it may be placed in the plan portion just above the upper profile margin at the appropriate corresponding station.

Station equations and exceptions shall be shown. Begin and end stations of project, construction, bridge culvert shall also be shown.

4.3.2 Vertical Alignment

The proposed profile grade shall be shown and labeled. Vertical curve PC's PT's shall be indicated by small circle and PL's by a small triangle with short sections of tangent shown on each side. Percents of grade to 3 significant places shall be shown on the tangent line (trailing zeros need not be shown). Vertical lines shall be extended from the PC and PT points and a dimension line placed between these

lines indicating the length of the vertical curve. The PC and PT stations and elevations shall be indicated on the vertical lines.

For vertical curves, the profile grade elevations shall be given on even stations and at appropriate intervals. The elevations shall be between the dimension line and the grade line. The curve length, dimension lines and the profile grade elevations shall be placed above the grade line for sag vertical curves and below the grade line for crest vertical curves. The dimensions and elevations shall be placed reasonably near the grade line whenever possible. The PI station and elevation shall be noted, lettered vertically above the PI symbol for crest curves and below for sag curves.

The profile grade elevation of the beginning and ending station of each sheet shall be shown vertically just above the grade line, except when the beginning of ending station on the sheet in on a vertical curve.

4.3.3 Grades

Percents of grades to two (2) decimal places shall be indicated for each tangent section on every sheet (trailing zeros need not be shown). When two tangent grades intersect and no vertical curve is required the PI station and elevations shall be labeled vertically, using the same criteria as for vertical curves.

4.3.4 Superelevation and Special Profiles

For non-standard superelevted section of the project, the begin and end superelevation station should be indicated on the profile with a note: "For Superelevation details see sheet _____" (special profiles sheet).

Other special profiles that cannot be clearly shown on the plan-profile sheets shall be referenced in a similar manner to non-standard superelevated sections.

4.3.5 Other Profile Features

For rural construction projects, special ditches shall be indicated in the profile and labeled. Percent of ditch grade and a beginning or ending ditch PI with elevation and station plus shall be shown. For multi-lane divided project, three special ditch grades (right and left roadway ditches and median ditch) sometimes occur at the same location. In such cases it may be advantageous to show the median ditch at a convenient location on the sheet with a separate elevation datum.

Uniform ditches of non-standard depth should be indicated by dimension line in the lower portion of the grip and noted as a special ditch with location and depth, or they should be indicated by flagging the DPI's at each end with station elevation and side. Standard depth ditches are not shown.

Special gutter grades shall be shown in profile for cases where the gutter grades are not controlled by the typical section and no "special profiles" are included in the plans set.

Prolongations of gutter profile grades across street intersections shall be included on plan profile sheet if an inlet is not provided before the intersection.

Storm sewer pipe, inlets and manholes along the main line shall be shown. Pipes shall be noted by size. Proposed structures may by shown by structure number only. Flow line elevations shall be shown for all pipes entering and leaving the structure.

Proposed cross drain pipes and culverts be plotted. The section shall be shown at the correct location and elevation of the proposed structure crossing the centerline of construction. Cross drains shall be identified by structure number only.

4.4 General Notes for Roadway Plan and Roadway Plan Profile sheet

General notes for the project shall be placed on the right portion of the first plan-profile sheet if a project layout sheet is no included in the plans set, otherwise, they shall be included on the layout sheet.

Exhibit 4-1 General Notes for Roadway Plan and Roadway Plan-Profile Sheets

The benchmark datum used for the plans shall be noted in the first General Note. Other notes are as follows:

1. Buildings to be removed by others, unless otherwise note.

2. Existing drainage structures within construction limits shall (be removed/remain) unless otherwise noted

3. (If there are no drainage structure sheets in the plans, the following notes shall be included in the general noted, if applicable

    a. Special attention is directed to the fact that portions of some drainage structures extend into the stabilized portion to the roadbed and extreme caution will be necessary in stabilization operations at these locations.

    b. (To be use when there are cross drain pipe and/or storm sewer pipe and optional materials are provided for one or both).

        Some/all of the drainage structures have optional culvert materials. When optional materials are allowed, one of the optional materials has been used as the basis of the pay quantities. The material selected as the basis of pay quantities is identifies on the Tabulation of (Cross Drain, Storm Sewer, or described and design and installation information for each option is provided on this sheet.

4. Any public land corner within the limits of construction is to be protected. If a corner monument is in danger of being destroyed and has not been properly referenced, the Engineer should notify the Department of Lands and Surveys, without delay, by telephone.

6. Existing driveways within the limits of this project are to be replaced at the same location and width, unless otherwise shown in the plans.

Chapter 5 - Intersection Details/Layouts

5.1 General

These sheets provide layout and details for intersections with consideration for turning and weaving movements of vehicular traffic. For a safe and efficient roadway system (including provisions for bicycles and pedestrians), these areas must be designed with special attention to channelization, turning movements, signalization, drainage and vertical alignment. The various design details shall be shown explicitly for accurate construction.

Intersection layout sheets shall show all necessary details and geometric controls/access management features, including channelization, tapers, turn lanes, special drainage, and grading. The sheets shall be prepared on a standard plan format using a scale large enough to show details clearly and legibly.

5.2 Intersections

Intersection details shall be shown on separate plan format if they cannot be shown clearly on the plan-profile sheet format.

In cases of simple, no signalized intersection covering relatively small areas, regular plan-profile format be used. The intersection layout shall be placed, using an appropriate scale, in the plan portion, and the necessary profile graded in the profile portion.

For larger, more complicated intersection involving channelization, signalization or tapered connections, the layout shall be placed on a standard plan format. Match lines should be used when more than one sheet is required.

The profiles shall be presented separately on a grid format.

Existing topography need not be shown on these details if it is shown else where in the plans. Information given is generally the same as in the plan portion. Pavement edges, R/W lines, curb and gutter, channelizing and median curbs, driveways, drainage structure, pavement dimensions, radii and appropriate notes shall be included.

All intersection layouts shall be dimensioned, stationed adequately, and shall include in pertinent construction notes and alignment data. Design speed data shall be given when appropriate. Widths of turning lanes and turning paths shall be checked for possible encroachments or conflicts.

A north arrow and scale shall be shown at a point of maximum visibility on the plan. The scale used shall be sufficient to cover all necessary details, preferably 1” = 40”. The scale shall not be smaller that 1” = 50”.

Chapter 6 - Drainage Structures

6.1 General

Drainage structure sheets show the drainage structures, their location, cross section, flow line elevations of all weirs or slots, top of grates, culverts and top of manholes elevations, and similar data. Drainage structure sheets also show the vertical relationships of the entire drainage system. During the process of design/placement of the drainage structures, potential conflicts with existing or proposed utilities shall be identified and resolved early, thereby avoiding costly time delays during the construction phases.

All projects required the plotting of drainage structures. When only cross drains are to be constructed or modified, drainage structures may be plotted on the cross section sheets. Otherwise drainage structures should be plotted on separate structure sheet.

6.2 Required Information

The existing ground line for rural projects shall be shown at the location of the structure with the existing elevation placed immediately below the ground line at the survey baseline. No existing structures shall be shown except those to be incorporated into the proposed drainage system or otherwise modified. These shall be shown and their flow line elevations noted.

The roadway template and proposed structures shall be shown, with the proposed profile grade elevation placed above the grade point. The structure shall be located by station and offset to the centerline of construction. Flow line information shall be provided at each culvert end. Structures are to be plotted in detail according to the applicable index of the **Design standards**, with walls, grates, tops pipes, etc. shown.

Cross drain section shall include the size and length for each proposed structure.

Sections for skewed cross drains shall be depicted along the centerline of the structure. Clear zone distances are to be measured at right angles to the traffic lane for all structures.

All structure locations should be checked and R/W shown where the R/W may have potential impact on construction of structure.

For each drainage structure, all necessary information shall be shown by note, including, as appropriate size, end treatment and flow lines, as well as structure, index and station number. The note shall be placed as close to the structure as possible, preferably **below** the plotted structure. Elevations shall be given for

manhole top, and ditch bottom inlet grates and slots. Grates elevations for shoulder gutter and edge of pavement elevations for curb and gutter inlets shall be shown. Alternate "G" or other special grate treatment shall be included with the inlet not. Additional details, such as special bedding, 36" manhole rings, etc., shall be indicated. Flow direction arrows shall be shown.

If existing structures are to be filled and/or plugged and are to remain in place, they should be shown in the plans with an appropriate note.

6.3 Utility Conflict

All major underground utilities, shall be plotted in conjunction with the structure so that conflicts may be detected during design, and to alert construction forces of potential conflicts.

In the case of longitudinal pipes, a section should be plotted for each location of a crossing of any major underground line.

Utilities that have been verified (Level A locate) shall be noted and plotted to scale in the appropriate locations on the Drainage Structure Sheets, Cross Section Sheet and bridge foundation plans. These utilities should be labeled with the following symbol:

V_{vh} = Verified Vertical Elevation and Horizontal Location

6.4 Sheet Setup

Structures should be plotted as sections along the centerline of the structure. They should be shown on a standard cross section format with the sections spaced sufficiently apart to avoid overlapping of structures or notes. Beginning at the bottom of the sheet, the sections should be shown successively by stations and should be number and location station should be shown near the right border of the sheet.

If a structure must be shown out of order, a not shall be placed in the correct sequence, referring to the sheet where the structure is shown. The scale shall be the same as that used for roadway cross sections, with the centerline of construction placed near the center of the sheet.

Exhibit 6-1 Drainage Structure Notes

These notes, when required, are to be placed on the first drainage structure sheet.

1. Special attention is directed to the fact that portions of some drainage structures extend into the stabilized portion of the roadbed and extreme caution will be necessary in stabilization operations at these locations.

2. (To be used when there are Cross Drain Pipe and optional materials are provided).

Chapter 7 - Lateral Ditch/Outfalls, Retention/Detention and Mitigation Areas

7.1 General

Drainage systems that convey stormwater from the roadway may be made up of many components such as inlets, manholes, pipes, ditches, and retention/detention areas. Usually, these systems required additional right of way and/or easements

Mitigation areas, although not usually a component of the highway drainage system, may have drainage components in them.

If space permits, drainage components adjacent to the roadway may be shown on the roadway plan-profile sheets. Drainage components not adjacent to the roadway may require separate plan view sheets. In either case, profile views and/or cross sections may also be needed to provide enough detail to construct the components.

Plans for drainage components can generally be grouped into three categories:

1. Lateral ditch/outfalls
2. Retention/detention areas
3. Mitigation areas

7.2 Lateral Ditch/Outfall

Lateral ditch plans and profile shall be prepared on a standard plan-profile format using a horizontal scale of 1" = 100". However, if storm drain construction is proposed for a portion of the ditch, a scale of 1" = 40 or 1" = 50 may be used.

7.2.1 Plan Portion

Data presentation in the plan portion shall be oriented so that the lateral ditch/outfall centerline is parallel to the long side of the sheet. Information shall be shown in a manner similar to that described in **Chapter 4, Roadway Plan and Roadway Plan-Profile.**

Where the lateral ditch/outfall survey baseline does not follow the flow line of the existing ditch or channel, the existing ditch or channel profile shall be shown with a broken line and identified.

Structures shown in the profile will include flow line, structure numbers, pipe or culvert sizes, and utilities (if applicable).

The normal water elevation of the receiving system shall be indicated and labeled.

7.2.2 Typical Section

A typical section showing the width of proposed clearing and grubbing, right of way, ditch bottom width and side slopes shall be shown on the lateral ditch plan and profile sheet. This section does not need to be scale, but shall be dimensionally proportionate. If the width of clearing and grubbing is variable for the lateral ditch/outfall, the various widths and their respective station limits shall be noted below the typical section.

Lateral ditch cross sections shall be prepared in a manner similar to that of roadway cross sections (**Chapter 8** of this volume). The scale, generally, should be 1" = 10". Vertical and horizontal. Regardless of the horizonal scale used, the vertical scale shall always be 1"= 10'.

Often it is possible to place two or more columns of ditch cross sections on one sheet. They shall be plotted with the stationing progressing from the bottom of the sheet to the top, and from left to right.

7.3 Retention or Detention Areas

7.3.1 Pond Detail Sheet

The retention pond, including the outlet structure, is usually the end point of the drainage system for a particular project. The retention/detention pond detail sheet shall show the pond in plan view, with station and offset ties to the project centerline of construction. The plan view shall also include the following:

1. Locations of pond sections.
2. Side slopes and base dimensions.
3. Bottom and top elevations.
4. Location of maintenance berm.
5. Fence and gate locations.
6. Right of way.
7. Pond drainage structures with structure numbers.
8. Soil boring locations, and
9. Any other necessary data pertaining to the pond.

The pond sections shall show the bottom width and elevation, side slopes, normal water depth, if applicable, as well as soil borings. A minimum of two (2) sections, taken in directions perpendicular to each other, shall be shown.

7.3.2 Typical Section

A typical section is required when the pond sections do not represent the typical design features of the pond. Following is a list of appropriate information to be shown on the typical section:

1. Limits of clearing and gabbing
2. Typical side slopes
3. Bottom and top elevations
4. Details of maintenance berm
5. Fence location
6. Right of way
7. Water level information
8. Vegetation requirements

The typical section does not need to be to scale, but shall be dimensionally proportionate. It should be shown on the pond detail sheet, if room allow, or on a separate sheet when necessary.

7.3.3 Pond Cross Sections

Pond cross sections shall be prepared in a manner similar to that for roadway cross-sections **(Chapter 8 of this volume).** As with lateral ditches, the standard scale is 1" = 10' vertical. The standard horizontal scale is also 1" = 10', although another scale may be used if necessary.

If material is to be excavated from the pond the data from the soil survey sheet shall be shown on the cross sections.

7.4 Mitigation Areas

If construction details for mitigation areas are included in the plans, follow the requirements for retention/detention areas.

Chapter 8 - Roadway Cross-sections

8.1 General

Cross-sections depict the existing ground conditions, including al manmade features, as sections perpendicular to the respective stations along a survey baseline or construction centerline. The proposed cross-sectional outline of the new facility with all it functional elements is also shown on cross sections. Standard cross sections sheets shall be used for showing roadway cross-sections. This sheet features a standard grip five lines per inch, both in the vertical and horizontal. The vertical scale can be altered to ten lines per inch by utilizing a toggle feature in the CADD software.

The recommended vertical scale is 1" = 10'. The horizontal scale shall be such that the entire roadway R/W is shown on the sheet (generally 1" = 10 or 1"=20'), but shall not be smaller than 1" = 40' horizontal. It the entire R/W cannot be shown on one sheet, more sheets may be utilized and appropriate match lines shall be shown with referenced sheet numbers. The scale shall be shown at the bottom right corner of the sheet above the title box.

18.1 Required Information

Existing ground lines should be shown and the existing elevation at the centerline shall be noted just below the ground line at the centerline. The station number of the section shall be indicated opposite the ground line on the right side of the sheet and the location baseline of survey indicated along the top and bottom of the sheet. Lines parallel to the baseline of survey should show station equivalencies to the baseline of survey.

The surface, as well as the below ground portions of existing features such as pavements, curbs and sidewalks, shall be shown.

Existing parallel underground utilities which lies within the horizontal limits of the project shall be shown along with verification notation for those locations which have been verified. Utilities that have been verified should be labeled as shown in **Section 6.3**. Small distribution or service lines need not be drafted.

Soil data and water table shall be shown on cross section. If it is determined that at organic or plastic material must be removed below the finished grading template, the lower limits of removal of organic or plastic material will be shown to determine the area and volume of subsoil excavation.

The proposed roadway template shall be shown. The proposed profile grade elevation shall be placed vertically or at an angle to the horizontal, just above the profile grade line. Special ditch elevations shall also be shown.

Station equations shall be shown, even though a cross section may not be plotted at that point. For ramp cross sections equivalent mainline stations shall also be shown.

The right of way limits shall be symbolically shown for each cross section.

The beginning and ending stations for project, construction, exceptions, bridge/bridge culvert and the toe of slope under the bridge shall be shown. The beginning and ending earthwork stations shall be shown.

On projects with grade separations, intersections, etc., the earthwork shall be totaled on the last cross section sheets for each of the above and noted as to the station in which the earthwork is included on the project cross sections. Earthwork quantities shall be indicated in the appropriate columns on the right side of the sheet. Earthwork summaries shall be shown on the last cross section sheet of each roadway, etc. The grand total shall be tabulated in the Summary Earthwork and shown on the Summary of Quantities Sheet.

The order of assembling the cross sections in the plans set shall be:

1. Mainline

2. Side streets

3. Intersections

8.3 Sheet Set UP

Cross sections shall be shown on a standard preformatted cross section sheet with stations increasing from the bottom to the top of the sheet. Usually, only one column of sections shall be placed on the sheet.

The interval selected for showing sections on the cross section sheet will vary according to project specific factors. For new construction reconstruction, the normal interval for cross sections is 100 feet for rural projects and 50 feet for urban projects. Factors that may influence the frequency of cross sections include the presence of intersections, extent of driveway and turnout construction or reconstruction, drainage improvement, etc.

Sections shall be centered on the sheet with the survey baseline or the construction centerline placed vertically in the center. In cased where additional lanes are to be constructed adjacent to existing lanes, centering the sections will depend upon the location of the survey line and the side on which the new construction to be placed. Sections shall be oriented such that the complete ultimate section will be approximately centered on the sheet. When the centerlines of construction and survey are not parallel, the distance between the two at each cross section shall be shown.

As many sections as possible shall be place on a sheet with sections being spaced to avoid overlapping. The soil profile should be checked for possible unsuitable material below existing ground, which may cause overlapping of sections.

When right of way is narrow enough and a horizontal scale of 1" = 20' is used, two columns of cross section may be placed on a sheet. Cross section placement progresses from left to

right as well as from the bottom to the top of the sheet. The sheet shall be set up to provide earthwork columns for each other column of sections